A MONOGRAPH OF THE GENUS GERANIUM L. (GERANIACEAE)

Carlos Aedo
Real Jardín Botánico
CSIC

This long awaited monograph deals with the fascinating group of plants known as geraniums or cranesbills. It is restricted to the plants covered by the scientific name *Geranium*, but does not include those plants known in English as "geranium" which botanists have transferred to the genus *Pelargonium*. The book is the result of 28 years of research by the author. It is lavishly illustrated with maps, line drawings and photographs.

There is a gap in the available botanical literature covering the geraniums. The last monographic treatment by Reinhard Knuth appeared in 1912. In the intervening years, much taxonomic information has been accumulated, rendering this massive and comprehensive work out of date. There have been many new species discoveries and much research has been conducted for revisional works. All these changes have caused much confussion to the outsider, making the need for a comprehensive monograph even more pressing.

For each of the 307 species covered in this book, complete synonymy and detailed description is given, as well as its distribution, relationships, variability and taxonomic history are discussed. Each species is provided with a map showing its known distribution based on specimens examined by the author, and is illustrated with line drawings and, if available, with colour photographs based on reliable specimens. Some introductory sections explain in detail the morphological structure of these plants, chromosome numbers, breeding system, phytochemistry, distribution, habitats and relationships. For practical reasons and to facilitate the identification of the species, four identification keys have been prepared that cover respectively North and Central America, South America, the Pacific area and the Old World species. This book will be of value to botanists, but also for specialists hobbyists and to anyone fascinated by these plants.

A MONOGRAPH OF THE GENUS GERANIUM L. (GERANIACEAE)

Carlos Aedo

A Monograph of the genus Geranium L. (Geraniaceae)

CONSEJO SUPERIOR DE INVESTIGACIONES CIENTÍFICAS

Madrid, 2023

Catálogo de publicaciones de la Administración General del Estado:
https://cpage.mpr.gob.es

Editorial CSIC: *editorial.csic.es* (correo: *publ@csic.es*)

GOBIERNO DE ESPAÑA
MINISTERIO DE CIENCIA E INNOVACIÓN
CSIC
Consejo Superior de Investigaciones Científicas
EDITORIAL CSIC

ISBN: 978-84-00-11123-6
e-ISBN: 978-84-00-11124-3
NIPO: 833-23-002-X
e-NIPO: 833-23-003-5
Depósito Legal: M-2393-2023

Diseño y maquetación: Ángel Merlo
Impresión y encuadernación: Imprenta Taravilla, S.L.
Impreso en España. *Printed in Spain*

En esta edición se ha utilizado papel ecológico sometido a un proceso
de blanqueado ECF, cuya fibra procede de bosques gestionados de forma sostenible.

CONTENTS

“Butanicum herbarum dicitur quod ibi herbae notentur”
[Se dice "*Butanicum*" (botánico) de hierbas a (el sitio) donde las hierbas son anotadas;
Herbal "Butanicum" (botanist) is said to (the place) where herbs are noted down]

Isidoro de Sevilla, *Etimologías*, Libro IV. 10.4 (*c*. 625)
[Stearn 1992: 22]

INTRODUCTION

Geranium L., with 307 species, is the largest genus of the Geraniaceae, a family that according to Stevens (2001), also contains the genera *Pelargonium* L'Hér. (280 species), *Erodium* L'Hér. (80 species, including *California* Aldasoro & al.), *Monsonia* L. (40 species, including *Sarcocaulon* Sweet) and *Hypseocharis* Remy (2 species; Lozada-Gobilard & al. 2020). *Hypseocharis*, however, differs from the other genera by its estipulate leaves, capitate stigma, ovaries with many ovules per loculus, and unbeaked fruits. This set of characters may support assignment to a monotypic family sister of the Geraniaceae core (Aedo 2012, Palazzesi & al. 2012). Retaining *Hypseocharis* would result in the Geraniaceae losing the main characters (stipulate leaves, style with 3-5 stigmatic branches, one or two ovules per loculus, beaked fruits) that define the family. Regarding the generic division of the family, the synonymization of *California*, and especially those of *Sarcocaulon* seems controversial (Albers 1996, Dreyer & al. 1997, Moffett 1979, 1997).

After the segregation of *Erodium*, *Monsonia*, *Pelargonium* (see *Historical overview*) from *Geranium*, the circumscription of the genus has been stable throughout its recent history. Three attempts to separate some species into independent genera have not been followed by most of the authors: *Robertium* to accommodate some species of sect. *Ruberta* (Picard 1837), *Neurophyllodes* to accommodate the species of sect. *Neurophyllodes* (Degener & Greenwell 1937), and *Geraniopsis* to accommodate two species of sect. *Trilopha* (Chrtek 1968).

The genus *Geranium* is easily differentiated from the other genera of the family by its usually actinomorphic flowers with five free petals, without hypanthium nor nectariferous tube, and with ten free stamens arranged in two whorls, very rarely the outer lacking the anthers. *Geranium* is distributed throughout most of the world except in lowland tropical areas, but it has diversified more in certain regions. The mountains around the Mediterranean Basin, the Caucasus and the Himalayas constitute some of these regions. Regarding the Old World, also South Africa and the mountains of New Guinea are very rich in endemic species. In the New World, the two areas particularly diverse in species are Mexico and adjacent regions of western U.S.A., and the north of the Andes, from Venezuela to northern Peru.

Knuth's (1912) worldwide monograph of *Geranium* was the most complete treatment of the genus during several decades, and a good starting point for an overview of the genus. This author accepted 269 species plus 72 more species in subsequent papers (Knuth 1913, 1915, 1916, 1922, 1923, 1930a, 1930b, 1931, 1933, 1934, 1936, 1937a, 1937b, 1938, 1939). This impressive monograph causes even more astonishment when we consider that it covers the whole Geraniaceae, in a broad sense, including small related families.

According to Melchior (1957: 185), Reinhard Knuth received his doctorate in 1902 with the dissertation entitled *Über die geographische Verbreitung und die Anpassungserscheinungen der Gattung Geranium im Verhältnis zu ihrer systematischen Gliederung* (Knuth 1903, 1904). He collaborated with F. Pax in the monograph treating Primulaceae published in 1905 in the Engler's *Pflanzenreich*. Subsequently he wrote monographs on Geraniaceae for the same series directed by A. Engler. The main work seems to have been carried out in a relatively short period, perhaps less than ten years, taking into account that his first taxonomic publication on the genus is from 1904 (Knuth 1904). This monograph should be seen in the context of its time, in which many areas were still unexplored or undercollected and loans between herbaria were not routinely done. This resulted, as an unavoidable consequence, in the scarcity of material for preparing full descriptions and keys, and for obtaining detailed distributions of the species. These limitations led to the description of some species that are now seen as synonyms. This however does not diminish the value of Knuth's work (Fig. 1).

Among the relevant contributions after Knuth's monograph, many floras can be mentioned. The list is, however, lengthy and it would be difficult to do justice to all the efforts of the authors of these works. One relevant example would be *Flora of the U.R.S.S.* (Bobrov 1949), that covers more than 22 million km^2, and presents a valuable taxonomic treatment of *Geranium* (55 species). Other important works that cover areas poorly known are those of Moore (1943) for species of Mexico and Central America, Jones & Jones (1943) for United States and Canada, Carolin (1965) for the southwestern Pacific area, Veldkamp & Moerman (1978) for the Malesian species, and Hilliard & Burtt (1985) for South African species.

A considerable advance in the knowledge of *Geranium* occurred with the works of P. Yeo, some focused on classification and others that studied various groups in particular. Among works on classification, it should be mentioned the new proposal for an infrageneric classification by Yeo

Fig. 1. Reinhard Knuth's handwritten label used to identify the plants studied in his monograph. Specimen preserved in the herbarium of University of Zurich (Z-000064950).

(1982, 1984, 1990), inspired in Tokarski (1972), and among group studies Yeo (1970, 1973a, 1973b, 1975, 1983, 1992, 2003, 2004).

The difficulty of preparing monographic treatments of large genera is well known (Frodin 2004) and applies to medium-sized genera as *Geranium* as well. The initial strategy for preparing an updated monograph of the genus was to review sections or subgenera that were well-characterized morphologically (Aedo 1996, 2001a, 2003, 2017b; Aedo & al. 1998, 2002, 2003, 2005a, 2005b, 2007, 2009, 2016; Aedo & Estrella 2006). However, these well-defined subgroups cover only a minor part of the genus. Consequently, to move forward, a change of approach was needed. For this reason the study of well-defined groups was combined with the study of species from little or poorly known areas. The species of China (Xu & Aedo 2008), the New World (Aedo 2012), the Iberian Peninsula (Aedo 2015), and the Pacific area (Aedo 2017a), have been revised in this way. Despite all this work, a part of the species of Eurasia and Africa requiring detailed study still remains. They are now here presented with the remaining of the genus.

Fig. 2. Specimens of *Geranium nodosum* (FI-060876) and *G. sanguineum* (FI-060877) from Anonimo Toscano herbarium (formely attributed to Michelle Merini), dated ca. 1544, and kept at the *Museo di Storia Naturale*, University of Florence (FI) [photo: the staff of the herbarium].

For the present monograph, these previous accounts were amended as necessary. The descriptions were harmonized as much as possible, but in some cases it was not possible to complete some characters of species because the loans had been returned. The nomenclature was revisited and some new types were found. The delimitation of the species, as well as keys and distribution ranges, have sometimes been refined in light of the study of new collections.

HISTORICAL OVERVIEW

In early manuscripts about plants of Western culture, geraniums are occasionally mentioned. Dioscorides in his *De Materia Medica*, written between AD 50 and 70, provided a reference and a drawing (3.116) of a species of this genus difficult to identify but probably *Geranium rotundifolium* or *G. molle* (Estreller 2006). Pliny the Elder in his *Historiae Naturalis* (AD 77) refers to what seem to be two geraniums. He describes the first as a herb similar to hemlock, with smaller leaves and shorter stem and bearing at the top of the branches heads of cranes, which strongly suggest that it is an *Erodium.* The second plant is described as having leaves like those of anemone and a round root like an apple, which could indicate that it is *G. tuberosum* or other species of the section *Tuberosa* (Huerta 1629: 415; Jones 1966: 344). According to Sharples & Minter (1983) there is, however, some controversy about the use of the term geranium in the botanical writings by Theophrastus and Pliny the Elder.

After the medieval period which contributed little to the botanical knowledge from the Greek and Latin classics, a new current developed in central Europe. The herbalist Leonhart Fuchs is one of its main representatives. Fuchs (1542: 204-211) provided six drawings of European *Geranium*, some identifiable as *G. robertianum* and *G. sylvaticum*, one *Erodium* sp. and some *Geranium* sp. Unfortunately, these authors did not conserve the plants in herbaria and therefore the identification of their species cannot be confirmed.

It is more difficult to find ancient references outside the scope of Western culture. An interesting case are the manuscripts of Francisco Hernández who traveled through Mexico between 1572 to 1577 and collected information on the natural history of Mexican pre-Hispanic cultures. His manuscripts were published abbreviately from 1629 by Nardi Antonio Reccho in different editions. In one edition two drawings of Mexican taxa of *Geranium* are found but they cannot be assigned to any known species (Hernández 1649: 293). No herbarium testimonies are known to clarify the identity of these species.

In the Cinquecento the technique of pressing plants and preserving them in bound volumes was developed in northern Italy. Over time this gave rise to herbaria as we know them today. The oldest known pressed specimens of *Geranium* date from this time. According to Chiovenda (1928: 130), specimens of *Geranium nodosum* and *G. san-*

guineum (Fig. 2) are found in the herbarium attributed to Michelle Merini. A recent study suggests that there is insufficient evidence to attribute this herbarium to Merini and that it is more appropriate to consider it anonymous (Cristofolini & Nepi 2021). This herbarium is kept at the *Museo di Storia Naturale*, University of Florence (FI) and dated ca. 1544. It seems that it was compiled with plants cultivated in the Pisa botanical garden. They are the oldest known herbarium specimens of *Geranium*. Since that time it is referred to as the Cibo herbarium, attributed to Francesco Petrollini. It contains thirteen specimens of *Geranium* (*G. dissectum, G. lucidum, G. macrorrhizum, G. nodosum, G. rotundifolium*, and *G. sanguineum*) (Fig. 3). This herbarium, kept in the *Biblioteca Angelica*, Rome, is dated from 1550-53 (Celani 1902; Stefanaki & al. 2019). The specimens were probably collected in Italy.

According to Caruel (1858: 114-115), in the herbarium of Andrea Cesalpino specimens of *G. columbinum, G. dissectum, G. nodosum, G. robertianum* and *G. sylvaticum* are preserved (Fig. 4). The specimens, probably from northern Italy, are organized following a new system of classification based on Aristotle and Theophrastus, later published by Cesalpino (1583) as *De Plantis libri XVI.* The geraniums are mentioned on the pages 558-559. This herbarium is kept at the *Museo di Storia Naturale*, University of Florence (FI) and dated from 1563 (Nepi 2007; Nepi & Gusmeroli 2008).

From this time on, the information about the plants of Europe and the Mediterranean Basin is increased with the appearance of numerous books and, progressively more collections preserved in herbaria. Caspar Bauhin (1623: 317-319) in his *Pinax Theatri Botanici*, mentions 26 geraniums, with a complete synonymy, giving his work an innovative character for its time. He describes different species of *Geranium* and *Erodium* which are widely distributed Europe that can be easily identified from the herbarium vouchers kept at the University of Basel, Switzerland (BAS).

John Ray (1688: 1055-1063) in his *Historia plantarum* recognized 40 species of *Geranium* (in a broad sense) that were expanded considerably in a supplement (Ray 1704: 511-515). In this work he introduces dichotomous keys to identify the genera. His herbarium vouchers are kept at The Natural History Museum, London (BM).

Tournefort (1700: 266-270) in his *Institutiones rei herbariae* accepts *Geranium* as a genus. The effort of this author had great influence on consolidation and consistent definition of the genera. The number of species accepted for the genus increased to 81 (including *Geranium* and *Erodium*), mostly Europeans but also from the Middle East where Tournefort himself carried out an expedition. His herbarium, kept at the *Muséum National d'Histoire Naturelle*, Paris (P-TRF), can help to clarify the complex polynomial nomenclature that Tournefort applied to his species.

The binomials that were used in an irregular way by previous authors were consolidated with the Linnaeus's *Species plantarum*, which is accepted as the starting point of modern nomenclature. Linnaeus's (1753: 676) circumscription of *Geranium* included *Erodium,* and *Pelargonium*, as the previous authors did. However, *Geranium* s.str. was recognized implicitly by Linnaeus as the group defined by "Staminibus decem fertilibus", in which he included fifteen species still accepted in *Geranium* s.str. today. Most of Linnaeus's geraniums are European (except those now transferred to *Pelargonium*) but there are two American and one Siberian. The former are *G. carolinianum* and *G. maculatum* that Linnaeus cited through Gronovius's *Flora virginica* (1743: 78), which was based on John Clayton's collections. Among the Clayton specimens at BM, only the original material of *G. carolinianum* is extant. It is the earliest collection of the genus in North America and probably dates from ca. 1735 (Reveal & Pringle 1993: 161).

Cavanilles (1787) published an important revision of the Geraniaceae, which listed 127 species, following Linnaeus's generic concept of *Geranium* and accepting the new genus *Monsonia* (Linnaeus 1767). Cavanilles had access to important extra-European collections in the Paris herbarium, which allowed him to work with the South African geraniums (now under *Pelargonium*). In his monograph he

Fig. 3. Specimen of *Geranium nodosum* from *Cibo herbarium,* attributed to Francesco Petrollini, prepared in 1550-53, and kept at the *Biblioteca Angelica*, Rome [Erbario B 129/498].

includes 31 species of *Geranium* s.str., most still European, although he described the first species from South America: his *G. sessiliflorum* was based on a collection by Philibert Commerson and Jeanne Baret, the French naturalists, who accompanied Louis Antoine de Bougainville on his voyage of circumnavigation in 1766-1769. There are, however, older references to *Geranium* from South America. For example, Feuillée (1725: 21, pl. 16) reported a species of *Geranium* from the Chilean coast in ca. 1709. No herbarium material was found, but the drawing shows a perennial species that probably belongs to the *Solanderi Group*.

In 1792 L'Héritier published the drawings of his *Geraniologia*, but the text was never published conventionally (Britten & Woodward 1905: 271; Guittonneau 1967: 42-45). Many of L'Héritier's names, including *Erodium* and *Pelargonium*, had been validated by Aiton (1789: 414, 417). L'Héritier's delimitation of the genus *Geranium* agrees with the current circumscription and has been widely accepted until today. The publications by Andrews (1805-06) and Dumont de Courset (1802, 1805, 1811) do not recognize L'Héritier's genera but they had little or no influence on *Geranium* s.str.

Fig. 4. Specimens of *Geranium dissectum, G. nodosum* and *G. sylvaticum* [plus *Erodium* sp.] from Andrea Cesalpino herbarium, prepared in 1563, and kept at the *Museo di Storia Naturale*, University of Florence (FI) [photo: the staff of the herbarium].

For many years the most remote regions of the world remained scarcely known from the floristic point of view. For instance, Carl Thunberg collected in Japan in 1775-1776 and mentioned only one species of *Geranium*, "Geranium palustre" from Nagasaki, which is probably one of the first collections of the genus in the area (Thunberg 1784: 268). No specimen of *Geranium* is kept in the Thunberg herbarium (UPS) (M. Hjertson, *in litt.*), but a specimen labeled by Thunberg is found in the Burman herbarium at G. This plant corresponds to *G. thunbergii*, a name proposed by Siebold & Zuccarini (1845: 28) and later validated by Lindley & Paxton (1851: 186).

The earliest known collection of a Hawaiian geranium was made in 1793 by Archibald Menzies, the surgeon and naturalist under Captain Vancouver on the HMS Discovery (Pax & al. 1997: 72). His finding was described by Hooker as *G. cuneatum* (1837). There were no further important additions to the knowledge of Hawaiian geraniums until the United States Exploring Expedition under the command of Commodore C. Wilkes in 1840. From the plants collected at that time by William Brackenridge and others, Gray (1854) published seven new geraniums, five of them accepted today at specific or subspecific level.

The geraniums of tropical southeastern Asia remained unknown until Zollinger (1845: 585) published his *G. ardjunense* as a new species, based on a collection that he made in Java. The higher mountains of New Guinea, which harbor most species of the genus on the island, remained unexplored and their species undescribed until the end of the twentieth century. The only species from the region published in the intervening period were two species from New Guinea published by Ridley (1916), based on collections by Cecil Kloss.

Joseph Banks and Daniel Solander arrived in New Zealand in October of 1769 accompanying Captain Cook on his first voyage on the HMS Endeavour (Adams 1986). They collected *G. potentilloides* and *G. retrorsum*, later described by De Candolle (1824), who attributed the collections to Banks only. The next species described from the region was *G. brevicaule*, which was based on a collection from Tasmania made by Ronald Gunn (Hooker 1834: 252).

In his worldwide synthesis of Geraniaceae, De Candolle (1824) agreed with L'Héritier's concept of the genus and recognized 66 species of *Geranium*, including species collected in the Andes by Alexander von Humboldt and Aimé Bonpland, by Martín Sessé and José Mociño in Mexico, by Nathaniel Wallich in the Himalayas, by Christian von Steven in the Caucasus and by several collectors in Siberia. De Candolle (1824) arranged an infrageneric proto-classification, partially inspired by Cavanilles (1787, without page number: *Geraniorum tabula analytica*), grouped the species in three clases: *Perennia, pedunculis 1-floris*, *Perennia, pedunculis bifloris*, and *Annua, pedunculis bifloris*. Bentham & Hooker (1862) proposed a wide delimitation of the Ge-

raniaceae, but maintained the narrow circumscription of *Geranium* and attributed to the genus about 100 species.

Dumortier (1827) accepted a division of the genus in three sections which only partially agreed with De Candolle (1824) and is restricted to Belgian species. Koch (1835) also proposed three sections, agreeing in part with those of previously mentioned authors but expanding the geographic area and the number of species. Picard (1837), Boissier (1867), Rouy (1897), Bubani (1901) and Fiori & Paoletti (1901) also organize the species in their respective work areas into infrageneric categories. It is necessary, however, to wait for Knuth's (1912) monograph to find a proposal for a worldwide infrageneric classification.

After De Candolle's synthesis, a large number of new species were published, generally linked to the exploration of little-known areas. These were evaluated in Knuth's (1912) monograph. More recent relevant treatments are noted in the Introduction.

MATERIAL AND METHODS

This revision is based on 25,953 herbarium specimens from the following herbaria: A, AAU, ABS, AD, AK, ALA, ANG, APP, ARAN, ARIZ, ATH, B, BAF, BC, BCN, BEOU, BH, BIRM, BISH, BM, BO, BOL, BOLV, BP, BR, BRIT, BRNM, BRNU, BRSL, BUCA, C, CAL, CAN, CANB, CAR, CAS, CDBI, CGE, CHR, CL, CLU, CM, COFC, COI, COL, COLO, CONC, CORD, CTES, DAO, DBN, DUKE, E, ENCB, ERE, F, FI, FT, G, GA, GB, GDA, GH, GOET, GRA, GRM, GZU, H, HA, HAL, HAO, HBG, HBIL, HGI, HO, HUA, HUB, HUJ, HULE, HVR, IBF, IBSC, ICEL, IEB, ILL, INB, IND, ISC, ISTE, ISTO, JACA, JBAG, JBSD, JE, JEPS, K, KANU, KASH, KE, KR, KRA, KUH, KUN, KUS, KW, KY, KYO, L, LD, LE, LEB, LIL, LINN, LISE, LISI, LIV, LOJA, LOU, LP, LPA, LPB, LUX, LW, LWG, LY, LZ, M, MA, MACB, MADJ, MADM, MAF, MEL, MER, MERL, MEXU, MFU, MICH, MIN, MO, MONTU, MOR, MPU, MSB, MSC, MSTR, MU, MUB, MW, NA, NAP, NBG, NDG, NEB, NEU, NHMC, NMC, NMW, NSK, NSW, NU, NY, O, OBG, OBI, OKL, ORE, OSC, OXF, P, PACA, PAL, PAVL, PE, PERTH, PH, PO, PORT, PR, PRC, PRE, QCA, QFA, QPLS, R, RB, RENO, RO, RSA, S, SALA, SAPS, SBBG, SD, SEV, SGO, SI, SIB, SKO, SLBI, SOM, SP, SS, STU, SYD, SZ, TAA, TAI, TAUF, TBI, TENN, TEX, TFC, TI, TK, TNS, TUB, U, UB, UC, UNM, UPA, UPS, US, USM, V, VEN, VLA, VT, W, WA, WAG, WELT, WIS, WRSL, WTU, WU, WVA, XAL, Z, ZT, and the private herbaria of J. Bouchard, G.G. Guittonneau, S. Halloy and G.H. Parent.

The revision includes 652 herbarium specimens of *Geranium* belonging to 110 species and assessments of natural populations obtained by the author in field trips to Argentina, Bolivia, Brazil, Chile, Costa Rica, Ecuador, Nicaragua, Peru, the United States, and Venezuela in the New World and to Armenia, Austria, Bulgaria, Cyprus, Equatorial Guinea, France, Germany, Great Britain, Greece, Italy, Morocco, Norway, Portugal, Romania, Slovenia, South Africa, Spain, Switzerland, Tunisia, and Turkey in the Old World.

The account presented in the *Taxonomy* includes a comprehensive synonymy. All names have been verified in their original publication. The names that share the same type are indicated in the same paragraph, ordered by publication date. In each paragraph there is a heading named "type locality" in which the geographical information of the protologue is literally transcribed. These data are followed by the type, giving the information that comes from the label in a standard way, and supplying the geographic or collector information that may be missing. The disposition of names for which no type material was available is based on the opinions of previous authors or in a few cases, on the original description. Invalidly published names and names that could not be fixed with certainty are listed under *Miscellaneous doubtful and not validly published names* (see also Appendix 2 for names which now belong to other genera).

One hundred nine (109) characters, 72 qualitative traits, and 32 quantitative traits, as well as five ratios were scored for the description of the species. At least 15 specimens were scored for each species, if available. Quantitative characters were assessed with a Mitutoyo CD-15CD digital caliper (Mitutoyo, Kawasaki, Japan). The most frequent values are percentiles (between the 25th and 75th percentiles), are shown without brackets, and the extreme values are enclosed in brackets. All measurements were taken from herbarium specimens. The line drawings of leaf laminas and petals show the adaxial surface, and drawings of the sepals show their abaxial surface, unless stated otherwise. In the descriptions and key, the length of the sepal does not include the length of the mucro. The use of the term "Leaves" refers to the lamina of the leaf unless stated otherwise. Similarly, the description of the leaf segments refers to the middle segment unless otherwise indicated.

Under the heading *Representative specimens examined* a selection of specimens representative of the distribution of the species is indicated. When the species is rare or few specimens have been studied, all of them are listed under the *Additional specimens examined* section. In no case are the type specimens repeated, as they have already been mentioned together with their corresponding names. The specimen labels have been transcribed in the language in which they were written. Only in those cases written in non-Latin alphabets (Chinese, Japanese, Korean or Russian), have they been transliterated to the Latin alphabet, either to English or to Spanish. For country names, the 1999 edition of *The Times comprehensive Atlas of the World* [Times Books, London] has generally been followed. Changes after that date have been incorporated when considered useful. In the case of the Democratic Republic of the Congo, however, the name of Zaire has been maintained, because it is widely used in the literature and avoids confusing with the neighboring Republic of the Congo.

Each species has been mapped based on the studied specimens. When the specimens lacked geographic coordi-

nates, they have been georeferenced using the *NGA GEOnet Names Server website* and other similar tools. The precision of these georeferencing is logically variable and heterogeneous.

Color photographs were taken by the author unless stated otherwise. For SEM, samples were glued to aluminum stubs, coated with 40-50 nm of gold, and examined with a JEOL-TSM T330A (JEOL USA Inc., Peabody, Massachusetts) SEM at 15 kV.

For practical reasons and to facilitate the identification of the species, four identification keys have been prepared. In these regional keys there is little overlapping, except for some non-native species. Each regional key includes all native species, species non-native but clearly naturalized, and some occasional or adventive species usually based on reliable bibliographic records in each of the four delimited areas. The four areas are (Fig. 5): a) North and Central America, from Alaska to Panama, b) South America, from Colombia to Patagonia; c) the Pacific area, i.e., Australia and the islands of Japan, Taiwan, Indonesia, East Timor, Papua New Guinea, New Zealand, and Hawaii; and d) the Old World, i.e., Europe, Africa (including Macaronesian islands and Madagascar) and Asia (excluding the islands of the Pacific area).

MORPHOLOGY

Duration and Habit

The 21 annual species and the three biennial (two of them sometimes annual) are distributed among the sect. *Batrachioidea*, the sect. *Divaricata*, the sect. *Ruberta*, the sect. *Trilopha*, the sect. *Dissecta,* the sect. *Geranium*, and the sect. *Lanuginosa*. Annuals and biennials are easily distinguished by the absence of a rhizome and by their simple taproot, with thin secondary roots. The remaining species of the genus are perennials.

Perennials are usually herbaceous with a well-developed, prostrate to erect, aerial stem and a vertical to horizontal rootstock. The species from the *Sibbaldioides Group*, the *Sessiliflorum Group* (sect. *Geranium*) and the sect. *Subacaulia* are an exception to this pattern; they are acaulescent, usually cushion-like, with cymules arising directly from the rootstock. This growth form seems an adaptation to the extreme climatic conditions at high elevations also found in other groups of vascular plants.

The species of sect. *Neurophyllodes* are all shrubs. Among them, *G. hanaense*, *G. hillebrandii*, and *G. kauaiense* are dwarf shrubs, decumbent and often rooting at the nodes. *Geranium arboreum* and *G. multiflorum* are well-developed shrubs, the first reaching up to four meters in height. This is quite unusual in *Geranium*, but not unique. Some species from South America: *G. exallum* and *G. jahnii* (sect. *Paramensia*), and *G. loxense* (sect. *Geranium*) are dwarf shrubs in paramo habitats, while *G. lignosum* and *G. lindenianum* (sect. *Geranium*) are more developed shrubs. Three species from South Africa, *G. brycei*, *G. pulchrum*, and *G. robustum* (and probably *G. amatolicum* and *G. grandistipulatum*), are also described as shrubs, although somewhat less than four meters in height. According to Hilliard & Burt (1985: 176) the latter are not true shrubs although they have woody stems that persist for more than one season. A pachycaul

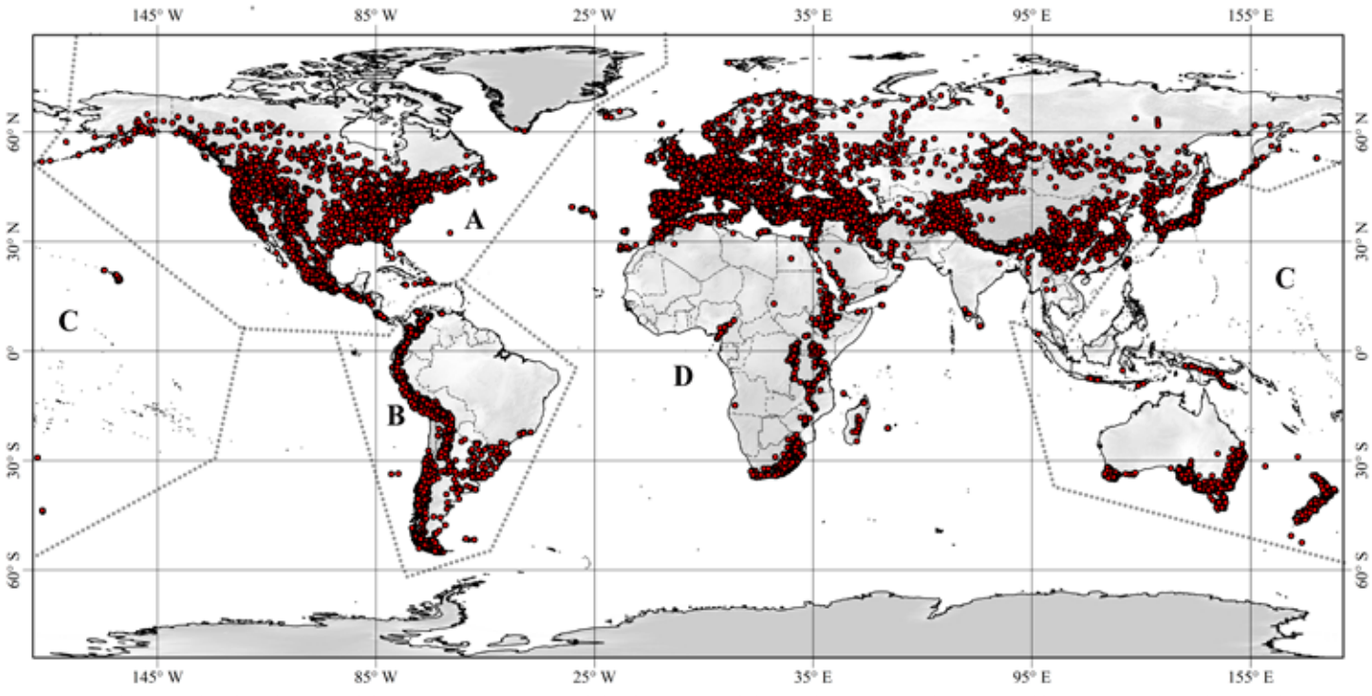


Fig. 5. Map showing the distribution of the genus *Geranium* and the four areas delimited to arrange the regional keys: a) North and Central America, b) South America, c) the Pacific area, and d) the Old World.

habit is found in the Macaronesian perennials *G. palmatum* and *G. reuteri*, and the monocarpic *G. maderense*.

Some species, mainly from sect. *Geranium*, but also from sect. *Aculeolata* and sect. *Neurophyllodes*, are characterized by prostrate to ascending stems occasionally rooting at the nodes. An unusual pattern is seen in *G. stoloniferum*, which has a basal rosette of leaves giving rise to one erect main stem with a well-developed dichasial inflorescence and one or two herbaceous procumbent stolons. These epigeal stolons, borne from the inner part of the rosette, reach up to 20 cm long, have several pairs of leaves, and terminate in a bud. They seem to result from the growth of one year. *Geranium stoloniferum* has also some hypogeous, lignified stolons. These are borne from the external part of the rosette, are ramified, and reach up to 100 cm long. The lignified stolons bear several secondary rosettes and terminate in a rosette as well. It is possible that these structures originate from herbaceous stolons. Epigeal stolons have also been found in five species of the *Papuanum Group*.

Some species from the northern and central Andes (the *Sibbaldioides Group* and the *Multiceps Group*) and from New Guinea (the *Papuanum Group*) have structures that have been termed "vegetative stems" in order to facilitate description. These species produce a kind of bud towards the apex of the branches, sometimes quite long and covered by stipules (usually without petiole remains), which bears a rosette of leaves and an inflorescence (see drawings for a better understanding). This structure may represent the growth of each vegetative period.

The underground parts of perennials (roots and rootstocks) are generally not thoroughly studied owing to their poor representation in herbaria.

Probably as a response to arid climatic conditions from the Mediterranean Basin and central Asian highlands some groups have developed tuberculate rootstocks (sect. *Tuberosa* and two species of the *Pylzowianum Group*). In a similar way, the turnip-shaped rootstocks found on species of the *Sessiliflorum Group*, the *Solanderi Group*, the *Potentillifolium Group*, the *Diffusum Group*, the *Rupicola Group*, the *Mexicanum Group*, the *Renifolium Group* and the sect. *Incana* may have evolved to withstand drought conditions in South Africa, South America, Mexico and Oceania.

Species with rootstocks that have thickened roots are widespread among different groups of *Geranium*. Normally these roots are arranged along the rhizome but in some species of the *Palustre Group*, the *Krameri Group*, the *Sibiricum Group* and one of the *Pylzowianum Group* (sect. *Geranium*) plus in one species of sect. *Dissecta* the thickened roots are grouped in a fascicle.

Indumentum

Most *Geranium* species are covered in variable density by various types of hair. Exceptionally some species are almost entirely glabrous (e.g., *G. glaberrimum* and *G. lucidum*).

The following types of hairs, all simple and uniseriate (Theobald & al. 1979), have been found in *Geranium* (Figs. 6-8). (1) Eglandular hairs (0.1-5.4 mm long), unicellular, smooth or papillose, appressed, more or less uncinate or patent; these occur in a variable frequency in most species. In *G. schiedeanum* and *G. lozanoi* some hairs have a circular basal portion and others a narrowly elliptic one. The second type appears under the microscope as "plane" or "scale-like", particularly if it is very short. According to Payne (1978), all these hairs belong to the "subulate" type. (2) Glandular

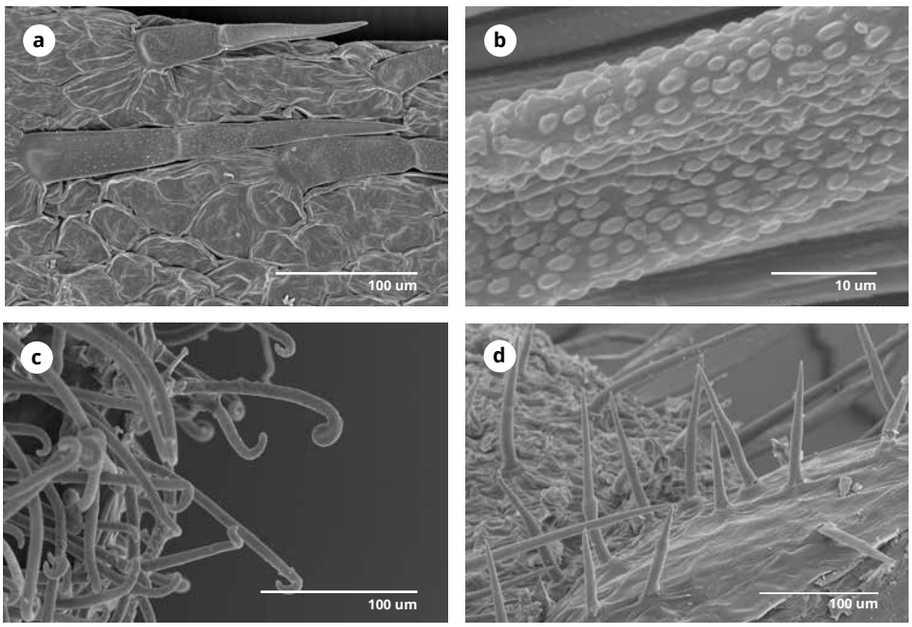
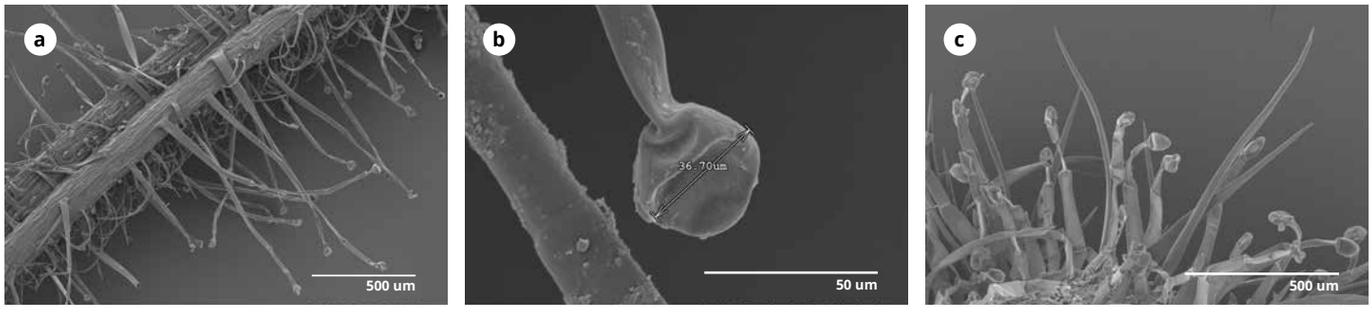


Fig. 6. SEM photographs showing indumentum types found in *Geranium.* a. Eglandular hairs on the leaf of *G. biuncinatum* (sect. *Trilopha*). b. Detail of an eglandular hair on the pedicel of *G. core-core* (sect. *Geranium*). c. Eglandular hooked hairs on the mericarp of *G. lasiopus* (sect. *Ruberta*). d. Eglandular hairs on the mericarp of *G. libanoticum* (sect. *Tuberosa*). (Based on: a, *Wood 3126,* MA; b, *Aedo 7073,* MA; c, *Mutlu 848,* HUB; d, *Zederbauer s.n., June 1902*, WU).



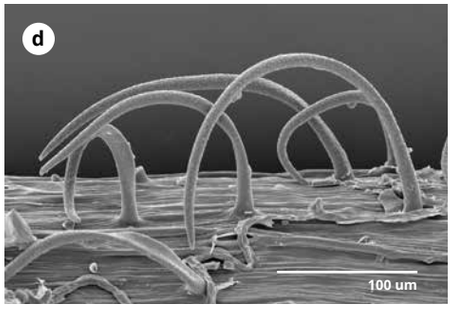


Fig. 7. SEM photographs showing indumentum types found in *Geranium.* a. Glandular and eglandular hairs on the pedicel of *G. sintenisii* (sect. *Dissecta*). b. Apex of a glandular hair on the pedicel of *G. sintenisii* (sect. *Dissecta*). c. Glandular and eglandular hairs on the sepal of *G. fallax* (sect. *Geranium*). d. Uncinate, eglandular hairs on the peduncle of *G. strictipes* (sect. *Polyantha*). (Based on: a, *Herrero & al. 1402,* MA; b, *Herrero & al. 1402,* MA; c, *Beck 21256,* MA; d, *Boufford & al. 33029,* MA).

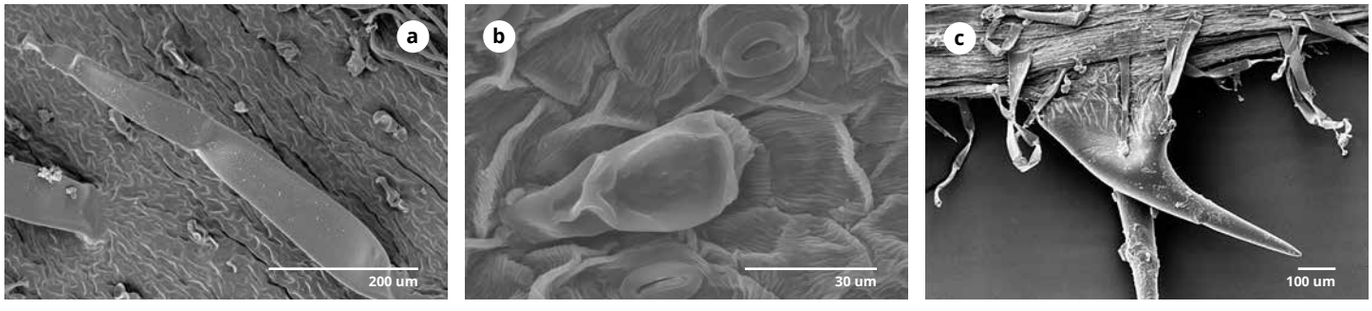


Fig. 8. SEM photographs showing indumentum types found in *Geranium.* a. Plane, glandular hair on the leaf of *G. nakaoanum* (sect. *Polyantha*). b. Short glandular hair on the sepal of *G. schultzei* (sect. *Geranium*). c. Curved prickles and glandular hairs on the petiole of *G. aculeolatum* (sect. *Aculeolata*). (Based on: a, *Miyamoto 10140,* E; b, *Cuadros & Gentry 2782,* MO; c, *Lebrun 7308,* P).

hairs (0.1-3.9 mm long), with a foot consisting of cylindrical or decussate cells and an apical broader cell; rarely the apical cell is of similar width to that of the basal cell (e.g., *G. maculatum*); these occur on almost all structures of plants, sometimes restricted to the inflorescences. (3) Plane, glandular hairs (0.4-1.2 mm long), with two to four cells, usually papillose. These are restricted to the leaves in some species of sect. *Polyantha*, sect. *Ruberta,* and sect. *Trilopha*. (4) Short glandular hairs (< 55 µm long), smooth, usually of two cells, but sometimes with a bicellular foot, are present in all species studied here. Because these are visible only at high magnification, they are not included in the descriptions. Additionally, *G. aculeolatum* has sharp retrorsely curved prickles 0.5-1.2 mm long on the stem and inflorescence. In *G. latilobum* the middle portion of the stem bears abundant stout eglandular hairs, some of them prickle-like.

The presence of glandular hairs is a character to be used taxonomically with caution. Some species consistently lack glandular hairs, but in others the presence of glandular hairs varies even among individuals.

A detailed study of the glandular hairs of *G. robertianum* and its secretions is provided by Pedro & al. (1990, 1991).

Leaves

Geranium leaves are usually palmatifid (Fig. 9), sometimes palmatisect (Fig. 10), polygonal in outline, with five segments, cordate at the base, petiolate and with a couple of stipules. Basal leaves are usually arranged in a persistent or deciduous rosette. In shrubby species the basal leaves are soon deciduous and are not present on mature plants or are unknown. Cauline leaves are similar in shape to the basal leaves, although they become progressively shorter towards the apex of the shoot. A diagram of dimensions used to describe the leaf lamina is shown in Fig. 11. The primary division of the leaf is called a “segment” and the subsequent divisions are called “lobes”.

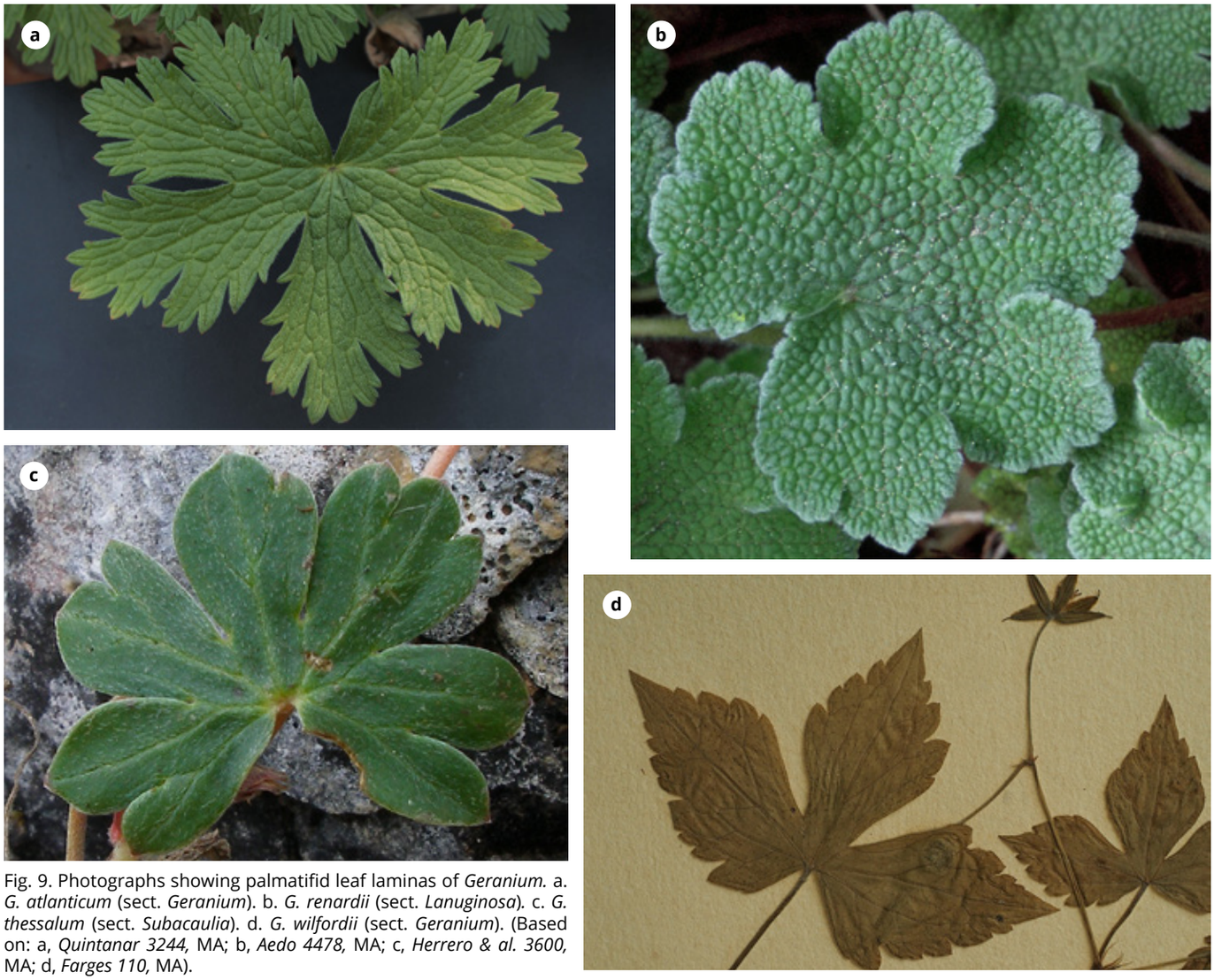


Fig. 9. Photographs showing palmatifid leaf laminas of *Geranium.* a. *G. atlanticum* (sect. *Geranium*). b. *G. renardii* (sect. *Lanuginosa*). c. *G. thessalum* (sect. *Subacaulia*). d. *G. wilfordii* (sect. *Geranium*). (Based on: a, *Quintanar 3244,* MA; b, *Aedo 4478,* MA; c, *Herrero & al. 3600,* MA; d, *Farges 110,* MA).

Geranium ornithopodioides has peltate leaves (with the petiole attached to the blade not by the margin), an unknown trait in other species of the genus.

The Hawaiian endemic species of sect. *Neurophyllodes* have a distinctive leaf lamina. It is unlobed, with an ovate to obtriangular-cuneiform outline, with 3-7 teeth restricted to the apex or almost to the base and with a cuneate base. In the sect. *Paramensia*, *G. jahnii* has quite similar leaves, obtriangular in outline, cuneate and with a tridentate apex, and *G. exallum* differs from all other species in the genus in its entire, narrowly lanceolate, ericoid lamina. In the sect. *Geranium*, four species from the northern Andes (*G. digitatum, G. maniculatum, G. rhomboidale*, and *G. trujillense*; the *Sibbaldioides Group*) plus *G. cavanillesii* (the *Multiceps Group*), have digitate laminas, with the lateral segments turned upward. *Geranium campii* (the *Sibbaldioides Group*), also from this region, has a very distinctive lamina, which is tripartite with broadly lanceolate segments. *Geranium azorelloides* (the *Sibbaldioides Group*) has a rather different tridentate lamina that is quite similar to that of *G. jahnii* (Figs. 12, 13).

The cauline leaves of *Geranium* are opposite in most species but alternate leaves are also common. In species of different groups the middle cauline leaf (usually one, sometimes two) is alternate but the more distal leaves are opposite. In contrast, in five species of the *Papuanum Group* the cauline leaves are opposite while those of the buds alternate. *Geranium oaxacanum* shows a trait unknown in any other species of *Geranium*: a whorl of 3-6 leaves at the first branch point of the inflorescence. Sometimes a second whorl of leaves is present between the base and the first branch point.

The six species of sect. *Neurophyllodes* share a singular feature: an abscission zone at the base of the petiole, just at the junction with the stipules. It should be noted that two species from sect. *Paramensia* also have leaves with an abscission zone. In these species, however, the abscission zone is between the lamina and the petiole.

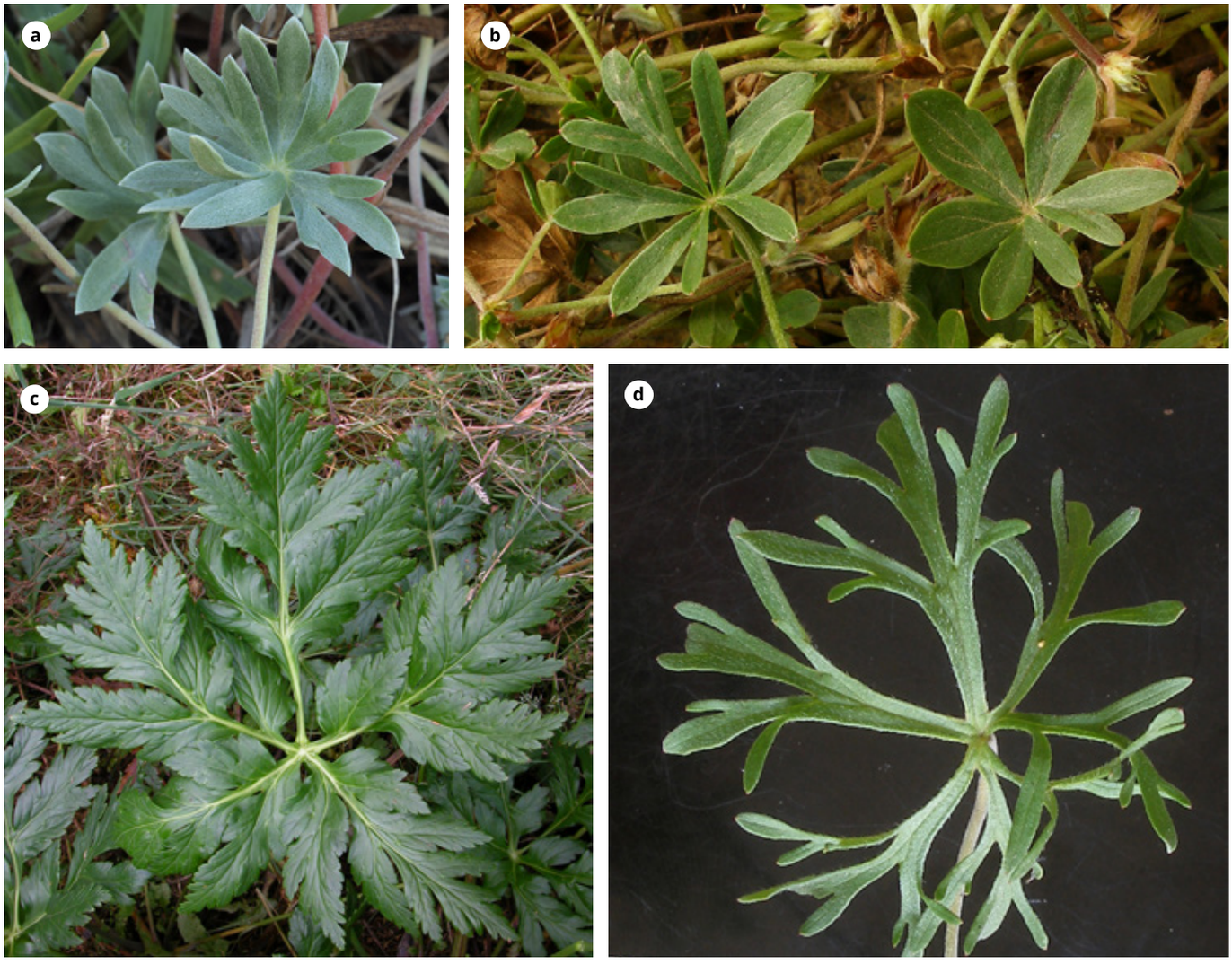


Fig. 10. Photographs showing palmatisect leaf laminas of *Geranium.* a. *G. argenteum* (sect. *Subacaulia*). b. *G. ayavacense* (sect. *Geranium*). c. *G. palmatum* (sect. *Ruberta*). d. *G. retrorsum* (sect. *Geranium*). (Based on: a, *Aedo 20891,* MA; b, *Aedo 16622,* MA; c, *Aedo 9697,* MA; d, *Crawford 2474,* MA).

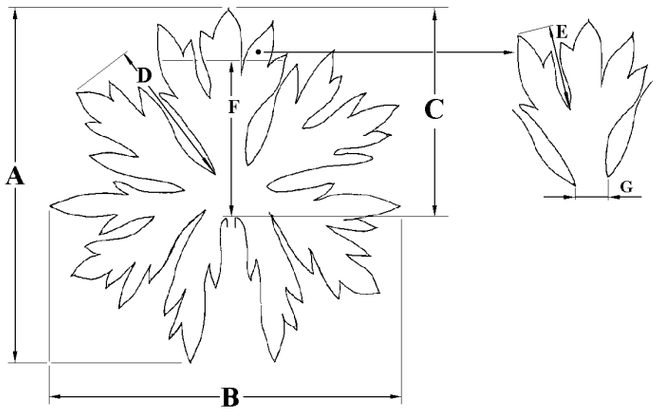


Fig. 11. Diagram of characters used to describe leaf lamina. a. Lamina length. b. Lamina width. c. Segment length. d. Main-sinus length. e. Secondary sinus length. f. Maximum width. g. Segment width at the base.

Each leaf has two stipules, one on either side of the petiole base. The stipules are usually free and lanceolate (in some species ovate), sometimes with a setaceous or short bifid apex (Fig. 14). In a part of the species of the *Sibbaldioides Group* they end in 1-3 short bristles. In some species each stipule is connate with one stipule of the opposite leaf for most of its length. This feature has been observed in species of the *Arabicum Group*, the *Krameri Group*, the *Palustre Group*, the *Papuanum Group*, the *Refractum Group*, the *Wallichianum Group,* all of the sect. *Geranium* and in *G. aculeolatum* (sect. *Aculeolata*) (Fig. 15). In a part of these species this character is variable because the stipules are free in some nodes and connate in others of the same individual. In the six species of sect. *Neurophyllodes* the stipules of each leaf (leaves are alternate) are fused at the base to form a sheath that surrounds the next portion of the branchlet. When the petioles and leaf lamina abscise from the stem, the branchlets ac-

Fig. 12. Photographs showing obtriangular-cuneiform or lanceolate leaf laminas of *Geranium.* a. *G. azorelloides* (sect. *Geranium*). b. *G. cuneatum* subp. *cuneatum* (sect. *Neurophyllodes*). c. *G. jahnii* (sect. *Paramensia*). d. *G. exallum* (sect. *Paramensia*). (Based on: a, *Cuatrecasas & Willard 26343,* MA; b, *Remy 828,* MA; c, *Riina & al. 597,* MA; d, *Sklenář 15822,* MA).

quire a unique aspect because of the persistent, sheathing stipules (Fig. 16). The stipules of the South African species of sect. *Incana* are lanceolate to flabelliform in outline, with 2-9 narrow and deep lobes (Fig. 16).

Inflorescence

Acaulescent species (*e.g.*, sect. *Subacaulia*, *Sessiliflorum Group* or *Sibbaldioides Group*), have a reduced inflorescence of cymules arising directly from the rootstock. In the caulescent species the usually 2-flowered cymules are in a dichasially arranged inflorescence, sometimes with monochasial branches (e.g., sect. *Tuberosa*, *Caespitosum Group*, *Multiceps Group*, *Sylvaticum Group*). It is more frequent, however, that 1- or 2-flowered cymules are borne at the nodes along the stem, i.e., in a monochasial cyme. In both cases some species may have umbel-like aggregates of cymules at the top of each branch in which the peduncles are usually short or absent.

The shrubby species of sect. *Neurophyllodes* (from Hawaii) have a complex inflorescence. Along each branch some floriferous branchlets can occur. These partial inflorescences have 1-flowered cymules grouped into (1)7-12(60)-flowered cymes at the end of a brachyblast. Some axillary leaves occur on the basal part of these inflorescences. From each node usually one single-flowered cymule is borne. All nodes of the inflorescences, i.e., the base of the peduncle and the partial branchlets have abscission lines. The abscission of peduncles together with the fruits may contribute to seed dispersal as a complementary mechanism of autochory, superposed upon the ballistic seed-ejection system of this group of *Geranium*.

Some robust species from Macaronesian islands also exhibit a complex inflorescence. *Geranium palmatum* and *G. reuteri* (sect. *Ruberta*) produce a terminal inflorescence with axillary branches arising below the uppermost rosette leaves, which is basically dichasial with 2-flowered cymules. However, the suppression of internodes, the absence of growth in certain axes, and the abortion of flowering peduncles combine to display a complex inflorescence with numerous flowers together. *Geranium maderense* (sect. *Ruberta*) has a similar but immense inflorescence with four to eight crowded terminal branches at the apex of the rosette leaves.

In some shrubby species from South Africa (sect. *Incana*) the inflorescence shows peduncles opposite to the

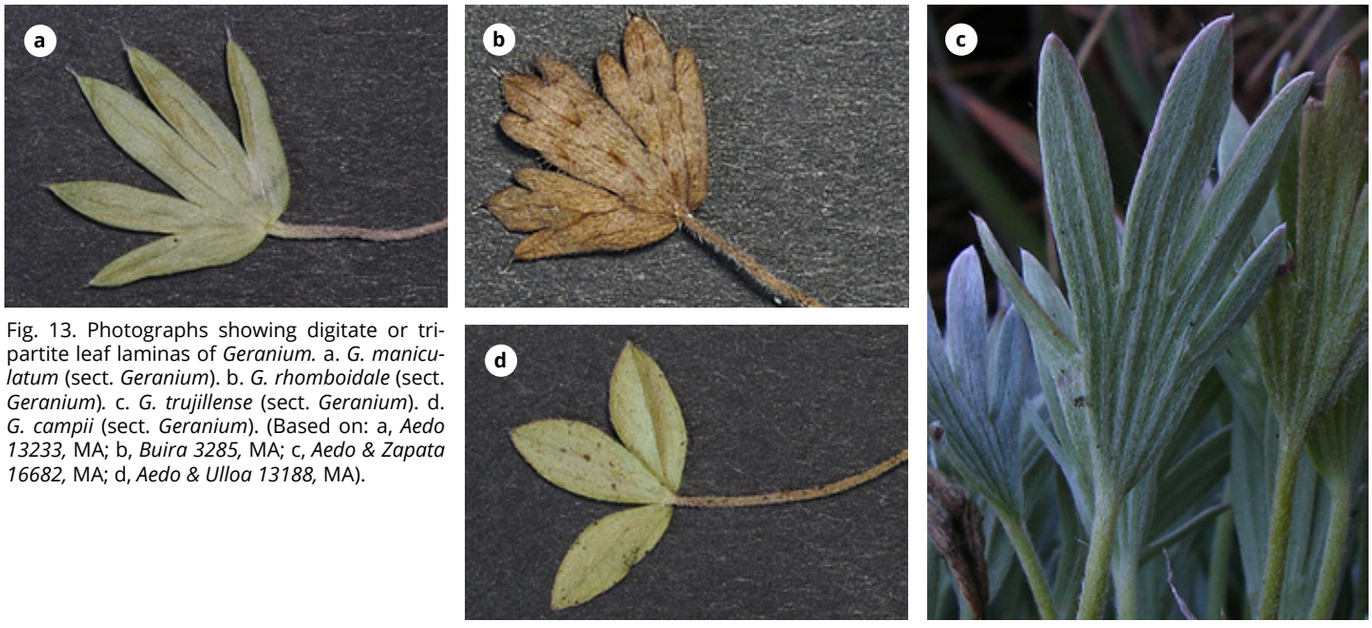


Fig. 13. Photographs showing digitate or tripartite leaf laminas of *Geranium.* a. *G. maniculatum* (sect. *Geranium*). b. *G. rhomboidale* (sect. *Geranium*). c. *G. trujillense* (sect. *Geranium*). d. *G. campii* (sect. *Geranium*). (Based on: a, *Aedo 13233,* MA; b, *Buira 3285,* MA; c, *Aedo & Zapata 16682,* MA; d, *Aedo & Ulloa 13188,* MA).

Fig. 14. Photographs showing free and lanceolate stipules of *Geranium.* a. *G. bohemicum* (sect. *Lanuginosa*). b. *G. collinum* (sect. *Geranium*). c. *G. lanuginosum* (sect. *Lanuginosa*). (Based on: a, *Aedo 24061,* MA; b, *Aedo 16716,* MA; c, *Aedo 24060,* MA).

upper leaves along the branches forming large compound and complex cymes, lacking leaves on the upper nodes and with ultimate peduncles mostly 2-flowered.

In species with 2-flowered cymules there are four whorled bracteoles dividing the peduncle from the pedicel, while in those with 1-flowered cymules there are two opposite bracteoles (except when they lack pedicels) (Fig. 17). In the species of sect. *Neurophyllodes* the two bracteoles on each peduncle are not sheathing, but instead their bases overlap on one side of the peduncle, exposing the opposite part and giving a sheathed appearance (Fig. 17). Some species of the *Papuanum Group* from New Guinea also have quite similar bracteoles.

Calyx

The sepals form a quincuncial calyx. The two inner sepals are usually less pubescent than the others. The external surface of each sepal is smooth, sometimes with thickened nerves. In *G. glaberrimum* and *G. lasiopus* (sect. *Ruberta*) the three outer sepals have 2-3 longitudinal ribs and the inner are smooth, while in *G. lucidum* (sect. *Ruberta*) the three outer sepals have lengthwise keels and transverse flaps between these, and the two inner are ± smooth.

The sepals may be somewhat elongated on the fruit but they are obviously only accrescent in a few scattered species of sect. *Geranium*, sect. *Lanuginosa* and sect. *Trilopha*, most of them annuals. The sepals of most species end in a distinct mucro. Only *G. planum* (sect. *Geranium*) and *G. makmelikum* (sect. *Subacaulia*) lack mucro in all or part of specimens examined. In descriptions and key, the length of the sepal does not include the length of the mucro.

Kenda (1956) studied the presence of subepidermal calcium oxalate crystals in the sepals of some geraniums.

Corolla

The actinomorphic corolla of *Geranium* has five petals that are usually erect-patent or, more rarely, patent. Two spe-

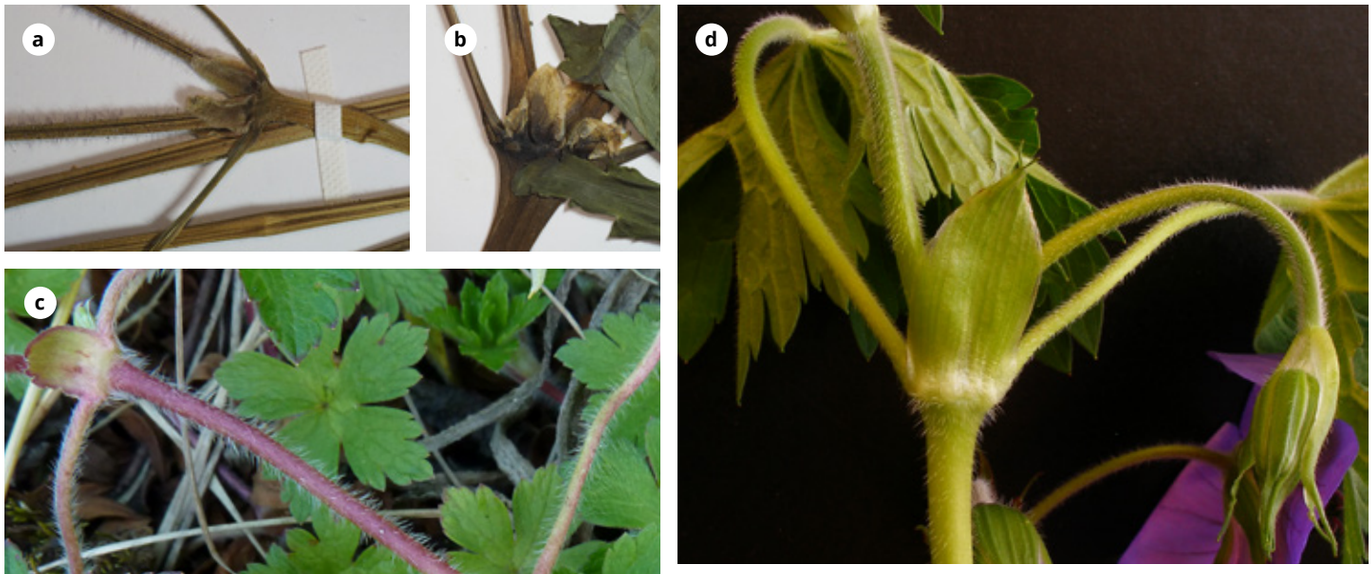


Fig. 15. Photographs showing free or connate, ovate stipules of *Geranium.* a. *G. maderense* (sect. *Ruberta*). b. *G. reuteri* (sect. *Ruberta*). c. *G. arabicum* subsp. *arabicum* (sect. *Geranium*). d. *G. wallichianum* (sect. *Geranium*). (Based on: a, *Sequeira & Góis-Marques 7961,* MA; b, *Panero & Ortega 6942,* MA; c, *Aedo 18093,* MA; d, *Aedo 15739,* MA).

Fig. 16. Photographs showing sheathing or flabelliform and deeply lobed stipules of *Geranium.* a. *G. cuneatum* subp. *cuneatum* (sect. *Neurophyllodes*). b. *G. multisectum* (sect. *Incana*). c. *G. pulchrum* (sect. *Incana*). (Based on: a, *Remy 828,* MA; b, *Aedo 15092b*, MA; c, *Aedo 15016*, MA).

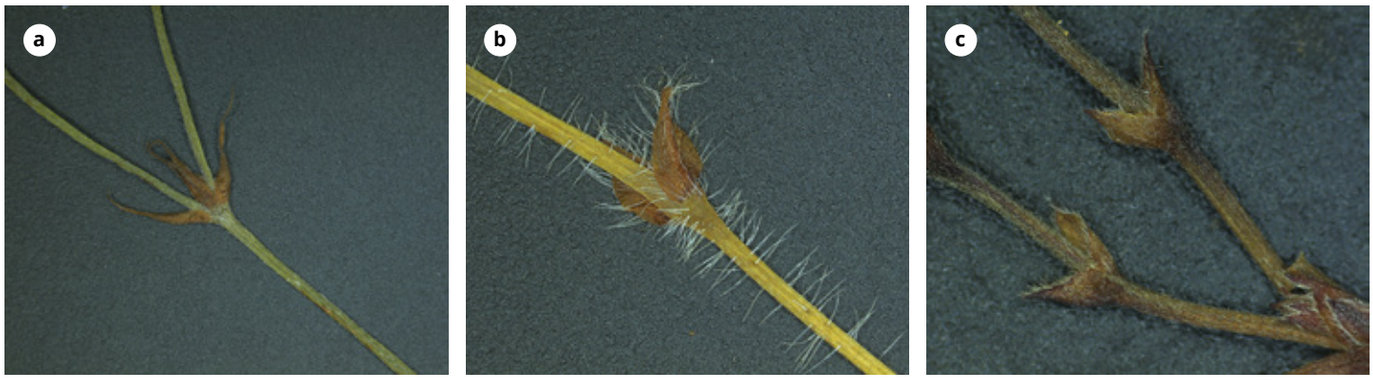


Fig. 17. Photographs showing whorled, opposite or overlaping bracteoles of *Geranium.* a. *G. nodosum* (sect. *Geranium*). b. *G. sanguineum* (sect. *Geranium*). c. *G. cuneatum* subp. *cuneatum* (sect. *Neurophyllodes*). (Based on: a, *Calvo & al. 6606*, MA; b, *Galán Cela 1261*, MA; c, *Remy 828,* MA).

cies of sect. *Erodioidea*, five species of the *Refractum Group* (sect. *Geranium*) and one the *Caespitosum Group* (sect. *Geranium*), however, have reflexed petals. The corolla of *G. arboreum* is unique in the genus, with the petals arcuate, the upper three erect (with revolute apex), the lower ones reflexed, forming a zygomorphic corolla. The two species of sect. *Unguiculata* have also a zygomorphic corolla, while in *G. palmatum* (sect. *Ruberta*) it is slightly zygomorphic.

The petal apex is usually rounded, but in some species it may be also retuse or slightly notched, or even emarginate. The base gradually narrows or more rarely differs into a claw in some species of subg. *Geranium* and subg. *Robertium*. In the ten species of sect. *Ruberta* and in *G. rotundifolium* the claw is bicarenated on the adaxial side. Petal length varies greatly and is taxonomically useful. Annual species have short petals, but some perennial species, such as *G. sibiricum* or *G. core-core*, also show this trait. In *Geranium* few species have absolutely glabrous petals. It is more common that they have some short hairs on the base, especially at the basal margins. In some groups of sect. *Geranium* (i.e.: the *Caespitosum Group*, the *Hernandesii Group*, the *Krameri Group* and others single species) and in *G. glanduligerum* (sect. *Erodioidea*), the petals are hairy on the basal 1/5 to 3/4 of the adaxial surface. The color of the petals varies from white, pale pink or blue to a more or less intense purple, or exceptionally blackish. In *G. arboreum* the petals are reddish. In some species of sect. *Geranium*, sect. *Trilopha*, and sect. *Subacaulia* the petals have a distinctive dark basal spot.

Androecium

The flower has two whorls of five fertile stamens each. The stamens are usually shorter than the petals, except in species with patent to reflexed petals. The anthers are dorsifixed and dehisce by longitudinal slits. The antesepalous anthers (inner whorl) dehisce first, followed by the antepetalous whorl. Endress (2010) studied deeply the anatomic and organizational aspects of obdiplostemony of the androecium of *G. robertianum*. *Geranium pusillum* (sect. *Batrachioidea*) and *G. texanum* (sect. *Geranium*) are two annual species with the external whorl lacking anthers and with reduced filaments.

The filaments are usually lanceolate, but in some species they have a broad triangular base and an abruptly narrowed apex; they are usually glabrous or with short hairs, but some species (e.g., *G. reinii*) have hairs up to 4.2 mm long. The color of the filaments varies from white or pink to more or less deep purple. The exception are some species of sect. *Trilopha* and sect. *Geranium*, which have black filaments at least at the tip.

Geranium usually has five hemispheric nectaries alternate with the petals. In *G. lucidum* the nectaries are strongly reduced. *Geranium sinense* is the only species in the genus with a nectary forming a ring all around the flower. Nectaries can be glabrous, with a tuft of hairs at the apex, or dorsally hairy. Mirimanoff (1941), Link (1990) and Konarska & Masierowska (2019) provided further data about the nectar composition, affinities and structure of the *Geranium* nectaries.

Pollen

The pollen of *Geranium* is tricolporate and more or less isodiametric. In size they range from 47 to 123 µm (polar diameter) and 42 to 120 µm (equatorial diameter) (Stafford & Blackmore 1991; Verhoeven & Venter 1992). The exine bears reticulate ornamentation formed by baculate, clavate, or gemmate supratectal elements, which is defined as *Geranium*-type (Bortenschlager 1967; Stafford & Blackmore 1991). There is some variation in the size of supratectal elements, having gemmate elements that may protrude further from the reticulum giving the grain an irregular outline. On this basis some subtypes of little taxonomic interest were definited. The exine ornamentation studied in the four sections of subg. *Erodioidea* (54 % of the species studied), the five sections of subg. *Geranium* (62 % of the species studied) and all species of subg. *Tuberosa*, always shows the *Geranium*-type (Bortenschlager 1967; Gagnepain 1903; Lu & al. 1996; Park & Kim 1997; Perveen & Gaiser 1999; Shehata 2008; Stafford & Blackmore 1991; Tan & al. 1996; Velasco 1992b; Verhoeven & Marais 1990; Verhoeven & Venter 1992) (Figs. 18-20).

In contrast, in the species of sect. *Trilopha* and sect. *Polyantha*, both of subgenus *Robertium*, the exine shows a striate-rugulose pattern, similar to that found in *Erodium*, which is defined as *Erodium*-type (Aedo 2016; Aedo & al. 2016; Bortenschlager 1967) (Fig. 21). However, Shehata (2008) indicated that *G. trilophum* has *Geranium*-type pollen, and Park & Kim (1997) and Perveen & Gaiser (1999) show the same for *G. ocellatum*. This could be the result of a mistake in the identification of these specimens. Thus, the identity of the vouchers should be revised to confirm such type of ornamentation in sect. *Trilopha*. In the remaining species of subgenus *Robertium* (sect. *Batrachioidea*, sect. *Divaricata*, sect. *Ruberta* and sect. *Unguiculata*), the pollen is of the *Geranium*-type (Bortenschlager 1967; Gagnepain 1903; Park & Kim 1997; Perveen & Gaiser 1999; Stafford & Blackmore 1991; Tan & al. 1996; Velasco 1992b, Verhoeven & Marais 1990; Weber 1996).

The identity of the fossil pollen grains attributed to *Geranium* and *Erodium* (Van Campo 1989: 16 fig. 18-19, 19 fig. 1-10) should be confirmed before to use them as evidence to support phylogenetic reconstructions.

Gynoecium

The gynoecium comprises five carpels, each with two ovules, of which only one develops into a mature seed. According to Albers & Van der Walt (2007) the "ovules are anatropous, bitegmic and crassinucellate. Embryo sac development is of the *Polygonum* type; the early endosperm conforms to the Nuclear type, and both endosperm and nucellus are later resorbed by the embryo". The ovary has five locules and is lobed. The five styles are fused into a col-

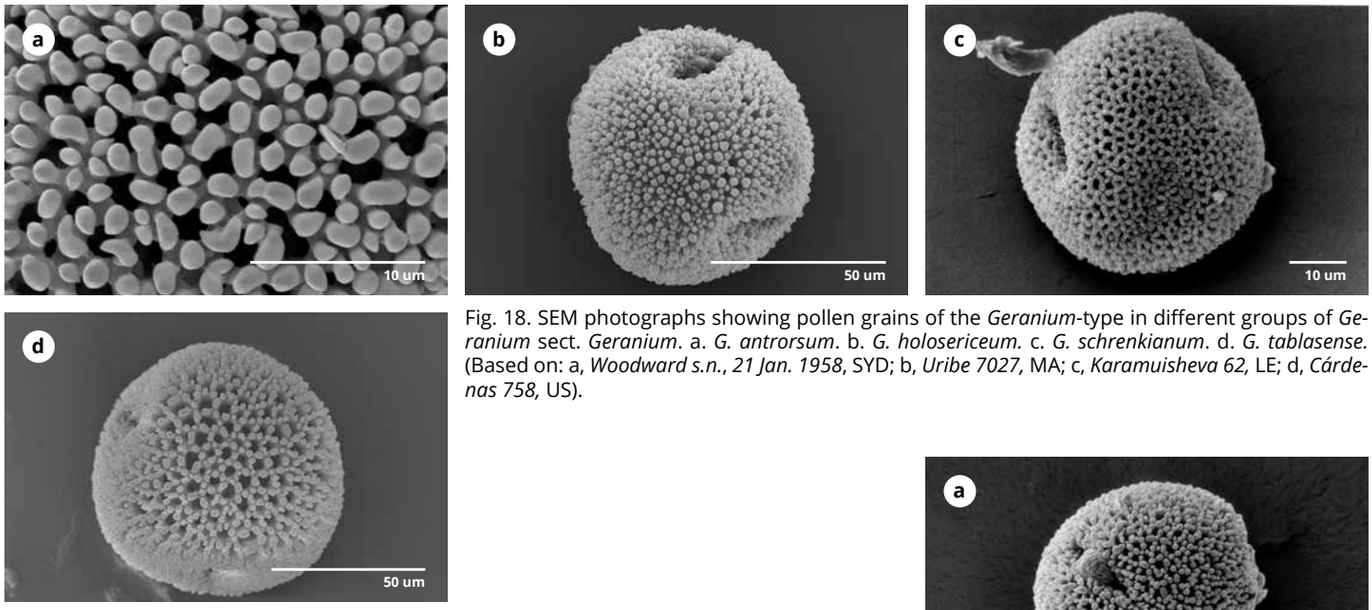


Fig. 18. SEM photographs showing pollen grains of the *Geranium*-type in different groups of *Geranium* sect. *Geranium*. a. *G. antrorsum*. b. *G. holosericeum.* c. *G. schrenkianum*. d. *G. tablasense.* (Based on: a, *Woodward s.n.*, *21 Jan. 1958*, SYD; b, *Uribe 7027,* MA; c, *Karamuisheva 62,* LE; d, *Cárdenas 758,* US).

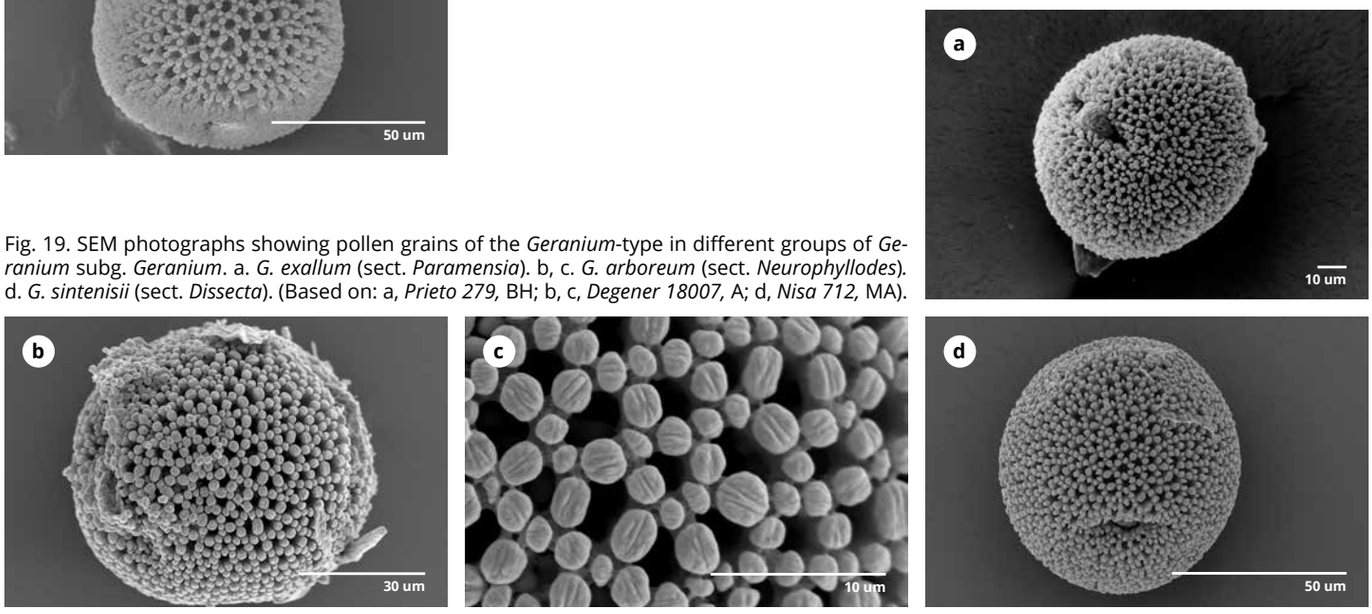


Fig. 19. SEM photographs showing pollen grains of the *Geranium*-type in different groups of *Geranium* subg. *Geranium*. a. *G. exallum* (sect. *Paramensia*). b, c. *G. arboreum* (sect. *Neurophyllodes*). d. *G. sintenisii* (sect. *Dissecta*). (Based on: a, *Prieto 279,* BH; b, c, *Degener 18007,* A; d, *Nisa 712,* MA).

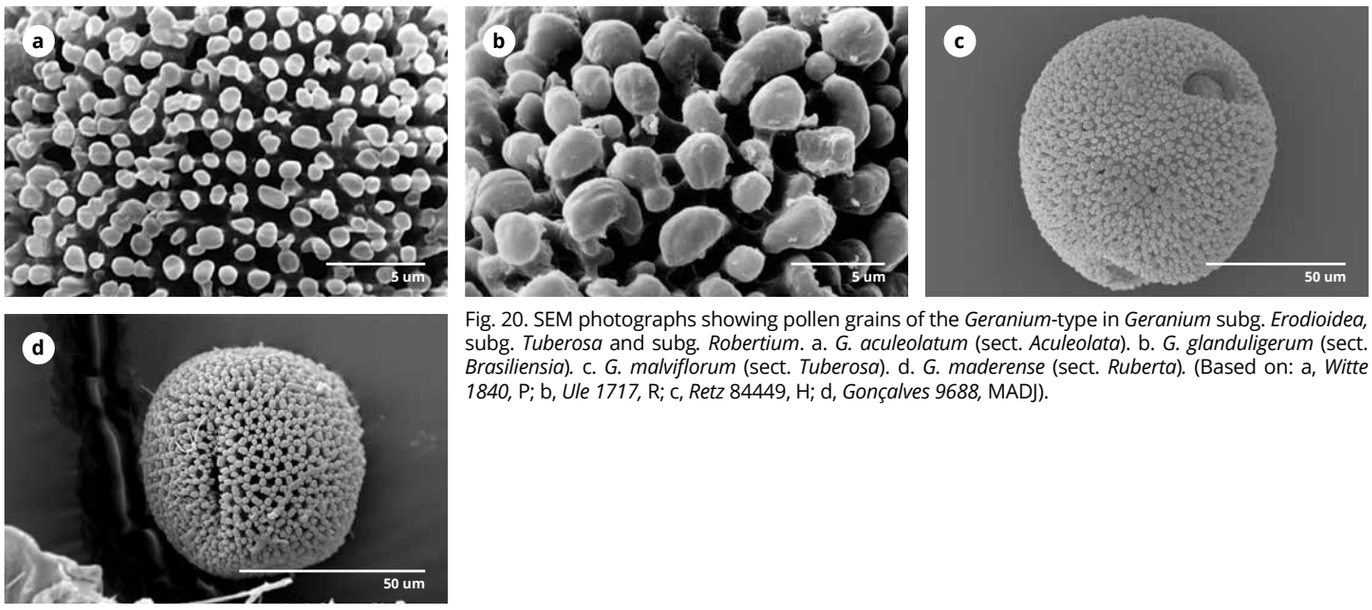


Fig. 20. SEM photographs showing pollen grains of the *Geranium*-type in *Geranium* subg. *Erodioidea,* subg. *Tuberosa* and subg. *Robertium*. a. *G. aculeolatum* (sect. *Aculeolata*). b. *G. glanduligerum* (sect. *Brasiliensia*). c. *G. malviflorum* (sect. *Tuberosa*). d. *G. maderense* (sect. *Ruberta*). (Based on: a, *Witte 1840,* P; b, *Ule 1717,* R; c, *Retz* 84449, H; d, *Gonçalves 9688,* MADJ).

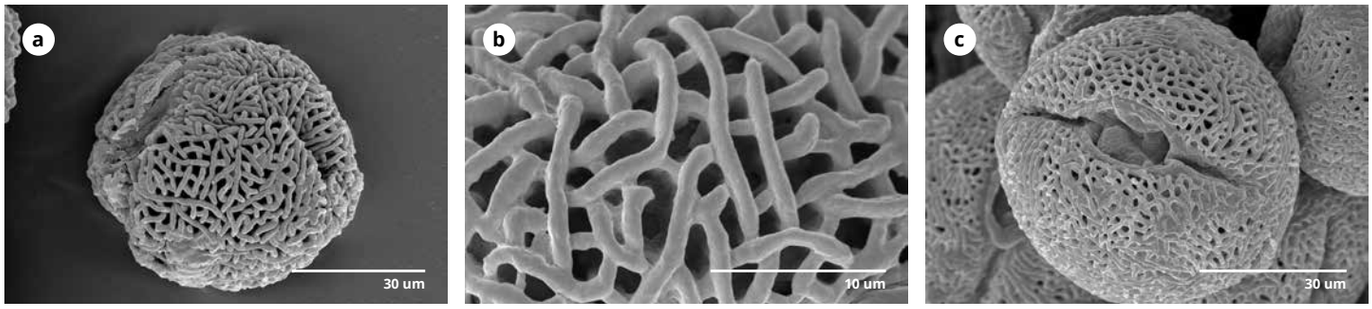


Fig. 21. SEM photographs showing pollen grains of the *Erodium*-type in *Geranium* subg. *Robertium*. a. *G. hispidissimum* (sect. *Polyantha*). b. *G. trilophum* (sect. *Trilopha*). c. *G. yemense* (sect. *Trilopha*). (Based on: a, *Sino-Amer. Bot. Exped. 1349,* GH; b, *Koie s.n.*, *15 Mar. 1937*, C; c, *Wood 73/67,* BM).

umn, divided at the apex into five branches, each of which has a stigmatic surface on the adaxial side. Erbar (1998) studied the ontogeny of the coenocarpous gynoecium of *Geranium* in the case of *G. sanguineum*. Dragunova (1985) studied the ultrastructure of the integuments and nucellus in *G. gracile*. Kumar (1977) described the embryology of *G. lucidum*, *G. nepalense* and *G. wallichianum* and Phouphas (1950) that of *G. robertianum*.

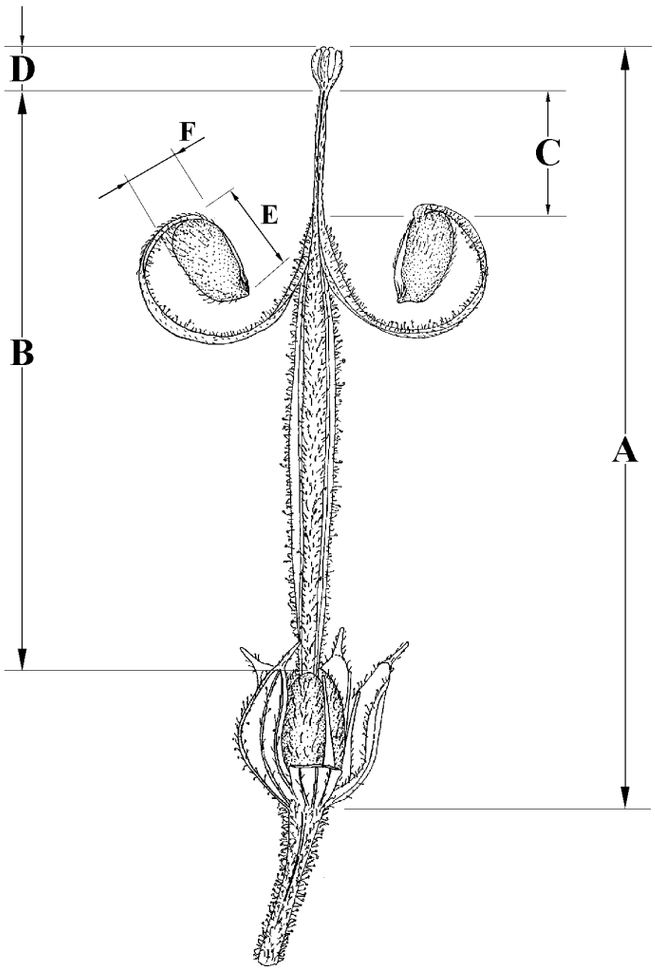


Fig. 22. Diagram of characters used to describe fruit. a. Fruit length. b. Rostrum length. c. Rostrum narrowed apex length. d. Length of persistent stigma lobes. e. Mericarp length. f. Mericarp width.

Fruit

The fruit of *Geranium* is a schizocarp. Figure 22 shows the characters used to describe the fruit. After fertilization a prominent rostrum develops proximal to the style. The rostrum in some species has a narrowed apex of stylar origin and always bears the remnants of the five stigmas. At maturity the carpel shows two main parts: (1) a loculus containing the seed, called the mericarp, and (2) a sterile portion forming a ribbon-like band (the awn), which is derived from the rostrum that has a central axis or columella.

The type of fruit discharge is the basis for the subgeneric classification proposed by Yeo (1984). Yeo (1984) described three main classes of discharge mechanism, one of which has three subclasses.

In the "*Erodium*-type" of discharge, the entire mericarp, including the coiled awn, is propelled over a short distance. The seed remains inside of mericarp, because the lateral margins of the mericarp are close together on the adaxial side and prevent the seed from falling off. The "*Erodium*-type" of discharge is found in the four sections of subg. *Erodioidea*. In this type of fruit the base of the mericarp usually narrows into a beak and ends in a thickening or callus. It seems that the function of this callus would be to facilitate the burial of the mericarp, rather than to prevent the seed from falling. The mericarps surface has usually some transverse ribs towards the apex. Three species of sect. *Subacaulia* have lost the basal callus. In contrast with other species of the subgenus *Erodioidea,* the mericarps of *G. aculeolatum* end abruptly, lacking the basal beak (Figs. 23, 24).

In the "carpel-projection type" of discharge the whole mericarp, containing the seed and without the awn, is dispersed by the propelling force of the explosive recurvature of the awn (Figs. 25-27). The "carpel-projection type" of discharge is found in the six sections of subg. *Robertium*. In the sect. *Divaricata* the mechanism of propelling the mericarp is not operative because the rostrum is not well developed and thus the mericarp including the seed is ejected only a short distance. Nevertheless Yeo (1984) classified this

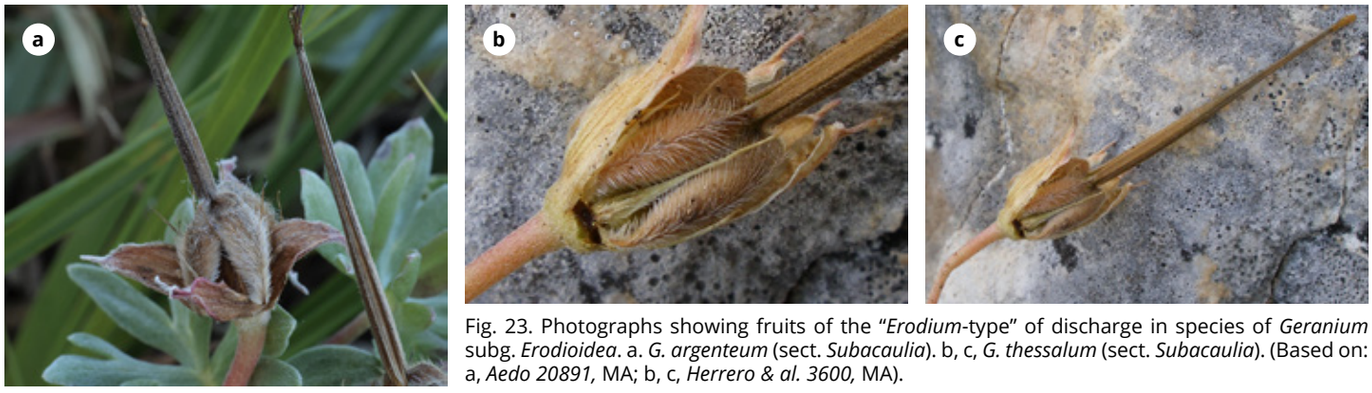


Fig. 23. Photographs showing fruits of the "*Erodium*-type" of discharge in species of *Geranium* subg. *Erodioidea*. a. *G. argenteum* (sect. *Subacaulia*). b, c, *G. thessalum* (sect. *Subacaulia*). (Based on: a, *Aedo 20891,* MA; b, c, *Herrero & al. 3600,* MA).

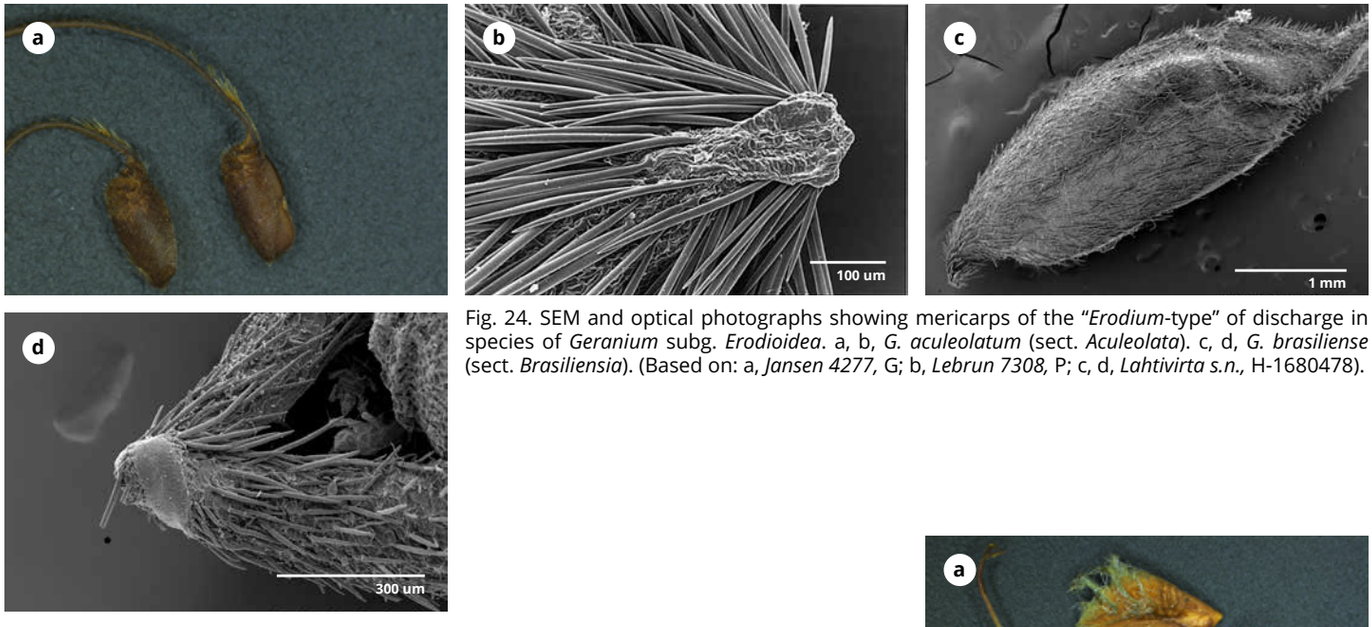


Fig. 24. SEM and optical photographs showing mericarps of the "*Erodium*-type" of discharge in species of *Geranium* subg. *Erodioidea*. a, b, *G. aculeolatum* (sect. *Aculeolata*). c, d, *G. brasiliense* (sect. *Brasiliensia*). (Based on: a, *Jansen 4277,* G; b, *Lebrun 7308,* P; c, d, *Lahtivirta s.n.,* H-1680478).

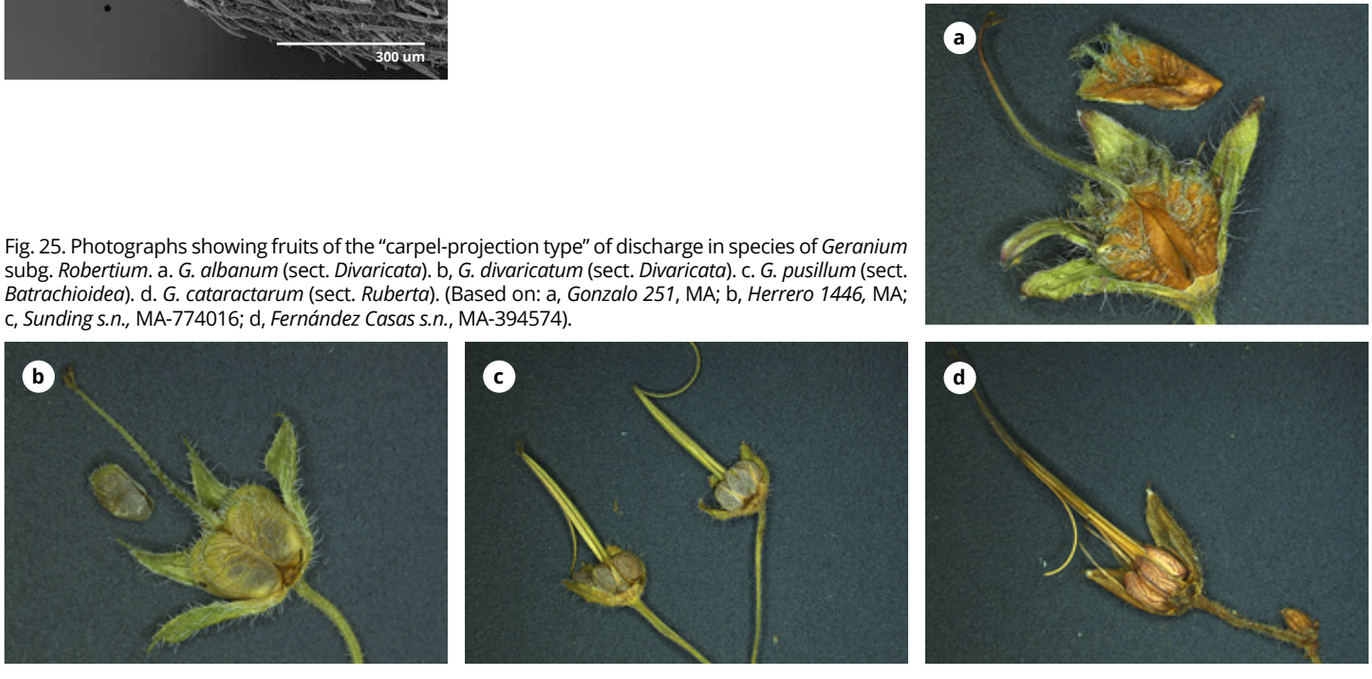


Fig. 25. Photographs showing fruits of the "carpel-projection type" of discharge in species of *Geranium* subg. *Robertium*. a. *G. albanum* (sect. *Divaricata*). b, *G. divaricatum* (sect. *Divaricata*). c. *G. pusillum* (sect. *Batrachioidea*). d. *G. cataractarum* (sect. *Ruberta*). (Based on: a, *Gonzalo 251*, MA; b, *Herrero 1446,* MA; c, *Sunding s.n.,* MA-774016; d, *Fernández Casas s.n.*, MA-394574).

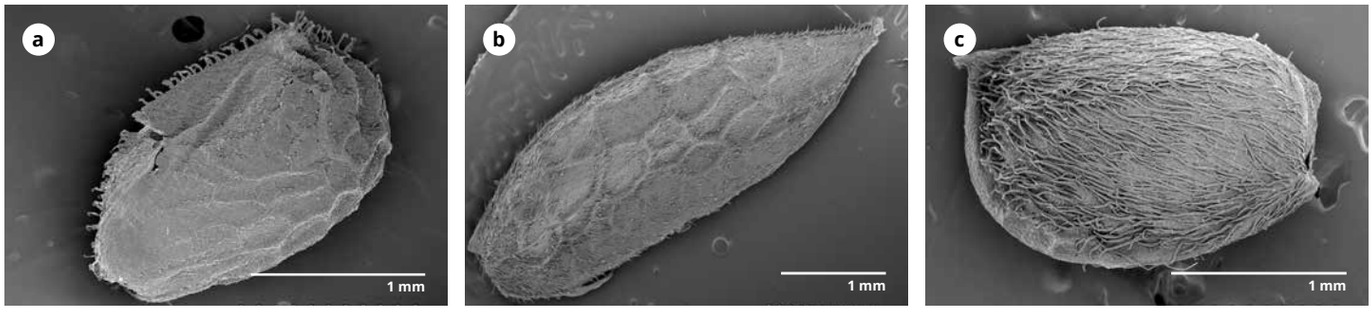


Fig. 26. SEM photographs showing mericarps of the "carpel-projection type" of discharge in species of *Geranium* subg. *Robertium.* a. *G. lucidum* (sect. *Ruberta*). b. *G. polyanthes* (sect. *Polyantha*). c. *G. pusillum* (sect. *Batrachioidea*). (Based on: a, *Aedo 9162,* MA; b, *Watson 219,* E; c, *Lázaro s.n.,* MA-794689).

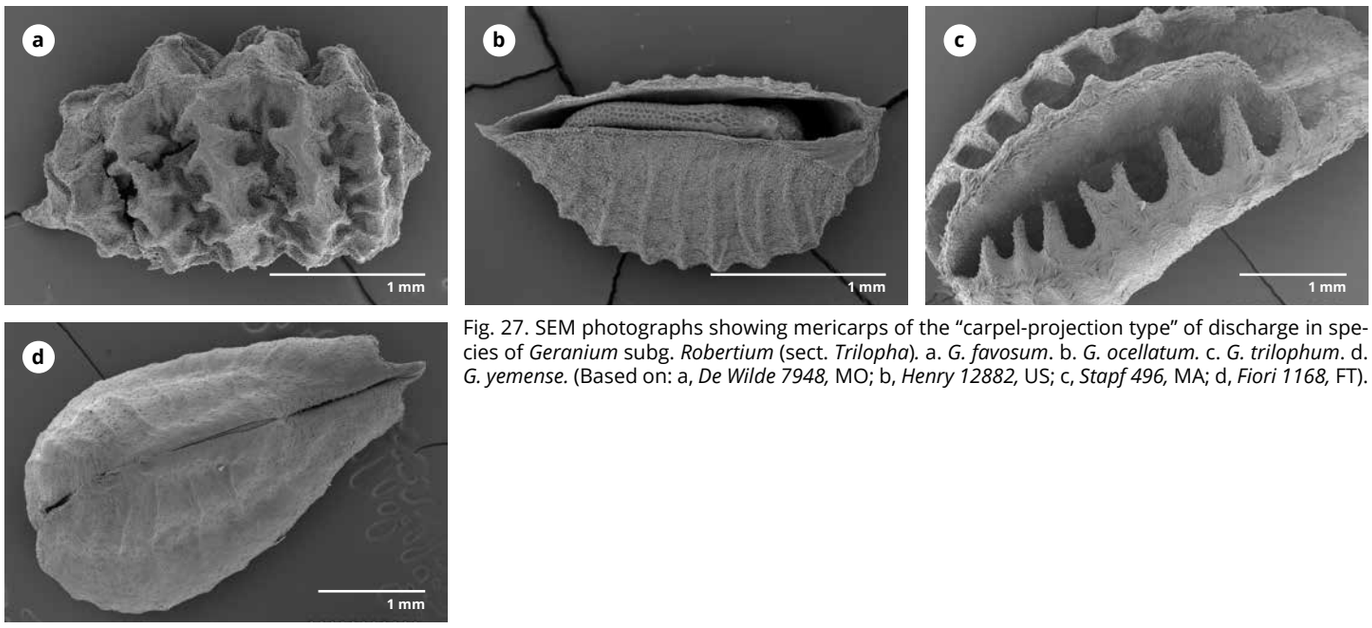


Fig. 27. SEM photographs showing mericarps of the "carpel-projection type" of discharge in species of *Geranium* subg. *Robertium* (sect. *Trilopha*). a. *G. favosum*. b. *G. ocellatum.* c. *G. trilophum*. d. *G. yemense.* (Based on: a, *De Wilde 7948,* MO; b, *Henry 12882,* US; c, *Stapf 496,* MA; d, *Fiori 1168,* FT).

section under the subg. *Robertium* because "... they have a sculptured mericarp that is freed with the seed inside it and without the awn". In sect. *Divaricata* the seed remains inside of the mericarp, because the lateral margins of the mericarp are close together on the adaxial side and prevent the seed from falling. Three of the four species of sect. *Batrachioidea* have smooth mericarps but otherwise they fit well with the "carpel-projection type". Two species of sect. *Ruberta* have a strand of fibers derived from the beak, attached near the apex on either side. They have an adhesive property so that the mericarps are suspended in other plants when they are ejected. According to Yeo (1973a: 305) "The fibers are formed in two bundles, one along either side of the elater, but on their release they form a single strand except near their points of attachment, which are just below the apex of the carpel." Three of the six species of sect. *Trilopha* have a peculiar mericarp with two longitudinal toothed wings bent dorsally to form a trough-like structure. The five ribbon-like bands of the rostrum are usually parallel in *Geranium*, but in all species of sect. *Trilopha* they are twisted. A similar twist is found in the species of subg. *Tuberosa.*

In the "seed-ejection type" of discharge each single seed is launched by the explosive recurvature of the awn, and the mericarp remains attached to the awn, which usually remains apically attached to the columella. There are three variants of the mechanism retaining the seed within the mericarp during the pre-explosive interval. This permits a division into three subclasses.

In the first subclass there is no structure for retaining the seed in the pre-explosive interval. Instead, the mericarp is twisted at its attachment to the awn and, consequently, the orifice faces almost horizontally. The upper part of the mericarp is longitudinally compressed, probably strengthening the connection between the awn and the mericarp and favoring the twisting of the mericarp. The five ribbon-like bands of the rostrum are twisted. This type is found in the two sections of subg. *Tuberosa* (Figs. 28, 29).

Fig. 28. Photographs showing fruits of the "seed-ejection type" of discharge in species of *Geranium* subg. *Tuberosa* and sect. *Dissecta*. a. *G. platypetalum* (sect. *Lanuginosa*). b. *G. lanuginosum* (sect. *Lanuginosa*). c. *G. dissectum* (sect. *Dissecta*). (Based on: a, *Aedo 11454,* MA; b, *Aedo 24060,* MA; c, without voucher, from Madeira, Portugal, photo: M. Sequeira).

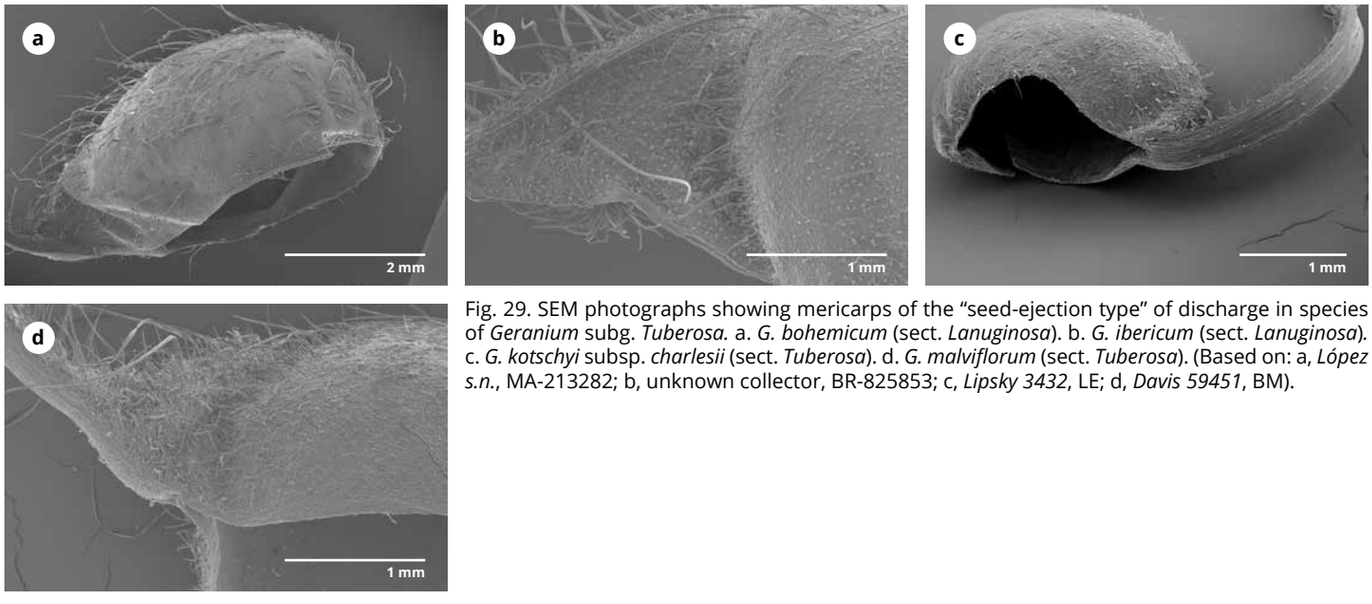


Fig. 29. SEM photographs showing mericarps of the "seed-ejection type" of discharge in species of *Geranium* subg. *Tuberosa.* a. *G. bohemicum* (sect. *Lanuginosa*). b. *G. ibericum* (sect. *Lanuginosa*). c. *G. kotschyi* subsp. *charlesii* (sect. *Tuberosa*). d. *G. malviflorum* (sect. *Tuberosa*). (Based on: a, *López s.n.*, MA-213282; b, unknown collector, BR-825853; c, *Lipsky 3432*, LE; d, *Davis 59451*, BM).

In the second subclass the seed is retained in the mericarp during the pre-explosive interval by a part of the mericarp wall, which projects as a prong. This prong has the same texture as the rest of the mericarp wall. This type is found in the sect. *Dissecta* (subg. *Geranium*) (Figs. 28, 30). Yeo (2002a: 39) has suggested that subclasses first and second might deserve the rank of subgenus. In the present work this range has only been accepted for the first group due to the strong morphological differentiation of its fruits.

In the third subclass the mericarp has a basal callus with a cluster of bristles at the lower end, which prevents the seed from falling out prematurely during the pre-explosive interval. This type is found in the remaining groups classified into the subg. *Geranium* (Figs. 30-32).

In the three subclasses of the "seed-ejection type" the mericarp is smooth, occasionally with 1-3 transverse veins at the apex.

The rostrum of some species of *Geranium* is gradually narrowed toward the apex, whereas in others it terminates abruptly in a narrow apex, in which case the apical portion of the rostrum is easily differentiated from the basal one. This narrowed apex is of taxonomic utility at the species level.

Structural aspects of the hygroscopic movements of the awn in Geraniaceae are analyzed by Abraham & Elbaum (2013).

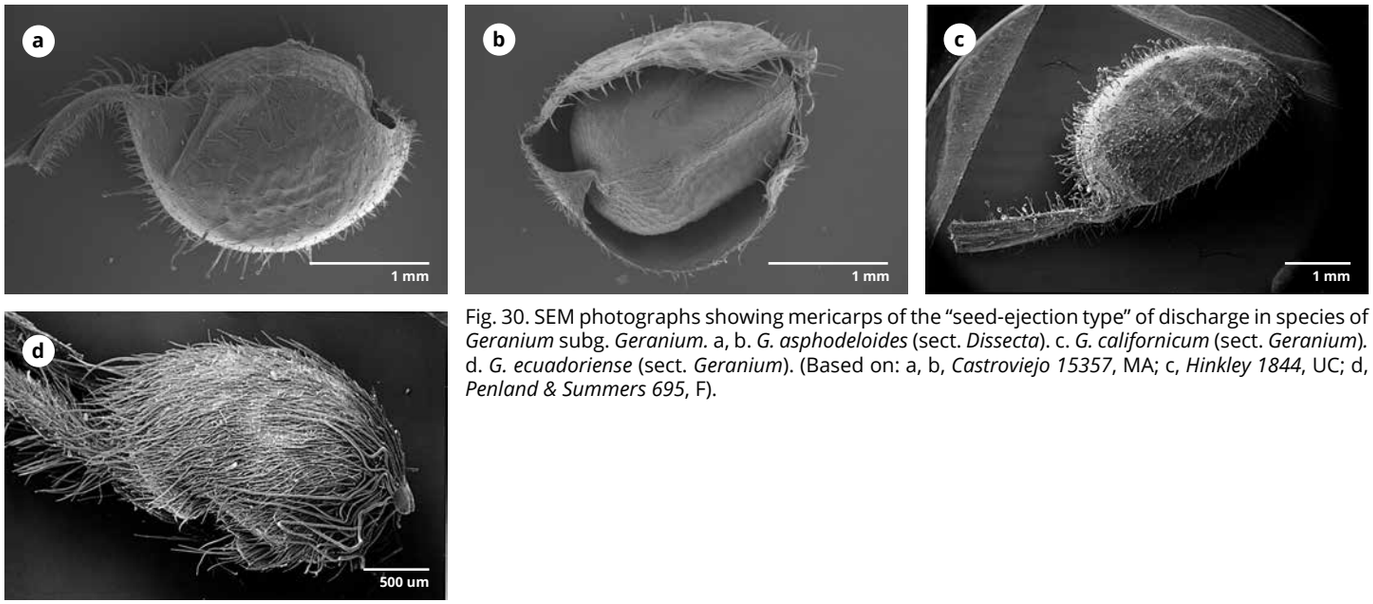


Fig. 30. SEM photographs showing mericarps of the "seed-ejection type" of discharge in species of *Geranium* subg. *Geranium.* a, b. *G. asphodeloides* (sect. *Dissecta*). c. *G. californicum* (sect. *Geranium*). d. *G. ecuadoriense* (sect. *Geranium*). (Based on: a, b, *Castroviejo 15357*, MA; c, *Hinkley 1844*, UC; d, *Penland & Summers 695*, F).

Fig. 31. Photographs showing fruits of the "seed-ejection type" of discharge in species of *Geranium* sect. *Geranium*. a. *G. solanderi*. b, *G. versicolor*. c. *G. core-core*. d. *G. ecuadoriense.* (Based on: a, *de Lange 225,* MA; b, *Aedo 14260,* MA; c, *Aedo 7073,* MA; d, *Aedo 13228,* MA).

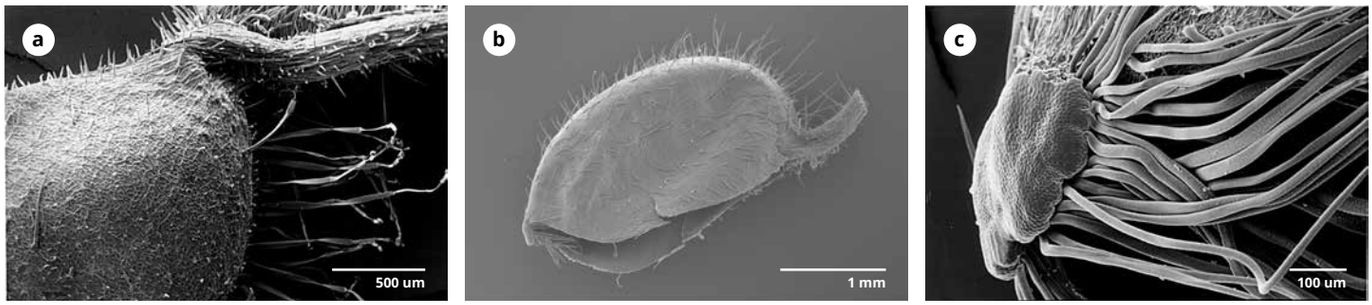


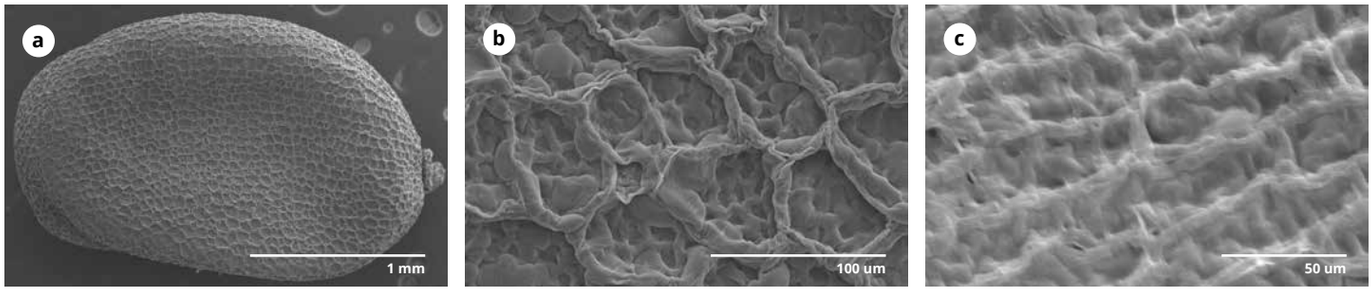
Fig. 32. SEM photographs showing mericarps of the "seed-ejection type" of discharge in species of *Geranium* subg. *Geranium.* a. *G. maculatum* (sect. *Geranium*). b. *G. skottsbergii* (sect. *Geranium*). c. *G. weddellii* (sect. *Geranium*). (Based on: a, *Fleischmann 88,* DAO; b, *Aedo 6838*, MA; c, *Beck 21990*, LPB).

Seeds

The seeds are more or less ellipsoid and slightly compressed. Most species of the genus show a finely reticulate surface. The depth and length of the alveolus vary within some species, suggesting that this feature has little taxonomic value. In many species of subg. *Robertium* (but also in few cases of those of the subg. *Geranium* and subg. *Tuberosa*) the surface appears smooth at low magnification, but a reticulum is revealed at high magnification (Fig. 33). Exceptionally, the seeds of *G. rotundifolium* and few other species show a distinct reticulation even to the unaided eye (Fig. 34). The outer layer of the seed-coat has cells with anticlinally thickened walls, forming a polygonal pattern. These anticlinally thickened walls, usually straight in the genus, are more or less curved in the seeds of the sect. *Neurophyllodes*, giving the seed-coat surface a distinctive reticulate-sinuous aspect. Seeds are glabrous in *Geranium*, except in *G. rupicola*, which has scattered hairs on the seed surface (Fig. 35).

According to Albers & Van der Walt (2007) the seeds are campylotropous with large embryos and strongly folded cotyledons, when viewed in transverse section, and have no or very little endosperm; they are rich in lipid substances and poor in starch (see also Boesewinkel & Been 1979; Boesewinkel 1988, 1997; Yeo 1990). Cotyledons usually have an entire margin but in some species they have one or two notches on each side. This feature has been found only in *G. aculeolatum* (with two notches on each side) (subg. *Erodioidea*), *G. albanum* (subg. *Robertium*), *G. aristatum* (subg. *Erodioidea*), *G. bohemicum* (subg. *Tuberosa*), and *G. divaricatum* (subg. *Robertium*).

Specific studies about *Geranium* seeds production, development, dormancy, germination and seed survival are addressed in the following papers: Abrams & Dickmann (1984), Ågren & Willson (1992), Baskin & Baskin (1974), Gama-Arachchige & al. (2010, 2011, 2012), Herrera (1991), Meisert (2002), Meisert & al. (1999), Milberg (1994), Raunkiaer (1888), Roberts & Boddrell (1985), Van Assche & Vandelook (2006), Vandelook & Van Assche (2010) and Varga & al. (2015).



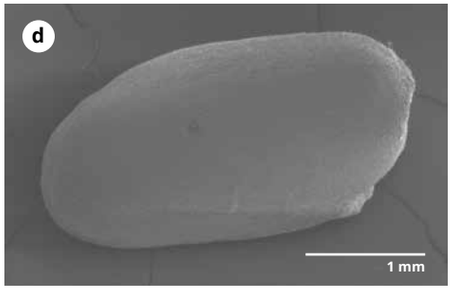


Fig. 33. SEM photographs showing seeds and seed-coat details of *Geranium*. a, b. *G. holosericeum*. c, d. *G. maderense*. (Based on: a, b, *Fernández Alonso 7742,* MA; c, d, *Navarro 3396,* MA).

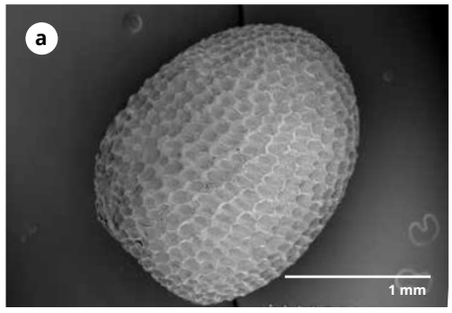
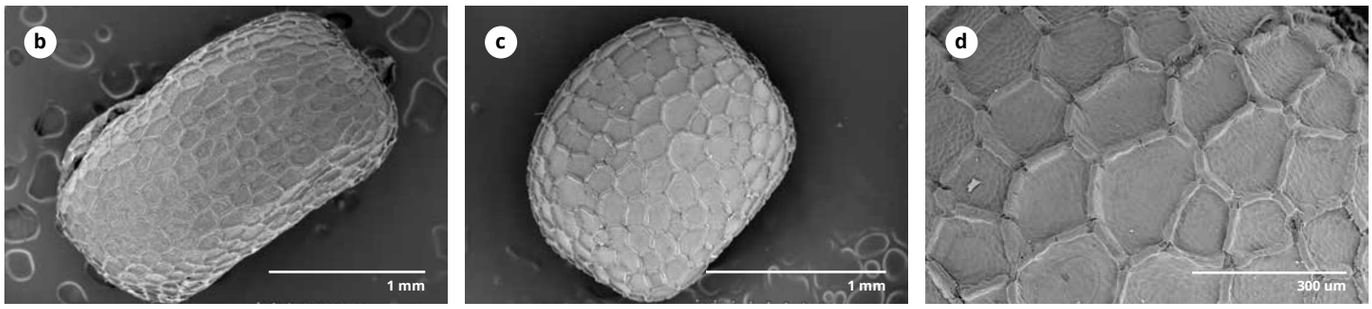
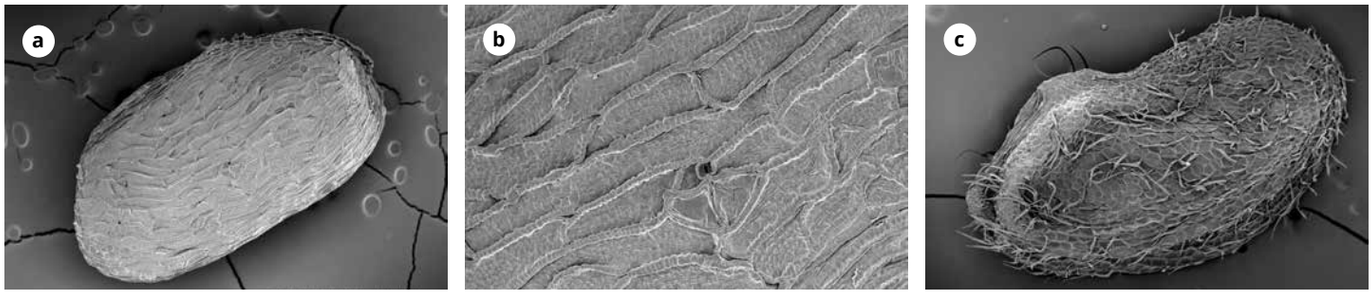


Fig. 34. SEM photographs showing seeds and seed-coat details of *Geranium*. a. *G. dissectum*. b. *G. grande*. c, d. *G. rotundifolium*. (Based on: a, *Quintanar 3888*, MA; b, *Cunninghan 30*, MEL; c, d, *Herrero 1306,* MA).





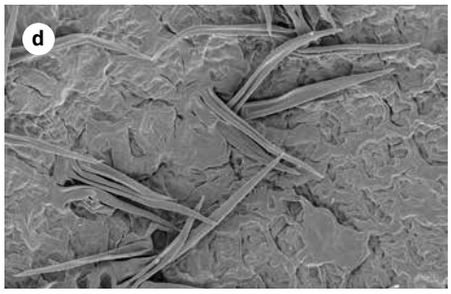


Fig. 35. SEM photographs showing seeds and seed-coat details of *Geranium*. a, b. *G. arboreum*. c, d. *G. rupicola*. (Based on: a, b, *Smith s.n.*, H-1128788; c, *Cárdenas 5457*, US; d, *Fiebrig 2644*, P).

CHROMOSOME NUMBERS

Preliminary studies with chromosome numbers on scattered species of *Geranium* were published by Heitz (1926) and Tjebbes (1928). The first detailed study of the family is provided by Gauger (1937). Soon after, the relevant contribution by Warburg (1938a, 1938b) appeared entitled "Taxonomy and Relationship in the Geraniales in the Light of their Cytology". As was customary, the information on the localities of origin of the individuals counted in these early works was fragmentary and there are no herbarium vouchers explicitly indicated. The lack of herbarium vouchers is currently an obstacle in clarifying some dubious chromosome numbers. Although there have been many subsequent contributions, the works of Van Loon (1984a, 1984b, 1984c) are for their exhaustiveness a reference for cytological studies of *Geranium*. Unfortunately these studies only refer to European species. Many species from Africa, America, Asia and Oceania as yet remain uncounted (see Appendix 1).

All the cytologically known species of subg. *Erodioidea* (ten of sect. *Subacaulia* and three of sect. *Erodioidea)* are diploid (2*n* = 28; except *G. ponticum* whose count of 2*n* = 26 should be confirmed). No information is available from sect. *Aculeolata* and sect. *Brasiliensia*. Only *G. subcaulescens* and *G. reflexum* have both diploid and tetraploid numbers. A different number has been proposed (Quézel 1957: 393) for *G. nanum* (*n* = 13), but it is not correct according to Guittonneau (1975: 200). Lastly, Tschermark-Woess & al. (1954: 97) and Nagl (1962: 448), studying somatic polyploidization and endomitosis, proposed 2*n* = 14 for G. *phaeum,* but according to Yeo (1984: 25) this number should be confirmed.

Regarding the subg. *Geranium* no cytological information is available from sect. *Paramensia*. In sect. *Incana* only one of the 22 species has been counted: *G. caffrum* (2*n* = 22). In sect. *Neurophyllodes* only one of the six species has been counted: *G. arboreum* (2*n* = ca. 50). In sect. *Dissecta* it has been well documented that *G. dissectum* has 2*n* = 22, and both *G. crenophilum* and *G. sintenisii*, 2*n* = 26 chromosomes. *Geranium asphodeloides* has been reported to have 2*n* = 24, 26, 28 and 30. Strid & Franzén (1981: 835) found some chromosomal fragments in addition to the 30 A chromosomes. The sampling in sect. *Geranium* is quite complete in Europe and to a lesser extent in Asia, where 40 species were counted almost all with 2*n* = 28. In Africa only *G. arabicum* has been counted with 2*n* = 28 as well. Older chromosome counts 2*n* = 24 of *G. pratense* should be confirmed. Belaeva & Siplivinsky (1975: 869) found plants in this species with supernumerary chromosomes in addition to regular diploids 2*n* = 28. Chromosome numbers of *G. sanguineum* different to 2*n* =84 should also be confirmed. Van Loon (1984b: 271), only found 2*n* = 84 in this species, and suggested that it is a hexaploid with basic number *x* = 14. Sansome (1936: 362) indicated that there is autohexaploid segregation of flower color in *G. sanguineum*. This section has not been extensively studied in America and Oceania (16 and 9 species, respectively). In both regions the counts ranges from 26-28 to 112. The most common numbers are 2*n* =52 and 2*n* = 56.

Eleven of the 17 species of the subg. *Tuberosa* are cytologically known. Regarding sect. *Tuberosa* only four taxa have been counted: *G. libanoticum* (2*n* = 28), *G. macrostylum* (2*n* = 28, 42), *G. malviflorum* (2*n* = ca. 56) and *G. tuberosum* (2*n* = 28). Van Loon (1984b: 269) indicated that the plants of *G. macrostylum* with 2*n* = 42 have a high percentage of abnormal pollen grains and do not produce seeds. He suggested that they may be autotriploids. The two annual species of sect. *Lanugiosa* are *G. bohemicum* (2*n* = 28) and *G. lanuginosum* (2*n* = 48). According to Van Loon the ba-

sic chromosome number of *G. lanuginosum* is probably *x* = 14, and its number 2*n* = 48 may have originated from a dysploid. Only five more species of this section have been counted: *G. gracile* with 2*n* = 26, *G. gymnocaulon*, *G. ibericum, G. libani* and *G. platypetalum* with 2*n* = 28 in all cases, but with some additional numbers to be confirmed in *G. ibericum* (2*n* = 56), and *G. platypetalum* (2*n* =42).

There is uneven information regarding the six sections of the subg. *Robertium*. The four species of sect. *Batrachioidea* have 2*n* = 26. It seems that some different numbers attributed to these species should be disregarded (Van Loon 1984b, 1984c). In the sect. *Divaricata*, *G. divaricatum* has 2*n* = 28 while *G. albanum* has 2*n* = 20; in both species there are old counts which are difficult to verify (Van Loon 1984b, 1984c). The sect. *Trilopha* and sect. *Polyantha* are poorly studied. In the former only two species were counted, *G. brevipes* with 2*n* = 56 and *G. favosum* with 2*n* = 50. In the latter only *G. polyanthes* was studied resulting in 2*n* = 28. In sect. *Unguiculata*, 2*n* = 46 was found in *G. dalmaticum,* while *G. macrorhizum* showed a variable number of chromosomes, in some cases 2*n* = 46 and in others from 2*n* = 87 to 93 (see Van Loon 1984b: 269 for further details). All species of sect. *Ruberta* were studied. The figures obtained in this group are quite heterogeneous. According to Van Loon (1984c: 283) *G. lucidum* has a polyploid series (2*n* = 20 to 44) with the basic chromosome number *x* = 10. The tetraploid cytotype (2*n* = 40) is the most common and it comprises an ascending dysploid series. According to Yeo (1973a: 314) and Wilder-Kiefer & Yeo (1987), *G. purpureum* (2*n* = 32), *G. robertianum* (2*n* = 64) and *G. yeoi* (2*n* = 128) probably represent a polyploid series. This author indicates that the triploid hybrid *G. purpureum* × *G. robertianum* formed *n* univalents and *n* bivalents at the first division of meiosis, strongly suggesting that *G. robertianum* is an allopolyploid with *G. purpureum* and an unknown species as parents. Yeo & Wilder-Kiefer (1990: 2) pointed out that the results of their study on the presence/absence of amino acids are congruent with the hypothesis of the allopolyploid origin of *G. robertianum* and the autopolyploid origin of *G. yeoi* [as *G. rubescens*]. The remaining species of the section are: *G. glaberrimum* (2*n* = 30), *G. cataractarum* (2*n* = 36), *G. lasiopus* (2*n* = 48), *G. maderense* (2*n* = 68), *G. palmatum* (2*n* = 68) and *G. reuteri* (2*n* = 128). Wilder-Kiefer & Yeo (1987: 287) reported that the hybrid of *Geranium maderense* × *G. cataractarum* formed ca. 16 univalents and ca. 18 bivalents at the first division of meiosis, which strongly suggests an allopolyploid origin for *G. maderense*, with *G. cataractarum* and an unknown species as parents.

According to Van Loon (1984b, 1984c) most species of *Geranium* are diploid with 2*n* = 28 and the main basic chromosome number is *x* = 14 (Van Loon 1984b, 1984c; Warburg 1938a, 1938b), but other numbers (*x* = 9 to *x* = 23), mainly in annual species, have also been reported (Van Loon 1984b, 1984c). These data are probably due to a sampling focused on Eurasian species and could change when more species from Africa, America and Oceania can be studied. Polyploidy appears to be an important pathway far evolution in some groups, like sect. *Ruberta* (Yeo 1973a: 308). It may be interesting to note that in some species from different subgenera (e.g.: *G. asphodeloides*, *G. caeruleatum*, *G. lucidum*, *G. macrorrhizum*, *G. macrostylum, G. potentilloides, G. reflexum, G. subcaulescens*) a variable number of chromosomes have been found. These cytotypes do not differ from each other morphologically.

BREEDING SYSTEM

It is widely accepted that the species of the genus *Geranium* are predominantly protandrous with an internal whorl of stamens that matures earlier than the external one, and a stigma which matures after pollen dispersal, which favours decreasing selfing processes (Aedo 1996; Knuth 1908; Sprengel 1793; Wildler-Kiefer & Yeo 1987). Several authors, however, have found different variations on this pattern. Philipp (1985) found that plants of *G. brevicaule* [as *G. sessiliflorum*] were protandrous at one locality, homogamous at another, and protogynous at a third locality. Martin (1965: 127) reported that *G. maculatum* is predominantly protandrous but also may be partially homogamous. Tofts (2004a: 549) summarized the available information about *G. robertianum*, that may be homogamous, slightly protandrous or protogynous. Protogyny is also reported by Bertin (2001) for *G. robertianum*, and by Knuth (1908) for *G. dissectum* and *G. pusillum*.

Although protandry (or protogyny) suggests a strong preference for outcrossing, in plants with a large number of simultaneously blooming flowers, pollination can occur between different flowers of the same individual. Such is the case reported by Hessing (1986: 467) in protandrous plants of *G. caespitosum,* where "geitonogamous pollination is an extremely common event, probably overwhelming the effects of dichogamy". Moreover, Hessing (1988: 1328) suggested that the low decrease of fertility after selfing of *G. caespitosum* is not caused by self-incompatibility. Asikainen & Mutikainen (2005b: 488) also pointed out that hermaphrodite flowers of *G. sylvaticum* are self-compatible. Wildler-Kiefer & Yeo (1987: 288) indicated that flowers in *Geranium* are fully self-compatible.

Cruden (1976, 1977) emphasized that the Log pollen-ovule ratios are correlated with the breeding system. A substantial decrease in Log P/O suggests a pass from outcross pollination to self-pollination. Aedo & al. (2002) pointed out that some perennial species from the Andes (such as *G. multipartitum* and *G. sibbaldioides*) show low Log P/O ratios, suggesting facultative self-pollination. This is congruent with homogamy observed in herbarium specimens of these perennial species.

Shirk & Hamrick (2014) found that *G. carolinianum*, an annual species with short petals, is incompletely protogy-

nous and that there is a short "period when female stage flowers are available for exclusively outcross pollination, followed by reproductive assurance via delayed self-pollination". This is interesting because other annuals species with small flowers had been considered strictly homogamous and self-pollinated (Proctor & al. 1996: 332).

In some species of sect. *Trilopha* and sect. *Polyantha* cleistogamous flowers have been found. According to Schönbeck-Temesy (1970) *G. mascatense* and *G. trilophum* frequently produce non-opening, self-pollinating flowers. Kers (1971) reported such cleistogamous flowers for *G. brevipes,* Yeo (2002a: 161, 165) for *G. polyanthes* and *G. ocellatum* and Aedo & al. (2016: 363) for *G. biuncinatum.*

Some species of *Geranium* are gynodioicous, containing female and hermaphrodite plants that coexist. In these species the flowers of female plants usually are significantly smaller than those of hermaphrodites. The anthers produce either no pollen or small, inviable grains. Within the sect. *Geranium* the following gynodioicous species have been reported: *G. caespitosum* (Hessing 1988: 1332, 1989: 235), *G. maculatum* (Ågren & Wilson 1991; Chang 2006; Van Etten & al. 2008), *G. richardsonii* (Williams & al. 2000), *G. sylvaticum* (Asikainen & Mutikainen 2003, 2005a, 2005b; Putrament 1962; Vaarama & Jääskeläinen 1967), and within the subg. *Tuberosa*, *G. kotschyi*, *G. linearilobum*, and *G. tuberosum* (Davis 1970: 98) and *G. peloponnesiacum* (Aedo & al. 2007: 120).

Vaarama & Jääskeläinen (1967: 12) indicated that *G. sylvaticum* may have hermaphrodite flowers, protandrous or rarely homogamous, intermediate flowers with different stages of stamen degeneration, pistillate flowers with rudimentary stamens and pistillate flowers with no stamen mixed in the same individual or located separately in different individuals (gynomonoecy or gynodioecy). These authors reported that gynodioecy and gynomonoecy also has been observed in *G. columbinum, G. palustre*, *G. phaeum*, *G. pratense*, *G. pyrenaicum*, *G. robertianum* and *G. sanguineum* (Vaarama & Jääskeläinen 1967: 8).

It was established through the work of Christian Konrad Sprengel, towards the end of the eighteen century, that the pollination of *Geranium* is conducted mainly by insects. Most geraniums are pollinated through this vector (Dlussky & al. 2000; Kandori, 2002; Knuth 1908; Proctor & al. 1996: 17, 48, 66, 67, 99, 103, 145). One exception is the Hawaiian *G. arboreum,* that is unique in the genus because of its zygomorphic reddish corolla, which is probably an adaptation to bird pollination. Carlquist (1980: 135) reported that he has seen its flowers visited by a honeycreeper bird (*Himatione* sp.).

Like the case of studies of the chromosome number, studies related to the breeding system are concentrated in very few species, almost all from Europe or North America. The extension of the sampling to species from other areas, with different habitats and pollinators, belonging to different subgroups of the genus, is necessary to provide a more balanced and accurate view of the genus.

PHYTOCHEMISTRY

Leifertová & al. (1965) studied the tannins of ten species from the former Czechoslovakia and located some differences in those found in *G. phaeum* and *G. nodosum*.

Bate-Smith (1973) studied flavonoids of 60 species of *Geranium* and found that "the genus is very uniform as regards these constituents, differences between species being mainly in regard to the presence or absence of myricetin, leucodelphinidin and leucocyanidin. Gallic acid, hexahydroxydiphenic acid (present as ellagic acid in acid hydrolysates and recorded as such), *p*-coumaric and caffeic acids, quercetin and kaempferol are present in almost every species but not in the same absolute or relative amounts", and "reduced flavonoids such as flavones and flavanones, O-methylated flavonols and coumarins, which are often helpful in identifying groups of related species, appeared to be completely absent."

Okuda & al. (1980) studied the distribution of geraniin and mallotusinic acid in Geraniaceae, Euphorbiaceae and other related families. They found that geraniin is the main tannin in the species of *Geranium* from Japan (13 species) and in *Erythroxylum coca* Lam., and that geraniin and mallotusinic acid compose the main tannins in some Euphorbiaceae.

Bate-Smith (1981) studied the leaf tannins of 70 species of *Geranium*, analysing for proanthocyanidins, total galloyl esters, hexahydroxydiphenoylglucose and astringency. He found that "proanthocyanidins are present in most species (prodelphinidin in four) but only rarely in considerable quantities and then not readily extracted. A reaction with potassium iodate characteristic of geraniin (a derivative of dihexahydroxydiphenoylglucose) is given by most species" and that "the considerable differences in astringency between species cannot at present be accounted for in terms of chemical differences."

Yeo & Wilder-Kiefer (1990) studied essential oils, electrophoretic bands of seed proteins and nectar amino acids of nine species of sect. *Ruberta* and sect. *Unguiculata*. They found that "*G. macrorrhizum* had very much more oil than any other species; the remaining species appeared to be similar to each other and qualitatively different from *G. macrorrhizum* but had a very poor yield of oil" and that the pattern of protein bands and the presence/absence of amino acids are congruent with the hypothesis of the allopolyploid origin of *G. robertianum* and the autopolyploid origin of *G. yeoi* [as *G. rubescens*].

Ivancheva & Petrova (2000) studied flavonoids of eleven species of *Geranium* form Bulgaria and found that "quercetin and its derivatives were the most common aglycones with lesser amounts of kaempferol, myricetin and luteolin."

A chemical characterization of *G. molle* is provide by Graça & al. (2016) and more specific studies of tannins of *G. thunbergii* is provided by Ishimaru & Shimomura (1991) and for *G. macrorrhizum* by Genova & Ivancheva (1995).

The compilation of the preceding paragraphs is necessarily incomplete because only the taxonomic literature could be examined, but it seems useful to provide a general overview about this topic. As Stuessy & al. (2014) pointed out phytochemical data have been used successfully in systematics but in recent times they have flagged considerably. Regarding *Geranium*, it seems that most the studies have been focused on flavonoids. Their results are obviously interesting to understand the species that have been studied, but at the moment they seem of little taxonomic utility, either to characterize the infrarageneric groups or the species.

DISTRIBUTION AND HABITATS

The genus *Geranium* is distributed throughout most of the world except in lowland tropical areas (Fig. 5). In the New World most of the 123 native species belong to sect. *Geranium*. The exceptions are the two species of sect. *Paramensia* (subg. *Geranium*) growing on the northern Andes and the three of sect. *Brasiliensia* (subg. *Erodioidea*) found in southern Brazil and northern Argentina. Only two species of sect. *Geranium* are native in the New World as well as elsewhere: *G. erianthum* also occurs in eastern Asia, and *G. sylvaticum* is widespread in Europe and western Asia. The Andes in Colombia and Ecuador harbor many endemic species but the greatest diversity is found in Peru (34 species) and in Mexico (36 species).

The Pacific area that includes the islands of Japan, Taiwan, Indonesia, East Timor, Papua New Guinea, Australia, New Zealand, and Hawaii harbor 42 native species, all from sect. *Geranium* except the Hawaiian species of the sect. *Neurophyllodes* (subg. *Geranium*). The greatest diversity is found in New Guinea and Japan, both with 11 species; the species of New Guinea are all endemic, while the diversity of *Geranium* in Japan includes three endemic species and eight species shared with mainland Asia, one extending to North America. Other areas of high diversity of *Geranium* in the Pacific area are Australia and New Zealand (nine species, all endemic), and the Hawaiian Islands (six species, all endemic).

In Sub-Saharan Africa the genus is generally poorly represented. The richest area is South Africa where most of the 22 species of sect. *Incana* are endemic, some of them reaching the mountains of southeastern Africa. The only representative of sect. *Aculeolata* (subg. *Erodioidea*) is spread across the highlands of eastern Africa from Ethiopia to Malawi. Most of the seven species of the sect. *Trilopha* (subg. *Robertium*) are found in the Horn of Africa area and the nearby Arabian peninsula, but one reaches the eastern and western mountains of tropical Africa and another is endemic to the Himalayas. The sect. *Ruberta* (subg. *Robertium*) is represented in eastern mountains of tropical Africa by one non-endemic species, and the sect. *Geranium* by three species, one endemic from Madagascar.

The richest area both in number of species and in diversity of sections and subgenera is the region that includes the mountains around the Mediterranean Basin, the Caucasus, central Asia, the Himalayas and China. In this area the six sections of the subg. *Robertium* are found, the two sections of the subg. *Tuberosa*, two of the four sections of the subg. *Erodioidea* and two of the five sections of the subg. *Geranium*.

The 15 species of sect. *Subacaulia* (subg. *Erodioidea*) and the three species of the sect. *Erodioidea*) are found in the mountains around the Mediterranean Basin, although a species of the latter group reaches northern Europe.

The sect. *Tuberosa* (seven species), found from the western Mediterranean to the highlands of central Asia and the western Himalayas, is better represented in the central area of this region. The sect. *Lanuginosa* (subg. *Tuberosa*; 10 species) is better represented in the Caucasus and Iranian mountains, but a couple of species reach the western Mediterranean and northern Europe.

Regarding the subg. *Robertium*, it has already been mentioned that sect. *Trilopha* is focused on the Horn of Africa area and the nearby Arabian peninsula, and in southern Iran (five species) plus one species endemic to the Himalayas. The sect. *Polyantha* (seven species) is found throughout the Himalayas reaching Burma and the mountains of western China. One of the two species of sect. *Divaricata* is restricted to the Caucasus and northern Iran while the other is widespread, occurring from western and central Europe to central Asia and the Himalayas. The sect. *Batrachioidea* (four species) is also widespread, occurring from western and central Europe to central Asia and the Himalayas. The sect. *Ruberta* has four species endemic from Macaronesian islands, three endemic from the Mediterranean Basin and the remaining three widespread throughout the Mediterranean Basin, central Europe, Asia and Africa. The native status of *G. robertianum* in northeastern U.S.A. and Japan is controversial (Aedo 2012; Nishida & al. 2012). Finally, the sect. *Unguiculata* has two species restricted to the north side of the Mediterranean Basin.

The *sect. Geranium* is represented in Europe and mainland Asia by 53 native species. This section comprises three species widely distributed through Europe and Asia. Besides, six species are restricted to the mountains of southern Europe and northern Africa and seven more occur also in lowlands of central Europe and extend to Caucasus and West or central Asia. The greatest diversity of section *Geranium* is found in southern China and adjacent areas of the Himalayas with 22 species, and in eastern Siberia and adjacent regions of northeastern China and Korean peninsula with 10 species. Four species extend throughout Siberia, Mongolia and nearby areas and one is restricted to the mountains of south India. The sect. *Dissecta* (four species) is better represented in the eastern Mediterranean Basin, although one species has spread to Macaronesia and northern Europe.

Geranium occurs over a broad latitudinal range, from 73°N in Siberia (*G. albiflorum*) to 55°S in the Patagonia (*G. berteroanum* and *G. sessiliflorum*). The northernmost record of *G. sylvaticum* in Spitsbergen (Norway) at 78ºN may be a single adventive specimen or a mislabeling. *G. sylvaticum*, is found however, at 71ºN in Cape Nord and *G. pratense* in Siberia at 69ºN.

Annuals species occur mainly in disturbed areas such as roadsides or fields. Perennial species grow in a diversity of habitats, such as evergreen and deciduous forests, shrublands, grasslands, meadows, cliffs, bogs, dunes and rocky areas; some perennials (e.g., *G. arabicum* or *G. nepalense*) are also common on disturbed areas. The elevation range extends from sea level to 5300 m. *Geranium donianum* was collected in some places of the Himalayas at 5300 m. *Geranium nakaoanum* and *G. saxatile* were collected also in the Himalayas at 5000 m. The other species that reach 5000 m are *G. humboldtii*, *G. maniculatum, G. sessiliflorum* and *G. sibbaldioides,* the four from the Andes. Species at low elevations and even sea level occur only in temperate or cold regions, except *G. limae*, which grows at sea level in the coastal deserts of Peru.

RELATIONSHIPS BASED ON DNA MARKERS AND CLASSIFICATION

Price & Palmer (1993) studied the chloroplast *rbc*L gene sequences to assess the circumscription of Geraniaceae, generic relationships within the family and the affinities of the close families. They found that only *Hypseocharis* receives strong support as close relative of the Geraniaceae core comprising *Erodium*, *Geranium*, *Monsonia*, *Pelargonium* and *Sarcocaulon*. Geraniaceae *s.str.* is also supported as natural group by the loss of the intron in the plastid gene *rpl*16 (Downie & Palmer 1992: 27; Price & al. 1990). According to Price & Palmer (1993) *Geranium* and *Erodium* appear as sister genera. Within *Geranium* the sampling was too small to draw conclusions about the relationships within the genus. These authors only studied six species of *Geranium,* four of them of the subg. *Robertium* that appears as sister group of the remaining two that belong to subg. *Geranium* and subg. *Erodioidea*. Further findings about plastid and mitochondrial genomes of Geraniaceae and its evolutive implications can be found in Palmer & al. (1987), Bakker & al. (2006), and Guisinger & al. (2008, 2011).

The unusual species of Hawaiian *Geranium* (sect. *Neurophylodes*) was analyzed by Pax & al. (1997) using *rbc*L gene sequences. This work, which includes seven of the nine taxa of the section, provides strong support to sect. *Neurophylodes* as a natural group. The sect. *Neurophylodes* is deeply nested within subg. *Geranium* with some species from America as close relatives. The authors indicated that an additional sampling from the American species of subg. *Geranium* is required to more precisely establish the relationships of this group within the genus.

The nrITS and chloroplast *trnL-trnF* spacers were sequenced for the four species of sect. *Dissecta* (Aedo & al. 2005b). This work provides strong support to sect. *Dissecta* as a natural group. In the study the annual *G. dissectum* appeared as sister to the three perennial remaining species.

Hyeon & Park (2006) studied the relationships of 16 taxa of Korean *Geranium,* all belonging to sect. *Geranium*, using ITS sequences. These authors suggests that all Korean species constitute a "monophyletic group". This conclusion becomes almost inevitable since no *Geranium* species from other areas was studied. As outgroups they studied species of *Erodium* and *Pelargonium*. It is interesting to note the close relationship suggested to *G. nepalense, G. thunbergii, G. tripartitum* and *G. wilfordii*, all of them gathered into the *Sibiricum Group* in the present study together with other species form Asia and Oceania.

The nrITS and chloroplast *trnL-trnF* spacers were sequenced to the ten species of sect. *Lanuginosa* [as subsect. *Mediterranea*] by Aedo & al. (2007). This work provides strong support to sect. *Lanuginosa* as a natural group. Two clades are recovered, one including the two annual species and other with the eight perennials, in which *G. tuberosum* (sect. *Tuberosa*) emerges within sect. *Lanuginosa*. Further analyses that include sequences from the remaining six species of sect. *Tuberosa* are needed to elucidate the expected close relationship of both groups.

Fiz & al. (2008) used chloroplast *trnL-trnF* and *rbcL* sequences to explore the relationships of Geraniaceae and Hypseocharitaceae. They include sequences of 42 species of *Geranium*. The clade of the genus *Geranium* showed two main branches, one formed by most species of subg. *Robertium* (except those of sect. *Batrachioidea* and sect. *Divaricata*), and the other formed by subg. *Geranium,* subg. *Erodioidea*, subg. *Tuberosa* and the two previously mentioned sections of subg. *Robertium*). As the authors pointed out, a more extensive sampling is needed to acquire sufficient information for a new taxonomic treatment within the genera *Geranium* and *Erodium*. I regret that the main authors of this article did not listen to my request to carefully review the appendices with the vouchers, which resulted in some errors. The *Alves 2762* (MA) collection is attributed to *G. brasiliense* in the appendix 1 and to *G. arachnoideum* in the appendix 2; the first is correct. The collection *Aedo 468* does not exist; it probably corresponds to *Aedo 4681b*, a specimen of *G. divaricatum* from Spain, not from Turkey. *Cousineau 43581* is a collection of *G. bicknellii* from Canada, not from U.S.A. In other cases it is not possible to trace the vouchers in any herbarium.

Mitchell & al. (2009) studied the relationships of nine native taxa of New Zealand, all belonging to sect. *Geranium*, using ITS and ETS sequences. As outgroups they include species of sect. *Dissecta* (subg. *Geranium*) and sect. *Lanuginosa* (subg. *Tuberosa*). The results shows that the New Zea-

land species are grouped into a well-supported clade. As the authors pointed out, further sampling of Australian and South American related species must be carried out to clarify the relationships of New Zealand cranesbills.

Nishida & al. (2012) carried out a detailed study of *G. robertianum* in Japan using DNA sequences from the plastid regions of the *trnL* intron, *trnL3'-trnF* and *trnH-psbA* intergenic spacer regions, and the nuclear ITS region. They found three major groups and suggested that in Japan there are both indigenous populations and others naturalized from abroad. As the authors pointed out, further sampling from outside of Japan might help to identify the origin of these non-native populations of *G. robertianum*.

Park & al. (2015) studied the evolution of *Geranium* (17 species) mitochondrial genomes in relation to the movement of genetic material between unrelated species or horizontal gene transfer. They found extensive loss of genes and introns in *Geranium* mitochondrial genomes and the presence of foreign DNAs that "is the most extensive of any eudicot examined so far (except holoparasite Rafflesia)". The results of this work indicated that "... several *Geranium* species containing foreign organellar DNA from diverse eudicots, including many transfers from parasitic plants". *Geranium brycei* and *G. incanum* have a *cox2* gene that was transferred from *Cuscuta* L., and they have "at least 13 foreign MIPTs [mitochondrial DNA of plastid origin] in their mitochondrial genomes".

Wakasugi & al. (2017) carried out a detailed study of *G. yesoense*, an endemic from Japan using DNA sequences of the plastid regions of the *trnL* intron plus *trnL-trnF*, and the nuclear ITS region. Eleven other species of *Geranium* from Japan were added to this study. They analyzed 17 samples of *G. yesoense,* a good sampling of the geographical and morphological variability of this species, concluding that there is no support for recognized subgroups within this species. On the other hand, their results support the close relationship among the species of the *Krameri Group* (*G. krameri, G. soboliferum, G. yoshinoi, G. yesoense*) and those of the *Palustre Group* (*G. shikokianum*). Furthermore, they also found a close relationships among the species of the *Sibiricum Group* (*G. sibiricum, G. thunbergii, G. tripartitum, G. wilfordii*) which was previously described by Woo & Park (2006).

Kurata & al. (2021b) performed a phylogenetic analyses of the eleven native species from Japan using chloroplast genome sequencing and genome-wide single-nucleotide polymorphisms. They results support the close relationship among the species of the *Sibiricum Group* (*G. nepalense*, *G. sibiricum, G. thunbergii, G. tripartitum, G. wilfordii*) and the *Erianthum Group* (*G. erianthum, G. reinii*). Furthermore, they obtained a clade that included species of the *Krameri Group* (*G. krameri, G. soboliferum, G. yoshinoi, and G. yesoense*) and the *Palustre Group* (*G. maximowiczii*, *G. shikokianum*). This clade is difficult to interpret because it also includes isolated representatives of other groups from eastern Asia. Kurata & al. (2022) investigated genetic differentiation among populations of *G. erianthum* and related species using chloroplast genome and single-nucleotid polymorphisms. The lack of significant genetic differentiation suggests that the current range of *G. erianthum* resulted from rapid expansion during the last glaciar era.

Wondimu & al. (2017) studied the complex of *G. arabicum* and allied species using AFLP markers. They focused their work on alpine populations and they identified only two genetic groups corresponding to *G. arabicum* and *G. kilimandscharicum*.

Esfandani Bozchaloyi & al. (2017a) studied *G. robertianum* in Iran using ISSR markers. A similar work was carried out with *G. dissectum* (Esfandani Bozchaloyi & al. 2017b), *G. purpureum* (Esfandani Bozchaloyi & al. 2017c) and *G. molle* (Esfandani Bozchaloyi & al. 2018a). These authors found some variability in the Iranian samples studied and suggested the existence of ecotypes. Esfandani Bozchaloyi & al. (2017d, 2018b) studied sect. *Batrachioidea* and subg. *Geranium* respectively in order to explore species identification using ISSR markers as well. Their conclusions are limited by a geographical approach, since they only studied Iranian samples of the species of this country.

Marcussen & Meseguer (2017) studied fruit evolution within *Geranium* using all available GenBank sequences (Nov. 2014) of rDNA (i.e., ITS: 143 sequences), the cpDNA regions *rbcL* (172 sequences) and *trnL-trnF* (93 sequences), covering a total of 54 species. They found a clade A contained all taxa with carpel-projection type of fruit, (i.e. subg. *Robertium*, excluding sects. *Batrachioidea* and *Divaricata*), and a clade B where the sect. *Tuberosa* (seed-ejection type without callus nor prong) was recovered as a sister to the rest. As nested sister came a weakly supported clade containing sect. *Subacaulia* (*Erodium*-type), *G. divaricatum* of sect. *Divaricata* (carpel-projection type inoperative), sect. *Erodioidea* (*Erodium*-type), and sect. *Batrachioidea* (carpel-projection type), and a weakly supported clade containing the rest. Within the 'rest clade', a moderately supported subclade, containing sect. *Brasiliensia* (*Erodium*-type) plus sect. *Aculeolata* (*Erodium*-type) plus *G. albanum* of sect. *Divaricata* (carpel-projection type inoperative), was sister to a strongly supported clade consisting of sect. *Dissecta* (seed-ejection type with prong) and the large sect. *Geranium* (seed-ejection type with callus).

According to Marcussen & Meseguer (2017) the infrageneric classification should be accommodate to this structure. As a result, subg. *Robertium* (removing sect. *Batrachioidea* and sect. *Divaricata*) was restricted and subg. *Geranium* including the remaining groups was expanded. These authors, however, indicated that such subg. *Geranium* is "morphologically difficult to characterise", while they proposed a combination of two characters to define the subg. *Robertium*, both partially shared by the subg. *Geranium*.

Marcussen & Meseguer (2017) suggest that *Erodium*-type of seed discharge is ancestral in *Geranium*, as Yeo

(1984) and Nieto Feliner & Aedo (1995) pointed out, and that the other discharge syndromes were derived from it multiple times. These authors considered that "the four extant lineages having retained the *Erodium*-type of seed discharge may be considered relictuous, in terms of being early divergent, geographically confined and species-poor", and that the "seed-ejection type discharge syndrome might have enhanced diversification in *Geranium*, probably by allowing species to disperse more efficiently into new habitats". It should be noted, however, that some species with carpel-projection type, such as *G. molle* or *G. pusillum*, have spread with great efficiency as weeds throughout most of the world.

Studies with different DNA markers are providing valuable results to better interpret the evolution of *Geranium* and to accommodate, as much as possible, the infrageneric classification to the evolutionary history of the group. However, the complex evolutionary history of *Geranium*, in which biparental transmission of plastids (Corriveau & Coleman 1988), hybridization (Wilder-Kiefer & Yeo 1987), polyploidy (Van Loon 1984a, 1984b, 1984c; Yeo 1973a, 1984) and horizontal gene transfer (Park & al. 2015) have played an important role, make it very difficult to arrange a consistent and operative infrageneric classification.

In this scenario, some complex morphological structures, such as different types of fruit, could have arisen several times in the course of evolution. But the opposite option seems less expensive in evolutionary terms and as, a consequence, more parsimonious. The contradictions between the different data sets cannot be resolved in favour of the DNA markers in a simplistic way without further evidence, especially considering the limitations of the current available molecular data, in terms of scope and homology, and the way in which they have been analyzed, based on the similarity of extant species.

The redefinition of established infrageneric groups in others with a weak morphological base which lack unique or well-defined characters, and the exclusion or underestimation of important characters difficult to acquire in evolutionary terms, seems undesirable. A new hypothesis has to explain all the known facts better. For these reasons, the infrageneric classification proposed by Yeo, based on morphologically recognizable groups, is maintained in general lines, awaiting a new and operative hypothesis that better explains all the evidence.

I am confident that within sect. *Geranium* there are some groups that reflect trends of variation with some phylogenetic signal and show geographical cohesion that deserve to be recognized, perhaps as sections. However, they have discordant elements, resulting in an unsatisfactory classification. Thus, while a satisfactory solution emerges, it seems useful to join the most similar species into informal groups in order to yield a framework to advance toward a natural classification. Yeo (2002a) realized this problem when he stated that sect. *Geranium* " ... needs to be divided up into smaller groups but at present I do not see how such groups can be defined". Consequently, Yeo (2002a) proposed to divide sect. *Geranium* into 28 informal groups using the name of one representative species of each group (the *Palustre Group*, the *Refractum Group*, etc.). These groups have been used in this work with some modifications to arrange the species in operative units.

CONSPECTUS OF CLASSIFICATION

I. subg. Erodioidea

Ia. sect. Erodioidea

1. *G. phaeum*
2. *G. reflexum*
3. *G. aristatum*

Ib. sect. Aculeolata

4. *G. aculeolatum*

Ic. sect. Subacaulia

5. *G. cinereum*
6. *G. subargenteum*
7. *G. dolomiticum*
8. *G. cazorlense*
9. *G. nanum*
10. *G. argenteum*
11. *G. austroapenninum*
12. *G. subcaulescens*
13. *G. thessalum*
14. *G. subacutum*
15. *G. petri-davisi*
16. *G. palmatipartitum*
17. *G. makmelicum*
18. *G. ponticum*
19. *G. lazicum*

Id. sect. Brasiliensia

20. G. *arachnoideum*
21. *G. brasiliense*
22. *G. glanduligerum*

II. subg. Geranium

IIa. sect. Geranium

The Sylvaticum Group

23. *G. albiflorum*
24. *G. atlanticum*
25. *G. caeruleatum*
26. *G. endressii*
27. *G. pseudosibiricum*
28. *G. rivulare*
29. *G. schmidii*
30. *G. sylvaticum*

The Erianthum Group

31. *G. erianthum*
32. *G. platyanthum*
33. *G. reinii*

The Pratense Group

34. *G. collinum*
35. *G. pratense*
36. *G. saxatile*

The Wallichianum Group

37. *G. christensenianum*
38. *G. lambertii*
39. *G. procurrens*
40. *G. wallichianum*

The Refractum Group

41. G. *delavayi*
42. *G. pogonanthum*
43. *G. refractum*
44. *G. shensianum*
45. *G. sinense*
46. *G. yunnanese*

The Pylzowianum Group

47. *G. canopurpureum*
48. *G. donianum*
49. *G. farreri*
50. *G. napuligerum*
51. *G. pylzowianum*

The Palustre Group

52. *G. koreanum*
53. *G. maximowiczii*
54. *G. palustre*
55. *G. shikokianum*
56. *G. wlassovianum*

The Krameri Group

57. *G. dahuricum*
58. *G. krameri*
59. *G. soboliferum*
60. *G. hayatanum*
61. *G. yoshinoi*
62. *G. yesoense*

The Columbinum Group

63. *G. columbinum*
64. *G. schenkianum*

The Sibiricum Group

65. *G. arnottianum*
66. *G. nepalense*
67. *G. sibiricum*
68. *G. thunbergii*
69. *G. wilfordii*
70. *G. tripartitum*
71. *G. suzukii*
72. *G. frigidurbis*
73. *G. potentilloides*
74. *G. ardjunense*
75. *G. homeanum*
76. *G. traversii*
77. *G. neglectum*

The Nodosum Group

78. *G. nodosum*
79. *G. rectum*
80. *G. versicolor*

The Arabicum Group

81. *G. andringitrense*
82. *G. arabicum*
    subsp. *arabicum*
    subsp. *latistipulatum*
83. *G. kilimandscharicum*

Other species from Eurasia

84. *G. franchetii*
85. *G. psilsotemon*
86. *G. rosthornii*
87. *G. rotundifolium*
88. *G. rubifolium*
89. *G. sanguineum*
90. *G. swatense*

The Papuanum Group

91. *G. leptodactylon*
92. *G. clemensiae*
93. *G. castroviejoi*
94. *G. monticola*
95. *G. wilhelminae*
96. *G. hyperacrion*
97. *G. editum*
98. *G. papuanum*
99. *G. whartonianum*
100. *G. balgooyi*
101. *G. niuginiense*

The Solanderi Group

102. *G. solanderi*
103. *G. obtusisepalum*
104. *G. grande*
105. *G. retrorsum*
106. *G. berteroanum*
107. *G. limae*
108. *G. albicans*
109. *G. magellanicum*
110. *G. skottsbergii*
111. *G. core-core*
112. *G. tablasense*
113. *G. venturianum*
114. *G. fallax*

The Sessiliflorum Group

115. *G. antrorsum*
116. *G. brevicaule*
117. *G. cruentum*
118. *G. sessiliflorum*
119. *G. parodii*

The Carolinianum Group

120. *G. carolinianum*
121. *G. bicknellii*
122. *G. texanum*

The Caespitosum Group

123. *G. caespitosum*
124. *G. californicum*
125. *G. dodecatheoides*
126. *G. lentum*
127. *G. wislizeni*
128. *G. richardsonii*
129. *G. viscosissimum*
130. *G. latum*
131. *G. tenue*
132. *G. potosinum*
133. *G. niveum*

Other species from N America

134. *G. maculatum*
135. *G. oreganum*

The Mexicanum Group

136. *G. mexicanum*
137. *G. lozanoi*
138. *G. crenatifolium*
139. *G. pringlei*

The Potentillifolium Group

140. *G. potentillifolium*
141. *G. bellum*
142. *G. andicola*
143. *G. schiedeanum*
144. *G. goldmanii*

The Hernandesii Group

145. *G. hernandesii*
146. *G. deltoideum*
147. *G. gentryi*
148. *G. latilobum*
149. *G. hystricinum*
150. *G. lilacinum*
151. *G. hintonii*
152. *G. monanthum*

The Seemannii Group
153. G. seemannii
subsp. *seemanii*
subsp. *repens*
154. G. cruceroense

Other species from Mexico
155. G. alpicola
156. G. madrense
157. G. charucanum
158. G. oaxacanum
159. G. trolliifolium
160. G. campanulatum
161. G. mooreanum
162. G. unguiculatum
163. G. durangense

The Sibbaldioides Group
164. G. azorelloides
165. G. sibbaldioides
subsp. *sibbaldioides*
subsp. *beckianum*
subsp. *elongatum*
166. G. loxense
167. G. alonsoi
168. G. costaricense
169. *G. campii*
170. G. rhomboidale
171. G. maniculatum
172. G. foreroi
173. G. paludosum
174. G. stramineum
175. G. ecuadoriense
176. G. multipartitum
177. G. humboldtii
178. G. macbridei
179. G. sagasteguii
180. G. jaekelae
181. G. pavonianum
182. G. crassipes
183. G. planum
184. G. digitatum
185. G. trujillense
186. G. nivale
187. G. ruizii
188. G. sericeum
189. G. tovarii
190. G. weddellii

The Diffusum Group
191. G. diffusum
192. G. pseudodiffusum
193. G. antisanae
194. G. ayavacense
195. G. smithianum
196. G. reptans

The Renifolium Group
197. G. renifolium
198. G. stuebelii
199. G. peruvianum
200. G. comarapense

The Rupicola Group
201. G. chilloense
202. G. laxicaule
203. G. ayacuchense
204. G. rupicola
205. G. soratae
206. G. leucanthum

The Multiceps Group
207. G. multiceps
208. G. cavanillesii
209. G. lainzii
210. G. santanderiense
211. G. jaramilloi
212. G. sebosum
213. G. stoloniferum
214. G. velutinum
215. G. subnudicaule
216. G. holosericeum
217. G. schultzei
218. G. *lindenianum*

The Killipii Group
219. G. killipii
220. G. meridense

Other species from S America
221. G. lignosum
222. G. matucanense
223. G. mutisii
224. G. paramicola

IIb. sect. Paramensia
225. G. exallum
226. *G. jahnii*

IIc. sect. Neurophyllodes
227. *G. arboreum*
228. G. multiflorum
229. G. cuneatum
subsp. *cuneatum*
subsp. *holoeucum*
subsp. *hypoleucum*
subsp. *tridens*
230. G. hanaense
231. G. hillebrandii
232. G. kauaiense

IId. sect. Incana
233. *G. incanum*
subsp. *incanum*
subsp. *magniflorum*
subsp. *nyassense*
234. G. multisectum
235. G. vagans
236. G. pulchrum
237. G. brycei
238. G. robustum
239. G. discolor
240. G. harveyi
241. G. canescens
242. G. drakensbergense
243. G. angustipetalum
244. G. ornithopodioides
245. G. baurianum
246. G. amatolicum
247. G. grandistipulatum
248. G. schlechteri
249. G. contortum
250. G. ornithopodon
251. G. wakkerstroomianum
252. G. caffrum
253. G. subglabrum
254. G. sparsiflorum

IIe. sect. Dissecta
255. *G. asphodeloides*
256. G. crenophilum
257. G. sintenisii
258. G. dissectum

III. subg. Tuberosa
IIIa. sect. Tuberosa
259. *G. kotschyi*
subsp. *kotschyi*
subsp. *charlesii*
260. G. libanoticum
261. G. linearilobum
262. G. macrostylum
263. G. malviflorum
264. G. tuberaria
265. G. tuberosum

IIIb. sect. Lanuginosa
266. *G. bohemicum*
267. G. lanuginosum
268. G. gracile
269. G. renardii
270. G. ibericum
271. G. platypetalum
272. G. peloponnesiacum
273. G. libani
274. G. gymnocaulon
275. G. kurdicum

IV. subg. Robertium
IVa. sect. Batrachioidea
276. *G. aequale*
277. G. molle
278. G. pusillum
279. G. pyrenaicum
subsp. *pyrenaicum*
subsp. *lusitanicum*

IVb. sect. Divaricata
280. *G. albanum*
281. G. divaricatum

IVc. sect. Trilopha
282. *G. trilophum*
283. G. yemense
284. G. biuncinatum
285. G. favosum
286. G. mascatense
287. G. ocellatum
288. G. brevipes

IVd. sect. Polyantha
289. *G. hispidissimum*
290. G. moupinense
291. G. nakaoanum
292. G. polyanthes
293. G. strictipes
294. G. umbelliforme
295. G. wardii

IVe. sect. Ruberta
296. *G. glaberrimum*
297. G. lasiopus
298. G. lucidum
299. G. purpureum
300. G. robertianum
301. G. yeoi
302. G. cataractarum
303. G. maderense
304. G. palmatum
305. G. reuteri

IVf. sect. Unguiculata
306. *G. macrorrhizum*
307. G. dalmaticum

TAXONOMY

Geranium L., Sp. Pl.: 676. 1753; Gen. Pl. ed. 5: 306. 1754. Type: *G. sylvaticum* L. (designated by Hanks & Small 1907: 4).

Annual, biennial, or perennial herbs, rarely shrubs, usually pubescent. Leaves simple, usually palmatifid or palmatisect, sometimes digitate or entire, rarely peltate, stipulate, petiolate; basal leaves usually forming a rosette; cauline leaves opposite or alternate, rarely verticillate; stipules lanceolate to ovate, entire or multisect. Inflorescence terminal or axillary, cymose, bracteate with the cymules arranged dichasially or monochasially, the cymules sometimes in umbel-like aggregates or on floriferous branchlets (brachyblasts). Flowers usually in cymules 1- or 2-flowered, actinomorphic, rarely somewhat zygomorphic, without hypanthium and without a nectariferous tube. Sepals 5, imbricate, obtuse or mucronate at apex. Petals 5, free, frequently emarginate, sometimes clawed. Stamens 10, in two whorls, stamens of outer whorl opposite petals, stamens of inner whorl alternate with petals, all bearing anthers or, very rarely, the 5 outer reduced to a short filament; filaments lanceolate, free, glabrous or with eglandular hairs. Nectaries 5, alternating with petals or, rarely, forming a ring all around the flower. Ovary 5-locular, lobed, with 2 superposed ovules per locule, style distinct, diverging into five stigma lobes at the apex. Fruit a long-beaked schizocarp, splitting into five 1-seeded mericarps, with stigma remnants persistent at the apex; rostrum portion of fruit either gradually or abruptly narrowed; mericarp with a basal callus or prong to retain the seed, or retention structure absent, sometimes with a strand of fibers at apex (for type of fruit dispersal and its morphological implications see morphology chapter). Seed ellipsoid, slightly compressed, more or less finely reticulate, with little or no endosperm; embryo with massive induplicate or convoluted cotyledons.

KEY TO SPECIES OF GERANIUM IN NORTH AND CENTRAL AMERICA (FIG. 5)

1. Annuals, rarely biennials.
    2. Three outer sepals with lengthwise keels and transverse flaps between these, two inner sepals ± smooth. **298. G. lucidum**
    2. All sepals smooth.
        3. Mericarps reticulate or transversely wrinkled.
            4. Leaves palmatifid; petals emarginate. **277. G. molle**
            4. Leaves palmatisect; petals rounded (rarely retuse).
                5. Petals (14.9)16.2-19.3(20.7) mm long; mericarps usually lacking fibers derived from the rostrum and attached near the apex; staminal filaments (8.7)9.6-11.3(12.8) mm long. **301. G. yeoi**
                5. Petals 5.3-14.2 mm long; mericarps usually with fibers derived from the rostrum and attached near the apex; staminal filaments (3.7)5.2-7.3(8) mm long.
                6. Petals (8.5)10.5-12.5(14.2) mm long, (2.1)2.6-4.5(6.1) mm wide; anthers purple; mericarps reticulate, with few thin ridges and scarcely anastomosing in the basal half but more abundant distally and forming 1-2(3) overlapping, collar-like keels at the apex. **300. G. robertianum**
                6. Petals (5.3)6.3-8.4(9.9) mm long, (0.8)1.5-2(2.6) mm wide; anthers yellow; mericarps reticulate, with thick ridges dense throughout or sometimes thin and sparce in the basal half and forming 1-4 overlapping collars or contiguous circumferential ridges at apex. **299. G. purpureum**
        3. Mericarps smooth.
            7. Mericarps with a basal prong, without a callus. **298. G. dissectum**
            7. Mericarps without a basal prong, usually with a callus.
                8. Mericarps with a basal callus.
                9. Rostrum of fruit with an evident narrowed apex 1.9-6.8 mm long.
                10. Petals (6.4) 7-10.7 mm long; peduncles with retrorse, appressed, eglandular hairs. **63. G. columbinum**
                10. Petals 3.3-8.7 mm long; peduncles with patent, glandular, and eglandular hairs.
                11. Leaves polygonal in outline, deeply divided (ratio main-sinus length/middle segment length = 0.82-0.95); petals emarginate; mericarps black. **121. G. bicknellii**
                11. Leaves orbicular in outline, not deeply divided (ratio main-sinus length/middle segment length = 0.51-0.65); petals rounded; mericarps brown. **63. G. rotundifolium**
                9. Rostrum of fruit with a very short narrowed apex 0.5-2 mm long.
                12. Pedicels with patent, sometimes retrorse (not appressed) eglandular hairs and patent, glandular hairs; mericarps densely hairy, the hairs 0.5-1.9 mm long. **120. G. carolinianum**

12. Pedicels with retrorse, appressed, eglandular hairs; mericarps sparsely hairy, the hairs 0.2-0.7 mm long. **122. G. texanum**
8. Mericarps without a basal callus
13. Mericarps with appressed hairs covering all the surface. **278. G. pusillum**
13. Mericarps glabrous but densely ciliate at the base. **276. G. aequale**
1. Perennials.
14. Herbs acaulescent.
15. Cymules 1-flowered. **168. G. costaricense**
15. Cymules 2-flowered.
16. Mericarps without basal callus; flowers zygomorphic. **307. G. dalmaticum**
16. Mericarps with basal callus; flowers actinomorphic.
17. Leaves palmatisect; peduncles with antrorse, appressed, eglandular hairs. **155. G. alpicola**
17. Leaves palmatifid; peduncles with patent to retrorse, eglandular hairs and patent, glandular hairs. **138. G. crenatifolium**
14. Herbs with developed aerial stem.
18. Cymules 1-flowered (Note: *G. andicola* and *G. sibiricum* occasionally also with some 2-flowered cymules).
19. Petals hairy on 3/4 of the adaxial surface. **152. G. monanthum**
19. Petals glabrous adaxially, sometimes hairy towards the base.
20. Petals (2.2)4-8.1 mm long.
21. Leaves with the middle segment obtriangular, 3-5(9)-lobed at the apex. **73. G. potentilloides**
21. Leaves with middle segment rhombic, (7)9-14-lobed in the distal half. **67. G. sibiricum**
20. Petals (9.6)10-21.8 mm long.
22. Leaves with middle segment 3-5(7)-lobed in distal half. **89. G. sanguineum**
22. Leaves with middle segment (5)7-14(28)-lobed in distal half.
23. Peduncles (77)90-138(215) mm long; petals white. **142. G. andicola**
23. Peduncles 27-97(115) mm long; petals white or purple.
24. Petals purple; anthers 1.2-1.8 mm long; leaves sericeous abaxially. **140. G. potentillifolium**
24. Petals white; anthers 1.7-2.2 mm long; leaves densely hairy abaxially. **141. G. bellum**
18. Cymules 2-flowered, rarely more.
25. Stipules 2-4-fid, with linear and deep lobes. **233. G. incanum**
25. Stipules entire, sometimes with a very short bifid apex.
26. Mericarps without a basal callus.
27. Mericarps reticulate, glabrous.
28. Petals (18.5)21-22.5(24.2) mm long, glabrous; leaves palmatisect. **304. G. palmatum**
28. Petals (12.4)14-16.7(18.1) mm long, hairy at the base; leaves palmatifid. **307. G. dalmaticum**
27. Mericarps smooth, hairy.
29. Petals 7-11 mm long; rostrum of fruit without narrowed apex. **279. G. pyrenaicum**
29. Petals 15.4-28.4 mm long; rostrum of fruit with a narrowed apex 2.6-6.7 mm long. **270. G. ibericum**
26. Mericarps with a basal callus
30. Petals with a claw 6.1-11.1 mm long. **162. G. unguiculatum**
30. Petals without a claw, or rarely with a short claw 0.8-1.1 mm long.
31. Pedicels and peduncles with antrorse, appressed, eglandular hairs. **155. G. alpicola**
31. Pedicels and peduncles with retrorse to patent hairs.
32. Leaves sericeous on both surfaces. **133. G. niveum**
32. Leaves ± hairy but not sericeous adaxially.
33. Leaves palmatisect.
34. Petals (4.2)5.1-6.4(6.8) mm long. **154. G. cruceroense**
34. Petals 13.4-16.3(17.5) mm long.
35. Inflorescence with glandular hairs. **156. G. madrense**
35. Inflorescence without glandular hairs. **157. G. charucanum**
33. Leaves palmatifid (*G. solanderi* occasionally also palmatisect).
36. Leaves verticillate at basal nodes and opposite towards the apex. **158. G. oaxacanum**
36. Leaves never verticillate.

37. Petals glabrous adaxially or hairy towards the base (usually with short hairs), ciliate at the base.
    38. Pedicels with eglandular hairs, without glandular hairs (sometimes with sessile minute glands).
        39. Petals (3)4-6(8.5) mm long.
            40. Pedicels with retrorse, appressed hairs; sepals accrescent, ovate. **111. G. core-core**
            40. Pedicels with patent to retrorse, not appressed hairs; sepals not accrescent, lanceolate. **102. G. solanderi**
        39. Petals (7.8)9-21(24.1) mm long.
            41. Rostrum of fruit with a narrowed apex 4.5-7 mm long; mericarps with glandular hairs 1.1-1.9 mm long. **134. G. maculatum**
            41. Rostrum of fruit with a narrowed apex (1)2.1-4.2 mm long; mericarps without glandular hairs.
                42. Sepals glabrous, except for some eglandular hairs on the veins.
                43. Petals (7.8)9.2-11 mm long; stem with retrorse, curved, eglandular hairs 0.3-0.6 mm long. **163. G. durangense**
                43. Petals (11.5)13.7-16.1(18.2) mm long; stem with patent, eglandular hairs (0.4)1-1.7 mm long. **144. G. goldmanii**
                42. Sepals hairy abaxially.
                44. Petals 18.4-21.4(23.5) mm long, white. **137. G. lozanoi**
                44. Petals (11.5)15.5-17.9(24.1) mm long, usually purple. **143. G. schiedeanum**
    38. Pedicels with glandular hairs.
        45. Petals (3.5)4.5-8.3(9.1) mm long; fruits 15.2-26.6 mm long.
            46. Petal apex rounded or retuse; mericarps smooth, black or deep brown. **68. G. thunbergii**
            46. Petal apex emarginate; mericarps with one transverse vein at apex, usually brown. **153a. G. seemannii** subsp. **seemannii**
        45. Petals (10)11-24(35) mm long; fruits (19.3)22-52 mm long.
            47. Middle cauline leaves alternate, distal cauline leaves opposite; cymules solitary or in aggregates at the apex of each branch.
                48. Petals emarginate; stigmatic lobes hairy. **26. G. endressii**
                48. Petals rounded or rarely slightly emarginate at the apex; stigmatic lobes glabrous.
                49. Peduncles (105)119-170(235) mm long. **136. G. mexicanum**
                49. Peduncles 11-72(90) mm long.
                50. Staminal filaments with eglandular hairs 0.2-0.7 mm long. **30. G. sylvaticum**
                50. Staminal filaments with eglandular hairs 1.2-3.2 mm long.
                51. Petioles with retrorse, appressed, eglandular hairs 0.2-0.5 mm long. **31. G. erianthum**
                51. Petioles with patent, eglandular hairs 0.2-1.6 mm long, and, rarely, patent glandular hairs 0.2-0.6 mm long. **159. G. trolliifolium**
            47. Cauline leaves opposite; cymules usually solitary.
                52. Nectaries hairy.
                53. Fruits 29-37.8 mm long, pointing downward or reflexed when immature; staminal filaments with a broad triangular base. **35. G. pratense**
                53. Fruits 35-52 mm long, erect; staminal filaments lanceolate. **135. G. oreganum**

52. Nectaries glabrous.
54. Fruits reflexed. **161. G. mooreanum**
54. Fruits erect.
55. Middle and distal cauline leaves hastate in outline. **150. G. lilacinum**
55. Middle and distal cauline leaves polygonal in outline.
56. Staminal filaments 16-24(30) mm long; sepals mucro 3-4.2 mm long; rostrum of fruit with a narrowed apex 15-18.3 mm long. **160. G. campanulatum**
56. Staminal filaments 3.3-12.4 mm long; sepals mucro 0.3-2.2 mm long; rostrum of fruit with a narrowed apex 0.9-6 mm long.
57. Cymules 2-flowered, solitary.
58. Petals 10-13.9 mm long. **153b. G. seemannii** subsp. **repens**
58. Petals 15-20.8 mm long.
59. Staminal filaments with hairs 0.5-1.5(2.2) mm long; stem with glandular hairs 0.1-0.5 mm long. **138. G. crenatifolium**
59. Staminal filaments with hairs 1.1-2.8 mm long; stem without glandular hairs. **139. G. pringlei**
57. Cymules 2-6-flowered, solitary or in aggregates at the apex of each branch.
60. Peduncles (105)119-170(235) mm long; staminal filaments with hairs 0.4-0.8 mm long. **136. G. mexicanum**
60. Peduncles 16-72(90) mm long; staminal filaments with hairs (1.2) 1.5-2.8 mm long. **159. G. trolliifolium**

37. Petals hairy on (1/5)1/3-3/4 of the adaxial surface, usually with long hairs.
61. Inflorescence monochasially branched, with cymules borne singly at the nodes along the stem.
62. Herbs prostrate to ascending, rooting at nodes. **151. G. hintonii**
62. Herbs erect or prostrate to ascending but not rooting at nodes.
63. Petals 14-16.8(17.2) mm long; sepals mucro (2.6)2.8-4.8 mm long; pedicels only with eglandular hairs; peduncles (67)111-222(240) mm long. **145. G. hernandesii**
63. Petals (6.1)7-12 (13.9) mm long; sepals mucro (0.6)1.2-1.7(2.5) mm long; pedicels usually with glandular hairs; peduncles (12)21-73(89) mm long.
64. Petals (6.1)7.2-8.4 (9.8) mm long.
65. Rostrum of fruit without a narrowed apex; middle segment of the leaves 7.9-12.9(15.3) mm wide at the base. **149. G. hystricinum**
65. Rostrum of fruit with a narrowed apex 1.7-3.2 mm long; middle segment of the leaves (14.6) 17.3-25.4 mm wide at the base. **148. G. latilobum**
64. Petals (8)9.2-12.3(13.9) mm long.
66. Petals white to pink, hairy on 1/2-3/4 of the adaxial surface, basally ciliate on the margin, with hairs 0.7-1.6 mm long; stem and leaves usually with only eglandular hairs. **146. G. deltoideum**

66. Petals purple, hairy on 1/4-1/3 of the adaxial surface, basally ciliate on the margin, with hairs 0.3-0.7 mm long; stems and leaves with glandular hairs. **147. G. gentryi**

61. Inflorescence dichasially branched, with terminal cymules.

67. One (rarely two) alternate cauline leaf between the base and the first branch point; staminal filaments with hairs (0.7)1.3-1.6 (2) mm long; nectaries with a tuft of hairs covering the entire surface. **130. G. latum**

67. Leaves all opposite; staminal filaments with hairs 0.2-1(1.2) mm long (if longer, then nectaries with a tuft of hairs at the apex, adaxially glabrous); nectaries glabrous to hairy.

68. Petals reflexed. **125. G. dodecatheoides**

68. Petals patent to erect patent.

69. Nectaries glabrous or with a tuft of hairs at the apex and adaxially glabrous.

70. Petals 5-9(10.5) mm long; sepals 5.4-6.5(8) mm long. **126. G. lentum**

70. Petals (10)11-20 mm long; sepals (6.9) 8-11 mm long.

71. Stigmatic remnants 3-6(6.8) mm long; basal leaves (7.1)10-16 cm wide. **129. G. viscosissimum**

71. Stigmatic remnants (4)6-8 mm long; basal leaves 2.4-7.3 cm wide.

72. Peduncles (8)18-120(170) mm long; pedicels 18-33(49) mm long; fruits 22-31 (36) mm long; rostrum of fruit with a narrowed apex 2-3.8 mm long. **123. G. caespitosum**

72. Peduncles (22)82-190(310) mm long; pedicels (17)44-86 mm long; fruits (29)32-42 mm long; rostrum of fruit with a narrowed apex (2.9)4-6.1 mm long. **124. G. californicum**

69. Nectaries adaxially hairy, sometimes with short hairs.

73. Petals 12.1-20 mm long.

74. Petals purple; leaves 2.2-3.5 cm long, with the middle segment 5-7-lobed in distal half; stigmatic remnants 2.1-2.2 mm long. **132. G. potosinum**

74. Petals white; leaves (3.9)4.5-10.5 cm long with the middle segment 6-11(16)-lobed in distal half; stigmatic remnants 3-4.2 mm long. **128. G. richardsonii**

73. Petals 6-11(13.1) mm long.

75. Stem with patent to retrorse, appressed, eglandular hairs 0.3-1.2 mm long; leaves 2.9-6.6(8) cm long, with the middle segment 5-15-lobed in distal half. **127. G. wislizeni**

75. Stem with retrorse, appressed eglandular hairs 0.3-0.5 mm long; leaves 2-3.2 cm long with the middle segment 3-7-lobed in distal half. **131. G. tenue**

KEY TO SPECIES OF GERANIUM IN SOUTH AMERICA

1. Annuals, rarely biennials.

2. Fertile stamens 5 (external whorl lacking anthers). **278. G. pusillum**

2. Fertile stamens 10.

3. Mericarps reticulate or transversely wrinkled.

4. Leaves palmatifid; petals emarginate. **277. G. molle**

4. Leaves palmatisect; petals entire, rarely retuse.

5. Petals (8.5)10.5-12.5(14.2) mm long, (2.1)2.6-4.5(6.1) mm wide; anthers purple; mericarps reticulate, with few thin ridges and scarcely anastomosing in the basal half but more abundant distally and forming 1-2(3) overlapping, collar-like keels at the apex. **300. G. robertianum**
5. Petals (5.3)6.3-8.4(9.9) mm long, (0.8)1.5-2(2.6) mm wide; anthers yellow; mericarps reticulate, with thick ridges dense throughout or sometimes thin and sparce in the basal half and forming 1-4 overlapping collars or contiguous circumferential ridges at apex. **299. G. purpureum**
3. Mericarps smooth.
6. Mericarps glabrous over most of the surface, densely ciliate at the base. **276. G. aequale**
6. Mericarps hairy over most of the surface.
7. Mericarps with a basal prong, without a basal callus. **258. G. dissectum**
7. Mericarps without a basal prong, with a basal callus.
8. Rostrum of fruit with an evident narrowed apex 2-5.6 mm long. **121. G. bicknellii**
8. Rostrum of fruit with a short narrowed apex 0.5-2 mm long. **120. G. carolinianum**
1. Perennials.
9. Leaves with an abscission zone between lamina and petiole.
10. Leaves lanceolate, entire, with marginal cilia; pedicels without glandular hairs. **225. G. exallum**
10. Leaves obtriangular, tridentate at the apex, glabrous; pedicels usually with glandular hairs. **226. G. jahnii**
9. Leaves without an abscission zone between lamina and petiole.
11. Small shrubs.
12. Cymules 1-flowered; pedicels without glandular hairs. **166. G. loxense**
12. Cymules 2-flowered; pedicels with glandular hairs.
13. Petals 10-14.2 mm long, dark purple; sepals mucro 0.6-1.5 mm long; stipules lanceolate. **221. G. lignosum**
13. Petals (11.2)13.1-19.3 mm long, purple; sepals mucro (1.2)1.7-2.2 mm long; stipules lanceolate with a setaceous apex 1.9-7.7 mm long. **218. G. lindenianum**
11. Herbs.
14. Cymules 1-flowered.
15. At dispersal, mericarps propelled with enclosed seed and attached awn (*Erodium*-type discharge).
16. Mericarps with a basal beak 0.8-0.9 mm long; peduncles and pedicels without glandular hairs. **20. G. arachnoideum**
16. Mericarps with a basal beak 0.2-0.4 mm long; peduncles and pedicels with glandular hairs.
17. Petals glabrous adaxially; basal leaves without glandular hairs abaxially. **21. G. brasiliense**
17. Petals hairy on the basal 1/4 of the adaxial surface; basal leaves with glandular hairs abaxially. **22. G. glanduligerum**
15. At dispersal, each single seed is launched from mericarp by the explosive recurvature of the awn (seed-ejection type discharge), while the awn and the mericarp wall remain attached to the columella.
18. Herbs scapiform (usually cushion-like), sometimes with more or less developed internodes covered by stipules.
19. Leaves sericeous, at least adaxially.
20. Leaves sericeous adaxially, glabrous abaxially. **177. G. humboldtii**
20. Leaves sericeous on both surfaces.
21. Leaves digitate, with 3-5 segments (lateral segments turned upward).
22. Petioles with patent to retrorse hairs; rostrum of fruit with a narrowed apex 1.6-2 mm long. **184. G. digitatum**
22. Petioles with antrorse hairs; rostrum of fruit without a narrowed apex. **185. G. trujillense**
21. Leaves palmatifid to palmatisect (lateral segments plane or turned downward).
23. Leaves palmatisect.
24. Petioles with antrorse hairs.
25. Petals 4-7.4 mm long; nectaries glabrous; rostrum of fruit without narrowed apex. **189. G. tovarii**
25. Petals 10.6-15 mm long; nectaries hairy; rostrum of fruit with a narrowed apex 1-1.7 mm long. **190. G. weddellii**

24. Petioles with patent or retrorse hairs.
26. Leaves 0.4-0.8 cm long; petioles with retrorse, ± appressed hairs 0.2-1 mm long; sepals 4.1-8.2 mm long. **175. G. ecuadoriense**
26. Leaves 0.9-1.7 cm long; petioles with patent to retrorse (not appressed) hairs 0.8-1.6 mm long; sepals 7-9 mm long. **188. G. sericeum**
23. Leaves palmatifid.
27. Leaves 0.3-0.9 cm long; peduncle hairs 0.1-0.4(0.6) mm long.
28. Sepals without mucro; petals 6-7 mm long. **183. G. planum**
28. Sepals mucro 0.2-0.6 mm long; petals 5.2-10.5 mm long. **182. G. crassipes**
27. Leaves 0.7-1.4 cm long; peduncle hairs 0.4-1.5 mm long.
29. Middle and usually lateral leaf segments 3-lobed; rostrum of fruit without narrowed apex. **187. G. ruizii**
29. Middle and lateral leaf segments entire; rostrum of fruit with a narrowed apex. **186. G. nivale**
19. Leaves glabrous to densely hairy, never sericeous.
30. Leaves entire with tridentate apex, the middle segment 1(3)-lobed at the apex; petals slightly emarginate. **164. G. azorelloides**
30. Leaves tripartite, digitate, palmatifid, or palmatisect; petals usually rounded at apex.
31. Leaves tripartite. **169. G. campii**
31. Leaves digitate, palmatifid, or palmatisect.
32. Leaves digitate, with 3-5 segments (lateral segments turned upward).
33. Leaves glabrous or with antrorse cilia on the margin, and with the middle segment entire. **171. G. maniculatum**
33. Leaves with patent cilia on the margin and with the middle segment (2)3-lobed. **170. G. rhomboidale**
32. Leaves palmatifid or palmatisect (lateral segments plane or turned downward).
34. Leaves palmatisect.
35. Petioles with retrorse, appressed hairs; nectaries hairy; rostrum of fruit with a narrowed apex 1 mm long. **178. G. macbridei**
35. Petioles with patent hairs (sometimes glabrous); nectaries glabrous; rostrum of fruit without narrowed apex. **176. G. multipartitum**
34. Leaves palmatifid.
36. Stipules scarious, stramineous, obtuse (with a setaceous apex). **174. G. stramineum**
36. Stipules papery, brown or reddish, lanceolate (sometimes with a setaceous apex).
37. Rootstock vertical, turnip-shaped.
38. Petals (9.5)11.5-15.7 mm long, hairy on margin and base of abaxial surface; nectaries hairy; rostrum of fruit with a narrowed apex 0.7-1.5 mm long. **119. G. parodii**
38. Petals (4.5)6-12.8 mm long, glabrous (rarely with a few cilia on the basal margin); nectaries glabrous; rostrum of fruit without narrowed apex. **118. G. sessiliflorum**
37. Rootstock not turnip-shaped.
39. Petioles with antrorse hairs. **180. G. jaekelae**
39. Petioles with patent to retrorse hairs.
40. Cymules (1.9)2.6-4.2 times as long as adjacent leaves. **167. G. alonsoi**
40. Cymules (0.5)0.7-1.8 times as long as adjacent leaves.
41. Leaves ± hairy on one or both surfaces.
42. Stipules ending in 1-3 bristles 0.2-0.6 mm long; leaves with the middle segment lanceolate, sometimes obtriangular. **165c. G. sibbaldioides** subsp. **elongatum**
42. Stipules not ending in bristles; leaves with the middle segment broadly obovate. **181. G. pavonianum**

41. Leaves glabrous, except on the margins.
43. Leaves with the middle segment entire, sometimes with a lateral tooth. **165a. G. sibbaldioides** subsp. **sibbaldioides**
43. Leaveswith the middle segment 3(4)-lobed at apex.
44. Petioles with patent, eglandular hairs 0.2-0.7 mm long. **172. G. foreroi**
44. Petioles with retrorse, appressed, eglandular hairs 0.1-0.5 mm long.
45. Sepals mucro (0.6)0.7-0.8(1.2) mm long; petals (7.8)10.1-11.5(13.2) mm long, usually glabrous. **165b. G. sibbaldioides** subsp. **beckianum**
45. Sepals mucro 0.3-0.7 mm long; petals 10.5-21 mm long.
46. Petals hairy on both surfaces, mainly at the base of adaxial surface; nectaries glabrous. **173. G. paludosum**
46. Petals glabrous; nectaries hairy. **179. G. sagasteguii**

18. Herbs with developed aerial stems, sometimes prostrate but the internodes not covered by stipules.
47. At least some cymules arising from the rootstock; sepals usually with patent hairs 0.9-2.8 mm long on margin.
48. Petals (9.5)11.5-15.7 mm long, hairy on margin and base of abaxial surface; nectaries hairy; rostrum of fruit with a narrowed apex 0.7-1.5 mm long. **119. G. parodii**
48. Petals (4.5)6-12.8 mm long, glabrous (rarely with a few cilia at the basal margin); nectaries glabrous; rostrum of fruit without narrowed apex. **118. G. sessiliflorum**
47. All cymules borne on aerial stems; sepals without long patent hairs on margin.
49. Herbs erect; leaves (1.5)3-5.6(8.5) cm long.
50. Seeds hairy; pedicels sometimes with glandular hairs. **204. G. rupicola**
50. Seeds glabrous; pedicels without glandular hairs. **206. G. leucanthum**
49. Herbs usually prostrate to ascending; leaves (0.5)1-4(7.3) cm long.
51. Cymules with peduncles, pedicels and 2 bracteoles, and leaves deeply divided (ratio main-sinus length/middle segment length = 0.63-0.90).
52. Petals (6.2)7.8-11.3(16.3) mm long. **202. G. laxicaule**
52. Petals (4.4)5-5.6(6.3) mm long. **66. G. nepalense**
51. Cymules without pedicels and bracteoles, or leaves little divided [ratio main-sinus length/middle segment length = (0.49)0.56-0.64(0.69)].
53. Petals (8.4)10-14(15.4) mm long and leaves not deeply divided (except in *G. ayacuchense*); fruits (11.8)12-22(25) mm long.
54. Leaves deeply divided [ratio main-sinus length/middle segment length = (0.68)0.72-0.86]. **203. G. ayacuchense**
54. Leaves not deeply divided [ratio main-sinus length/middle segment length = (0.38)0.52-0.64(0.69)].
55. Leaves hairy on nerves abaxially and on margin. **197. G. renifolium**
55. Leaves hairy on both surfaces.
56. Mericarps without glandular hairs; peduncles usually without glandular hairs. **199. G. peruvianum**
56. Mericarps with glandular hairs; peduncles with glandular hairs.
57. Leaves polygonal in outline, (1.7)1.8-3.1(3.4) cm long. **198. G. stuebelii**
57. Leaves orbicular in outline, 1.3-2.1 cm long. **200. G. comarapense**
53. Petals (3.9)5.2-7.2(12.4) mm long and leaves deeply divided; fruits 6.4-15(21) mm long.
58. Petioles and peduncles with glandular hairs.
59. Fruits 17-21 mm long; rostrum of fruit with a narrowed apex 1.1-2.1 mm long; stem ascending or climbing 26-100(200) cm long. **201. G. chilloense**

59. Fruits 6.4-11.2 mm long; rostrum of fruit without narrowed apex; stem prostrate 2.8-17 cm long.
60. Leaves ± divided [ratio secondary sinus length/middle segment length = (0.31)0.44-0.52(0.61)], with appressed, eglandular hairs restricted to margins and nerves of abaxial surface, sometimes also adaxially. **192. G. pseudodiffusum**
60. Leaves not deeply divided [ratio secondary sinus length/middle segment length = (0.20)0.25-0.31(0.36)], with patent, eglandular hairs on both surfaces. **193. G. antisanae**
58. Petioles and peduncles without glandular hairs.
61. Leaves palmatisect. **194. G. ayavacense**
61. Leaves palmatifid.
62. Petioles and peduncles with patent hairs. **196. G. reptans**
62. Petioles and peduncles with retrorse, appressed hairs.
63. Stem erect; leaves with the middle segment 6-9-lobed. **205. G. soratae**
63. Stem prostrate to ascending; leaves with the middle segment (1)3-5(6)-lobed.
64. Leaves with the middle segment 5(6)-lobed. **195. G. smithianum**
64. Leaves with the middle segment (1)3(5)-lobed. **191. G. diffusum**

14. Cymules 2-flowered.
65. Mature leaves lanuginous abaxially.
66. Petals (14.1)20-22(27.2) mm long; rostrum of fruit with a narrowed apex 6.3-8.5 mm long; sepals and pedicels without glandular hairs. **222. G. matucanense**
66. Petals 9.8-14.1 mm long; rostrum of fruit with a narrowed apex 1.2-2 mm long; sepals and pedicels with glandular hairs.
67. Stem with patent, eglandular hairs; cauline leaves always petiolate. **224. G. paramicola**
67. Stem with retrorse, appressed, eglandular hairs; cauline leaves usually sessile. **223. G. mutisii**
65. Mature leaves ± hairy abaxially.
68. Inflorescence branched dichasially.
69. Pedicels without glandular hairs.
70. Leaves digitate (lateral segments upward); rostrum of fruit with a narrowed apex. **208. G. cavanillesii**
70. Leaves palmatifid, sometimes with the base broadly cuneate; rostrum of fruit usually without narrowed apex.
71. Leaves with the middle segment entire, broadly lanceolate; rostrum of fruit with a narrowed apex 0.9-1.9 mm long. **211. G. jaramilloi**
71. Leaves with the middle segment 3(5)-lobed, obtriangular; rostrum of fruit without narrowed apex.
72. Leaves with antrorse, appressed cilia on the margin, giving a scarious aspect; basal leaves cordate; petals ciliate on the basal margin. **210. G. santanderiense**
72. Leaves with patent cilia or glabrous on the margin; basal leaves usually subtruncate or cuneate; petals usually glabrous.
73. Basal leaves coriaceous, with 3(5) segments, subtruncate, with some eglandular hairs at the apex of each segment and near the margin (sometimes with patent cilia). **209. G. lainzii**
73. Basal leaves not coriaceous, with (3)5 segments, usually broadly cuneate to subtruncate, with patent eglandular hairs on the margin. **207. G. multiceps**
69. Pedicels with glandular hairs 0.2-1.7 mm long (rarely without glandular hairs, then leaves velutinous abaxially and fruits reflexed).
74. Vegetative stems ± horizontal, covered with imbricate stipules, usually without petiole remnants. **216. G. holosericeum**
74. Vegetative stems absent.
75. Petals (12.8)14.8-18.8 mm long. **217. G. schultzei**
75. Petals 6-12.5 mm long.

76. Petioles of basal leaves densely covered by patent hairs, eglandular hairs 0.5-2.5 mm long and glandular hairs 0.3-0.5 mm long. **212. G. sebosum**
76. Petioles of basal leaves only with eglandular hairs 0.1-0.9 mm long.
77. Stolons present; leaves 1.6-2.7 cm long, with a middle segment 3-lobed. **213. G. stoloniferum**
77. Stolon absent; leaves (1.9)3.6-5.8 cm long, with a middle segment (3)5-13-lobed.
78. Fruits reflexed. **214. G. velutinum**
78. Fruits erect. **215. G. subnudicaule**
68. Inflorescence branched monochasially.
79. Herbs prostrate to ascending, rooting at nodes; leaves subtomentose in bud.
80. Leaves with the middle segment (3)5-9(15)-lobed; basal and middle peduncles (25)57-91(125) mm long; petals (7.5)9.1-10.4(11.4) mm long. **219. G. killipii**
80. Leaves with the middle segment 3-5(7)-lobed; basal and middle peduncles (16)37-59(92) mm long; petals (5.6)6.3-8.5(9.3) mm long. **220. G. meridense**
79. Herbs usually erect but sometimes ascending, not rooting at nodes (except *G. seemannii* subsp. *seemannii* and *G. thunbergii* trailing to ascending, and sometimes rooting at the nodes); leaves not subtomentose in bud.
81. Petals (11.4)13.4-16.4(16.9) mm long, glabrous, rarely with a few cilia on the basal margin; rostrum of fruit with a narrowed apex (2)2.3-3.8(5) mm long. **112. G. tablasense**
81. Petals (3.1)5-8(14.3) mm long, ciliate on the basal margin or sometimes on the base of the adaxial surface; rostrum of fruit with a narrowed apex (0)1-2(2.9) mm long, in some species lacking.
82. Peduncles (59)82-151(251) mm long. **113. G. venturianum**
82. Peduncles (3.6)16-65(139) mm long.
83. Peduncles with glandular hairs.
84. Leaves with the middle segment rhombic; rostrum of fruit with a narrow apex (0)1-2(2.9) mm long.
85. Sepals (3.4)4.3-5.3(7.3) mm long. **153a. G. seemannii** subsp. **seemannii**
85. Sepals (5.1)5.4-6.5(8.2) mm long.
86. Herbs erect or ascending, not rooting at nodes; roots thickened; petals glabrous on the base of the adaxial surface and ciliate on the basal margin. **114. G. fallax**
86. Herbs trailing and ascending, sometimes rooting at nodes; roots not thickened; petals hairy on the base of the adaxial surface and on the basal margin. **68. G. thunbergii**
84. Leaves with the middle segment obtriangular; rostrum of fruit without narrowed apex.
87. Basal leaves deeply divided with narrow lobes [ratio secondary sinus length/middle segment length = (0.25)0.40-0.53(0.62)]; petals (7)7.9-10.2(14) mm long. **110. G. skottsbergii**
87. Basal leaves not deeply divided [ratio secondary sinus length/middle segment length = (0.13)0.24-0.38(0.42)]; petals (5.1)6.5-8(9) mm long. **106. G. berteroanum**
83. Peduncles without glandular hairs.
88. Herbs ascending (not rooting at nodes); cymules at the basal part of the stem usually 1-flowered (some arising directly from the rootstock), cymules of the distal part 2-flowered. **109. G. magellanicum**
88. Herbs usually erect to ascending; cymules always 2-flowered and arising along leafy stems.
89. Basal leaves deeply divided with narrow lobes [ratio secondary sinus length/middle segment length = (0.25)0.40-0.53(0.62)]; petals (7)7.9-10.2(14) mm long. **110. G. skottsbergii**

89. Basal leaves not deeply divided [ratio secondary sinus length/middle segment length = (0.13)0.21-0.41(0.42)]; petals (3.1)3.5-7.5(9) mm long.
90. Pedicels with retrorse-appressed hairs. **111. G. core-core**
90. Pedicels with patent hairs.
91. Petals (4)4.5-5.1(6.1) mm long; leaves with the middle segment rhombic. **108. G. albicans**
91. Petals (5)5.6-8(9) mm long; leaves with the middle segment obtriangular.
92. Leaves with moderately wide middle segment at the base [ratio segment width at the base/middle segment length = (0.20)0.24-0.32(0.42)]; nectaries usually hairy; sepals mucro (0.2)0.3-0.4(0.5) mm long. **107. G. limae**
92. Leaves with a more narrow middle segment at the base [ratio segment width at the base/middle segment length = (0.11)0.17-0.22(0.31)]; nectaries glabrous; sepals mucro (0.3)0.6-0.8(0.9) mm long. **106. G. berteroanum**

KEY TO THE SPECIES OF GERANIUM IN THE PACIFIC AREA

1. Annuals, rarely biennials.
2. Fertile stamens 5 (external whorl lacking anthers). **278. G. pusillum**
2. Fertile stamens 10.
3. The three outer sepals with lengthwise keels and transverse flaps between these, the two inner ± smooth. **298. G. lucidum**
3. All sepals smooth
4. Mericarps reticulate or transversely wrinkled.
5. Leaves palmatifid; petals emarginate. **277. G. molle**
5. Leaves palmatisect; petals rounded (rarely retuse).
6. Petals (14.9)16.2-19.3(20.7) mm long; mericarps usually lacking fibers derived from the rostrum and attached near the apex; staminal filaments (8.7)9.6-11.3(12.8) mm long. **301. G. yeoi**
6. Petals 5.3-14.2 mm long; mericarps usually with fibers derived from the rostrum and attached near the apex; staminal filaments (3.7)5.2-7.3(8) mm long.
7. Petals (8.5)10.5-12.5(14.2) mm long, (2.1)2.6-4.5(6.1) mm wide; anthers purple; mericarps reticulate, with few thin ridges and scarcely anastomosing in the basal half but more abundant distally and forming 1-2(3) overlapping, collar-like keels at the apex. **300. G. robertianum**
7. Petals (5.3)6.3-8.4(9.9) mm long, (0.8)1.5-2(2.6) mm wide; anthers yellow; mericarps reticulate, with thick ridges dense throughout or sometimes thin and sparce in the basal half and forming 1-4 overlapping collars or contiguous circumferential ridges at apex. **299. G. purpureum**
4. Mericarps smooth.
8. Mericarps with a basal prong, without a basal callus. **258. G. dissectum**
8. Mericarps without a basal prong, usually with a basal callus.
9. Mericarps glabrous over most of the surface, densely ciliate at base, without a basal callus. **276. G. aequale**
9. Mericarps hairy over most of the surface, with a basal callus.
10. Cauline leaves uniformly opposite; rostrum of fruit with a narrowed apex 1.9-4.2 mm long. **87. G. rotundifolium**
10. Cauline leaves alternate in middle of shoot but becoming opposite toward the apex; rostrum of fruit with a narrowed apex 0.5-2 mm long. **120. G. carolinianum**

1. Perennial herbs or shrubs [Note: *G. yeoi*, a biennial, is included again here, because the life-form of robust specimens may be difficult to determine.]
11. Petioles with an abscission zone at base; stipules connate at the base, sheathing; small shrubs.

12. Corolla zygomorphic; petals reddish; sepals (10.5)11-12.1(13.5) mm long; rostrum of fruit with narrowed apex 12.8-16.1 mm long. **227. G. arboreum**
12. Corolla actinomorphic; petals white, sometimes with purplish veins; sepals 4.7-9(11.8) mm long; rostrum of fruit with a narrowed apex 0.4-2.9 mm long.
13. Leaves ovate to elliptic, rarely obovate, with (1)4-14 teeth on each side, usually serrate almost to base (but at least 1/3 from apex). **228. G. multiflorum**
13. Leaves obtriangular-cuneiform, rarely elliptic or obovate, with 3-7 teeth near the apex.
14. Leaves sericeous on both surfaces.
15. Leaves predominantly tridentate at apex. **229d. G. cuneatum** subsp. **tridens**
15. Leaves predominantly 5-7-toothed at apex.
16. Peduncles (11)17.7-20.6(25.9) mm long; ascending shrubs rooting at nodes. **230. G. hanaense**
16. Peduncles (3.3)4-7(9.4) mm long; erect shrubs not rooting at nodes. **229b. G. cuneatum** subsp. **hololeucum**
14. Leaves glabrous except for a line of silky appressed hairs on the nerves of both surfaces, or sericeous only on the abaxial surface.
17. Leaves usually glabrous except for a line of silky, appressed hairs on the nerves on both surfaces, rarely with sparse hairs between nerves. **229a. G. cuneatum** subsp. **cuneatum**
17. Leaves sericeous on abaxial surface.
18. Peduncles (14.1)21-28(33.4) mm long. **232. G. kauaiense**
18. Peduncles 3.1-11(13.3) mm long.
19. Erect shrubs, not rooting at nodes; inflorescence with cymules grouped in (3)7-15-flowered cymes at ends of brachyblasts; petals (7.7)9-10(11.7) mm long. **229c. G. cuneatum** subsp. **hypoleucum**
19. Ascending shrubs, often rooting at nodes; inflorescence with cymules grouped in 2-5-flowered cymes at ends of brachyblasts; petals (9.5)12-15.5(17.6) mm long. **231. G. hillebrandii**
11. Petioles without an abscission zone at base; stipules free or connate, sometimes overlapping but not sheathing; herbs.
20. Mericarps without a basal callus.
21. Leaves palmatifid; petals 7-11 mm long, emarginate. **279. G. pyrenaicum**
21. Leaves palmatisect; petals (14.9)16-20(22.5) mm long, rounded at the apex.
22. Leaves (16)20-30(45) cm long; petals (8.5)11.4-14.5(19.9) mm wide, with claw 0.8-3.1 mm long. **303. G. maderense**
22. Leaves (5)6.1-11.7(18.8) cm long; petals (4.6)6.5-8.3(9.4) mm wide, with claw 5.8-8.1 mm long. **301. G. yeoi**
20. Mericarps with a basal callus.
23. Cymules 2-flowered.
24. Stipules 2-4-fid, with linear and deep lobes. **233. G. incanum**
24. Stipules ovate to lanceolate, entire, sometimes with a very short bifid apex.
25. Petals patent to subreflexed; at dispersal, mericarp propelled with enclosed seed and attached awn (*Erodium*-type discharge). **1. G. phaeum**
25. Petals erect-patent; at dispersal, each single seed is launched from mericarp by the explosive recurvature of the awn (seed-ejection type discharge), while the awn and the mericarp wall remain attached to the columella.
26. Leaves palmatisect.
27. Rootstock short, vertical, ± cylindrical, not turnip-shaped; leaves with 3 segments. **70. G. tripartitum**
27. Rootstock turnip-shaped; leaves with 5 segments.
28. Hairs of pedicels retrorsely appressed. **105. G. retrorsum**
28. Hairs of pedicels patent to retrorse but not appressed. **102. G. solanderi**
26. Leaves palmatifid.
29. Hairs of staminal filaments 1.4-4.2 mm long; rostrum of fruit with a narrowed apex 5-11.4 mm long.
30. Hairs of stem and petioles retrorse-appressed, eglandular; leaves deeply divided [ratio main-sinus length/middle segment length = (0.80)0.82-0.91]. **31. G. erianthum**

30. Hairs of stem and petioles, patent, eglandular and usually glandular as well; leaves moderately divided [ratio main-sinus length/middle segment length = 0.63-0.71(0.81)]. **33. G. reinii**

29. Hairs of staminal filaments 0.1-0.8 mm long; rostrum of fruit with a narrowed apex 0.5-5.5 mm long or abruptly ending in the stigmatic remnants, without any narrowing of the apex.

31. Leaves with 3(5) segments. **69. G. wilfordii**

31. Leaves with 5(9) segments.

32. Petals (2.8)4-8(9.2) mm long; anthers 0.3-1.1 mm long.

33. Rootstock turnip-shaped.

34. Hairs of pedicels retrorsely appressed. **105. G. retrorsum**

34. Hairs of pedicels patent to retrorse but not appressed. **102. G. solanderi**

33. Rootstock more or less cylindrical, not turnip-shaped.

35. Sepals with glandular hairs; petals (6.8)7.3-8.3(9) mm long. **68. G. thunbergii**

35. Sepals without glandular hairs; petals (2.8)3.3-5.6(7.8) mm long.

36. Rostrum of fruit with a narrowed apex 0.9-2 mm long; sepals (4.1)4.4-5.5(5.8) mm long; petals (4.4)5-5.6(6.3) mm long. **66. G. nepalense**

36. Rostrum of fruit abruptly ending on the stigmatic remnants, without narrowed apex; sepals (2.8)3.5-4.2(5.7) mm long; petals (2.8)3.3-4.7(7.8) mm long. **75. G. homeanum**

32. Petals (9.7)11-18 (25.1) mm long; anthers 1.2-3.1 mm long.

37. Petals glabrous on both surfaces, ciliate on basal margin and sometimes with some hairs on base of adaxial surface.

38. Stipules connate, broadly ovate.

39. Petals rounded at the apex; staminal filaments white. **55. G. shikokianum**

39. Petals emarginate; staminal filaments black at least at tip. **40. G. wallichianum**

38. Stipules free, lanceolate.

40. Staminal filaments lanceolate with a broad triangular base and an abruptly narrowed apex; nectaries hairy. **35. G. pratense**

40. Staminal filaments lanceolate; nectaries glabrous.

41. Petals 11.3-13.2(14.6) mm long, rounded at the apex. **104. G. grande**

41. Petals (16.1)18.3-23.9(25.1) mm long, emarginate. **26. G. endressii**

37. Petals hairy on 1/4-1/2 of adaxial surface and on basal margin.

42. Petals (13.2)14-18(20) mm long.

43. Sepals with minute, antrorse, appressed hairs 0.2-0.3 mm long; stigmatic remnants (5)5.6-6.4(6.7) mm long; nectaries with a tuft of hairs at apex. **59. G. soboliferum**

43. Sepals with ± erect-patent hairs 0.3-1.7 mm long; stigmatic remnants (3.3)3.6-3.9(4.3) mm long; nectaries usually glabrous. **62. G. yesoense**

42. Petals (9.7)11-13.5(14.6) mm long.

44. Stigmatic remnants (3.6)3.8-4.3(4.6) mm long; sepals 6.2-7.4(7.8) mm long; leaves with the middle segment (7.1)8.1-11.4(15.5) mm wide at base. **61. G. yoshinoi**

44. Stigmatic remnants (4.5)5.6-6.2(6.6) mm long; sepals (6.2)7.4-9.1(10) mm long; leaves with the middle segment (4.3)5.4-8.5(8.8) mm wide at base. **58. G. krameri**

23. Cymules usually 1-flowered.

45. Herbs acaulescent.

46. Leaves with the middle segment elliptic to obovate, usually entire. **117. G. cruentum**

46. Leaves with the middle segment obtriangular, with 3-7 lobes in distal half.

47. Pedicels with antrorse hairs; leaves with the base cuneate to subtruncate (with basal leaf segments patent or oriented upward). **115. G. antrorsum**

47. Pedicels with patent to retrorse hairs; leaves with the base cordate (with basal leaf segments oriented downward). **116. G. brevicaule**

45. Herbs caulescent.

48. Petals emarginate; anthers (1.3)1.7-2.7(2.8) mm long. **89. G. sanguineum**
48. Petals rounded or slightly emarginate at the apex; anthers 0.5-1.6(2.1) mm long.
49. Petals (12.1)14.1-18.4(20.5) mm long; stipules connate, 2.9-6.6 mm wide, broadly ovate. **60. G. hayatanum**
49. Petals (2.2)5-12(15.9) mm long; stipules usually free, 0.2-2.6(4.3) mm wide, lanceolate or ovate.
50. Petals (5.2)7-12(15.9) mm long.
51. Stem erect, not rooting at nodes; leaves silky-hairy on both surfaces; petals with claw 1-2.6 mm long. **76. G. traversii**
51. Stem prostrate to ascending, usually rooting at nodes; leaves ± hairy on both surfaces; petals without claw.
52. Leaves (0.6)0.7-0.9(1.3) cm long. **98. G. papuanum**
52. Leaves (1.1)2.2-3.7(5.2) cm long.
53. Petals (9)10.8-13.6(15.6) mm long; peduncles (27)57-93(205) mm long. **77. G. neglectum**
53. Petals (5.2)7.2-8.4(12.7) mm long; peduncles (25)37-50(72) mm long. **71. G. suzukii**
50. Petals 2.2-6(8.1) mm long.
54. Leaves palmatisect.
55. Sepals with both eglandular and glandular hairs. **93. G. castroviejoi**
55. Sepals with only eglandular hairs.
56. Leaves with 7(9) segments, the pair of basal segments ± perpendicular to the plane formed by remaining segments; middle segment 9-12-lobed in distal half, 0.2-0.3 mm wide at base, with linear lobes. **91. G. leptodactylon**
56. Leaves (3)5 segments, all arranged in the same plane; middle segment 3-4(6)-lobed in distal half, (0.3)0.6-1.3 mm wide at base, with lanceolate lobes. **92. G. clemensiae**
54. Leaves palmatifid.
57. Leaves sericeous abaxially. **94. G. monticola**
57. Leaves ± densely hairy or strigose abaxially.
58. Hairs of sepals patent, glandular; stipules ovate. **95. G. wilhelminae**
58. Hairs of sepals eglandular, rarely with glandular hairs but then stipules lanceolate.
59. Leaves with the middle segment entire.
60. Peduncles 12.1-17.7 mm long; leaves sparsely strigose adaxially. **97. G. editum**
60. Peduncles 1.7-5.1 mm long; leaves glabrous adaxially. **96. G. hyperacrion**
59. Leaves with the middle segment 3-14-lobed in distal half.
61. Peduncles 1.5-5(9) mm long. **100. G. balgooyi**
61. Peduncles (1.5)6.5-35(83) mm long.
62. Rootstock turnip-shaped; sepals mucro 0.1-0.2(0.3) mm long. **103. G. obtusisepalum**
62. Rootstock not turnip-shaped; sepals mucro (0.2)0.5-1(1.6) mm long.
63. Leaves (0.6)1.2-3(3.8) cm long, with the middle segment 3-5(9)-lobed, obtriangular.
64. Sepals (5.4)6.6-7.4(7.9) mm long. **74. G. ardjunense**
64. Sepals (2.9) 3.6-5(6.2) mm long.
65. Leaves with the adaxial surface glabrous or with scattered long hairs; ratio main-sinus length/middle segment length = 0.62-0.70(0.76). **99. G. whartonianum**
65. Leaves with the adaxial surface pilose or strigose; ratio main-sinus length/middle segment length = (0.65)0.73-0.81(0.84).

66. Rostrum of fruit with a narrowed apex 0.7-0.9(1) mm long; sepals mucro (0.6)1-1.1 mm long. **72. G. frigidurbis**
66. Rostrum of fruit without a narrowed apex or with a narrowed apex 0.4-0.5(1) mm long; sepals mucro (0.3)0.5-0.7(1.2) mm long.
67. Leaves with the middle segment 3-5(9)-lobed; bracteoles (0.2)0.4-0.5(0.6) mm wide. **73. G. potentilloides**
67. Leaves with the middle segment 3-lobed; bracteoles (0.5)0.7-1(1.5)mm wide. **101. G. niuginiense**
63. Leaves (1.7)2.9-5.1(5.8) cm long, with the middle segment (6)9-14-lobed, rhombic.
68. Leaves with the middle segment narrowly rhombic; sepals mucro (0.9)1-1.5(1.6) mm long [ratio mucro length/sepal length = (0.18)0.23-0.28(0.35)]. **67. G. sibiricum**
68. Leaves with the middle segment broadly rhombic; sepals mucro (0.4)0.7-0.9(1) mm long [ratio mucro length/sepal length = (0.10)0.15-0.20(0.23)]. **66. G. nepalense**

KEY TO THE SPECIES OF GERANIUM IN EURASIA AND AFRICA

1. Stem and inflorescence armed with prickles. **4. G. aculeolatum**
1. Stem and inflorescence without prickles.
2. At dispersal, mericarp propelled with enclosed seed and attached awn (*Erodium*-type discharge).
3. Petals patent or reflexed, obtuse or mucronate at apex; inflorescence with glandular hairs; stems tall (20-80 cm), always erect.
4. Petals patent to subreflexed, 6-8(9) mm wide. **1. G. phaeum**
4. Petals reflexed, 3.5-6.5 mm wide.
5. Sepals mucro 0.3-0.5 mm long; mericarps 4.5-5 mm long; cauline leaves alternate. **2. G. reflexum**
5. Sepals mucro 4-5(7) mm long; mericarps 7-8.5 mm long; cauline leaves opposite. **3. G. aristatum**
3. Petals erect-patent, emarginate or obtuse at apex; inflorescence without glandular hairs; stems short, usually prostrate (except in *G. petri-davisii*).
6. Leaves with the middle segment entire or 2(3)-lobed.
7. Sepals 9-12 mm long, with ± patent hairs 0.7-1.7 mm long on the margins; petioles with patent hairs. **16. G. palmatipartitum**
7. Sepal 8-9(10) mm long, with appressed hairs 0.2-0.4 mm long only; petioles with appressed hairs. **13. G. thessalum**
6. Leaves with the middle segment 3-9-lobed.
8. Leaves with the middle segment 3-lobed, rarely some leaves with more.
9. Stems 30-50 cm, ± erect; lower cauline leaves alternate; terminal cymules 2-3, crowded and umbel-like. **15. G. petri-davisii**
9. Stems up to 35 cm, prostrate; cauline leaves, if present, all opposite; terminal cymules solitary.
10. Leaves palmatisect, sericeous on both surfaces. **10. G. argenteum**
10. Leaves palmatifid, ± pilose, sometimes sericeous below.
11. Petals with a very dark basal spot; staminal filaments and stigma very dark purple. **12. G. subcaulescens**
11. Petals without basal spot; staminal filaments usually white or ± yellow.
12. Herbs 1-5.5 cm high; peduncles 1-10 mm long, sometimes absent; leaves 0.8-1(2.6) cm long, 0.8-1(2.5) cm wide. **9. G. nanum**
12. Herbs (1)5-35 cm high; peduncles 20-120 mm long; leaves 0.9-3.4 cm long, 0.9-3.6 cm wide.
13. Expanded base of external staminal filaments with aurides. **8. G. cazorlense**
13. Expanded base of external staminal filaments without auricules.
14. Petioles with scattered retrorse hairs. **5. G. cinereum**

14. Petioles pilose, the hairs mostly patent.
15. Staminal filaments purple. **11. G. austroapenninum**
15. Staminal filaments yellow.
16. Sepals mucro 0.3-2 mm long; anthers very dark purple. **14. G. subacutum**
16. Sepals mucro (0)0.1-0.3 mm long; anthers dark yellow. **17. G. makmelicum**
8. Leaves with the middle segment usually 5-9-lobed.
17. Staminal filaments very dark purple; petals with a dark basal spot; leaves glabrous on the abaxial surface, except on veins. **18. G. ponticum**
17. Staminal filaments yellow or deep purple; petals without a basal spot; leaves pilose to sericeous.
18. Leaves pilose on both surfaces.
19. Staminal filaments yellow. **7. G. dolomiticum**
19. Staminal filaments purple. **11. G. austroapenninum**
18. Leaves pilose on the adaxial surface and sericeous on the abaxial surface, the abaxial surface paler.
20. Sepals 7-8 mm long; petals 12-15 mm long, slightly emarginate; mericarps with a long basal beak, 0.7-0.8 mm long. **19. G. lazicum**
20. Sepals 8-11.5 mm long; petals 15-18 mm long, emarginate; mericarps with a short basal beak, 0.2-0.6 mm long. **6. G. subargenteum**
2. At dispersal, seed ejected from mericarp (seed-ejection type) or the mericarp, containing the seed, ejected from the plant (carpel-projection type).
21. At dispersal, the whole mericarp, containing the seed, is ejected by the propelling force of the explosive recurvature of the awn, while the awn remains attached to the columella (carpel-projection type) [Note: in *G. albanum* and *G. divaricatum* the rostrum of fruit is not well developed (0.4-0.6 mm wide at the base), and thus the mericarp including the seed is shortly ejected].
22. Leaves palmatisect.
23. Annuals or biennials.
24. Petals (14.9)16.2-19.3(20.7) mm long; mericarps usually lacking fibers derived from the rostrum and attached near the apex; staminal filaments (8.7)9.6-11.3(12.8) mm long. **301. G. yeoi**
24. Petals 5.3-14.2 mm long; mericarps usually with fibers derived from the rostrum and attached near the apex; staminal filaments (3.7)5.2-7.3(8) mm long.
25. Petals (8.5)10.5-12.5(14.2) mm long, (2.1)2.6-4.5(6.1) mm wide; anthers purple; mericarps reticulate, with few thin ridges and scarcely anastomosing in the basal half but more abundant distally and forming 1-2(3) overlapping, collar-like keels at the apex. **300. G. robertianum**
25. Petals (5.3)6.3-8.4(9.9) mm long, (0.8)1.5-2(2.6) mm wide; anthers yellow; mericarps reticulate, with thick ridges dense throughout or sometimes thin and sparce in the basal half and forming 1-4 overlapping collars or contiguous circumferential ridges at apex. **299. G. purpureum**
23. Perennials.
26. Leaves with the middle segment 12-31-lobed in distal half; fruits (14.3)15-17(20.3) mm long; sepals (4.8)5.3-6.2(6.3) mm long. **302. G. cataractarum**
26. Leaves with the middle segment (33)100-260(460)-lobed in distal half; fruits (26)29-38(41) mm long; sepals (5.1)6-8.8(10.5) mm long.
27. Rostrum of fruit hairy on the narrowed apex, with eglandular hairs only; petals (2.8)5.4-5.9(6.4) mm wide. **305. G. reuteri**
27. Rostrum of fruit hairy on the narrowed apex, with eglandular and glandular hairs; petals (8.5)10-14(19.9) mm wide.
28. Staminal filaments (12.7)15.4-16.6(19) mm long, much longer than the sepals; rostrum of fruit with a narrowed apex (10.4)12.1-14.6(16) mm long. **304. G. palmatum**
28. Staminal filaments (5.5)7.8-9(10.3) mm long, not or shortly exserted; rostrum of fruit with a narrowed apex (6.2)7-7.8(9.4) mm long. **303. G. maderense**
22. Leaves palmatifid.

29. Rostrum of fruit very thin (0.4-0.6 mm wide at the base), not developed and thus the discharge mechanism inoperative.
    30. Perennials; petals 12-14 mm long; mericarps with a longitudinal crest. **280. G. albanum**
    30. Annuals; petals 4-6.5 mm long; mericarps without a longitudinal crest. **281. G. divaricatum**
29. Rostrum of fruit well developed and thus the discharge mechanism operative.
    31. Annuals; petals (1.6)2-9.7(11.7) mm long.
        32. The three outer sepals with lengthwise keels and transverse flaps between these, the two inner ± smooth. **298. G. lucidum**
        32. Sepals all smooth.
            33. Fertile stamens 5 (external whorl lacking anthers). **278. G. pusillum**
            33. Fertile stamens 10.
                34. Petals emarginate; rostrum of fruit not twisted.
                35. Mericarps transversely wrinkled. **277. G. molle**
                35. Mericarps smooth. **276. G. aequale**
                34. Petals with rounded apex; rostrum of fruit twisted distally.
                36. Mericarps with two longitudinal toothed wings bent dorsally to form a trough-like structure.
                37. Mericarps with two horns at apex. **284. G. biuncinatum**
                37. Mericarps without horns.
                38. Petals (8.8)9-9.8(11.2) mm long; mericarps with an evident ridge in the middle, protruding beyond the trough-like structure. **282. G. trilophum**
                38. Petals (4.8)6.1-8.1(8.7) mm long; mericarps with a small ridge in the middle, not protruding beyond the trough-like structure. **283. G. yemense**
                36. Mericarps without wings.
                39. Mericarps transversely wrinkled with slightly prominent ribs.
                40. Ribs of mericarps 8-14, 0.2-0.3 mm apart, glabrous. **287. G. ocellatum**
                40. Ribs of mericarps 4-6, 0.3-0.4 mm apart, with appressed, eglandular hairs 0.1 mm long, mainly on the ribs. **288. G. brevipes**
                39. Mericarps transversely wrinkled with prominent ribs.
                41. Leaves deeply palmatifid [ratio main-sinus length/middle segment length = (0.80)0.86-0.89(0.90)]; petals without a basal spot. **285. G. favosum**
                41. Leaves palmatifid [ratio main-sinus length/middle segment length = (0.63)0.66-0.74(0.81)]; petals usually with a dark basal spot. **286. G. mascatense**
    31. Perennials; petals (8.6)13-15(18.8) mm long.
        42. Flowers zygomorphic.
            43. Basal leaves (4.4)5.2-8.7(10.8) cm long, with the middle segment (8)10-34-lobed in distal half; sepals mucro (1.4)2-3.2(4.2) mm long. **306. G. macrorrhizum**
            43. Basal leaves (2)2.1-3.2(3.6) cm long, with the middle segment 3-5(6)-lobed in distal half; sepals mucro (0.9)1.1-1.6(1.7) mm long. **307. G. dalmaticum**
        42. Flowers actinomorphic.
            44. Sepal with longitudinal ribs; petal claw bicarinate.
                45. Stem glabrous. **296. G. glaberrimum**
                45. Stem densely hairy. **297. G. lasiopus**
            44. Sepal smooth; petals without claw.
                46. Petals emarginate; mericarps smooth. **279. G. pyrenaicum**
                46. Petals rounded or slightly emarginate; mericarps reticulate.
                47. Cymules in umbel-like aggregates at the top of each branch.
                48. Cymules 2(3)-flowered, in dense umbel-like aggregates at apex of each branch, usually without pedicels; rostrum of fruit without narrowed apex (sometimes up to 0.8 mm); petals (7.8)9.3-11.8(14.1) mm long. **292. G. polyanthes**
                48. Cymules (2)3-flowered, in loose umbel-like aggregates at apex of each branch with well developed peduncles and pedicels; rostrum of fruit with a narrowed apex 2-2.1 mm; petals (13.1)13.8-15.2(16.8) mm long. **294. G. umbelliforme**

47. Cymules solitary.
49. Cymules 1(2)-flowered; stem glabrous. **291. G. nakaoanum**
49. Cymules 2-flowered; stem ± hairy.
50. Basal cauline leaves alternate. **290. G. moupinense**
50. Basal cauline leaves opposite.
51. Leaves deeply divided [ratio main-sinus length/middle segment length = (0.70)0.80-0.86(0.89)]. **293. G. strictipes**
51. Leaves moderately divided [ratio main-sinus length/middle segment length = (0.55)0.68-0.77(0.81)].
52. Petals (8.6)9-9.8(10.6) mm long; nectaries hairy at the top; sepals mucro 0.8-2.4 mm long; leaves with the middle segment 9-16-lobed. **289. G. hispidissimum**
52. Petals 12.6-13.4 mm long; nectaries glabrous; sepals mucro 1.1-1.2 mm long; leaves with the middle segment 7-8-lobed. **295. G. wardii**

21. At dispersal, each single seed is launched from mericarp by the explosive recurvature of the awn, while the awn and the mericarp wall remain attached to the columella (seed-ejection type).
53. Mericarps without basal callus.
54. Mericarps not compressed at the apex and with a basal prong; rostrum of fruit not twisted.
55. Annuals; leaves deeply palmatifid [ratio main-sinus length/middle segment length = 0.78-0.88(0.94)]; petals 2.9-5.8 mm long. **258. G. dissectum**
55. Perennials; leaves palmatifid (ratio main-sinus length/middle segment length = 0.52-0.74); petals 8.5-16.5 mm long.
56. Rootstock ± vertical, slender, ± turnip shaped, without thickened roots; petals 3.5-4.8 mm wide; pedicels with glandular hairs 1-1.7 mm long. **257. G. sintenisii**
56. Rootstock oblique, bearing thickened roots; petals (5.8)6-9.4 mm wide; pedicels with or without glandular hairs.
57. Stem with retrorse, eglandular hairs, without glandular hairs, or also with short glandular hairs 0.2-1 mm long. **255. G. asphodeloides**
57. Stem with glandular hairs 0.6-2.1 mm long. **256. G. crenophilum**
54. Mericarps longitudinally compressed at the apex and without basal prong; rostrum of fruit twisted.
58. Rootstock not tuberose; leaves palmatifid.
59. Annuals.
60. Seeds brown, mottled; cotyledons with a notch on each side; petals with ciliae at the apex; nectaries with a tuft of hairs at the top. **266. G. bohemicum**
60. Seeds uniformly brownish red; cotyledons entire; petals glabrous at the apex; nectaries glabrous. **267. G. lanuginosum**
59. Perennials.
61. Leaves reticulate. **269. G. renardii**
61. Leaves without reticulate nervation.
62. Pedicels bearing only eglandular hairs.
63. Leaves deeply palmatifid [ratio main-sinus length/middle segment length = 0.71-0.84(0.9)]; stems and petioles glabrous or with sparse eglandular hairs. **275. G. kurdicum**
63. Leaves moderately palmatifid [ratio main-sinus length/middle segment length = (0.49)0.55-0.65(0.76)]; stem and petioles usually hairy.
64. Peduncles with uncinate eglandular hairs 0.1-0.3 mm long, without long patent hairs. **274. G. gymnocaulon**
64. Peduncles with uncinate eglandular hairs 0.1-0.3 mm long and patent eglandular hairs 0.4-3.3 mm long.
65. Peduncles with patent, eglandular hairs 0.4-0.7(0.8) mm long; petals (10.4)12.9-16.9(18.3) mm long; leaves with the middle segment (8)9-13(16)-lobed. **273. G. libani**

65. Peduncles with patent, eglandular hairs (1)2.1-2.5(3.3) mm long; petals (15.4)19.5-24.9(28.4) mm long; leaves with the middle segment (14)16-24(39)-lobed. **270. G. ibericum**

62. Pedicels bearing glandular and eglandular hairs.

66. Leaves with short secondary lobes (ratio secondary sinus length/ middle segment length = 0.04-0.09); petals 5.4-10.6 mm width. **268. G. gracile**

66. Leaves with deeper secondary lobes (ratio secondary sinus length/ middle segment length = 0.15-0.35); petals 9.5-22.5 mm width.

67. Peduncles with patent eglandular hairs 0.6-1(1.2) mm long; petals hairy on the base of abaxial surface, glabrous on the adaxial surface, ciliate on the basal margin. **272. G. peloponnesiacum**

67. Peduncles with patent eglandular hairs (1)2.3-3.1(4.8) mm long; petals glabrous on both surfaces, ciliate on the basal margin.

68. Leaves with the middle segment rhombic [ratio maximum width/middle segment length = (0.58)0.61-0.68(0.74)]; bracteoles (3.2)5.2-6.4(8.2) mm length. **270. G. ibericum**

68. Leaves with the middle ± obtriangular [ratio maximum width/middle segment length = (0.75)0.76-0.79(0.84)]; bracteoles (8.4)9.6-14.1(18.8) mm length. **271. G. platypetalum**

58. Rootstock tuberose; leaves ± palmatisect.

69. Rootstock vertical of closely superimposed tubercles; basal leaves always absent at flowering time.

70. Leaves with 9-13 segments, in more than 1 plane; middle segment with 6-12 lobes; pedicels usually with glandular hairs. **259a. G. kotschyi** subsp. **kotschyi**

70. Leaves with 5-7(9) segments, in 1 plane; middle segment with (1)3-7 lobes; pedicels usually without glandular hairs. **259b. G. kotschyi** subsp. **charlesii**

69. Rootstock horizontal of usually ± distant tubercles; basal leaves usually present at flowering time.

71. Pedicels with glandular hairs.

72. Stem with an opposite pair of cauline leaves below the first bifurcation. **262. G. macrostylum**

72. Stem with 1-2(3) alternate cauline leaves below the first bifurcation. **264. G. tuberaria**

71. Pedicels without glandular hairs.

73. Sepals (6.7)7.5-9.1 mm long; petals (10.3)16.5-19.3(21) mm long; tubercles fusiform (ratio tubercle width/tubercle length = 0.3-0.5). **263. G. malviflorum**

73. Sepals 4.2-6.5(7.3) mm long; petals 6.9-14(17.1) mm long; tubercles subglobose (ratio tubercle width/tubercle length = (0.5)0.7-1.3).

74. Stem with 1(2) alternate cauline leaves below the first bifurcation. **261. G. linearilobum**

74. Stem naked or with an opposite pair of leaves below the first bifurcation.

75. Stem below the first bifurcation naked. **265. G. tuberosum**

75. Stem bearing a pair of opposite cauline leaves below the first bifurcation.

76. Rostrum of fruit with a narrowed apex (2.1)2.4-3.2 mm long; non-tuberous separations between tubercles (1.7)2.2-5.2 mm wide. **260. G. libanoticum**

76. Rostrum of fruit with a narrowed apex 0.2-0.5(2.1) mm long; non-tuberous separations between tubercles 0.6-2.2(2.7) mm wide. **265. G. tuberosum**

53. Mericarps with basal callus.

77. Stipules entire, sometimes with a very short bifid apex.

78. Annuals.

79. Leaves palmatisect or deeply palmatifid; pedicels with only eglandular hairs.

80. Peduncles and pedicels with retrorse eglandular hairs; rostrum of fruit 15-19 mm long, with a 4-6.8 mm long narrowed apex. **63. G. columbinum**

80. Peduncles and pedicels with antrorse eglandular hairs; rostrum of fruit 9-12 mm long, with a 1-2.1 mm long narrowed apex. **64. G. schrenkianum**

79. Leaves palmatifid; pedicels usually with eglandular and glandular hairs.
  81. Rostrum of fruit with a very short narrowed apex 0.5-2 mm long.
    82. Pedicels with patent, sometimes retrorse (not appressed) eglandular hairs and patent, glandular hairs; mericarps densely hairy, the hairs 0.5-1.9 mm long. **120. G. carolinianum**
    82. Pedicels with retrorse, appressed, eglandular hairs; mericarps sparsely hairy, the hairs 0.2-0.7 mm long. **122. G. texanum**
  81. Rostrum of fruit with an evident narrowed apex, 1.9-5.6 mm long.
    83. Leaves polygonal in outline, deeply divided (ratio main-sinus length/ middle segment length = 0.82-0.95); petals emarginate; mericarps blackish. **121. G. bicknellii**
    83. Leaves orbicular in outline, moderately divided (ratio main-sinus length/middle segment length = 0.51-0.65); petals rounded at apex; mericarps brownish. **87. G. rotundifolium**
78. Perennials.
  84. Cymules usually with l flower.
    85. Petals (12.3)13-17(21.8) mm long.
      86. Stipules free or connate at the base; anthers (1.3)1.7-2.7(2.8) mm long; petals emarginate. **89. G. sanguineum**
      86. Stipules connate; anthers 1-1.2(1.3) mm long; petals rounded. **81. G. andringitrense**
    85. Petals (3.9)4-9(12.4) mm long.
      87. Stipules connate.
        88. Leaves orbicular in outline, with the middle segment obtriangular, 3-5(7)-lobed in distal half. **83. G. kilimandscharicum**
        88. Leaves polygonal in outline, with the middle segment rhombic, (7)11-15(19)-lobed in distal half. **82. G. arabicum**
      87. Stipules free.
        89. Leaves with the middle segment narrowly rhombic; sepals mucro (0.9)1-1.5(1.6) mm long [ratio mucro length/sepal length = (0.18)0.23-0.28(0.35)]. **67. G. sibiricum**
        89. Leaves with the middle segment broadly rhombic; sepals mucro (0.4)0.7-0.9(1) mm long [ratio mucro length/sepal length = (0.10)0.15-0.20(0.23)]. **66. G. nepalense**
  84. Cymules usually with 2 flowers.
    90. Petals reflexed.
      91. Nectary forming a ring around flower; petals sparsely hairy on the basal margin. **45. G. sinense**
      91. Nectaries 5, hemispheric, separate; petals with a dense tuft of hairs on the basal margin.
        92. Pedicels with dense and purple glandular hairs. **43. G. refractum**
        92. Pedicels with glandular hairs colourless, dense to sparse, or absent.
          93. Petals with hairs only on basal margin. **44. G. shensianum**
          93. Petals with hairs on basal margin and inside base.
            94. Staminal filaments almost glabrous or with a few 0.3-0.8(1.1) mm hairs; petals (6.1)8-11(12.3) mm, blackish red to pink with an evident whitish basal zone. **41. G. delavayi**
            94. Staminal filaments base with numerous 1-1.8 mm hairs; petals (9.5)11.7-13.9(16.7) mm, white to pink or purple without a whitish basal zone. **42. G. pogonanthum**
    90. Petals erect-patent.
      95. Rootstock tuberose with subglobose tubercles connected by thin non-tuberous separations; cauline leaves alternate.
        96. Petals 8.4-11.9 mm long; sepals 5.3-6.3 mm long. **47. G. canopurpureum**
        96. Petals (15.5)15.8-17.2(18.2) mm long; sepals (6.9)7.8-9.6(11.1) mm long. **51. G. pylzowianum**
      95. Rootstock without tubercles; cauline leaves opposite or alternate.

97. Cauline leaves alternate (upper usually opposite).
98. Staminal filaments with hairs 1.5-3.2 mm long; rostrum of fruit with a narrowed apex more than 4.8-9.8 mm long.
99. Stem and petioles with retrorse appressed hairs; leaves deeply divided [ratio main-sinus length/middle segment length = (0.80)0.82-0.91]. **31. G. erianthum**
99. Stem and petioles with patent hairs; leaves moderately divided [ratio main-sinus length/middle segment length = 0.60-0.75(0.78)]. **32. G. platyanthum**
98. Staminal filaments with hairs 0.2-0.7(2.5) mm long; rostrum of fruit with a narrowed apex 0.5-5(8.5) mm long.
100. Leaves with 3(5) segments; petals 4-6.2(9.2) mm long. **69. G. wilfordii**
100. Leaves with 5(7) segments; petals (7.2)10-23(27) mm long.
101. Leaves moderately divided [ratio main-sinus length/middle segment length = (0.62)0.79-0.86(0.89)]; glandular hairs on peduncles and pedicels usually present.
102. Petals hairy on 1/4-1/2 of their adaxial and abaxial surfaces, ciliate on the basal margin; glandular hairs on peduncles and pedicels absent. **84. G. franchetii**
102. Petals hairy on the base of the adaxial surface, glabrous on the abaxial surface, ciliate on the basal margin; glandular hairs on peduncles and pedicels usually present.
103. Stigma dark purple; nectaries with a tuft of hairs at the apex. **88. G. rubifolium**
103. Stigma pale pink to purple; nectaries glabrous.
104. Stigmatic remnants with hairy lobes; petals (16.1)18.3-23.9(25.1) mm long; cymules solitary. **26. G. endressii**
104. Stigmatic remnants glabrous; petals (8.1)10-17(19.3) mm long; cymules solitary or in aggregates at the top of each branch.
105. Petals (8.1)10.2-12.7(13.2) mm long, (3.7)4.4-5.8(7.5) mm wide, usually white and emarginated; sepals (4)4.7-6(7.1) mm long. **23. G. albiflorum**
105. Petals (12.2)13-17.6(19.3) mm long, (6.3)7-10.8(12.6) mm wide, usually purple and rounded; sepals (6.7)7.2-8.6(9.6) mm long. **30. G. sylvaticum**
101. Leaves deeply divided [ratio main-sinus length/middle segment length = (0.73)0.89-0.93(0.97)]; glandular hairs on peduncles and pedicels usually absent.
106. Sepals (4)4.9-5.6(6.8) mm long; sepals mucro (0.4)0.7-1.1(1.6) mm long. **27. G. pseudosibiricum**
106. Sepals (5.4)6.5-9(10.9) mm long; sepals mucro (0.7)1-2(2.6) mm long.
107. Petals (7.2)9.9-11.5(15.8) mm long, white; anthers (1.2)1.4-1.6(1.7) mm long. **28. G. rivulare**
107. Petals (11.7)13-20(21.1) mm long, purple; anthers (1.6)1.7-1.8(2.5) mm long.
108. Nectaries with a tuft of hairs at the top; rootstock with napiform roots; leaves with the middle segment (25)38-73(96)-lobed in distal half. **24. G. atlanticum**
108. Nectaries glabrous; rootstock with thickened roots; leaves with the middle segment (6)9-18(34) l obed in distal half.
109. Petals apices rounded; sepals (5.9)6.5-7.7(8.3) mm long. **25. G. caeruleatum**

109. Petal apices emarginate; sepals (8)8.1-9.6(9.8) mm long. **29. G. schmidii**

97. Cauline leaves opposite.

110. Petals 3.1-8(12.4) mm long; anthers 0.3-1.2 mm long.

111. Stipules broadly ovate, connate for most of their length. **82. G. arabicum**

111. Stipules lanceolate, free.

112. Sepals with glandular hairs; petals (6.8)7.3-8.3(9) mm long. **68. G. thunbergii**

112. Sepals without glandular hairs; petals (3.1)4.1-6(7.1) mm long.

113. Sepals not accrescent; pedicels with patent to retrorse eglandular hairs. **66. G. nepalense**

113. Sepals accrescent; pedicels with retrorse, appressed eglandular hairs. **111. G. core-core**

110. Petals (7.9)10-20(27.7) mm long; anthers (0.9)1.4-3.1 mm long.

114. Staminal filaments with a broad triangular base and an abruptly narrowed apex.

115. Immature fruits erect. **34. G. collinum**

115. Immature fruits reflexed.

116. Leaves (4.2)7-10.6(16.5) cm long, deeply divided [ratio main-sinus length/middle segment length = (0.81)0.87-0.91(0.94)]; sepals mucro (1.7)2.3-3.1(4.3) mm long. **35. G. pratense**

116. Leaves (1.4)3-4.4(6.2) cm long, moderately divided [ratio main-sinus length/middle segment length = (0.63)0.76-0.83(0.89); sepals mucro (0.6)0.9-1.6(2.5) mm long. **36. G. saxatile**

114. Staminal filaments lanceolate or sometime with a slightly dilated at base.

117. Petals with a black basal spot.

118. Petals (11.8)13.1-15.1(19.7) mm long; stipules broadly lanceolate, some free and some partially connate. **39. G. procurrens**

118. Petals (14.9)17-20.1(20.7) mm long; stipules lanceolate, all free. **85. G. psilostemon**

117. Petals without a black basal spot.

119. Staminal filaments black.

120. Stipules broadly ovate, connate for most of their length. **40. G. wallichianum**

120. Stipules lanceolate, free.

121. Petals 12.3-13.6(16) mm long; staminal filaments with 0.2-0.8 mm hairs long. **37. G. christensenianum**

121. Petals (20.4)21.9-24.3(25.4) mm long; staminal filaments covered densely with hairs 1.1-2.2 mm long. **38. G. lambertii**

119. Staminal filaments white to purple.

122. Stipules broadly ovate, connate for most of their length.

123. Leaves deeply divided [ratio main-sinus length/middle segment length = (0.74)0.79-0.84(0.87)]. **55. G. shikokianum**

123. Leaves shallowy divided [ratio main-sinus length/middle segment length = (0.65)0.72-0.79(0.80)]. **52. G. koreanum**

122. Stipules lanceolate or broadly lanceolate, free or sometimes connate for part of their length.

124. Dwarf alpine herbs 4-20(35) cm tall; stipules free.

125. Rootstock with several napiform roots clustered round it; leaves with glandular hairs abaxially. **50. G. napuligerum**

125. Rootstock without napiform roots clustered round it; leaves without glandular hairs.

126. Petals very pale pink, claw 2.3-6.1 mm long, apex rounded. **49. G. farreri**
126. Petals deep purple, without a claw, apex usually emarginate. **48. G. donianum**
124. Herbs (12)50-129 cm tall; stipules connate or free.
127. Petal apices emarginate.
128. Petals (8.3)8.4-9.7(12.2) mm long. **65. G. arnottianum**
128. Petals (11.1)13-25.1 mm long.
129. Leaves with the middle segment (25)38-73(96)-lobed in distal half; rootstock with napiform roots. **24. G. atlanticum**
129. Leaves with the middle segment (9)11-25(41)-lobed in distal half; rootstock without thickened roots.
130. Leaves with an ovate middle segment; ratio secondary sinus length/middle segment length = (0.05)0.06-0.11(0.17).
131. Pedicels with patent, eglandular hairs 0.4-1 mm long, and patent, glandular hairs 0.1 mm long. **80. G. versicolor**
131. Pedicels with retrorse, appressed or hook-shaped, eglandular hairs 0.1-0.3 mm long. **78. G. nodosum**
130. Leaves with a rhombic middle segment; ratio secondary sinus length/middle segment length = (0.14)0.17-0.26(0.27).
132. Petals (16.1)18.3-23.9(25.1) mm long; stigmatic remnants hairy. **26. G. endressii**
132. Petals (13.4)13.8-15.7(17.5) mm long; stigmatic remnants glabrous. **79. G. rectum**
127. Petals apices rounded.
133. Rootstock horizontal or vertical, long, with thickened roots along it or with thin roots.
134. Pedicels with patent, glandular hairs 1.3-3 mm long. **90. G. swatense**
134. Pedicels without glandular hairs.
135. Petals (10.1)11.7-13.4(15.7) mm, hairy on 1/3-1/2 of the adaxial surface. **86. G. rosthornii**
135. Petals (12.9)15.9-18.7(20.6) mm, with hairs only at base.
136. Nectaries with a tuft of hairs at the top, dorsally glabrous; anthers blue black; fruits reflexed when immature. **46. G. yunnanense**
136. Nectaries glabrous; anthers blue or cream; fruits erect. **54. G. palustre**
133. Rootstock vertical, short, with a fascicle of long and thickened roots.
137. Leaves deeply divided [ratio main-sinus length/middle segment length = (0.82)0.86-0.96].
138. Petals (13.4)14.2-18(20) mm long. **59. G. soboliferum**
138. Petals (7.9)9-13(14.6) mm long.

139. Stigmatic remnants (4.5)5.6-6.2(6.6) mm long; nectaries apically with a tuft of hairs; sepals (6.2)7.4-9.1(10) mm long; leaves with the middle segment (4.3)5.4-8.5(8.8) mm wide at base. **58. G. krameri**

139. Stigmatic remnants 2.8-4.5 mm long; nectaries usually glabrous; sepals (5.4)5.8-7.1(9) mm long; leaves with the middle segment (1.6)2.9-4.8(5.7) mm wide at base. **57. G. dahuricum**

137. Leaves moderately divided [ratio main-sinus length/middle segment length = (0.59)0.70-0.81(0.84)].

140. Sepals (5.6)6.6-7.8(8) mm long; petals (9.1)11.4-14.1(15.2) mm long; leaves with the lateral lobes of the middle segment shallowly divided [ratio secondary sinus length/middle segment length = (0.11)0.15-0.18(0.25)]; nectaries glabrous. **53. G. maximowiczii**

140. Sepals (7.9)8.9-10.3(11.2) mm long; petals (15.5)16.1-19.5(23) mm long; leaves with the lateral lobes of the middle segment more divided [ratio secondary sinus length/middle segment length = (0.14)0.21-0.26(0.29)]; nectaries apically with a tuft of hairs. **56. G. wlassovianum**

77. Stipules (2)3-5(11)-fid, with linear to lanceolate and deep lobes.

141. Leaves peltate. **244. G. ornithopodioides**

141. Leaves not peltate.

142. Leaves palmatisect, with lobes narrow (0.3)0.5-2(3.4) mm wide, usually linear.

143. Leaves hairy mainly on the nerves of the abaxial surface, not sericeous. **235. G. vagans**

143. Leaves sericeous on the abaxial surface (but see comments under *G. multisectum*).

144. Leaves with the lateral lobes of the middle segment pinnate, ± perpendicular to the plane formed by the segments, which gives the leaf a much entangled appearance when it dries; sepals mucro (0.2)0.4-0.6(0.9) mm long. **234. G. multisectum**

144. Leaves with the lateral lobes of the middle segment entire, lobed or pinnate, all in the same plane; sepals mucro (0.4)0.7-1.3(1.6) mm long. **233. G. incanum**

142. Leaves palmatifid or palmatisect but with wider and not linear lobes.

145. Leaves sericeous on the abaxial surface.

146. Leaves palmatisect. **238. G. robustum**

146. Leaves palmatifid or deeply palmatifid.

147. Leaves densely covered with greyish-white, eglandular hairs or sericeous on the adaxial surface.

148. Pedicels with only eglandular hairs; sepals (5.1)5.3-6(6.4) mm long. **240. G. harveyi**

148. Pedicels with glandular and eglandular hairs; sepals (6.5)6.9-7.6(10) mm long. **241. G. canescens**

147. Leaves with ± appressed, eglandular hairs on the adaxial surface.

149. Leaves slightly divided [ratio main-sinus length/middle segment length = (0.54)0.62-0.68(0.76)]. **239. G. discolor**

149. Leaves moderately divided [ratio main-sinus length/middle segment length = (0.73)0.82-0.94(0.97)].

150. Shrubby.
151. Petioles with retrorse, appressed hairs; sericeous indumentum of the abaxial surface of the leaves covering the nerves. **236. G. pulchrum**
151. Petioles with patent to retrorse, not appressed hairs; leaves abaxially covered by closely matted-white, eglandular hairs between the nerves and long coarse spreading eglandular hairs over the veins. **237. G. brycei**
150. Perennial herbs.
152. Petals (6.7)8.1-11.9(12.8) mm wide; sepals (6.1)7.3-7.9(8.8) mm long, with glandular hairs 0.3-0.9 mm long. **242. G. drakensbergense**
152. Petals 4.6-6.4 mm wide; sepals 6-6.5 mm long, with glandular hairs 0.6-1.5 mm long. **243. G. angustipetalum**
145. Leaves ± hairy but not sericeous on the abaxial surface.
153. Petals narrow [(2.4)3.7-4.3(5) wide] and deeply emarginate. **251. G. wakkerstroomianum**
153. Petals (2.8)4-11(16.6) mm wide, rounded or ± emarginate.
154. Sepals mucro (1.7)2.4-3.2(3.6) mm long. **246. G. amatolicum**
154. Sepals mucro (0.3)0.8-1.4(1.9) mm long.
155. Stipules 2-3-fid, with lanceolate lobes 1.4-2.2 mm wide. **247. G. grandistipulatum**
155. Stipules (2)3-6-fid, with linear lobes 0.2-0.8(1.3) mm wide.
156. Leaves slightly divided [ratio main-sinus length/middle segment length = (0.28)0.32-0.43(0.47)]. **245. G. baurianum**
156. Leaves moderately divided [ratio main-sinus length/middle segment length = (0.71)0.74-0.83(0.99)].
157. Leaves hairy all over of the abaxial surface, moderately divided [ratio main-sinus length/middle segment length = (0.71)0.74-0.83(0.86)].
158. Sepals (7.3)7.6-8.4(8.7) mm long; petals (12.6)13.2-15.8(18.2) mm long. **249. G. contortum**
158. Sepals (4.5)5.5-6.2(7.7) mm long; petals 6.6-15.3 mm long.
159. Leaves with glandular and eglandular hairs on the abaxial surface. **248. G. schlechteri**
159. Leaves with only eglandular hairs on the abaxial surface. **250. G. ornithopodon**
157. Leaves hairy mainly on the nerves of the abaxial surface, deeply palmatifid to palmatisect [ratio main-sinus length/middle segment length = (0.80)0.82-0.98(0.99)].
160. Leaves with the middle segment (0.5)0.9-2(3.5) mm wide at the base, deeply palmatifid to palmatisect [ratio main-sinus length/middle segment length = (0.90)0.94-0.98(0.99)]. **252. G. caffrum**
160. Leaves with the middle segment (2.1)3-8.1 mm wide at the base, deeply palmatifid [ratio main-sinus length/middle segment length = (0.80)0.82-0.95(0.96)].
161. Petioles with with retrorse, appressed, eglandular hairs 0.3-0.5 mm long; peduncles with glandular hairs 0.1-0.6 mm long. **253. G. subglabrum**
161. Petioles with patent, eglandular hairs 0.2-0.6 mm long and patent, glandular hairs 0.6-1.3 mm long; peduncles with glandular hairs 0.6-1.6 mm long. **254. G. sparsiflorum**

I. Geranium subg. **Erodioidea** (Picard) Yeo, Bot. J. Linn. Soc. 89: 10. 1984. Type: *G. reflexum* L. (designated by Yeo 1984: 10).

Fruit of *Erodium*-type discharge. At dispersal, mericarp propelled with enclosed seed and attached awn.

Ia. Geranium sect. **Erodioidea** Picard, Mém, Soc. Agric. Boulogne-sur-Mer 2(1): 114. 1837, ["Erodioideae"]. Type: *G. reflexum* L. (designated by Yeo 1984).

Geranium sect. *Alternifolia* Paol. in Fiori & Paol., Fl. Italia 2: 233, 235. 1901. Type: *Geranium phaeum* L. (here designated). *Geranium* sect. *Reflexa* R. Knuth in Engl., Pflanzenr. IV.129 (Heft 53): 45, 130. 1912. Type: *G. phaeum* L. (designated by Knuth 1912: 45).

Stem erect, leafy, without prickles. *Cymules* 2-flowered. *Petals* patent or reflexed. *Cotyledons* usually with entire margins.

1. Geranium phaeum L., Sp. Pl.: 681. 1753. *Geranium montanum* Bubani, Fl. Pyren. 3: 307. 1901, nom. illeg. Type locality: "Habitat in Alpibus Pannonicis, Helveticis, Styriacis". Type: "Habitat in Alpibus Pannonicis, Helveticis, Styriacis" (lectotype, designated by Aedo 1996: 72, LINN-858.57 image!).

Geranium fuscum L., Mant. Pl.: 97. 1767. *Geranium phaeum* var. *fuscum* (L.) DC., Prodr. 1: 641. 1824. *Geranium phaeum* subvar. *fuscum* (L.) Rouy in Rouy & Foucaud, Fl. France 4: 82. 1897. Type locality: "Habitat in Europa Australi". Type: Habitat in Europa Australi (lectotype, designated by Aedo 1996: 72, LINN-858.58 image!).

Geranium planipetalum Chaix, Pl. Vap.: 22. 1785. Type locality: "à Durbon, à la Grangette, in subalpinis". Type: France. Gap, Durbon, à la Grangette, 44°38'N, 5°45'E, *D. Chaix s.n.* (no original material located).

Geranium patulum Vill., Hist. Pl. Dauphiné 1: 283. 1786. *Geranium phaeum* var. *patulum* (Vill.) Nyman, Consp. Fl. Eur.: 137. 1878. Type locality: "Plantes de la Grande Chartreuse... à Charmanson". Type: France. Isère, Grande Chartreuse, pr. Grenoble, 45°18'N, 5°48'E, *D. Villars s.n.* (lectotype, designated by Aedo 1996: 73, GRM!; isolectotype?, G-00365984!).

Geranium lividum L'Hér. in Aiton, Hort. Kew. 2: 434. 1789. *Geranium phaeum* var. *lividum* (L'Hér.) DC., Prodr. 1: 641. 1824. *Geranium phaeum* subsp. *lividum* (L'Hér.) Hayek, Fl. Steiermark 1: 628. 1909. Type locality: "Nat. of Switzerland". Type: Switzerland, unknown collector (lectotype, designated by Aedo 1996: 73, BM!).

Geranium subcoeruleum Dick ex Schleich., Cat. Pl. Helv.: 25. 1800. Type locality: "in ditione Aquilejensi, in monte Luan, in lapidosis, qua a Veige versus Drapel descenditur; circa molendinum le Grand Champ. Circa Valorsine, in valle Kienthal" [according to Haller 1768: 404]. Syntypes: Switzerland. In ditione Aquilejensi, in monte Luan [46°21'N, 6°58'E], in lapidosis, qua a Veige versus Drapel [46°19'N, 6°58'E], descenditur; circa molendinum le Grand Champ. Circa Valorsine, in valle Kienthal [46°34'N, 7°45'E], *J.C. Schleicher* (no original material located).

Geranium phaeum var. *maculatum* Schur, Enum. Pl. Transsilv.: 135. 1866. *Geranium phaeum* [I] *maculatum* (Schur) Graebn. in Asch. & Graebn., Syn. Mitteleur. Fl. 7(1): 7. 1913. *Geranium phaeum* f. *maculatum* (Schur) Gams in Hegi, Ill. Fl. Mitt.-Eur. 4(3): 1691. 1924. Type locality: "an feuchten Orten der Arpaser und Kerzesorer Gebirge". Type: Romania. An feuchten Orten der Arpaser und Kerzesorer Gebirge, 45°38'N, 32°48'E, *F. Schur s.n.* (no original material located).

Geranium phaeum var. *nodosum* Schur, Enum. Pl. Transsilv.: 135. 1866. *Geranium phaeum* [subvar.] *nodosum* (Schur) A. Terracc., Malpighia 4: 219. 1890. *Geranium phaeum* [II] *nodosum* (Schur) Graebn. in Asch. & Graebn., Syn. Mitteleur. Fl. 7(1): 7. 1913. Type locality: "unweit der Kerzesorer Glashütte. Jun.". Type: Romania. Unweit der Kerzesorer Glashütte, 45°38'N, 32°48'E, *F. Schur s.n.* (no original material located).

Geranium phaeum var. *atropurpureum* Duftschmid, Fl. Oberösterreich 4: 138. 1885. Type locality: "Häufig am Neustiftbache bei Neustift, am Dambache bei Windischgarsten, an der krummen Steyerling bei Molln, an der Steyerling im Stoder; um Kirchdorf, Michldorf, Klaus. Massenhaft in Hainen bei Steyr, Hall, längs der Krems bei Kremsmünster. Längs der Traun in Auen und Hainen die ganze Haide entlang. Um LambaCh, Aistersheim (Keck). Auf Bergwiesen um Gmunden, Ischl, im Echernthale bei Hallstatt (Kerner), um Mondsee, Weissenbach am Attersee". Syntypes: Austria. Häufig am Neustiftbache bei Neustift [48°30'N, 15°03'E], am Dambache bei Windischgarsten [47°43'N, 14°20'E], an der krummen Steyerling bei Molln [47°53'N, 14°15'E], an der Steyerling im Stoder; um Kirchdorf [48°17'N, 13°16'E], Michldorf, Klaus [47°49'N, 14°09'E]. Massenhaft in Hainen bei Steyr [48°03'N, 14°25'E], Hall, längs der Krems bei Kremsmünster [48°03'N, 14°08'E]. Längs der Traun in Auen und Hainen die ganze Haide entlang. Um Lambach [48°05'N, 13°53'E], Aistersheim (Keck) [48°11'N, 13°45'E]. Auf Bergwiesen um Gmunden [47°55'N, 13°48'E], Ischl [47°43'N, 13°38'E], im Echernthale bei Hallstatt (Kerner) [47°33'N, 13°39'E], um Mondsee [47°52'N, 13°21'E], Weissenbach am Attersee [47°55'N, 13°33'E], *J.B. Duftschmid s.n., A. Kerner s.n. & Kerk s.n.* (no original material located, LI?, Aedo 1996: 73).

Geranium phaeum var. *balcanicum* A. Terracc., Malpighia 4: 215. 1890. Type locality: "e s'arresta alla regione subalpina del monte Rodope in Tracia". Type. Bulgaria. monte Rodope in Tracia, 41°36'N, 24°34'E, unknown collector (no original material located, NAP?, Aedo 1996: 73).

Geranium phaeum subsp. *austriacum* Wiesb. ex Hayek, Fl. Steiermark 1: 628. 1909. *Geranium phaeum* subvar. *austriacum* (Wiesb. ex Hayek) Gams in Hegi, Ill. Fl. Mitt.-Eur. 4(3): 1691. 1924. Type locality: "Beide Pflanzen sind im Schulgarten des Seminars zu Mariaschein (Böhmen) verwildert. G. austriacum stammt vom Freinberg bei Linz (Oberösterreich), wo es beim Bibliotheksgebäude wild wächst". Type: Austria. Schulgarten in Mariaschein, stammt von Linz, 48°18'N, 14°18'E, 31 May 1893, *J. Wiesbaur s.n.* (lectotype, designated by Aedo 1996: 7: OXF!; isolectotypes, JE!, K-000729296!, LD!, LI, xerox-copy seen US-00624323 image!, W!).

Geranium phaeum f. *hungaricum* Wiesb. ex Gams in Hegi, Ill. Fl. Mitt.-Eur. 4(3): 1691. 1924. Type locality: "Beide Pflanzen sind im Schulgarten des Seminars zu Mariaschein (Böhmen) verwildert... G. hungaricum ist aus Nagy Kapornak in Westungarn". Type: Hungary. Schulgarten in Mariaschein, stammt aus Westungarn (Nagy Kapornak), 46°49'N, 16°59'E, 31 May 1893, *J. Wiesbaur s.n.* (lectotype, designated by Aedo 1996: 73, G!; isotypes, LD!, OXF!, W!).

Geranium lividum var. *caerulescens* Murr, Deutsche Bot. Monatsschr. 18: 117. 1900. *Geranium phaeum* [I] *caerulescens* (Murr) Graebn. in Asch. & Graebn., Syn. Mitteleur. Fl. 7(1): 7. 1913. Type locality: "auf der Berqwiese hinter der Ruine Castelcorno bei Roveredo". Type: Switzerland. Ruine Castelcorno bei Roveredo, 46°14'N, 9°07'E, *J. Murr s.n.* (no original material located, GB?, Aedo 1996: 74).

Geranium phaeum f. *pallidum* Gortani & M. Gortani, Fl. Friulana 2: 299. 1906. *Geranium phaeum* [I] *pallidum* (Gortani & M. Gortani) Graebn. in Asch. & Graebn., Syn. Mitteleur. Fl. 7(1): 7. 1913. Type locality: "Col tipo a Sauris di Sª (1380)". Type: Italy. Sauris di Sopera, 46°28'N, 12°42'E, 27 July 1905, *L. Gortani & M. Gortani 1380* (lectotype, designated by Aedo 1996: 74, MFU!).

Geranium phaeum f. *linnaei* C.E. Lundstr., Acta Horti Berg. 5: 76, Taf. 4 Fig. 3. 1914. Type locality: [not indicated]. Type: cultivated

at Bergius Botanic Garden, *C.E. Lundström s.n.* (no original material located, S?).

Perennial herbs, 25-80 cm tall. *Rootstock* 8-10 mm in diameter, ± horizontal, not tuberculate, not turnip-shaped, without thickened roots. *Stem* erect, leafy, not rooting at nodes, stolons absent, without vegetative stems, with patent, eglandular hairs 1.5-2.4 mm long, patent, eglandular hairs 0.1-0.2 mm and patent, glandular hairs 0.1-0.2 mm long. *Basal leaves* in a persistent rosette, cauline leaves alternate; leaf laminas 4-10 cm long, 5.5-11 cm wide, not peltate, palmatifid [ratio main-sinus length/middle segment length = 0.75-0.8], polygonal in outline, base cordate, not coriaceous, with nerves not projected, pilose, with appressed, eglandular hairs on both surfaces; segments 5-7, in 1 plane, middle segment rhombic, 8-15 mm wide at the base [ratio segment width at the base/middle segment length = 0.13-0.32], 7-15(26)-lobed in distal half [ratio secondary sinus length/middle segment length = 0.15-0.25]; petioles up to 25 cm long, without abscission zone, terete, not swollen, not deflexed in age, with patent, eglandular hairs 1.5-2 mm long, patent, eglandular hairs 0.1-0.2 mm long and patent, glandular hairs 0.1-0.2 mm long; stipules 6-8(18) mm long, 2-3(7) mm wide, lanceolate, free, papery, brown, with eglandular hairs on abaxial surface and on the margin, usually glabrous adaxially. *Inflorescence* a monochasial cyme; cymules 2-flowered, solitary [ratio cymule length/leaf length = 1-2.1]; peduncles 30-65(100) mm long, with eglandular, patent, hairs 1.5-2 mm long, patent, eglandular hairs 0.1-0.2 mm long and patent, glandular hairs 0.1-0.2 mm long; bracteoles 3-3.5 mm long, 0.5-0.8 mm wide, lanceolate, whorled; pedicels 20-45 mm long, with eglandular, patent, hairs 1.5-2 mm long, patent, eglandular hairs 0.1-0.2 mm long and patent, glandular hairs 0.05-0.2 mm long. Flowers actinomorphic. *Sepals* 7-7.5 mm long, 2.2-3 mm wide, lanceolate, smooth, not accrescent, nerves 3, mucro 0.2-0.3 mm long [ratio mucro length/sepal length = 0.05-0.06], with ± patent, eglandular hairs 1.5-2 mm long and patent, glandular hairs 0.1-0.2 mm long on the abaxial surface, usually glabrous adaxially. *Petals* 8-9(12) mm long, 6-8(9) mm wide, patent to subreflexed, mucronate to rounded, without claw, blackish purple (sometimes with a white spot), hairy on the base of the adaxial surface, glabrous abaxially, ciliate on the basal margin, with hairs 0.2-0.4 mm long. *Stamens* 10, both whorls bearing anthers; filaments 9-10 mm long, lanceolate, purple, glabrous on both surfaces, ciliate on the proximal half, with hairs 1-1.8 mm long; anthers 2.1-2.9 mm long, yellow. Nectaries 5, hemispheric, with a tuft of hairs at the top, dorsally glabrous. *Gynoecium* 10-11 mm long, yellow. *Fruit* 22-25 mm long, erect, discharge of *Erodium*-type; mericarps 5-6 mm long, 1.5-1.8 mm wide, without a strand of fibers, compressed at the apex, with 3-4 transverse ribs at apex, with basal beak 0.2-0.3 mm long, with a basal callus, without a basal prong, brown, with ± appressed, eglandular hairs 0.1-1 mm long; rostrum 13-15 mm long, with a narrowed apex 2-3 mm long, not twisted, with erect-patent, eglandular hairs 0.1-0.2 mm long; stigmatic remnants 1.2-3 mm long, with 5 glabrous lobes. *Seeds* 3-3.2 mm long, 1.5-1.6 mm wide, finely reticulate, uniformly colored, brown, glabrous. Cotyledons with entire margin. Figs. 36, 37.

Pollen. *Geranium*-type (Bortenschlager 1967: 455; Stafford & Blackmore 1991: 69; Velasco 1992b: 61).

Chromosome number. 2*n* = 14?, 28.

Phenology. Collected in flower from May to September.

Distribution. This species ranges from western and central to southern Europe (Fig. 38).

Habitat. Grassy slopes, roadsides, rocky places and *Alnus* Mill. or *Fagus* L. forests; 50-2200 m.

Representative specimens examined. **Austria.** Carinthia: ad margines silvarum pr. Pörtschach, 46°37'N, 14°5'E, 22 Aug. 1899, *Jabornegg s.n.* (E, G, LD). Lower Austria: Thayatal, Hardegg, 48°50'N, 15°53'E, 10 June 1978, *Grünweis 267* (MA). Styria: Steiermark, Graz, unter Gebüsch beim Deniggut in Andritz, 47°5'N, 15°22'E, 24 May 1952, *Höpflinger s.n.* (LD). **Belgium.** Flemish: Gebüsche, Sarlardinge, Flandre orientale, 50°45'N, 3°49'E, 3 May 1863, *Crépin 737* (JE); Grand-Bigard, prov. Brabant, 50°52'N, 4°15'E, 12 May 1867, *Piré s.n.* (LD). **Bosnia-Herzegovina.** in silvaticis ad Bojiste pr. Nevesinje, 43°15'N, 18°10'E, July, *Sagorski s.n.* (JE); Jajce, Vrbastal oberhalb von Crna Rijeka, 44°29'N, 17°10'E, 18 May 1978, *Krach & Koepff 3075* (MA). **Bulgaria.** Pernik: M. Vitosa, 42°33'N, 23°15'E, 14 June 1953, *Vihodzevssky s.n.* (MA, JE). Sofia: montañas de Rila, distr. Kyustendil, cerros montañosos c. Kirilova, 42°8'N, 23°33'E, 6 July 2004, *Quintanar & al. 1358* (MA). **Croatia.** Karlovac: montes Kapela, Lit, 45°0'N, 15°45'E, 12 June 1911, *Hagen s.n.* (MA); Primorje-Gorski Kotar: Biela Lasiza pr. Ogulin, 45°16'N, 14°57'E, July 1877, *Marchesetti s.n.* (FI). **Czech Republic.** Liberec: Flor. Siles., Boskau, 50°38'N, 15°20'E, 1869, *Stein s.n.* (JE). Zlín: Moravia Orient., Vsetín, Hovezí in alneto ad rivulum Huslenky, 49°18'N, 18°4'E, June, Říčan *426* (LD, WA). **Denmark.** Midtjylland: W of Aarhus, Ahaded wayside, 56°10'N, 10°13'E, 16 June 1969, *Pedersen & Warncke s.n.* (G, JE, MA). **France.** Nouvelle-Aquitaine: Licq, Xuberoa, 43°3'N, 0°53'W, 21 Sep. 1993, *Aedo 2967* (MA); Provence-Alpes-Côte d'Azur: Alpes-Maritimes, Mont Aution, près Fontan, 44°0'N, 7°27'E, 2 July 1886, *Reverchon & Derbez 111* (E, MA); Champoleón, 44°44'N, 6°15'E, 9 July 1904, *Gerod s.n.* (G); Haute-Savoie, Vallon de Flaine-Cluses, vallée de l'Arve, 46°4'N, 6°35'E, 16 July 1964, *Vautier & al. s.n.* (LD). **Germany.** Bavaria: Bayern, Allgäu, Balderschwang, 47°28'N, 10°6'E, 11 June 1975, *Dorr s.n.* (MA). Saxony: Sachsen, Flohalal b. Ranenstein, 50°38'N, 13°10'E, 18 June 1953, *Meyer s.n.* (JE); Sachsen, Rochlitz, Schliss, 51°4'N, 12°48'E, 1 June 1958, *Uhmann s.n.* (JE). **Great Britain.** England: South Malling, Lewes, Sussex, 50°52'N, 0°3'E, 11 May 1898, *Gregor s.n.* (MA); near Thirsk, Yorkshire, 54°14'N, 1°20'W, *Baker s.n.* (G). **Hungary.** Heves: Hungaria septentr. montis Matra, silvae in cacumine montis Kékes, 47°52'N, 20°1'E, 20 May 1968, *Chrtek s.n.* (LD). Zala: aus Nagy Kapornak im Zalaëer Komitate qu. sp. in Mariaschein, Bömen [cultivated from Hungary], 46°49'N, 16°59'E, 28 May 1893, *Wiesbaur s.n.* (JE). **Italy.** Lombardy: cima di Menna, vers nord, Valsecca, Brembana, Alpes Bergamasques, 45°57'N, 9°45'E, 4 Aug. 1911, *Chenevard s.n.* (G). Piedmont: prov. Cuneo, Colla Bassa, reg. du Mt. Antoroto, 44°10'N, 7°55'E, 23 June 1985, *Charpin & Salana 19606* (G). Trentino-Alto Adige: San Martino di Castrozza, S. Tyrol, 46°49'N, 12°12'E, *Ball s.n.* (E). **Montenegro.** Žabljak: 2 km E of Alugo, 43°8'N, 19°15'E, July, *Frost-Olsen 5876* (MA); 40 km NNE Niksic,

7 km SSE Zabljak, Bare, 43º10'N, 19º5'E, 18 June 1971, *Suominen 643* (E). **Netherlands.** Utrecht: Doornburgh nera Maarssen, 52º8'N, 5º4'E, 11 June 1951, *Stoffers s.n.* (MA). **North Macedonia.** Polog: nordz. Ljubotengebirge, am Stando??-gesamelz?, 42º12'N, 21º5'E, July, *Seltter s.n.* (G). **Poland.** Leschmita, Friedhof, flora von Schlesien, 1 May 1898, *Giefché s.n.* (E). Lesser Poland: Reg. Subtatrica, dito urbis Zakopane, inter stadium Srednia Skoczinia et os vallis Nad Capkami, 49º18'N, 19º58'E, *Piekós s.n.* (G). Subcarpathian: Biesczady-Gebirge, Okraklig- fasto, Strabengraben, 49º9'N, 22º29'E, 2 July 1974, *Lippold s.n.* (JE). **Romania.** Sud-Muntenia: Prahova, pr. Sinaia, 45º21'N, 25º31'E, 6 Aug. 2009, *Aedo 16745* (MA). Sud-Vest Oltenia: Oltenia, Craiova, in silva Lunca Mofleni pr. Craiova, 44º18'N, 23º47'E, 10 May 1965, *Olaru & Cîrtu s.n.* (MA). **Serbia.** Southern and Eastern Serbia: in nemoribus ad pedes montis Belava prope G?rot, 43º11'N, 22º30'E, May (E). **Slovakia.** Banská Bystrica: Niedere Tatra südl Korytniza, 48º53'N, 19º18'E, 11 July 1976, *Z[?] s.n.* (JE). Prešov: Slovakia N, montes Vysoké Tatry, Belanské Tatry, in valle Dolina Siedmich ad pagum Tatranská Kotlina, 49º19'N, 20º15'E, 5 June 1969, *Chrtek & Krisa s.n.* (LD). **Slovenia.** Inner Carniola–Karst: au dessous du chateau de Predjama, 45º48'N, 14º10'E, 1 June 1976, *Chautems 12148* (E, G). Upper Carniola: Triglav N. P., inter Kranjska Gora et Mojstrana, 46º29'N, 13º49'E, 28 May 2010, *Calvo 4699* (MA). **Spain.** Gerona: Camprodon, prado y bosque de la Font Nova, 42º19'N, 2º23'E, 6 July 1921, *Cuatrecasas s.n.* (MAF). Guipúzcoa: Aia, Altzolaras, 43º13'N, 2º11'W, 8 Aug. 1990, *Garín s.n.* (ARAN). Huesca: Ansó, barranco de Petrechema, 19 June 2002, *Ederra & Juaristi s.n.* (MA). La Rioja: San Millán de la Cogolla, río Cardenas, Barranco Malo, 42º16'N, 3º10'W, 3 July 1985, *Alejandre 1466/85* (MA). Lérida: Caneján, San Juan de Torán, 42º49'N, 0º47'E, 10 July 1992, *Aedo & al. 2401* (MA). Navarra: abunda en el margen de los prados de Burguete, cerca de las bordas de Garralda a la borda de Arobi, 42º59'N, 1º20'W, June, *Neé s.n.* (G). **Sweden.** Skåne: Sk Krageholm, 55º30'N, 13º12'E, 11 June 1883, *Ahlen s.n.* (MA). Stockholm: Stockholm, 59º20'N, 18º5'E, 12 June 1867, *Brown s.n.* (G). **Switzerland.** Valais: colline de la 'Linnaea', Bourg-Saint-Pierre, 45º58'N, 7º13'E, 31 July 1975, *Greuter 13040* (LD, MA, MAF). Vaud: mont Reculet, Jura, 46º26'N, 6º5'E, 26 July 1857, *Ducommun s.n.* (JE). Zürich: Winterthur, 47º30'N, 8º45'E, May, *Keller s.n.* (MA).

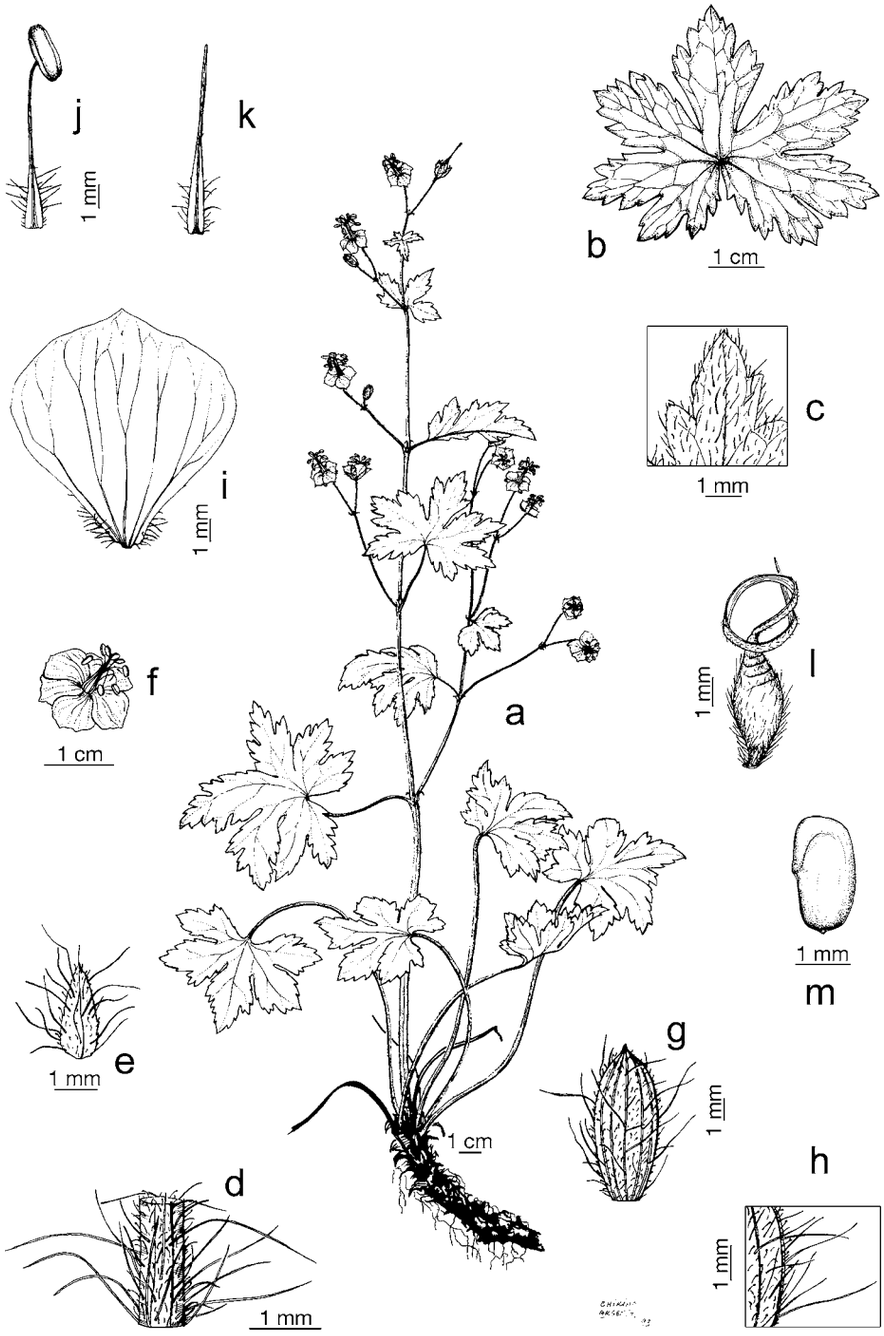


Fig. 36. *Geranium phaeum*. a. Habit. b. Leaf. c. Detail showing indumentum of leaf surface. d. Portion of peduncle. e. Bracteole. f. Flower. g. Sepal. h. Detail showing indumentum of sepal. i. Petal. j. Stamen of outer whorl. k. Staminal filament of inner whorl. 1. Mericarp. m. Seed. (Based on: *Aedo & al. 2401*, MA).

Discussion. Geranium phaeum is easily distinguished from *G. reflexum* and *G. aristatum* because the former has ± patent, darker and as long as wide petals, not very narrow and reflexed petals as the latter. A number of minor morphological variants have been recognized, as is evident from the long list of synonyms for *G. phaeum.* After examining ca. 600 sheets I was not able to discern any consistent patterns of variation. The most distinctive differences have been attributed to *G. phaeum* subsp. *lividum.* According to Hess & al. (1977: 628) this taxon differs from typical representatives of *G. phaeum* by its light petals and narrowly lanceolate

Fig. 37. *Geranium phaeum* (Based on: a, *Quintanar & al. 1358,* MA; b, c, *Calvo 4699,* MA, photo: J. Calvo; d, *Calvo 4799*, MA, photo: J. Calvo).

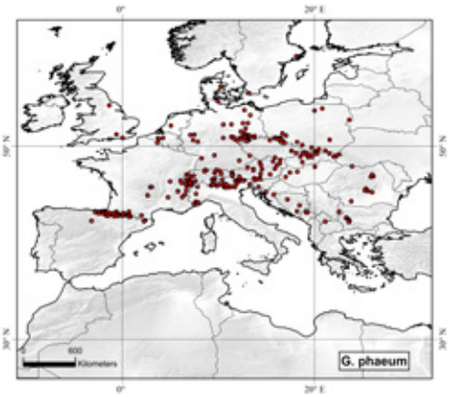


Fig. 38. Distribution of *Geranium phaeum*.

staminal filaments; however, I found many individuals with dark petals and narrowly lanceolate staminal filaments. Furthermore, I did not find any correlation between light petals and other character states, such as color of stigmas and staminal filaments, and thus do not believe "subsp. *lividum"* should formally recognized. Tschemark-Woess & al. (1954: 97) and Nagl (1962: 448), studying somatic polyploidization and endomitosis, reported 2*n* = 14 for this species, but according to Yeo (1984: 25) this number needs to be confirmed.

It is difficult to determine the exact distribution of this species, which is probably native to the mountains of central and southern Europe (Pyrenees, Alps, Carpathians, etc.) but through cultivations as an ornamental and as fodder has spread northward. According to J. Suominen (*in litt.*) *G. phaeum* cannot be native to Denmark, Sweden, and Finland (where it reaches 63ºN in Vaasa). The same was suggested by Pawłowska (1959: 337) for the localities in Poland, by Gams (1924: 1691) for localities in Germany, by Claphman & al. (1989: 172) and Stace (1991: 571) for Irish and British records, and by Bonnier (1913: 83) for localities in north-eastern France and Belgium. I was not able to see any Ukraine and Moldavia material, but Bobrov's (1949: 39) report is quite reliable, as well as that from Belorussia by Blazhevich & Shablunskii (1977). On the contrary, according to Persson (1987: 549), Zaganiaris's (1938) report from Belles, Greece, has yet to be confirmed. Its presence in New Zealand, probably as garden-escape, is based on a specimen at CHR could not be studied. Tsyrenova (2006a: 98) recorded *G. phaeum* in Sakhalin (eastern Siberia), as collected in a park (*Mazurenko & Khokhryakov s.n.*, MHA).

2. Geranium reflexum L., Mant. Pl. Altera: 257. 1771. *Geranium phaeum* subsp. *reflexum* (L.) A. Terracc., Malpighia 4: 219. 1890. Type locality: "Habitat in Italia". Type: "Habitat in Italia. H. U." (lectotype, designated by Aedo 1996: 79, S-G-10042 image!).

Geranium molloides Formánek, Verh. Naturf. Vereins Brünn 34: 343. 1896. Type locality: "Habitat Haggibariza pl. in M.". Type: Yugoslavia. North Macedonia, Haggibariza pl., 41°40'N, 20°38'E, July 1895, *E. Formánek s.n.* (lectotype, designated by Aedo 1996: 79, BRNM!).

Geranium tuberosum f. *hirta* Formánek, Verh. Naturf. Vereins Brünn 34: 343. 1896. Type locality: "Momena čuka pl. in M.". Type: Yugoslavia. North Macedonia, Momina Čuka, 41°52'N, 22°54'E, *E. Formánek s.n.* (no original material located).

Perennial herbs, 40-70 cm tall. *Rootstock* 10-16 mm in diameter, ± horizontal, not tuberculate, not turnip-shaped, without thickened roots. *Stem* erect, leafy, not rooting at nodes, stolons absent, without vegetative stems, with patent, eglandular hairs 1-2(4.5) mm long and patent, glandular hairs 0.1-0.2 mm long. *Basal leaves* in a persistent rosette, cauline leaves alternate; leaf laminas 5-10.5 cm long, 5-14 cm wide, not peltate, palmatifid [ratio main-sinus length/middle segment length = 0.70-0.80], polygonal in outline, base cordate, not coriaceous, not reticulate, with nerves not projected, pilose, with appressed, eglandular hairs on both surfaces; segments 5-7, in 1 plane, middle segment rhombic,

8-15 mm wide at the base [ratio segment width at the base/middle segment length = 0.18-0.19], 10-17-lobed in distal half [ratio secondary sinus length/middle segment length = 0.05-0.15]; petioles up to 25 cm long, without abscission zone, terete, not swollen, not deflexed in age, with patent, eglandular hairs 1.5-2 mm long and patent, glandular hairs 0.1-0.2 mm long; stipules 10-14(16) mm long, 3-3.5(7) mm wide, lanceolate, free, papery, brown, with glandular or eglandular hairs on abaxial surface and on the margin, usually glabrous adaxially. *Inflorescence* a monochasial cyme; cymules 2-flowered, solitary [ratio cymule length/leaf length = 1.8-2.2]; peduncles 15-85 mm long, with patent, eglandular hairs 1-2 mm long and patent, glandular hairs 0.1-0.2 mm long; bracteoles 3-6 mm long, 0.4-0.5 mm wide, lanceolate, whorled; pedicels 23-30 mm long, with patent, eglandular hairs 1-2 mm long and patent, glandular hairs 0.1-0.2 mm long. Flowers actinomorphic. *Sepals* 7-10 mm long, 3-3.5 mm wide, lanceolate, smooth, not accrescent, nerves 3, mucro 0.3-0.5 mm long [ratio mucro length/sepal length = 0.10-0.11], with ± patent, eglandular hairs 2-3 mm long and patent, glandular hairs 0.1-0.2 mm long on the abaxial surface, glabrous adaxially. *Petals* 9-12 mm long, 3.5-6.5 mm wide, reflexed, rounded to erose, without claw, deep purple with a white base, glabrous on both surfaces, ciliate on the basal margin, with hairs 0.6-1.8 mm long. *Stamens* 10, both whorls bearing anthers; filaments 8-9 mm long, lanceolate, white with purple apex, pilose on the abaxial surface, ciliate on the proximal half, with hairs 0.4-0.8 mm long; anthers 2.2-2.5 mm long, yellow. Nectaries 5, hemispheric, with a tuft of hairs at the top, dorsally glabrous. *Gynoecium* 10-11 mm long, yellow. *Fruit* 27-31 mm long, reflexed when immature, discharge of *Erodium*-type; mericarps 4.5-5 mm long, 1.5-1.7 mm wide, without a strand of fibers, compressed at the apex, with 2-3 transverse ribs at apex, with basal beak 0.3-0.4 mm long, with a basal callus, without a basal prong, brown, with ± appressed, eglandular hairs 0.1-1 mm long; rostrum 20-21 mm long, with a narrowed apex 1.5-3 mm long, not twisted, with erect-patent, eglandular hairs 0.1-1 mm long; stigmatic remnants 1.5-2 mm long, with 5 glabrous lobes. *Seeds* 3.2-3.5 mm long, 1.5-1.9 mm wide, finely reticulate, uniformly colored, brown, glabrous. Cotyledons with entire margin. Figs. 39, 40.

Pollen. *Geranium*-type (Bortenschlager 1967: 429).

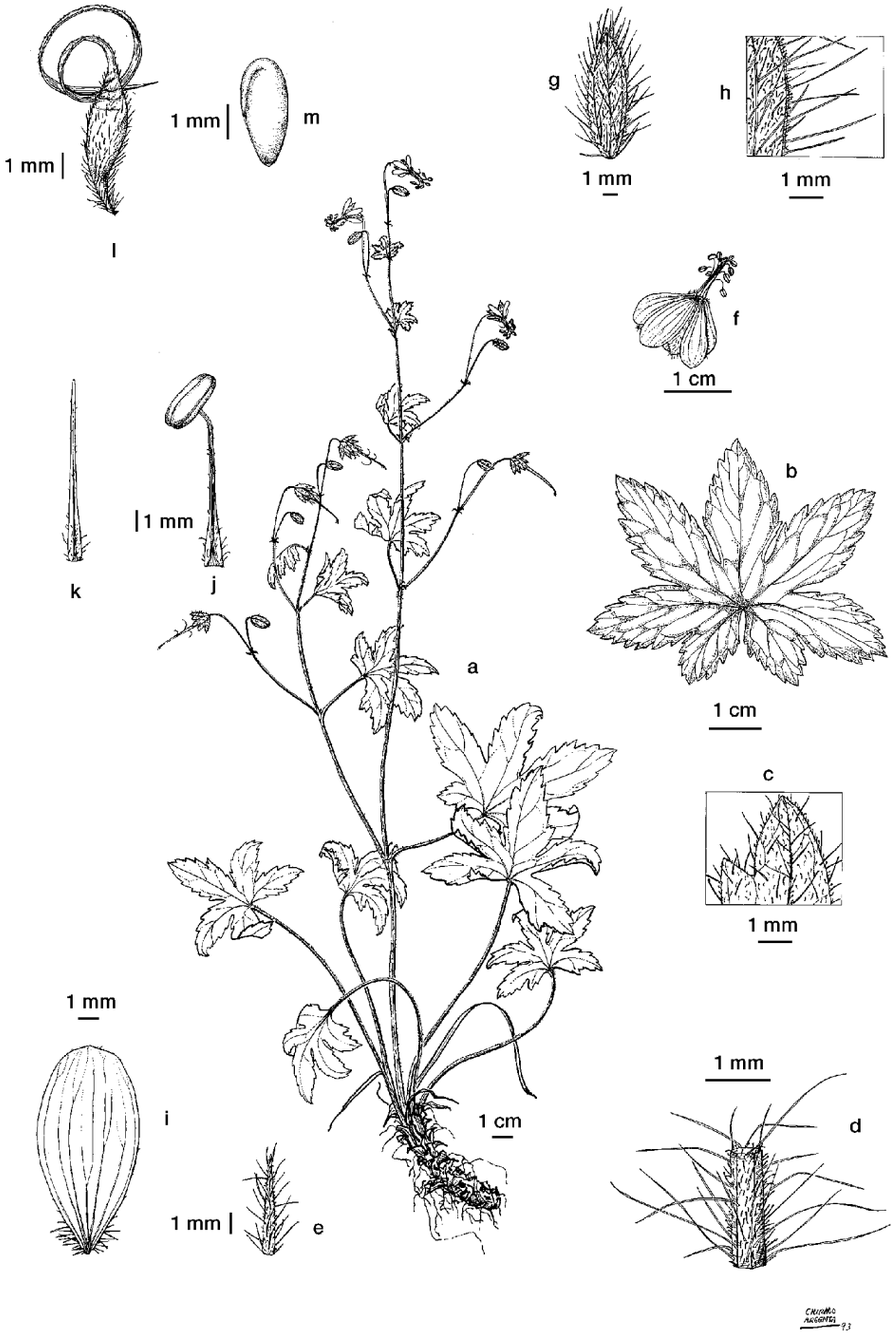


Fig. 39. *Geranium reflexum*. a. Habit. b. Leaf. c. Detail showing indumentum of leaf surface. d. Portion of peduncle. e. Bracteole. f. Flower. g. Sepal. h. Detail showing indumentum of sepal. i. Petal. j. Stamen of outer whorl. k. Staminal filament of inner whorl. 1. Mericarp. m. Seed. (Based on: *Frost-Olsen 4059*, MA).

Chromosome number. 2*n* = 28, 56.

Phenology. Collected in flower from June to July.

Distribution. This species ranges from central Italy, through Montenegro, Kosovo, North Macedonia and Albania to northwestern Greece and southwestern Bulgaria (Fig. 41).

Habitat. Rocky places and *Fagus* L. forests with damp soils; 900-1900 m.

Representative specimens examined. **Albania.** Shkodër: Sala, Zwischen Gebusch auf Cafa Nermajns bei Abatë, 42°18'N, 19°48'E, 23 June 1916, *Dörfler 153* (BRNM, LD). **Bulgaria.** Blagoevgrad: in silvacis Mt. Pirini supra Nevrokp, 41°34'N, 23°44'E, 25 July 1935, *Askr s.n.* (SOM); Pirin in herbosis pr. ref. Javorov, 41°50'N, 23°18'E, 18 Aug. 1974, *Petrova & al. s.n.* (BRNM, E, G, JE, MA). Smolyan: Rhodopes centrales, Trigrad, alrededores de Dyavolsko Gurlo, 41°36'N, 24°22'E, 2 July 2004, *Navarro & al. 4846* (MA); Rhodopes centrales, carretera de Beden a Siroka-Laka, 41°42'N, 24°51'E, 2 July 2004, *Navarro & al. 4949* (MA). Sofia: Rila Mt., in the valley of the river Dzumajska Bistrica, 42°8'N, 23°33'E, 28 June 1976, *Kuzmanov s.n.* (G). **Greece.** Epirus: Metsovo, pr. embalse Aoos Springs, 39°48'N, 21°5'E, 27 July 2007, *Calvo & al. 1045* (MA); Epirus, nom. Ioanninon, ep. Konitsis, Mt. Smolikas, 5 km of Paraskevi, just E peak Petra Subila, 40°7'N, 20°54'E, 5 July 1976, *Hartvig & al. 5643* (G). Thessaly: Pindus thessaliae, in fagetus supra Castania, 39°42'N, 21°21'E, 6 June 1960, *Pinatzi 16554* (G); Chaliki, in subalpini Turnara, 39°40'N, 21°8'E, 26 June 1896, *Sintenis 675* (BRNM, E, JE, LD). West Macedonia: vom Vigla pass nach Pisoderion, Laubmischwald, 40°48'N, 21°15'E, 4 July 1978, *Krendl s.n.* (G); nom. Florinis, Mt. Boutsi NE of summit, by end of road from the Vatochorion, 40°41'N, 21°7'E, 9 July 1981, *Strid & al. 18815* (G). **Italy.** Abruzzo: Mt. Cornu, Abruzzo, 42°28'N, 13°35'E, 1876, *Boissier s.n.* (G); Abruzzen, 2-3 km SE Ovindoli im V. D. Arano, 42°8'N, 13°31'E, 9 July 1978, *Burri & Krendl s.n.* (G); Abruzzo, L'Aquila, Gioia dei Marsi, Vallone Lampazo, 41°51'N, 13°44'E, 4 July 2002, *Herrero & al. 2016* (MA); Campo Imperatore, prov. L'Aquila, Abruzzo, at the foot of Colle Caciaro, 42°28'N, 13°35'E, 9 July 1991, *Iberite & Marchi s.n.* (MA); Gran Sasso d'Italia, monte Corno a Campo Pericoli ex Aprutio, 42°28'N, 13°35'E, 21 May 1875, *Levier s.n.* (G); Pescara, Vado di Sole, 42°23'N, 13°47'E, 2 July 2002, *Navarro & al. 4219* (MA). Lazio: supra la Serra di Santo Antonio di Filettiino, 41°53'N, 13°19'E, 14 July 1856, *Rolli s.n.* (FI). Molise: sorgenti pr la piana di Campitello, 41°27'N, 14°23'E, July 1973, *Bianchini s.n.* (FI); in silvaticis subalpinis montis Majella, vall d'Orferrta, pr. la Cascata grand, 41°38'N, 14°0'E, 31 July 1824, *Levier s.n.* (E); in pascuis umbrosis vallis du Orferrta, Aprutri, 41°38'N, 14°0'E, 15 Apr. 1899, *Rigo 480* (E). **Kosovo.** Peja: Kosovo Metohija, Péc-shane nad Decane, 42°40'N, 20°20'E, 12 June 1967, *Dvoráh s.n.* (BRNM). **Montenegro.** Andrijevica: in nemorosis montis Jerinja Glana, 42°40'N, 19°40'E, 26 July 1933, *Shrivánek s.n.* (BRNM). Plav: in latere occ. jugi Cakor, Andrijevica-Pec, 42°40'N, 20°0'E, 7 July 1976, *Greuter 13795* (G). Plužine: ad coenob. Piva, 43°10'N, 18°50'E, 11 May 1906, *Rohlena s.n.* (LD); m. Varda, Piva, 43°10'N, 18°50'E, July, *Rohlena s.n.* (JE). Podgorica: Greca, Trijepsi, 42°29'N, 19°21'E, 25 July 1900, *Baldacci 163* (G). **North Macedonia.** Southwestern: Galicica, 40°58'N, 20°51'E (BRNM); Luben pl., 41°25'N, 21°5'E, 11 Aug. 1993, *Formánek s.n.* (BRNM); Galicica plan., pass on the road Trpejca-Lescovec, 40°58'N, 20°51'E, 21 June 1981, *Frost-Olsen 4059* (MA). Vardar: Babuna, vom Ceplec-Schutzhaus zur Babuna, Buchenwald, Felsen, 41°30'N, 21°30'E, 1 July 1977, *Krendl s.n.* (G).

Fig. 40. *Geranium reflexum* (Based on: a-c, *Calvo 1045*, MA, photo: J. Calvo; d, *Navarro & al. 4219,* MA).

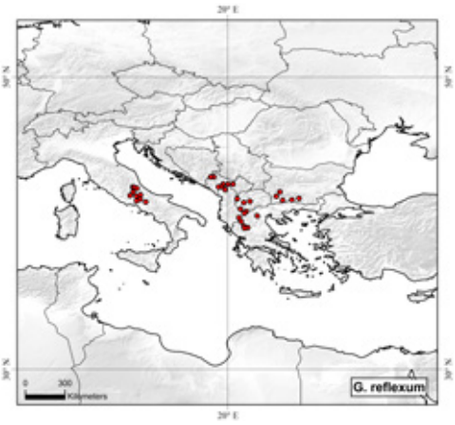


Fig. 41. Distribution of *Geranium reflexum*.

Discussion. Geranium reflexum is probably closest to G. *phaeum.* Both species have alternate lower cauline leaves and simple or bifurcate monopodial branching, but they differ in the position and size of petals, and in other floral and fruiting characters.

Knuth (1912: 577) listed G. *tuberosum* f. *hirta* Formánek as synonym for *G. reflexum.* I was not able to find any sheet that could be linked to the protologue of Formánek's name at BRNM. Because Formánek's diagnosis is very short and only slightly informative, *G. tuberosum* f. *hirta* should be considered as a doubtful synonym of *G. reflexum.*

3. Geranium aristatum Freyn & Sint., Bull. Herb. Boissier 5: 587. 1897. Type locality: "Thessalia graeca in fissuris rupium montis Plaka Pindi tymphaei prope pagum Chaliki rarum die 4. Julii 1896 leg. Sintenis (exs. 673)". Type: Greece. Chaliki, mont Plaka, Thessalia graeca, 39°40'N, 21°08'E, 4 July 1896, *P. Sintenis 673* (lectotype, designated by Aedo 1996: 83, LD-1035606!; isolectotypes, BRNM-10586 image!, PRC-455270 image!).

Perennial herbs, 20-70 cm tall. *Rootstock* 6-10 mm in diameter, ± horizontal, not tuberculate, not turnip-shaped, without thickened roots. *Stem* erect, leafy, not rooting at nodes, stolons absent, without vegetative stems, with ± patent, eglandular hairs 0.3-1.5 mm long. *Basal leaves* in a ± deciduous rosette, cauline leaves opposite; leaf laminas 5-7.5 cm long, 5-8 cm wide, not peltate, palmatifid [ratio main-sinus length/middle segment length = 0.78-0.80], polygonal in outline, base cordate, not coriaceous, not reticulate, with nerves not projected, pilose, with appressed, eglandular hairs and, sometimes, scattered glandular hairs; segments 5-7, in 1 plane, middle segment rhombic, 8-15 mm wide at the base [ratio segment width at the base/middle segment length = 0.16-0.23], 10-22-lobed in distal half [ratio secondary sinus length/middle segment length = 0.20-0.38]; petioles up to 22 cm long, without abscission zone, terete, not swollen, not deflexed in age, with patent, eglandular hairs 0.8-1 mm long and, sometimes, patent, glandular hairs 0.3-0.9 mm long; stipules 10-16 mm long, 2-3 mm wide, lanceolate, free, papery, brown, with eglandular hairs on abaxial surface and on the margin, usually glabrous adaxially. *Inflorescence* a monochasial cyme; cymules 2-flowered, solitary [ratio cymule length/leaf length = 1.5-1.6]; peduncles 15-30 mm long, with patent, eglandular hairs 0.5-1.5 mm long and patent, glandular hairs 0.1-0.2 mm long; bracteoles 7-9 mm long, 0.5-0.6 mm wide, lanceolate, whorled; pedicels 16-28 mm long, with patent, eglandular hairs 0.6-1.5 mm long and patent, glandular hairs 0.1-0.2 mm long. Flowers actinomorphic. *Sepals* 8-10 mm long, 3-4 mm wide, lanceolate, smooth, not accrescent, nerves 3(5), mucro 4-5(7) mm long [ratio mucro length/sepal length = 0.40-0.47], with ± patent, eglandular hairs 2-3.5 mm long and patent, glandular hairs 0.1-0.9 mm long on the abaxial surface, glabrous adaxially. *Petals* 11-12 mm long, 5-5.5 mm wide, reflexed, mucronate (sometimes rounded), without claw, strong purple, glabrous on both surfaces, ciliate on the basal margin, with hairs 0.7-0.8 mm long. *Stamens* 10, both whorls bearing anthers; filaments 7-9 mm long, lanceolate, light purple, glabrous on both surfaces, ciliate on the proximal half, with hairs 0.2-0.9 mm long; anthers 2.5-2.9 mm long, yellow. Nectaries 5, hemispheric, with a tuft of hairs at the top, dorsally glabrous. *Gynoecium* 6-7 mm long, yellow. *Fruit* 35-39 mm long, erect, discharge of *Erodium*-type; mericarps 7-8.5 mm long, 2-2.1 mm wide, without a strand of fibers, compressed at the apex, with 2-3 transverse ribs at apex, with basal beak 1-1.5 mm long, with a basal callus, without a basal prong, brown, with ± appressed, eglandular hairs 0.1-1 mm long; rostrum 28-30 mm long, without a narrowed apex, not twisted, with erect-patent, eglandular hairs 0.1-0.2 mm long; stigmatic remnants 1.5-1.7 mm long, with 5 glabrous lobes. *Seeds* 4.5-4.7 mm long, 1.8-1.9 mm wide, finely reticulate, uniformly colored, brown, glabrous. Cotyledons with with a notch on each side margin. Fig. 42.

Pollen. Ornamentation not studied.

Chromosome number. 2*n* = 28.

Phenology. Collected in flower from June to August.

Distribution. This species ranges from Albania, western Bulgaria and North Macedonia to northwestern Greece (Fig. 43).

Habitat. Shady, damp places in clearings of *Fagus* L. forests or alpine meadows, also in rock crevices, on limestone or igneous rocks; 1000-2200 m.

Additional specimens examined. **Albania.** Dibër: Bulqizë, villagigio di Qyteti, presso Bulqizë, 41°31'N, 20°13'E, 13 June 2017, *Cecchi s.n.* (FI). **Bulgaria.** Blagoevgrad: West Frontier Mts (Mt Vlahina) between Sushitsa (Kadiitsa) village, Blagoevgrad district and the old frontier post, 41°47'N, 22°59'E, 15 July 1981, *Petrova s.n.* (SOM). **Greece.** Epirus: Pardam Shatar, Samarina, Perevoli, Macedonia, 40°7'N, 21°1'E, 13 July 1937, *Balls & Gourlay B3585* (E); Epirus, nom. Ioanninon, Ep. Konitsis, Mt. Smolikas, W of Paraskevi, Petra Subila, 40°7'N, 20°54'E, 5 July 1976, *Hartvig & al. 5626* (G); pirus in monte Gamila, 39°56'N, 20°51'E, 5 July 1957, *Pinatzi 10936* (G). West Macedonia: distr. Florina, Mts. Varnous -Kalo Nero- in SE verticum Bela Voda vocatorum, 40°48'N, 21°12'E, 1 Aug. 1976, *Greuter 14127* (G); Macedonia W, eparhia Kastoria, W montis Epano Arena, 40°18'N, 20°54'E, 8 Aug. 1977, *Greuter 15545* (G); W Macedonia, nom. Kastorias, Mt. Grammos 3,5 km ENE of Aetomilitsa, 40°19'N, 20°53'E, 22 July 1977, *Hartvig & al. 7162* (G); Macédonie, Florina, massif du Peristeri, Bela Voda ou Kalo Nero, 40°12'N, 21°48'E, 11 July 1983, *Parent 83/102* (herb. Parent); Macédonie, Kastoria, Massif du Grammos, Epano Arena, 40°22'N, 20°50'E, 28 July 1990, *Parent 90/189* (herb. Parent); Florina, N Pindus, aufstieg zur Kawiniza, Östl. Vorgipfel des Kalo Nero vom Kataphygion bei Pissoderi, 40°48'N, 21°12'E, 8 July 1982, *Podlech 37426* (G); Nom. Florinis, Mt. Boutsi, by end of forest road from village of Vatochorion, 40°41'N, 21°7'E, 9 July 1981, *Strid & al. 18814* (G). **North Macedonia.** Pelagonia: Galicica Mts., 40°58'N, 20°51'E, 20 Aug. 1964, *Archibald 662* (E); Galicica Mts., E lacum Prespa, supar vicum Leskoveb, 40°54'N, 21°1'E, 27 June 1937, *Klásterský s.n.* (PR); parc national de Galicica, pres de la frontiere albanaise, 40°56'N, 20°50'E, 9 Aug. 1982, *Parent 82/265* (herb. Parent); parc national de Galicica, versant du Galicica, pres de la frontiere albanaise, 40°56'N, 20°50'E, 9 Aug. 1982, *Parent 82/267* (herb. Parent). Polog: Popova Sapka, Sar Mts., 41°59'N, 20°49'E,

23 Aug. 1964, *Archibald 719* (E); Mavrovi Hanovi, Korab, 41°45'N, 20°32'E, 21 July 1934, *Behr s.n.* (MA); Tetovo, Sar Planina, de Popova Sapka a Titov Vrh, 41°59'N, 20°49'E, 28 June 1982, Černoch *39276* (G, LD, MA, MAF); montis Luboten, Sar Planina, 42°12'N, 21°7'E, July 1937, *Deyl s.n.* (PR); Sar Planina, E side of Titov Vrhn, 41°59'N, 20°49'E, 17 July 1970, *Edmondson 186* (E); 2 km NE of Leunovo, E of lake Mavrovo, 41°41'N, 20°47'E, 10 July 1984, *Frost-Olsen 6377* (MA); S of Mavrovo, 41°38'N, 20°40'E, 25 June 1965, *Ooststroom 24125* (L); montis Korab ad Nicpur, 41°44'N, 20°31'E, Aug. 1937, *Pilát s.n.* (PR); Sar Planina, Rudoka, popova Sapka W Tetovo Hänge W der Bergstation, 41°59'N, 20°49'E, 7 June 1979, *Poelt 165* (LD); montes Bistra, apud fontem Padisah, 4 km Marovo, 41°31'N, 20°42'E, 25 Aug. 1979, *Skalický s.n.* (PRC); montibus Korab supra vicum Zirovnica, 41°40'N, 20°35'E, 20 July 1938, *Weber s.n.* (PR).

Discussion. Geranium aristatum is easily recognized by its reflexed petals, the long mucro of the sepals, and the opposite cauline leaves. Knuth (1912: 133) suggested that *G. aristatum* should be included in *G. reflexum*, because both *Sintenis 673* (the type of *G. aristatum*) and *Sintenis 675* (which is *G. reflexum*) came from the same locality, but he had not examined any material of *G. aristatum*. In most individuals glandular hairs are usually confined to the inflorescence, but some plants have glandular hairs on the leaves and the lower part of the stem as well. I found both types of plants in a large set kept at G (G-188590). López (1982: 528) found the same variation even in only one plant of *Geranium collinum*. Thus, like Persson (1987: 544), I do not accord taxonomic recognition to this variation. In any case, the type material I examined has several glandular hairs only in the inflorescence and the upper part of the stem.

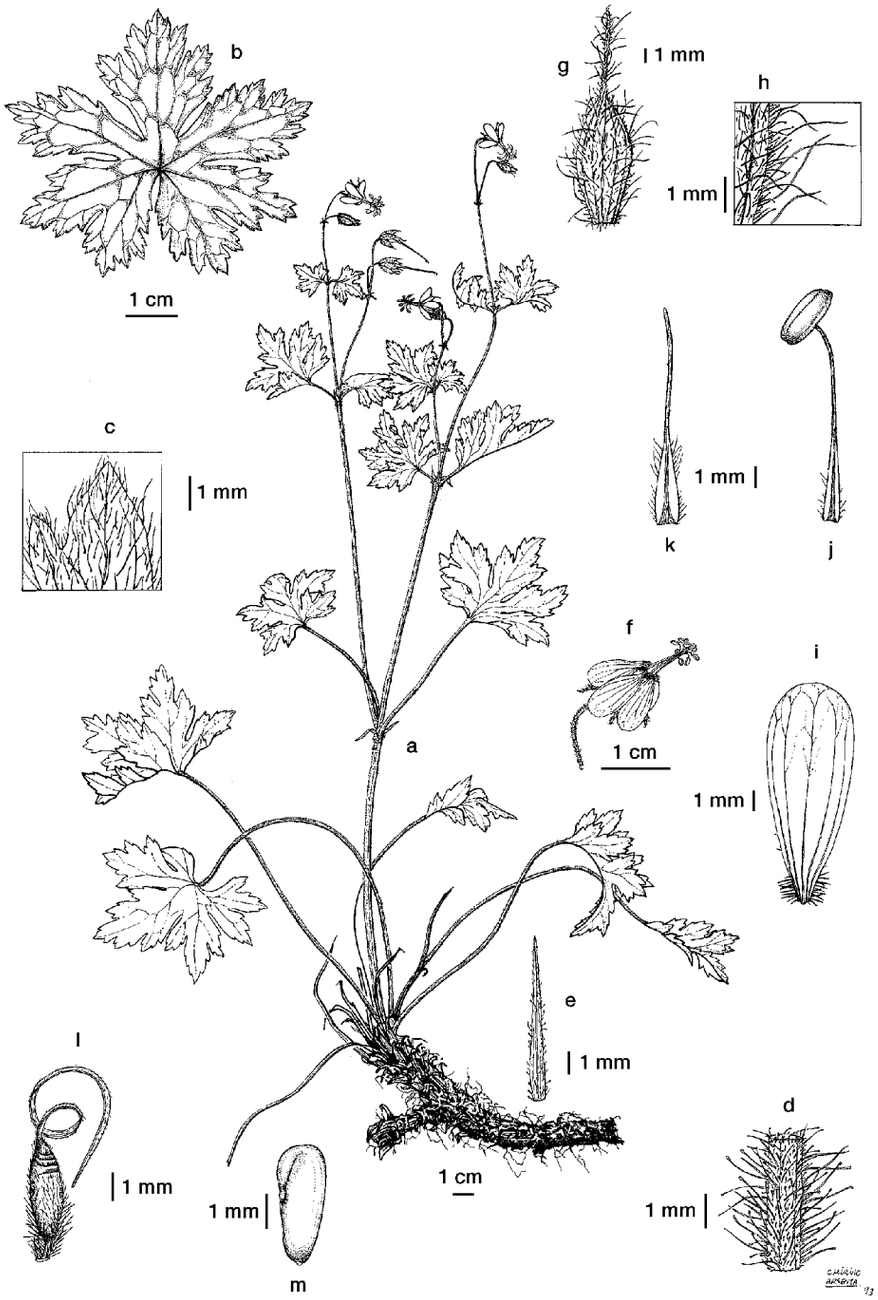


Fig. 42. *Geranium aristatum*. a. Habit. b. Leaf. c. Detail showing indumentum of leaf surface. d. Portion of peduncle. e. Bracteole. f. Flower. g. Sepal. h. Detail showing indumentum of sepal. i. Petal. j. Stamen of outer whorl. k. Staminal filament of inner whorl. l. Mericarp. m. Seed. (Based on: *Greuter 14127*, G-134854).

Ib. Geranium sect. **Aculeolata** Yeo in P. Vorster, Proc. Intern. Geraniaceae Symp.: 22. 1990. Type: *G. aculeolatum* Oliv. (art. 10.8).

Stem scandent, leafy, with prickles. *Cymules* 2-flowered. *Petals* erect-patent. *Cotyledons* with two notches on each side.

Fig. 43. Distribution of *Geranium aristatum*.

4. Geranium aculeolatum Oliv., Fl. Trop. Afr. 1: 291. 1868. Type locality: "Nile Land. Abyssinia, Schimper! Roth!". Type: Ethiopia. Tigray region, Mt. Jumetiz, Maitsa kolo, 13º48'N, 38º22'E, 16 Sep. 1852, *W. Schimper 665* (lectotype, designated by Kokwaro 1971a: 642, K-000417208!; isolectotypes, G!, MPU-027494!, P!, S).

Geranium bequaertii De Wild., Pl. Bequaert. 1: 476. 1922, ["Bequaerti"]. Type locality: "Mukule, 26 septembre 1914 (Steppe à Acanthus. -J. Bequaert, n. 5891bis)". Type: Zaire. North Kivu, Mukule, 1º20'S, 29º15'E, 26 Sep. 1914, *J. Bequaert 5891bis* (lectotype, here designated, BR-887881!).

Perennial herbs, ca. 100(300) cm tall. *Rootstock* ca. 3 mm in diameter, without thickened roots. *Stem* scandent, leafy, rooting at nodes, stolons absent, without vegetative stems, with sharp retrorsely curved prickles 0.5-1.2 mm long, patent, eglandular hairs 0.1-0.2 mm long and patent, glandular hairs 0.2-0.8 mm long. *Basal leaves* unknown, cauline leaves opposite; leaf laminas (1.5)4-7.5 cm long, (2)3.5-9 cm wide, not peltate, palmatifid [ratio main-sinus length/middle segment length = 0.75-0.80], polygonal in outline, base cordate, not coriaceous, with nerves not projected, pilose, with ± patent, eglandular (and sometimes glandular) hairs and curved prickles on both surfaces; segments 5, in 1 plane, middle segment rhombic, 2-10 mm wide at the base [ratio segment width at the base/middle segment length = 0.23-0.28], 18-65-lobed in distal half [ratio secondary sinus length/middle segment length = 0.17-0.23]; petioles up to 10 cm long, without abscission zone, terete, not swollen, not deflexed in age, with sharp curved prickles 0.5-1 mm, patent eglandular hairs 0.5-1 mm long and patent, glandular hairs 0.3-1.2 mm long; stipules 4-10(11) mm long, 1-3.5(4) mm wide, broadly lanceolate (with a setaceous apex 1-2 mm long), connate, papery, brown, with eglandular and glandular hairs on abaxial surface and on the margin, glabrous adaxially. *Inflorescence* a monochasial cyme; cymules 2-flowered, solitary [ratio cymule length/leaf length = 1.2-1.5]; peduncles 30-75(100) mm long, with curved or straight prickles 0.6-1 mm, patent, eglandular hairs 0.3-1 mm long and patent, glandular hairs 0.5-1.1 mm long; bracteoles 3-4 mm long, 0.5 mm wide, linear-lanceolate, whorled; pedicels 8-30 mm long, with curved or straight prickles 0.3-1 mm, patent, eglandular hairs 0.1-0.3 mm long and patent, glandular hairs 0.3-1.1 mm long. Flowers actinomorphic. *Sepals* 5.5-8.1 mm long, 2-3 mm wide, lanceolate, smooth, not accrescent, nerves 3, mucro 0.5-1 mm long [ratio mucro length/sepal length = 0.07-0.16], with patent eglandular hairs 0.2-1.4 mm long and patent glandular hairs 0.3-1.7 mm long on the abaxial surface, glabrous adaxially. *Petals* 9-13 mm long, 6-9 mm wide, erect-patent, rounded, without claw, white or pink, glabrous on both surfaces, ciliate on the basal margin, with hairs 0.5-1 mm long. *Stamens* 10, both whorls bearing anthers; filaments 5-7 mm long, lanceolate, yellow, pilose on the abaxial surface, ciliate on the proximal half, with hairs 0.1-0.3 mm long; anthers 1-1.5 mm long, yellow. Nectaries 5, hemispheric, glabrous. *Gynoecium* 5-6 mm long, purple. *Fruit* 19-26 mm long, erect, discharge of *Erodium*-type; mericarps 3.5-5.5 mm long, 1-1.5 mm wide, without a strand of fibers, not compressed at the apex, with 1-3 transverse ribs at apex, without basal beak, with a basal callus, without a basal prong, brown, with ± appressed, eglandular hairs 0.1-0.5 mm long; rostrum 12-20 mm long, without a narrowed apex, not twisted, with erect-patent, eglandular hairs 0.1-0.2 mm long; stigmatic remnants 2-4 mm long, with 5 hairy lobes. *Seeds* 2.5-3 mm long, 1.2-1.5 mm wide, finely reticulate, uniformly colored, brown, glabrous. Cotyledons with with two notches on each side margin. Figs. 44, 45.

Pollen. *Geranium*-type (Bortenschlager 1967: 433).

Chromosome number. Unknown.

Phenology. Collected in flower from January to December.

Distribution. This species ranges from northern Ethiopia to southern Malawi, in eastern Africa (Fig. 46).

Habitat. Mountain rain-forests, especially in clearings, also along streams, in marshy places and savannas; 1200-3000 m.

Representative specimens examined. **Burundi.** Bujumbura: Ijenda-Mayuyu, 3º29'S, 29º34'E, 18 May 1969, *Lewalle 3570* (BR). Cibitoke: Urundi, Bubanza, route Nyongwe, pres de la riv. Lua, 2º44'S, 29º15'E, 13 June 1958, *Christiaensen 2388* (BR); Bubanya, Mabayi, 2º42'S, 29º15'E, 11 May 1971, *Reekmans 657* (BR). Muramvya: Bugarama, 3º18'S, 29º33'E, 7 June 1969, *Lewalle 3679* (BR); Mt. Teza, 3º10'S, 29º34'E, 9 July 1974, *Rammeloo 3794* (BR). **Ethiopia.** Addis Ababa: near secondary school c. 13 km E of Addis Ababa, 9º1'N, 38º44'E, 12 Oct. 1947, *Ambjörn 381* (S). Amhara: ex Tigrè v. Begemder, 11º50'N, 38º2'E, 1863-68, *Schimper 1175* (K, BM, COI); Debare-Mindigabasa, 13º8'N, 37º57'E, 15 Nov. 1952, *Scott 255* (BM); road Bedeno-Longhe, 3 km from Bedeno, 10º52'N, 39º48'E, 26 Oct. 1967, *Westphal & Westphal-Stevels 2405* (BR). Oromia: Harar prov., about 10 km of Bedenno, 9º6'N, 41º38'E, 4 Aug. 1962, *Burger 1957* (FI); Oromia, Shewa, mt. Wechecha, Managesha State Forest, 8º58'N, 38º35'E, 25 Oct. 1982, *Hedberg 9007* (UPS). Southern Nations, Nationalities, and Peoples: Agheremariam, 5º38'N, 38º14'E, 5 Dec. 1952, *Gillett 14624* (B, BR, FI, FT). South west: Kaffa prov., at the road between Bonga and Shewa Gimira, some 40 km W of Bonga, at the village Dinbira, 7º18'N, 36º2'E, 19 Nov. 1970, *Friis & al. 347* (BR); Mpwapwa distr., Kibakwe division, Mbuga Ward, 6º52'N, 36º35'E, 3 June 2005, *Kindeketa & al. 2583* (MO). **Kenya.** Bungoma: Kitale, Trans-Nzoia distr., 1º2'N, 35º0'E, 17 Sep. 1984, *Mungai 156/84* (BR). Meru: Meru district, 0º02'N, 37º30'E, 1 Feb. 1985, *Burney & Mathenge L3* (NY); Meru district, 1 mile S of Kibirichia camp., 0º04'N, 37º30'E, 1 Sep. 1949, *White 1273* (BM, BR). Nakuru: Rift Valley, NE of Nakuru, Bahati Escarpment, 0º22'S, 35º43'E, 11 Sep. 1966, *Strid 3112* (GB). Nyandarua: Aberdare Mts., above Kinangop forest station, Naivasha prov., 0º5'S, 36º26'E, 25 Oct. 1934, *Taylor 1200* (BM, BR, GB). **Malawi.** Central: Dedza, on the lower E slopes of Downe Hill, above Trinidad's place, 14º20'S, 34º24'E, 1 Apr. 1961, *Chapman 1210* (BM, NY). Northern: edge of Mabja rain-forest, Mzuzu, 11º31'S, 34º0'E, 1954, *Chapman 297* (BM, BR, P); Nkhata Bay district, 5 m NE Chikangawa, 11º50'S, 33º48'E, 7 July 1978, *Phillips 3463* (Z). Southern: Zomba Plateau, Zomba district, 15º22'S, 35º22'E, 3 June 1946, *Brass*

16186 (BR, NY); Masuku plateau, 14º43'S, 34º58'E, July, *Whyte s.n.* (G). **Rwanda.** Northern: flanc sud du volcan Sabyinyo, 1º24'S, 29º37'E, 15 Aug. 1984, *Lejoly 84/402* (BR); Shangugu, route Bukavu-Astrida, environ d'Uwinka, colline Pindura, 2º29'S, 29º13'E, 13 July 1959, *Troupin 10511* (BR, NY). Southern: Nyakisosi, Akanyaru, Bashumba, Asrtida, 2º36'S, 29º44'E, July, *Becquet 723* (BR). Western: foret de Rugege, préf. Cyangugu au km 102 env. de la route Butare-Cyangugu, colline Kohabashi, 2º30'S, 29º15'E, 2 Aug. 1974, *Auquier 3592* (BR); km 15 route Muramba-Rutsiro, Gisenyi, 2º11'S, 29º16'E, 14 June 1974, *Nuyt 307* (BR); Gikungu, a 30 km N de Rutsiro, Gisenyi, 1º47'S, 29º23'E, 23 July 1974, *Troupin 15154* (BR). **South Sudan.** Eastern Equatoria: Gilo, Imatong Mts., Torit, 4º2'N, 32º52'E, 18 Oct. 1948, *Jackson 438* (BM); Iribo, Imatong, prov. Equatoria, distr. Torit, 4º2'N, 32º50'E, 25 Oct. 1929, *Jackson 853* (BM); Imatong Mt., Didinga Hills, near Duguru village, Nagichot, 4º16'N, 33º35'E, 17 Dec. 1983, *Lund 361* (C); Dongotona Mts., Ki?ia, 4º11'N, 33º7'E, Dec., *Macdonald 6* (BM); Katire to Itibol, 4º1'N, 32º52'E, 17 Dec. 1935, *Thomas s.n.* (BM). **Tanzania.** Arusha: W side Mt. Meru, 3º14'S, 36º45'E, 21 July 1957, *Bally 11578* (BR). Kigoma: Ksangayi, Mpanda district, Mahali Mts., 6º13'S, 29º49'E, 23 July 1958, *Jefford & al. 190* (B, BR). Kilimanjaro: Kilimandscharo, Marangu, Biswarikhutte, 3º4'S, 37º22'E, 24 June 1926, *Peter 41790* (B). Manyara: Mangati, Mdingara, Dareda, 4º13'S, 35º33'E, 11 Aug. 1926, *Peter 43966* (B); Mt. Hanang, above Katesh, Mbulu distr., 4º26'S, 35º24'E, 2 May 1962, *Polhill & Paulo 2292* (B, BR). Mbeya: nr. Mbeya, 12 mls, 8º50'S, 33º20'E, 1 July 1951, *Bullock 3986* (B, BR); Rungwe district, Ngozi Poroto Mts., 8º59'S, 33º33'E, 17 Oct. 1956, *Richards 6567* (B, BR). Morogoro: Morogoro, 6º49'S, 37º40'E, 18 Feb. 1933, *Schlieben 3477* (BR). Ruvuma: Kihuru hill, near Ngwambo about 11 km NW Miyau, Songea district, Matengo hills, 10º55'S, 34º56'E, 22 May 1956, *Milne-Redhead & Taylor 10414* (B, BR). Songwe: Mbosi, Iringa province, 9º2'S, 32º56'E, June, *Horsbrugh-Porter s.n.* (BM). Tanga: Shagai forest, near Sunga, W Usambaras, Lushoto district, 4º31'S, 38º17'E, 24 May 1953, *Drummond & Hemsley 2708* (B, BR). **Uganda.** Eastern: Mt. Nkokonjeru,

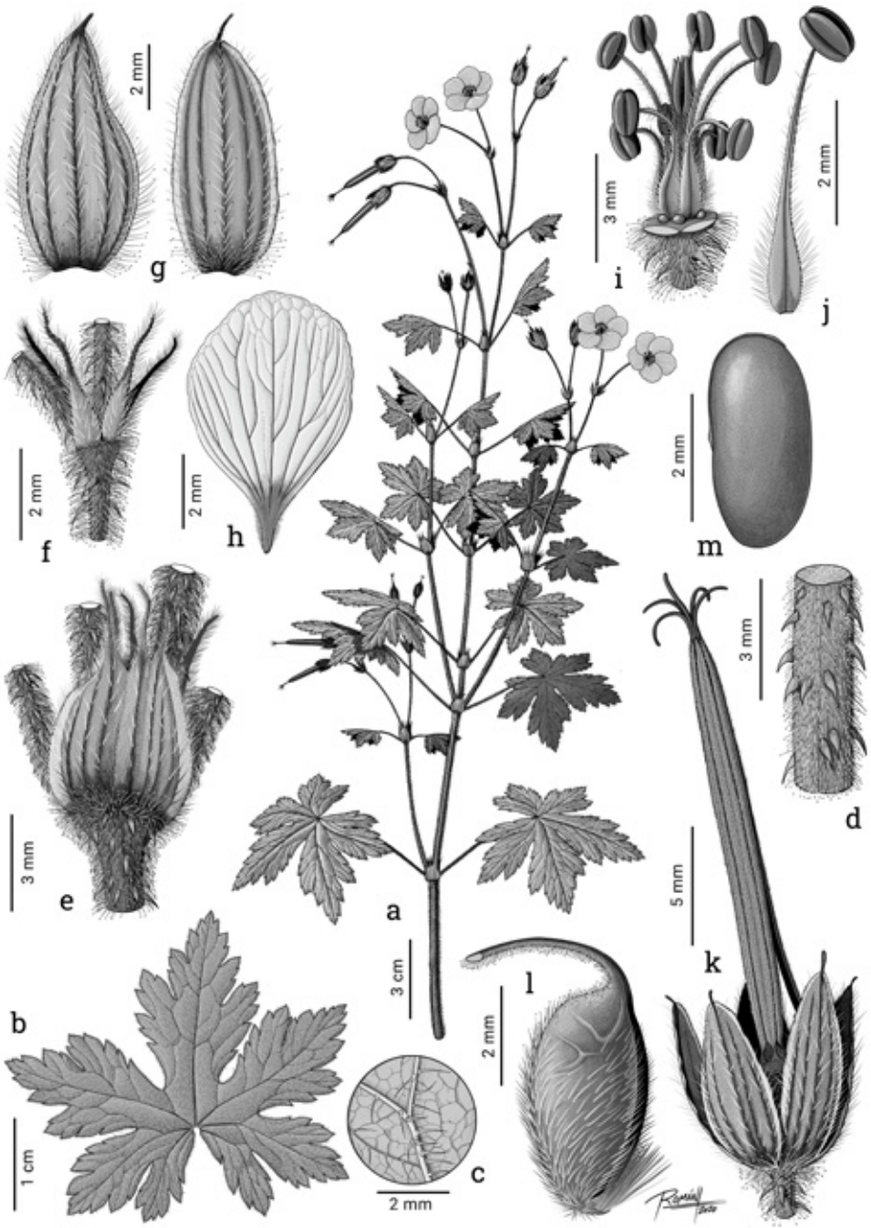


Fig. 44. *Geranium aculeolatum.* a. Branch with flowers and fruits. b. Leaf. c. Detail of leaf indumentum on the abaxial surface. d. Detail of stem showing the prickles. e. Stipules. f. Bracteoles. g. Sepals. h. Petal. i. Flower without petals and sepals. j. Stamen. k. Fruit. l. Mericarp. m. Seed. (Based on: a-c, e, f, h-j: *Chiovenda 2567*, FT; d, k: *Jansen 4277*, G; g, l, m: *Gillett 14624*, FT).

Fig. 45. *Geranium aculeolatum* (Based on: *Aizpuru s.n.,* without voucher).

1º1'N, 34º15'E, 20 Dec. 1924, *Snowden 949*

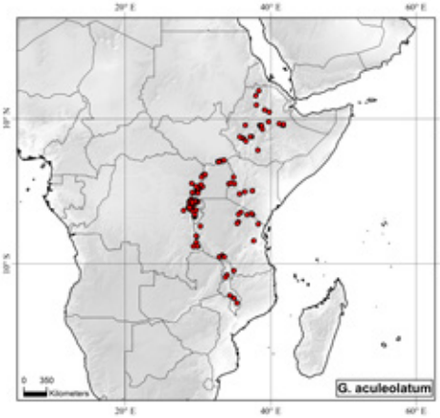


Fig. 46. Distribution of *Geranium aculeolatum*.

(BM); NE Elgon, 1°8'N, 34°33'E, Sep. 1960, *Tweedie 2063* (FI, FT). Western: Mafuga forest, Kinkizi, Kigezi distr., 0°2'S, 29°52'E, 16 May 19251, *Dawkins 732* (BM); route Kabae-Kisoro, Fort Portal, 0°40'N, 30°17'E, 14 Feb. 1942, *Germain 1204* (BR); Ruwenzori mountains, Kichuchu, 0°21'N, 29°56'E, 27 Feb. 1924, *Godman & Godman 372* (BM); Bunyangabu, Toro, Ruwenzori, 0°20'N, 30°10'E, 1914, *Snowden 99* (BM); Virunga Mts., Kanaba Gap, Kigezi distr., 1°18'S, 29°46›E, 19 Nov. 1934, *Taylor 1806* (BM); Virunga Mts., Sabinio, Kigezi distr., 1°23'S, 29°36'E, 24 Nov. 1934, *Taylor 2021* (BM). **Zaire.** Ituri: Nioka, Mahagi, 2°18'N, 30°59'E, 2 Feb. 1959, *Fromment 359* (BR); réserve de Djugu, 1°56'N, 30°30'E, 28 Nov. 1951, *Smeyers 122* (BR). North Kivu: Kivu, Luberu, Bikara, 0°10'S, 29°14'E, 1 Feb. 1975, *Baudet 727* (BR); Mukule, 1°20'S, 29°15'E, 26 Sep. 1914, *Bequaert 5891* (BR); W ridge of Lamia, Kivu province, 0°40'N, 29°45'E, 5 Aug. 1952, *Osmaston 1954* (BR). South Kivu: W of Katana, lake Kivu, 2°14'S, 28°49'E, 27 July 1959, *165* (BM); Tshibinda, 2°19'S, 28°45'E, 11 Sep. 1940, *Hendrickx 1091* (BR); Mt. Bugulumiza Ineac, 2°19'S, 28°45'E, 26 July 1955, *Pierlot 670* (BR). Tanganyika: Marungu-Sampwe, 7°33'S, 29°52'E, Apr., *Dubois 1051* (BR); Kirungu volkan, 7°1'S, 29°45'E, 10 Aug. 1908, *Kassner 3217* (BM, P); Kipiri, Marungu, ferme Vanderbrande, 7°35'S, 29°53'E, Nov., *Quarré 7295* (BR).

Discussion. Geranium aculeolatum is a long, scandent perennial herb sometimes rooting on nodes; the underground parts are unknown. It is always easily identified by the prickles covering younger parts of stems; in older parts the hairs are sloughed off, and the prickles are broken but stumps remain. This feature is a unique condition in the entire genus, but *G. latilobum* shows stout eglandular hairs, some of them prickle-like. *Geranium aculeolatum* has an inflorescence with cymules arranged monochasially, opposite leaves with broadly lanceolate, connate stipules ending in a setaceous apex, short petals and fruit of the *Erodium*-type of discharge. The mericarps has a basal small callus, not so developed as in other groups of *Geranium.* In contrast with other species of the subgenus *Erodioidea* the mericarps ends abruptly, that is without basal beak.

The type of *G. bequaertii* is a fragment with not well-developed fruits whose identity has been difficult to clarify. It has, however, some peduncles with small prickles that indicate unequivocally that is a specimen of *G. aculeolatum*.

Ic. Geranium sect. **Subacaulia** (Boiss.) Reiche in Engl. & Prantl, Nat. Pftanzenfam. 3(4): 8. 1890. *Geranium* [*§*] *Subacaulia* Boiss., Fl. Orient. 1: 869. 1867. Type: *G. subcaulescens* L'Hér. ex DC. (art. 10.8).

Geranium sect. *Petraea* Bubani, Fl. Pyren. 3: 312. 1901. Type: *G. varium* L'Hér. [= *G. cinereum* Cav.] (designated by Aedo 1996: 23).

Stem scapiform or subscapiform, usually prostrate, without prickles. *Cymules* usually 2-flowered. *Petals* erect-patent. *Cotyledons* with entire margins.

5. Geranium cinereum Cav., Diss. 4: 204, tab. 89 fig. 1. 1787. *Geranium cineraceum* Lapeyr., Fig. Pl. Pyrénées 1: 3, tab. 2. 1795-1801, nom. illeg. *Geranium argenteum* subsp. *cinereum* (Cav.) Bonnier & Layens, Tabl. Syn. Pl. Vasc. France: 58. 1894. Type locality: "Habitat in montosis Galliae meridionalis. V.S. in herb. d'Isnard et de Jussieu". Type: France. In montosis Galliae meridionalis, *A. Jussieu s.n.* (lectotype, designated by Velasco 1992a: 296, MA-475729!; isolectotype, P-JU-12501!).

Geranium varium L'Hér., Geraniologia, tab. 37. 1792. Type locality: [not indicated]. Type: France. Pyrénées, *J.P. Lamouroux s.n.* (lectotype, designated by Aedo 1996: 35, NEU!).

Perennial herbs, 7-35 cm tall. *Rootstock* 4-8 mm in diameter, ± horizontal, not tuberculate, not turnip-shaped, without thickened roots. *Stem* prostrate, scapiform or subscapiform, not rooting at nodes, stolons absent, without vegetative stems, with retrorse, not appressed, eglandular hairs 0.1-0.2 mm long. *Basal leaves* in a persistent rosette, cauline leaves usually absent, sometimes 1-2(3) pairs, opposite; leaf laminas 2.2-3 cm long, 2.6-3.4 cm wide, not peltate, palmatifid [ratio main-sinus length/middle segment length = 0.70-0.85], polygonal in outline, base cordate, not coriaceous, with nerves not projected, pilose, with appressed, eglandular hairs on both surfaces; segments 5, in 1 plane, middle segment obtriangular, 3-4 mm wide at the base [ratio segment width at the base/middle segment length = 0.21-0.27], 3(7)-lobed in distal half [ratio secondary sinus length/middle segment length = 0.13-0.33]; petioles up to 20 cm long, without abscission zone, terete, not swollen, not deflexed in age, with retrorse, not appressed, eglandular hairs 0.1-0.2 mm long; stipules 10-11 mm long, 2-2.5 mm wide, lanceolate, free, papery, brown, with eglandular hairs on abaxial surface and on the margin, usually glabrous adaxially. *Cymules* 2-flowered, solitary [ratio cymule length/leaf length = 1.3-1.5]; peduncles 50-150 mm long, with retrorse, not appressed, eglandular hairs 0.1-0.2 mm long; bracteoles 7-10 mm long, 1-1.3 mm wide, linear-lanceolate, whorled; pedicels 20-50 mm long, with retrorse, not appressed, eglandular hairs 0.1-0.2 mm long. Flowers actinomorphic. *Sepals* 8-10 mm long, 3-4.2 mm wide, lanceolate, smooth, not accrescent, nerves 5, mucro 1-1.7 mm long [ratio mucro length/sepal length = 0.11-0.19], with eglandular hairs 0.1-0.5 mm long on the abaxial surface (0.5-0.7 mm long on the margin), glabrous adaxially. *Petals* 14-17 mm long, 11-12 mm wide, erect-patent, emarginate (notch 0.8-1.5 mm deep), without claw, purple (without a dark basal spot), hairy on the base of the adaxial surface, glabrous abaxially, ciliate on the basal margin, with hairs 0.3-0.9 mm long. *Stamens* 10, both whorls bearing anthers; filaments 5.5-6.5 mm long, lanceolate, yellow, pilose on the abaxial surface, ciliate on the proximal third, with hairs 0.1-0.3 mm long; anthers 1.8-2.2 mm long, deep purple. Nectaries 5, hemispheric, glabrous. *Gynoecium* 8-9 mm long, yellow. *Fruit* 32-33 mm long, erect, discharge of *Erodium*-type; mericarps 6-6.2 mm long, 2-2.5 mm wide, without a strand

of fibers, compressed at the apex, with 2 transverse ribs at apex, with basal beak 0.8-0.9 mm long, with a basal callus, without a basal prong, brown, with ± appressed, eglandular hairs 0.1-0.9 mm long; rostrum 21-24 mm long, without a narrowed apex, not twisted, with erect-patent, eglandular hairs 0.1-0.2 mm long; stigmatic remnants 2.3-3 mm long, with 5 hairy lobes. *Seeds* 3.5-4 mm long, 1.5-1.8 mm wide, finely reticulate, uniformly colored, brown, glabrous. Cotyledons with entire margin. Figs. 47, 48.

Pollen. *Geranium*-type (Bortenschlager 1967: 425, Velasco 1992b: 62).

Chromosome number. 2*n* = 28.

Phenology. Collected in flower from June to August.

Distribution. This species ranges from eastern Cantabrian Mountains to central Pyrenees (Fig. 49).

Habitat. Grassy slopes and ledges of limestone or igneous rocks; 1200-2650 m.

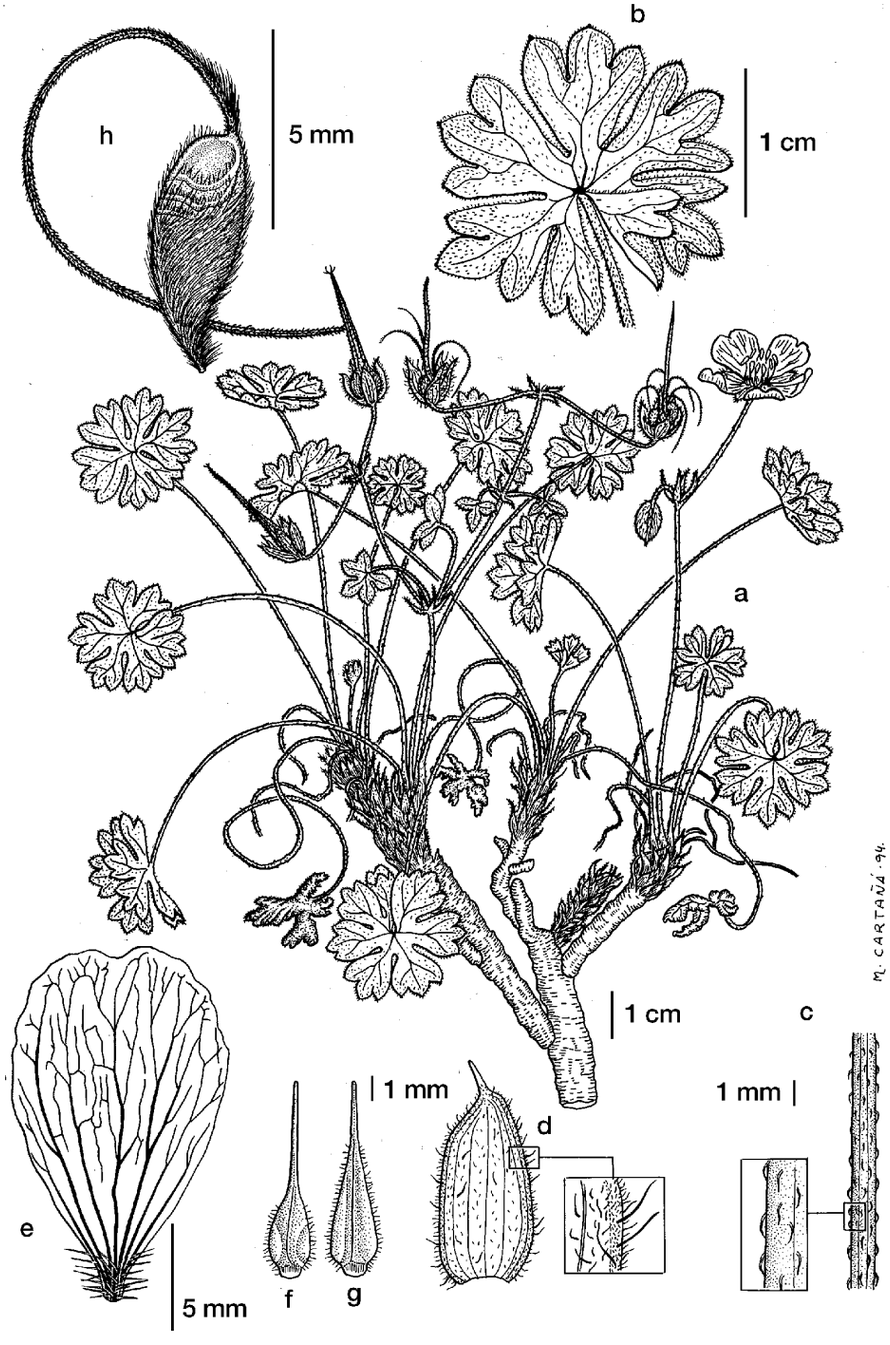


Fig. 47. *Geranium cinereum*. a. Habit. b. Leaf. c. Portion of peduncle and detail showing indumentum. d. Sepal and detail showing indumentum. e. Petal. f. Staminal filament of outer whorl. g. Staminal filament of inner whorl. h. Mericarp. (Based on: *Montserrat s.n.*, MA-331309).

Fig. 48. *Geranium cinereum* (Based on: *Aedo 22022*, MA).

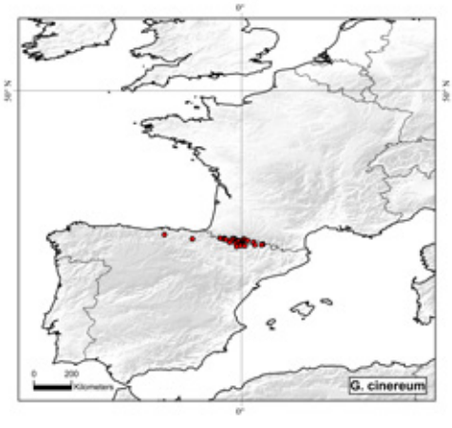


Fig. 49. Distribution of *Geranium cinereum*.

Representative specimens examined. **France.** Nouvelle-Aquitaine: Basses Pyrénées, in yugo col de Tortes, 42º57'N, 0º22'W, 1861, *Ball s.n.* (E); Basses Pyrénées, col de Tortes, pic du Ger, 42º57'N, 0º22'W, 1846, *Feisthamel s.n.* (G); Basses Pyrénées, region de Gourette, 42º58'N, 0º20'W, 16 July 1968, *Richard s.n.* (G); Basses Pyrénées, Eaux-Chaudes, raillère montagnon d'Iseye, 42º57'N, 0º26'W, 15 July 1921, *Tapi s.n.* (G); Pyrénées-Atlantiques, entre Col de Pierre St. Martin & les rochers de Donndrale, 42º59'N, 0º48'W, 15 July 1979, *Charpin & Jacquemoud 15680* (E); Pyrénées Atlantiques, Sainte Engrace, pic Lakhoura, 42º57'N, 0º50'W, 1 Aug. 2004, *Peralta & López s.n.* (MA); Pyrénées Atlantiques, pico Orhi, Zazpigaina, 42º59'N, 1º1'W, 19 July 2008, *Aedo & Aizpuru 15825* (MA). Occitanie: Hautes-Pyrénées, Pic du Midi, 42º57'N, 0º8'E, *Blytt s.n.* (C); Hautes-Pyrénées, cirque de Gavarnie, 42º44'N, 0º3'W, 2 July 1870, *Boissier & Reuter s.n.* (G, JE); Hautes-Pyrénées, versant N du pic d'Arbizon, 42º52'N, 0º18'E, 10 July 1852, *Boutigny 522B* (BM, G); Hautes-Pyrénées, ad houle du Marboré, 42º41'N, 0º3'E, July, *Desvaux s.n.* (G); Hautes-Pyrénées, à la Piquette d'Endrettis, *Duchartre s.n.* (G); Hautes-Pyrénées, pic d'Ayre, 42º52'N, 0º6'E, 24 July 1849, *Franqueville s.n.* (BM, G, JE, LE); Hautes-Pyrénées, Gèdre, 42º47'N, 0º3'E, *Grenier s.n.* (W); Hautes-Pyrénées, Pic Tourcanade ad pedem montis Maladetta, 42º39'N, 0º39'E, 20 Aug. 1847, *Lezat s.n.* (C); Hautes-Pyrénées, Cauterets, mont Péguère, partie du chemin forestier entre la Laone et le vallée de Cambasque, 42º52'N, 0º6'W, 12 July 1903, *Neyraut s.n.* (B); Hautes-Pyrénées, Pic d'Arbilzon, 42º52'N, 0º18'E, 1859, *Philippe s.n.* (G). **Spain.** Cantabria: Castro Valnera, 43º9'N, 3º40'W, 19 Aug. 1989, *Moreno Moral s.n.* (MA). Guipúzcoa: Sierra de Aizgorri, Aitzuri-Iraule, 42º57'N, 2º20'W, 22 July 1983, *Lizaur s.n.* (ARAN). Huesca: barranco de Montinier, pr. Bielsa, 42º37'N, 0º11'E, 15 July 1994, *Aedo & al. 3261* (MA); Valle de Ordesa, Goriz, 42º39'N, 0º3'E, 5 Aug. 1935, *Ceballos s.n.* (MA); Ansó-Fago, solana del Budoguia, 42º55'N, 0º45'W, 5 July 1985, *Fernández Betoño & Alejandre 978.85* (MA); Pirineos Centrales, valle de Ordesa, pr. Gradas de Soaso, 42º38'N, 0º3'W, 30 July 1947, *Rivas Goday s.n.* (MA); Htes. Pyrénées, vallée d'Aspé, 42º47'N, 0º33'W, 10 Aug. 1903, *Sennen (frère) s.n.* (G). Lérida: valle de Arán, puerto de la Bonaigua, 42º40'N, 0º58'E, 6 Aug. 2014, *Aedo 22002* (MA); Valle de Arán, puerto de la Bonaigua, Tesso de la Mina, 42º41'N, 1º2'E, 8 July 1998, *Aedo & Pedrol 4785* (MA); Pallars Sobirà, Tabescau, pr. l'Estany de Mariola, 5 Aug. 1965, *Llensa de Gelcen s.n.* (BC); Valle d e Arán, pico Forca, 22 July 1998, *Sáez & al. 5107* (MA). Navarra: Pirineo navarro, Mesa de los Tres Reyes, 42º55'N, 0º44'W, 18 July 1961 (ARAN); Isaba, Lakora, 42º56'N, 0º50'W, 8 July 1986, *Aizpuru & Catalán s.n.* (ARAN); Otsagabia, puerto Larrún-pico Orhy, 42º59'N, 1º0'W, 22 July 1987, *Aizpuru & Catalán s.n.* (ARAN); Portillo de Eraize, Isaba, 42º58'N, 0º48'W, 19 Aug. 1969, *Montserrat s.n.* (MA, B, G, MAF).

Discussion. Geranium cinereum is probably related to *G. cazorlense*; the two species grow allopatrically in the Iberian Peninsula. They differ in details of the indumentum of the leaves, peduncles, and pedicels, and the morphology of the staminal filaments. *Geranium cinereum* is a somewhat variable species. In some herbarium material (e.g., *Morales 499*, *Morante & Alejandre 1488/89*, *Uribe & Urrutia s.n.* MA-478857) I found some unusual leaves with 5-7-lobed segments; however, most of the leaves are always 3-lobed.

---

6. Geranium subargenteum Lange in Willk. & Lange, Prodr. Fl. Hispan. 3: 525. 1878. *Geranium cinereum* subsp. *subargenteum* (Lange) Borja ex M. Laínz, Supl. Ci. Bol. Inst. Estud. Asturianos 22: 19. 1976. Type locality: "In regione subalpina et alp. inf. Hispan. bor. (Castell., Montes de Reynosa alt. 6-7000', LERESCHE! Pico Cordel reg. media, BOISS. et REUT.!)". Type: Spain. Cantabria, Vielle Castille, monts de Reynosa, 43º03'N, 4º18'W, 28 July 1862, *L.F. Leresche s.n.* (lectotype, designated by Aedo 1996: 28, G-00365977!).

Perennial herbs, 10-35(60) cm tall. *Rootstock* 5-10 mm in diameter, ± horizontal, not tuberculate, not turnip-shaped, without thickened roots. *Stem* prostrate, scapiform or subscapiform, not rooting at nodes, stolons absent, without vegetative stems, with retrorse, appressed, eglandular hairs 0.1-0.2 mm long. *Basal leaves* in a persistent rosette, cauline leaves usually absent, sometimes 1(2) pairs, opposite; leaf laminas 3.5-6.5 cm long, 4-7.5 cm wide, not peltate, palmatifid [ratio main-sinus length/middle segment length = 0.8-0.9], polygonal in outline, base cordate, not coriaceous, with nerves not projected, pilose above and sericeous beneath, with appressed, eglandular hairs; segments 5(7), in 1 plane, middle segment obtriangular, 3-8.7 mm wide at the base [ratio segment width at the base/middle segment length = 0.18-0.24], 3-5(9)-lobed in distal half [ratio secondary sinus length/middle segment length = 0.21-0.49]; petioles up to 25 cm long, without abscission zone, terete, not swollen, not deflexed in age, with retrorse, appressed, eglandular hairs 0.1-0.3 mm long; stipules 10-15 mm long, 2-3 mm wide, lanceolate, free, papery, brown, with eglandular hairs on abaxial surface and on the margin, usually glabrous adaxially. *Cymules* 2-flowered, solitary [ratio cymule length/leaf length = 1.7-9.9]; peduncles 25-70 mm long, with retrorse, appressed, eglandular hairs 0.1-0.2 mm long; bracteoles 7-8 mm long, 0.5-1 mm wide, lanceolate, whorled; pedicels 40-70 mm long, with retrorse, appressed, eglandular hairs 0.1-0.2 mm long. Flowers actinomorphic. *Sepals* 8-11.5 mm long, 3.3-4.5 mm wide, lanceolate, smooth, not accrescent, nerves 5, mucro 1-1.5 mm long [ratio mucro length/sepal length = 0.14-0.17], sericeous, with eglandular hairs 0.1-0.5 mm long on the abaxial surface, glabrous adaxially. *Petals* 15-18 mm long, 7-9.4 mm wide, erect-patent, emarginate (notch 0.8-1 mm deep), without claw, purple (without a dark basal spot), hairy on the base of the adaxial surface, glabrous abaxially, ciliate on the basal margin, with hairs 0.3-0.7 mm long. *Stamens* 10, both whorls bearing anthers; filaments 5-7 mm long, lanceolate, deep purple, pilose on the abaxial surface, ciliate on the proximal third, with hairs 0.2-0.3 mm long; anthers 2.2-2.5 mm long, deep purple. Nectaries 5, hemispheric, glabrous. *Gynoecium* 7-8 mm long, deep purple. *Fruit* 24-27 mm long, erect, discharge of *Erodium*-type; mericarps 4.9-7 mm long, 2.4-3 mm wide, without a strand

of fibers, compressed at the apex, with 2-3 transverse ribs at apex, with basal beak 0.2-0.6 mm long, without a basal callus, without a basal prong, brown, with ± appressed, eglandular hairs 0.7-1 mm long; rostrum 14-18 mm long, without a narrowed apex, not twisted, with erect-patent, eglandular hairs 0.1-0.2 mm long; stigmatic remnants 2.3-3 mm long, with 5 hairy lobes. *Seeds* 3.2-4 mm long, 2-2.5 mm wide, finely reticulate, uniformly colored, brown, glabrous. Cotyledons with entire margin. Figs. 50, 51.

Pollen. *Geranium*-type (Velasco 1992b: 63).

Chromosome number. 2*n* = 28.

Phenology. Collected in flower from June to September.

Distribution. This species ranges through Cantabrian Mountains, in northern Spain (Fig. 52).

Habitat. Grassy slopes or screes, on limestone or slate; 1300-2200 m.

Representative specimens examined. **Spain.** Asturias: Puerto Ventana, Vega de Socechares, 43º4'N, 5º59'W, 28 June 2013, *Aedo 20680* (MA); Ponga, puertos de Arcenorio, 43º6'N, 5º7'W, 4 Aug. 1993, *Aedo 2932* (MA); Somiedo, braña de Murias Longas, Valle de Lago, 43º6'N, 6º10›W, 25 Aug. 1985, *Aedo s.n.* (MA); Miro la Pedra, Somiedo, 43º2'N, 6º17'W, 14 July 1958, *Laínz s.n.* (JBAG); Las Moruecas, Somiedo, 43º1'N, 6º16'W, 16 Aug. 1958, *Laínz s.n.* (JBAG); La Cigacha, macizo de Ubiña, Quirós, 43º3'N, 5º57'W, Sep., *Lueje s.n.* (JBAG). Cantabria: Alto Campoo, ladera NW del pico Cuchillón, 43º1'N, 4º23'W, 6 Aug. 2008, *Aedo 15852* (MA); ladera N del pico Cordel, 43º2'N, 4º19'W, 22 July 2009, *Aedo 16827* (MA); Peña Sagra, canal del Carro, 43º8'N, 4º28'W, 26 July 2009, *Aedo 16871* (MA); Polaciones, Tresmares, 43º3'N, 4º23'W, 25 July 1992, *Aedo 2406* (MA); Espinama, 43º5'N, 4º49'W, 24 June 1931, *Blackburn & Schafer s.n.* (BM); Cuenca Cré, Alto Campoo, 43º3'N, 4º23'W, 9 July 1983, *Navarro & Valle s.n.* (MA, MAF). León: Polvoredo, ladera S de Peña Ten, 43º5'N, 5º8'W, 10 July 2012, *Aedo & Pedrol 19200* (MA); Robledo, al N del pico Pozo Lao, 43º0'N, 6º6'W, 30 June 2013, *Aedo 20704* (MA); Sosas de Laciana, 42º57'N, 6º18'W, 9 Aug. 1992, *Aedo 2423* (MA); Lumajo, 42º59'N, 6º15'W, 9 Aug. 1992, *Aedo 2424* (MA); Laguna Verde, Torre de Babia, 43º0'N, 6º8'W, 1 Oct. 1994, *Aedo & Aldasoro 3386* (MA); entre Torrebarrio & Peña Ubiña, 43º1'N, 5º58'W, *Bayón & al. 8473SC* (MA); Puerto de las Señales, 43º6'N, 5º16'W, 27 Aug. 1979, *Casaseca & al. s.n.* (MA); collado de Remoña, sobre la vega de Liordes, 43º9'N, 4º51'W, 31 July 1980, *Delgado s.n.* (JBAG); Cordillera Cantabrica, Picos de Mampodre, puerto de las Señales, 43º6'N, 5º16'W, 22 July 1983, *Gardner & Gardner 2209* (BM); majada de Pozua near the Puerto del Ponton, Asturias, 43º6'N, 5º2'W, 13 July 1927, *Lacaita 484? 17645* (BM); laguna en Vega Penouta, 23 July 1988, *Valdés Bermejo 11445* (MA). Palencia: Cervera de Pisuerga, subida a Peñalabra, 43º4'N, 4º25'W, 10 July 1978, *Castroviejo & al. 4212EV* (MA); Piedrasluengas, 43º4'N, 4º27'W, 23 July 1975, *Segura Zubizarreta s.n.* (MA).

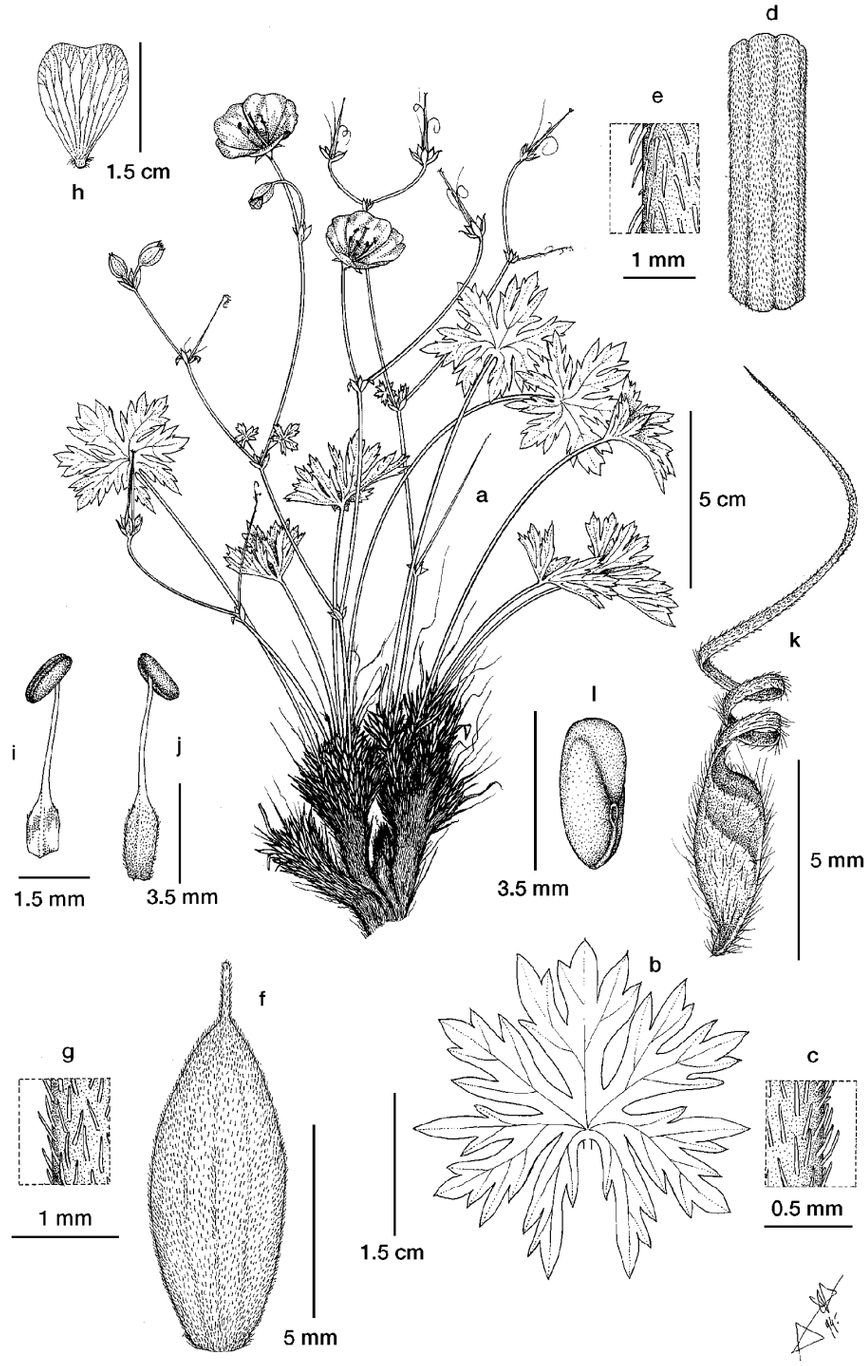


Fig. 50. *Geranium subargenteum*. a. Habit. b. Leaf. c. Detail showing indumentum of leaf surface. d. Portion of peduncle. e. Detail showing indumentum of peduncle. f. Sepal. g. Detail showing indumentum of sepal. h. Petal. i. Stamen of outer whorl. j. Stamen of inner whorl. k. Mericarp. l. Seed. (Based on: *Aedo 2423*, MA).

Fig. 51. *Geranium subargenteum* (Based on: *Aedo 15852,* MA).

Fig. 52. Distribution of *Geranium subargenteum*.

Discussion. Geranium subargenteum is probably closely related to *G. dolomiticum*. Both Cantabrian species have mericarps without a basal callus (like *G. cazorlense*) and leaves more deeply divided than those of other species of the western Mediterranean region. The deep purple staminal filaments, sepals without long marginal hairs, and discolorous leaves (pilose above and sericeous beneath) are three useful characters that distinguish G. *subargenteum.*

7. Geranium dolomiticum Rothm., Bol. Soc. Esp. Hist. Nat. 34: 151. 1934 [25 May 1934]. *Geranium subargenteum* subsp. *dolomiticum* (Rothm.) M. Laínz, Bol. Inst. Estud. Asturianos, Supl. Ci. 1: 22. 1960. *Geranium cinereum* subsp. *dolomiticum* (Rothm.) M. Laínz, Supl. Ci. Bol. Inst. Estud. Asturianos 22: 19. 1976. Type locality: "Hab.: In pascuis alpinis et in fissuris rupium dolomiticarum 'Los apóstoles' montis 'La Guiana', part. Ponferrada, provincia León (leg. Rothmaler, Plantae Hisp. Bor.-Occid., n. 49)". Type: Spain. León, La Guiana, Los Apóstoles, 42º30'N, 6º36'W, 15 June 1933, *W. Rothmaler 49* (lectotype, designated by Velasco 1992a: 296, Z!; isolectotypes, BC-80054!, BM, JE-00019621!, MA-71421!, MAF-25277!).

Perennial herbs, (6)9-25(40) cm tall. *Rootstock* 5-9 mm in diameter, ± horizontal, not tuberculate, not turnip-shaped, without thickened roots. *Stem* prostrate, scapiform or subscapiform, not rooting at nodes, stolons absent, without vegetative stems, with patent, eglandular hairs 0.1-0.2 mm long. *Basal leaves* in a persistent rosette, cauline leaves usually absent, sometimes 1(3) pairs, opposite; leaf laminas (3)5-6 cm long, (4)5-7 cm wide, not peltate, palmatifid [ratio main-sinus length/middle segment length = 0.73-0.77], polygonal in outline, base cordate, not coriaceous, with nerves not projected, pilose, with appressed, eglandular hairs on both surfaces; segments 5(7), in 1 plane, middle segment obtriangular, 4-7 mm wide at the base [ratio segment width at the base/middle segment length = 0.21-0.29], (3)5-8-lobed in distal half [ratio secondary sinus length/middle segment length = 0.16-0.38]; petioles up to 28 cm long, without abscission zone, terete, not swollen, not deflexed in age, with retrorse, appressed, eglandular hairs 0.1-0.2 mm long; stipules 9-13 mm long, 2-2.5 mm wide, lanceolate, free, papery, brown, with eglandular hairs on abaxial surface and on the margin, usually glabrous adaxially. *Cymules* 2-flowered, solitary [ratio cymule length/leaf length = 1.1-6.2]; peduncles (30)60-140 mm long, with patent, eglandular hairs 0.1-0.2 mm long; bracteoles 5-6 mm long, 0.5-0.7 mm wide, linear-lanceolate, whorled; pedicels 25-50 mm long, with patent, eglandular hairs 0.1-1 mm long. Flowers actinomorphic. *Sepals* 6.5-8.2 mm long, 2.6-3.5 mm wide, lanceolate, smooth, not accrescent, nerves 5, mucro 1-2.5 mm long [ratio mucro length/sepal length = 0.12-0.16], with patent, eglandular hairs 0.1-0.2 mm long on the abaxial surface (1.5-2 mm long on the margin), glabrous adaxially. *Petals* 12-13 mm long, 6.4-8.5 mm wide, erect-patent, emarginate (notch 0.9-1.1 mm deep), without claw, purple (without a dark basal spot), hairy on the base of the adaxial surface, glabrous abaxially, ciliate on the basal margin, with hairs 0.5-1 mm long. *Stamens* 10, both whorls bearing anthers; filaments 5-6 mm long, lanceolate, yellow, pilose on the abaxial

surface, ciliate on the proximal half, with hairs 0.3-0.5 mm long; anthers 2-2.2 mm long, deep purple. Nectaries 5, hemispheric, glabrous. *Gynoecium* 7-8 mm long, yellow. *Fruit* 24-28 mm long, erect, discharge of *Erodium*-type; mericarps 5.6-6 mm long, 2-2.2 mm wide, without a strand of fibers, compressed at the apex, with 2 transverse ribs at apex, with basal beak 0.7-0.8 mm long, without a basal callus, without a basal prong, brown, with ± appressed, eglandular hairs 0.1-1 mm long; rostrum 17.2-20 mm long, without a narrowed apex, not twisted, with erect-patent, eglandular hairs 0.1-0.3 mm long; stigmatic remnants 1.2-2.5 mm long, with 5 hairy lobes. *Seeds* 3-3.6 mm long, 1.6-2 mm wide, finely reticulate, uniformly colored, brown, glabrous. Cotyledons with entire margin. Figs. 53, 54.

Pollen. *Geranium*-type (Velasco 1992b: 63).

Chromosome number. 2*n* = 28.

Phenology. Collected in flower from June to August.

Distribution. This species is endemic to northwestern Spain (Fig. 55).

Habitat. Crevices and on ledges of dolomite rocks, also close to rocks on substrates nitrogen-enriched by animal feces; 850-1650 m.

Additional specimens examined. **Spain.** León: pr. Ferradillo, 42º27'N, 6º39'W, 8 June 2015, *Aedo 22987* (MA); Montes Aquilianos, vertiente N de La Guiana, Los Apóstoles, 42º30'N, 6º36'W, 20 June 1981, *Alamillo & Nieto Feliner 134GN* (MA); Los Apóstoles, la Guiana, 42º30'N, 6º36'W, 26 July 1984, *Fernández & al. s.n.* (MA); Ponferrada, San Pedro de los Montes, Los Apóstoles, 42º30'N, 6º36'W, 1 Aug. 1935, *Font Quer & Rothmaler s.n.* (MA); Montes Aquilianos, vertiente N de La Guiana, Los Apóstoles, 42º30'N, 6º36'W, 11 June 1982, *Ibañez & Nieto 576GN* (MA); Montes Aquilianos, Los Apóstoles, 42º30'N, 6º36'W, 21 July 1972, *Laínz s.n.* (MA); Los Apóstoles, supra San Adrián de Valdueza, 42º30'N, 6º36'W, 17 June 1972, *Laínz s.n.* (MA); Priaranza del Bierzo, Ferradillo, 42º32'N, 6º38'W, 12 July 1981, *Lansac & Nieto Feliner 315GN* (MA); Montes Aquilianos, vertiente N de La Guiana, Los Apóstoles, 42º30'N, 6º36'W, 18 July 1982, *Nieto Feliner 768* (MA); e montibus aquilinis, 42º30'N, 6º36'W, *Pourret 2778* (MAF-P); S. P. de Mtes. [San Pedro de Montes], 42º30'N, 6º36'W, *Pourret s.n.* (MAF-P); S. P. de Mtes. [San Pedro de Montes], 42º30'N, 6º36'W, *Pourret s.n.* (MAF-P); Mtes [San Pedro de Montes], 42º30'N, 6º36'W, *Pourret s.n.* (MAF-P).

Discussion. Geranium dolomiticum is found only in a small area in the southeast of the Cantabrian Mountains. It has more deeply divided leaves than

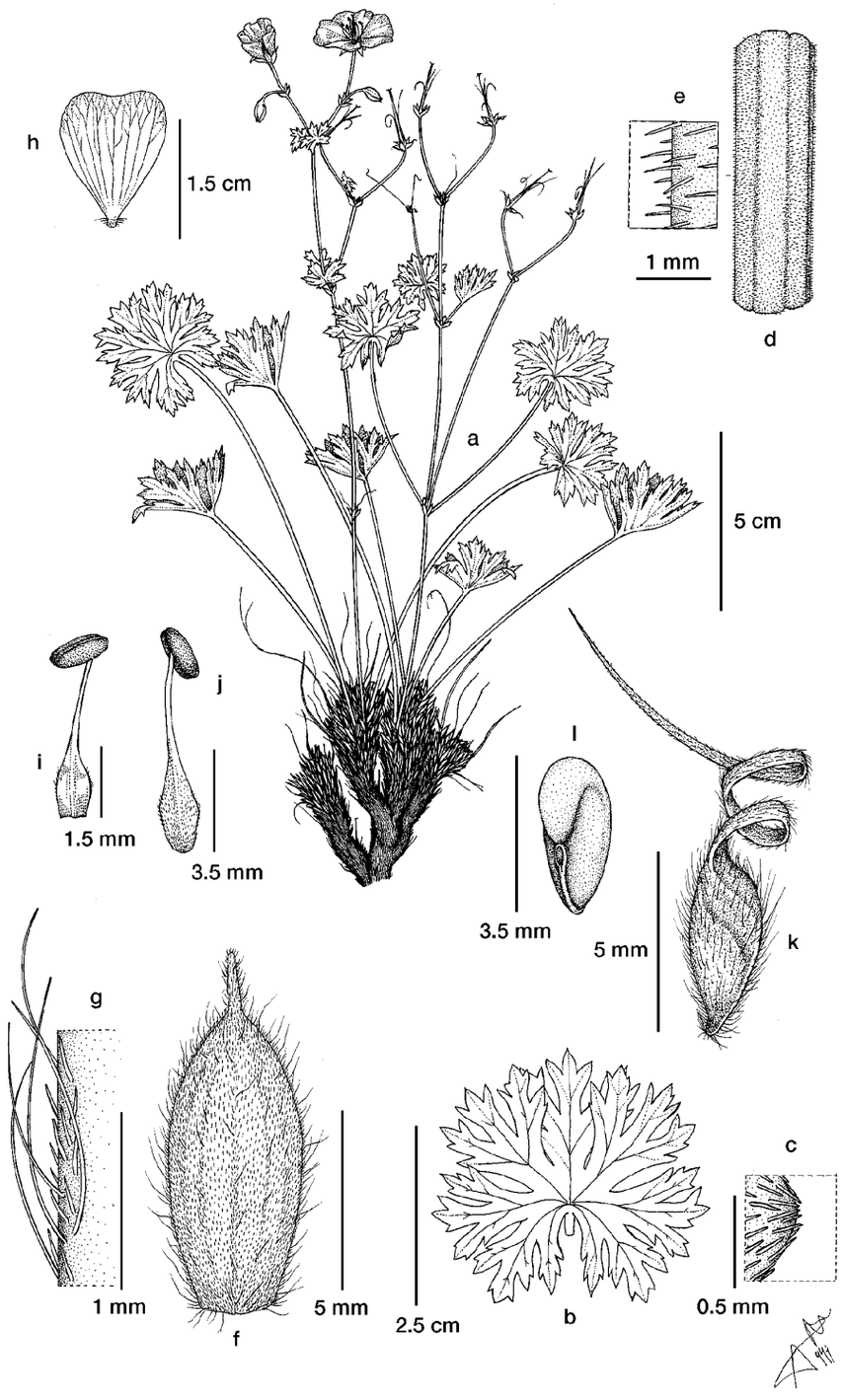


Fig. 53. *Geranium dolomiticum*. a. Habit. b. Leaf. c. Detail showing indumentum of leaf surface. d. Portion of peduncle. e. Detail showing indumentum of peduncle. f. Sepal. g. Detail showing indumentum of sepal. h. Petal. i. Stamen of outer whorl. j. Stamen of inner whorl. k. Mericarp. l. Seed. (Based on: *Aedo 2433*, MA).

Fig. 54. *Geranium dolomiticum* (Based on: *Aedo 22987*, MA).

Fig. 55. Distribution of *Geranium dolomiticum*.

other species of sect. *Subacaulia;* only one other Cantabrian taxon (*G. subargenteum*) and two Caucasian ones (*G. lazicum* and *G. ponticum*) have similar leaves. *Geranium dolomiticum* is also close to *G. subargenteum* in other features, such as the absence of the basal callus of the mericarp. The color of the staminal filaments and the indumentum of leaves and sepals separate the two species. As a historic consideration, it is worth noting that Pierre André Pourret (1754-1818) had collected this plant at the beginning of the 19th century near the place where *G. dolomiticum* was found by Rothmaler more than 100 years later. Unfortunately, Pourret never published his discoveries of new species in the northwestern Spain.

8. Geranium cazorlense Heywood, Bull. Brit. Mus. (Nat. Hist.), Bot. 1: 112. 1954. *Geranium cinereum* subsp. *cazorlense* (Heywood) Fern. Casas, Trab. Dep. Bot. Univ. Granada 1: 37. 1972. Type locality: "Prov. Jaén: Montes de Cazorla, Sierra de Pozo Alcón, Pico de Cabañas, near and under limestone arch, in limestone crevices, rocks, flowers white veined with violet, 1 July 1948, Heywood & Davis 447 (BM, holotype; C; E; K)". Type: Spain. Jaén, Montes de Cazorla, Sierra de Pozo Alcón, Pico de Cabañas, 37º48'N 2º56'W, 1 July 1948, *V.H. Heywood & P.H. Davis 447* (holotype, BM-000751350!; isotypes, C, E, K; according to Velasco 1992a, erroneously, also at MA).

Perennial herbs, 1-9 cm tall. *Rootstock* 5-8 mm in diameter, ± horizontal, not tuberculate, not turnip-shaped, without thickened roots. *Stem* prostrate, scapiform or subscapiform, not rooting at nodes, stolons absent, without vegetative stems, with patent to retrorse, appressed, eglandular hairs 0.1-0.2 mm long. *Basal leaves* in a persistent rosette, cauline leaves usually absent, sometimes 1(2) pairs, opposite; leaf laminas 1.1-2-2 cm long, 1.4-2-2 cm wide, not peltate, palmatifid [ratio main-sinus length/middle segment length = 0.60-0.82], polygonal in outline, base cordate, not coriaceous, with nerves not projected, pilose, with appressed, eglandular hairs on both surfaces; segments 5, in 1 plane, middle segment obtriangular, 4-7 mm wide at the base [ratio segment width at the base/middle segment length = 0.29-0.35], 3-lobed in distal half [ratio secondary sinus length/middle segment length = 0.13-0.33]; petioles up to 10 cm long, without abscission zone, terete, not swollen, not deflexed in age, with patent, eglandular hairs 0.3-0.8 mm long; stipules 3.2-7 mm long, 1.6-2 mm wide, lanceolate, free, papery, brown, with eglandular hairs on abaxial surface and on the margin, usually glabrous adaxially. *Cymules* 2-flowered, solitary [ratio cymule length/leaf length = 1-1.5]; peduncles 20-60 mm long, with patent, eglandular hairs 0.1-0.3 mm long; bracteoles 2-3.3 mm long, 0.7-1 mm wide, lanceolate, whorled; pedicels 20-45 mm long, with patent, eglandular hairs 0.1-1 mm long. Flowers actinomorphic. *Sepals* 6.5-7.4 mm long, 2.3-2.6 mm wide, lanceolate, smooth, not accrescent, nerves 3, mucro 0.3-0.4 mm long [ratio mucro length/sepal length = 0.05-0.07], with eglandular hairs 0.2-0.3 mm long on the abaxial surface (0.7-0.8 mm long on the margin), glabrous adaxially. *Petals* 10-11 mm long, 6-6.2 mm wide, erect-patent, emarginate (notch 1-1.5 mm deep), without claw, white or pink (without a dark basal spot), hairy on the base of the adaxial surface, glabrous abaxially, ciliate on the basal margin, with hairs 0.3-0.5 mm long. *Stamens*

10, both whorls bearing anthers; filaments 4-5.5 mm long, lanceolate with an abruptly narrowed apex (the expanded base of the inner whorl auriculate), yellow, pilose on the abaxial surface, ciliate on the proximal third, with hairs 0.3-0.4 mm long; anthers 1.4-1.5 mm long, deep purple. Nectaries 5, hemispheric, glabrous. *Gynoecium* 6-7 mm long, yellow. *Fruit* 18-19 mm long, erect, discharge of *Erodium*-type; mericarps 4-4.3 mm long, 1.5-1.6 mm wide, without a strand of fibers, compressed at the apex, with 1-2 transverse ribs at apex, with basal beak 0.1-0.3 mm long, without a basal callus, without a basal prong, brown, with ± appressed, eglandular hairs 0.5-1 mm long; rostrum 12-14 mm long, without a narrowed apex, not twisted, with erect-patent, eglandular hairs 0.1-0.3 mm long; stigmatic remnants 1.4-1.6 mm long, with 5 hairy lobes. *Seeds* 2.9-3 mm long, 1.5-1.6-mm wide, finely reticulate, uniformly colored, brown, glabrous. Cotyledons with entire margin. Figs. 56, 57.

Pollen. *Geranium*-type (Velasco 1992b: 62).

Chromosome number. 2*n* = 28.

Phenology. Collected in flower from June to August.

Distribution. This species is endemic to southeastern Spain (Fig. 58).

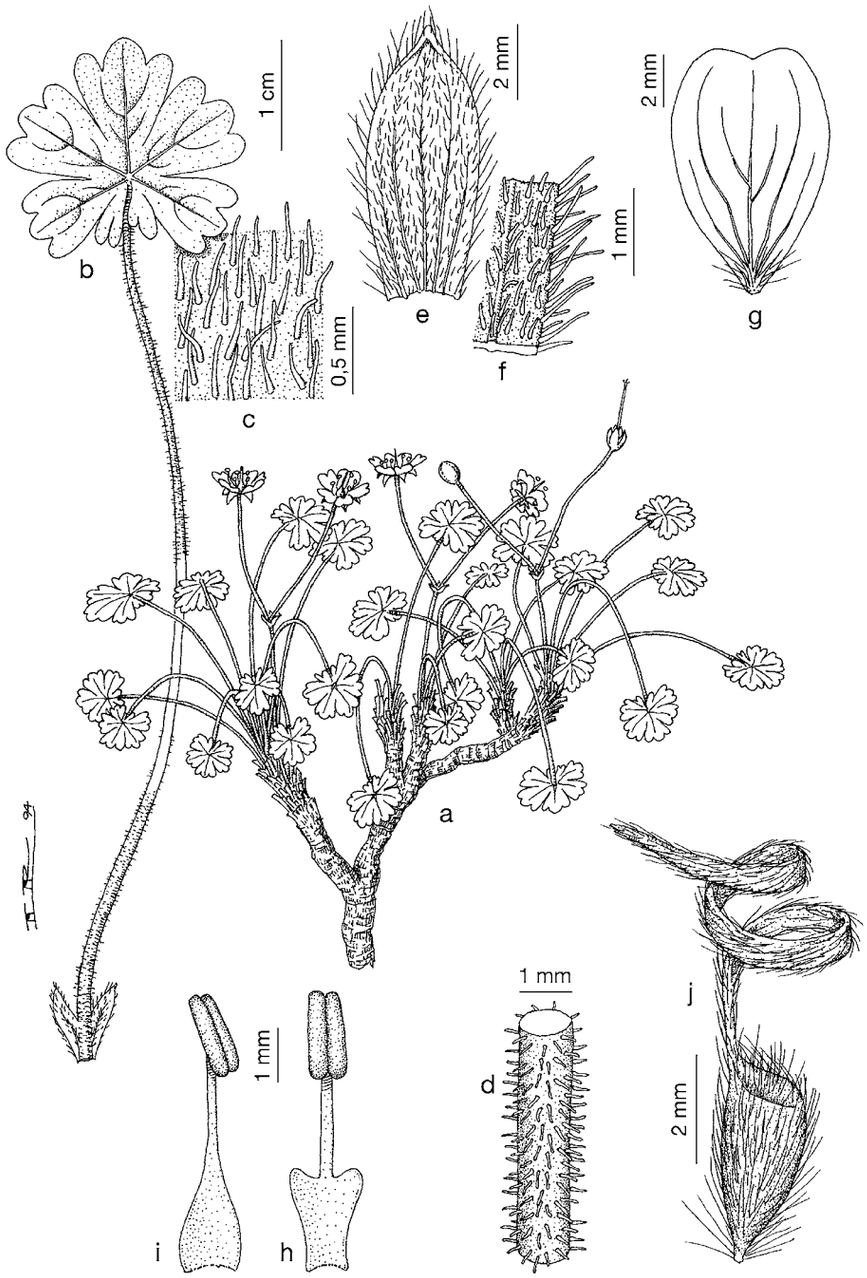


Fig. 56. *Geranium cazorlense*. a. Habit. b. Leaf. c. Detail showing indumentum of leaf surface. d. Portion of peduncle. e. Sepal. f. Detail showing indumentum of sepal. g. Petal. h. Stamen of outer whorl. i. Stamen of inner whorl. j. Mericarp. (Based on: a-i. *Castroviejo & Valdés Bermejo 2579*, MA; j. *Muñoz Garmendia & Soriano 3163*, MA).

Fig. 57. *Geranium cazorlense* (Based on: *Aedo 2587*, MA).

Fig. 58. Distribution of *Geranium cazorlense*.

Habitat. Crevices of limestone rocks; 1800-2050 m.

Additional specimens examined. **Spain.** Jaén: pico Cabañas, 37º48'N, 2º56'W, 20 July 1977, *Castroviejo & Valdés Bermejo 2579EV* (MA); Sierra Cazorla, pico de Cabañas, 37º48'N, 2º56'W, 23 July 1973, *Fernández Casas s.n.* (MA); Sierra de Cazorla, pico de Cabanos, 37º48'N, 2º56'W, 14 Sep. 1960, *Gibbs 205* (BM); Pozo Alcón, pico de Cabañas, 37º48'N, 2º56'W, 27 Sep. 1975, *González Rebollar & al. s.n.* (MA); Pozo Alcón, pico Cabañas, 37º48'N, 2º56'W, 20 June 1975, *González Rebollar & al. s.n.* (MA); Sierra Cazorla, pico de Cabañas, 37º48'N, 2º56'W, 24 July 1971, *Morales & Fernández Casas s.n.* (MA); Quesada, W del barranco de los Tornillos, pr. puerto Llano, 37º49'N, 2º56'W, 7 July 1976, *Muñoz Garmendia & Soriano 3163* (MA); Sierra Cazorla, pico de Cabañas, 37º48'N, 2º56'W, 6 Aug. 1968, *Segura Zubizarreta s.n.* (MA); Pozo Alcón, pico de Cabañas, 37º48'N, 2º56'W, 18 July 1980, *Soriano 1177* (MA); Pozo Alcón, pico de Cabañas, 37º48'N, 2º56'W, 27 Sep. 1979, *Soriano s.n.* (MA).

Discussion. Geranium cazorlense is found only in a small area in the southeast of Spain. It is probably related to G. *nanum.* Both have white or pale-pink petals (like *G. makmelicum)* and short leaves. The indumentum of the sepals and especially the auriculate staminal filaments serve to separate G. *cazorlense* from G. *nanum.*

---

9. Geranium nanum Coss. ex Batt. in Batt. & Trab., Fl. Algérie (Dicot.): 119. 1888. *Geranium pyrenaicum* var. *nanum* (Coss. ex Batt.) A. Terracc., Malphigia 4: 211. 1890. *Geranium cinereum* subsp. *nanum* (Coss. ex Batt.) Maire, Mém. Soc. Sci. Nat. Maroc 22: 9. 1930. Type locality: "Maroc" [according to Cosson (1882, tab. 103): "In montibus excelsis ad boreali-orientem urbis Maroc.--MAR. Dj. Ghat in ditione Aït Bou-Oulli provinciae Demnat (Ibr.). In imperio Maroccano hucusque tantum notum"]. Type: Morocco. prov. Demnat, montagne du territoire des Aït Bou-Oulli, Djebel Ghat, 31°35'N, 6°42'W, 28 July 1882, *A. Ibrahim s.n.* (lectotype, designated by Aedo 1996: 30, MPU-009258!; isolectotypes, BR-0000013347079 image!, FI!, G-00018762!, K-000417201!, LE!, P-00084486!, Z).

Perennial herbs, 1-5.5 cm tall. *Rootstock* 20-30 mm in diameter, ± horizontal, not tuberculate, not turnip-shaped, without thickened roots. *Stem* prostrate, scapiform or subscapiform, not rooting at nodes, stolons absent, without vegetative stems, with retrorse, appressed, eglandular hairs 0.1-0.2 mm long. *Basal leaves* in a persistent rosette, cauline leaves usually absent, sometimes 1 pairs, opposite; leaf laminas 0.8-1(2.6) cm long, 0.8-1(2.5) cm wide, not peltate, palmatifid [ratio main-sinus length/middle segment length = 0.75-0.85], orbicular in outline, base cordate, not coriaceous, with nerves not projected, pilose, with appressed, eglandular hairs on both surfaces; segments 5, in 1 plane, middle segment obtriangular, 1-1.5 mm wide at the base [ratio segment width at the base/middle segment length = 0.26-0.27], 3-lobed in distal half [ratio secondary sinus length/ middle segment length = 0.12-0.35]; petioles up to 3-4(9.5) cm long, without abscission zone, terete, not swollen, not deflexed in age, with retrorse, appressed, eglandular hairs 0.1-0.2 mm long; stipules 5-9 mm long, 1.2-2 mm wide, lanceolate, free, papery, brown, glabrous. *Cymules* (1)2-flowered, solitary [ratio cymule length/leaf length = 0.8-0.9]; peduncles 1-10 mm long, with retrorse, not appressed, eglandular hairs 0.1-0.2 mm long; bracteoles 1.5-3 mm long, 0.5-0.6 mm wide, lanceolate, whorled or opposite; pedicels absent or 25-30(45) mm long, with retrorse, ± appressed, eglandular hairs 0.1-0.2 mm long. Flowers actinomorphic. *Sepals* 4.3-6 mm long, 1.5-2.5 mm wide, lanceolate, smooth, not accrescent, nerves 3, mucro 0.25-0.3 mm long [ratio mucro length/sepal length = 0.07-0.09], with ± appressed, eglandular hairs 0.2-0.4 mm long on the abaxial surface (without long marginal hairs), glabrous adaxially. *Petals* (8)10-12 mm long, 6-8 mm wide, erect-patent, emarginate (notch 0.5 mm deep), without claw, white or pink (without a dark basal spot), hairy on the base of both surfaces, ciliate on the basal margin, with hairs 0.2-0.4 mm long. *Stamens* 10, both whorls bearing anthers; filaments 3-5 mm long, lanceolate, white, pilose on the abaxial surface, ciliate on the proximal half, with hairs 0.2-0.3 mm long; anthers 1-1.3 mm long, blue. Nectaries 5, hemispheric, glabrous. *Gynoecium* 4-5 mm long, white. *Fruit* 16 mm long, erect, discharge of *Erodium*-type; mericarps 4.5-5 mm long, 2.5 mm wide, without a strand of fibers, compressed at the apex, with 1-2 transverse ribs at apex, with basal beak ca. 0.7 mm long, with a basal callus, without a basal prong, brown, with ± appressed, eglandular hairs 0.2-0.6 mm long; rostrum ca. 10 mm long, without a narrowed apex, not twisted, with appressed, eglandular hairs 0.1-0.2 mm long; stigmatic remnants 1 mm long, with 5 hairy lobes. *Seeds* 3 mm long, 1 mm wide, finely reticulate, uniformly colored, brown, glabrous. Cotyledons not studied. Fig. 59, 60.

Pollen. *Geranium*-type (Bortenschlager 1967: 427).

Chromosome number. 2*n* = 26?, 28.

Phenology. Collected in flower from June to August.

Distribution. This species ranges from High Atlas to Middle Atlas, in Morocco (Fig. 61).

Habitat. Grassy or rocky places on limestone or igneous rocks; 2800-3600 m.

Additional specimens examined. **Morocco.** Jaurhomen (MPU); Gr. Atlas, Zania Achaural, Palacia? cal. de l'K?ka-a-Tazzert, 21 July 1934 (MPU). Béni Mellal-Khénifra: falaises calc. du Dj Azourki, 31°45'N, 6°18'W, 19 July 1934 (MPU); Tizi n'Ait Melal Djebel Ghat, 31°35'N, 6°42'W, 11 July 1936, *Balls B.3071* (BM); Aqqa n'Tazzagth, GA, Ahanasal, 32º6'N, 6º27'W, 19 June 1985, *Dobignard 3832* (G); S Beni Mellal & Oued Bougmez, High Atlas, N facing Irhil Ouaougoulzate, 31º39'N, 6º16'W,4 July 1966, *Harley 621* (BM); edge of scree slopes on S facing of Jbel Azourki, prov. Beni Mellal,

31°45'N, 6°18'W, 14 Aug. 1964, *Lloyd 212* (BM); Ghat, 31°35'N, 6°42'W, *Quezel s.n.* (MPU). Drâa-Tafilalet: Grand Atlas Oriental, Ari Ayachi, 32°27'N, 4°59'W, 29 July 1923, *Humbert 77* (MPU); Ayachi, J. Ayachi, E de Saïd-on-Ali, 32°27'N, 4°59'W, 17 Apr. 1965, *Mathez 3277* (MPU). Fès-Meknès: Atlas Medio, Jbel Bou Iblane, 33°38'N, 4°7'W, 24 June 1997, *Aedo & al. 4199* (MA); Moyen Atlas, chaîne du gaberrans, mont Bou-Nacer, 33°33'N, 3°53'W, 21 July 1929, *Emberger s.n.* (MPU); in Atlantis Medii montibus Bou Iblani, Mousa-ou-Salah, 33°39'N, 4°6'W, 22 June 1927, *Maire s.n.* (G, MPU); Bou Nacer, 33°33'N, 3°53'W, *Vilmorin s.n.* (MPU). Marrakesh-Safi: J. Toubkal by Neltner hut, 31°3'N, 7°55'W, 22 July 1973, *Davis 55483* (BM); refuge Neltner, W of Toubkal, 31°3'N, 7°55'W, 7 July 1966, *Lambert 104* (NY, SEV); Tifenout, Djebel Toubkal, vers S, 31°3'N, 7°55'W,2 6 July 1923, *Litardière s.n.* (G, MPU); M. Grand Atlas, Ourika, Dj Tack Oirt, 31°11'N, 7°46'W, 12 July 1921, *Maire s.n.* (MPU).

Discussion. Geranium nanum has very small leaves and quite often has the pedicels arising from the rootstock. These characteristics seem to be constant in populations at upper elevations, even in shaded habitats (3200 m, *Balls 307J,* BM!). At lower altitudes (2800 m, *Dovignard* 3832, G-301700!) *G. nanum* has considerably larger leaves, but other qual-

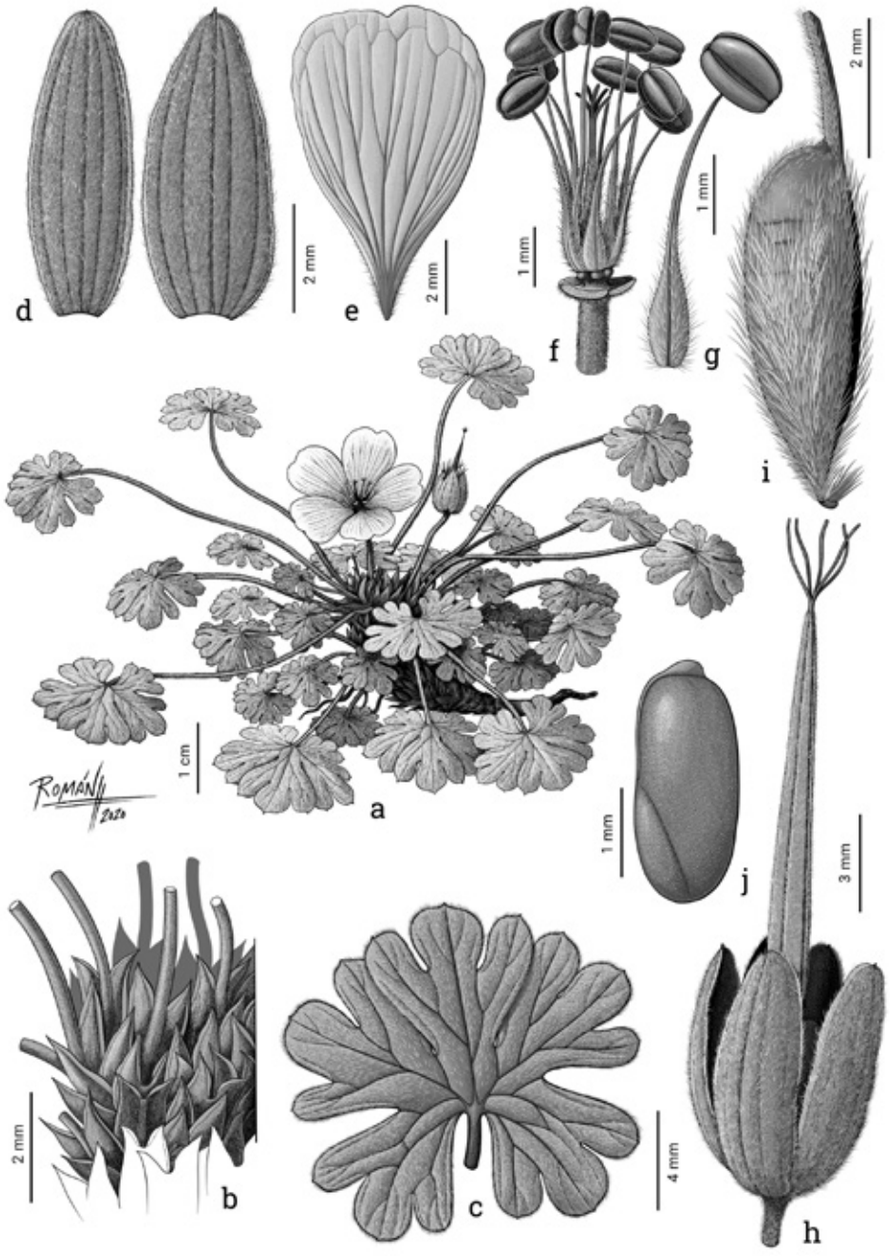


Fig. 59. *Geranium nanum.* a. Habit. b. Base of the stem. c. Leaf. d. Sepals. e. Petal. f. Flower without petals and sepals. g. Stamen. h. Fruit. i. Mericarp. j. Seed. (Based on: *Ibrahim s.n.*, P-4812335).

Fig. 60. *Geranium nanum* (Based on: *Aedo & al. 4199,* MA, photo: M. Sequeira).

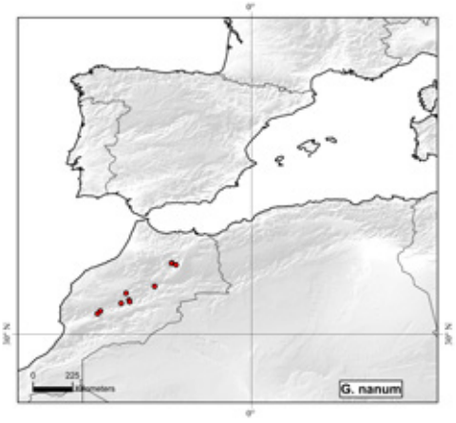


Fig. 61. Distribution of *Geranium nanum*.

itative characters of indumentum, leaves, and flowers are the same. Quézel (1957: 393) proposed *n* = 13 as the chromosome number for this species; however, Guittonneau (1975: 200), after studying plants from Quézel's locality (Ayachi), stated that *n* = 13 might be an incorrect number for *G. nanum.* Favarger & al. (1979: 34-35, 52) came to the same conclusion and proposed 2*n* = 28 as the only number for this species.

10. Geranium argenteum L., Cent. Pl. II: 25. 1756. Type locality: "Habitat in Baldi summis praeruptis rupibus Seguier". Type: Italy. "Habitat in Baldi summis praeruptis rupibus", 45º43'N, 10º50'E, *J.F. Séguier s.n.* (lectotype, designated by Aedo 1996: 39, LINN-858.67 image!).

Perennial herbs, 5-21 cm tall. *Rootstock* 6-8 mm in diameter, ± horizontal, not tuberculate, not turnip-shaped, without thickened roots. *Stem* prostrate, scapiform or subscapiform, not rooting at nodes, stolons absent, without vegetative stems, with retrorse, not appressed, eglandular hairs 0.2-0.4 mm long. *Basal leaves* in a persistent rosette, cauline leaves usually absent, sometimes 1(2) pairs, opposite; leaf laminas 1-1.8(4) cm long, 2.5-2.8(4) cm wide, not peltate, palmatisect, polygonal in outline, base cordate, not coriaceous, with nerves not projected, sericeous on both surfaces, with appressed, eglandular hairs; segments 5(7), in more than 1 plane, middle segment obtriangular, 1-2 mm wide at the base [ratio segment width at the base/middle segment length = 0.06-0.09], 3-lobed in distal half [ratio secondary sinus length/middle segment length = 0.35-0.59]; petioles up to 9 cm long, without abscission zone, terete, not swollen, not deflexed in age, with retrorse, appressed, eglandular hairs 0.2-0.3 mm long; stipules 12-14 mm long, 2.2-2.5 mm wide, lanceolate, free, papery, brown, with eglandular hairs on abaxial surface and on the margin, usually glabrous adaxially. *Cymules* 2-flowered, solitary [ratio cymule length/leaf length = 1.2-1.8]; peduncles 20-80(150) mm long, with retrorse, appressed, eglandular hairs 0.2-0.5 mm long; bracteoles 6-8 mm long, 1-1.5 mm wide, linear-lanceolate, whorled; pedicels 20-50 mm long, with retrorse, appressed, eglandular hairs 0.2-0.4 mm long. Flowers actinomorphic. *Sepals* 7-9 mm long, 3-4.5 mm wide, lanceolate, smooth, not accrescent, nerves 5, mucro 0.5-1.5 mm long [ratio mucro length/sepal length = 0.11-0.13], sericeous, with eglandular hairs 0.2-0.4 mm long on the abaxial surface (without long hairs on the margin), glabrous adaxially. *Petals* 14-15 mm long, 11-13 mm wide, erect-patent, emarginate (notch 0.5-1 mm deep), without claw, pink (without a dark basal spot), hairy on the base of the adaxial surface, glabrous abaxially, ciliate on the basal margin, with hairs 0.5-1 mm long. *Stamens* 10, both whorls bearing anthers; filaments 7-8 mm long, lanceolate with an abruptly narrowed apex, white, pilose on the abaxial surface, ciliate on the proximal half, with hairs 0.3-0.4 mm long; anthers 2.2-2.5 mm long, yellow with purplish lines. Nectaries 5, hemispheric, glabrous. *Gynoecium* 7-8 mm long, yellow. *Fruit* 25-27 mm long, erect, discharge of *Erodium*-type; mericarps 5.5-6.8 mm long, 2-2.2 mm wide, without a strand of fibers, compressed at the apex, with 1-2 transverse ribs at apex, with basal beak 0.7-1 mm long, with a basal callus, without a basal prong, brown, with appressed, eglandular hairs 0.5-2 mm long; rostrum 18-19 mm long, without a narrowed apex, not twisted, with appressed, eglandular hairs 0.2-0.3 mm long; stigmatic remnants 1.9-2.7 mm long, with 5 hairy lobes. *Seeds* 3.5-3.6 mm long, 1.9-2 mm wide, finely reticulate, uniformly colored, brown, glabrous. Cotyledons with entire margin. Figs. 62, 63.

Pollen. *Geranium*-type (Bortenschlager 1967: 427).

Chromosome number. 2*n* = 28.

Phenology. Collected in flower from June to September.

Distribution. This species ranges from southeastern France, through northern and central Italy to Slovenia (Fig. 64).

Habitat. Grassy slopes and ledges of limestone, dolomite, or igneous rocks; 1300-2700 m.

Representative specimens examined. **Italy.** Emilia-Romagna: mont Cimone, da Pian Cavallaro alla vetta Prati rocciosi, 44º12'N, 10º42'E, 12 Aug. 1988, *Foggi s.n.* (BM, FI). Trentino-Alto Adige: Tirolia austral, Val di Ledro, 45º56'N, 10º42'E, 8 Aug. 1881, *Porta s.n.* (B, JE, LD); Valsugana in montibus di Tesino, Tyr. it, 46º3'N, 11º28'E, *Ambrosius s.n.* (B, G, RO); Seiser Alm, Dolomiten, 46º32'N, 11º35'E (JE); M Cavallo Belluni, 46º34'N, 12º0'E, Aug., *Kellner s.n.* (RO, W). Tuscany: Pania della Croce, versanye NE, 44º2'N, 10º19'E, 1 July 1969, *Romagnoli s.n.* (FI); Emilia, in monte Corno alle Scale, rupi e vaccinieti dall'arrivo della seggiovia a Punta la Sofia, 44º7'N, 10º49'E, 6 Aug. 1987, *Foggi s.n.* (FI). Veneto: monte Baldo, Coal Santo, 45º41'N, 10º49›E, *20* Aug. 2013, *Aedo 20891* (MA); Venetia, in rupestribus Mt. Serva?, 46º12'N, 12º12'E, 4 Aug. 1873, *Huter & Porta s.n.* (JE). **France.** Provence-Alpes-Côte d'Azur: Basses Alpes, montagne de Boule près Digne, 44º10'N, 6º29'E, Aug. (B); Basses Alpes, montagne des Boules au-dessus de la forêt de Faye-Feu, pr. Digne, 44º10'N, 6º29'E, 3 Aug. 1855, *Jayet s.n.* (BM, G, JE, LE); Hautes Alpes, Chaillol, près Gap, 44º44'N, 6º12'E, Aug., *Garnier s.n.* (BM). **Slovenia.** Gorizia: Krain, am Gipfel des Cerna prst bei Feistritz in der Wochein, 46º13'N, 13º54'E, 20 Aug. 1886, *Engelhardt s.n.* (BM); copiose in summo monte Cerná prst, Wochein, Carniolia, 46º13'N, 13º54'E, 19 July 1886, *Polák s.n.* (JE); monte Nero, 46º16'N, 13º36'E, 29 June 1970, *Feoli s.n.* (MA); Littorale, Alpe Slieme Vrch pr. Tolmino, 46º16'N, 13º36'E, 4 Aug. 1873, *Marchesetti s.n.* (JE, LD); Alpes Julicae, in pratis alpinis montis Krn, 46º16'N, 13º36'E, 16 July 1959, *Wraber s.n.* (B).

Discussion. Geranium argenteum is a very distinctive species always easily identified by its sericeous palmatisect leaves with very deeply 3-lobed segments. It is unlikely to be confused with any other species. It has been reported from three isolated areas: a) southern French Alps; b) northwest of

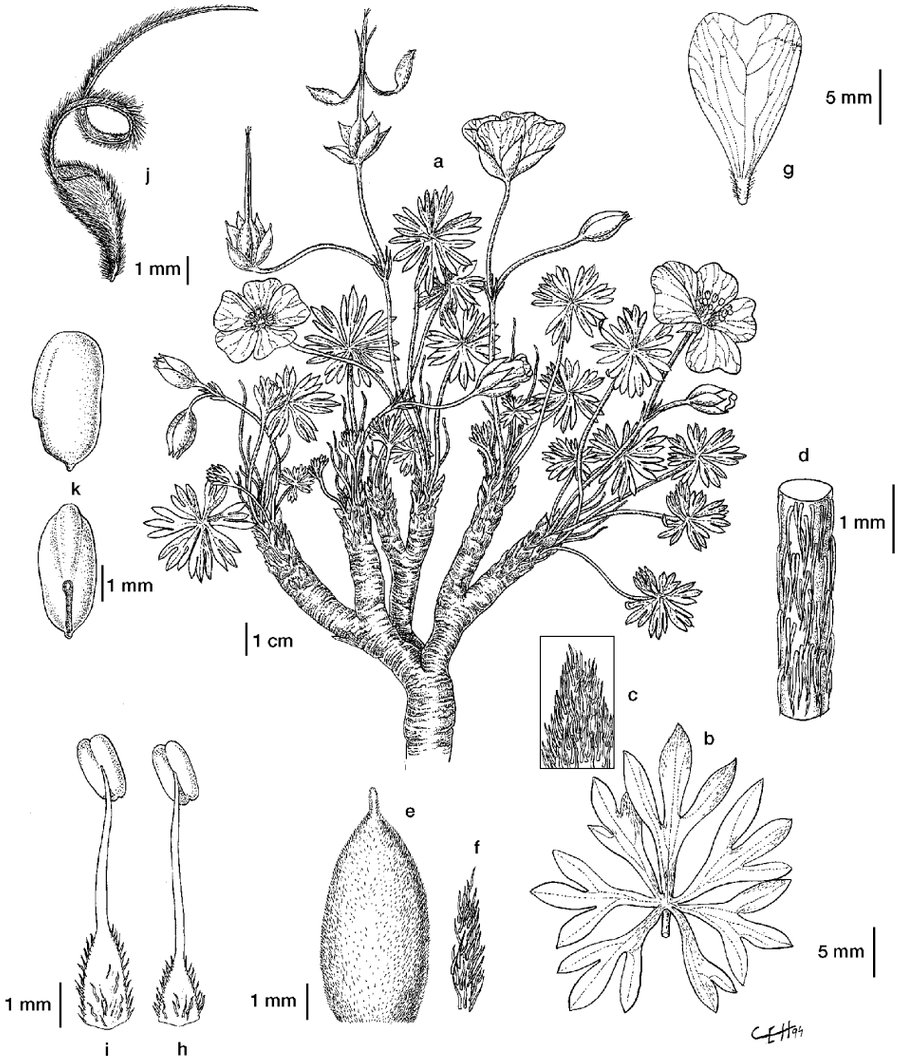


Fig. 62. *Geranium argenteum*. a. Habit. b. Leaf. c. Detail showing indumentum of leaf surface. d. Portion of peduncle. e. Sepal. f. Detail showing indumentum of sepal. g. Petal. h. Stamen of outer whorl. i. Stamen of inner whorl. j. Mericarp. k. Seed, two views. (Based on: a, *Porta s.n.*, *8 Aug. 1881*, JE; b-k, *Aeschiman 3036*, G).

Fig. 63. *Geranium argenteum* (Based on: *Aedo 20891*, MA).

the Apennines; c) Slovenian Alps and northeastern Italy. Octavianio's locality (Bertoloni 1850: 225), which would be the southernmost for the species, "ex Umbria in montibus delle Fonti prope il Sasso Borghese" (42°50'N, 13°18'E), has been reported by many authors (Chiarugi 1937: 639; Favarger 1975: 39; Ferrarini 1967: 379; Fiori & Paoletti 1901: 238; Parlatore 1873: 137). I did not see any material from the Abruzzo mountains, and I agree with Pignatti (1982: 6) that this locality must be confirmed.

Fig. 64. Distribution of *Geranium argenteum*.

11. Geranium austroapenninum Aedo, Anales Jard. Bot. Madrid 52(1): 105. 1994. Type locality: "Scanno (Italia, Abruzzo, Chieti), Coppo del Campitello, alt. 1880-1920 m, 12 juillet 1978; leg. C. Ricceri & C.H. Steinberg, the upper specimen; isotypus: B, MA 252448, MA 359090; G 201480. This plant was distributed by the Société pour l'Échange des Plantes Vasculaires de l'Europe Occidentale et du Bassin Méditerranéen with the n.° 9398, as *Geranium cinereum* Cav. subsp. *subcaulescens* (DC.) Hayek...". Type:

Italy. Scanno, Abruzzo, Chieti, Coppo del Campitello, 41°53'N, 13°52'E, 12 July 1978, *C. Ricceri & C.H. Steinberg s.n.* [distributed by the Société pour l'Échange des Plantes Vasculaires de l'Europe Occidentale et du Bassin Méditerranéen as no. 9398] (holotype, G-201480!; isotypes, B!, BR-0000005109289 image!, C!, MA-252448!, MA-359990!, FI!).

Geranium argenteum var. *lucanum* N. Terracc., Nuov. Giorn. Bot. Ital. ser. 2, 14: 137. 1907. Type locality: "Salinice". Type: Italy. Basilicata, Salinice, 40º45'N, 15º28'E, *N. Terracciano s.n.* (no original material located, NAP?, Aedo 1996: 39).

Perennial herbs, 5-20 cm tall. *Rootstock* 5-12 mm in diameter, ± horizontal, not tuberculate, not turnip-shaped, without thickened roots. *Stem* prostrate, scapiform or subscapiform, not rooting at nodes, stolons absent, without vegetative stems, with usually patent, eglandular hairs 0.1-0.3 mm long. *Basal leaves* in a persistent rosette, cauline leaves usually absent, sometimes 1(2) pairs, opposite; leaf laminas 1.4-2.8 cm long, 1.6-3 cm wide, not peltate, palmatifid [ratio main-sinus length/middle segment length = 0.6-0.7], polygonal in outline, base cordate, not coriaceous, with nerves not projected, pilose, with appressed, eglandular hairs on both surfaces; segments 5(7), in 1 plane, middle segment obtriangular, 2-5 mm wide at the base [ratio segment width at the base/middle segment length = 0.06-0.09], 3-4(5)-lobed in distal half [ratio secondary sinus length/middle segment length = 0.17-0.41]; petioles up to 10 cm long, without abscission zone, terete, not swollen, not deflexed in age, with patent, eglandular hairs 0.1-0.3 mm long; stipules 5-7 mm long, 0.9-2 mm wide, lanceolate, free, papery, brown, with eglandular hairs on abaxial surface and on the margin, glabrous adaxially. *Cymules* 2-flowered, solitary [ratio cymule length/leaf length = 1.2-1.8]; peduncles 40-120 mm long, with patent, eglandular hairs 0.1-0.5 mm long; bracteoles 4-5 mm long, 0.8-1 mm wide, lanceolate, whorled; pedicels 20-55 mm long, with patent, eglandular hairs 0.1-0.5 mm long. Flowers actinomorphic. *Sepals* 8-9 mm long, 2.5-3.5 mm wide, lanceolate, smooth, not accrescent, nerves 3(5), mucro 0.7-1.1 mm long [ratio mucro length/sepal length = 0.11-0.13], with eglandular hairs 0.1-0.5 mm long on the abaxial surface (0.7-1 mm long on the margin), glabrous adaxially. *Petals* 14-15 mm long, 9-10 mm wide, erect-patent, emarginate (notch 1-1.1 mm deep), without claw, purple (without a dark basal spot), glabrous on both surfaces, ciliate on the basal margin, with hairs 0.3-0.7 mm long. *Stamens* 10, both whorls bearing anthers; filaments 6-7 mm long, lanceolate, purple, pilose on the abaxial surface, ciliate on the proximal third, with hairs 0.2-0.3 mm long; anthers 2-2.5 mm long, yellow. Nectaries 5, hemispheric, glabrous. *Gynoecium* 8-9 mm long, yellow. *Fruit* 32-35 mm long, erect, discharge of *Erodium*-type; mericarps 7-8 mm long, 1.6-2.5 mm wide, without a strand of fibers, compressed at the apex, with 1-2 transverse ribs at apex, with basal beak 1-1.1 mm long, with a basal callus, without a basal prong, brown, with ± appressed, eglandular hairs 1-1.2 mm long; rostrum 23-25 mm long, without a narrowed apex, not twisted, with subappressed, eglandular hairs 0.2-0.3 mm long; stigmatic remnants 1.5-2.1 mm long, with 5 usually glabrous lobes. *Seeds* 4.5-5 mm long, 1.5-2 mm wide, finely reticulate, uniformly colored, brown, glabrous. Cotyledons with entire margin. Figs. 65, 66.

Pollen. Ornamentation not studied.

Chromosome number. Unknown.

Phenology. Collected in flower from June to July.

Distribution. This species ranges through central and southern Apennines, in Italy (Fig. 67).

Habitat. Grassy or rocky places on limestone; 1500-2000 m.

Additional specimens examined. **Italy.** E montibus regno napolitano, *Moricand s.n.* (G). Abruzzo: L'Aquila, Gole di Sagittario, carretera de Anversa a Villalago, 41°49'N, 13º56'E, 4 July 2002, *Herrero & al. 2073* (MA); Abruzzo, L'Aquila, Gioia dei Marsi, Vallone Lampazo, 41º50'N, 13º44'E, 4 July 2002, *Herrero & al. 2018* (MA); in saxosis montis Sirente in Aprutio, 42º9'N, 13º37'E, *Groves s.n.* (C); Montes Sirente, 42º9'N, 13º37'E, July, *Groves s.n.* (BM); Mt. Canale of the Sirente Longo, 42º9'N, 13º37'E, *Groves s.n.* (E); M. Sirente, Cal. Orient, in herbosis subalpinis ad Breccialone, 42º9'N, 13º37'E, 20 July 1882, *Levier s.n.* (G). Basilicata: Calabria, Piani di Pollino, base di Serra delle Ciovole, 39º54'N, 16º11'E, 25 June 1994, *Bernardo s.n.* (CLU); Appennino-calabro-lucano, M. Pollino, pr. Piano di Pollino, 39º54'N, 16º11'E, 23 July 1935, *Gavioli s.n.* (BM, MA); Calabria, m. Pollino, in pascuis saxosis Piani di Pollino, 39º54'N, 16º11'E, 5 July 1898, *Rigo s.n.* (B, G); Calabria, m. Pollino in pascuis saxosis loco i Piani, 39º54'N, 16º11'E, 26 July 1906, *Rigo s.n.* (JE); Calabria, montis Pollino, 39º54'N, 16º11'E, July, *Rigo s.n.* (B, BM, E, G, JE, LD, LE, MA); piano di Pollino, 39º54'N, 16º11'E, July 1885, *Terracciano s.n.* (RO); du mont Pollino in Calabro, 39º54'N, 16º11'E, *Thomas s.n.* (G). Campania: monte Motola, Salerno, al Coenzzo di Motola, 40º22'N, 15º26'E, 18 July 1919, *Lacaita s.n.* (BM); M. Cerealto, Avellino, 40º47'N, 15º8'E, 20 June 1908, *Lacaita 219/08* (BM). Molise: Matese, 41º27'N, 14º23'E, Aug., *Pedicino s.n.* (MA); Matese a m. Miletto, 41º27'N, 14º23'E, July 1821, *Terracciano s.n.* (WU).

Discussion. Specimens of sect. *Subacaulia* from the central and southern Apennines here assigned to *G. austroapenninum* traditionally have been considered conspecific with the Pyrenean *G. cinereum* (Bertoloni 1850: 225; Fiori & Paoletti 1901: 238; Parlatore 1873: 138; Tenore 1820: 101). More recently these specimens have been identified as *G. cinereum* subsp. *subcaulescens* (Davis & Roberts 1955: 21; Pignatti 1982: 6). Curiously, Terracciano (1890), in his *Specie rare o critiche di geranii italiani,* did not deal with this difficult group. The plants from the southern and central Apennines that I examined differ from *G. cinereum* by the dense patent hairs on petioles, peduncles and pedicels the deep purple staminal filaments, and the more deeply divided leaves with 3-5 lobes per segment. *Geranium cinereum* has sparse, retrorse, appressed hairs (especially on petioles, peduncles, and pedicels), yellow staminal filaments, and less deeply divided leaves with

usually 3-5-lobes per segment. In addition, plants of *G. austroapenninum* can also be distinguished from *G. subcaulescens* by the petals, which lack a dark basal spot, the color of the staminal filaments and stigmas, and the more deeply divided leaves. *Geranium subcaulescens* has petals with a dark basal spot, very dark purple staminal filaments and stigmas, and leaves with usually 3 lobes per segment. In view of these differences I recognized the Italian populations as a separate species (Aedo 1994).

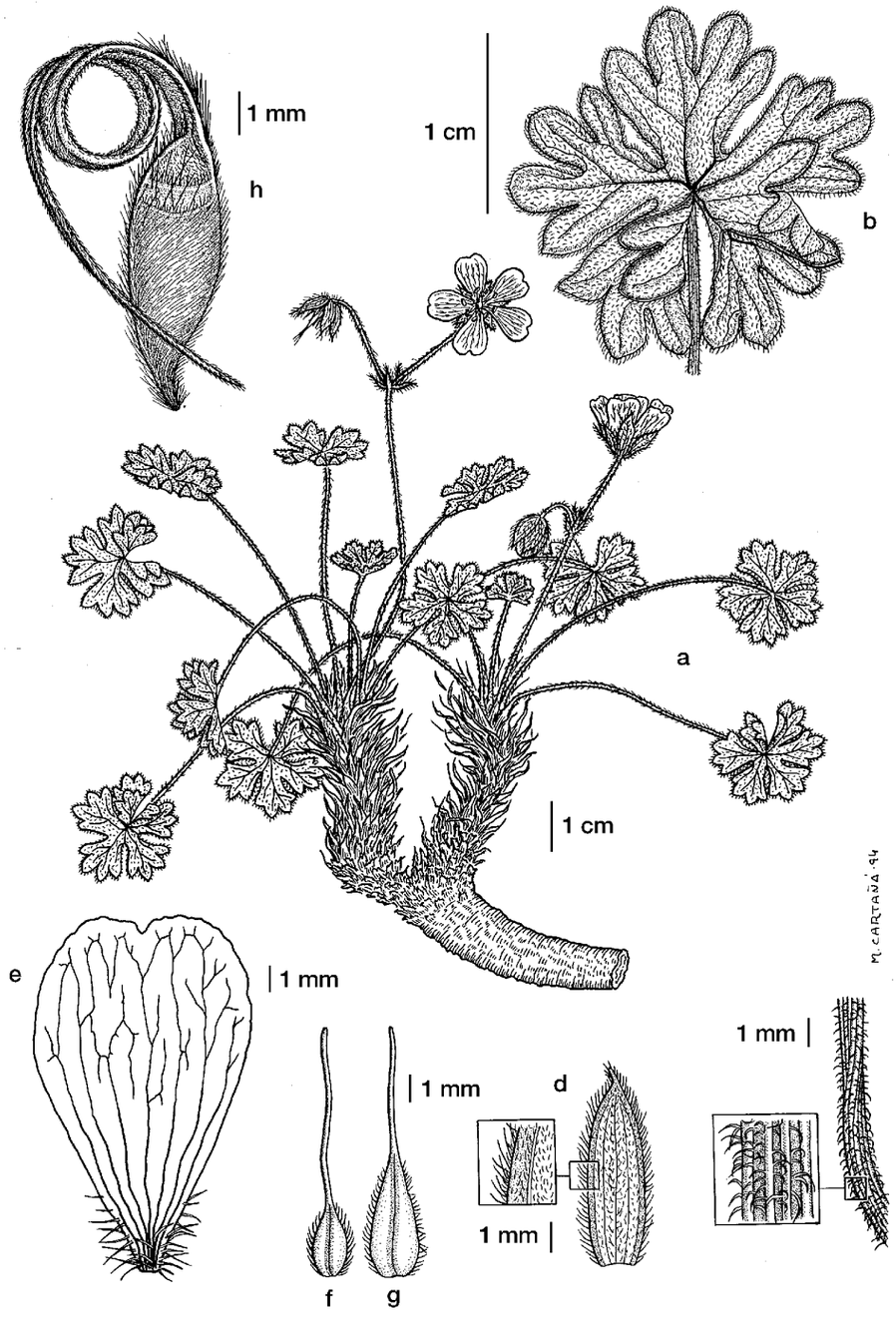


Fig. 65. *Geranium austroapenninum*. a. Habit. b. Leaf. c. Portion of peduncle and detail showing indumentum. d. Sepal and detail showing indumentum. e. Petal. f. Staminal filament of outer whorl. g. Staminal filament of inner whorl. h. Mericarp. (Based on: *Ricceri & Steinberg s.n., 12 July 1978*, B).

Fig. 66. *Geranium austroapeninnum* (Based on: *Herrero & al. 2018,* MA).

Fig. 67. Distribution of *Geranium austroapenninum*.

12. Geranium subcaulescens L'Hér. ex DC., Prodr. 1: 640. 1824. *Geranium cinereum* var. *subcaulescens* (L'Hér. ex DC.) R. Knuth in Engl., Pflanzenr. IV.129 (Heft 53): 92. 1912. *Geranium cinereum* subsp. *subcaulescens* (L'Hér. ex DC.) Hayek, Repert. Spec. Nov. Regni Veg. Beih. 30: 572. 1925. TYPE LOCALITY: "in summo monte Parnas-

so, Sibthorp. G. asphodeloïdes fl. gr. prod. 2. p. 40. ic t. 661... (v. s.)". Type: Greece. In summo monte Parnasso, 38º32'N, 22º35'E, *H. Sibthorp s.n.* (lectotype, designated by Aedo 1996: 45, G-DC-214987!; isolectotype?, OXF color slide!).

Geranium subcaulescens var. *major* Hausskn., Mitth. Thüring. Bot. Vereins 5: 64. 1893. Type locality: "in saxosis alpinis m. Ghavellu et Karava abunde". Type: Greece. In summi montis Karava, 39º18'N, 21º34'E, 1 July 1885, *C. Haussknecht s.n.* (lectotype, designated by Aedo 1996: 45, JE!; isolectotype, LE!).

Geranium subcaulescens var. *minor* Hausskn., Mitth. Thüring. Bot. Vereins 5: 64. 1893. Type locality: "in saxosis alpinis m. Ghavellu et Karava abunde". Type: Greece. In summi montis Karava, 39º18'N, 21º34'E, 1 July 1885, *C. Haussknecht s.n.* (lectotype, designated by Aedo 1996: 45, JE!).

Geranium humbertii Beauverd, Bull. Soc. Bot. Genève 31: 447. 1940. Type locality: "... au sommet du Kaïmaktchalan... ". Type: Greece. Massif du Kaïmaktchalan, Macedonia, 40º54'N, 21º50'E, Sep. 1938, *H. Humbert & S. Topali 68* (lectotype, designated by Aedo 1996: 45, G!).

Geranium cinereum subsp. *macedonicum* Micevski, Maced. Acad. Sci. Arts Contr. I 2: 27. 1980. *Geranium cinereum* var. *macedonicum* Micevski, Maced. Acad. Sci. Arts Contr. I 2: 27. 1980. Type locality: "Jugoslavia: Macedonia: Bistra, in saxosis calcareis, 1620 m. s.m. (29. 6. 1978, leg. et. det. K. Micevsky)". Type: North Macedonia. Bistra, 41°31'N, 20°42'E, 29 June 1978, *K. Micevski s.n.* (holotype, SKO!).

Geranium cinereum var. *rupestris* Micevski, Maced. Acad. Sci. Arts Contr. I 2: 26. 1980. Type locality: "Jugoslavia: Macedonia: Mt. Galičica- Stara Galičica, in saxosis calcareis, 1950 m (23. vii 1980, leg. et. det. K. Micevski)". Type: North Macedonia. Mt. Galičica-Stara Galičica, 40°58'N, 20°51'E, 23 Aug. 1980, *K. Micevski s.n.* (holotype, SKO).

Perennial herbs, 5-30 cm tall. *Rootstock* 5-15 mm in diameter, ± horizontal, not tuberculate, not turnip-shaped, without thickened roots. *Stem* prostrate, scapiform or subscapiform, not rooting at nodes, stolons absent, without vegetative stems, with usually patent, eglandular hairs 0.1-0.3 mm long. *Basal leaves* in a persistent rosette, cauline leaves usually absent, sometimes 1(2) pairs, opposite; leaf laminas 1.2-3.2 cm long, 1.2-3.1 cm wide, not peltate, palmatifid [ratio main-sinus length/middle segment length = 0.70-0.80], polygonal in outline, base cordate, not coriaceous, with nerves not projected, pilose, with appressed, eglandular hairs on both surfaces; segments 5(7), in 1 plane, middle segment obtriangular, 2-4 mm wide at the base [ratio segment width at the base/middle segment length = 0.30-0.38], 3(5)-lobed in distal half [ratio secondary sinus length/middle segment length = 0.13-0.26]; petioles up to 12 cm long, without abscission zone, terete, not swollen, not deflexed in age, with patent, eglandular hairs 0.2-0.7 mm long; stipules 5-8 mm long, 2-2.2 mm wide, lanceolate, free, papery, brown, with eglandular hairs on abaxial surface and on the margin, glabrous adaxially. *Cymules* 2-flowered, solitary [ratio cymule length/leaf length = 1.6-2.3]; peduncles 30-100(170) mm long, with usually patent, eglandular hairs 0.1-0.3 mm long; bracteoles 2-10 mm long, 0.5-1 mm wide, lanceolate to linear, whorled; pedicels 20-50 mm long, with patent, eglandular hairs 0.1-0.4 mm long. Flowers actinomorphic. *Sepals* 8-9 mm long, 2.5-3.5 mm wide, lanceolate, smooth, not accrescent, nerves 5, mucro 1-1.5 mm long [ratio mucro length/sepal length = 0.14-0.20], with erect-patent, eglandular hairs 0.1-0.8 mm long on the abaxial surface, glabrous adaxially. *Petals* 12-14 mm long, 9-11 mm wide, erect-patent, slightly emarginate (notch 0.5-0.6 mm deep), without claw, purple (with a dark basal spot), glabrous on both surfaces, ciliate on the basal margin, with hairs 0.4-0.8 mm long. *Stamens* 10, both whorls bearing anthers; filaments 4-6 mm long, lanceolate, dark purple, pilose on the abaxial surface, ciliate on the proximal third, with hairs 0.1-0.2 mm long; anthers 2-2.5 mm long, dark purple. Nectaries 5, hemispheric, glabrous. *Gynoecium* 7-8 mm long, dark purple. *Fruit* 30-37 mm long, erect, discharge of *Erodium*-type; mericarps 7-8 mm long, 1.8-2.5 mm wide, without a strand of fibers, compressed at the apex, smooth (with 1-2 transverse veins at the apex), with basal beak 1 mm long, with a basal callus, without a basal prong, brown, with ± appressed, eglandular hairs 0.1-1 mm long; rostrum 21-28 mm long, without a narrowed apex, not twisted, with ± appressed, eglandular hairs 0.1-0.3 mm long; stigmatic remnants 1.3-2 mm long, with 5 usually glabrous lobes. *Seeds* 3.5-4 mm long, 1.5-2 mm wide, finely reticulate, uniformly colored, brown, glabrous. Cotyledons with entire margin. Figs. 68, 69.

Pollen. Ornamentation not studied.

Chromosome number. 2*n* = 28, 56.

Phenology. Collected in flower from May to August.

Distribution. This species ranges from Croatia and Montenegro, through Albania, Kosovo and North Macedonia to southern Greece (Fig. 70).

Habitat. Grassy or rocky places, usually on limestone rocks; 700-2500 m.

Additional specimens examined. **Albania.** Berat: yugo Baldenes m. Olycika supra Dodonam distr. Janina?, 40º38'N, 20º9'E, 17 June 1896, *Baldacci 308* (BM, G). Dibër: Korat, 41°39'N, 20°10'E, July, *Behr s.n.* (MA). Gjirokastër: in glaerosis ad nives delicuescentes m. Kaudaoiz (?ivas), 40°17'N, 20°1'E, 25 July 1892, *Baldacci 118* (G, RO). Korçë: Melesinë, above Lescovik, 40º9'N, 20º34'E, 19 June 1933, *Alston & Sandwith 1767* (BM). Kukës: Kalis, Korab, alpine wiesen gegen Radomir, 41º50'N, 20º21'E, 6 July 1918, *Dörfler 829* (LD); subalpine Weiden am Südabhang der Gjalica Ljums, 42º0'N, 20º28'E, 17 June 1918, *Zerny s.n.* (W). **Croatia.** Split-Dalmatia: Mt. Mosor, Spalato, 43º31›N, 16º38'E, 2010, *Conti s.n.* (APP). **Greece.** Central Greece: Parnassus, 38º32'N, 22º37'E, 2 Aug. 1938, *Davis 327* (E); Aetolia adjecta, m. Korak, 38º42'N, 22º5'E, Aug., *Heldreich s.n.* (G); Katafigon, Ypati, Oeta, 38º50'N, 22º20'E, 11 June 1937, *Balls & Balfour s.n.* (E); Vilugo in Aetolien, 38º55'N, 21º51'E (E). Central Macedonia: Pieria edge of treeline on main peak, 40º14'N, 22º11'E, 26 Apr. 1943, *Akeroyd 114* (E); nom. Pellis, Mt. Tzena, summit area, 41º8'N, 22º14'E, 19 July 1981, *Farsakoglou & al. 19264* (G). Epirus: Eparchia Karditsa, Berg Galátsi ca 4 km SW Stefaniás, 39º14'N, 21º18'E, 17 Sep. 180, *Binder & al. 307* (B); Epirus, Mt. Olytsika, 39º30'N, 20º46'E, July, *Gui-*

ol 1101 (BM); Pindus Mts., Epirus, Peristeri, open E-W, N-facing slopes, 39°40'N, 21°8'E, 3 Aug. 1964, *Archibald 446* (E); monte Peristeri, pico Tsoukarela, cadena Lakmos, 39°41'N, 21°7'E, 30 June 2007, *Castroviejo & al. 18317* (MA); Ioanninon, Mt. Timfi, 5 km E of Papigon, 2 km E the peak Astraka, 39°56'N, 20°51'E, 26 Aug. 1980, *Franzén & Akeroyd 188* (LD); Ioanninon, Mt. Smolikas, Dracolimni, 40°4'N, 20°54'E, 28 June 2007, *Gonzalo & al. 750* (MA); Epirus, Macedonia, distr. Konisa/Kastoria, Mts. Grammos, 40°19'N, 20°47'E, 14 Aug. 1976, *Greuter 14349* (B, G). Peloponnese: Lakonia, Mt. Taygetos, 1 km NE of the summit Prof. Ilias, 37°7'N, 22°19'E, 19 July 1980, *Franzén & Baden 4* (LD); Peloponeso, Korinthia, Kilini, 37°55'N, 22°24'E, 22 June 2007, *Herrero & al. 3363* (MA); Achaia, Mt. Chelmos, 4 km SSW of the village of Zarouhla, 37°59'N, 22°12'E, 1 Aug. 1980, *Franzén & Baden 44* (LD); in m. Panachaïco supra Patras, 38°10'N, 21°54'E, 28 May 1878, *Heldreich 2192* (LD). Thessaly: Thessalia pindica, in monte Voutsikaki, 39°17'N, 21°38'E, 28 May 1961, *Pinatzi 17195* (G); in reg. alpina montis Avgo, Epirus, 39°29'N, 21°23'E, 19 Aug. 1934, *Regel s.n.* (G); in m. Ossa, Thessaliae, 39°48'N, 22°41'E, July, *Heldreich s.n.* (JE); Thessalia, m. Olympos, in declivibus austro-occidentalibus circa refugium B, 40°4'N, 22°23'E, 26 July 1970, *Rechinger 38722* (G). West Macedonia: mountains above Pisoderion, slopes of Belavoda, 40°48'N, 21°15'E, 31 May 1932, *Alston & Sandwith 591* (BM); Macedonia occ., prov. Pella, eparhia Almopia, Mts. Kaimaktsalan, NE Osmanakos, 40°54'N, 21°50'E, 12 Aug. 1977, *Greuter 15680* (G); Macedonia occ., distr. Almopia, in vertice montis Pinovo seu Kozuf supra Pefkoto, 41°6'N, 22°6'E, 20 Aug. 1976, *Greuter 14605* (B, G). **Kosovo.** Ferizaj: Sar Planina, 26 km E of Prizren above the ski center 5 km SE Brecovica, NW face sloping pr. the peaks Livadica, 42°10'N, 21°1'E, 15 Aug. 1982, *Hartvig & al. 10044* (B, G). Prizren: Popova Sapka, NE des Hotelkomplexes, ca. 10 km W von Tetovo, 41°59'N, 20°49'E, 1991, *Baltisberger & Schäppi 12250* (ZT); Tetovo, montes Sar Planina, inter Popova Sapka et Titov Vrh, 41°59'N, 20°49'E, 1 July 1982, Černoch *39275* (B, C, G, MA, MAF); NW Macedonia, Sar Planina 10 km WSW of Tetovo, 2 km S ski-center Popova Sapka, 41°59'N, 20°49'E, 27 Aug. 1981, *Franzén & al. 936* (B, G). **Montenegro.** Bar: ad summum yugum m. Lisinj, 42°10'N, 19°10'E, 5 July 1891, *Baldacci 104* (G). **North Macedonia.** in monte Scardo, Schar-dagh, occid., in reg. alpina cacuminis Kobelitza, 13 Aug. 1917, *Bornmüller 479* (JE). Pelagonia: Galicica planina, N-facing slopes S the pass on the road Trpejca and Otesevo, 40°58'N, 20°51'E, 22 July 1979, *Frost-Olsen 2455* (MA); grasland auf Kalk?, Galicica pass, SR Macedonija, 40°58'N, 20°51'E, 16 July 1978, *Röthlisberger s.n.* (G). Polog: Bistra Planina, S of Mavrovo, E of the road Mavrovo-Galicnik above the timber-line, 41°31'N, 20°42'E, 16 July 1979, *Frost-Olsen 2299* (MA); Bistra Planina, SW of Marovo, 3.5 km E. road Marovo to Galicnik along the trail S of the skilifts area, 41°38'N, 20°43'E, 17 July 1984, *Frost-Olsen 6484* (MA). Skopje: in reg. alp. cac. Pepelak, alp. Golesnica-pl., 41°46'N, 21°32'E, 20 June 1918, *Bornmüller 3680* (JE). Southwestern: 8 km SE of Ohrid, 41°4'N, 20°51'E, 10 July 1971, *Chater 313* (BM); Stogovo Planina tra Dibra e Kicevo, mt. Kanesc, 41°27'N, 20°38'E, 24 June 1941, *Pichi Sermolli 12561* (FI).

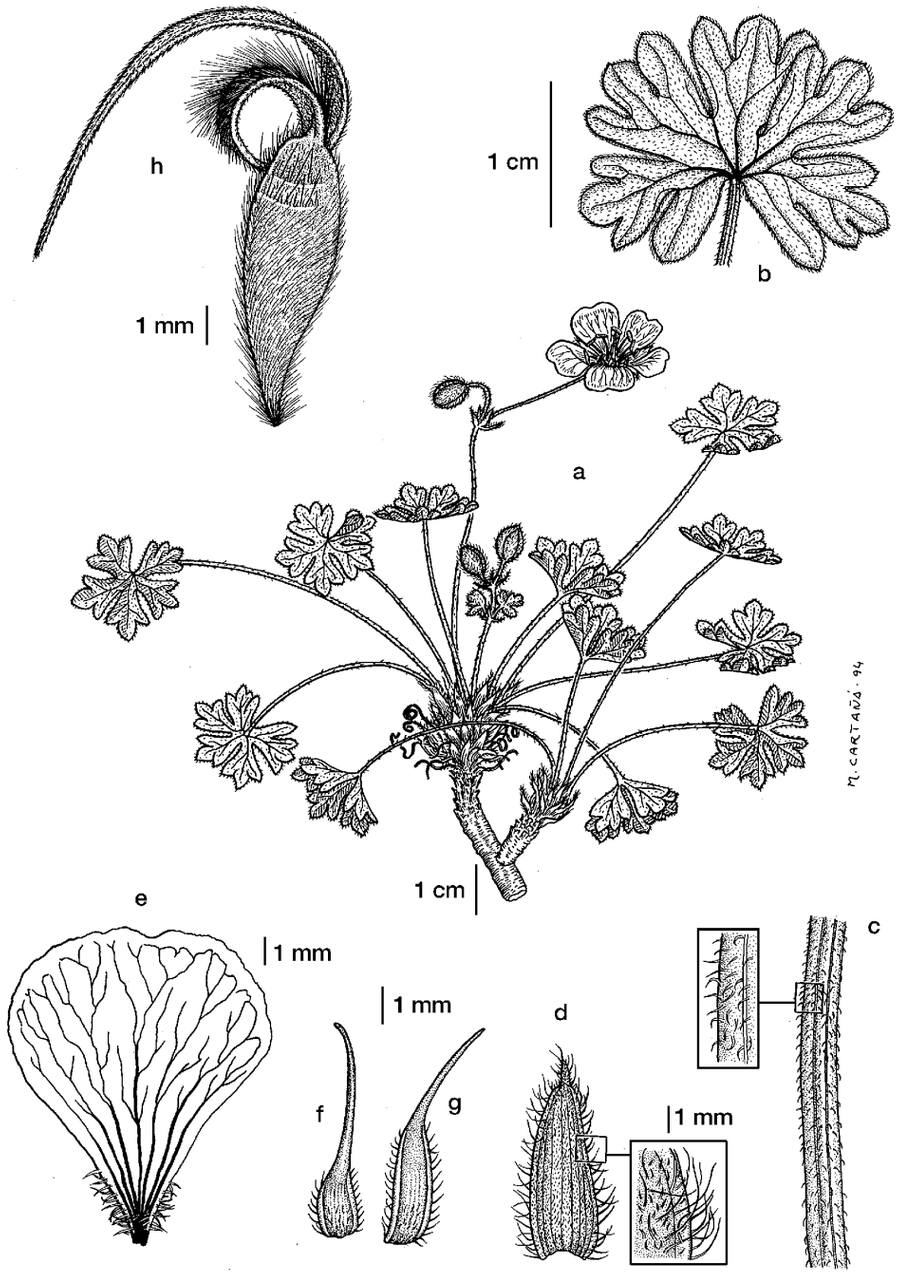


Fig. 68. *Geranium subcaulescens*. a. Habit. b. Leaf. c. Portion of peduncle and detail showing indumentum. d. Sepal and detail showing indumentum. e. Petal. f. Staminal filament of outer whorl. g. Staminal filament of inner whorl. h. Mericarp. (Based on: *Heldreich 26*, LE).

Fig. 69. *Geranium subcaulescens* (Based on: a-c, *Herrero & al. 3363*, MA; d, *Castroviejo 18317,* MA).

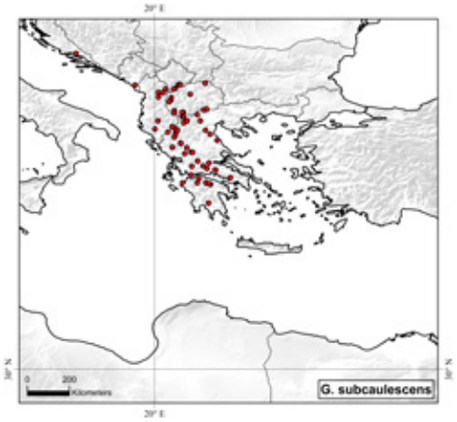


Fig. 70. Distribution of *Geranium subcaulescens*.

Discussion. According to some authors this Balkan species grows also in Turkey and Lebanon (Boissier 1867: 872; Mouterde 1966: 435), while others believe that it reaches the Apennines in Italy (see under *G. austroapenninum*). The inclusive circumscription is supported by Davis (1967: 471), who recognizes *G. subcaulescens* as subspecies of *G. cinereum* (and all the Turkish taxa as varieties). However, I maintain that there are two endemic Balkan species: *G. thessalum*, with 1- 2-lobed leaf segments and pale flowers, and *G. subcaulescens,* with more deeply divided leaves and a typical dark spot on the petals. The following describes the most notable variability of *G. subcaulescens.* The orientation of the hairs of the petiole, peduncle, and pedicel has been considered a useful character in other species of sect. *Subacaulia,* but it is too variable a feature in *G. subcaulescens.* As a general rule this species has patent hairs; however, among plants from Mount Ossa and Mount Peristéri (northern Thessalia, Greece) I have found specimens with both patent and retrorse hairs. Northward, especially in Macedonian localities, retrorse hairs are also common. The sepal hairs are short and appressed on the surface and long and ± patent on the margin; however, in some localities (as in northern Macedonia) I found plants with only short and appressed hairs on the surface but none on the margin. Thus, the variation of the indumentum does not fit a geographic pattern and should not be used to segregate any local taxa. The dark basal spot on the petal is usually very large and covers the proximal third. Yet, in some cases it is much smaller and restricted to the very base of the petal (usually in poorly prepared specimens); thus, a light (or white) strip separates the two zones. Persson (1987: 541) may have referred to this when he stated: "In Peloponnisos and Sterea Ellas specimens of *G. subcaulescens* with white-based petals are quite common, and specimens with pink petals can also be found". Furthermore, I have found that very dark purple staminal filaments, anthers, and stigmas are closely correlated with the dark basal spot of the petals. I found two anomalous collections (*Guiol s.n.,* BM; *Heldreich s.n.,* E), from Mount Cithaeron (southeastern Greece), which lack dark pigmentation in the petals, staminal filaments, anthers, and stigmas. I believe that a local loss of pigmentation has become stabilized in peripheral populations of *G. subcaulescens;* obviously, these plants are difficult to separate from *G. subacutum. G. subcaulescens* is closely related to *G. austroapenninum* and *G. subacutum.* I did not recognize any of them at the subspecific rank, because they do not intergrade in areas of contact.

Baltisberger (1993: 12) reported 2*n* = 56 in *G. subcaulescens* from northern Macedonia, which is the only tetraploid number reported in subg. *Erodioidea.* I examined the voucher *(Baltisberger* & *Schappi 12250,*

ZT) and some others collections from the same locality, and found that they do not differ from typical representatives of *G. subcaulescens.*

13. Geranium thessalum Franzén, Nordic J. Bot. 2(6): 549, 550 fig. 1 A-E. 1983 [Jan. 1983]. Type locality: "Orig. coll.: Greece, Nom. Kozanis, Mt Siniatsikon (Askion), 6 km SEE of the village of Vlasti. Stony calcareous soils, 1750-2100 m. 28 Jun 1979. L.-Å Gustavsson & R. Franzén 8063 (LD holotype; ATH, B, C isotypes)". Type: Greece. Nom. Kozanis, Mt. Siniatsikon (Askion), 6 km SEE of the village of Vlasti, 40°24'N, 21°33'E, 28 June 1979, *L.-Å Gustavsson & R. Franzén 8063* (holotype, LD-1005277!; isotypes, ATH, B-10-0277729!, C).

Geranium cinereum var. *liskensis* Micevski, Maced. Acad. Sci. Arts Contr. I 2: 28. 1980. Type locality: "Jugoslavia: Macedonia: Illinska Planina, in saxosis calcareis sub cacuminis Liska, 1780 m.s.m. (27.7.1980, leg. et. det. K. Micevski)". Type: North Macedonia. Ilinska Planina, 41°18'N, 20°57'E, 27 July 1980, *K. Micevski s.n.* (holotype, SKO!).

Geranium cinereum var. *pallidum* Micevski, Maced. Acad. Sci. Arts Contr. I 2: 29. 1980. Type locality: "Jugoslavia: Macedonia: Kičevo, mt. Baba Sač, in saxosis calcareis, 1100-1400 m.s.m. (26.6.1980, leg. et. det. K. Micevski)". Type: North Macedonia: Kičevo, mt. Baba Sač, 41°26'N, 21°6'E, 26 June 1980, *K. Micevski s.n.* (holotype, SKO!).

Perennial herbs, 5-19 cm tall. *Rootstock* 10-16 mm in diameter, ± horizontal, not tuberculate, not turnip-shaped, without thickened roots. *Stem* prostrate, scapiform or subscapiform, not rooting at nodes, stolons absent, without vegetative stems, with usually patent, eglandular hairs 0.2-0.3 mm long. *Basal leaves* in a persistent rosette, cauline leaves usually absent, sometimes 1-2 pairs, opposite; leaf laminas 1.8-2.8 cm long, 2.1-3.7 cm wide, not peltate, palmatifid [ratio main-sinus length/middle segment length = 0.65-0.80], polygonal in outline, base cordate, not coriaceous, with nerves not projected, pilose above and sericeous beneath, with appressed, eglandular hairs; segments 5(7), in 1 plane, middle segment obtriangular, 2-3 mm wide at the base [ratio segment width at the base/middle segment length = 0.26-0.28], (1)2(3)-lobed in distal half [ratio secondary sinus length/middle segment length = 0-0.18]; petioles up to 7(10) cm long, without abscission zone, terete, not swollen, not deflexed in age, with retrorse, appressed, eglandular hairs 0.1-0.2 mm long; stipules 4-6 mm long, 2-2.3 mm wide, lanceolate, free, papery, brown, with eglandular hairs on abaxial surface and on the margin, glabrous adaxially. *Cymules* 2-flowered, solitary [ratio cymule length/leaf length = 1.2-1.3]; peduncles 60-80 mm long, with usually appressed, eglandular hairs 0.2-0.4 mm long; bracteoles 4-5 mm long, 1-1.1 mm wide, linear-lanceolate, whorled; pedicels 40-60(100) mm long, with retrorse, appressed, eglandular hairs 0.1-0.2 mm long. Flowers actinomorphic. *Sepals* 8-9(10) mm long, 2.5-3 mm wide, lanceolate, smooth, not accrescent, nerves 5, mucro 0.7-1.2 mm long [ratio mucro length/sepal length = 0.13-0.14], sericeous, with appressed, eglandular hairs 0.2-0.4 mm long on the abaxial surface (without long hairs on the margin), glabrous adaxially. *Petals* (12)16-17 mm long, 10-12 mm wide, erect-patent, slightly emarginate (notch 0.5 mm deep), without claw, purple (without a dark purple basal spot), glabrous on the adaxial surface, ciliate on the basal margin, with hairs 0.3-0.5 mm long. *Stamens* 10, both whorls bearing anthers; filaments 4.5-6 mm long, lanceolate with an abruptly narrowed apex, yellow, pilose on the abaxial surface, ciliate on the proximal third, with hairs 0.3-0.5 mm long; anthers 2-2.5 mm long, yellow. Nectaries 5, hemispheric, glabrous. *Gynoecium* 5-6 mm long, yellow. *Fruit* 32-33 mm long, erect, discharge of *Erodium*-type; mericarps 7-7.5 mm long, 2-2.1 mm wide, without a strand of fibers, compressed at the apex, with (0)1 transverse rib at apex, with basal beak 1 mm long, with a basal callus, without a basal prong, brown, with ± appressed, eglandular hairs 0.7-1 mm long; rostrum 22-24 mm long, without a narrowed apex, not twisted, with ± appressed, eglandular hairs 0.1-0.2 mm long; stigmatic remnants 1.8-2 mm long, with 5 glabrous lobes. *Seeds* 4-4.1 mm long, 1.5-2 mm wide, finely reticulate, uniformly colored, brown, glabrous. Cotyledons with entire margin. Figs. 71, 72.

Pollen. Ornamentation not studied.

Chromosome number. Unknown.

Phenology. Collected in flower from June to August.

Distribution. This species ranges from North Macedonia to northern Greece (Fig. 73).

Habitat. Rocky limestone slopes; 1100-2100 m.

Additional specimens examined. **Greece.** West Macedonia: Kozanis, Mt. Siniatsikon (Askion), 6 km SSE of the village of Vlasti, 40°24'N, 21°33'E, 30 Aug. 1980, *Franzén 240* (LD); nom. Kozani, Mt. Siniatsikon, 6 km SSE of the Vlasti, 40°24'N, 21°33'E, 30 Aug. 1980, *Franzén s.n.* (B); nom. Kozani, eparchia Vojos, Askion (Siniatsikon) Massiv, östlich von Namata, 40°24'N, 21°33'E, 21 Aug. 1983, *Hagemann & al. 1246* (B); eparchia Vojos, Askion (Siniatsikon) Massiv, östlich von Namata, 40°24'N, 21°33'E, 22 Aug. 1983, *Hagemann & al. 1269* (B); Kozani, Askio, monte Siniatsikon, por encima de Námata, 40°24'N, 21°32'E, 1 July 2007, *Herrero & al. 3600* (MA); Kozani, Askio, monte Siniatsikon, por encima de Námata, 40°24'N, 21°32'E, 1 July 2007, *Herrero & al. 3648* (MA).

Discussion. Geranium thessalum was discovered by Micevski (1980: 29), who described it as *G. cinereum* var. *pallidum*. Later, Franzén (1983: 549) proposed the new heterotypic name at the specific level, perhaps because he was unaware of Micevski's paper. This species is easily distinguished from *G. subcaulescens*. Although clearly a member of sect. *Subacaulia*, it does not have an obvious sister-species. I saw only the type of the taxon described as *G. cinereum* var. *liskensis* but no additional collections. It is very similar to *G. thessalum*, particularly in its elliptic 2-lobed leaf segments, but

differs in its very dark purple staminal filaments. I include Micevski's variety in *G. thessalum* with some hesitancy. Persson (1987: 541) refers to a plant perhaps related to *G. thessalum*, collected in Dhouskon (northern Greece, pr. Albania boundary, *Hartvig 896*). Unfortunately, I was not able to examine any specimen of this collection, since I did not find any duplicates of Hartvig's number at B, C, or G; ATH did not respond to my loan request.

14. Geranium subacutum (Boiss.) Aedo, Anales Jard. Bot. Madrid 52(1): 106. 1994. *Geranium subcaulescens* var. *subacutum* Boiss., Fl. Orient. 1: 872. 1867. *Geranium cinereum* var. *subacutum* (Boiss.) Bég. & Diratz., Contr. Fl. Armenia: 67. 1912. *Geranium cinereum* f. *subacutum* (Boiss.) R. Knuth in Engl., Pflanzenr. IV.129 (Heft 53): 94. 1912. Type locality: "Hab. in Cappadociâ in monte Argaeo (Auch. exs. 2104! Bal!), alpibus Ponti (Ky Suppl. 788!), Armeniâ in rupibus supra Gumuschkhané (Bourg!)". Type: Turkey. Mont Argée, 38°32'N, 35°27'E, 9 July 1956, *B. Balansa 1036* (lectotype, designated by Davis & Roberts 1955: 22, G-00365995!; isolectotype, K-000729480!).

Geranium subcaulescens var. *leucophaeum* Hausskn. & Bornm. ex Bornm., Mitth. Thüring. Bot. Vereins 20: 11. 1905. *Geranium cinereum* var. *leucophaeum* (Hausskn. & Bornm. ex Bornm.) R. Knuth in Engl., Pflanzenr. IV.129 (Heft 53): 94. 1912. *Geranium subcaulescens* subvar. *leucophaeum* (Hausskn. & Bornm. ex Bornm.) Bornm., Repert. Spec. Nov. Regni Veg. Beih. 89(3): 183. 1938. Type locality: "Anatolia or.: Amasia, in fisuris rupium summi montis Sanadagh. 1600-1650 m. s. m.; legi 15. VI. 1889 (no. 945b) et 15. V. 1890 (no. 953b, 2890)". Type: Turkey. Sana dag, 40º31'N, 35º53'E, 15 May 1889, *J. Bornmüller 954* (lectotype, designated by Aedo 1996: 54, JE-00019502!; isolectotypes, BM!, G!, LD!, LE-00014591!, W!).

Geranium cinereum var. *pisidicum* Peşmen & Güner, Notes Roy. Bot. Gard. Edinburgh 36: 36. 1978. Type locality: "Turkey. C3 Konya: dist. Beysehir, Kurucuova, above Suludere, E slope of Dedegöl Da., 1500-2000 m, calcareous alpine pasture, 8 VI 1975, H. Peşmen & A. Güner 2209". Type: Turkey. Beysehir, Kurucuova, above Suludere, E slope of Dedegöl Da., 37º40'N, 31º17'E, 8 June 1975, *H. Peşmen & A. Güner 2209* (holotype, HUB!; isotype, E!).

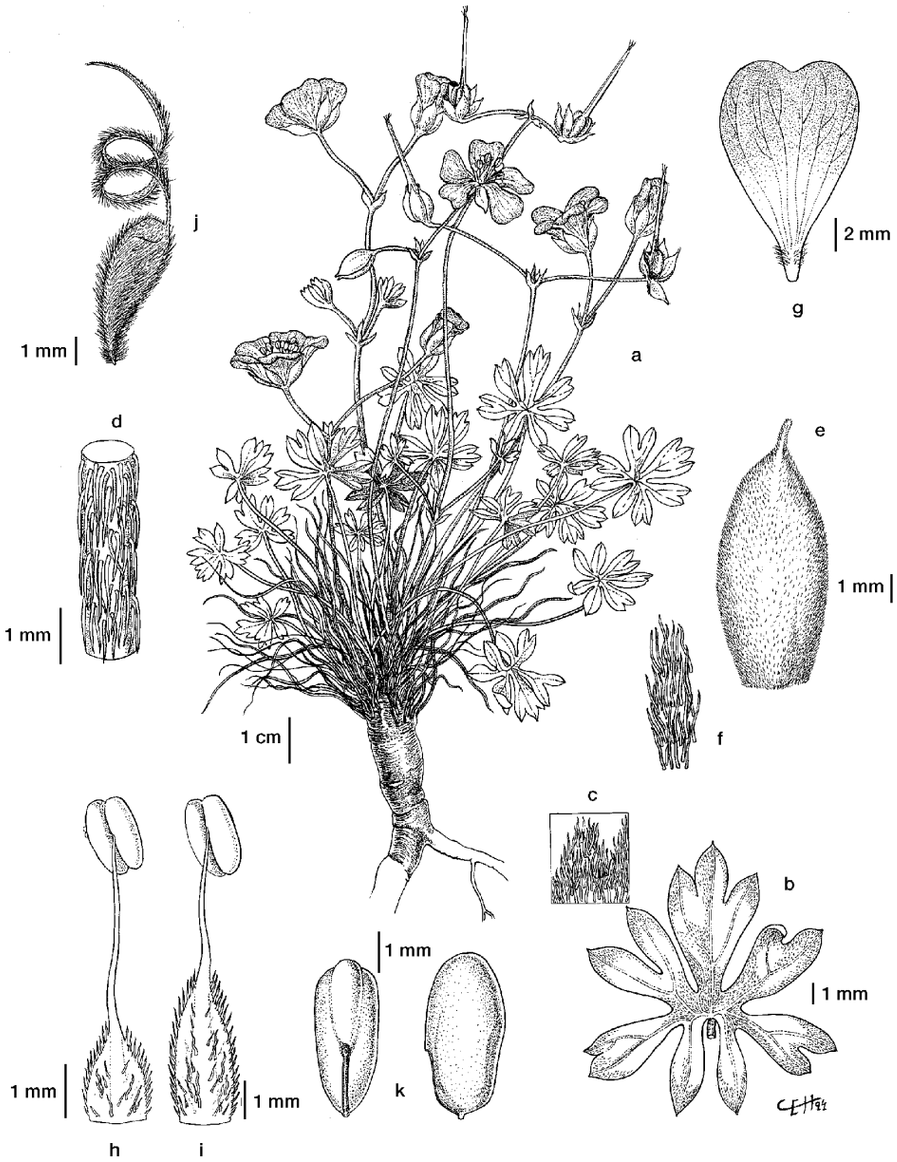


Fig. 71. *Geranium thessalum*. a. Habit. b. Leaf. c. Detail showing indumentum of leaf surface. d. Portion of peduncle. e. Sepal. f. Detail showing indumentum of sepal. g. Petal. h. Stamen of outer whorl. i. Stamen of inner whorl. j. Mericarp. (Based on: *Hagemann el al. 1246*, B).

Perennial herbs, 5-16 cm tall. *Rootstock* 5-20 mm in diameter, ± horizontal, not tuberculate, not turnip-shaped, without thickened roots. *Stem* prostrate, scapiform or subscapiform, not rooting at nodes, stolons absent, without vegetative stems, with usually patent, eglandular hairs 0.1-0.4 mm long. *Basal leaves* in a persistent rosette, cauline leaves usually absent, sometimes 1-3 pairs, opposite; leaf laminas 1.6-3.4 cm long, 2.3-3.6 cm wide, not peltate, palmatifid [ratio main-sinus length/ middle segment length = 0.55-0.75], polygonal in outline, base cordate, not coriaceous, with nerves not projected, pilose, with appressed, eglandular hairs on both surfaces; segments 5(7), in 1 plane, middle segment obtriangular, 2-3 mm wide

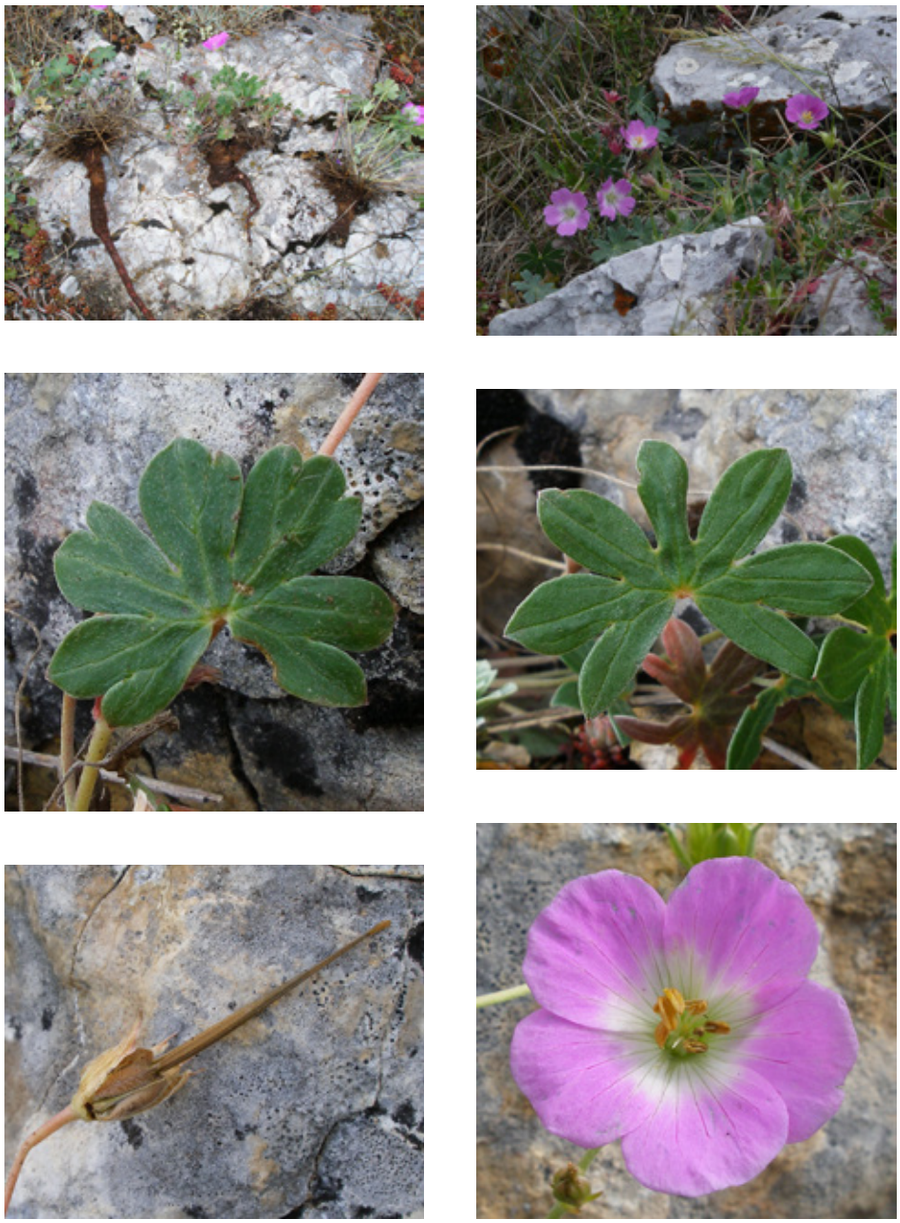


Fig. 72. *Geranium thessalum* (Based on: *Herrero & al. 3600*, MA).

Fig. 73. Distribution of *Geranium thessalum*.

at the base [ratio segment width at the base/middle segment length = 0.21-0.24], (1)3-lobed in distal half [ratio secondary sinus length/middle segment length = 0.13-0.31]; petioles up to 12 cm long, without abscission zone, terete, not swollen, not deflexed in age, with usually patent, eglandular hairs 0.2-0.4 mm long; stipules 6-7 mm long, 1.1-2 mm wide, lanceolate, free, papery, brown, with eglandular hairs on abaxial surface and on the margin, glabrous adaxially. *Cymules* 2-flowered, solitary [ratio cymule length/leaf length = 1.6-1.8]; peduncles 30-80 mm long, with usually patent, eglandular hairs 0.2-0.4 mm long; bracteoles 3-4 mm long, 0.5-1 mm wide, linear-lanceolate, whorled; pedicels 20-45 mm long, with usually patent, eglandular hairs 0.2-0.4 mm long. Flowers actinomorphic. *Sepals* 6-9(11) mm long, 2.5-3.5 mm wide, lanceolate, smooth, not accrescent, nerves 5, mucro 0.3-2 mm long [ratio mucro length/sepal length = 0.17-0.23], with appressed, eglandular, hairs 0.2-0.7 mm long on the abaxial surface (ca. 1.5 mm long on the margin), glabrous adaxially. *Petals* 13-15 mm long, 9-10 mm wide, erect-patent, slightly emarginate (notch 0.5-0.8 mm deep), without claw, purple (without a dark basal spot), sometimes white, glabrous on both surfaces, ciliate on the basal margin, with hairs 0.2-0.6 mm long. *Stamens* 10, both whorls bearing anthers; filaments 4-5 mm long, lanceolate with an abruptly narrowed apex, yellow, pilose on the abaxial surface, ciliate on the proximal third, with hairs 0.1-0.6 mm long; anthers 2-3 mm long, dark purple. Nectaries 5, hemispheric, glabrous. *Gynoecium* 5-6 mm long, dark purple. *Fruit* 28-40 mm long, erect, discharge of *Erodium*-type; mericarps 7-8 mm long, 2.1-2.5 mm wide, without a strand of fibers, compressed at the apex, with 1-2 transverse ribs at apex, with basal beak 1 mm long, with a basal callus, without a basal prong, brown, with ± appressed, eglandular hairs 0.8-1 mm long; rostrum 22-30 mm long, without a narrowed apex, not twisted, with ± appressed, eglandular hairs 0.1-0.3 mm long; stigmatic remnants 1.5-2 mm long, with 5 glabrous lobes. *Seeds* 3.4-4.5 mm long, 1.5-2 mm wide, finely reticulate, uniformly colored, brown, gla-

brous. Cotyledons with entire margin. Fig. 74.

Pollen. Ornamentation not studied.

Chromosome number. 2*n* = 28.

Phenology. Collected in flower from June to September.

Distribution. This species ranges through southwestern and central Turkey (Fig. 75).

Habitat. On grassy slopes, usually on limestone or igneous rock; 1050-3000 m.

Additional specimens examined. **Turkey.** Adana: Nattache, près de Hadjine?, 38°5'N, 36°3'E, 14 July 1914, *Manissadjian s.n.* (E, G); Adana, Tufanbeyli, 38°15'N, 36°13'E, 30 June 2005, *Dönmez 12506* (HUB). Adiyaman: Armenia minor, in monte Gol-dagh, 37°38'N, 37°41'E, June, *Bornmüller 3304* (G, JE). Amasya: Pontus Galaticus, in monte super. Sana-dag, 40°31'N, 35°53'E, 13 May 1890, *Bornmüller 2893* (G, LD); Pontus australis, Sana-dag, 40°31'N, 35°53'E, 15 May 1890, *Bornmüller 953b* (BM, G, W); Amasya, Akdağ, above Zefe Köy, Grid A6, 40°42'N, 35°59'E, 26 June 1965, *Davis & Roberts 1205* (E); Nordliche Kleinasien, Akdağ bei Amasya, 40°42'N, 35°59'E, *Manissadjian 11086* (B); Akdagh bei Amasya, 40°42'N, 35°59'E, *Manissadjian 1108b* (K); A5 summit of Alagöz dağ, N of Çorum, 40°54'N, 35°4'E, 31 May 1965, *Coode & Jones 1922* (E). Aydin: Cadmud supra Geyre, 37°43'N, 28°44'E, June, *Boissier s.n.* (BM, C, G, LE, W). Erzurum: Pontus australis, in m. Yildiss-dağ, 40°8'N, 36°55'E, 7 June 1890, *Bornmüller 2348* (G, JE); Yildiz dağ, A6 Sivas, 40°8'N, 36°55'E, 15 July 1969, *Sorger 69-58-64* (W). Gümüşhane: in rupibus supra Gumuschkhané, 40°22'N, 39°50'E, *Bourgeau s.n.* (MPU); Armenia turcica, Szandschak Gümüschkhane, Kirkpauli, 40°22'N, 39°50'E, 28 May 1894, *Sintenis 3694* (JE); In rupestribus montis Courcoulizos prope Gumusch-Khané, 40°26'N, 39°26'E, 8 June 1862, *Bourgeau 61* (K, Z); A7 Gümüşane, near old Gümüşhane, 40°26'N, 39°26'E, 21 June 1972, *Gözler & Kerestecioğlu s.n.* (ISTE); Armenia turcica, Szandschak Gümüschkhane, Stadodopi, 40°32'N, 39°27'E, 4 June 1894, *Sintenis 5761* (BM, E, G, JE, K, LE, LD); Gümüshane, carretera hacia Siran y que parte de la carretera de Torul a Gümüshane, 40°34'N, 39°17'E, 24 June 2001, *Herrero & al. 1336* (MA). Isparta: distr. Sütçüler (Isauria), Dedegöl dag in the cirque Anici, 37°40'N, 31°17'E, 2 Aug. 1949, *Davis 15992* (E, LE). Kahramanmaraş: Agca dag, W Cokak, 37°44'N, 36°18'E, 7 June 1973, *Sorger 73-15-44* (W); Maras, Engizelk Dag, Uzundere Meukii, 37°50'N, 37°10'E, 14 June 2002, *Ilçim 643* (MA); prov. Maras, Berit dağ, Elbistan, 38°1'N, 36°52'E, 16

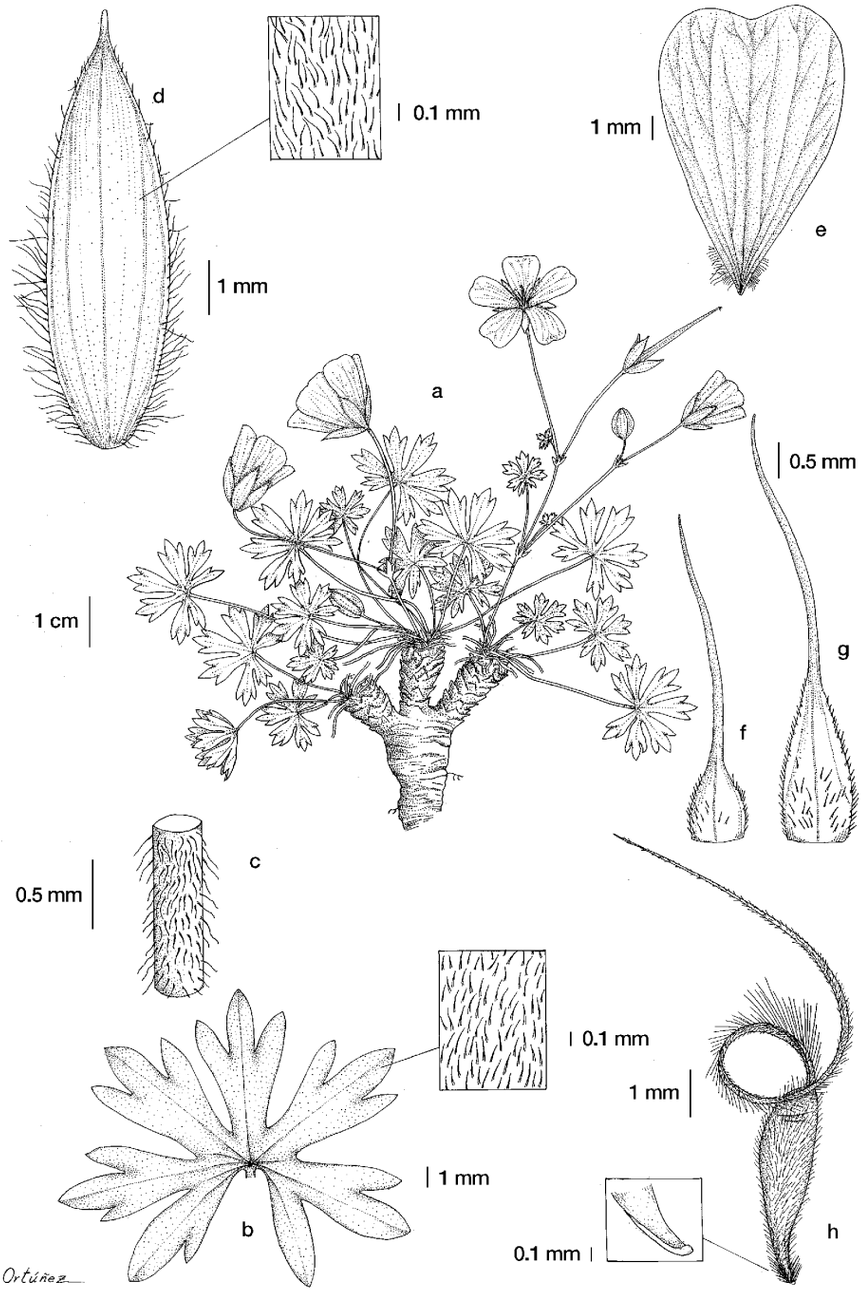


Fig. 74. *Geranium subacutum*. a. Habit. b. Leaf and detail showing indumentum. c. Portion of peduncle. d. Sepal and detail showing indumentum. e. Petal. f. Staminal filament of outer whorl. g. Staminal filament of inner whorl. h. Mericarp and detail showing base. (Based on: *Balansa 1036*, O).

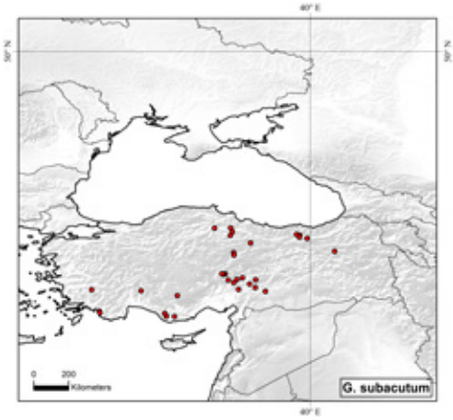


Fig. 75. Distribution of *Geranium subacutum*.

June 1960, *Stainton & Henderson 5609* (E); C6 k. Maras, Süleymanli, Berit dağ, Sarigöl, 38°1'N, 36°52'E, 11 June 1978, *Xildiz 2047* (HUB); prov. Maraş, Sarda near Elbistan, 38°14'N, 37°11'E, 7 May 1957, *Davis & Hedge 27651* (BM, E, K). Karaman: C4 Antalya, Gazipaşa, Cimbiti Yaylasi, 36°30'N, 32°30'E, 18 May 1983, *Sümbül 1801* (HUB); montis Karadagh, Lycaonia, 37°25'N, 33°9'E, June, *Heldreich s.n.* (BM, E, G, LE, RO). Kayseri: Bakir Dağ, at Akoluk yayla, above Kisge, 38°13'N, 35°46'E, 29 June 1952, *Davis & al. 19451* (BM, E, ISTE). Kirşehir: ladera E del Erciyas Dag, 38°31'N, 35°31'E, 18 June 2001, *Aedo & al. 6663* (MA); Erciyas dag, Kayserie, 38°32'N, 35°27'E, 18 June 1934, *Balls 1404* (BM, E, K). Mersin: C4 Igeli, Anamur, Anamur-Kazanci karayola, Kizilalan medii, 36°20'N, 33°0'E, 24 June 1984, *Sümbül 3115* (HUB). Muğla: Baba dağ, Coria, 36°32'N, 29°10'E, 19 June 1938, *Davis 254* (E); Sivas: prov. Maras, distr. Göksun, Binboğa dağ, on Işik dağ above Karli Y., 38°20'N, 36°30'E, 15 June 1952, *Davis & al. 20028* (BM, E); Cappadocia borealis, in summo yugo Karababa, montis Qr-dagh, 39°30'N, 36°4'E, 28 Apr. 1889, *Bornmüller 953* (BM, G, JE, LE, LD, K, W). Samsun:Amasya, Lâdik, Taşli Yayla, 40°54'N, 35°54'E, 27 May 1964, *Tobey 642* (E). Yozgat: Akdağmadeni to Büyük Nalbant dağ above Yukari Çulhali, 39°38'N, 36°3'E, 6 June 1965, *Coode & Jones 2052* (E).

Discussion. Geranium subacutum, endemic to Turkey, has purplish petals (without a dark basal spot) and leaves with usually 3-lobed segments. It differs from *G. subcaulescens* by lighter pigmentation of staminal filaments, anthers, and stigmas and by its petals lacking a basal spot. *Geranium subacutum* appears to be a somewhat variable species. Three collections from Gümüşane in northeastern Turkey (*Sintenis 5694, Stainton 8385*, and *Bourgeau 61*) are here included with hesitation. They have very dark purple staminal filaments and stigmas, and sometimes also spotted petals. Davis & Roberts (1955: 22) considered Gümüşane collections to be *G. subcaulescens* s.str., whereas Freyn annotated them with the nomen nudum *G. subcaulescens* f. *purpureo-violacea*. These plants grow at the northeastern limit of the range of *G. subacutum,* where *G. ponticum* also occurs. On the other hand, specimens from Sana dağ, Lâdik, and Ak dağ, in central Turkey (near Amasya) occasionally have leaves with undivided segments and white flowers. Bornmüller named this variant var. *leucophaeum.* Some plants are much like *G. thessalum,* but they differ in that their sepals have long hairs. After studying several collections from some of these localities, I consider the occurrence of undivided leaf segments as an unusual deviation in *G. subacutum.* Peşmen & Güner (1978: 36) characterized *G. cinereum* var. *pisidicum* by petioles, pedicels, and peduncles with patent hairs; however, I found great variability in these characters in Turkish plants. On the whole, this "variety" occasionally showed more divided segments than other populations of *G. subacutum.*

Four collections are quoted in Boissier's protologue (Boissier 1867: 872). Two of them are from Mount Argaeus [Erciyas Daği] (*Aucher 2104* and *Balansa 1036*), one from Armenia (*Bourgeau 61*), and one from the Pontic Alps *(Kotschy* 788). After examining Kotschy's collection 788 (W!), I must exclude it from the *G. subacutum.* This collection, due to its more deeply divided, almost glabrous leaves, and its very dark-purple spotted petals, stamen filaments, and stigmas, should be assigned to *G. ponticum.* Boissier (1888: 141) excluded the glabrescent plants (f. *glabrescens* Boiss., nom. nud.) found in the Pontic mountains from the circumscription of *G. subacutum* but without formal description of this form. *Bourgeau 61*, with its very dark purple staminal filaments, is a deviant form of G. *subacutum.* These plants grow at the northeastern limit of the species' range, where they coexist with *G. ponticum,* which perhaps has influenced them. However, according to Davis & Roberts (1955: 22) *Bourgeau 61* is *G. subcaulescens* s.str. These authors consider the other collection from Mount Argaeus (*Aucher 2104*) an intermediate form between *G. subcaulescens* and *G. subacutum.* I believe that all the Argaeus collections are homogeneous and belong to *G. subacutum.*

15. Geranium petri-davisii Aedo, Anales Jard. Bot. Madrid 52(1): 105. 1994. *Geranium cinereum* var. *elatium* P.H. Davis, Notes Roy. Bot. Gard. Edinburgh 28: 36. 1967, ["elatius"]. Type locality: "Turkey: B6 Maraş: d. Göksun, Hübek Dağ, 2000 m, among shady rocks, Davis 20169 (holo. E! iso. K!)". Type: Turkey. Kahramanmaraş, Göksun, Höbek Dağ, 37°50'N, 36°32'E, 21 July 1952, *P.H. Davis, L.G. Dodds & D.* Çetik 20169 (holotype, E!; isotypes, BM!, F-0060434F!, K!, LD!, LE!).

Perennial herbs, 30-50 cm tall. *Rootstock* 10-15 mm in diameter, ± horizontal, not tuberculate, not turnip-shaped, without thickened roots. *Stem* erect, leafy, not rooting at nodes, stolons absent, without vegetative stems, with retrorse, not appressed, eglandular hairs 0.1-0.3 mm long. *Basal leaves* in a persistent rosette, cauline leaves alternate in middle of shoot, the upper 1-3 pairs opposite; leaf laminas 3.5-5 cm long, 3.5-6.5 cm wide, not peltate, palmatifid [ratio main-sinus length/ middle segment length = 0.65-0.7], polygonal in outline, base cordate, not coriaceous, with nerves not projected, pilose, with appressed, eglandular hairs on both surfaces; segments 5-7, in 1 plane, middle segment obtriangular, 2-3 mm wide at the base [ratio segment width at the base/middle segment length = 0.18-0.31], 3-lobed in distal half [ratio secondary sinus length/middle segment length = 0.14-0.29]; petioles up to 29 cm long, without abscission zone, terete, not swollen, not deflexed in age, with retrorse, not appressed, eglandular hairs 0.2-0.4 mm long; stipules 7.1-15 mm long, 1.9-3 mm wide, lanceolate, free, papery, brown, with eglandular hairs on abaxial surface and on the margin, glabrous adaxially. *Inflorescence* a monochasial cyme; cymules 2-3-flowered, usually in aggregates at the top of each branch [ratio cymule length/leaf length = 2-4]; peduncles 30-75 mm long, with usually retrorse, not appressed, eglandular hairs ca. 0.2 mm long; bracteoles 3-4 mm long, 1-1.5 mm wide, lanceolate,

whorled; pedicels 20-35 mm long, with retrorse, not appressed, eglandular hairs 0.2-0.4 mm long. Flowers actinomorphic. *Sepals* 10-12 mm long, 3-3.2 mm wide, lanceolate, smooth, not accrescent, nerves 5, mucro 0.7-1 mm long [ratio mucro length/sepal length = 0.04-0.12], with ± patent, eglandular, hairs 0.2-0.3 mm long on the abaxial surface (ca. 1 mm on the margin), glabrous adaxially. *Petals* 14-17 mm long, 10-11 mm wide, erect-patent, emarginate (notch 2-2.5 mm deep), without claw, purple (without a dark basal spot), glabrous on both surfaces, ciliate on the basal margin, with hairs 0.5-0.8 mm long. *Stamens* 10, both whorls bearing anthers; filaments 4-5 mm long, lanceolate with an abruptly narrowed apex, dark purple, pilose on the abaxial surface, ciliate on the proximal third, with hairs up to 0.2-0.3 mm long; anthers 2-2.5 mm long, yellow or dark purple. Nectaries 5, hemispheric, glabrous. *Gynoecium* 5-6 mm long, dark purple. *Fruit* 40-42 mm long, erect, discharge of *Erodium*-type; mericarps 8-10 mm long, 2-3 mm wide, without a strand of fibers, compressed at the apex, with 1-2 transverse ribs at apex, with basal beak 1.5-2 mm long, with a basal callus, without a basal prong, brown, with ± appressed, eglandular hairs 0.7-0.8 mm long; rostrum 29-30 mm long, without a narrowed apex, not twisted, with ± appressed, eglandular hairs 0.1-0.3 mm long; stigmatic remnants 2 mm long, with 5 glabrous lobes. *Seeds* 4-5 mm long, 2 mm wide, finely reticulate, uniformly colored, brown, glabrous. Cotyledons not studied. Fig. 76.

Pollen. Ornamentation not studied.

Chromosome number. 2*n* = 28.

Phenology. Collected in flower in July.

Distribution. This species is endemic to central-eastern Turkey (Fig. 77).

Habitat. Among shaded rocks; ca. 2000 m.

Discussion. Geranium petri-davisii is known only from the type locality in central Turkey. It is unusual within sect. *Subacaulia* in its ± erect stem (without cymules arising from the rootstock), alternate lower cauline leaves, and terminal cymules grouped in 2's and/or 3's and umbel-like. I include it in sect. *Subacaulia* because of its erect-patent, emarginate petals, short inflorescence glands, and some micromorphological characters (features of the hairs and mericarp surface). *Geranium petri-davisii* does not show close resemblance to any other species of the section and is easily distinguished from them.

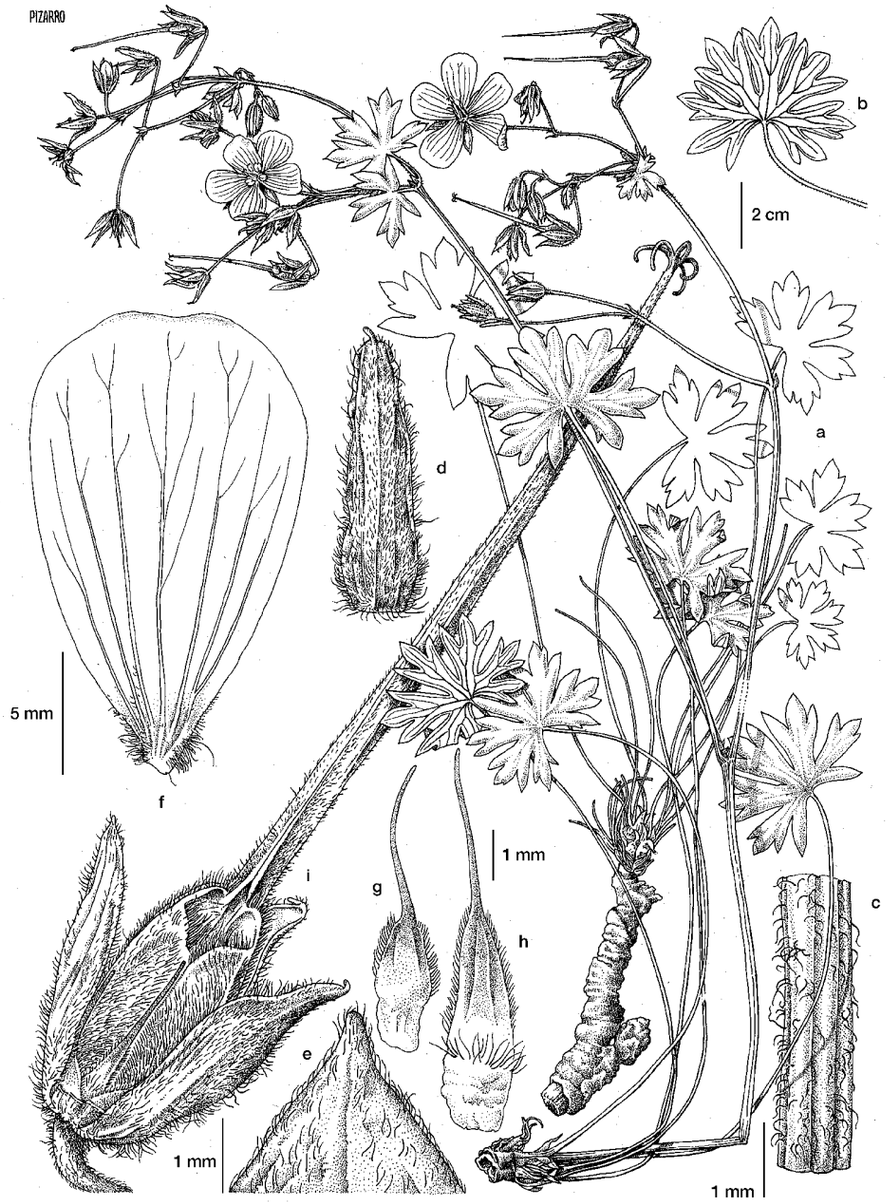


Fig. 76. *Geranium petri-davisii*. a. Habit. b. Leaf. c. Portion of peduncle. d. Sepal. e. Apex of sepal. f. Petal. g. Staminal filament of outer whorl. h. Staminal filament of inner whorl. i. Mericarp subtended by calyx (two sepals removed). (Based on: *Davis & al. 20169*, E).

Fig. 77. Distribution of *Geranium petri-davisii*.

16. Geranium palmatipartitum (Hausskn. ex R. Knuth) Aedo, Anales Jard. Bot. Madrid 52(1): 105. 1994. *Geranium cinereum* var. *palmatipartitum* Hausskn. ex R. Knuth in Engl., Pflanzenr. IV.129 (Heft 53): 94, 93 tab. 16 G-K. 1912. Type locality: "G. subcaulescens var. palmatipartitum Hsusskn. in sched. ... Turkisch-Armenien: Egin (Sintenis, It. orient. a. 1890 n. 2481!)". Type: Turkey. Egin, Kirkgoez baschi, 39°16'N, 38°29'E, 28 May 1890, *P. Sintenis 2481* (lectotype, designated by Aedo 1996: 59, W!; isolectotypes, BM-000796364!, BR-0000005109302 image!, E!, F!, G-00365779!, HBG-517313 image!, JE!, K-000729275!, LD-1092749!, LE-00014595!, P!, PH-00011910, WU!).

Geranium kalenderianum A. Ilçim & L. Behçet, Ann. Bot. Fennici 43: 451, fig. 1, 2c. 2006. Type locality: "Turkey. Kahramanmaraş, Afşin, Tanir kasabasi, Güvek Yaylasi (high land), Binboğa Daği (Binboğa Mt.) rocky places, between rock clefts, 1915-1950 m, 20.VI.2001 A. Ilçim 1373 (holotype, KSUH; isotypes, GAZI and VANF)". Type: Turkey. Kahramanmaraş, Afşin, Tanir kasabasi, Güvek Yaylasi, Binboğa Daği, 38º21'N, 36º32'E, 20 June 2001, *A. Ilçim 1373* (holotype, KSUH; isotypes, GAZI, VANF).

Perennial herbs, 10-20 cm tall. *Rootstock* 6-25 mm in diameter, ± horizontal, not tuberculate, not turnip-shaped, without thickened roots. *Stem* prostrate, scapiform or subscapiform, not rooting at nodes, stolons absent, without vegetative stems, with patent, eglandular hairs 0.2-0.5(1) mm long. *Basal leaves* in a persistent rosette, cauline leaves usually absent, sometimes 1 pairs, opposite; leaf laminas 1.5-2.7 cm long, 2.2-4.4 cm wide, not peltate, palmatifid [ratio main-sinus length/middle segment length = 0.65-0.8], polygonal in outline, base cordate, not coriaceous, with nerves not projected, pilose, with appressed, eglandular hairs on both surfaces; segments 5(7), in 1 plane, middle segment elliptic, 3-4 mm wide at the base [ratio segment width at the base/middle segment length = 0.07-0.10], entire, sometimes 2-3-lobed in distal half; petioles up to 9 cm long, without abscission zone, terete, not swollen, not deflexed in age, with patent, eglandular hairs 0.4-0.7 mm long; stipules 5-8 mm long, 1-1.5 mm wide, lanceolate, free, papery, brown, with eglandular hairs on abaxial surface and on the margin, glabrous adaxial-

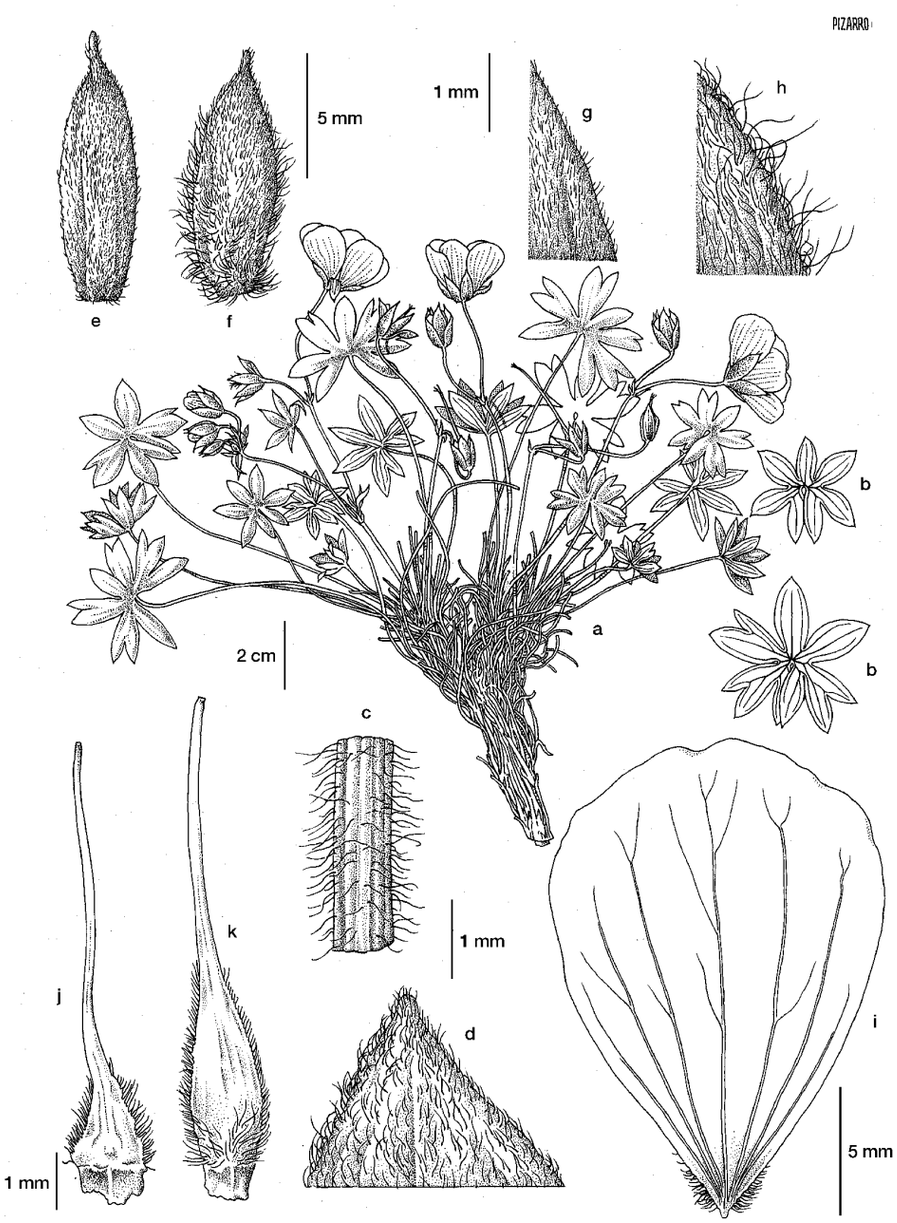


Fig. 78. *Geranium palmatipartitum*. a. Habit. b. Leaf. c. Portion of peduncle. d. Apex of sepal. e. f. Sepals. g, h. Details showing indumentum of sepals. i. Petal. j. Staminal filament of outer whorl. k. Staminal filament of inner whorl. (Based on: *Sintenis 2481*, W).

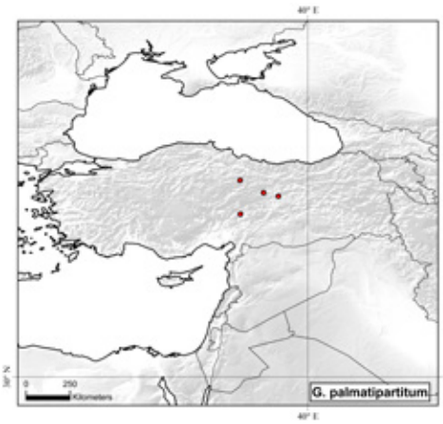


Fig. 79. Distribution of *Geranium palmatipartitum*.

ly. *Cymules* 2-flowered, solitary [ratio cymule length/leaf length = 1.3-1.5]; peduncles 35-80 mm long, with usually patent, eglandular hairs 0.3-0.7 mm long; bracteoles 4-5 mm long, 0.4-1 mm wide, linear-lanceolate, whorled; pedicels 20-50 mm long, with usually patent, eglandular hairs 0.5-0.7 mm long. Flowers actinomorphic. *Sepals* 9-12 mm long, 3-4 mm wide, lanceolate, smooth, not accrescent, nerves 5, mucro 1.2-2 mm long [ratio mucro length/sepal length = 0.07-0.15], with ± appressed, eglandular, hairs 0.2-0.5 mm long on the abaxial surface (0.7-1.7 mm long on the margin), glabrous adaxially. *Petals* 16-17 mm long, 10-11 mm wide, erect-patent, slightly emarginate, without claw, purple (without a dark basal spot), glabrous on both surfaces, ciliate on the basal margin, with hairs 0.5-0.8 mm long. *Stamens* 10, both whorls bearing anthers; filaments 6-8 mm long, lanceolate with an abruptly narrowed apex, purple, pilose on the abaxial surface, ciliate on the proximal third, with hairs up to 0.2-0.3 mm long; anthers 3 mm long, yellow. Nectaries 5, hemispheric, glabrous. *Gynoecium* 7-8 mm long, dark purple. *Fruit* 33-35 mm long, erect, discharge of Erodium-type; mericarps 6.2-7 mm long, 2-2.6 mm wide, without a strand of fibers, compressed at the apex, with (0)1 transverse rib at apex, without a basal prong, brown, with ± appressed, eglandular hairs 1-1.5 mm long; rostrum 23-26 mm long, without a narrowed apex, not twisted, with ± appressed, eglandular hairs 0.3-0.4 mm long; stigmatic remnants 1.5-2 mm long, with 5 hairy lobes. *Seeds* unknown. Cotyledons not studied. Fig. 78.

Pollen. Ornamentation not studied.

Chromosome number. Unknown.

Phenology. Collected in flower from May to June.

Distribution. This species ranges through central-eastern Turkey (Fig. 79).

Habitat. Rocky places; 1800-1950 m.

Additional specimens examined. **Turkey.** Kahramanmaraş-Sivas: Afsin, Güvek Yaylasi, Armuth Pinarin Karsisi, 38º21'N, 36º32'E, 20 June 2000, *Ilçim 986* (MA). Tokat: T?ha?nlübel [Çamlibel?] Siwas et Tokat, 40º5'N, 36º31'E, 31 May 1890, *Bornmüller 1973* (JE).

Discussion. Geranium palmatipartitum is one of the most distinctive species of the section by virtue of its leaves, which usually have elliptic entire segments. Information on fruit morphology is based only on one unripe fruit of *Sintenis 2481* (JE).

Ilçim & Behçet (2006) described *G. kalenderianum,* a new species related to *G. palmatipartitum.* I have examined a specimen from the type locality that fall well within the range of variability of *G. palmatipartitum.*

I could not find any type material of *G. palmatipartitum* in the Berlin herbarium, although Davis & Roberts (1955: 23) referred to it. Later, Davis (1967: 472) noted the existence of type material only in the Edinburgh and Kew herbaria.

---

17. Geranium makmelicum Aedo, Anales Jard. Bot. Madrid 52(1): 105. 1994. *Geranium subcaulescens* var. *obtusilobum* Bornm., Beih. Bot. Centralbl. 31(1): 197. 1913, [nom. subst.], non *G. obtusilobum* (Willd.) Poir. (1812). *Geranium cinereum* var. *obtusilobum* (Bornm.) Yeo, Hardy Geraniums: 189. 1985. Type locality: "Nördl. Libanon, westl. Abhänge des Dahr el-Khodib, 25-2600 m (Nr. 11540)". Type: Lebanon. Montium Libani borealis Dahr el-Khodib, 34°18'N, 36°07'E, 5 July 1910, *J. Bornmüller 11540* (lectotype, designated by Yeo 1985: 189, JE-00025923!; isolectotypes, G-00365768!, LE!, W!).

Perennial herbs, 1-7(12) cm tall. *Rootstock* 5-10 mm in diameter, ± horizontal, not tuberculate, not turnip-shaped, without thickened roots. *Stem* prostrate, scapiform or subscapiform, not rooting at nodes, stolons absent, without vegetative stems, with usually patent, eglandular hairs 0.2-1 mm long. *Basal leaves* in a persistent rosette, cauline leaves usually absent, sometimes 1-2 pairs, opposite; leaf laminas 0.9-2 cm long, 0.9-2.2 cm wide, not peltate, palmatifid [ratio main-sinus length/middle segment length = 0.6-0.8], suborbicular in outline, base cordate, not coriaceous, with nerves not projected, pilose, with appressed, eglandular hairs on both surfaces; segments 5(7), in 1 plane, middle segment obtriangular, 2-4 mm wide at the base [ratio segment width at the base/middle segment length = 0.28-0.29], 3-lobed in distal half [ratio secondary sinus length/middle segment length = 0.14-0.23]; petioles up to 6(9) cm long, without abscission zone, terete, not swollen, not deflexed in age, with usually patent, eglandular hairs 0.2-1 mm long; stipules 5-6 mm long, 1.1-2 mm wide, lanceolate, free, papery, brown, with eglandular hairs on abaxial surface and on the margin, glabrous adaxially. Cymules 2-flowered, solitary [ratio cymule length/leaf length = 0.7-1.1]; peduncles 30-80 mm long, with patent, eglandular hairs 0.2-1 mm long; bracteoles 4-5 mm long, 0.8-1 mm wide, lanceolate, whorled; pedicels 12-30 mm long, with patent, eglandular hairs 0.2-1 mm long. Flowers actinomorphic. *Sepals* (5)8-9 mm long, 2-3 mm wide, lanceolate, smooth, not accrescent, nerves 5, mucro absent or 0.1-0.3 mm long [ratio mucro length/sepal length = 0.07-0.08], with ± appressed, eglandular, hairs 0.2-0.5 mm long on the abaxial surface (0.8-1 mm long on the margin), glabrous adaxially. *Petals* 10-14 mm long, 8-9 mm wide, erect-patent, slightly emarginate, without claw, pink (without a dark basal spot), sometimes white, hairy on the base of the adaxial surface, glabrous abaxially, ciliate on the basal margin, with hairs 0.3-0.8 mm long. *Stamens* 10, both whorls bearing anthers; filaments 5-6 mm long, lanceolate with an abruptly narrowed apex, yellow, pilose on the abaxial surface, ciliate on the proximal third, with hairs 0.2-0.4 mm long; anthers 2-2.5 mm long, dark yellow. Nectaries 5, hemispheric, glabrous. *Gynoe-*

cium 5-6 mm long, yellow. *Fruit* 26-30 mm long, erect, discharge of *Erodium*-type; mericarps 6-7 mm long, 2-2.3 mm wide, without a strand of fibers, compressed at the apex, with 1 transverse rib at apex, with basal beak 1 mm long, with a basal callus, without a basal prong, brown, with ± appressed, eglandular hairs 0.6-0.7 mm long; rostrum 20-22 mm long, without a narrowed apex, not twisted, with ± appressed, eglandular hairs 0.1-0.3 mm long; stigmatic remnants 2-3.2 mm long, with 5 glabrous lobes. *Seeds* 3.9-4 mm long, 1.5-1.7 mm wide, finely reticulate, uniformly colored, brown, glabrous. Cotyledons with entire margin. Fig. 80.

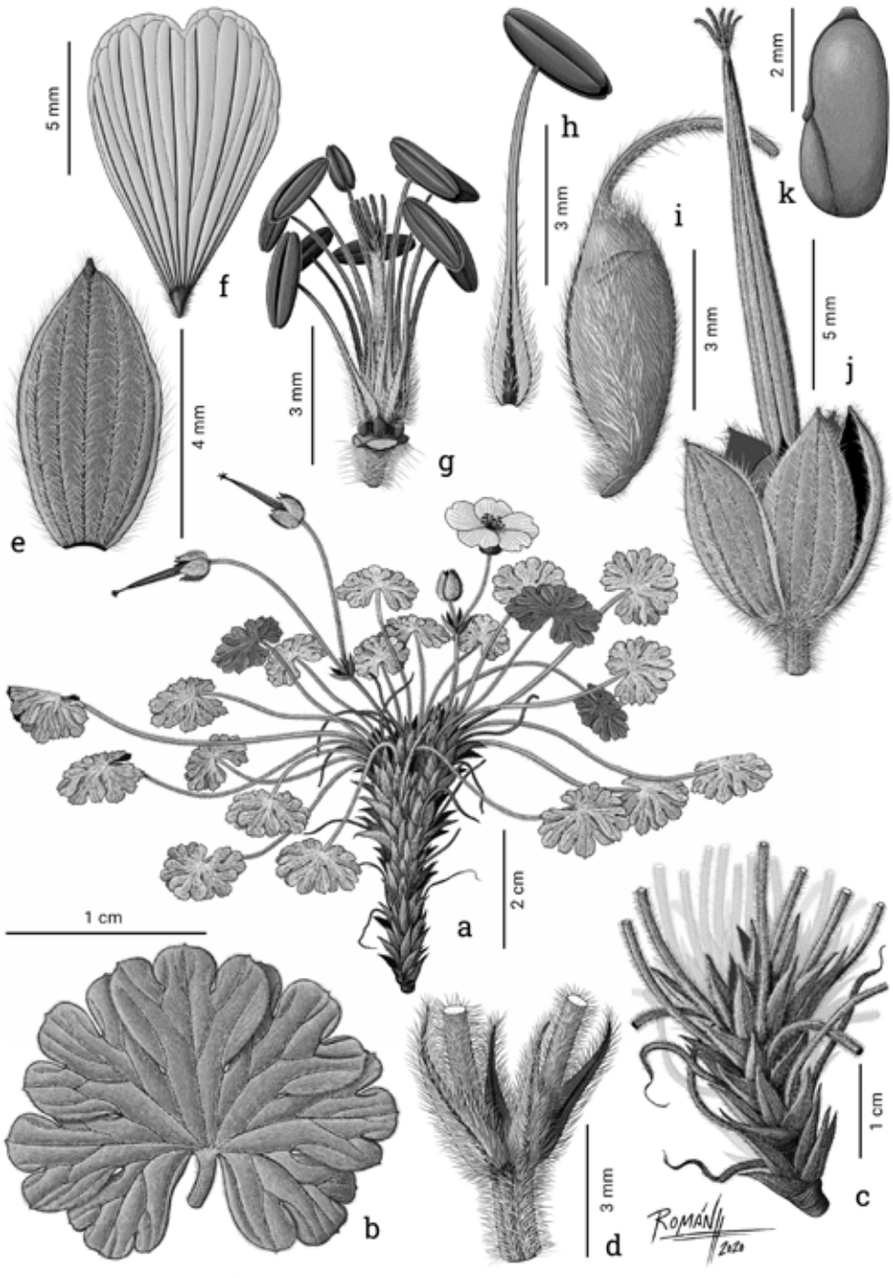


Fig. 80. *Geranium makmelicum.* a. Habit. b. Leaf. c. Base of the stem. d. Bracteoles. e. Sepal. f. Petal. g. Flower without petals and sepals. h. Stamen. i. Mericarp. j. Fruit. k. Seed. (Based on: *Gombault 1143*, MA).

Pollen. Ornamentation not studied.

Chromosome number. Unknown.

Phenology. Collected in flower from June to August.

Distribution. This species is endemic to northern Lebanon (Fig. 81).

Habitat. Grassy or rocky places; 1800-2600 m.

Additional specimens examined. **Lebanon.** Haut Liban, 18 June 18[??] (E); Sir Heba & Succar, 4 June 1933 (G); Sir, 4 June 1933, *Gombault 2260* (P); Liban, *Labillardière s.n.* (G). Mount Lebanon: Jabal ech Chalalé près de Laqlouq, 34º9'N, 35º54'E, 6 July 1950 (G); Jourd Tannourine, Ht. Libano, 34º9'N, 35º55'E, 18 June 1866, *Blanche 106* (JE); Jebel ech Chahali, au dessus du Lagloug, 34º9'N, 35º54'E, 6 July 1950, *Mouterde s.n.* (G). North: col d'Ainata, 34º11'N, 36º4'E, 22 Aug. 1955 (G); Makmel, 34º15'N, 36º2'E, 1850, *Boissier s.n.* (G, LE); Birket to Souaiye, about Makmel, 34º15'N, 36º2'E, 15 Aug. 1945, *Davis 10201* (E); cirque des Cedres, 34º15'N, 36º2'E, 16 Aug. 1930, *Gombault 1143* (MA, P); monte Makmel in Libano ad Bscherre et circa Cedretum, in monte Makmel declivitate occidentali, 34º15'N, 36º2'E, 23 July 1855, *Kotschy 299* (BM, K); Djard Hasroun, 34º15'N, 36º0'E, 8 Aug. 1890, *Post s.n.* (BM, G); Makmel, 34º15'N, 36º2'E, 25 Aug. 1898, *Post s.n.* (BM, K); vers Qornet el Achara, W du massif de Makmel, 34º20'N, 36º9'E, 11 June 1946, *Mouterde 8546* (G).

Discussion. Geranium makmelicum is characterized by its sepals, which have a very short mucro or even lack it, and dark-yellow anthers. It is an isolated species probably related to *G. subacutum.* Dinsmore in Post (1896:

Fig. 81. Distribution of *Geranium makmelicum*.

190-191) distinguished two taxa from Lebanon: plants with purple flowers (*G. subcaulescens s.str.*) and plants with white flowers (var. *obtusilobum* Bornm.). All material I studied (including Post's collections: BM!, G!) has white or pink flowers (without a dark basal spot) and dark yellow staminal filaments. Therefore no Lebanese plant can be included in the Balkan *G. subcaulescens* s.str., which has petals with a dark basal spot and very dark purple staminal filaments. All the material examined was from the Lebanese mountains except for Ehrenberg's collection (C!, K!, LE!) labeled: "Syria: ad Kafram juxta mi[??]s." I have found a similarly spelled Syrian locality: "Kafroun" (34º52'N, 36º14'E), but it is at too low an elevation for a mountain plant. Furthermore, neither Post (1896: 190-191) nor Dinsmore in Post (1932: 255-256) nor Mouterde (1966: 435-436) nor Zohary & al. (1983: 1), reported this taxon outside of Lebanon. On the other hand, Yeo (1985: 174) noted "Lebanon, Syria" for the range of this species.

18. Geranium ponticum (P.H. Davis & J. Roberts) Aedo, Anales Jard. Bot. Madrid 52(1): 106. 1994. *Geranium cinereum* var. *ponticum* P.H. Davis & J. Roberts, Notes Roy. Bot. Gard. Edinburgh 22: 23. 1955. Type locality: "Prov. Rize: region alpine superieure du Lazistan, au dessus de Djmil [Cimil], ver 2800 m., Balansa 1369 (K!)". Type: Turkey. Lazistan, au dessus de Djmil, 2800 m, 39°40'N, 40°40'E, July 1866, *B. Balansa 1369* (holotype, K-000729269!; isotypes, G-00370306!, JE!, LE-00014585!, P-00757918!, RO!, US-00624268 image!, W!).

Perennial herbs, 5-30 cm tall. *Rootstock* 5-16 mm in diameter, ± horizontal, not tuberculate, not turnip-shaped, without thickened roots. *Stem* prostrate, scapiform or subscapiform, not rooting at nodes, stolons absent, without vegetative stems, with retrorse, appressed, eglandular hairs 0.1-0.2 mm long. *Basal leaves* in a persistent rosette, cauline leaves usually absent, sometimes 1-2(4) pairs, opposite; leaf laminas 1.8-3.6 cm long, 2.3-3.7 cm wide, not peltate, palmatifid [ratio main-sinus length/middle segment length = 0.75-0.8], polygonal in outline, base cordate, not coriaceous, with nerves not projected, pilose above, with appressed, eglandular hairs and almost glabrous abaxially; segments 5(7), in 1 plane, middle segment obtriangular, 3-4 mm wide at the base [ratio segment width at the base/middle segment length = 0.25-0.29], 5-8-lobed in distal half [ratio secondary sinus length/middle segment length = 0.15-0.35]; petioles up to 12 cm long, without abscission zone, terete, not swollen, not deflexed in age, with retrorse, appressed, eglandular hairs 0.1-0.2 mm long; stipules 5-8 mm long, 1.2-2 mm wide, lanceolate, free, papery, brown, with eglandular hairs on abaxial surface and on the margin, glabrous adaxially. *Cymules* 2-flowered, solitary [ratio cymule length/leaf length = 1.60-1.75]; peduncles 25-90 mm long, with retrorse, appressed, eglandular hairs 0.1-0.2 mm long; bracteoles 5-6 mm long, 0.7-1 mm wide, lanceolate, whorled; pedicels 25-40 mm long, with retrorse, appressed, eglandular hairs 0.1-0.2 mm long. Flowers actinomorphic. *Sepals* 6-7.5 mm long, 3.5-4 mm wide, lanceolate, smooth, not accrescent, nerves 5, mucro 1.4-2.5 mm long [ratio mucro length/sepal length = 0.14-0.16], with ± appressed, eglandular, hairs 0.1-0.2 mm long on the abaxial surface (1-1.1 mm long on the margin), glabrous adaxially. *Petals* 11-13 mm long, 10-11 mm wide, erect-patent, slightly emarginate (notch 0.3-0.6 mm deep), without claw, purple (with a dark basal spot), glabrous on both surfaces, ciliate on the basal margin, with hairs 0.4-0.6 mm long. *Stamens* 10, both whorls bearing anthers; filaments 4.5-6 mm long, lanceolate with an abruptly narrowed apex, dark purple, pilose on the abaxial surface, ciliate on the proximal third, with hairs 0.2-0.3 mm long; anthers 1.9-3 mm long, dark purple. Nectaries 5, hemispheric, glabrous. *Gynoecium* 5-6 mm long, dark purple. *Fruit* 28-30 mm long, erect, discharge of *Erodium*-type; mericarps 6-7 mm long, 2.3-2.5 mm wide, without a strand of fibers, compressed at the apex, with 1-2 transverse ribs at apex, with basal beak 1-1.5 mm long, with a basal callus, without a basal prong, brown, with ± appressed, eglandular hairs 1-1.4 mm long; rostrum 21-24 mm long, without a narrowed apex, not twisted, with ± appressed, eglandular hairs 0.1-0.3 mm long; stigmatic remnants 2-2.5 mm long, with 5 glabrous lobes. *Seeds* 3.3-3.9 mm long, 1.5-1.7 mm wide, finely reticulate, uniformly colored, brown, glabrous. Cotyledons with entire margin. Figs. 82, 83.

Pollen. Ornamentation not studied.

Chromosome number. 2*n* = 26?

Phenology. Collected in flower from June to August.

Distribution. This species ranges through northeastern Turkey (Fig. 84).

Habitat. Grassy or rocky places, usually on granite; 1850-3000 m.

Additional specimens examined. **Turkey.** Lazistan, *Aucher-Éloy 2106* (G, FI). Bayburt: Alischeri Chan in alpibus Ponti, 40º22'N, 40º4'E, 26 July 1859, *Kotschy 788* (W); prov. of Trabzon of Bayburt road, about 45 milles S from of N side of pass, 40º30'N, 40º21'E, 7 July 1962, *Apold & al. 184* (E); Kara Kaya dağ, N of Baiburt, 40º30'N, 40º21'E, 24 July 1934, *Balls 1669A* (BM). Erzurum: S of Ispir on way to Koçunbogazi, 39º55'N, 41º17'E, 30 June 1968, *Barclay 880* (K); Erzurum, by lake near Mesçit Da, SE of Ispir, 40º22'N, 41º11'E, 1 July 1968, *Barclay 907* (K); pr. Ispir, Armenia, 40º29'N, 41º2'E, June, *Huet du Pavillon s.n.* (G); passhohe zw. Ikizdere u. Ispir, 40º34'N, 40º50'E, 10 Aug. 1982, *Sorger 82-119-47* (W); A8 Erzurum, Ispir'in 10 km GB'si, 40º34'N, 40º50'E, 25 Aug. 1976, *Tafli 5467* (HUB); Sari Kaya, 40º41'N, 42º26'E, 6 July 1933, *Balls 471* (E, K). Gümüşhane: puerto de Kostandagi, vertiente N, 40º30'N, 39º46'E, 25 June 2001, *Herrero & al. 1524* (MA). Gümüşhane-Trabzon: Soganli dağ, at the pass, 40º2'N, 40º44'E, 4 Aug. 1957, *Davis & Hedge 32141* (BM, E, K); Trabzon, Soganli Pass, 40º2'N, 40º44'E, 16 Aug.

1962, *Furse 3931* (K). Rize: Ovit dagi Gecidi, 40°37'N, 40°46'E, 28 June 2002, *Nisa & al. 796* (MA); Zigana dağ, 40°38'N, 39°25'E, 12 July 1934, *Balls 1669* (BM, E, K); Trabzon, Zigana D., 40°38'N, 39°25'E, 9 Aug. 1968, *Baytop 14294* (E, ISTE); Anatoliae orientalis, Sa?dz Tre?pezunt, Zigana dağ, in alp. pr. Zigana-Korduni, 40°38'N, 39°25'E, 5 July 1917, *Schisckkin s.n.* (BM); distr. Ikizdere, between Carankaya yäyla and Baskoy, 40°44'N, 40°45'E, 26 Aug. 1952, *Davis & Dodds 20936* (BM, E, K, LE).

Discussion. Geranium ponticum occurs at high elevations in the Pontic Alps of northeastern Turkey. This species has more deeply divided leaves than the others of sect. *Subacaulia;* only one other Turkish species (*G. lazicum*) and two Spanish ones (*G. subargenteum* and *G. dolomiticum*) have similar leaves. Both Turkish taxa differ from the Spanish ones by the presence of a basal callus on the mericarp. *Geranium ponticum* is distinguished from *G. lazicum* by its abaxially glabrous leaves (except on veins), very dark purple staminal filaments, and petals with a very dark basal spot. Boissier (1888: 141) proposed a name without description (f. *glabrescens*) for *Balansa 1369*; the same collection has been used by Davis & Roberts (1955: 23) to typify their var. *ponticum.* The chromosome number 2*n* = 26 attributed to this species (Martin & al. 2022) should be confirmed.

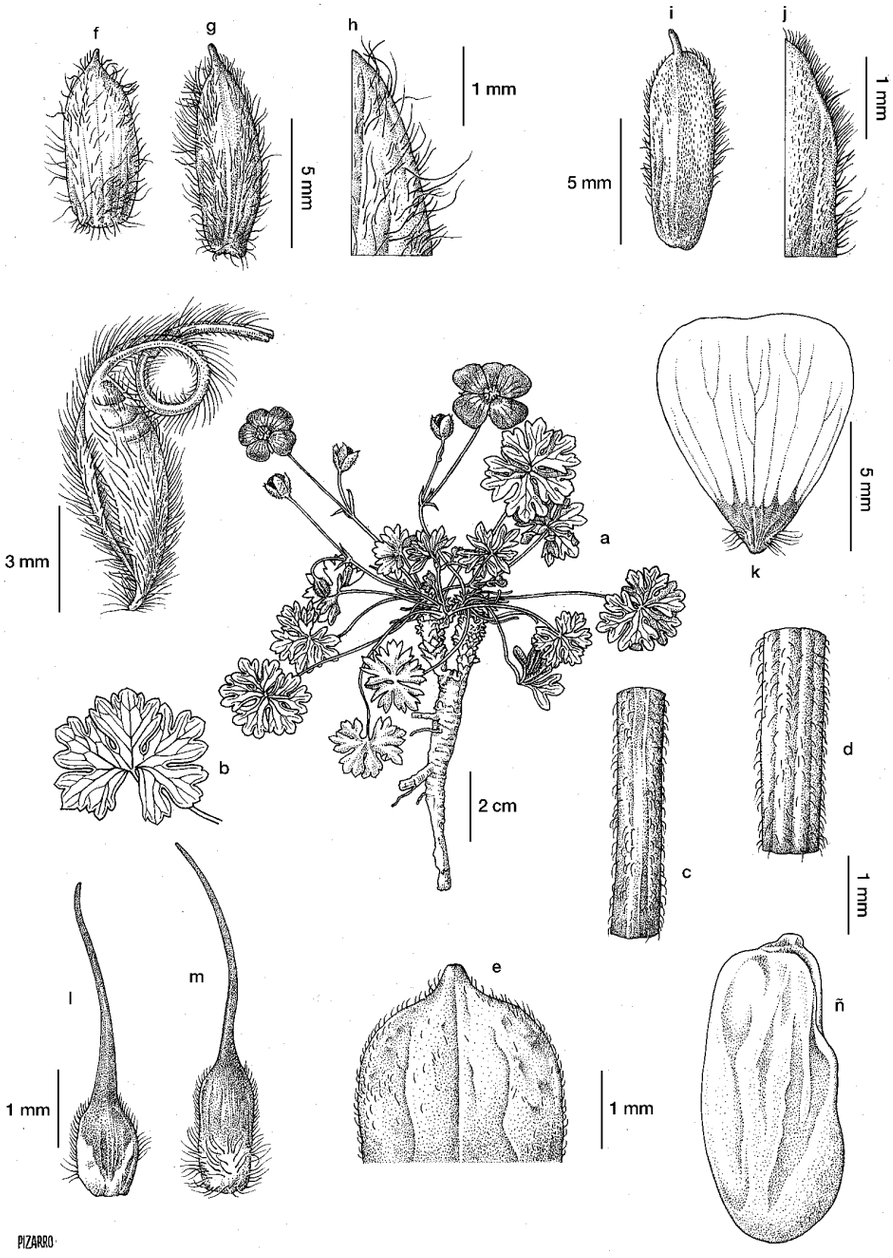


Fig. 82. *Geranium ponticum*. a. Habit. b. Leaf. c, d. Portion of peduncles. e. Apex of sepal. i-j. Sepals and details showing indumentum. k. Petal. l. Staminal filament of outer whorl. m. Staminal filament of inner whorl. n. Mericarp. ñ. Seed. (Based on: *Apold & al. 184*, E).

Fig. 83. *Geranium ponticum* (Based on: *Herrero & al. 1524,* MA).

Fig. 84. Distribution of *Geranium ponticum*.

19. Geranium lazicum (Woronow) Aedo, Anales Jard. Bot. Madrid 52(1): 105. 1994. *Geranium subcaulescens* var. *lazicum* Woronow in Kusn., N. Busch & Fomin, Fl. Cauc. Crit. 3(7): 10. 1908. *Geranium cinereum* f. *lazicum* (Woronow) R. Knuth in Engl., Pflanzenr. IV.129 (Heft 53): 94. 1912. *Geranium cinereum* var. *lazicum* (Woronow) P.H. Davis & J. Roberts, Notes Roy. Bot. Gard. Edinburgh 22: 24. 1955. Type locality: "Hab. in alpinis Lazistaniae rossicae.— [text in Russian: [A.A. Gora Kvachida; Arvinskij okr. 6. VII. 04. fl. Michajlovskij!]". Type: Turkey. Lazistaniae rossicae, Ghora Kvakhidye, Artvinskii okr., 41°12'N, 41°48'E, 6 July 1904, *Mikhailovski s.n.* (no original material located). Turkey. Artvin, Batum, in monte Egre-su, 41º07'N, 41º31E, 2 July 1912, *O.R. Holmberg 2081b* (neotype, here designated, S!; isoneotype, LD!).

Perennial herbs, 9-18 cm tall. *Rootstock* 5-11 mm in diameter, ± horizontal, not tuberculate, not turnip-shaped, without thickened roots. *Stem* prostrate, scapiform or subscapiform, not rooting at nodes, stolons absent, without vegetative stems, with retrorse, appressed, eglandular hairs 0.1-0.2 mm long. *Basal leaves* in a persistent rosette, cauline leaves usually absent, sometimes 1-2(3) pairs, opposite; leaf laminas 2.7-3.8 cm long, 3.1-4.5 cm wide, not peltate, palmatifid [ratio main-sinus length/middle segment length = 0.70-0.75], polygonal in outline, base cordate, not coriaceous, with nerves not projected, pilose above and sericeous beneath, with appressed, eglandular hairs; segments 5-7, in 1 plane, middle segment obtriangular, 3-5 mm wide at the base, 5-8-lobed in distal half [ratio secondary sinus length/middle segment length = 0.12-0.34]; petioles up to 7.5 cm long, without abscission zone, terete, not swollen, not deflexed in age, with retrorse, appressed, eglandular hairs ca. 0.1 mm long; stipules 6-10 mm long, 3 mm wide, lanceolate, free, papery, brown, with eglandular hairs on abaxial surface and on the margin, glabrous adaxially. *Cymules* 2-flowered, solitary; peduncles 40-60 mm long, with retrorse, appressed, eglandular hairs 0.1-0.3 mm long; bracteoles 6-7 mm long, 1 mm wide, lanceolate, whorled; pedicels 20-40 mm long, with retrorse, appressed, eglandular hairs ca. 0.15 mm long. Flowers actinomorphic. *Sepals* 7-8 mm long, 3-3.5 mm wide, lanceolate, smooth, not accrescent, nerves 5, mucro 0.7-1.5 mm long [ratio mucro length/sepal length = 0.10-0.18], with ± appressed, eglandular hairs 0.1-0.2 mm long on the abaxial surface, glabrous adaxially. *Petals* 12-15 mm long, 8-11 mm wide, erect-patent, slightly emarginate, without claw, purple (without a dark basal spot), glabrous on the adaxial surface, ciliate on the basal margin, with hairs 0.2-0.8 mm long. *Stamens* 10, both whorls bearing

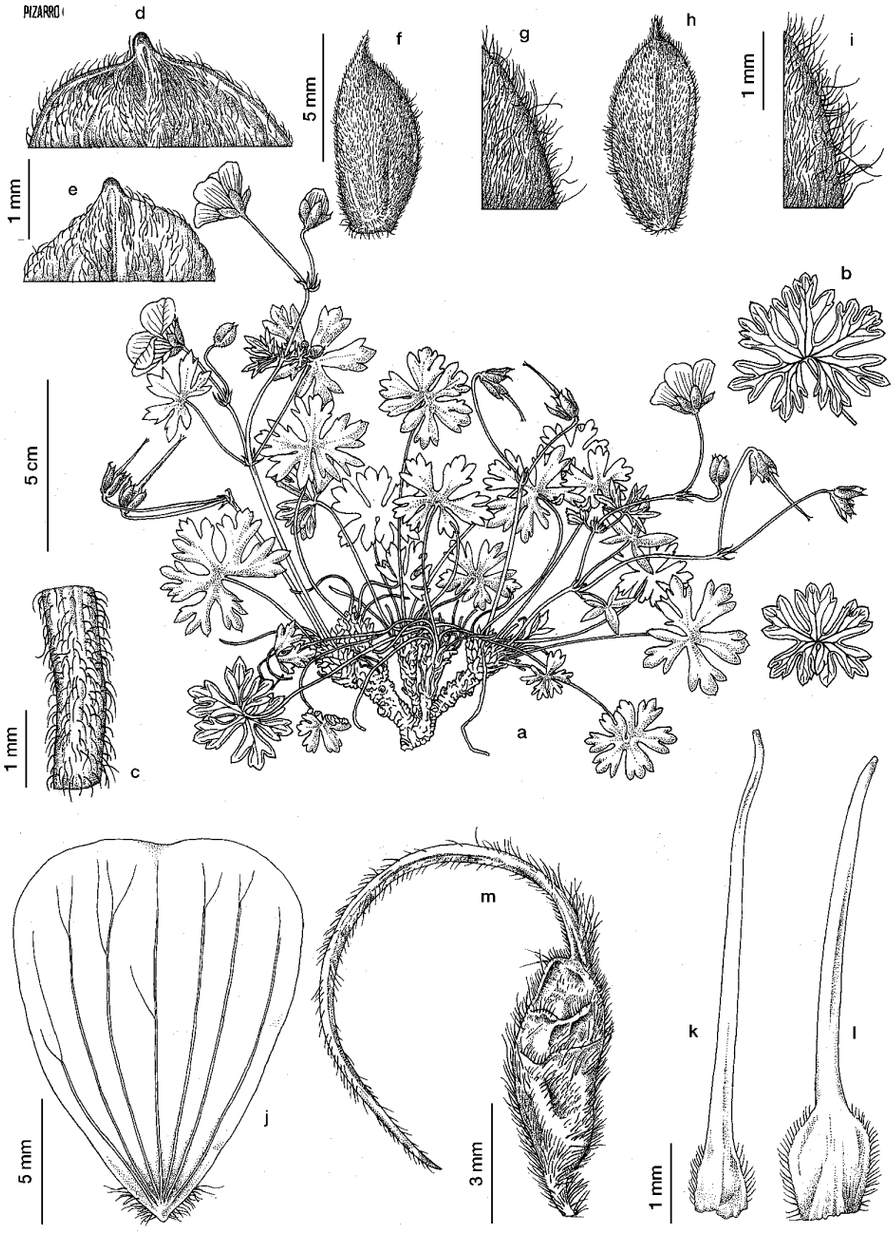


Fig. 85. *Geranium lazicum*. a. Habit. b. Leaves. c. Portion of peduncle. d, e. Apices of sepals. f-i. Sepals and details showing indumentum. j. Petal. k. Staminal filament of outer whorl. l. Staminal filament of inner whorl. m. Mericarp. (Based on: *Davis & Dodds 21067*, E).

Fig. 86. Distribution of *Geranium lazicum*.

anthers; filaments 4.5-5.5 mm long, lanceolate with an abruptly narrowed apex, yellow, pilose on the abaxial surface, ciliate on the proximal third, with hairs 0.1-0.3mm long; anthers 2 mm long, yellow. Nectaries 5, hemispheric, glabrous. *Gynoecium* 5-6 mm long, yellow. *Fruit* 27-29 mm long, erect, discharge of *Erodium*-type; mericarps 7 mm long, 2 mm wide, without a strand of fibers, compressed at the apex, with 1-2 transverse ribs at apex, with basal beak 0.7-0.8 mm long, with a basal callus, without a basal prong, brown, with ± appressed, eglandular hairs 0.2-0.8 mm long; rostrum 20 mm long, without a narrowed apex, not twisted, with ± appressed, eglandular hairs 0.1-0.3 mm long; stigmatic remnants 2 mm long, with 5 glabrous lobes. *Seeds* 3.5 mm long, 1.5 mm wide, finely reticulate, uniformly colored, brown, glabrous. Cotyledons not studied. Fig. 85.

Pollen. Ornamentation not studied.

Chromosome number. Unknown.

Phenology. Collected in flower from July to August.

Distribution. This species ranges through northeastern Turkey (Fig. 86).

Habitat. Grassy or rocky places, usually on granite; 2500-3100 m.

Additional specimens examined. **Turkey.** Rize: Anjer, S of Rize, 40°35'N, 40°31'E, 29 July 1934, *Balls 1669b* (BM, E, K); prov. Rize, distr. Ikizdere, çermanin Tepe above Cimil, 40°38'N, 40°53'E, 29 Aug. 1952, *Davis & Dodds 21067* (BM, E, LE); Kaçkar Dag, Uffes? Kauron valley, 40°50'N, 41°10'E, 2 July 1963, *Grod? 16* (K); Rize province, region of Kackar-Dag, N side of the range, 40°50'N, 41°10'E, 23 Aug. 1969, *Riddley & al. s.n.* (K); A8 Rize, Çamlihemsin, Yukari Kavrum yaylasi, Mezevit-Kaçkar arasi, 40°55'N, 41°11'E, 9 Aug. 1980, *Güner 2869* (HUB).

Discussion. Geranium lazicum is probably closely related to *G. ponticum.* Both species grow in a small area of northeastern Turkey and have more deeply divided leaves than other taxa of the eastern Mediterranean region. *Geranium lazicum* is distinguished from *G. ponticum* by its petals, which lack a basal spot, and its leaves, which are pilose above and sericeous below. I was not able to locate the type material for this species. Mikhailovski's collection, cited by Woronow in the protologue, came from the Caucasus Mountains (now in Turkey, ± 41°12'N, 41°48'E). According to Vegter (1988: 1186) Woronow's material is deposited in LE, but I could not obtain any specimen related to the protologue from this herbarium. The neotype here chosen matches the original description, and was collected in the same region as indicated in the protologue.

Bobrov (1949: 10) refers to other interesting material that I was not able to examine: "Albov's specimens from Kramskaya Yaila are similar to the Kvakhid ones in the color of the corolla, but differ in their glabrous leaves". *Geranium lazicum* has discolorous leaves, pilose above and sericeous beneath, thus different from Albov's specimen. Grossheim (1932: 5, 1962: 10) and other authors only refer to the type.

Id. Geranium sect. **Brasiliensia** R. Knuth in Engl., Pflanzenr. IV.129 (Heft 53): 46, 149. 1912. Type: *G. arachnoideum* A. St.-Hil. (designated by Knuth 1912: 46).

Stem erect, leafy, without prickles. *Cymules* 1-flowered. *Petals* erect-patent. *Cotyledons* with entire margins.

20. Geranium arachnoideum A. St.-Hil., Fl. Bras. Merid. 1: 82, tab. 20. 1825. Type locality: "Nascitur in sylvis caeduis ad locum dictum Itaque, haud longè ad urbe Curitibà, parte australi provinciae S. Pauli. Inveni Martio cum fructibus". Type: Brazil. Paraná, Curitibà, Itaque, 25°25'S, 49°15'W, *A. Saint Hilaire 1614* (lectotype, designated by Aedo 2001a: 208, P-00147004!; isolectotype, MPU!).

Perennial herbs, 10-74 cm tall. *Rootstock* 2-4.8 mm in diameter, vertical, not tuberculate, not turnip-shaped, without thickened roots. *Stem* erect, leafy, not rooting at nodes, stolons absent, without vegetative stems, with retrorse, not appressed, eglandular hairs 0.2-0.4 mm long and patent, eglandular hairs 1-3.6 mm long. *Basal leaves* in a persistent rosette, cauline leaves opposite; leaf laminas 1.7-5.4 cm long, 1.9-6.3 cm wide, not peltate, palmatifid [ratio main-sinus length/middle segment length = 0.70-0.90], polygonal in outline, base cordate, not coriaceous, with nerves not projected, pilose on both surfaces, with long appressed, eglandular hairs; segments 5(7), in 1 plane, middle segment rhombic, 2.1-7.5 mm wide at the base [ratio segment width at the base/middle segment length = 0.11-0.26], 5-15-lobed in distal half [ratio secondary sinus length/middle segment length = 0.20-0.44]; petioles up to 16 cm long, without abscission zone, terete, not swollen, not deflexed in age, with retrorse, not appressed, eglandular hairs 0.2-0.4 mm long and patent, eglandular hairs 1-3.4 mm long; stipules 1.7-3 mm long, 0.5-1.2 mm wide, lanceolate, free, papery, brown, with eglandular hairs on abaxial surface and on the margin, glabrous adaxially. *Inflorescence* a monochasial cyme; cymules 1-flowered, solitary [ratio cymule length/leaf length = 1.4-4.1]; peduncles 14-47 mm long, with retrorse, not appressed, eglandular hairs 0.2-0.3 mm long and patent, eglandular hairs 1-3.8 mm long; bracteoles 2-4.2

mm long, 0.5-0.7 mm wide, linear-lanceolate, opposite; pedicels 14-28 mm long, with retrorse, not appressed, eglandular hairs 0.2-0.3 mm long and patent, eglandular hairs 1-3.6 mm long. Flowers actinomorphic. *Sepals* 4.5-7.5 mm long, 1.7-2.6 mm wide, lanceolate, smooth, not accrescent, nerves 3, mucro 0.5-1.1 mm long [ratio mucro length/sepal length = 0.13-0.19], with ± appresed, antrorse, eglandular hairs 0.1-0.2 mm long and patent, eglandular hairs 1-3.5 mm long on the abaxial surface, glabrous adaxially. *Petals* 4.5-7.2 mm long, 2.5-5.9 mm wide, erect-patent, rounded, without claw, purple, glabrous on both surfaces, ciliate on the basal margin, with hairs 0.2-0.5 mm long. *Stamens* 10, both whorls bearing anthers; filaments 2.7-3.5 mm long, lanceolate with an abruptly narrowed apex, yellow, pilose on the abaxial surface, ciliate on the proximal half, with hairs 0.2-0.4 mm long; anthers 0.6-0.9 mm long, purple. Nectaries 5, hemispheric, glabrous. *Gynoecium* 3-4 mm long, purple. *Fruit* 14-23.4 mm long, erect, discharge of *Erodium*-type; mericarps 4-5.9 mm long, 1-1.4 mm wide, without a strand of fibers, not compressed at the apex, smooth, with basal beak 0.8-0.9 mm long, with a basal callus, without a basal prong, brown, with antrorse, erect-patent, eglandular hairs 0.4-1 mm long; rostrum 9-16 mm long, without a narrowed apex, not twisted, with erect-patent, eglandular hairs 0.2-0.4 mm long; stigmatic remnants 1-1.4 mm long, with 5 glabrous lobes. *Seeds* 2.3-3.2 mm long, 1-1.3 mm wide, finely reticulate, uniformly colored, brownish red, glabrous. Cotyledons with entire margin. Fig. 87.

Pollen. *Geranium*-type (Bortenschlager 1967: 429).

Chromosome number. Unknown.

Phenology. Collected in flower from October to February.

Distribution. This species ranges from southern Brazil to Uruguay (Fig. 88).

Habitat. Grassland, dry open grounds, sometimes in marshy places; 200-1650 m.

Fig. 87. *Geranium arachnoideum.* a. Habit. b. Leaf. c. Peduncle. d. Flower. e. Sepal. f. Petal. g. Staminal filament. h. Fruit. i. Mericarp. j. Seed. (Based on: a, c, e, g-j, *Smith & Reitz 10402*, R; b, *Smith & al. 7679*, R; d, f, *Hatschbach 15049*, P).

Fig. 88. Distribution of *Geranium arachnoideum*.

Additional specimens examined. **Uruguay.** Lavalleja: Penitente, 33º50'S, 54º45'W, 1 Nov. 1931, *Herter & al. 1982b* (Z); **Brazil.** Paraná: Palmas, Rio Chopim, 26º30'S, 52º0'W, 20 Oct. 1966, *Hatschbach 15049* (P). Rio Grande do Sul: Arroio Alegre, 28º14'S, 53º28'W, 10 Oct. 1906, *Bornmüller 741* (JE, GH); Passo do Socorro, pr. Vacaria, 28º22'S, 50º49'W, 28 Dec. 1951, *Rambo s.n.* (PACA); Faz da Ronda, pr. Vacaria, 28º30'S, 50º56'W, 10 Jan. 1947, *Rambo s.n.* (PACA); Bom Jesus, Fazenda Bernardo Velho, 28º40'S, 50º26'W, 5 Jan. 1947, *Rambo 35016* (S); Serra da Rocina, pr. Bom Jesus, 28º42'S, 50º24'W, 14 Jan. 1942, *Rambo s.n.* (PACA); Vila Oliva, pr. Caxias, 29º14'S, 50º53'W, 1 Jan. 1946, *Rambo s.n.* (PACA); Taimbé, São Francisco de Paula, 29º23'S, 50º30'W, 18 Dec. 1950, *Sehnem 5134* (PACA); Taimbesinho, pr. São Francisco de Paula, 29º27'S, 50º35'W, 18 Dec. 1950, *Rambo 49376* (B); Fazenda Englert, pr. São Francisco de Paula, 29º27'S, 50º35'W, 1 Jan. 1954, *Rambo 54757* (B). Santa Catarina: 6 km W of Campo Erê, 26º22'S, 53º6'W, 6 Dec. 1964, *Smith & Klein 13731* (R, US); Agua Doce, Campos de Palmas, 26º45'S, 51º24'W, 3 Dec. 1964, *Smith & Klein 13402* (NY, R, US); São Joaquim, camino a Lajes, 10 km. de São Joaquim, 27º48'S, 50º19'W, 15 Dec. 1967, *Lourteig 2187* (K); Bom Jardim, São Joaquim, 27º48'S, 50º19'W, 15 Dec. 1958, *Reitz & Klein 7952* (P); Fazenda Campo dos Padres, 27º57'S, 48º43'W, 23 Jan. 1957, *Rambo 60204* (B); Bom Retiro, between Fazenda Santo Antônio and Fazenda Campo dos Padres, 27º57'S, 48º43'W, 24 Jan. 1957, *Smith & Reitz 10402* (NY, R); Bom Retiro, Fazenda Campo dos Padres, 27º57'S, 48º43'W, 17 Nov. 1956, *Smith & al. 7679* (R, US); entre Lages et São Joaquim, pr. Painel,, 27º58'S, 50º4'W, 22 Oct. 1961, *Pabst 6170* (B, MA, PEL); Santa Barbara, 28º7'S, 49º30'W, 3 Jan. 1965, *Smith & Klein 14209* (US); Serra do Oratorio, 28º22'S, 49º20'W, Feb., *Ule 1415* (CORD, HBG).

Discussion. Geranium arachnoideum is the most distinctive species in sect. *Brasiliensia*. Its peduncles (and pedicels) bear only eglandular hairs (i.e., they lack the glandular hairs found in *G. brasiliense* and *G. glanduligerum*), and the mericarps have a long basal beak and lack transverse ribs at the apex. Knuth (1912: 150) recorded this species from northeastern Argentina near the Brazilian border (Misiones, Villa de Palmas, *Niederlein 1268*) but without any indication of herbarium. According to Barboza (1999: 756) this is a doubtful record for the Argentinean flora. Unfortunately, no specimen supporting this record has been found.

21. Geranium brasiliense Progel in Mart., Fl. Bras. 12(2): 522. 1877. Type locality: "Rio de Janeiro: Glaziou 4776". Type: Brazil. Rio de Janeiro, Campos de Itatiaia, près du Ribeirão, 22º30'S, 44º30'W, 21 Jan. 1873, *A. Glaziou 4776* (lectotype, designated by Aedo 2001a: 209, S-R-10014!; isolectotypes, C-10012686!, K!, P-00147012!, R-000008024!).

Perennial herbs, 40-64 cm tall. *Rootstock* 4-6.9 mm in diameter, vertical, not tuberculate, not turnip-shaped, with thickened roots along the rootstock. *Stem* erect, leafy, not rooting at nodes, stolons absent, without vegetative stems, with retrorse, not appressed, eglandular hairs 0.2-0.3 mm long and patent, eglandular hairs 1-2 mm long. *Basal leaves* in a persistent rosette, cauline leaves opposite; leaf laminas 2.7-7.5 cm long, 3.7-8.4 cm wide, not peltate, palmatifid [ratio main-sinus length/middle segment length = 0.73-0.86], polygonal in outline, base cordate, not coriaceous, with nerves not projected, pilose mainly on the adaxial surface, with ± appressed, eglandular hairs; segments 5(7), in 1 plane, middle segment rhombic, 3-7.1 mm wide at the base [ratio segment width at the base/middle segment length = 0.13-0.24], 7-15-lobed in distal half [ratio secondary sinus length/middle segment length = 0.22-0.34]; petioles up to 29 cm long, without abscission zone, terete, not swollen, not deflexed in age, with patent, eglandular hairs 0.2-2 mm long; stipules 2.2-8.8 mm long, 1.5-5.1 mm wide, lanceolate, free, papery, brown, with eglandular hairs on abaxial surface and on the margin, glabrous adaxially. *Inflorescence* a monochasial cyme; cymules 1-flowered, solitary [ratio cymule length/leaf length = 1-1.9]; peduncles 7-15(29) mm long, with patent, eglandular hairs 0.2-1.3 mm long and patent, glandular hairs 0.3-0.9 mm long; bracteoles 1.1-2.5 mm long, 0.5-0.7 mm wide, linear-lanceolate, whorled; pedicels 8.8-20 mm long, with patent, eglandular hairs 0.2-1 mm long and patent, glandular hairs 0.2-0.9 mm long. Flowers actinomorphic. *Sepals* 4.4-7 mm long, 2-3.5 mm wide, lanceolate, smooth, not accrescent, nerves 3, mucro 0.3-0.8 mm long [ratio mucro length/sepal length = 0.09-0.18], with ± patent, eglandular hairs 0.3-1.3 mm long and ± patent, glandular hairs 0.5-1.1 mm long on the abaxial surface, glabrous adaxially. *Petals* 4.9-8.2 mm long, 2.6-6.2 mm wide, erect-patent, rounded, without claw, purple, glabrous on both surfaces, ciliate on the basal margin, with hairs 0.2-0.6 mm long. *Stamens* 10, both whorls bearing anthers; filaments 2.7-3.8 mm long, lanceolate with an abruptly narrowed apex, yellow, pilose on the abaxial surface, ciliate on the proximal half, with hairs 0.2-0.3 mm long; anthers 0.9-1 mm long, purple. Nectaries 5, hemispheric, glabrous. *Gynoecium* 3-4 mm long, purple. *Fruit* 13-15.9 mm long, erect, discharge of *Erodium*-type; mericarps 3.5-4.5 mm long, 1-1.4 mm wide, without a strand of fibers, not compressed at the apex, smooth (with 2 transverse veins at the apex), with basal beak ca. 0.3 mm long, with a basal callus, without a basal prong, brown, with antrorse, ± appressed, eglandular hairs 0.1-0.3 mm long; rostrum 7.4-9 mm long, without a narrowed apex, not twisted, with erect-patent, eglandular hairs 0.2-0.3 mm long; stigmatic remnants 1.9-2.4 mm long, with 5 hairy lobes. *Seeds* 2.4-3 mm long, 1-1.4 mm wide, finely reticulate, uniformly colored, brownish red, glabrous. Cotyledons with entire margin. Figs. 89, 90.

Pollen. *Geranium*-type (Bortenschlager 1967: 429).

Chromosome number. Unknown.

Phenology. Collected in flower from January to December.

Distribution. This species is endemic to southern Brazil (Fig. 91).

Habitat. Damp places, and forest edges; 2000-2500 m.

Additional specimens examined. **Brazil.** Minas Gerais: Serra de Mantiqueira, Brejo da Lapa, 22°21'S, 44°44'W, 4 May 2012, *Aedo & al. 1186* (MA); Alto Itatiaia, Brejo da Lapa, 22°21'S, 44°44'W, 12 Feb. 1954, *Lutz s.n.* (R). Rio de Janeiro: Fazenda do Rio Preto, 22°15'S, 44°25'W, 21 Sep. 1876, *Glaziou 8613* (P, G, K); Brejo da Lapa, road to Itataia, 22°21'S, 44°44'W, 1 Feb. 1967, *Lindeman & Haas 4126* (U); Serra de Mantiqueira, Abrigo Rebouças, 22°22'S, 44°41'W, 4 May 2012, *Aedo & al. 1198* (MA); Itatiaia, Abrigo Rebouças, 22°23'S, 44°40'W, 30 Dec. 1966, *Castellanos 26106* (HBG, K, U); Itatiaia, Pedra Fronteira ao Abrigo Rebouças, 22°23'S, 44°40'W, 20 Apr. 1957, *Emygdio 1455* (R); Parque Nacional Itatiaia, pr. Abrigo Rebouças, 22°23'S, 44°40'W, 12 Jan. 1961, *From & al. 129* (R); Itatiaia, Abrigo Rebouças, 22°23'S, 44°40'W, Dec., *Lutz s.n.* (R); municipio Itatiaia, arrededores do Parque Nacional de Itatiaia, 22°25'S, 44°41'W, 15 Nov. 2002, *Alves & Marín 2762* (MA); Parque Nacional de Itatiaia, 22°25'S, 44°41'W, 16 Jan. 1961, *Barth 333* (US); Itatiaia, 22°25'S, 44°41'W, 25 Nov. 1952, *Brade 21270* (Z); Parque Nacional do Itatiaia, pasture near lake at km. 8, 22°25'S, 44°41'W, 11 Oct. 1977, *Maas & Martinelli 3200* (K, NY, U); Itatiaia, 22°25'S, 44°41'W, 18 Dec. 1968, *Merxmüller 25611* (M); Itatiaia, 22°25'S, 44°41'W, Nov., *MGF 21270* (NY); Serra do Itatiaia, km 16,

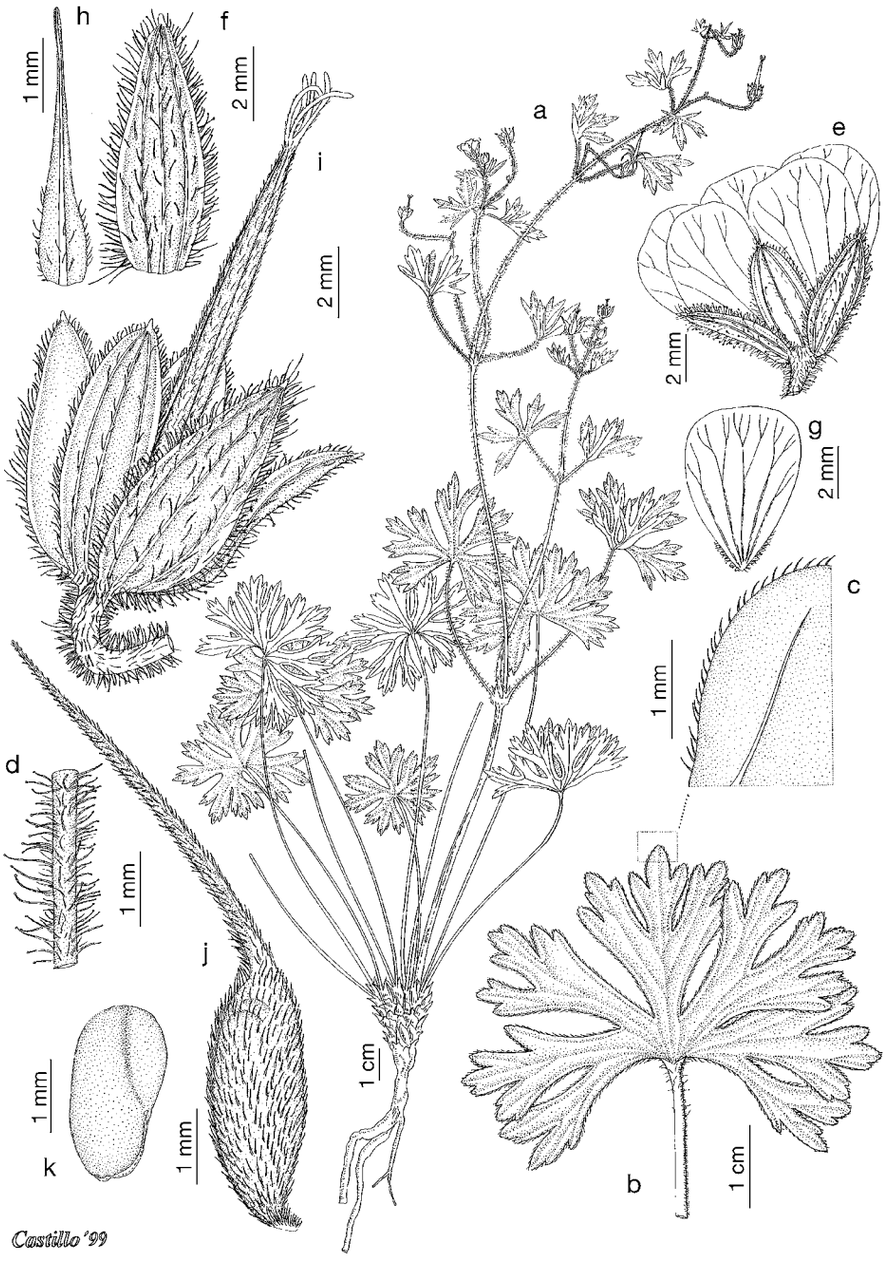


Fig. 89. *Geranium brasiliense*. a. Habit. b. Leaf. c. Leaf detail showing indumentum. d. Peduncle. e. Flower. f. Sepal. g. Petal. h. Staminal filament. i. Fruit. j. Mericarp. k. Seed. (Based on: a, d, f, h, i, *Glaziou 8613*, P; b, c, *Kemmdorf 610*, R; e, g, j, k, *Lutz s.n.*, *12 Feb. 1954*, R).

Fig. 90. *Geranium brasiliense* (Based on: *Aedo & al. 1186,* MA).

Fig. 91. Distribution of *Geranium brasiliense*.

22°30'S, 44°34'W, 18 May 1902, *Dusén 243* (R); Itatiaia, 22°30'S, 44°34'W, 7 Nov. 1947, *Pereira s.n.* (PACA); Resende Co., Serra do Itatiaia, 22°30'S, 44°34'W, 1953, *Segadas Vianna & al. 1134* (P); Resende Co., Serra do Itatiaia, 22°30'S, 44°34'W, 1953, *Segadas Vianna & al. 1305* (R); Serra do Itatiaia, 22°30'S, 44°34'W, 4 June 1913, *Tamandaré & Brade 6371* (SP, S); Serra do Itatiaia, 22°30'S, 44°34'W, Mar., *Ule 131* (HBG, R); Serra do Itatiaia, 22°30'S, 44°34'W, *Ule 85* (R); Serra do Itatiaia, Retiro ad rivulum Ribeirao da Lapa, 22°31'S, 44°30'W, Dec., *Moreira 16* (R).

Discussion. Geranium brasiliense is found only in a small area in the Serra da Mantiqueira near Itatiaia (Rio de Janeiro), Brazil. It shares some features with *G. glanduligerum*: fusiform swollen roots, glandular vesture of peduncles and pedicels, and mericarps with a short beak and transverse ribs at the apex. *Geranium brasiliense* has more deeply divided leaves than *G. glanduligerum,* and its petals are glabrous adaxially. The shape and color of the staminal filaments also separate the two species.

22. Geranium glanduligerum R. Knuth in Engl., Pflanzenr. IV.129 (Heft 53): 150. 1912. Type locality: "Brasilien: St. Catharina, am Bache im Walde der Serra Geral (Ule a. 1890 n. 1717!)". Type: Brazil. Santa Catarina, Serra Geral, 27°40'S, 50°01'W, Dec. 1890, *E. Ule 1717* (lectotype, designated by Aedo 2001a: 214, R!; isolectotypes, CORD-00002996!, HBG-517308!, P-00147010!).

Perennial herbs, 35-60 cm tall. *Rootstock* 4-7.8 mm in diameter, vertical, not tuberculate, not turnip-shaped, with thickened roots along the rootstock. *Stem* erect, leafy, not rooting at nodes, stolons absent, without vegetative stems, with patent, eglandular hairs 0.2-2.2 mm long and patent, glandular hairs 0.4-1.2 mm long. *Basal leaves* in a persistent rosette, cauline leaves opposite; leaf laminas 2.2-5.5 cm long, 3.6-6.3 cm wide, not peltate, palmatifid [ratio main-sinus length/middle segment length = 0.78-0.80], polygonal in outline, base cordate, not coriaceous, with nerves not projected, pilose with ± appressed, eglandular hairs on the adaxial surface and with ± appressed, eglandular and glandular hairs abaxially; segments 5, in 1 plane, middle segment rhombic, 3.2-7.3 mm wide at the base [ratio segment width at the base/middle segment length = 0.14-0.29], 5-13-lobed in distal half [ratio secondary sinus length/middle segment length = 0.16-0.23]; petioles up to 20 cm long, without abscission zone, terete, not swollen, not deflexed in age, with patent, eglandular hairs 0.4-2.2 mm long and patent, glandular hairs 0.4-1 mm long; stipules 3-6.2 mm long, 1.5-2.5 mm wide, lanceolate, free, papery, brown, with eglandular hairs on abaxial surface and on the margin, glabrous adaxially. *Inflorescence* a monochasial cyme; cymules 1-flowered, solitary [ratio cymule length/leaf length = 1.5-2.4]; peduncles 7-25 mm long, with retrorse, not appressed, eglandular hairs 0.2-0.3 mm long (sometimes patent, eglandular hairs up to 2 mm) and patent, glandular hairs 0.3-0.9 mm long; bracteoles 2.7-4 mm long, 0.5-1 mm wide, linear-lanceolate, opposite; pedicels absent or 9.3-25 mm long, with retrorse, not appressed, eglandular hairs 0.2-0.3 mm long (sometimes patent eglandular hairs up to 2 mm) and patent, glandular hairs 0.5-0.9 mm long. Flowers actinomorphic. *Sepals* 5.6-7 mm long, 2.5-3.5 mm wide, lanceolate, smooth, not accrescent, nerves 3, mucro 0.5-0.9 mm long [ratio mucro length/sepal length = 0.10-0.17], with ± patent, eglandular hairs 0.3-2.5 mm long and ± patent, glandular hairs 0.4-1.5 mm long on the abaxial surface, glabrous adaxially. *Petals* 6-8.8 mm long, 4-7.1 mm wide, erect-patent, rounded, without claw, purple, hairy on the basal 1/4 of their adaxial surface, glabrous abaxially, ciliate on the basal margin, with hairs 0.1-0.3 mm long. *Stamens* 10, both whorls bearing anthers; filaments 4-5 mm long, lanceolate, purple, pilose on the abaxial surface, ciliate on the proximal half, with hairs 0.2-0.4 mm long; anthers 1-1.5 mm long, purple. Nectaries 5, hemispheric, glabrous. *Gynoecium* 4-5.9 mm long, purple. *Fruit* 15-18 mm long, erect, discharge of *Erodium*-type; mericarps 3.5-4.5 mm long, 1.2-2 mm wide, without a strand of fibers, not compressed at the apex, smooth (with 1-2 transverse veins at the apex), with basal beak 0.2-0.4 mm long, with a basal callus, without a basal prong, brown, with antrorse, ± appressed, eglandular hairs 0.2-0.5 mm long; rostrum ca. 9 mm long, without a narrowed apex, not twisted, with erect-patent, eglandular hairs 0.2-0.4 mm long; stigmatic remnants 2.5-2.6 mm long, with 5 glabrous lobes. *Seeds* 2.4-2.5 mm long, 1.1-1.5 mm wide, finely reticulate, uniformly colored, brownish red, glabrous. Cotyledons with entire margin. Fig. 92.

Pollen. *Geranium*-type.

Chromosome number. Unknown.

Phenology. Collected in flower from September to March.

Distribution. This species ranges from northeastern Argentina to southern Brazil (Fig. 93).

Habitat. Marshy places and forest edges; 1200-1700 m.

Additional specimens examined. **Argentina.** Formosa: Monteagudo, 24°11'S, 60°36'W, 24 Mar. 1885, *Kurtz 1717* (CORD). **Brazil.** Rio Grande do Sul: Rio dos Touros, pr. Bom Jesus, 28°42'S, 50°24'W, 13 Jan. 1942, *Rambo s.n.* (PACA). Rio Grande do

Sul: cabeceira do Rio das Antas, 29°4'S, 51°21'W, 4 Dec. 1971, *Lindeman & al. 9408* (U). Santa Catarina: Cambujuva pr. São Joaquim, 28°18'S, 49°56'W, 10 Apr. 1955, *Reitz 4881* (PACA); São Joaquim, 9 km E de Bom Jardim da Serra, 28°20'S, 49°38'W, 24 Dec. 1982, *Krapovickas & Schinini 38275* (CORD, CTES, F, UC); São Joaquim, 28°20'S, 49°38'W, 29 Jan. 1960, *Reitz 3486* (S, US). São Paulo: Campos de Jordao, camino da Cachoeira, ao longo do rio das Trutas, Campo de Altitude, 22°43'S, 45°34'W, 6 Oct. 1990, *Queiroz & al. s.n.* (NY); Campos de Jordao, 22°45'S, 45°33'W, 22 Aug. 1938, *Hashimoto 69* (RB); Campos de Jordao, 22°45'S, 45°33'W, 20 Sep. 1950, *Hoehne s.n.* (MA); Campos de Jordao, 22°45'S, 45°33'W, 27 Oct. 1979, *Mizoguchi & al. 1064* (MO); Campos de Jordao, 22°45'S, 45°33'W, 28 Dec. 1970, *Teixeira 337* (MA); Campos de Jordao, 22°45'S, 45°33'W, 28 Dec. 1970, *Teixeira 359* (SP).

Discussion. Geranium glanduligerum shares some features with *G. brasiliense*, but it is always easily identified by its leaves with glandular hairs on the abaxial surface and its petals with hairs on the adaxial surface. *Geranium glanduligerum* occurs in southern Brazil and northern Argentina. Its main range extends from southern Santa Catarina to northern Rio Grande do Sul, but it is also found in two apparently disjunct areas: 1) in northern São Paulo, ca. 600 km northeastward and 2) in Formosa province, ca. 800 km westward. More intensive collecting may fill the gaps.

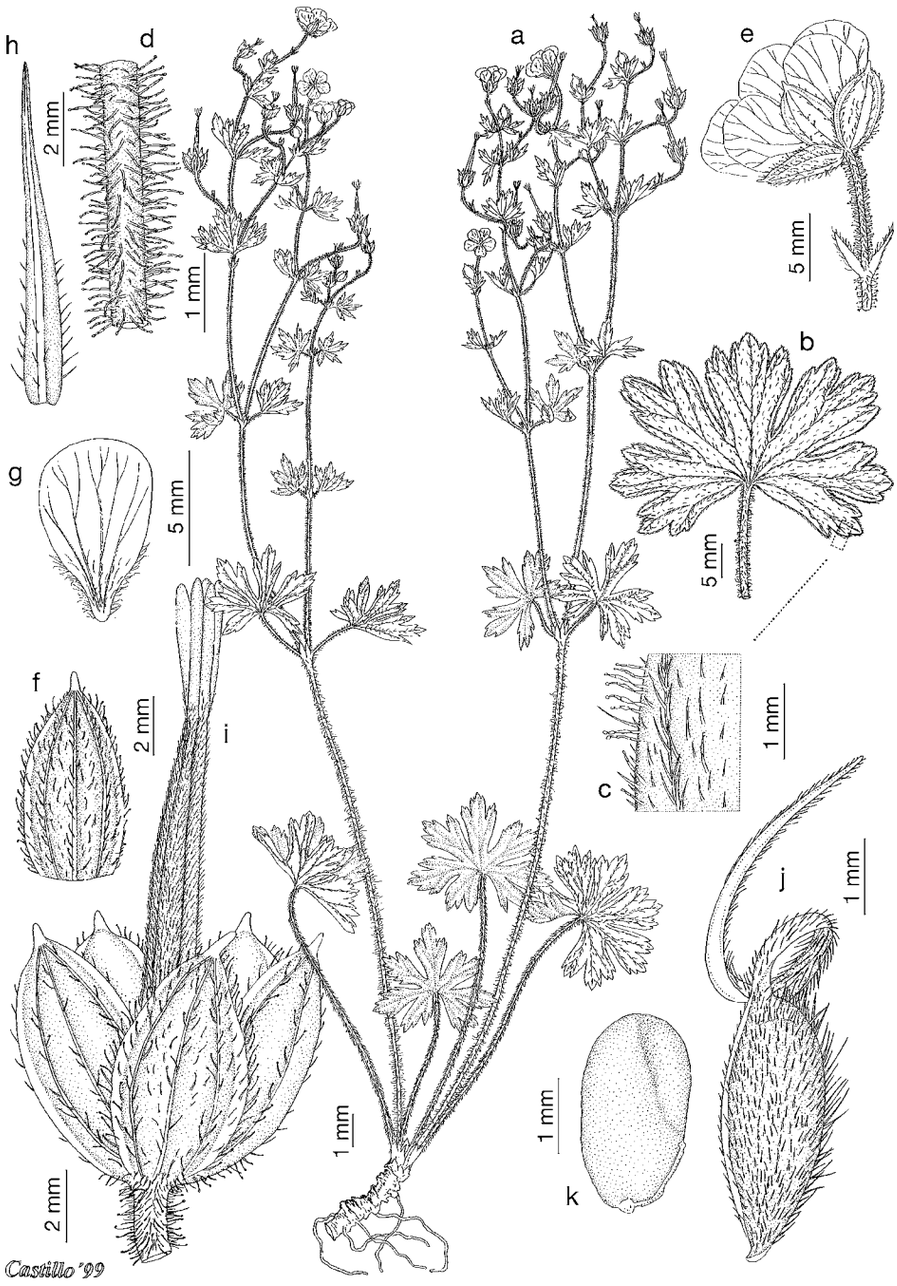


Fig. 92. *Geranium glanduligerum*. a. Habit. b. Leaf. c. Leaf detail showing indumentum. d. Peduncle. e. Flower. f. Sepal. g. Petal. h. Staminal filament. i. Fruit. j. Mericarp. k. Seed. (Based on: *Ule 1717*, P).

II. Geranium L. subg. **Geranium**, Sp. Pl.: 676. 1753.

Fruit of seed-ejection type. At dispersal, each single seed is launched from mericarp by the explosive recurvature of the awn, while the awn and the mericarp wall remain attached to the columella. Mericarps not compressed at the apex, with a basal callus or prong.

IIa. Geranium L. sect. **Geranium**, Sp. Pl.: 676. 1753. Type: *Geranium sylvaticum* L. (designated by Hanks & Small 1907: 4).

Geranium sect. *Trygonium* Dumort., Fl. Belg.: 112. 1827. *Geranium* sect. *Columbina* W.D.J. Koch, Syn. Fl. Germ. Helv.: 140. 1835, nom. superfl. Type: *Geranium columbinum* L. (designated by Van Loon 1984c: 290). This previous designation was overlooked by Aedo & Muñoz Garmendia (1996: 105).

Fig. 93. Distribution of *Geranium glanduligerum*.

Geranium sect. *Hederacea* Paol. in Fiori & Paol., Fl. Italia 2: 233, 240. 1901. Type: *Geranium nodosum* L. (here designated).

Geranium sect. *Andina* R. Knuth, Bot. Jahrb. Syst. 32: 222. 1903. Type: *Geranium sessiliflorum* Cav. (designated by Knuth 1912: 45).

Geranium sect. *Incanoidea* R. Knuth, Bot. Jahrb. Syst. 32: 209. 1903. Type: *Geranium potentillifolium* DC. (designated by Knuth 1912: 45).

Geranium sect. *Biflora* R. Knuth, Bot. Jahrb. Syst. 37: 560. 1906. Type: *Geranium fiebrigianum* R. Knuth (= *G. fallax* Steud.) (here designated).

Geranium sect. *Diffusa* R. Knuth, Bot. Jahrb. Syst. 37: 559. 1906. Type: *Geranium harmsii* R. Knuth (here designated).

Knuth (1906: 559) when described this section only mentioned one species: *G. harmsii*, a likely synonym of *G. diffusum*. He indicated, however, that it is a section with more species (not mentioned) that are distributed by Colombia, Ecuador and Peru. It seems that he is implicitly referring to *G. diffusum*, both by description and by distribution and epithet. Despite this, the designation of *G. diffusum* as type of the section, as did Knuth (1912: 47), is not acceptable because it is not explicitly included in the prologue. Then, *G. harmsii* should be considered the type of the section.

Geranium sect. *Rupicola* R. Knuth, Bot. Jahrb. Syst. 37: 555. 1906. Type: *Geranium rupicola* Wedd. (art. 10.8).

Geranium sect. *Australiensia* R. Knuth in Engl., Pflanzenr. IV. 129 (Heft 53): 46, 150. 1912. Type: *Geranium microphyllum* Hook. f. (= *G. potentilloides* L'Hér. ex DC.) (designated by Knuth 1912: 46).

Geranium sect. *Caespitosa* R. Knuth in Engl., Pflanzenr. IV. 129 (Heft 53): 45, 99. 1912. Type: *Geranium caespitosum* E. James (art. 10.8).

Geranium sect. *Chilensia* R. Knuth in Engl., Pflanzenr. IV. 129 (Heft 53): 45, 68. 1912. Type: *Geranium patagonicum* Hook. f. (= *G. berteroanum* Colla) (designated by Knuth 1912: 45).

Geranium subsect. *Collina* R. Knuth in Engl., Pflanzenr. IV. 129 (Heft 53): 47, 175. 1912. Type: *Geranium collinum* Stephan ex Willd. (art. 10.8).

Geranium sect. *Gracilia* R. Knuth in Engl., Pflanzenr. IV. 129 (Heft 53): 45, 104. 1912. Type: *Geranium multiceps* Turcz. (designated by Knuth 1912: 45).

Geranium sect. *Laxicaulia* R. Knuth in Engl., Pflanzenr. IV. 129 (Heft 53): 47, 208. 1912. Type: *Geranium elongatum* R. Knuth (= *G. killipii* R. Knuth) (designated by Knuth 1912: 47).

Geranium sect. *Mexicana* R. Knuth in Engl., Pflanzenr. IV. 129 (Heft 53): 47, 196. 1912. Type: *Geranium mexicanum* Kunth (art. 10.8).

Geranium sect. *Palustria* R. Knuth in Engl., Pflanzenr. IV. 129 (Heft 53): 47, 174. 1912. *Geranium* subsect. *Palustria* R. Knuth in Engl. Engl. Pflanzenr. IV. 129 (Heft 53): 47, 174. 1912. Type: *Geranium palustre* L. (art. 10.8).

Geranium subsect. *Recurvata* R. Knuth in Engl., Pflanzenr. IV. 129 (Heft 53): 109. 1912. *Geranium* sect. *Recurvata* (R. Knuth) Novoselova, Bot. Zhurn. (Moscow & Leningrad) 84(5): 130. 1999. Type: *Geranium pratense* L. (designated by Novoselova 1999: 130).

Geranium sect. *Renifolia* R. Knuth in Engl., Pflanzenr. IV. 129 (Heft 53): 46, 157. 1912. Type: *Geranium renifolium* Hieron. (art. 10.8).

Geranium sect. *Sanguinea* R. Knuth in Engl., Pflanzenr. IV. 129 (Heft 53): 46, 138. 1912. Type: *Geranium sanguineum* L. (art. 10.8).

Geranium sect. *Simensia* R. Knuth in Engl., Pflanzenr. IV. 129 (Heft 53): 47, 202. 1912. Type: *Geranium simense* Hochst. (= *G. arabicum* Forssk.) (art. 10.8).

Geranium sect. *Striata* R. Knuth in Engl., Pflanzenr. IV. 129 (Heft 53): 47, 188. 1912. *Geranium* subsect. *Striata* (R. Knuth) Tsyren., Bot. Zhurn. (Moscow & Leningrad) 70(9): 1257. 1985. Type: *Geranium striatum* L. (≡ *G. versicolor* L.) (art. 10.8).

Geranium sect. *Sibirica* R. Knuth in Engl., Pflanzenr. IV. 129 (Heft 53): 47, 195. 1912. Type: *Geranium sibiricum* L. (art. 10.8).

Geranium sect. *Fruticulosa* R. Knuth, Repert. Spec. Nov. Regni Veg. 28: 10. 1930. Type: *Geranium lignosum* R. Knuth (designated by Knuth 1930a: 10).

Geranium sect. *Petraea* R. Knuth, Repert. Spec. Nov. Regni Veg. 40: 220. 1936, nom. illeg., non Bubani, 1901. *Geranium* sect. *Azorelloida* Aedo & al., Anales Jard. Bot. Madrid 56: 243. 1998. Type: *Geranium guanacosense* R. Knuth (≡ *G. azorelloides* Sandwith) (designated by Knuth 1936: 220 and Aedo & al. 1998: 243 respectively).

Geranium subsect. *Orientalia* Tsyren., Bot. Zhurn. (Moscow & Leningrad) 70(9): 1258. 1985. *Geranium* sect. *Orientalia* (Tsyren.) Novoselova, Bot. Zhurn. (Moscow & Lenigrad) 84(5): 132. 1999. Type: *Geranium nepalense* Sweet (designated by Tsyrenova 1985c: 1258).

Geranium sect. *Neoandina* Aedo, Anales Jard. Bot. Madrid 58: 183. 1998. Type: *Geranium sibbaldioides* Benth. (designated by Aedo & al. 1998: 183).

Geranium sect. *Eriantha* Novoselova, Bot. Zhurn. (Moscow & Leningrad) 84(5): 129. 1999. *Geranium* subsect. *Beringica* Tsyren. in Probatova & al., Fl. Russian Far East: 445. 2006. Type: *Geranium erianthum* DC. (art. 10.8).

Geranium sect. *Sobolifera* Novoselova, Bot. Zhurn. (Moscow & Leningrad) 84(5): 133. 1999. Type: *Geranium soboliferum* Kom. (art. 10.8).

Geranium subsect. *Nemoralia* Tsyren. in Probatova & al., Fl. Russian Far East: 445. 2006. Type: *Geranium eriostemon* Fisch. ex DC. (designated by Tsyrenova 2006b: 445).

Geranium sect. *Dahurica* Tsyren. in Probatova & al., Fl. Russian Far East: 445. 2006. Type: *Geranium dahuricum* DC. (art. 10.8).

Leaves and petiole without any abscission zone. *Stipules* ovate to lanceolate, entire, sometimes with a very short bifid apex. *Mericaps* with a basal callus.

The Sylvaticum Group—This group is characterized by the presence of alternate cauline leaves, free stipules, the dichasially branched inflorescence, with 2-flowered cymules solitary or in aggregates toward the apex of each branch, the petals hairy only on the base, the staminal narrow filaments, without an expanded base, and the glabrous nectaries. In general terms, *G. atlanticum* and *G. endressii* fit well within the group, although the former have hairy nectaries and the latter, solitary cymules.

23. Geranium albiflorum Ledeb., Icon. Fl. 1: 6, tab. 18. May-Dec. 1829. Type locality: "Hab. in umbrosis subhumidis" ["... prope Riddersk et alibi (L.); in laricetis ad fl. Mön in fl. Tschuja influentem (B)" according to Ledebour, Fl. Alt. 3: 230, 1831]". Type: Russia. Altai, Gromotucha, 4 May 1826, *C.F. Ledebour s.n.* (*herb. Ledebour 109*) (lectotype, desigated by Ivleva 2013: 232, LE-01009474 image!; isolectotypes, B-100629127!, C!, HAL-111356 image!, M-0243808!, P-00712056!, S!, W-0075334!).

Geranium sylvaticum var. *albiflorum* Krylov, Trudy Obšč. Estestvoisp. Imp. Kazansk. Univ. 9(6): 59. 1881. *Geranium krylovii* Tzvelev, Novosti Sist. Vyssh. Rast. 29: 95. 1993. Type locality: "This variety substitute typical plants in the alpine parts of Permskaya guberniya where it is rather usual in the mountain meadows

and on the banks of mountain streams. Kvarkush, Chuvalskii, Mortaiskii, Kuroksarskii, Tulymskii kamni, Isherim, Yalping-ner, Yany-enki, Sizhup and some other mountains. Rarely it occurs in the mountain valleys where grows in wet rocky banks of the rivers (upper reaches of Unia river, mouth of Njulas river) ". Type: Russia. Perm, Ural, Mortaiskii kamen, 61º08'N, 58º56'E, 10 July 1878, *P. Krylov s.n.* (lectotype, designated by Tzvelev 1993: 96, LE-01032145!).

Geranium albiflorum var. *grandiflorum* Reverd. & Vylzan ex Gureeva & Balashova, Syst. Notes Krylov Herb. 115: 8. 2017. Type locality: "Enisei River, N 68º40', Fokina River, wet thicket. 27 June 1914. V. Reverdatto" (Holotype TK-001295! Isotypes TK-001296! TK-001297! TK-001298!). Type: Russia. Krasnoyarsk, Enisei River, Fokina River, 68º40'N, 86º18'E, 27 June 1914, *V. Reverdatto s.n.* (holotype, TK-001205 image!).

Geranium malyschevii Troschkina, Rast. Mir Aziatsk. Rossii 3(27): 27, 30 fig. 6. 2017. Type locality: "East Sayan, Tunkinskij Range, r. Sagan-Shuluta, M-47-10, forest belt, h = 1900 m above sea level, among high grasses, 31 VII 1975, No. 196, R. Krogulevich. 2n = 28. Det. R. Krogulevich (NSK0000775)". Type: Russia. Buryatiya, East Sayan, Tunkinskij Range, r. Sagan-Shuluta, 51º53'N, 101º58'E, 31 July 1975, *R. Krogulevich 196* (holotype, NSK-0000775 image!).

Perennial herbs, (17)28-48(62) cm tall. *Rootstock* 5.3-15.3 mm in diameter, ± horizontal, not tuberculate, not turnip-shaped, with thickened roots along the rootstock. *Stem* erect, leafy, not rooting at nodes, stolons absent, without vegetative stems, with retrorse, ± appressed, eglandular hairs 0.2-0.5 mm long. *Basal leaves* in a ± deciduous rosette, cauline leaves alternate (usually 1) and upper opposite; leaf laminas (3.2)4.9-7.4(10.2) cm long, 3.8-14.3 cm wide, not peltate, palmatifid [ratio main-sinus length/middle segment length = (0.65)0.79-0.83(0.85)], polygonal in outline, base cordate, not coriaceous, with nerves not projected, pilose, with appressed, eglandular hairs on both surfaces; segments 5, in 1 plane, middle segment rhombic, (4.1)6.3-9.8(14.8) mm wide at the base [ratio segment width at the base/middle segment length = (0.10)0.15-0.19(0.24)], (9)11-17(22)-lobed in distal half [ratio secondary sinus length/middle segment length = (0.17)0.19-0.22(0.26)]; petioles up to 27 cm long, without abscission zone, terete, not swollen, not deflexed in age, with retrorse, ± appressed or uncinate, eglandular hairs 0.2-0.6 mm long; stipules 4.9-9.2 mm long, 1.3-3.2 mm wide, lanceolate, free, papery, brown, glabrous or with scattered, eglandular hairs on abaxial surface and on the margin, usually glabrous adaxially. *Inflorescence* a dichasial cyme; cymules 2-flowered, solitary or in aggregates at the top of each branch [ratio cymule length/leaf length = (0.76)1.5-3(8.3)]; peduncles (13)15-32(115) mm long, with retrorse, uncinate, eglandular hairs 0.1-0.4 mm long and, usually, patent, glandular hairs 0.2-0.7 mm long; bracteoles 1.4-5.5 mm long, 0.4-1 mm wide, lanceolate, whorled; pedicels (4.5)8-16(27) mm long, with retrorse, uncinate, eglandular hairs 0.1-0.4 mm long and, usually, patent, glandular hairs 0.2-0.7 mm long. Flowers actinomorphic. *Sepals* (4)4.7-6(7.1) mm long, 1.6-3.1 mm wide, lanceolate, smooth, not accrescent, nerves 3, mucro (0.6)0.9-1.4(2.7) mm long [ratio mucro length/sepal length = 0.15-0.41], with erect-patent, eglandular hairs 0.2-0.9 mm long and, usually, patent, glandular hairs 0.2-1 mm long on the abaxial surface, glabrous adaxially. *Petals* (8.1)10.2-12.7(13.2) mm long, (3.7)4.4-5.8(7.5) mm wide, erect-patent, emarginate (notch 0.3-1.5 mm deep), without claw, white, rarely pale lilac, hairy on the base of the adaxial surface, glabrous abaxially, ciliate on the basal margin, with hairs 0.2-0.7 mm long. *Stamens* 10, both whorls bearing anthers; filaments (2.1)5.4-6.7(7.4) mm long, lanceolate, white, pilose on the abaxial surface, ciliate on the proximal half, with hairs 0.2-0.4 mm long; anthers 1-1.4(1.7) mm long, blue. Nectaries 5, hemispheric, glabrous. *Gynoecium* 4.1-8.8 mm long, pale pink. *Fruit* (18.3)19-27(28.5) mm long, erect, discharge of seed-ejection type; mericarps 2.9-3.8 mm long, 1.5-2 mm wide, without a strand of fibers, not compressed at the apex, smooth (sometimes with 1-2 transverse veins at the apex), without basal beak, with a basal callus, without a basal prong, brown, with ± patent, eglandular hairs 0.1-0.4 mm long and scattered, glandular hairs 0.2-0.5 mm long (mainly at the top of the mericarp); rostrum 14.2-20.6 mm long, with a narrowed apex 1.6-3.5 mm long, not twisted, with ± patent, eglandular hairs 0.1-0.3 mm long and usually glandular hairs 0.3-0.8 mm long; stigmatic remnants 1.1-3.4 mm long, with 5 glabrous lobes. *Seeds* 2.2-3 mm long, 1.4-1.8 mm wide, finely reticulate, uniformly colored, brown, glabrous. Cotyledons with entire margin. Fig. 94, 95.

Pollen. Ornamentation not studied.

Chromosome number. 2*n* = 26, 28.

Phenology. Collected in flower from May to September.

Distribution. This species ranges from northern Ural Mountains through western and southern Siberia (Altay, Arkhangelsk, Buryatiya, Chita, Irkutsk, Komi, Krasnoyarsk, Perm, Tuva and West Siberia) to northwestern China (Xinjiang), eastern Kazakhstan, Kyrgyzstan and Mongolia (Fig. 96).

Habitat. Meadows, stony tundra, shrubby formations with *Betula* L. and *Salix* L. and edge of *Larix* Mill., *Picea* A. Dietr. and *Pinus* L. forests; 200-2700 m.

Representative specimens examined. **China.** Xinjiang: Uygur, prefectura Yili, Hasake, distrito Xinyuan, zona protegida de la naturaleza del río Qiapuhe, 43º24'N, 83º18'E, 2 July 1994, *Dafang 94343* (MO); Mon. Saur, pendiente sur, barranco río Kuragaitu, orilla derecha Bain-Tsagán, 47º0'N, 86º0'E, 23 June 1957, *Unatov 312* (LE, MO); distrito Aletai, población Fuhai, pueblo Azubai, 47º8'N, 87º30'E, 29 June 1957, *Chen Shunli 71* (PE). **Kazakhstan.** Almaty: Tien Shien, lle Alatau National Nature park, 43º3'N, 76º58'E, 4 June 2008, *Stenberg 214* (S). East Kazakhstan: Kazachstania prov., N of Uspenka, at small river Belesek, 48º37'N, 86º0'E, 13 June 1993, *Karis 574* (S); Altai meridional, montium Narymensium, pr. pagum Katon-Karagaj, 49º10'N, 85º36'E, 30 Aug. 1930, *Smirnow 53* (B, PRC). **Kyrgyzstan.** Issyk-Kul:Ysyk-Köl oblast, Ak-Suu Rayon, Terskej-Ala-Too, Con-Asuu Pass, 42º30'N, 78º56'E, 23 July 2003, *Janssen & al. 2174* (JE). **Mongolia.** Töv: montes Chentej, in valle rivi Terelz, 1-20 km S montem Asralt-chajrchan, 48º17'N, 107º28'E, 8 Sep. 1966, *Vašák 9451* (MA); montes Kentei ad fontes fluviorum Mensa,

48º30'N, 108º30'E, 18 July 1929, *Ikonnikov 3135* (S); montes Kentei ad fontes fluviorum Kerulen et Onon, 48º30'N, 108º30'E, 24 July 1928, *Ikonnikov 486* (GH, S). Selenge: montes Kentei ad fontes fluviorum Tola, 48º57'N, 104º48'E, 5 July 1929, *Ikonnikov 2513* (GH). **Russia.** Altay: montes de Altai, entre Kairu y Surijza, 51º16'N, 88º6'E, 13 Aug. 1996, *Castroviejo & al. 14068SC* (MA); montes de Altai, entre Ayu-Kol y Ayu-Kel, 51º17'N, 87º51'E, 10 Aug. 1996, *Castroviejo & al. 13931* (MA). Arkhangelsk: Nenets distrito, parte E de la tundra Bolshezemelskaya, curso superior del río Korotaikha, desembocadura del río Sava Yu, 68º53'N, 60º57'E, 15 July 1964, *Rebristaya 179* (M); Distrito Nenetskiy, borde este de la tundra Bolshezemelskaya, orilla derecho del río Kara, curso alto, 69º13'N, 64º55'E, 18 July 1959, *Rebristaya s.n.* (H, S). Buryatiya: Nuchu Daban, 51º12'N, 104º8'E, *Schtschukin s.n.* (UPS); lago Baikal, montes de Baikal, nacimiento de río Muzhinai, 54º51'N, 108º54'E, 15 Aug. 1967, *Egorova & Siplivinskiy s.n.* (H); Chita: Zabaikalskaya region, Akshinsk distr., Sohondo Mt., Barun-Sohondo river upper reaches, 49º43'N,

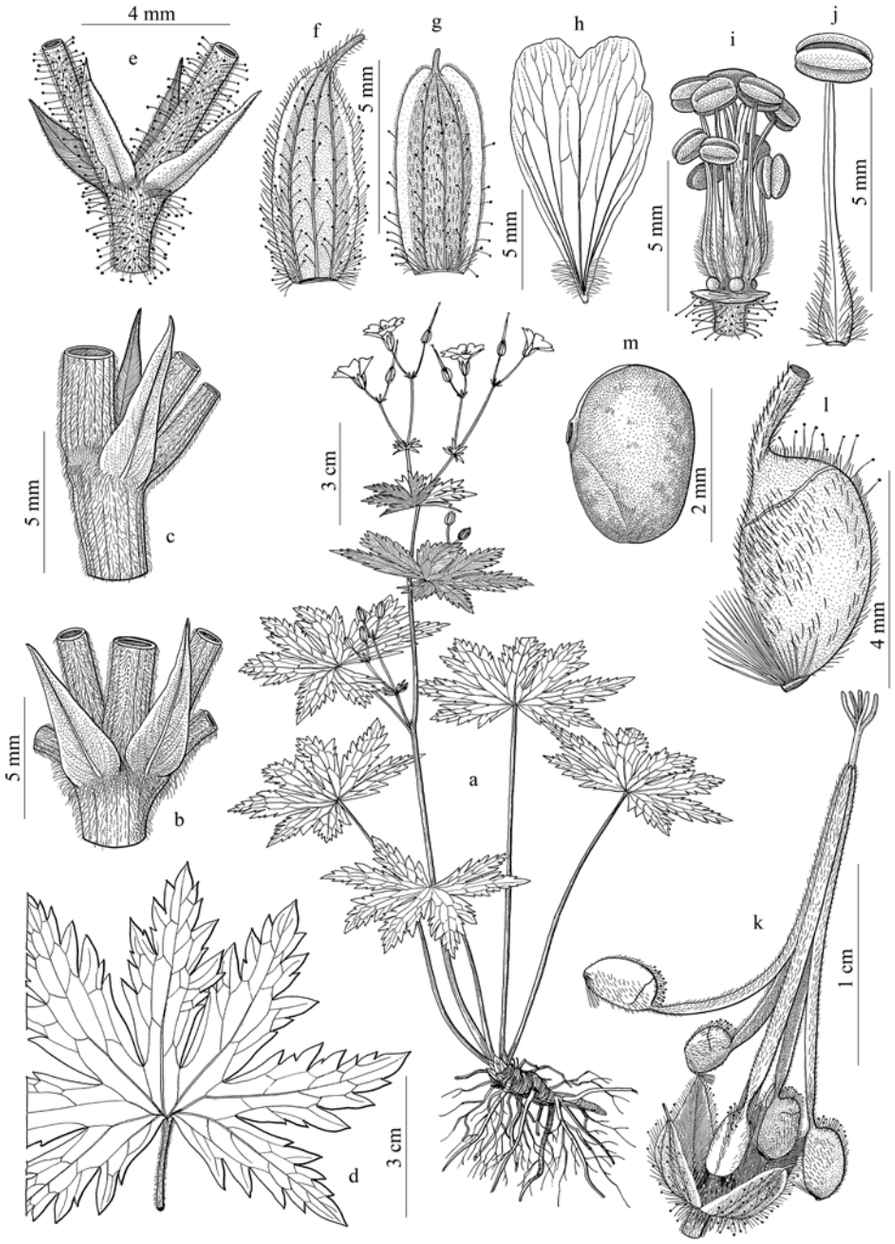


Fig. 94. *Geranium albiflorum*. a. Habit. b, c. Stipules. d. Leaf. e. Bracteoles. f, g. Sepals. h. Petal. i. Flower without petals and sepals. j. Stamen. k. Fruit. l. Mericarp. m. Seed. (Based on: a, b, d, *Castroviejo & al. 14068,* MA; c, *Ganeschin s.n.,* MA-690193; e, k-m, *Brenner s.n.,* S; f-j, *Smirnov 257a,* MA).

Fig. 95. *Geranium albiflorum* (Based on: *Castroviejo 13931,* MA).

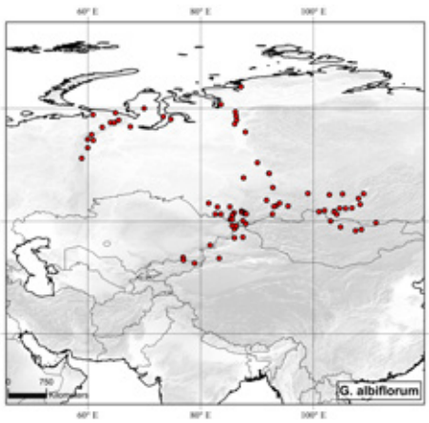


Fig. 96. Distribution of *Geranium albiflorum*.

111°5'E, 28 June 1913, *Smirnov 257a* (MA). Irkutsk: Irkustsk region, Balagansk distr., bank of Tuchem stream, 50°0'N, 103°2'E, 17 June 1909, *Ganeschin s.n.* (MA); Irkustsk region, Nizhneudinsk distr., Yandinsky mountain range, 11-18 verst from Yandy, 54°54'N, 99°1'E, 17 June 1909, *Ganeschin s.n.* (MA). Komi: Yugyd-va National Park, Balbanyu valley around Sana-Vozh and towards concluence of rivers Balbanyu and Kozhim, 65°20'N, 60°42'E, 29 June 2004, *Alsos & Tribsch 142* (WU); Nenets national District, right side of Kara river, 67°55'N, 65°28'E, 18 July 1959, *Rebristaya s.n.* (UPS). Krasnoyarsk: Sistema Zap. Sayan, cordillera Aradanskiy, prados alpinos en curso alto del río Obrezistiy, 52°35'N, 93°0'E, 16 July 1967, *Gudoshnikov s.n.* (H); Taimyr occidental, orilla derecha del río Pyasina, en los tramos superiores, 73°50'N, 87°9'E, 20 July 1976, *Matveeva 1558* (M). Tuva: West Sayan mountains, E Tonnola Range, Schvelig river valley, 20 km SE of Isthichen, 120 km W of Kazil, 51°15'N, 92°44'E, 17 July 1983, *Elias 7682* (US); Todzha, alrededores de c. Systyg-Jem, 52°39'N, 95°30'E, 8 July 1978, *Krasnoborov & Danilov s.n.* (MO). West Siberia: Tomsk, Biysk district, snowy peak between Inya river and the peak of Sentelek, 15 verst of Pokrovka village, 51°12'N, 83°36'E, 29 July 1913, *Kusnezow 2183* (UPS); prov. Tjumen, peninsula Jamal, fl. Laptajacha, 20 km SW pago Mys Kamenny, 68°32'N, 73°24'E, 19 July 1979, *Rebristaya 6333* (B, C, G, GH, H, M, MO, NY, S, UPS, W).

Discussion. Geranium albiflorum is a perennial with a short horizontal rootstock and an erect habit. The basal leaves are in a ± deciduous rosette. The stem usually has an alternate leaf toward the middle (sometimes two nodes have alternate leaves) and opposite leaves on the inflorescence. The leaves are moderately divided. The indumentum of the lower part of the stem and petioles of basal leaves consists of appressed, eglandular hairs that are variable in density. On the inflorescence (peduncles, pedicels, sepals, etc.) both glandular and eglandular hairs are found. However, there are some individuals with only eglandular hairs (for instance, the isolectotypes of *G. albiflorum*). I consider that these glandular forms do not deserve taxonomic recognition, but other authors differ from this point of view (Troschkina 2017). The petals are white or, rarely, pale lilac with violet veins, narrow and emarginate.

Geranium albiflorum is close to *G. sylvaticum*. Both species share moderately divided leaves and the frequent presence of glandular indumentum. *Geranium albiflorum* is easily distinguished from *G. sylvaticum* by its shorter and narrower petals. Additionally, petals of *G. sylvaticum* are purple (except in the case of albinistic individuals) and with an entire apex, while those of *G. albiflorum* are white and emarginate. *G. albiflorum* also has shorter sepals with shorter mucro, shorter staminal filaments, shorter anthers, and shorter fruit than *G. sylvaticum.* As in *G. sylvaticum,* female individuals have been excluded from the descriptions.

Novoselova (1999: 129) designated a drawing as lectotype of *G. albiflorum* (Ledebour, Ic. Pl. Fl. Ross. 1: 6, tab. 18, 1829). However, according to the art. 9.19 of the the Shenzhen Code, Novoselova's choice should be superseded because one syntype collected by Ledebour from Altai has been located by Ivleva (2013) at LE herbarium.

24. Geranium atlanticum Boiss., Diagn. Pl. Orient. ser. 1, 1: 59. 1843. Type locality: "Hab. in Africâ boreali circà Constantine herb. meum". Type: Algeria. Constantine, 36°32'N, 5°27'E, 1840, *E. Boissier s.n.* (lectotype, designated by Knuth 1912: 109, G-00365968!).

Geranium maurum Pau in Font Quer, Iter Marocc. 1930, n.° 395. 1932, in sched. *Geranium atlanticum* var. *maurum* (Pau) Font Quer, Iter Marocc. 1930, n.° 395. 1932, in sched. Type locality: "Hab. in declivibus umbrosis c. Sidi Alí (Beni Aros), ad 350 m. alt.; 6 majii". Type: Morocco. Sidi Alí, Beni Aros, 35°18'N, 5°35'W, 6 May 1930, *P. Font Quer s.n.* (lectotype, here designated, MA-71451!; isolectotypes, BC-98264!, BM!, JE-00010352 image!, MAF-25313!).

Geranium atlanticum var. *stenopetalum* Maire, Bull. Soc. Hist. Nat. Afrique N. 7: 101.1940. Type locality: "Algérie: Mont Zaccar; ravin des Righas, dans le Quercetum Ilicis (Battandier)". Type: Algeria. Miliana, ravin des Righas, 36°17'N, 2°14'E, May 1940, *J.A. Battandier s.n.* (lectotype, here designated, MPU-004354!).

Perennial herbs, 21-55 cm tall. *Rootstock* 5-10.7 mm in diameter, ± horizontal, not tuberculate, not turnip-shaped, with napiform roots (27-105 mm long, 6-10 mm wide) along the rootstock. *Stem* erect, leafy, not rooting at nodes, stolons absent, without vegetative stems, with ± patent, eglandular hairs 0.7-2.3 mm long. *Basal leaves* in a persistent rosette, cauline leaves opposite (in some specimens medium cauline leaf alternate); leaf laminas (5)5.7-9.1(15) cm long, 6.8-22 cm wide, not peltate, palmatifid [ratio main-sinus length/middle segment length = (0.82)0.86-0.89(0.91)], polygonal in outline, base cordate, not coriaceous, with nerves not projected, pilose, with ± appressed, eglandular hairs on both surfaces; segments 5(7), in 1 plane, middle segment rhombic, (4)4.7-9.4(12.4) mm wide at the base [ratio segment width at the base/middle segment length = (0.11)0.12-0.14(0.23)], (25)38-73(96)-lobed in distal half [ratio secondary sinus length/middle segment length = (0.29)0.32-0.52(0.56)]; petioles up to 41 cm long, without abscission zone, terete, not swollen, not deflexed in age, with ± patent, eglandular hairs 0.9-2 mm long; stipules 6.9-16.1 mm long, 1.6-3.6 mm wide, lanceolate, free, papery, brown, with eglandular hairs on abaxial surface and on the margin, glabrous adaxially. *Inflorescence* a dichasial cyme; cymules 2-flowered, usually in aggregates at the top of each branch [ratio cymule length/leaf length = (1.3)1.5-2.3(2.7)]; peduncles (16)19-38(49) mm long, with patent, eglandular hairs 0.7-1.2 mm long; bracteoles 3.1-7.1 mm long, 0.6-1.3 mm wide, lanceolate, whorled; pedicels (12)14-23(29) mm long, with patent, eglandular hairs 0.4-1.3 mm long. Flowers actinomorphic. *Sepals* (6.3)7.7-9.6(10.9) mm long, 2.8-4.2 mm wide, lanceolate, smooth, not accrescent, nerves 5, mucro (1.2)1.3-2(2.4) mm long [ratio mucro length/sepal length = 0.15-0.32], with ± appresed, antrorse, eglandular hairs 0.5-1.5 mm long on the abaxial surface, glabrous adaxially. *Petals* (16)16.4-

18.8(19.7) mm long, (8.8)10.4-12(12.4) mm wide, erect-patent, emarginate (notch 0.4-1 mm deep), without claw, purple, hairy on the base of the adaxial surface, glabrous abaxially, ciliate on the basal margin, with hairs 0.4-1.3 mm long. *Stamens* 10, both whorls bearing anthers; filaments (7.3)8.1-9.9(10.6) mm long, lanceolate, purple, pilose on the abaxial surface, ciliate on the proximal half, with hairs 0.8-2.5 mm long; anthers 2.1-2.4(2.5) mm long, dark purple. Nectaries 5, hemispheric, with a tuft of hairs at the top, dorsally glabrous. *Gynoecium* 8-9 mm long, purple. *Fruit* (28)31-37 mm long, erect, discharge of seed-ejection type; mericarps 3.6-4.5 mm long, 2.4-2.9 mm wide, without a strand of fibers, not compressed at the apex, smooth (with 1-2 transverse veins at the apex), without basal beak, with a basal callus, without a basal prong, brown, with ± appressed, eglandular hairs 0.2-0.4 mm long; rostrum 20-29 mm long, with a narrowed apex 6.1-8.5 mm long, not twisted, with erect-patent, eglandular hairs 0.1-0.3 mm long; stigmatic remnants 2-2.8 mm long, with 5 glabrous lobes. *Seeds* 2.3-2.5 mm long, 2.2-2.4 mm wide, finely reticulate, uniformly colored, brown, glabrous. Cotyledons with with a notch on each side margin. Fig. 97, 98.

Pollen. Ornamentation not studied.

Chromosome number. Unknown.

Phenology. Collected in flower from March to June.

Distribution. This species ranges from northern Morocco, through northern Algeria to northwestern Tunisia (Fig. 99).

Habitat. Fields, grassy and rocky areas, *Quercus suber* L. and *Q. ilex* L. forests, on limestones, schistous or sandy soils; 350-1500 m.

Additional specimens examined. **Algeria.** Bejaïa: Djebel Babor, 36°35'N, 5°25'E, 5 June 1980, *Dubuis s.n.* (MPU); Kabylie des Babors, Mcid-ec-Ohta, Dt. Constantine, 36°35'N, 5°25'E, 27 May 1952, *Faurel s.n.* (MPU); Monts Babors, Kabylie, 36°35'N, 5°25'E, June, *Reverchon 13* (MA, B). Blida: Atlas de Blida, au-dessous de Chréa, 36°25'N, 2°52'E, 24 Apr. 1932, *Dubuis s.n.* (MPU); gorges de la Chiffa, 36°27'N, 2°44'E, 1923, *Humbert s.n.* (P); Blida, 36°28'N, 2°50'E, 1898, *Joly s.n.* (MPU). Boumerdes: Alger, Bou-Zegza, 36°36'N, 3°25'E, 3 June 1934, *Dubuis s.n.* (MPU). Constantine: foret de Bou-Masram, Constantine, 36°20'N, 6°36'E, 6 May 1888, *Cosson & Duval s.n.* (MPU); Constantine, 36°21'N, 6°36'E, 1873, *Reuter s.n.* (G); pic du Mécid, versant nord, 36°24'N, 6°45'E, 21 Apr. 1858, *Choulette s.n.* (MPU); Constantine, Djebel-Sidi-Mecid, 36°24'N, 6°45'E, Apr., *Reboud s.n.* (MPU); Constantine, Djebel Tababor, col d'El Fedja, 36°32'N, 5°27'E, 28 May 1952, *Faurel s.n.* (MPU). El Tarf: La Calle, 36°53'N, 8°26'E, May 1921, *Alleizette s.n.* (LD). Oran: Oran, montagne de N?edroma, 35°0'N, 1°44'W, 17 May 1856, *Bourgeau s.n.* (MPU); foret de M'Sila, env. d'Oran, 35°39'N, 0°53'E, Apr., *Alleizette s.n.* (MA). Tizi Ouzou: Kaby-

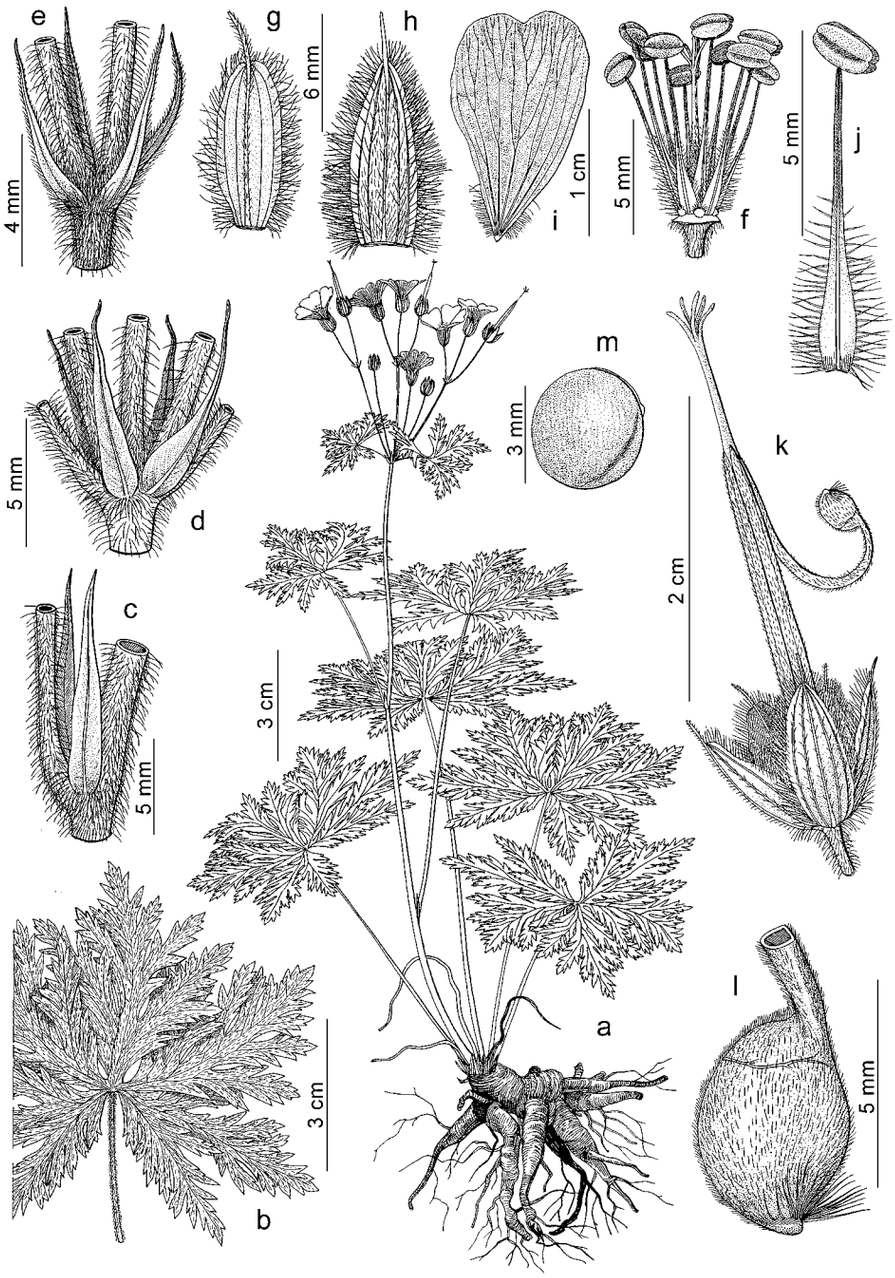


Fig. 97. *Geranium atlanticum*. a. Habit. b. Leaf. C, d. Stipules. e. Bracteoles. f. Flower without petals and sepals. g, h. Sepals. i. Petal. j. Stamen. k. Fruit. l. Mericarp. m. Seed. (Based on: a, c-e, g-i, *Faure s.n.,* MA-71445; b, k, *Pau s.n.,* MA-71451; f, j, *Jury & al. 15548,* MA; l, m, *Caballero s.n.,* MA-71436).

Fig. 98. *Geranium atlanticum* (Based on: *Quintanar & al. 3244,* MA).

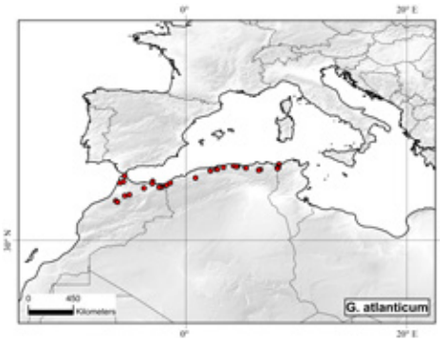


Fig. 99. Distribution of *Geranium atlanticum*.

liae, montium Akfadou, 36º40'N, 4º35'E, 19 May 1939, *Maire s.n.* (MPU); Constantine, près d'Adekar, massif de l'Akfadou, 36º41'N, 4º40'E, 22 Apr. 1948, *Dubuis s.n.* (MPU); Alger, Tamgout d'Azazga, 36º43'N, 4º21'E, 21 May 1952, *Dubuis s.n.* (MPU). Tlemcen: Dj. Atac, env. Tlemcen, 35º12'N, 1º24'W, 2 May 1872, *Courcière s.n.* (MPU). **Morocco.** Fès-Meknès: Meknès, Moulay-Idriss, Djebel Zerhoun, 34º2'N, 5º30'W, 6 Apr. 1994, *Montserrat & Valdés 2349/94* (BC); Ouezzan, 34º8'N, 5º5'W, 26 Apr. 1925, *Maire s.n.* (MPU); Berkane, 34º43'N, 3º46'W, June, *Sennen (frère) & Mauricio (frère) s.n.* (MA). Oriental: Taforalt, Maroc Oriental, 34º48'N, 2º13'W, 4 May 1930, *Faure s.n.* (M, MA, MPU); Beni-Snassen, on route to Maison Forrestiére Ain-Almon, 34º48'N, 2º24'W, 5 May 2000, *Jury & al. 15548* (MA); Beni-Snassen, Taforalt, 34º48'N, 2º13'W, 13 Apr. 1935, *Sennen (frère) & Mauricio (frère) 8367* (MA); Beni-Snassen, Tinissene, 34º50'N, 2º10'W, 31 May 1932, *Faure s.n.* (MPU); Beni Ouakhane, Beni Znassen, 34º50'N, 2º10'W, Apr., *Joly s.n.* (MPU); Harcha, Baïay, 35º8'N, 3º1'W, May, *Gattefossé s.n.* (MA); foret d'El Harcha, sur la piste du ravin du Lion, 35º8'N, 3º1'W, 21 Apr. 1949, *Sauvage & Vindt 7363* (MPU); Gurugú, Melilla, 35º21'N, 2º59'W, 3 June 1915, *Caballero s.n.* (MA); Melilla, au Gurugú, 35º21'N, 2º59'W, 19 May 1932, *Sennen (frère) & Mauricio (frère) s.n.* (MA). Rabat-Salé-Kénitra: Plateau Central, Jbel Mouchchene, 33º28'N, 6º10'W, 14 Apr. 1964, *Mathez 1528* (MPU); Rommani, El-Kiar, 33º34'N, 6º19'W, 11 Mar. 1967, *Mathez 3970* (MPU). Tanger-Tetouan-Al Hoceima: Haman, 35º12'N, 5º57'W, *Vidal López 240* (MA); Tanger ad Tetuan, Andjera, 35º49'N, 5º31'W, 18 Apr. 1911, *Pitard 624* (G). **Tunisia.** Jendouba: pr. Al Mawajin, 36º29'N, 8º18'E, 30 Mar. 2009, *Quintanar & al. 3244* (MA); près Hadjera Sghira, 36º33'N, 8º16'E, 19 May 1888, *Cosson s.n.* (P); massif forestier d'El-Fedja, bois de Houn a la base est du Dj. Ghorra, 36º35'N, 8º23'E, 21 May 1888, *Cosson s.n.* (P).

Discussion. Geranium atlanticum is an erect perennial herb, with horizontal and thick rootstock. Along the rootstock it has several distinctive napiform roots, that almost touch each other. The indumentum consists of patent, eglandular hairs. The leaves are deeply divided with a rhombic middle segment that has some deep secondary sinus. The leaves are usually opposite, but in a part of the herbarium specimens examined one alternate leaf appears toward the basal third of the stem. Additional field work may reveal whether alternate leaves are constant, at least on populations, or if they are occasional. The dichasial inflorescence bears 2-flowered cymules at the first node and an aggregate of cymules (pseudoumbels) toward the apex of the branches. The petals are long and emarginate at the apex although sometimes very slightly. Staminal filaments are lanceolate and have a few long hairs. The cotyledons have a notch on each side. This feature has been found only in *G. aculeolatum* (with two notches on each side) (subg. *Erodioidea*), *G. albanum* (subg. *Robertium*), *G. aristatum* (subg. *Erodioidea*), *G. bohemicum* (subg. *Tuberosa*), and *G. divaricatum* (subg. *Robertium*).

Yeo (2002a: 69) included *G. atlanticum* in the *Sylvaticum Group*. It shares some important features with this group such as the structure of the inflorescence and the arrangement of the leaves. In contrast, *G. atlanticum* has nectaries with a tuft of hairs at the top, while the remaining species of the group have glabrous nectaries.

25. Geranium caeruleatum Schur, Enum. Pl. Transsilv.: 136. 1866. *Geranium pratense* [b] *caeruleatum* (Schur) Graebn. in Asch. & Graebn., Syn. Mitteleur. Fl. 7(1): 11. 1913, ["caerulatum"]. *Geranium sylvaticum* subsp. *caeruleatum* (Schur) D.A. Webb & I.K. Ferguson, Feddes Repert. 74: 25. 1967. Type locality: "802 G. caeruleatum Schur. (G. coelestinum Schur herb. Transs. olim.)... Auf grasigen, etwas schattigen Abhängen des Konig-

stein bei Kronstadt. 6000'. Kalk. Aug.". Type: Romania. Transilvania, in monte Konigstein bei Kronstadt, 45°37'N, 25°34'E, 15 Aug. 1854, *F. Schur s.n.* (lectotype, here designated, LW-205571A image!; isolectotypes, W!, WU!).

Geranium oreades Pančiç, Elench. Pl. Vasc.: 17. 1875. *Geranium asphodeloides* subsp. *oreades* (Pančiç) Nyman, Consp. Fl. Eur.: 137. 1878. Type locality: "Hab. in declivibus herbidis m. Durmitor jugo Šljeme et in m. Kom supra Rogam". Type: Montenegro. Rogam, m. Kom, 43°15'N, 18°43'E & jugo Šljeme, m. Durmitor, 43°8'N, 19°01'E, *J. Pančiç s.n*. (lectotype, designated by Vukojičić & al. 2021: 6, 8 fig. 3, BEOU-3641 image!).

Geranium caroli-principis Panţu, Analele Acad. Române ser. 2, 29(3): 296, tab. 1. 1907. *Geranium caeruleatum* var. *caroli-principis* (Panţu) Şerb. in Săvul., Fl. Rep. Pop. Române 6: 128. 1958. Type locality: "Aceasta noua şi interesanta specie de Geranium am dedicat-o Alteţei Sale Regale Principelui Carol al României, care a descoperit-o prin paşunile alpine de pe Caraimanu din munţii Bucegi în ziua de 6/19 Iulie 1906, când Alteţa Sa Regala a aflat numai 2 frumoase exemplare... ". Type: Panţu, Analele Acad. Române ser. 2, 29(3): 296, tab. 1. 1907 (lectotype, here designated).

Geranium transsylvanicum Schott & Kotschy ex R. Knuth in Engl., Pflanzenr. IV.129 (Heft 53): 140. 1912. Type locality: "Siebenbürgen: Auf dem Berge Krajuly um 1800 m (Kotschy a. 1850 in Pl. Transsylvaniae Herbarii Schott n. 482-Typus in Herb. Berol.!". Type: Romania. Siebenbürgen, in monte Krajuly, 45°32'N, 25°12'E, 22 June 1850, *T. Kotschy 482* (holotype, B destroyed; isotypes, GOET- 004070 image!, P!, W!).

Perennial herbs, 20-43 cm tall. *Rootstock* 5.4-9.6 mm in diameter, ± horizontal, not tuberculate, not turnip-shaped, with thickened roots along the rootstock. *Stem* erect, leafy, not rooting at nodes, stolons absent, without vegetative stems, with retrorse, ± appressed, eglandular hairs 0.2-0.5 mm long. *Basal leaves* in a ± persistent rosette, cauline leaves alternate (usually 1) and upper opposite; leaf laminas (3.4)4.6-6.5(7) cm long, 3.4-8.8 cm wide, not peltate, palmatifid [ratio main-sinus length/middle segment length = (0.85)0.91-0.93(0.97)], polygonal in outline, base cordate, not coriaceous, with nerves not projected, pilose, with appressed, eglandular hairs on both surfaces; segments 5, in 1 plane, middle segment rhombic, (0.7)1.8-3.1(5) mm wide at the base [ratio segment width at the base/middle segment length = (0.03)0.06-0.07(0.10)], (9)11-18(34)-lobed in distal half [ratio secondary sinus length/middle segment length = (0.23)0.31-0.39(0.41)]; petioles up to 20 cm long, without abscission zone, terete, not swollen, not deflexed in age, with retrorse, ± appressed, eglandular hairs 0.2-0.5 mm long; stipules 6.3-12.1 mm long, 1.4-4.1 mm wide, lanceolate, free, papery, brown, with eglandular hairs on abaxial surface and on the margin, glabrous adaxially. *Inflorescence* a dichasial cyme; cymules 2-flowered, solitary or in aggregates at the top of each branch [ratio cymule length/leaf length = (1.3)1.6-2.6(3.5)]; peduncles (22)24-71(94) mm long, with retrorse, appressed, eglandular hairs 0.2-0.6 mm long; bracteoles 2.7-7.8 mm long, 0.5-1.2 mm wide, lanceolate, whorled; pedicels (11)15-24(33) mm long, with retrorse, appressed, eglandular hairs 0.2-0.6 mm long. Flowers actinomorphic. *Sepals* (5.9)6.5-7.7(8.3) mm long, 2.1-3.3 mm wide, lanceolate, smooth, not accrescent, nerves 3, mucro (0.7)1.2-2(2.6) mm long [ratio mucro length/sepal length = 0.11-0.35], with ± patent, eglandular hairs 0.4-2.2 mm long on the abaxial surface, glabrous adaxially. *Petals* (11.7)13-16.5(18.2) mm long, (5.2)7-10.6(15) mm wide, erect-patent, rounded, without claw, purple, hairy on the base of the adaxial surface, glabrous abaxially, ciliate on the basal margin, with hairs 0.4-0.6 mm long. *Stamens* 10, both whorls bearing anthers; filaments (4.8)6.1-6.7(7.7) mm long, lanceolate, white, pilose on the abaxial surface, ciliate on the proximal half, with hairs 0.2-0.7 mm long; anthers (1.6)1.7-1.8(2.1) mm long, yellow. Nectaries 5, hemispheric, glabrous. *Gynoecium* 4.8-7.9 mm long, deep pink. *Fruit* (19)23-26(28) mm long, erect, discharge of seed-ejection type; mericarps 3.4-4.7 mm long, 1.4-2.6 mm wide, without a strand of fibers, not compressed at the apex, smooth (sometimes with 1-2 transverse veins at the apex), without basal beak, with a basal callus, without a basal prong, brown, with ± patent, eglandular hairs 0.1-0.4 mm long and scattered, patent, glandular hairs 0.4-1 mm long (mainly at the top of the mericarp); rostrum 12-19 mm long, with a narrowed apex 0.5-2.7 mm long, not twisted, with ± patent, eglandular hairs 0.1-0.5 mm long and, sometimes, scattered, patent, glandular hairs 0.4-1.1 mm long; stigmatic remnants 1-3.8 mm long, with 5 glabrous lobes. *Seeds* 2.9-3.4 mm long, 1.3-2.2 mm wide, finely reticulate, uniformly colored, brown, glabrous. Cotyledons with entire margin. Fig. 100, 101.

Pollen. Ornamentation not studied.

Chromosome number. 2*n* = 28, 56.

Phenology. Collected in flower from May to September.

Distribution. This species ranges from central Romania to Bosnia-Herzegovina, southern Albania, North Macedonia and Bulgaria (Fig. 102).

Habitat. Grassy slopes, rocky outcrops and megaphorb formations; 1500-2350 m.

Additional specimens examined. **Albania.** Dibër: Albaniae boreali orientalis inter Prizren et Debra, montis Korab, pagum Radomir, 41°47'N, 20°32'E, 24 July 1918, *Kismmerle s.n.* (HBG). Korçë: distr. Kuci, m. Crila ad fines Turcorum, 40°35'N, 20°58'E, 11 July 1898, *Baldacci 177* (G, M, P, W, WU). Kukës: Buni Cereç mt Curajiepermï, Hekurooi, 42°20'N, 19°54'E, 23 July 1932, *Schütt s.n.* (G); Bertiscus, Alpes boreales albanicae, Prokletija, in monte Maja Potkajs, pr. pagum Gusinje, 42°26'N, 19°48'E, 25 July 1933, *Rechinger 1724* (G, LD, S); Malesi e Madhe, Nemuna mts., Vogelit, 42°27'N, 19°47'E, 16 July 2010, *Barina & al. 17996* (W). Shkodër: distr. Klementi, Maja Linerzit, 42°32'N, 19°37'E, 29 July 1900, *Baldacci 261* (G, M, MO, P, W); Trojan bei Gussin je, 42°33'N, 19°44'E, 20 July 1932, *Schütt s.n.* (G). **Bosnia-Herzegovina.** montes Prenj planina, 43°6'N, 17°50'E, 26 July 1933, *Deyl s.n.* (PRC); Maglic, 43°16'N, 18°43'E, Aug. 1913, *Vandas s.n.* (PR); Todor pl., pr. Jablan, 43°23'N, 18°31'E, Sep. 1910, *Vandas s.n.* (PR); Hrbograd, Jablan, 43°24'N, 18°29'E, Sep. 1910, *Vandas s.n.* (PR); Kamesnica, Gipfel Kote, 43°43'N, 16°52'E, 4 July 1909, *Handel-Mazzetti s.n.* (WU); Radovina, 43°56'N, 17°41'E, 29 July 1903, *Schiller s.n.* (WU). **Bulgaria.** Blagoevgrad: Mt. Pirin centralis ad oppidum Bansko, vallis Banderi-

ca, 41°24'N, 23°17'E, July 1936, *Kásterský & Deyl s.n.* (MA, PR); montes Pirin, montis Orelek, 41°33'N, 23°36'E, 26 June 2006, *Krivka s.n.* (B); Blagoevgrad district, Orelek peak, S Pirin Mts., 41°34'N, 23°36'E, 5 July 2004, *Aldasoro & al. 8559* (MA); Mt. Pirini ad Malkia volog. sub Eltepe, 41°46'N, 23°24'E, 12 Aug. 1982, *Btchtaroff s.n.* (SOM). Sofia: monte Vitosha, 42°34'N, 23°18'E, 8 July 2004, *Alarcón & al. 203* (MA, W). **Kosovo.** Peja: Kosovo i Metohija, SW von Pel, auf dem unpnja, vom schultzhaus zum gipfel, juniperusfluren, felstriften, 42°43'N, 20°19'E, 29 July 1975, *Krendl s.n.* (G). **Montenegro.** Berane: montes Bjelopoljska Bjelasica, NE Bardov, 42°52'N, 19°43'E, 20 July 1932, *Novák 6859* (PRC). Kolašin: Ost-Montenegro, Pivljan, 42°47'N, 19°36'E, 10 July 1916, *Janchen s.n.* (WU). Plužine: Maglić, Hänge am Pfad unterhalb del Maglić-Sattels, 0.4-0.7 km SE Maglić-Gipfel, 43°14'N, 18°46'E, 21 July 2007, *Gutermann 38370* (WU). Žabljak: Durmitor, Weide, Hrbatina bei Zabljak, Kalk, 43°7'N, 19°2'E, 24 July 1934, *Fiedler 11621* (B); Durmitor, montis Savin Kuk, 43°7'N, 19°4'E, 24 July 1933, *Sillinger s.n.* (PRC); Veliki Stulac, m. Durmitor, 43°8'N, 19°1'E, June 1896, *[illegible] s.n.* (G); Meded-Nordfub, Karstegelände nordöstlich der Lokvice-Talung, am Weg von der Vejkova zur Radulova kloiba, 4-4.5 km WSW Zabljak, 43°8'N, 19°4'E, 23 July 2007, *Gutermann 38785* (WU). **North Macedonia.** Pelagonia: Mt Jablanica, near Strižak, 41°17'N, 21°31'E, 19 July 206, *Niketić & Tomović s.n.* (BEO). **Romania.** Centru: comit. Togarus, in cacumine montis Nagy-Kiralyko supra Vleduska, 45°32'N, 25°13'E, 21 Aug. 1902, *Degen s.n.* (G); Transilvaniae

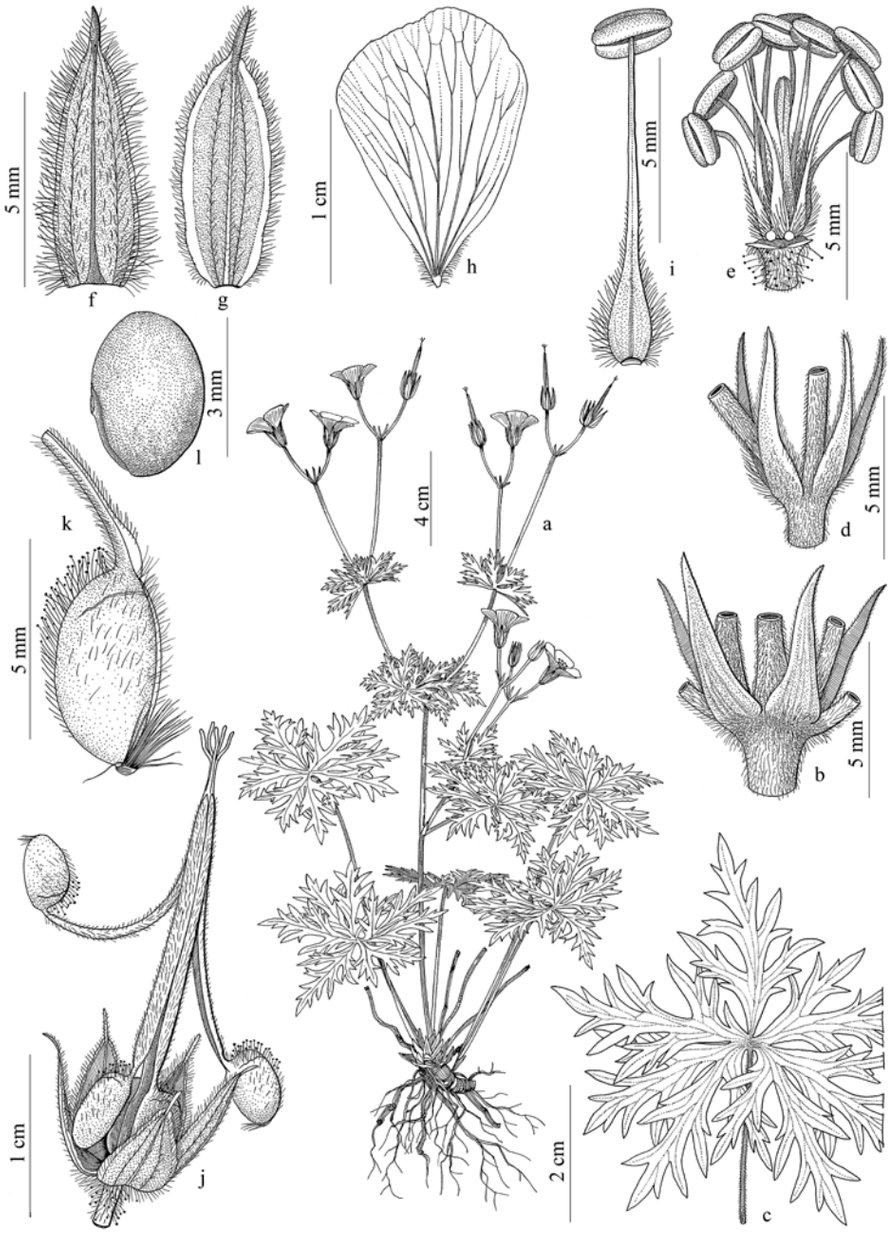


Fig. 100. *Geranium caeruleatum*. a. Habit. b. Stipules. c. Leaf. d. Bracteoles. e. Flower without petals and sepals. f, g. Sepals. h. Petal. i. Stamen. j. Fruit. k. Mericarp. l. Seed. (Based on: a, e-i, *Aldasoro & al. 8560,* MA; b-d, j-l, *Gutermann & al. 38785,* WU).

Fig. 101. *Geranium caeruleatum* (Based on: *Alarcón & al. 203,* MA, photo: J. Pedrol).

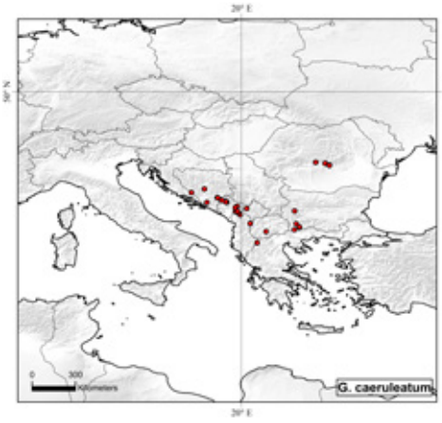


Fig. 102. Distribution of *Geranium caeruleatum*.

alpes austro-orientales, Kiralyko, 45º32'N, 25º13'E, 27 Aug. 1883, *Simkovics s.n.* (WU); Montibus Birsei, monte Piatra Craiului, 45º32'N, 25º12'E, 22 June 1979, *Ularu s.n.* (LD). Sud-Muntenia: montibus Bucegi, valle Cerbului, 45º24'N, 25º28'E, 9 July 1931, *Domin 900* (PRC); montes Bucegi, Coltu Tapului, a monte La Omu, 45º26'N, 25º27'E, 11 July 1959, *Soják s.n.* (PR); Draceul from Caraiman, 45º26'N, 25º28'E, 3 July 1911, *Voslost 51* (G); Arges, Mt. Fagaresenses, in graminosis cacuminis Capra Budei, 45º36'N, 24º37'E, 2 Aug. 1946, *Buia & Todor s.n.* (B, BM, G, H, MA, W).

Discussion. Geranium caeruleatum seems to be close to *G. rivulare.* They share a similar habit and inflorescence structure, deeply divided leaves, and a similar indumentum that is predominantly eglandular, except in the apex mericarp and the rostrum base where some glandular hairs are found. *Geranium caeruleatum*, however, has purple petals whereas *G. rivulare* has white petals. Additionally, some quantitative characters support the differentiation of both species, although with some overlap. *Geranium caeruleatum* has longer and wider petals and longer anthers than *G. rivulare.* In contrast, the fruit of *G. rivulare* is a bit longer, because the rostrum and the rostrum narrowed apex are longer than in *G. caeruleatum.* The areas of both species are separated by more than 700 km and no intermediate forms have been found.

26. Geranium endressii J. Gay, Ann. Sci. Nat. (Paris) 26: 228. 1832, ["Endressi"]. *Geranium palustre* subsp. *endressii* (J. Gay) Bonnier & Layens, Tabl. 58. 1894. Type locality: "Habitat in Pyrenaeorum maximè occidentalium monte Behorleguy, non longè à S. Joannis Pedeportuensis Fano, loco uliginoso Hilarecolepoa dicto, inter Juncos, altitud. circiter 500 hexapod. (Endress).-- Florentem 30ª junii collegit Endress". Type: France. Pyrénées Atlantiques, monte Behorleguy, 43º06'N, 1º04'W, June 1831, *P.A. Endress s.n.* (lectotype, here designated, W!; isolectotypes, BM!, COI!, K!, MO!, P!, PR-955581!, RO !, WU!).

Geranium endressii f. *luxurians* Turrill, J. Bot. 66: 46. 1928. Type locality: "Under this form are to be placed a specimen from Mt. Apanice, Herb. A. de Forestier, 1847, various plants cultivated at Kew and in other gardens, and all the garden-escapes from this country, of which I have seen specimens, including those from Cornwall, with the exception referred to below". Type: Great Britain. cultivated in Cadgwith, St. Agnes, 13 May 1914, *E. Thurston s.n.* (lectotype, here designated, K-000729323!).

Geranium endressii var. thurstonianum Turrill, J. Bot. 66: 46. 1928, ["Thurstoniana"]. Type locality: "A colony growing in the middle of the large patch of G. Endressii var. Endressii forma luxurians at Goonbell, St. Agnes, Aug. 4, 1927 (F. Rilstone)". Type: Great Britain. England, St. Agnes, Goonbell, 50º18'N, 5º11'W, 4 Aug. 1927, *F. Rilstone s.n.* (lectotype, here designated, K-000729314!).

Geranium endressii var. *armitageae* Turrill, Gard. Chron. ser. 3, 85: 164. 1929. Type locality: "Cultivated by Miss E. Armitage, Dadnor Garden, Herefordshire". Type: Great Britain. cultivated at Dadnor Gardens, Herefordshire, July 1928, *E. Armitage s.n.* (lectotype, here designated, BM-000603215!).

Perennial herbs, 21-66 cm tall. *Rootstock* 3-4.5 mm in diameter, ± horizontal, not tuberculate, not turnip-shaped, without thickened roots. *Stem* erect, leafy, not rooting at nodes, stolons absent, without vegetative stems, with patent, eglandular hairs 0.6-0.9 mm long and, sometimes, patent, glandular hairs 0.1-0.2 mm long. *Basal leaves* in a deciduous rosette, cauline leaves alternate (usually 1) and upper opposite; leaf laminas (2.9)5.4-8.3(12.1) cm long, 3.6-14.3 cm wide, not peltate, palmatifid [ratio main-sinus length/middle segment length = (0.69)0.80-0.85(0.87)], polygonal in outline, base cordate, not coriaceous, with nerves not projected, pilose, with ± appressed, eglandular hairs on both surfaces; segments 5, in 1 plane, middle segment rhombic, (3.9)9.1-13.8(16) mm wide at the base [ratio segment width at the base/middle segment length = (0.18)0.20-0.23(0.26)], (17)19-25(41)-lobed in distal half [ratio secondary sinus length/middle segment length = (0.16)0.18-0.26(0.27)]; petioles up to 28 cm long, without abscission zone, terete, not swollen, not deflexed in age, with patent, eglandular hairs 0.5-1 mm long; stipules 8.9-20.4 mm long, 1.5-3.9 mm wide, lanceolate, free, papery, brown, with eglandular hairs on abaxial surface and on the margin, usually glabrous adaxially. *Inflorescence* a monochasial cyme or primarily dichasial with monochasial branches; cymules 2-flowered, solitary [ratio cymule length/leaf length = (1.2)1.6-3.6(3.7)]; peduncles (63)78-110(138) mm long, with patent, eglandular hairs 0.4-0.8 mm long and patent, glandular hairs 0.1-0.6 mm long; bracteoles 5.9-10.5 mm long, 0.3-0.9 mm wide, lanceolate, whorled; pedicels (14)21-37(38) mm long, with patent, eglandular hairs 0.2-0.7 mm long and patent, glandular hairs 0.1-0.6 mm long. Flowers actinomorphic. *Sepals* (6.8)8.5-9.9(10.3) mm long, 2.6-3.5 mm wide, lanceolate, smooth, not accrescent, nerves (3)5, mucro (1.6)1.8-2.2(2.9) mm long [ratio mucro length/sepal length = 0.17-0.28], with ± patent, eglandular hairs 0.5-1 mm long and patent, glandular hairs 0.1-0.6 mm long on the abaxial surface, glabrous adaxially. *Petals* (16.1)18.3-23.9(25.1) mm long, (5.7)9.6-11.7(12) mm wide, erect-patent, emarginate (notch 0.5-2 mm deep), without claw, purple, hairy on the base of the adaxial surface, glabrous abaxially, ciliate on the basal margin, with hairs 0.3-0.6 mm long. *Stamens* 10, both whorls bearing anthers; filaments (4.6)6.5-7.9(8.2) mm long, lanceolate, yellow, pilose on the abaxial surface, ciliate on the proximal half, with hairs 0.3-0.4 mm long; anthers (1.5)1.6-1.8 mm long, yellow to blue. Nectaries 5, hemispheric, glabrous. *Gynoecium* 5.5-8.6 mm long, purple. *Fruit* (29)34-36(38) mm long, erect, discharge of seed-ejection type; mericarps 3.7-4.2 mm long, 2.1-2.3 mm wide, without a strand of fibers, not compressed at the apex, smooth (with 2 transverse vein at the apex), without basal beak, with a basal callus, without a basal prong, brown, with ± patent, eglandular hairs 0.5-0.7 mm long and, sometimes, patent, glandular hairs 0.1-0.4 mm long; rostrum 22-28 mm long, with a narrowed apex

3.6-5.5 mm long, not twisted, with ± patent, eglandular hairs 0.1-0.6 mm long and patent, glandular hairs 0.4-0.7 mm long; stigmatic remnants 2.3-3.7 mm long, with 5 hairy lobes. *Seeds* 2.5-3 mm long, 1.5-2 mm wide, finely reticulate, uniformly colored, brown, glabrous. Cotyledons with entire margin. Fig. 103, 104.

Pollen. *Geranium*-type (Stafford & Blackmore 1991: 73, Velasco 1992b: 55).

Chromosome number. 2*n* = 26?, 28.

Phenology. Collected in flower from April to September.

Distribution. This species is endemic to the western Pyrenees (France) and it is naturalized in Austria, Belgium, France (lowland localities), Great Britain, New Zealand and U.S.A. (Fig. 105).

Habitat. Damp grassy and rocky outcroops; 950-1650 m.

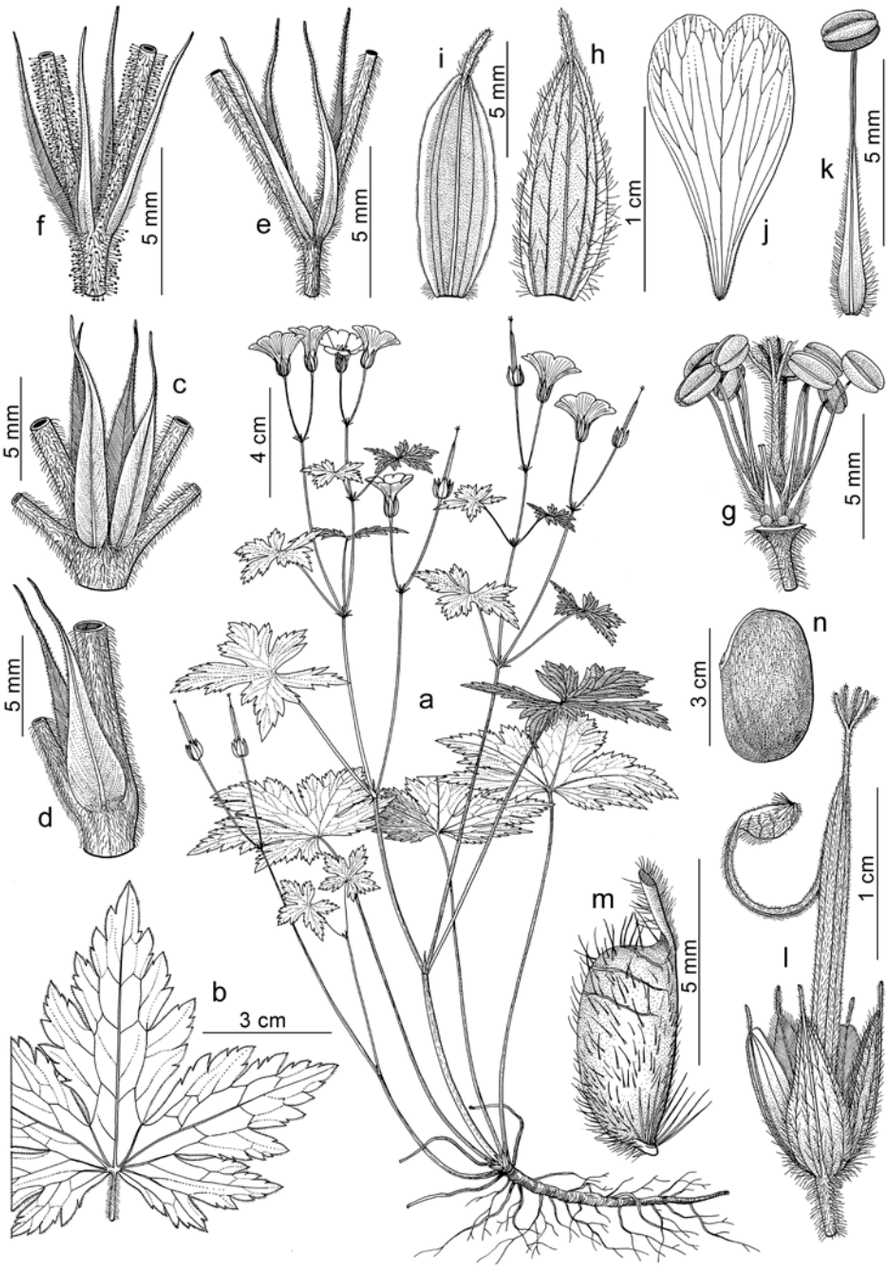


Fig. 103. *Geranium endressii*. a. Habit. b. Leaf. c, d. Stipules. e, f. Bracteoles. g. Flower without petals and sepals. h, i. Sepal. j. Petal. k. Stamen. l. Fruit. m. Mericarp. n. Seed. (Based on: a, c, d, f, g, j, k, *Catalán & Aizpuru s.n.,* MA-921355; b, *Vivant 64,* MA; e, l-n, *Jallu & Vivant 9011,* MA; h, i, *Aizpuru s.n.,* MA-921356).

Additional specimens examined. **Austria.** Lower Austria: Fuchsteich W Hirschbach, 48°44'N, 15°06'E, 16 July 2021, *Lefnaer s.n.* (MA). **Belgium.** Wallonia: Torgny, chemin ombrage le long de la Chiers, 49°30'N, 5°28'E, 20 July 1960, *Duvigneaud s.n.* (BR). **France.** Nouvelle-Aquitaine: Pyrénées Atlantiques, Saint Jean-Pied-de-Port, June, *Ritcher s.n.* (MPU); Pyrénées Atlantiques, pico de Orhy [cultivada en Jaca], 42°59'N, 1°0'W, 16 Aug. 1972 (MA); Pyrénées Atlantiques, pico Orhy, Zazpigaina, 42°59'N, 1°1'W, 19 July 2008, *Aedo & Aizpuru 15823* (MA); Pyrénées Atlantiques, pico Orhy, Zazpigaina, 42°59'N, 1°1'W, 11 July 1994, *Aizpuru s.n.* (MA); Pyrénées Atlantiques, cirque de Zaspignan, Orhy [cultivado en Chéraute, Francia], 42°59'N, 1°0'W, 11 July 1973, *Jallu & Vivant 9011* (MA); Pyrénées Atlantiques, Béhorléguy, col de Aphanize, 43°6'N, 1°4'W, 21 Sep. 1993, *Aedo & al. 2966* (MA); Pyrénées Atlantiques, Béhorléguy, 43°6'N, 1°4'W, 29 Apr. 1988, *Catalán & Aizpuru s.n.* (MA); Pyrénées Atlantiques, Saint Jean-Pied-de-Port, Mt. Aphanize, 43°6'N, 1°4'W, Sep. 1832, *Varennes s.n.* (LE); Pyrénées Atlantiques, Bayonne, 43°29'N, 1°28'W, July, *Bordère s.n.* (MPU); Finistère, naturalisé à Quimper, 48°0'N, 4°5'W, May, *Miciol s.n.* (MPU). **Great Britain.** England: South Somerset, Over Stowey, 51°9'N, 3°9'W, Aug. 1923, *Helsby s.n.* (SLBI); Surrey, Oxted, 51°14'N, 0°3'W, 15 Aug. 1932, *Britton s.n.* (SLBI). **USA.** Washington: King Co., N side of Hamlin Park, 47°45'N, 122°18'W, 5 July 2019, *Zika 29697* (MA).

Discussion. Geranium endressii is an erect perennial herb with long and thin horizontal rootstock, free stipules and long petals. The stem usually has an alternate leaf toward the basal third (sometimes two nodes have alternate leaves) and opposite leaves on the inflorescence. The leaves are shallowly divided, with a rhombic middle segment. The indumentum consists of short, spread, eglandular hairs. On the stem, peduncles, pedicels, sepals, and fruits there are also patent glandular hairs that vary in length and density. The inflorescence is dichasially arranged, with cymules that are noticeably long toward the base of the inflorescence. The sepals

Fig. 104. *Geranium endressii* (Based on: *Aedo 2966,* MA).

Fig. 105. Distribution of *Geranium endressii*.

usually have five nerves and a long mucro. The petals have a notch at the apex and a hairy base, and the stigmatic remnants are hairy.

The affinities of *G. endressii* are not fully solved. Yeo (2002a: 61) included *G. endressii* in the *Endressii Group*, along with *G. nodosum*, *G. versicolor,* and *G. rectum*. *Geranium endressii* has alternate leaves on the middle part of the stem, which suggests that it can be more related to the *Sylvaticum Group*. Additionally, *G. endressii* shares with the species of the latter group glabrous nectaries and narrow staminal filaments. It differs, however, in the structure of the inflorescence, which is monochasial or primarily dichasial with monochasial branches, while in the *Sylvaticum Group* it is dichasial with aggregates of cymules at the top of each branch. According to Van Loon (1984b: 268) the chromosome numbers different to 2*n* = 28 attributed to this species should be confirmed.

Geranium endressii is a narrow endemic species known only from two natural populations (one with some subpopulations) in western Pyrenean (Lazare & Royaud 1994: 2). It is widely used in gardens and occasional or naturalized in Austria, Belgium, Great Britain, New Zealand, and U.S.A. The French lowland localities showed in the map (i.e., Finistère, *Miciol s.n.* MPU; Bayonne, *Bordère s.n.*, MPU) probably also represent naturalizations. Its presence in New Zealand is based on a specimen at CHR could not be studied.

27. Geranium pseudosibiricum J. Mayer, Abh. Böhm. Ges. Wiss. 1786: 238. 1786, ["Pseudo-Sibiricum"]. *Geranium sylvaticum* subsp. *pseudosibiricum* (J. Mayer) D.A. Webb & I.K. Ferguson, Feddes Repert. 74: 26. 1967. Type locality: "Habitat in Deserto inter Tomium & Krasnojarium urbes". Type: Russia. Siberia, inter in stepposis desertis ultra Krasnojarsk, 56º00'N, 89º25'E, *A.W. Martini s.n.* (lectotype, here designated, PR-811214!).

Geranium bifolium Patrin ex DC., Prodr. 1: 642. 1824, nom. illeg., non Burm. f. 1759. Type locality: "in Dahuriae pinetis circa Barnaoul". Type: Russia. Altay, circa Barnaoul, 53°18'N, 83°40'E, July 1780, *E.L. Patrin s.n.* (lectotype, designated by Bobrov 1949: 30, LE; isolectotype, G-DC-215794!).

Geranium caeruleum Patrin ex DC., Prodr. 1: 642. 1824. Type locality: "in Dahuriae campestribus". Type: Russia. Chita, Dahuriae campestribus, 52º00'N, 114º00'E, 1784, *E.L. Patrin s.n.* (lectotype, here designated, G-DC-215791!).

Geranium laetum Ledeb., Icon. Pl. 2: 16, tab. 148. 1830. *Geranium pseudosibiricum* var. *laetum* (Ledeb.) Trautv., Bull. Soc. Imp. Naturalistes Moscou 33(1): 461. 1860. Type locality: "Hab. in apricis herbidis ad radicem collium frequens". Type: Kazakhstan. Altai, Riddersk, 50º19'N, 83º32'E, 17 May 1826, *C.F. Ledebour s.n.* (*herb. Ledebour 201*) (lectotype, designated by Ivleva 2013: 233, LE!; isolectotypes, HAL-111357 image!, M-0182662!, MO-1888980!, PRC-453985 image!, W!, WRSL-060010!, WU!).

Geranium pseudosibiricum var. *eglandulosum* Trautv., Bull. Soc. Imp. Naturalistes Moscou 33(1): 461. 1860, ["eglandulosa"]. Type locality: "In montibus Sandyktas m. Junio (flor.) observata est" [collected by Schrenk 1840-1843]". Type: Kazakhstan. Songoria, mt. Sandyktas, 45°22'N, 81°41'E, June 1841, *A. Schrenk s.n.* (lectotype, here designated, LE!).

Geranium pseudosibiricum var. *hirsuta* Trautv., Bull. Soc. Imp. Naturalistes Moscou 33(1): 461. 1860. Type locality: "Ad fl. Dshisdy Kingir 18 Jul. (deflor.) inventa est" [collected by Schrenk 1840-1843]. Type: Kazakhstan. Songoria, Dshisdy-Kingir, 45°25'N, 81°00'E, 18 July 1840, *A. Schrenk s.n.* (lectotype, here designated, LE!).

Geranium pseudosibiricum var. *glandulosum* Trautv. ex R. Knuth. in Engl., Pflanzenr. IV.129 (Heft 53): 125. 1912. Type locality: "Altai, bei Buchtarminsk (Ludwig nach Maximowicz". Type: Russia. Altai, bei Buchtarminsk, 50°48'N, 82°28'E, *Ludwig & C.J. Maximowicz s.n.* (no original material located).

Geranium szeewaldianum Prodán, Bul. Grăd. Bot. Univ. Cluj 6: 106, tab. 5 figs. A. 1927. Type locality: "Sibiria occidentalis, in locis arenosis prope pagum Berezovca (leg. Szeewald)". Type: Russia. Buryatiya, Sibiria occidentalis, pr. pagum Berezovca, 51°56'N 107°30'E, 12 July 1918, *F. Szeewald s.n.* (lectotype, here designated, BUCA-87935 image!).

Geranium asiaticum Serg., Sist. Zametki Mater. Gerb. Krylova Tomsk. Gosud. Univ. Kiybyševa 1934(1): 1. 1934. Type locality: "Habitat: in betuletis, pinetis et silvis mixtis, pratis sylvaticis et inundatis, in decliviis herbosis in Sibiria occidentali et orientali". Type: Russia. Altay, Berezovka village, 51°08'N, 82°05'E, 9 July 1932, *Z. Tarchevskaya & V. Vandysheva s.n.* (lectotype, designated by Troschkina 2015: 120, TK-001210 image!).

Geranium pseudosibiricum var. *parviflorum* Serg., Sist. Zametki Mater. Gerb. Krylova Tomsk. Gosud. Univ. Kiybyševa 1934(1): 3. 1934. Type locality: [not indicated]. Type: Russia. Krasnoyarskiy, Murta district, close to Mezhovaya village, 56°44'N, 92°85'E, 18 June 1931, *L. Levchuk, E. Turitsyna & V. Merkulova s.n.* (lectotype, designated by Troschkina 2015: 122, TK-001284 image!).

Geranium pseudosibiricum f. *latilobum* Serg., Sist. Zametki Mater. Gerb. Krylova Tomsk. Gosud. Univ. Kiybyševa 1934(1): 3. 1934. Type locality: [not indicated]. Type: Russia. Altai, Bashkaus River, 51°08'N, 87°42'E, 20 June 1913, *M.A. Lisitsyn s.n.* (lectotype, designated Gureyeva & Balashova 2017: 18, TK-001277 image!).

Geranium pseudosibiricum f. *lanceolatum* Serg., Sist. Zametki Mater. Gerb. Krylova Tomsk. Gosud. Univ. Kiybyševa 1934(1): 3. 1934. Type locality: [not indicated]. Type: Russia. Altai, Kotanda, 50°11'N, 86°10'E, 30 May 1897, *V. Sapozhnikov s.n.* (lectotype, designated Gureyeva & Balashova 2017: 17, TK-001275 image!).

Geranium caeruleum var. *subuschkanense* Popov in Popov & Bussik, Cons. Fl. Baical: 213. 1966. *Geranium pseudosibiricum* var. *subuschkanense* (Popov) Peschkova, Fl. Siberia 10: 17. 1996. Type locality: "Lacus Baical, promontorium Sagan-Marjan, 1955, M. Popov, V. Prochorov". Type: Russia. Irkutsk, Lacus Baical, promontorium Sagan-Marjan, 54°05'N, 108°17'E, 1 July 1955, *M.G. Popov & V. Prochorov s.n.* (lectotype, designated by Troschkina & Ovchinnikova 2020: 62, NSK-0000334 image!; isolectotype, NSK-0000335).

Geranium caeruleum var. *uschkanense* Popov in Popov & Bussik, Cons. Fl. Baical: 107 pl. 11, 213. 1966, ["ushkanense"]. *Geranium pseudosibiricum* var. *uschkanense* (Popov) Peschkova, Fl. Siberia 10: 17. 1996 Type locality: "Lacus Baical, insula Boljschoj Uschkanij, 1952, M. Popov, I. Andreeva". Type: Russia. Buryatiya, Lacus Baical, insula Boljschoj Uschkanij, 53°51'N, 108°38'E, 14 July 1952, *M.G. Popov s.n.* (holotype, NSK-0000337 image!).

Geranium igoschinae Troschkina, Rast. Mir Aziatsk. Rossii 3(23): 27, 28 fig. 5. 2016. Type locality: "Chelyabinsk region, Verkhneuralsk district, 10 km North of the village Arsinskiy, 53.89742 N – 59.86025 E, meadow steppe, 02 VI 2012, A.Y. Korolyuk (NSK0000707, isotypes – NSK0000706, NSK0000708)". Type: Russia. West Siberia, Chelyabinsk region, Verkhneuralsk district, 10 km North of the village Arsinskiy, 53°51'N, 59°51'E, 2 June 2012, *A.Y. Korolyuk s.n.* (holotype, NSK-0000707 image!).

Perennial herbs, 21-63 cm tall. *Rootstock* 1.1-3.6 mm in diameter, ± horizontal, not tuberculate, not turnip-shaped, with thickened roots along the rootstock. *Stem* erect, leafy, not rooting at nodes, stolons absent, without vegetative stems, with retrorse, ± appressed, eglandular hairs 0.2-0.5 mm long. *Basal leaves* in a ± persistent rosette, cauline leaves alternate (usually 1) and upper opposite; leaf laminas (3.9)4.2-6.5(7.4) cm long, 3.9-10.6 cm wide, not peltate, palmatifid [ratio main-sinus length/middle segment length = (0.86)0.89-0.92(0.95)], polygonal in outline, base cordate, not coriaceous, with nerves not projected, pilose, with ± appressed, eglandular hairs on both surfaces; segments 5, in 1 plane, middle segment rhombic, (1.7)2.6-4.3(5.4) mm wide at the base [ratio segment width at the base/middle segment length = (0.04)0.07-0.11(0.13)], (8)10-16(22)-lobed in distal half [ratio secondary sinus length/middle segment length = (0.19)0.25-0.3(0.36)]; petioles up to 29 cm long, without abscission zone, terete, not swollen, not deflexed in age, with retrorse, ± appressed, eglandular hairs 0.2-0.5 mm long; stipules 4.3-11.1 mm long, 1.2-3.9 mm wide, lanceolate, free, papery, brown, with eglandular hairs on abaxial surface and on the margin, glabrous adaxially. *Inflorescence* a dichasial cyme; cymules 2-flowered, solitary or in aggregates at the top of each branch [ratio cymule length/leaf length = (1.2)2.3-3.2(5.9)]; peduncles (14)25-43(115) mm long, with retrorse to uncinate, eglandular hairs 0.2-0.5 mm long and, sometimes, patent, glandular hairs 0.2-0.6 mm long; bracteoles 1.6-4.5 mm long, 0.5-0.9 mm wide, lanceolate, whorled; pedicels (7.9)14-22(36.8) mm long, with retrorse to uncinate, eglandular hairs 0.2-0.5 mm long and, sometimes, patent, glandular hairs 0.2-0.5 mm long. Flowers actinomorphic. *Sepals* (4)4.9-5.6(6.8) mm long, 1.7-2.8 mm wide, lanceolate, smooth, not accrescent, nerves 3, mucro (0.4)0.7-1.1(1.6) mm long [ratio mucro length/sepal length = 0.09-0.31], with ± patent, eglandular hairs 0.3-1.4 mm long and, sometimes, patent, glandular hairs 0.2-0.6 mm long on the abaxial surface, glabrous adaxially. *Petals* (7.4)9.1-10.5(14.3) mm long, (3.1)3.7-5(6.8) mm wide, erect-patent, rounded, without claw, purple or white, hairy on the base of the adaxial surface, glabrous abaxially, ciliate on the basal margin, with hairs 0.1-0.7 mm long. *Stamens* 10, both whorls bearing anthers; filaments (4.1)4.6-5.4(6.7) mm long, lanceolate, white, pilose on the abaxial surface, ciliate on the proximal half, with hairs 0.1-0.5 mm long; anthers (1)1.2-1.5(1.8) mm long, blue. Nectaries 5, hemispheric, glabrous. *Gynoecium* 3.6-8.4 mm long, deep pink. *Fruit* 21-24(25) mm long, erect, discharge of seed-ejection type; mericarps 2.9-3.9 mm long, 1.4-1.9 mm wide, without a strand of fibers, not compressed at the apex, smooth (sometimes with 1-2 transverse veins at the apex), without basal beak, with a basal callus, without a basal prong, brown, with ± appressed, eglandular hairs 0.1-0.3 mm long and patent, glandular hairs 0.7-1.1 mm long (mainly at the top of the mericarp); rostrum 14-17.9 mm long, with a narrowed apex 1.7-2.9 mm long, not twisted, with patent, eglandular hairs 0.2-0.3 mm long and patent, glandular hairs 0.5-1.1 mm long; stigmatic remnants 1.7-3.1 mm long, with 5 glabrous lobes. *Seeds* 2.4-2.5 mm long, 1.4-1.7 mm wide, finely reticulate, uniformly colored, brown, glabrous. Cotyledons with entire margin. Fig. 106.

Pollen. *Geranium*-type (Park & Kim 1997: 312).

Chromosome number. 2*n* = 28.

Phenology. Collected in flower from May to September.

Distribution. This species ranges through Siberia (from southern Ural Mountains to Baykal area) to eastern Kazakhstan, Mongolia and northwestern China (Fig. 107).

Habitat. Meadows and edge of *Betula* L., *Larix* Mill., *Pinus* L., and *Salix* L. forests; 300-2250 m.

Representative specimens examined. **China.** Xinjiang: sierra Jianshan, 43°35'N, 92°39'E, 3 Aug. 1957, *Guan Ke Jian 2378* (PE); Región autónoma de Uygusrsk, Mon. Saur, pendiente sur, barranco río Kuragaitu, orilla derecha Bain-Tsagán, 46°46'N, 85°42'E, 23 June 1957, *Unatov 336* (MO). **Kazakhstan.** Almaty: Montes Dzungarskiye suroeste, cordillera Altyn-Emel, Montes Mamay, cerca del río Mamay, 44°12'N, 80°13'E, 20 June 1951, *Goloskov s.n.* (US); in montis apricis Alatau, inter fl. Sarchan et Baskan, 46°14'N, 78°56'E, 1841, *Karelin & Kiriloff 1327* (M); Buchtorminsk, 48°54'N, 83°30'E, *Ladarg s.n.* (US). East Kazakhstan: Tarbagatai, 49°9'N, 86°16'E, *Karelin & Kiriloff 166* (H, P, W). **Mongolia.** Bulgan: 25 km SSW of Hujirt, 49°45'N, 103°9'E, 25 June 1970, *Norlindh & Ahti s.n.* (S). Dornod: Cholbalsanova hora u Ulan-Batoru, 48°0'N, 115°0'E, 1 Aug. 1961, *Hosticka s.n.* (PR). Övörkhangai: Altai Gobicus, N jugi Baga-Bogd-úl, 44°57'N, 101°35'E, 20 Aug. 1966, *Soják 7466* (PR). Ulaanbaatar: Ulan-Bator, Salhitain-am, 47°55'N, 106°55'E, 6 July 1974, *Sakiyama s.n.* (TI). Uvs: Mongolia borealis, circa lacus Ubsa, 50°20'N, 92°45'E, 1879, *Potanin s.n.* (P, G, P, W). **Russia.** Altay: Kosh-Agach district, montes Severochuyski khrebet, inter rivum Aktru et angustias Uchitel, 50°2'N, 87°30'E, 17 July 1972, *Vašák s.n.* (PR); Kosh-Agach district, Chagan_ Uzun, steep SW facing slopes 5 km NW of the settlement, 50°8'N, 88°20'E, 3 Aug. 2005, *Lustyk s.n.* (W); S of Shebalino, 120 km S of Gorno Altaysk, 51°17'N, 85°40'E, 2 July 1983, *Elias & al. 7039* (US); pr. pagum Anos, 51°29'N, 85°56'E, 1911, *Smirnova s.n.* (NY); Barnaul, 53°18'N, 83°40'E, 1903, *Rosenberg s.n.* (C). Bashkiriya: Baimak district, between Srau-tash and Balta-tau, 52°23'N, 58°21'E, 15 June 1954, *Kutcherov s.n.* (M); Salavat district, Maloyazy forest, 53°23'N, 55°54'E, 22 July 1959, *Kutcherov s.n.* (M); Issil-Kulj ad oppidum Ufa, 54°44'N, 56°0'E, 31 May 1900, *Odenvall s.n.* (H). Buryatiya: ad pagum Utotschkina, juxta flumen Selenga, 51°56'N, 107°30'E, 24 June 1900, *Ehnberg s.n.* (H); montes Barguzinskiy, curso alto del río Lev. Mal. Saranjur, 53°51'N, 109°43'E, 2 Aug. 1961, *Siplivinskiy*

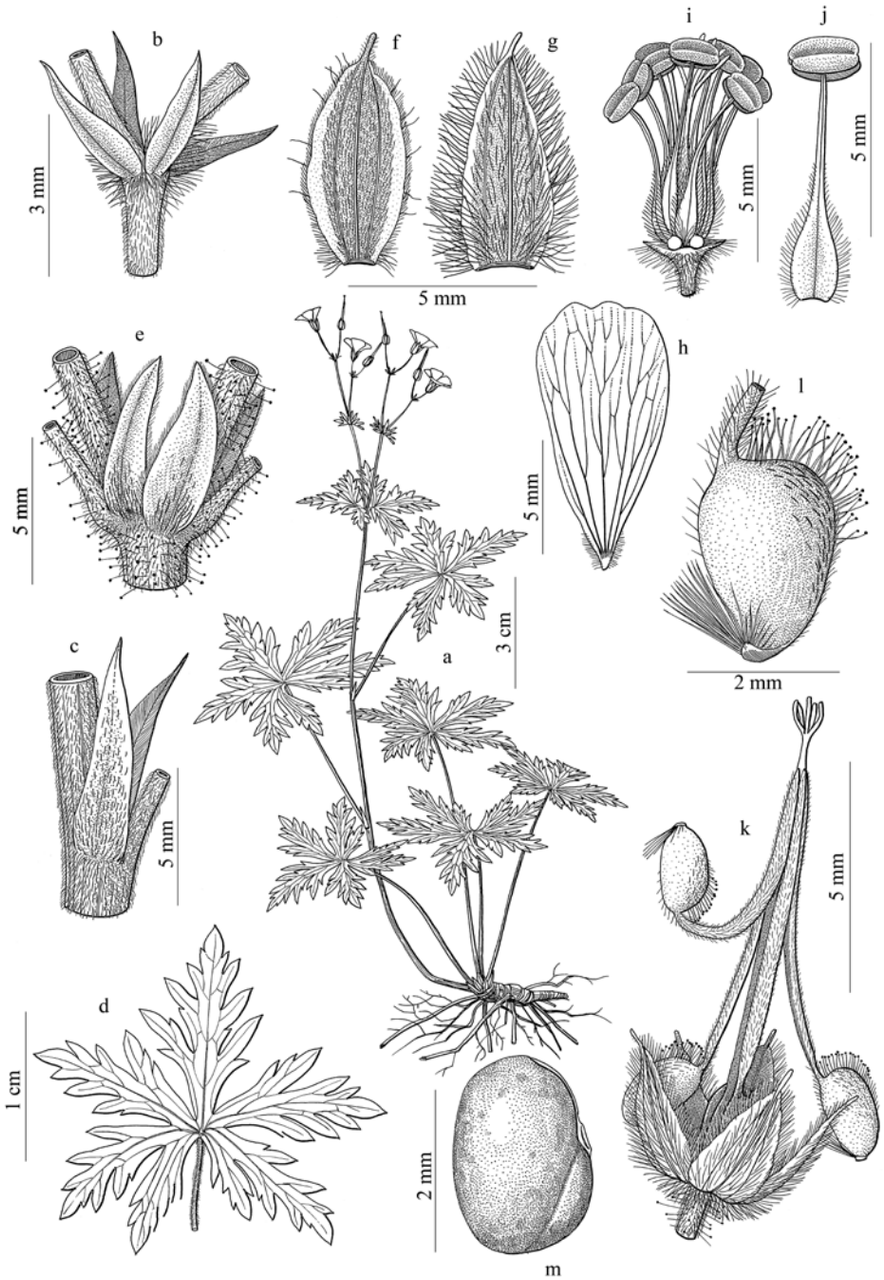


Fig. 106. *Geranium pseudosibiricum*. a. Habit. b, c. Stipules. d. Leaf. e. Bracteoles. f, g. Sepals. h. Petal. i. Flower without petals and sepals. j. Stamen. k. Fruit. l. Mericarp. m. Seed. (Based on: a, k-m, *Borissov s.n.,* MA-690186; b, e-j, *Odenvall s.n.,* H-1368311; c, d, *illegible,* MO-1891019).

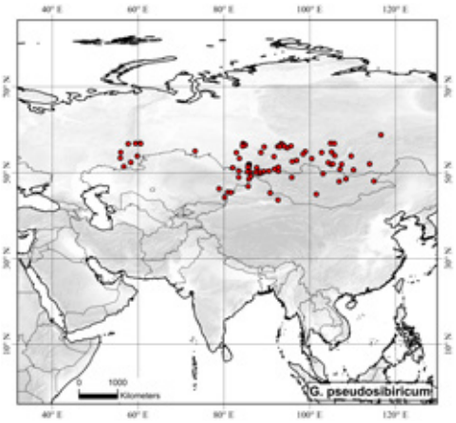


Fig. 107. Distribution of *Geranium pseudosibiricum*.

& Lagutskaya s.n. (MA). Chita: Transbaicalia, la vallée des eaux minérales de Yamarowka, 50º37'N, 110º15'E, 15 June 1897, *Nasomov s.n.* (G). Irkutsk: Irkutsk, 52º18'N, 104º22'E, June, *Jurinsky s.n.* (MA); Irkutsk region, Verkholensk distr., near Kachug village, 53º57'N, 105º53'E, May 1914, *Lukashik s.n.* (MA); Tutura river valley, near winter house of Kunitsyny, 54º46'N, 105º11'E, 1910, *Kusnezow 192* (MA); Lena superior, Ust'-Kut, 56º47'N, 105º46'E, 12 June 1901, *Cajander 2916* (H); Balaganskh, 58º47'N, 116º39'E, 29 May 1913, *Maltsev s.n.* (BC). Krasnoyarsk: Krasnojarsk, pr. opp. Minussinsk, in silva ad fl. Minussinka, 53º43'N, 91º44'E, 3 July 1903, *Martjanov 3435* (BM, C, G, H, M, MO, NY, PR, S, US, W, WA); 3 km supra Krasnojarsk, 56º4'N, 93º4'E, 13 June 1876, *Brenner s.n.* (H); Manino, non procul ab oppidum Krasnojarsk, 56º5'N, 92º36'E, 3 June 1900, *Odenvall s.n.* (H); distr. Kansk, gub. Enisseisk, orilla derecha curva y pedregosa del río Rybnaya, cerca de molino a 3 verstas del pueblo Olguinskoye, 56º7'N, 94º9'E, 20 May 1911, *Kusnezow 46* (C); región de Sujobuzimskiy, pr. pueblo Ust-Kan, 56º30'N, 93º48'E, 21 June 1958, *Kazak & Mareyeva s.n.* (C). Orenburg: Werchne, 51º24'N, 56º42'E, 1870, *Loffiecowski 155* (S); Ekatherinburg, pr. pagum Maly-Istok, 56º50'N, 60º35'E, 20 June 1901, *Clere s.n.* (L, LD). Tuva: region de Mongún-Tayginskiy, montes Chijachev, valle del río Alte-Gimate a 2 km de la desembocadura, 50º20'N, 90º30'E, 5 Aug. 1980, *Krasnikov & al. s.n.* (MO); región Oviurskiy, montes Tannu-Ola oeste, cerca del puerto Jundurgunskiy, 50º49'N, 91º51'E, 6 Aug. 1986, *Janminchun & al. s.n.* (MO); West Sayan mountains, E Tonnola Range, Schevelig river valley, 20 km SE of Isthichen, 120 km W of Kazil, 51º15'N, 92º44'E, 17 July 1983, *Elias & al. 7683* (US); región de Todzhinskiy, lago Kzdysh, cerca de la carretera, 52º50'N, 97º0'E, 20 June 1972, *Kurbatskiy & al. s.n.* (MA). West Siberia: provincia de Novosibirsk, region de Iktimsk, pr. pueblo Sosnovka, 54º40'N, 82º57'E, 10 June 1975, *Koroleva s.n.* (MO); Omsk, 55º0'N, 73º20'E, 1872, *Weckman s.n.* (H); región de Tomsk, alrededores del pueblo Batalino, 56º11'N, 84º25'E, June 1955, *Kogan s.n.* (MA); Perm, Krassnoufimsk district, 56º42'N, 57º45'E, 5 July 1886, *Korshinsky s.n.* (G); in vicinis urbis Sverdlovsk, in collibus saxosis Uktus, 56º45'N, 60º39'E, 20 June 1967, *Storozheva s.n.* (H, M).

Discussion. Geranium pseudosibiricum is similar to *G. caeruleatum* and *G. rivulare* in habit, leaf disposition, and inflorescence structure. They also share quite similar leaves, deeply divided, which differentiate this group of species from *G. albiflorum* and *G. sylvaticum*. *Geranium pseudosibiricum* usually has an indumentum of retrorse to uncinate, eglandular hairs, except on the mericarp and rostrum where some glandular hairs are found. Some specimens, however, have patent glandular hairs on the inflorescence in a variable density, which varies within the same individual (for instance, *Raab-Straube 20144* (B)). It is interesting to note that the lectotype of *G. pseudosibiricum* has abundant glandular hairs on peduncles and pedicels. *Geranium pseudosibiricum* varies in petal color, from white to purple. The length of the sepal mucro also varies in a continuum. These features seem not to be correlated with each other, or with other characters or any particular geographical area. Thus, I consider that this variability do not deserve taxonomic recognition, but other authors differ from this point of view (Troschkina 2016).

Geranium pseudosibiricum is sometimes difficult to distinguish from *G. rivulare.* The most diagnostic feature is the sepal length, shorter in *G. pseudosibiricum* than in *G. rivulare.* Additionally, some quantitative characters support the differentiation of both species, although with some overlap. *Geranium rivulare* has longer petals, longer anthers, and longer bracteoles than *G. pseudosibiricum.* The areas of both species are separated by more than 3000 km. As in *G. sylvaticum* and *G. albiflorum,* female individuals have been excluded from the descriptions.

Bobrov (1949: 30) suggested that plants with white petals and without glandular hairs have a distinct geographical area and that they should be recognized as a different species, named *G. bifolium.* Peschkova (1996) considered three species: a) *G. laetum*, with glandular hairy pedicels; b) *G. bifolium,* with white petals, short sepal mucro and pedicels without glandular hairs; and c) *G. pseudosibiricum* with purple petals, long sepal mucro and pedicels without glandular hairs. As stated before, I have found that the presence of glandular hairs is not stable and is not correlated with the petal color, the sepal mucro length, or the geographical area, suggesting that *G. bifolium* and *G. laetum* should be synonymized to *G. pseudosibiricum*.

---

28. Geranium rivulare Vill., Prosp. Hist. Pl. Dauphiné: 40. 1779. *Geranium sylvaticum* subsp. *rivulare* (Vill.) Rouy in Rouy & Foucaud, Fl. France 4: 81. 1897. *Geranium sylvaticum* var. *rivulare* (Vill.) Paol. in Fiori & Paol., Fl. Italia 2: 240. 1901. Type locality: [not indicated] "Il vient sur les hautes montagnes, le long des fontaines & des torrents, parmi les gazons, au Noyer, dans le Champsaur; à Chantelouve en Valbonnais, aux Baux, &c.", according to Villars, Hist. Pl. Dauphiné 3(2): 372, 1789. Type: France. Isère, Champsaur, Valbonnais, 44º59'N, 5º58'E, *D. Villars s.n.* (lectotype, here designated, GRM!; isolectotype, PRC-418452!).

Geranium alpestre Chaix, Pl. Vap.: 23. 1785. Type locality: "Chaudun, Baux, in alpinis, ad Lariceta". Type: France. Alpes de Dauphiné, *D. Chaix s.n.* (lectotype, here designated, P-00375658!).

Geranium aconitifolium L'Hér., Geraniologia, tab. 40. 1792. *Geranium sylvaticum* var. *aconitifolium* (L'Hér.) Nyman, Consp. Fl. Eur.: 137. 1878. Type locality: [not indicated]. Type: France, des Alpes sous le nom de striatum, cultivated at the garden of Cels, *C.L. L'Héritier s.n.* (lectotype, here designated, G-DC-00215760 image!).

Geranium rivulare subvar. *latisectum* Le Grand, Bull. Assoc. Bot. France 4(38): 57. 1901. Type locality: "Hautes-Alpes: Valdes-Prés à Granon (Brachet)". Type: France. Hautes-Alpes, Valdes-Prés à Granon, 44°57'N, 6°41' E, *F. Brachet s.n.* (no original material located).

Geranium rivulare var. *parviflorum* Le Grand, Bull. Assoc. Bot. France 4(38): 57. 1901. Type locality: "Hautes-Alpes, glaciers du Monêtier (Alph. Faure!)". Type: France. Hautes-Alpes, glaciers du Monêtier, 44°23'N, 5°56' E, *A. Faure s.n.* (no original material located).

Perennial herbs, 18-41 cm tall. *Rootstock* 6-15 mm in diameter, ± horizontal, not tuberculate, not turnip-shaped, with thickened roots

along the rootstock. *Stem* erect, leafy, not rooting at nodes, stolons absent, without vegetative stems, with retrorse, ± appressed, eglandular hairs 0.2-0.4 mm long. *Basal leaves* in a ± persistent rosette, cauline leaves alternate (usually 1) and upper opposite; leaf laminas (3.8)4.5-6.5(8.4) cm long, 4.8-10.4 cm wide, not peltate, palmatifid [ratio main-sinus length/middle segment length = (0.87)0.91-0.93(0.95)], polygonal in outline, base cordate, not coriaceous, with nerves not projected, pilose, with appressed, eglandular hairs on both surfaces; segments 5, in 1 plane, middle segment rhombic, (1.7)2.1-3.5(4.2) mm wide at the base [ratio segment width at the base/middle segment length = (0.05)0.06-0.08(0.10)], (10)12-18(19)-lobed in distal half [ratio secondary sinus length/middle segment length = (0.22)0.26-0.32(0.37)]; petioles up to 23 cm long, without abscission zone, terete, not swollen, not deflexed in age, with retrorse, appressed, eglandular hairs 0.2-0.4 mm long; stipules 2.8-10.4 mm long, 1.3-3.7 mm wide, lanceolate, free, papery, brown, with eglandular hairs on abaxial surface and on the margin, usually glabrous adaxially. *Inflorescence* a dichasial cyme; cymules 2-flowered, solitary or in aggregates at the top of each branch [ratio cymule length/leaf length = (1.2)1.7-2.7(4.9)]; peduncles (9)22-56(80) mm long, with retrorse, ± appressed, eglandular hairs 0.2-0.6 mm long; bracteoles 2.1-4.9 mm long, 0.5-1.1 mm wide, lanceolate, whorled; pedicels (6)18-26(29.8) mm long, with retrorse, ± appressed, eglandular hairs 0.2-0.5 mm long. Flowers actinomorphic. *Sepals* (5.4)6.4-7.1(7.4) mm long, 1.8-3.4 mm wide, lanceolate, smooth, not accrescent, nerves 3, mucro (0.7)1-1.5(2.1) mm long [ratio mucro length/sepal length = 0.12-0.31], with ± patent, eglandular hairs 0.6-1.4 mm long on the abaxial surface, glabrous adaxially. *Petals* (7.2)9.9-11.5(15.8) mm long, (3.2)4.3-5.5(8.2) mm wide, erect-patent, rounded, without claw, white, with violet veins, hairy on the base of the adaxial surface, glabrous abaxially, ciliate on the basal margin, with hairs 0.2-0.7 mm long. *Stamens* 10, both whorls bearing anthers; filaments (3.8)5.3-6.6(6.9) mm long, lanceolate, white, pilose on the abaxial surface, ciliate on the proximal half, with hairs 0.2-0.5 mm long; anthers (1.2)1.4-1.6(1.7) mm long, purple. Nectaries 5, hemispheric, glabrous. *Gynoecium* 4.9-7.8 mm long, deep pink. *Fruit* (23.5)24-28(32) mm long, erect, discharge of seed-ejection type; mericarps 3.5-4.5 mm long, 1.9-2.4 mm wide, without a strand of fibers, not compressed at the apex, smooth (sometimes with 1-2 transverse veins at the apex), without basal beak, with a basal callus, without a basal prong, brown, with ± patent, eglandular hairs 0.2-0.5 mm long and scattered, glandular hairs 0.8-1.3 mm long (mainly at the top of the mericarp); rostrum 16.8-24 mm long, with a narrowed apex 1.4-3.3 mm long, not twisted, with ± patent, eglandular hairs 0.1-0.3 mm long and, sometimes, scattered, patent, glandular hairs 0.4-0.8 mm long; stigmatic remnants 1.7-2.8 mm long, with 5 glabrous lobes. *Seeds* 2.7-3 mm long, 1.4-1.9 mm wide, finely reticulate, uniformly colored, brown, glabrous. Cotyledons with entire margin. Fig. 108, 109.

Pollen. Ornamentation not studied.

Chromosome number. 2*n* = 28.

Phenology. Collected in flower from May to August.

Distribution. This species is endemic to Alps, from France to Italy and Switzerland (Fig. 110).

Habitat. Meadows, *Rhododendron* L. thickets and forest edges, on limestone or granitic areas; 1250-2350 m.

Representative specimens examined. **France.** Provence-Alpes-Côte d'Azur: Alpes Maritimes, Sestrière au Pertus, 44º18'N, 6º48'E, 7 Aug. 1889, *Vidal s.n.* (MPU); Alpes-de-Haute-Provence, Larche, Couste-Chamouse, 44º26'N, 6º51'E, 4 Aug. 1890, *Guiguet s.n.* (MPU); Hautes-Alpes, mont Céüse, près Gap, 44º31'N, 5º55'E, 15 June 1902, *Faure s.n.* (MA); Hautes-Alpes, Ceillac, le long du sentier du pied du Mélezet au lac Miroir, 44º38'N, 6º47'E, 4 Aug. 1984, *Charpin 19040* (G, S); SE von Briançon, Col d'Izoard, 44º49'N, 6º44'E, 12 July 1970, *Müller-Doblies 8660* (B); Rhône-Alpes, Isère, montagnes de St. Honoré, pres La Mure, 44º57'N, 5º49'E, June 1900, *Bernard s.n.* (P); Hautes-Alpes, vallée de la Guisane, au Casset, 44º59'N, 6º28'E, 30 June 1955, *Rufier-Lanche s.n.* (LD); Isère, Mont-de Lans, 45º1'N, 6º8'E, July, *Perret s.n.* (MA, WA); Hautes-Alpes, Le Lautaret, route de la Grave, 45º2'N, 6º24'E, 22 June 1934, *Prevel s.n.* (MA); Rhône-Alpes, Savoie, Chambery, mont Cenis, 45º14'N, 6º54'E, *Huguenin s.n.* (S); Rhône-Alpes, près Lanslebourg, 45º17'N, 6º52'E, 12 Aug. 1990, *Johler s.n.* (G); Rhône-Alpes, vallee de St. Nicolas, 45º50'N, 6º43'E, 1836, *Reuter s.n.* (MPU); Rhône-Alpes, ad Chamonix, col de Torolaz, 45º55'N, 6º52'E, 23 Aug. 1860, *Kotschy s.n.* (W). **Italy.** Aosta Valley: Vall d'Aosta, van rifugio Vittorio Sello naar Valnontey, 45º34'N, 7º18'E, 24 July 1960, *Stud. Biol. Rheno-Trai. 628* (U); provincia d'Aosta, N Cogne, Alpe Granson, 45º36'N, 7º21'E, 29 July 1983, *Buchner s.n.* (MA); Vallée de Cogne, Berg Gueula, 45º36'N, 7º21'E, 21 July 1896, *Wolf s.n.* (G); Val Grisanche, Col de Tei, 45º38'N, 7º4'E, 24 July 1889, *Beyer s.n.* (B); Vall d'Aosta, Alp d'Arbole, 45º40'N, 7º23'E, 4 Aug. 1883, *Naville s.n.* (G). Piedmont: Dauphiné, Mont Viso, 44º40'N, 7º5'E, 6 Aug. 1860, *Cosson s.n.* (MO); Melezet, 45º4'N, 6º41'E, 23 June 1902, *Berrino s.n.* (S). **Switzerland.** Graubünden: Berninagebiet, 46º24'N, 10º0'E, *Caviezel s.n.* (B); Grisons, Val Rosegg, 46º27'N, 9º52'E, 8 July 1884, *Tripet s.n.* (COI); extrémité supérieure du val Roseg, Engadine, 46º30'N, 10º0'E, 26 July 1873, *Brown s.n.* (H, S, UPS); Celerina, Alp Laret, 46º30'N, 9º51'E, July 1925, *Lorenz s.n.* (B); Engadine, Val Bugliauna, 46º36'N, 10º24'E, 15 July 1967, *Simon s.n.* (LD, S); Saint Moritz-Brattas gegen Alp Laret, 46º48'N, 10º13'E, 26 July 1918, *Branger 166* (C, G, GH, WU). Valais: Mont Foully, 45º56'N, 7º5'E, 3 July 1887, *Masson s.n.* (MA, S); Valais, pentes rocailleuses de la Plättje, 45º58'N, 7º48'E, 6 July 1907, *Marret 71* (S); Valesia, pr. Zermatt, 46º1'N, 7º44'E, July 1888, *Bernouilli s.n.* (MA, S); Valais, Saas Almagell, 46º2'N, 7º57'E, 17 Aug. 2013, *Aedo 20827* (MA); Valais, Col de Torrent, 46º7'N, 7º31'E, 19 May 1944, *Weber s.n.* (G); Valais, Val d'Hérémence, Combe de Praz, 46º8'N, 7º23'E, 7 July 1901, *Wilczek s.n.* (HBG, UPS); Lichter, felsiger Lärchen-Arvenwald, WSW von Arolla, Val d'Hérens, S von Sion, 46º10'N, 7º26'E, 22 July 2014, *Baltisberger 17273* (ZT); Valesia, in m. Rofswald supra Brieg, 46º16'N, 8º2'E, 10 July 1885, *Bernouilli s.n.* (LD, S); Valais, Randogne, à Pépinet sous Mont-la-Chaux, 46º18'N, 7º30'E, 11 July 1948, *Terretaz 2434* (G); Valais, Ausserberg, 46º18'N, 7º51'E, 29 June 1934, *Theurillat 4046* (G); Valais, Saflisch-Valley, S of Fiesch, 46º19'N, 8º5'E, 7 Aug. 1910, *Fries s.n.* (H).

Discussion. Geranium rivulare is a perennial with a short horizontal rootstock and an erect habit. The leaves are deeply cut into long and narrow segments. The medium cauline leaves are alternate at one or, rarely, two middle nodes, but become opposite toward the inflorescence. The flowers are actinomorphic and funnel-shaped, and the petals are white with fine violet veins. The indumentum consists predominantly of appressed, eglandular hairs that are variable in density. They are spread on stems, both surfaces of the leaves, peduncles and pedicels, sepals, and fruits. On the apex of the mericarp, however, the presence of glandular hairs is constant and, in some cases, on the base of the rostrum.

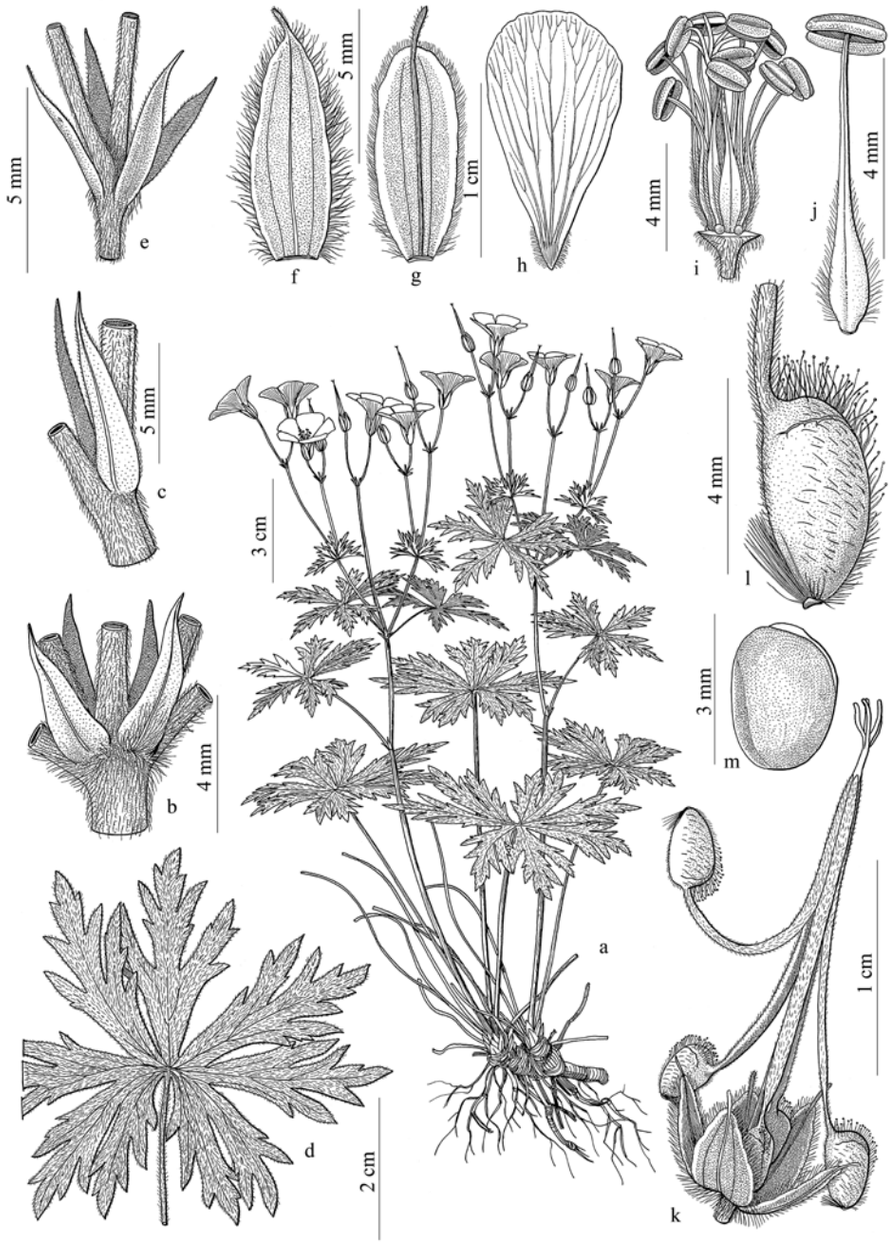


Fig. 108. *Geranium rivulare*. a. Habit. b, c. Stipules. d. Leaf. e. Bracteoles. f, g. Sepals. h. Petal. i. Flower without petals and sepals. j. Stamen. k. Fruit. l. Mericarp. m. Seed. (Based on: a, d-j, *Brown s.n.,* H-1368402; b, c, l, *Bernet s.n.,* H-1368417; k, m, *Aedo 20827,* MA).

Geranium rivulare is close to *G. sylvaticum* and, sometimes, it has been subordinate to the latter. Both species overlap their area in Central and Western Alps, and grow in similar habitats. In fact, they occasionally live together but no intermediate forms have been located. *Geranium rivulare* is easily identified from *G. sylvaticum* by its deeply divided leaves and the lack of glandular hairs on the inflorescence (except on the mericarp). Additionally, petals of *G. sylvaticum* are purple (except in the case of albinistic individuals), while those of *G. rivulare* are white.

The differences between *G. rivulare* and *G. caeruleatum* are addressed under the latter.

29. Geranium schmidii (Y.J. Nasir) Aedo, Flora Montiber. 78: 85. Nov. 2020. *Geranium pratense* var. *schmidii* Y.J. Nasir, Fl. Pakistan 149: 18 fig. 4, 21. 1983. Type locality: "Ishkoman Pass, 13-14,000', Aug 1954, F. Schmid s.n.". Type: Pakistan. Gilgit-Baltistan, Ishkoman Pass, 36°32'N, 73°49'E, Aug. 1954, *F. Schmid & R.R. Stewart s.n.* (holotype, RAW; now at KUH image!).

Geranium jainii Hurrah & V. Wagh, Nordic J. Bot. 38: 3 fig. 2, 4 fig. 4. Dec. 2020. Type locality: "India, Himachal Pradesh, Lahul and Spiti district, Rohtang, 32°23'114"N, 77°14'450"E, 3948 m a.s.l., 25 Jul 2018, Imtiyaz A. Hurrah 303999 (holotype LWG!)". Type: India. Himachal Pradesh, Rohtang, 32°23'N, 77°14'E, 25 July 2018, *I.A. Hurrah 303999 s.n.* (holotype, LWG image!).

Perennial herbs, 19-60 cm tall. *Rootstock* 6.7-8.2 mm in diameter, ± horizontal, not tuberculate, not turnip-shaped, with thickened roots along the rootstock. *Stem* erect, leafy, not rooting at nodes, stolons absent, without vegetative stems, with retrorse, ± appressed, eglandular hairs 0.3-0.5 mm long. *Basal leaves* in a ± persistent rosette, cauline leaves alternate (usually 1) and upper opposite; leaf laminas (3.6)5.4-6.3(7.6) cm long, 4.6-9.2 cm wide, not peltate, palmatifid [ratio main-sinus length/ middle segment length = (0.73)0.81-

Fig. 109. *Geranium rivulare* (Based on: *Aedo 20827,* MA).

Fig. 110. Distribution of *Geranium rivulare*.

0.89(0.92)], polygonal in outline, base cordate, not coriaceous, with nerves not projected, pilose, with ± appressed, eglandular hairs on both surfaces; segments 5, in 1 plane, middle segment rhombic, (2.6)4.4-6.6(6.8) mm wide at the base [ratio segment width at the base/middle segment length = (0.07)0.10-0.15(0.19)], (6)9-13(16)-lobed in distal half [ratio secondary sinus length/middle segment length = (0.20)0.22-0.30(0.36)]; petioles up to 18 cm long, without abscission zone, terete, not swollen, not deflexed in age, with retrorse, ± appressed, eglandular hairs 0.2-0.6 mm long; stipules 5.6-10.8 mm long, 1.1-2.7 mm wide, lanceolate, free, papery, brown, with eglandular hairs on abaxial surface and on the margin, glabrous adaxially. *Inflorescence* a dichasial cyme; cymules 2-flowered, solitary or in aggregates at the top of each branch [ratio cymule length/leaf length = (1.7)2-2.7(5.2)]; peduncles (18)40-56(65) mm long, with retrorse to uncinate, eglandular hairs 0.3-0.7 mm long and, sometimes, patent, glandular hairs 0.3-1.5 mm long; bracteoles 2.5-5.9 mm long, 0.6-1 mm wide, lanceolate, whorled; pedicels (8.5)18-25(31.5) mm long, with retrorse to uncinate, eglandular hairs 0.3-0.6 mm long and, usually, patent, glandular hairs 0.6-1.1 mm long. Flowers actinomorphic. *Sepals* (8)8.1-9.6(9.8) mm long, 2.8-4.1 mm wide, lanceolate, smooth (with a small dark purple zone at the base), not accrescent, nerves 3, mucro (0.9)1.4-2(2.1) mm long [ratio mucro length/sepal length = 0.10-0.25], with ± patent, eglandular hairs 0.5-1.1 mm long and, usually, patent, glandular hairs 0.2-1.1 mm long on the abaxial surface, glabrous adaxially. *Petals* (15)16.1-20.1(21.1) mm long, (6.7)8.4-10.4(12.5) mm wide, erect-patent, emarginate (notch 0.2-1.7 mm deep), without claw, purple, hairy on the base of the adaxial surface, glabrous abaxially, ciliate on the basal margin, with hairs 0.3-0.9 mm long.

Stamens 10, both whorls bearing anthers; filaments (7.7)8-8.5(10) mm long, lanceolate, white, pilose on the abaxial surface, ciliate on the proximal half, with hairs 0.2-1 mm long;

anthers 1.9-2.1(2.4) mm long, yellow. Nectaries 5, hemispheric, glabrous. *Gynoecium* 7-10 mm long, deep pink. *Fruit* 21-32 mm long, erect, discharge of seed-ejection type; mericarps 3.4-4.4 mm long, 2.2-2.3 mm wide, without a strand of fibers, not compressed at the apex, smooth (sometimes with 1-2 transverse veins at the apex), without basal beak, with a basal callus, without a basal prong, brown, with ± patent, eglandular hairs 0.3-0.4 mm long and scattered, patent, glandular hairs 1.1-1.3 mm long (mainly at the top of the mericarp); rostrum 15.5-23.6 mm long, with a narrowed apex 2.6-6.2 mm long, not twisted, with patent, eglandular hairs 0.2-0.4 mm long and patent, glandular hairs 0.5-1.3 mm long; stigmatic remnants 2.2-3.7 mm long, with 5 glabrous lobes. *Seeds* 3.1-3.2 mm long, 1.5-1.6 mm wide, finely reticulate, uniformly colored, brown, glabrous. Cotyledons not studied. Fig. 111.

Pollen. Ornamentation not studied.

Chromosome number. Unknown.

Phenology. Collected in flower from June to September.

Distribution. This species ranges from northern Pakistan and northwestern India (Jammu-Kashmir and Himachal Pradesh) (Fig. 112).

Habitat. Meadows, rocky outcroops and edge of *Abies* Mill., *Betula* L. and *Pinus* L. forests; 2600-4200 m.

Additional specimens examined. **India.** Himachal Pradesh: Lahul, Kyelang, 32°34'N, 77°1'E, 13 July 1930, *Koelz 541* (P); Jammu-Kashmir: Kashmir, Har Nag near mt. Kolahoy, 34°8'N, 75°22'E, Aug. 1927, *Stewart 13343* (G); Sonamarg, 34°18'N, 75°17'E, 18 Aug. 1928, *Stewart 13325* (MO, G); before Nichinai pass, 34°21'N, 75°11'E, Aug. 1989, *Chadwell 356* (A); Gadsar nullah, 34°25'N, 75°3'E, 16 Aug. 1940, *Pinfold 340* (BM). **Pakistan.** Gilgit-Baltistan: Baltistan, Deosai plateau, Skardu side, 34°45'N, 75°14'E, 21 July 1998, *Emanuelsson 2544* (S); Northern Areas, Deosai plateau, 34°45'N, 75°14'E, 24 July 1994, *Nüsser 1612* (B); Burzil, 34°54'N, 75°4'E, 21 July 1935, *Persson 790* (S); Chittakatha Sar, 34°55'N, 74°31'E, 21 Aug. 1953, *Schmid 654* (G); Rama, Aston distr., 34°58'N, 75°57'E, 25 July 1946, *Stewart 22898* (US); Northern Areas, Nanga Parbat, oberes Kosto-Tal, Jilipur High Camp, 35°18'N, 74°30'E, 11 July 1994, *Nüsser 1428* (B); Sachen glacier, Rama valley, 35°19'N, 74°46'E, 2 Sep. 1992, *Schickhoff 981* (M); Northern Areas, Nanga Parbat, Bayal, Raikot tal, 35°23'N, 74°37'E, 7 July 1994, *Nüsser 1283* (B); Northern Areas, Nanga Parbat, Bagrot-Tal, 35°52'N, 74°28'E, 4 July 1994, *Nüsser 1247* (B); Nagar state, Karakoram, Minapin Glacier, 36°10'N, 74°36'E, 8 Aug. 1961, *Lloyd & Megaw 78* (A); above Masot glacier, Rakaposhi North Range, 36°14'N, 74°26'E, 19 July 1992, *Schickhoff 188* (M); above Bichgari, Naltar valley, 36°19'N, 74°1'E, 2 July 1992, *Schickhoff 28* (M); Cachemire, Ulter nullah, derrière Baltit, 36°19'N, 74°39'E, 18 June 1954, *Schmid 1865* (G); Daintar, 36°22'N, 74°9'E, 1959, *Lobbichler 173* (M); Cachemire, Chhantir Gah, 36°33'N, 73°47'E, 5 Aug. 1954, *Schmid 2172* (G); Gilgit, Ramah, Diamer, 36°36'N, 73°10'E, 26 June 1977, *Ajab & Afzal 918* (Z).

Discussion. Geranium schmidii was described as a variety of *G. pratense.*

Fig. 111. *Geranium schmidii*. a. Habit. b. Leaf. c, d. Stipules. e. Bracteoles. f. Flower without petals and sepals. g. Sepals. h. Petal. i. Detail of the petal base. j. Stamen. k. Fruit. l. Detail of the rostrum indumentum. m. Mericarp. n. Seed. (Based on: a-j, *Schmid 654,* G; k-n, *Stewart 13325,* MO).

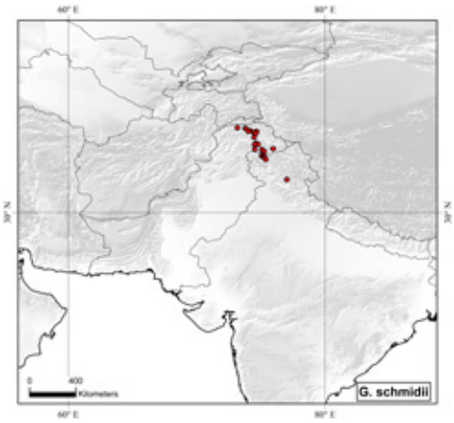


Fig. 112. Distribution of *Geranium schmidii*.

The former, however, has alternate leaves at the middle of the shoot, glabrous nectaries, narrow staminal filaments, and erect fruits, not opposite leaves, hairy nectaries, staminal filaments with an expanded base, and reflexed fruits as *G. pratense*. All these features strongly suggest that it belongs to the *Sylvaticum Group*. More specifically, it seems close to the subgroup comprising *G. caeruleatum*, *G. pseudosibiricum*, and *G. rivulare,* well characterized by its deeply divided leaves. *G. schmidii* is easily differentiated from all these species by its longer and emarginate petals. It has some overlap in petal length with *G. caeruleatum*, but the latter has more deeply divided leaves and only eglandular hairs on the inflorescence.

Hurrah & Wagh (2020) described a new species, *G. jainii*, as having alternate leaves at the middle of the shoot, glabrous nectaries, narrow staminal filaments, erect fruits and longer and emarginate petals. These authors compared his *G. jainii* with *G. pratense* and *G. collinum,* from which it is easily differentiated by the characters mentioned above. They also indicated that *G. jainii* differs from *G. pratense* var. *schmidii* in stipule length "the former having large stipules i.e. 6-10 mm long and the latter with ca 4 mm long stipules". In fact, however, *G. schmidii* has stipules 5.6-10.8 mm long. Although it has not been possible to study the type, all these facts support the synonymization of *G. jainii* to *G. schmidii*.

According to the article 53.2 of the Shenzhen Code "When two or more names of genera or species based on different types are so similar that they are likely to be confused (because they are applied to related taxa or for any other reason) they are to be treated as homonyms". For this reason the specific epithet choose by Hurrah & Wagh (2020) is very unfortunate as it is very similar to *G. jahnii*, an accepted species from Venezuela.

30. Geranium sylvaticum L., Sp. Pl.: 681. 1753*. Geranium pratense* subsp. *sylvaticum* (L.) Bonnier & Layens, Tabl. Syn. Pl. Vasc. France: 58. 1894. Type locality: "Habitat in Europae borealis sylvis". Type: "Habitat in Europae borealis sylvis" (lectotype, designated by Yeo in Jarvis & al. 1993: 49, LINN 858.63 image!).

Geranium sylvaticum var. album Weston, Bot. Univ. 2: 353. 1771. Type locality: [not indicated]. Type: Unknown locality. *R. Weston s.n.* (no original material located).

Geranium sylvaticum var. *variegatum* Weston, Bot. Univ. 2: 353. 1771. Type locality: [not indicated]. Type: Unknown locality. *R. Weston s.n.* (no original material located).

Geranium angulatum Curtis, Bot. Mag. 6, tab. 203. 1792. Type locality: "Of what country it is a native, or when it was first introduced, we have yet to learn; we first observed it in a nursery near town, where it was regarded as a very diferent species". Type: Curtis, Bot. Mag. 6, tab. 203. 1793 (lectotype, here designated).

Geranium sylvaticum var. *fastigiatum* Fr., Novit. Fl. Suec. Alt.: 211. 1828. *Geranium fastigiatum* (Fr.) Gliemann, Geogr. Besch. Island: 145. 1824. Type locality: "In Scaniae &c. dumetis herbidis". Type: Sweden. Blekinge, 56°19'N, 15°05'E, *E. Fries s.n.* (lectotype, here designated, UPS-V-149279 image!).

Geranium sylvaticum var. *glabriusculum* Gaudin, Fl. Helv. 4: 403. 1829. Type locality: "Bernaç im Sulgenbach. A Roche au Prépourri et aux Mosses. In Argonia vulgare. Tobinii. Amiciss. Suter. In vallibus iurianis circa Bellelai; in vallibus Ursaria et Lepontia; circa Mendrisium [45°52'N, 8°58'E]. Haller. In omnibus montis nostris iurianis frequentissimum. Supra Roumont, sur la Dolaz, supra Longirod [46° 29'N, 6°15'E] etc. In pratis prope arcem Chillon [46°24'N, 6°55'E] secus viam regiam". Syntypes: Switzerland. Several localities and collectors (no original material located).

Geranium sylvaticum var. *parviflorum* Mutel, Fl. Franç. 1: 203. 1834. Type locality: "Palanfrey sous la Moucherolle (Mut.)". Type: France. Rhone-Alpes, la Moucherolle, 45°00'N, 5°34'E, 14 July 1829, *A. Mutel s.n.* (lectotype, here designated, GRM!).

Geranium sylvaticum var. *parviflorum* Blytt, Bot. Not. 1845: 45. 1845, nom. illeg., non Mutel. 1834. Type locality: "Af denna art anträffade jag under sistlidne sommar pa Norefjeld i Norge en anmärkningsvard form, hvilken torde förtjena upföras som var. parviflorum: petalis... Arten varierar ofta till blommornas färg; vid Ronneby, äfvensom i vestra Norge, har jag traffat den med hvita blekt purpurstrimmiga kronblad men of vanlig storlek och form; varieteten fastigiatum är ej sällsynt vid Ronneby; den har mindre kronbladmen...". Type: Norway, Norefjeld, 62°17'N, 11°34'E, *M.N. Blytt s.n.* (no original material located).

Geranium alpestre Schur, Verh. Mitth. Siebenbürg. Vereins Naturwiss. Hermannstadt 10(5-6): 131. 1859. *Geranium sylvaticum* var. *alpestre* (Schur) Nyman, Consp. Fl. Eur.: 137. 1878. Type locality: "Auf Glimmerschiefersubstrat durch die ganze Alpenkette, beginnt bei 6000' und geht bis 7000'". Type: Romania. Transilvania, in monte Konigstein prope Coronam, 45°37'N, 25°34'E, 13 Aug. 1854, *F. Schur s.n.* (lectotype, here designated, LW-205581 image!).

Geranium sylvaticum var. *brachystemon* Godet, Fl. Jura: 126. 1852. *Geranium sylvaticum* [2] *brachystemon* (Godet) Graebn. in Asch. & Graebn., Syn. Mitteleur. Fl. 7(1): 15. 1913. Type locality: "Très répandu; parait cependant nul dans le Jura argovien; monte jusqu'aux sommités". Type: Switzerland. Val de Ruz, aux Loges, 47°02'N 6°54'E, 18 June 1837, *C.H. Godet s.n.* (lectotype, here designated, G!; isolectotype, BM!).

Geranium sylvaticum var. *alpinum* Rupr., Mém. Acad. Imp. Sci. Saint Pétersbourg ser. 7, 15(2): 273. 1869*. Geranium sylvaticum* [?] *alpinum* (Rupr.) Graebn. in Asch. & Graebn., Syn. Mitteleur. Fl. 7(1): 15. 1913. Type locality: "Tuschetia: in reg. alp. m. Diklo alt. 1600—1500 hex. 29 Jul. flor. legi var. alpinam... ibidem versus moles glaciales alt. 1540—1470 hex. 31 Jul. flor. legi var. alpinam... vidi ibidem alt. 1300—1250 hex. Vidi quoque 2 Aug. in vicinitate m. Pizzaro alt. 1500—1480 hex. et 9 Aug. inter Didigwerdi et Kartiani alt. 1200—1250 hex.... In m. Gunib alt. 1130—1000 hex. 27 Jun. flor. legi var. alpinam... Andes Salataviae: in cacumine minori m. Chenakoi-tau alt. 1320 hex. 1 Jul. fl. legit

D. Owerin var. alpinam fere Gunibensem". Type: Russia. Caucasus orient., Dagestania media, Gunib, 42°24'N, 46°52'E, 27 June 1861, *F.J. Ruprecht s.n.* (lectotype, here designated, LE!).

Geranium sylvaticum var. *hirsutum* Rupr., Mém. Acad. Imp. Sci. Saint Pétersbourg ser. 7, 15(2): 273. 1869. *Geranium sylvaticum* [1] *hirsutum* (Rupr.) Graebn. in Asch. & Graebn., Syn. Mitteleur. Fl. 7(1): 14. 1913. Type locality: "Promont bor. occid., e seminibus Stevenianus educta var. hirsuta". Type: Russia. Cultivated at St. Petersbourg Botanical Garden, from seed collected by C. Steven in NW Caucasus (lectotype, here designated, LE!).

Geranium sylvaticum var. *subeglandulosum* Rupr., Mém. Acad. Imp. Sci. Saint Pétersbourg ser. 7, 15(2): 273. 1869. *Geranium sylvaticum* [b] *subeglandulosum* (Rupr.) Graebn. in Asch. & Graebn., Syn. Mitteleur. Fl. 7(1): 15. 1913. Type locality: "Cauc. minor: in humidis versus cacumen m. Sarial copiose, Jul. fl. et defl. typicum (Hohen! p. 246); ibidem versus cacumen 2 Jun. fl. legit Kolenati var. subeglandulosam...". Type: Azerbaijan. In monte Sarijal districtus Airum, 40°35'N, 46°18'E, 2 June 1844, *F.A. Kolenati 1631* (lectotype, here designated, LE!).

Geranium sylvaticum var. *denudatum* Čelak., Prodr. F. Böhmen 3: 530. 1875. Type locality: "... am Kesselberge ([gamma], Knaf)!... ". Type: Czech Republic. Kesselberge, Kotel Mt., 50°45', 15°31'E, 8 Aug. 1841, *J. Knaf s.n.* (lectotype, here designated, PR-876491!).

Geranium sylvaticum var. *eglandulosum* Čelak., Prodr. F. Böhmen 3: 530. 1875. *Geranium eglandulosum* (Čelak.) Dalla Torre, Alpenfl.: 147. 1899. *Geranium sylvaticum* f. *eglandulosum* (Čelak.) Borza, Consp. Fl. Roman. 2: 173. 1949. Type locality: "... Ungarn und Krain". Type: Hungary. *F.P.A. Waldstein s.n.* (lectotype, here designated, PR-876495!).

Geranium sylvaticum var. *parviflorum* Knaf ex Čelak., Prodr. F. Böhmen 3: 530. 1875, nom. illeg., non Mutel. 1834. Type locality: "... im Elbgrund (mit ß, Knaf)! ... bei Weipert (ß, Knaf)! ... ". Type: Czech Republic. Weipert, 50°30'N, 13°1'E, *J. Knaf s.n.* (lectotype, here designated, PR-876492!).

Geranium sylvaticum var. *brachypetalum* Lecoq & Lamotte in Lamotte, Prodr. Pl. Plat. Centr.: 171. 1876. Type locality: "Cantal. Prés tourbeux près du buron de Pra-de-Bouc, en allant à Albepierre!". Type: France. Cantal, Pra-de-Bouc, 45°03'N, 2°44'E, Aug. 1846, *M. Lamotte s.n.* (lectotype, here designated, P-00710107!; isolectotype, MPU-018545!).

Geranium sylvaticum var. *vestitum* Lange in Willk. & Lange, Prodr. Fl. Hispan. 3: 528. 1878. *Geranium sylvaticum* [3] *vestitum* (Lange) Graebn. in Asch. & Graebn., Syn. Mitteleur. Fl. 7(1): 14. 1913. Type locality: "in pinetid ad Hoyocasero pr. Avila (Bourg., sine nom. specif. 22 Jul. c. fr.!)". Type: Spain. Ávila, Hoyocasero, 40°23'N, 4°58'W, 22 July 1863, *E. Bourgeau s.n.* (lectotype, here designated, C-10022098 image!).

Geranium sylvaticum [ß] *eglandulosum* Strobl, Jahres-Ber. Obergymn. Melk 32: 49. 1882, nom. illeg., non Čelak. 1875. *Geranium sylvaticum* var. *stroblii* Hayek, Fl. Steiermark 1: 630. 1909. *Geranium sylvaticum* [c] *stroblii* (Hayek) Graebn. in Asch. & Graebn., Syn. Mitteleur. Fl. 7(1): 15. 1913. Type locality: "Waldenregion des Pyrgas...". Type: Austria. Styria, m. Pyrgas, 47°39'N, 14°23'E, *P.G. Strobl s.n.* (no original material located, probably at ADMONT).

Geranium sylvaticum [A] *grandiflorum* Strobl, Jahres-Ber. Obergymn. Melk 32: 49. 1882. Type locality: [not indicated]. Type: Austria. Styria, *P.G. Strobl s.n.* (no original material located, probably at ADMONT).

Geranium sylvaticum [B] *parviflorum* Strobl, Jahres-Ber. Obergymn. Melk 32: 49. 1882, nom. illeg., non Mutel. 1834. Type locality: "(Voralpenregion des Kalbling)... ((Waldenregion des Pyrgas...". Type: Austria. Styria. *P.G. Strobl s.n.* (no original material located, probably at ADMONT).

Geranium sylvaticum var. *parviflorum* Knaf ex Potonié, Ill. Fl. Nord Mitt. Deutschland: 293. 1889, nom. illeg., non Mutel. 1834. Type locality: [not indicated]. Type: Germany. Without definite locality, *H. Potonié s.n.* (no original material located).

Geranium sylvaticum var. *wanneri* Briq., Bull. Trav. Soc. Bot. Genève 5: 201. 1889. *Geranium sylvaticum* [2] *wanneri* (Briq.) Graebn. in Asch. & Graebn., Syn. Mitteleur. Fl. 7(1): 14. 1913. Type locality: "Cette variété qui a été découverte sur le versant méridional du Mont Billiat par M. Wanner, de Genève... Cultivée dans les rocailles alpines de M. Badel près de Chêne, elle s'y maintient depuis plusieurs années sans variation". Type: France. Rodano-Alpes, from Mont Billiat (cultivated), 46°17'N, 6°35'E, *S.J. Wanner s.n.* (lectotype, here designated, G!).

Geranium sylvaticum f. *latisectum* Beck, Fl. Nieder-Österreich.: 560. 1892. *Geranium sylvaticum* var. *latisectum* (Beck) Rouy in Rouy & Foucaud, Fl. France 4: 80. 1897. *Geranium sylvaticum* [1] *latisectum* (Beck) Graebn. in Asch. & Graebn., Syn. Mitteleur. Fl. 7(1): 13. 1913. Type locality: [Austria, without precisse locality]. Type: Austria, Rax, 47°41'N, 15°41'E, 29 June 1889, *G. Beck s.n.* (lectotype, here designated, PRC-455650 image!).

Geranium sylvaticum f. *angustisectum* Beck, Fl. Nieder-Österreich.: 560. 1892. *Geranium sylvaticum* [1] *angustisectum* (Beck) Graebn. in Asch. & Graebn., Syn. Mitteleur. Fl. 7(1): 14. 1913. Type locality: [Austria, without precisse locality]. Type: Austria, Schneeberg, 47°46'N, 15°51'E, July 1897, *G. Beck s.n.* (lectotype, here designated, PRC-455654 image!).

Geranium lemanianum Briq., Annuaire Conserv. Jard. Bot. Genève 3: 83. 1899. *Geranium sylvaticum* subsp. *lemanianum* (Briq.) Schinz & R. Keller, Fl. Schweiz ed. french 2: 359. 1909. Type locality: "Eboulis sur le versant S. de la Pointe des Avoudruz, 2,000 m. (B, août 1893)". Type: France. Haute Savoie, Pointe des Avoudruz, 46°03'N, 6°*47›E, Aug. 1893, J. Briquet s.n.* (lectotype, here designated, G!).

Geranium sylvaticum var. *myriadenum* Sommier & Levier, Trudy Imp. S.-Peterburgsk. Bot. Sada 16: 98. 1900. *Geranium sylvaticum* [2] *myriadenum* (Sommier & Levier) Graebn. in Asch. & Graebn., Syn. Mitteleur. Fl. 7(1): 14. 1913. Type locality: "Parum supra flumen Tieberda in adscensu jugi Tieberdinsky, 1 Sept. fl. fr.". Type: Russia. Karachayevo-Cherkesiya, In jugo Tieberdinski perival dicto, inter flumina Tieberda et Do-ut, ditionis Kuban, parum supra flumen Tieberda, 43°26'N, 41°44'E, 1 Sep. 1890, *S. Sommier & E. Levier 251* (lectotype, here designated, FI-1017478!).

Geranium sylvaticum f. *sublilacinum* C.G. Westerl., Bot. Not. 1906: 23. 1906. *Geranium sylvaticum* [1] *sublilacinum* (C.G. Westerl.) Graebn. in Asch. & Graebn., Syn. Mitteleur. Fl. 7(1): 13. 1913. Type locality: "Bidrag till Hälsinglands flora... Kronblab ljust lilafärgade. Idenor: Sund (3 ex.; 4/7 1905).- Denna färgvariation kan gärna särskiljas. Den förekommer nästan alltid högst sparsamt och kan icke vara nagon standortsmodifikation, da jag alltid paträffat den tillsamman med hufvudformen". Type: Sweden. Hälsinglands, Idenor, 61°39'N, 17°03'E, 4 July 1905, *C.G. Westerlund s.n.* (lectotype, here designated, S-09-42514 image!).

Geranium sylvaticum var. *micranthum* Bordzitowski, in sched. 1907. Type locality: "Transcaucasia. Armenia Rossica. In decliv. saxosis montis Abul Majoris, c. 7000' in districtu Archalkalaxi". Type: Georgia. Archalkalaxi, montis Abul Majoris, 41°31'N, 43°40'E. 4 June 1907, *E. Bordzitowski s.n.* (lectotype, here designated, LE!).

Geranium pratense var. *parviflorum* Beck, Repert. Spec. Nov. Regni Veg. 17: 450. 1921. Type locality: "Bohemia in graminosis prope Stolzenhaun juxta Wiesental (Erzgebirge)... ". Type: Czech Republic. Bohemia in graminosis prope Stolzenhaun juxta Wiesental, Erzgebirge, 50°30'N, 13°10'E, 3 July 1921, *G. Beck s.n.* (lectotype, here designated, PRC!).

Geranium endressii var. *glandulosum* Sennen, Pl. Espagne n.° 6953. 1929, in

sched., *Geranium losae* Sennen, Pl. Espagne n.° 6953. 1929, in sched. Type locality: "Logroño: Piqueras, bords du torrent, 1500 m. 1929-VI. Leg. Dr. M. Losa". Type: Spain. La Rioja, Piqueras, 42º03'N, 2º32'W, June 1929, *T.M. Losa s.n.* (lectotype, here designated, BC!; isolectotypes, K!, MA-71650!, PH-00011904 image!).

Geranium sylvaticum f. *perglandulosum* Nyár., Kolozsvár Fl. 5: 338. 1943. Type locality: "Az alsó szártagok valamint a tövevelek nyele is mirigyszörös. Acsúcs bükkösciben 700-800 m (Ny IIKv)". Type: Romania. Cojocna distr., in silvis montis Peana et silva Făget, pr. Cluj, 46°43'N, 23°33'E, 25 May 1925, *E.J. Nyárády s.n.* (lectotype, here designated, CL-439367 image!; isolectotype, WA!).

Geranium sylvaticum var. *glanduligerum* Petrova & Kozhukharov in Jordanov, Fl. Rep. Pop. Bulg. 7: 492. 1979. Type locality: "m. Rila occidentalis l.d. Partizanska poljana prope cenobium Rilski Monastir, ad rivum Rilska reka, 1000 m s. m. 18. VI. 1972. Leg. A. Petrova et S. Kožuharov (SOM-135051)". Type: Bulgaria. m. Rila occidentalis l.d. Partizanska poljana prope cenobium Rilski Monastir, ad rivum Rilska, 42º08'N, 23º20'E, 18 June 1972, *A. Petrova & S. Kožuharov s.n.* (holotype, SOM-135051!).

Geranium uralense Kuvaev, Novosti Sist. Vyssh. Rast. 27: 102 fig. 1. 1990. Type locality: "Ural Septentrionalis, systema fl. Stczugor, ad fontem fl. Nanksory-Ja, pratum montanum ad limitem silvae, 6 VII 1928, W. Soczava (LE)". Type: Russia. Ural Septentrionalis, systema fl. Stczugor, ad fontem fl. Nanksory-Ja, 61º06'N, 56º39'E, 6 July 1928, *W. Soczava s.n.* (holotype, LE!; isotype, MW).

Geranium sylvaticum var. *borealis* Pohle ex Tzvelev, Novosti Sist. Vyssh. Rast. 29: 96. 1993. Type locality: "Peninsula Kola, montes Chibiny, 2 VIII 1909, R. Pohle". Type: Russia. Peninsula Kola, montes Chibiny, 67º45'N, 33º45'E, 2 Aug. 1909, *R. Pohle s.n.* (holotype, LE!).

Perennial herbs, 22-95 cm tall. *Rootstock* 4.8-12.2 mm in diameter, ± horizontal, not tuberculate, not turnip-shaped, with thickened roots along the rootstock. *Stem* erect, leafy, not rooting at nodes, stolons absent, without vegetative stems, with patent to retrorse, eglandular hairs 0.5-2 mm long and, sometimes, patent, glandular hairs 0.2-0.8 mm long. *Basal leaves* in a ± deciduous rosette, cauline leaves alternate (usually 1) and upper opposite; leaf laminas (5.8)7.2-10.1(13.3) cm long, 7.8-16.3 cm wide, not peltate, palmatifid [ratio main-sinus length/middle segment length = (0.77)0.81-0.88(0.89)], polygonal in outline, base cordate, not coriaceous, with nerves not projected, pilose, with appressed, eglandular hairs on both surfaces; segments 5(7), in 1 plane, middle segment rhombic, (5.1)5.7-12.3(16.1) mm wide at the base [ratio segment width at the base/middle segment length = (0.10)0.12-0.17(0.23)], (16)21-29(32)-lobed in distal half [ratio secondary sinus length/middle segment length = (0.15)0.19-0.25(0.32)]; petioles up to 30 cm long, without abscission zone, terete, not swollen, not deflexed in age, with patent, eglandular hairs 0.3-0.9 mm long and, sometimes, patent, glandular hairs 0.3-0.8 mm long; stipules 6.8-17.1 mm long, 1.1-5.2 mm wide, lanceolate, free, papery, brown, with eglandular hairs on abaxial surface and on the margin, usually glabrous adaxially. *Inflorescence* a dichasial cyme; cymules 2-flowered, solitary or in aggregates at the top of each branch [ratio cymule length/leaf length = (1.2)1.7-2.7(3.3)]; peduncles (14)19-45(68) mm long, with patent to uncinate, eglandular hairs 0.2-0.5 mm long and patent, glandular hairs 0.2-0.9 mm long; bracteoles 1.8-6.1 mm long, 0.4-0.9 mm wide, lanceolate, whorled; pedicels (3.8)10-19(23.1) mm long, with patent to uncinate, eglandular hairs 0.1-0.5 mm long and patent, glandular hairs 0.2-0.8 mm long. Flowers actinomorphic. *Sepals* (6.7)7.2-8.6(9.6) mm long, 2.4-3.7 mm wide, lanceolate, smooth, not accrescent, nerves 3, mucro (1)1.5-2.2(3) mm long [ratio mucro length/sepal length = 0.13-0.35], with ± patent, eglandular hairs 0.2-0.7 mm long and patent, glandular hairs 0.2-0.9 mm long on the abaxial surface, glabrous adaxially. *Petals* (12.2)13-17.6(19.3) mm long, (6.3)7-10.8(12.6) mm wide, erect-patent, rounded or rarely slightly emarginate (notch 0.2-0.8 mm deep), without claw, purple, rarely white, hairy on the base of the adaxial surface, glabrous abaxially, ciliate on the basal margin, with hairs 0.4-0.9 mm long. *Stamens* 10, both whorls bearing anthers; filaments (7.2)7.6-8.8(10.5) mm long, lanceolate, purple, pilose on the abaxial surface, ciliate on the proximal half, with hairs 0.2-0.7 mm long; anthers (1.6)1.7-2(2.4) mm long, purple. Nectaries 5, hemispheric, glabrous. *Gynoecium* 5.8-9.7 mm long, purple. *Fruit* (22)26-30(36.8) mm long, erect, discharge of seed-ejection type; mericarps 3.4-5.1 mm long, 1.4-2.7 mm wide, without a strand of fibers, not compressed at the apex, smooth (with 2 transverse veins at the apex), without basal beak, with a basal callus, without a basal prong, brown, with ± appressed, eglandular hairs 0.3-0.8 mm long and patent, glandular hairs 0.3-1 mm long; rostrum 16-27 mm long, with a narrowed apex (2.4)2.7-4.5(6) mm long, not twisted, with ± patent, eglandular hairs 0.2-0.5 mm long and patent, glandular hairs 0.3-0.9 mm long; stigmatic remnants 1.8-3.2 mm long, with 5 glabrous lobes. *Seeds* 2.7-3.4 mm long, 1.7-2.1 mm wide, finely reticulate, uniformly colored, brown, glabrous. Cotyledons with entire margin. Fig. 113, 114.

Pollen. *Geranium*-type (Bortenschlager 1967: 468; Stafford & Blackmore 1991: 73; Velasco 1992b: 54).

Chromosome number. 2*n* = 24?, c. 28, 28.

Phenology. Collected in flower from April to September.

Distribution. This species ranges from southern Greenland, through Europe and Caucasus to western Siberia (Fig. 115).

Habitat. Stream shores, moist meadows, rocky outcrops, forb formations, shrubby areas, *Rhododendron* L. thickets and edge of *Abies* Mill., *Betula* L., *Fagus* L., *Picea* A. Dietr. and *Pinus* L. forests; 0-3200 m.

Representative specimens examined. **Andorra**. Encamp: subida de Grau-Roig a estanis dels Pessons, 42º30'N, 1º39'E, 3 July 1992, *Navarro & al. 628* (MA). **Armenia.** Syunik: puerto de Meghrit, 39º3'N, 46º11'E, 27 June 2005, *Quintanar & al. 1581* (MA). Vayots Dzor: Vajk distr., Djermuk, Kechut, 39º49'N, 45º38'E, 19 June 2004, *Vitek & al. 04-0851* (MA). **Austria.** Tyrol: Ötztaler

Alpen, Gebiet Obergurgl, 46º52'N, 11º1'E, 11 July 1993, *Vitek s.n.* (MA). Vorarlberg: Gurtis, 47º11'N, 9º38'E, 4 June 1914, *Wimmer s.n.* (MA). **Belgium.** Wallonia: Lorraine, Chantemelle, 49º39'N, 5º39'E, 7 June 1912, *Errard s.n.* (MA); Chôdes, Malmedy, Liège, 50º25'N, 6º3'E, 8 June 1977, *Fontaine s.n.* (MA). **Belorussiya.** Grodno: Nowogrodek, Lubez, 53º40'N, 25º45'E, 9 1893, *Dybowski s.n.* (LE, WA). Mogilev: Mohilew, 53º54'N, 30º20'E, 1862, *Downar s.n.* (LE). **Bosnia-Herzegovina.** Pepeljak, 41º48'N, 21º20'E, 11 Aug. 1922, *Vandas s.n.* (PR); Gola Jahorina, SE Sarajevo, 43º41'N, 18º37'E, 15 July 1970, *Tyyret s.n.* (C). **Bulgaria.** Haskovo: montañas de Rila, distr. de Kyustendil, pr. Kirilova, 41º51'N, 26º8'E, 6 July 2004, *Quintanar & al. 1313* (MA). Smolyan: Central Rhodope Mts., Smolyan, pr. Gela, 41º39'N, 24º33'E, 28 June 2004, *Aedo & al. 10146* (MA). **Czech Republic.** Olomouc: Flora von Schlesien, Maihr, Gesenke, am Altvater, 50º4'N, 17º13'E, 12 July 1898, *Ziesché s.n.* (MA). **Denmark.** Faeroe Island, Torshavn, 62º0'N, 6º47'W, 15 June 1937, *Lagerkranz s.n.* (GH). Midtjylland: W of Aarhus, 56º10'N, 10º13'E, 11 June 1968, *Jensen & al. s.n.* (GH, L, MA). **Estonia.** Harju: Katharinenthal, Kosch, bei Reval, 59º20'N, 24º35'E, *Wiedemann 166* (LE). Ida-Viru: pr. ciudad Ust-Narva, en la orilla del golfo Narvskiy, 59º27'N, 28º2'E, 7 June 1974, *Nepli s.n.* (US). **Finland.** Åland: Varsinais-Soumi, Piikkiö, Finnby, Inkola, 59º55'N, 20º55'E, 17 June 1957, *Jääskeläinen s.n.* (MA). Lapland: Inari Lapland, Utsjoki, 69º53'N, 27º0'E, 15 July 1957, *Jääskeläinen s.n.* (MA). **France.** Occitanie: Conflent, pr. Aiguatèbia, 42º34'N, 2º11'E, 29 May 2009, *Calvo 3690* (MA); Hautes-Pyrenees, lac de Badet, 42º47'N, 0º8'E, 21 July 2000, *Aedo & Pedrol 5844* (MA). Provence-Alpes-Côte d'Azur: Hautes Alpes, col de Gleize, 44º37'N, 6º4'E, 2 June 2011, *Aedo 18431* (MA). **Georgia.** Abkhazia: monte Mamzdyscha, 43º18'N, 40º20'E, 17 July 1973, *Klatovy 2701* (PRC). Samtskhe-Javakheti: Kartli, Borjomi, Bakuriani, 41º41'N, 43º31'E, 27 June 1999, *Merello & al. 2373* (MA, MO). **Germany.** Bavaria: Baviera, pr. Berchtesgaden Markt, 47º37'N, 13º2'E, 9 Aug. 2018, *Aedo 26034* (MA). Hesse: Dillkreis, Waldaubach, E Fauernheck, 50º39'N, 8º8'E, 4 June 1978, *Kalheber s.n.* (GH). **Great Britain.** England: West Norfolk, Sporle, 52º40'N, 0º45'E, 29 June 1916, *Montague s.n.* (BIRM). Northern Ireland: Antrim Co., Glenarm, 54º58'N, 5º58'W, 15 July 1885, *Praeger 296* (DBN). Scotland: Logan Waterfall, Pentland Hills, Midlothian, 55º8'N, 3º4'W, 3 July 1956, *Currie 703* (LE). Wales: Monmouthshire, Grwyne Valley, under a house called Ty-uchaf, 51º50'N, 3º6'W, 30 June 1881, *Ley s.n.* (BIRM). **Greece.** Central Greece: Fthiotidos, mt. Iti, 38º50'N, 22º16'E, 9 June 1998, *Strid & al. 46284* (G). East Macedonia and Thrace: Dramas, mt. Falakron, summit area, 41º16'N, 24º4'E, 28 July 1985, *Strid 24933* (G). **Greenland.** Kujalleq: Kangikitsoq, Tunerqat, 60º16'N, 44º14'W, 15 Aug. 1966, *Hansen 440* (BM); Kangerssuneq qingordleq, Ánivia, 60º19'N, 44º7'W, 8 July 1966, *Hansen 66-1089* (MO). **Hungary.** Heves: in Tarko ad Balanboinya Cottus Csik, 48º4'N, 20º28'E, 11 Aug. 1902, *Kummerle 289* (LE). **Iceland.** South: Stora Gja, Reykjahd, 64º1'N, 20º26'W, 19 July 1895, *Tylor s.n.* (CAS); Möðruvellir, 65º46'N, 18º15'E, 1903, *Davidson s.n.* (GH). **Ireland.** Leinster: Dublin Co., Dalkey, 53º16'N, 6º6'W, 1880, *Barrington s.n.* (DBN). **Italy.** Tuscany: Toscana, Pistoja, Corno alle Scale, 44º6'N, 10º49'E, 24 June 1873, *Marchesetti s.n.* (FI). Veneto: monte Baldo, Col Santo, 45º41'N, 10º49'E, 20 Aug. 2013, *Aedo 20891* (MA). **Kosovo.** Prizren: in subalpinis montis Shara Planina, 42º0'N, 20º45'E, July 1903, *Bierbach s.n.* (LE). **Liechtenstein.** pr. Malbun, Sareis, 47º6'N, 9º37'E, 5 Aug. 2018, *Aedo 26003* (MA). **Lithuania.** Vilnius: Litwa, Wysoki Dwór, 54º34'N, 24º31'E, 19 May

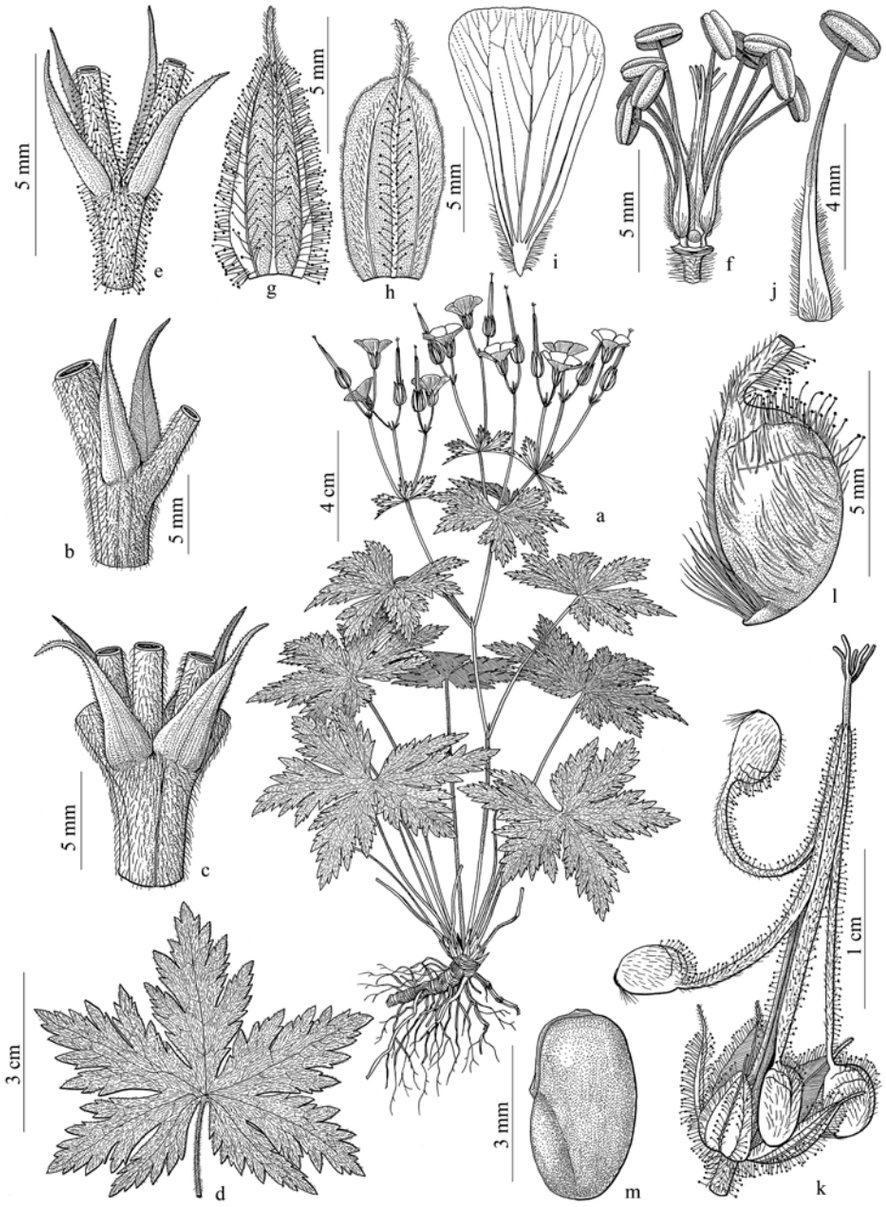


Fig. 113. *Geranium sylvaticum*. a. Habit. b, c. Stipules. d. Leaf. e. Bracteoles. f. Flower without petals and sepals. g, h. Sepals. i. Petal. j. Stamen. k. Fruit. l. Mericarp. m. Seed. (Based on: a, g-i, k-m, *Gil & Alejandre 858-91,* MA; b, c, *Losa & Montserrat s.n.,* MA-153485; d-f, j, *Valle s.n.,* MA-180476).

Fig. 114. *Geranium sylvaticum* (Based on: a, *Calvo 4800,* MA, photo: J. Calvo; b-d, *Aedo18431*, MA).

1887, *Kazimierz s.n.* (WA); Vilnae, 54°40'N, 25°12'E, 4 1893, *Symonowiczówna 149* (LE, WA). **Montenegro.** Žabljak: m. Durmitor, 43°8'N, 19°1'E, Aug. 1904, *Rohlena s.n.* (PR); Piva planina versus vicum Nedajno, 43°12'N, 18°59'E, 21 July 1933, *Sillinger s.n.* (PR). **North Macedonia.** Southwestern: NE von Debar, ob von Gorno Kosovrasti, 41°32'N, 20°34'E, 4 July 1976, *Krendl s.n.* (G). **Norway.** Spitsbergen, King's Bay, 78°55'N, 11°56'E, 6 July 1935, *Haley s.n.* (GH). Troms og Finnmark: Troms, pr. Skogsfjord, 69°56'N, 19°15'E, 2 Aug. 2016, *Aedo 24099* (MA); Cape North, 70°0'N, 23°30'E, 10 July 1922, *Kemp s.n.* (NY). Vestfold og Telemark: Telemark county, Notodden, Blefjell, Mt. Flaetebakkfjell, 59°46'N, 9°12'E, 6 June 2003, *Sunding s.n.* (MA). **Poland.** Lower Silesian: Slask Dolny, Dolina Bystrzycy, Dusznik-Zdroju do Zielenca, 50°24'N, 16°21'E, 11 June 1968, *Rostanski & Koziol 1065* (W). Podlaskie: Augustowskiew, Pollaskiew, 53°49'N, 23°8'E, 1826 (WA). **Romania.** Nord-Est Palanca, Mt. Macan, 46°32'N, 26°7'E, 1873, *Brandza s.n.* (P). Sud-Muntenia: Arges, muntii Fagarasului, 45°35'N, 24°37'E, 8 Aug. 2009, *Aedo 16778* (MA). **Russia.** Altay: Barnaul, Aleysskiy, 52°25'N, 82°45'E, 29 June 1913, *Krylov s.n.* (LE). Arkhangelsk: pr. Mesen, 65°51'N, 44°13'E, 13 June, *Ruprecht s.n.* (LE). Bashkiriya: Burzyan district, near village Islambayero, 53°24'N, 57°17'E, 3 Aug. 1952, *Muryseva s.n.* (M). Irkutsk: in viciniis pagum Taischet, ad ripam Taischetka, 55°56'N, 98°1'E, 23 June 1952, *Popov 4033* (BM, C, G, GH, H, LD, M, MO, NY, S, US, W). Kabardino-Balkaria: base of ski lift, Mt. Elbrus, Terskol, 43°17'N, 42°22'E, 15 July 1975, *Degener 33908* (MO, NY). Kaliningrad: Borussia orientalis, Instergurg, 54°38'N, 21°48'E, 13 June 1891, *Kuehn s.n.* (WA). Karachayevo-Cherkasskaiya: montes Bolsoj Kavkaz,

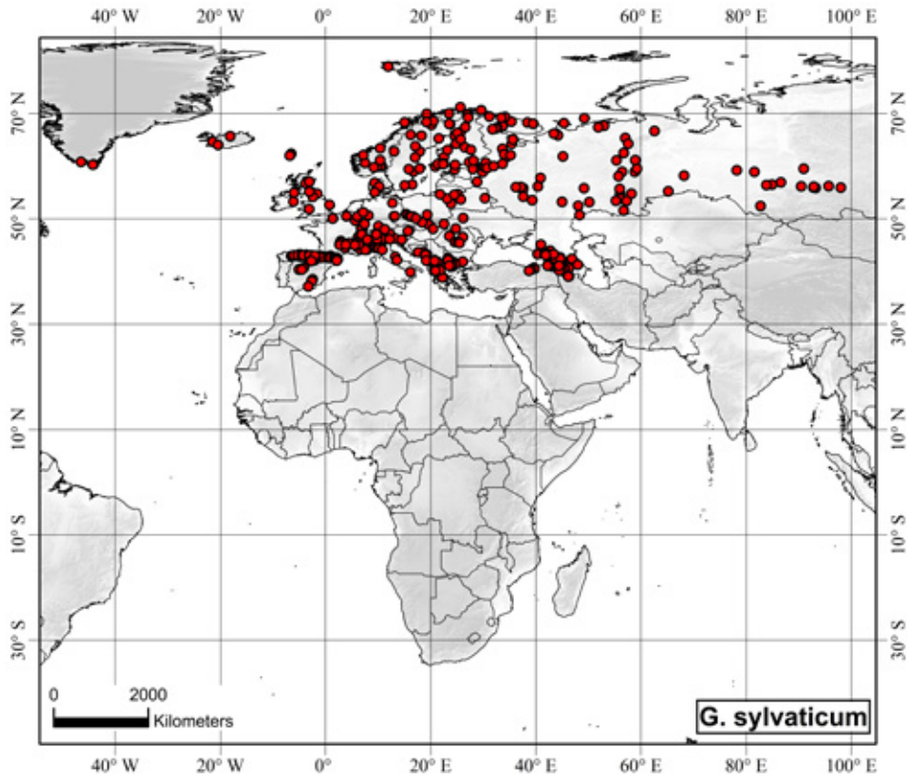


Fig. 115. Distribution of *Geranium sylvaticum*.

Teberdinskij zapovednik, montis Mussa-Acitara, 43°17′N, 41°39′E, 13 July 1976, *Stepánek s.n.* (PRC). Karelia: Petrosavodik, lacum Sandal, pago Tivdia, 62°23′N, 34°6′E, 5 June 1907, *Komarov s.n.* (LE). Komi: Urales del norte, cuenca del río Pechora, curso alto del río Shchugor, nacimiento del río Naiksorynia, 64°15′N, 57°35′E, 3 July 1928, *Sochava s.n.* (C). Kostroma: Kostroma, 57°45′N, 40°55′E, 15 June 1912, *Kossinsky 252* (LE). Krasnodar: Kubanskaya prov., upper river Kichkine-kola, 45°7′N, 40°58′E, 31 July 1907, *Busch 760* (MA). Krasnoyarsk: Yeniseiskaya prov., near Nazimovskoye, 59°30′N, 90°58′E, 14 July 1911, *Evseeva s.n.* (MA). Moscow: distr. Volokolansk, Chismena, 56°1′N, 36°12′E, 16 June 1990, *Skvortsov s.n.* (WU). Murmansk: near Kirovsk, 67°38′N, 33°40′E, 7 Aug. 2003, *Filimonova 96-03* (MA). Orenburg: Werchneuralsk, 51°34′N, 56°42′E, *Slorozow 154* (LE). Penza: Penza, 53°12′N, 45°0′E, 19 May 1915, *Sprygin 47* (LE). Pskov: Pskov, a 4 km al noroeste de los montes Pushkin, periferia norte del parque, aldea Trigorskoye, 57°3′N, 28°51′E, 5 July 1966, *Nepli 86* (C). Ryazan: Ranenburgskiy, 53°32′N, 39°19′E, 9 June 1926, *Savicz 128* (LE). Samara: Meshgu, 53°10′N, 50°10′E, 26 May 1920 (LE). Saratov: Kusneshkiy, 50°42′N, 48°20′E, 14 June 1910, *Stuckenberg s.n.* (LE). St. Petersburg: Leningradskaja oblast, Tosnenskij rajon, stan ija Sablino, Lesnoj, 59°38′N, 30°45′E, 10 July 1978, *Golubkova s.n.* (MA). Stavropol: carretera Kislovodsk- Karachaevsk km 43, 43°56′N, 42°44′E, 6 July 1976, *Goguina s.n.* (MO). Tatariya: Kazan, 55°48′N, 49°11′E, *Becher s.n.* (LE). Tula: Tula, 54°12′N, 37°37′E, 1812, *Steven s.n.* (H). Vladimir: Vladimir, 56°8′N, 40°24′E, 5 Aug. 1912, *Nasarow 1486* (LE). West Siberia: Tomsk, 56°30′N, 84°56′E, 9 July 1933, *Sergievskaya s.n.* (NY). **Slovakia.** Banská Bystrica: Brezno, Jaraba, 48°53′N, 19°42′E, 6 June 2010, *Calvo 4800* (MA). Prešov: montes Bukoské vrchy, Poloniny, ad rupes in summo montis Stinská supra pagum Zboj, 49°1′N, 22°32′E, 9 Sep. 1981, *Hadinec & Leps s.n.* (G). **Spain.** Cantabria: Campoo, Mazandrero, monte Gulatrapa, 42°58′N, 4°18′W, 2 July 1983, *Aedo s.n.* (MA). Granada: Sierra Nevada, Dehesa de la Hoya, 37°9′N, 3°16′W, 15 July 1979, *Hurtado & Saturio s.n.* (GDA). Lérida: Val d'Arán, Val de Montgarri, 42°45′N, 1°1′E, 15 June 2010, *Cano 5694* (MA). **Sweden.** Jämtland: Härjedalen, Storsjö, the Nea valley, Njuomeletjarve, 62°48′N, 13°4′E, 3 Aug. 1950, *Smith 1132* (MO). Norrbotten: Kiruna, 67°50′N, 20°10′E, 5 Aug. 1961 (L). **Switzerland.** Valais: La Fouly, pr. Orsieres, 45°56′N, 7°5′E, 17 Aug. 2013, *Aedo 20805* (MA). Vaud: Vals de Travers, 46°55′N, 6°40′E, 1 July 1956, *Comte 627* (MO). **Turkey.** Trabzon: Lazistan, vallée sous-alpine de Djimil, 40°40′N, 39°40′E, July 1866, *Balansa 1371* (G, P, US, W); Kars, SW side of Kisir dag, 40°58′N, 43°4′E, 3 July 1957, *Davis 30486* (BM). **Ukraine.** Ivano-Frankivsk: Verjovinsky, 48°9′N, 24°47′E, 25 July 1985, *Geltman 2033* (LE). Ternopil: Tschernigov, Surash, 50°8′N, 26°11′E, 28 May 1922, *Kreczetovicz 1233* (LE).

Discussion. Geranium sylvaticum has a horizontal rootstock, giving rise to an erect aerial stem with a ± deciduous rosette of leaves. The stem usually has an alternate leaf up to the first branch point of the inflorescence, where a pair of opposite leaves is always present. The inflorescence is dichasially branched, with 2-flowered cymules on the lower nodes and an aggregate of cymules toward the apex of each branch. In these aggregates, the peduncles are usually short or absent. Sometimes, a lateral branch arises from the node of the alternate leaf. The indumentum of *G. sylvaticum* usually comprises glandular and eglandular hairs on the inflorescence, while in the lower parts of the plant it is predominantly eglandular. Some individuals are, however, fully eglandular.

Gynodioecy is found in many populations of *G. sylvaticum* from northern Europe. The predominantly hermaphroditic populations included a variable proportion (less than 27%) of female plants (Asikainen & Mutikainen 2003). Female individuals have been excluded from the descriptions because they have short petals and reduced stamens with nonfunctional anthers, which could distort the range of variation of these characters. Korhonen & al. (2004) studied how light availability affects resource allocation in *G. sylvaticum*.

Geranium sylvaticum is quite similar to *G. albiflorum* in leaf division, while *G. caeruleatum*, *G. pseudosibiricum,* and *G. rivulare* have more deeply divided leaves. The differences between *G. sylvaticum* and the remaining species are addressed under each of them. This group of five species shares some important features with *G. erianthum*, *G. platyanthum,* and *G. reinii,* such as a similar inflorescence structure and the alternate leaf in the middle of the shoot. The latter are, however, well characterized by their staminal filaments with long hairs and by their fruit with a long narrowed apex.

According to Van Loon (1984b: 271) the chromosome numbers different to 2*n* = 28 attributed to *G. sylvaticum* should be confirmed.

The northernmost record of this species [Spitsbergen, King's Bay, 6 July 1935, *G. Haley s.n.* (GH)] has a doubtful status. According to A. Anderberg (*in litt*.), it may be a single adventive specimen or a mislabeling.

The Erianthum Group—This group shares some important features with the *Sylvaticum Group*, such as the presence of alternate cauline leaves, free stipules, the dichasially branched inflorescence, with 2-flowered cymules solitary or in aggregates toward the apex of each branch, the petals hairy only on the base, the staminal narrow filaments, without an expanded base, and the glabrous nectaries. However, they differ in the long hairs of the staminal filaments and the long narrowed apex of the fruit rostrum.

31. Geranium erianthum DC., Prodr. 1: 641. 1824. *Geranium pratense* var. *erianthum* (DC.) B. Boivin, Naturaliste Canad. 93: 1060. 1967. Type locality: "in Kamtschatkâ et Amer. bor. et occidentali. Nelson. (v. s.)". Type: U.S.A. Alaska, Newenham, 58°39′N, 162°10′W, *D. Nelson s.n.* (lectotype, designated by Aedo 2001b: 6, G-DC-215468!).

Geranium erianthum var. *elatum* Maxim., Prim. Fl. Amur.: 71. 1859. *Geranium elatum* (Maxim.) R. Knuth in Engl., Pflanzenr. IV.129 (Heft 53): 113. 1912. Type locality: "Hab. In der Nadelwaldregion des untern Amur: bei Ssutschu, 19 Juni, und bei Kitsi, 20 Juni 1855 (flor.), in Laubgehölzen häufig". Type: Russia. Amur, Ssutschu, 48°26′N, 134°32′W, 12 June 1855, *C.J. Maximowicz s.n.* (lectotype, designated by Tsyrenova 1985a: 1639, LE!).

Geranium eriostemon var. *orientale* Maxim., Bull. Acad. Imp. Sci. Saint-Pétersbourg 26: 464. 1880. *Geranium orientale*

(Maxim.) Freyn, Oesterr. Bot. Z. 52: 18. 1902, nom. illeg., non Mill. 1768. *Geranium gorbizense* Aedo & Muñoz Garm., Kew Bull. 52(3): 725. 1997, nom. nov. Type locality: "Mandshuria: ad Schilkam inferiorem, 70 stadia infra Gorbiza, in laricetis siccioribus frequens, medio Junio fl., ad Amur superiorem, silvis frondosis lapidosis montanis ad Tolbusino et Tschernäjewa frequens, ad Amur inferiorem, lucis pratisque humidis prope Kitsi, frequens, ad Usuri superiorem prope Dsiabigo in montibus lapidosis, fine Maji fl. incip., similibus locis secus fl. Li-Fudin, et circa portum S-tae Olgae, med. Junio fl. c. fr. immat.; Japonia: Nippon, ad rupes secus rivulos in alpe Niko (Tschonoski), prov. Senano (Tanaka, fide Franchet)". Type: Russia. Primorye, St Olga, 43º42'N, 135º14'E, 21 June 1860, *C.J. Maximowicz s.n.* (lectotype, designated by Novoselova 2004: 505, LE!).

Geranium erianthum f. *leucanthum* Takeda, Bot. Mag. (Tokyo) 24: 258. 1910. Type locality: "Hab. Yezo: in promontorio Tumoshiri prope Nemuro (H. Takeda! 12. VII. 1909); in herbosis Shunapaushi, prope oppid. Nemuro (H. Takeda! 5 et 10 VII. 1909)". Type: Japan. Hokkaidō, in herbosis Shunapaushi, prope Nemuro, 43º19'N, 145º34'E, 5 July 1909, *H. Takeda s.n.* (lectotype, designated by Aedo 2001b: 7, BM-000047187!).

Geranium subumbelliforme R. Knuth in Engl., Pflanzenr. IV.129 (Heft 53): 123. 1912. Type locality: "Japan: Gipfel des Rishiri (Faurie n. 3103!), Rebunshiri (Faurie n. 3104!)". Type: Japan. Hokkaidō, Rishiri, 45º10'N, 141º14'E, 25 July 1899, *U. Faurie 3103* (lectotype, here designated, MA-699079!; isolectotype, P-00757933!).

Geranium erianthum f. *albiflora* Kom., Fl. Kamtschatka 2: 295. 1929. Type locality: "Paratunka near Nikolaevskaya Bolsheretzka villages, 21 VII 1908, V. Komarov" [in Russian]. Type: Russia. Kamchatka, Paratunka river basin, Nikolaevskaya village, 52°57'N, 158°14'E, 8 [21] July 1908, *V. Komarov s.n.* (lectotype, here designated, LE!; choice made by M. Novoselova, in sched.).

Geranium erianthum f. *alpestris* Kom., Fl. Kamtschatka 2: 295. 1929. Type locality: "1908, 1. 17 VIII Shapochka; 2. 23 VIII Ranges Krasny; 3. 13 IX, Chemushka.- 1909, 1. 1 IX Hills Krasheninnikova; VII 1909 Cape Lopatka; 31 VII 1908 Kluchevskaya, V. Komarov" [in Russian]. Type: Russia. Kamtschatka, Kronotskoe lake basin, Krasheninnikova mountains, 50°17'N, 155°20'E, 19 Aug. [1 Sep] 1909, *V. Komarov s.n.* (lectotype, here designated, LE!; choice made by M. Novoselova, in sched.).

Geranium erianthum var. *angustifolium* Miyabe & Tatew., Trans. Sapporo Nat. Hist. Soc. 14: 263. 1936. Type locality: "Hab. S. Saghalien. Distr. Shikka: The upper Ennai (M. Kawashima, VII. 28, 1935)". Type: Russia. Sakhalin, Shikka [Poronaisk], Ennai, 49°13'N, 143°05'E, 28 July 1935, *M. Kawashima s.n.* (lectotype, here designated, SAPS image!).

Geranium pratense f. *leucanthum* B. Boivin, Phytologia 23: 136. 1972. Type locality: "W.B. Schofield 2489, Alaska, Cold Bay". Type: U.S.A. Alaska, Cold Bay, 55°11'N, 162°43'W, 28 July 1952, *W.B. Schofield 2489* (holotype, DAO-000424307 image!).

Perennial herbs, 10-50 cm tall. *Rootstock* 5-10 mm in diameter, ± horizontal, not tuberculate, not turnip-shaped, with thickened roots along the rootstock. *Stem* erect, leafy, not rooting at nodes, stolons absent, without vegetative stems, with retrorse, appressed, eglandular hairs 0.2-0.6 mm long. *Basal leaves* in a ± persistent rosette, cauline leaves alternate (1-2) and upper opposite; leaf laminas (4.8)6.2-8.9(11.7) cm long, 4.5-15 cm wide, not peltate, palmatifid [ratio main-sinus length/middle segment length = (0.80)0.82-0.91], polygonal in outline, base cordate, not coriaceous, with nerves not projected, pilose, with appressed, eglandular hairs on both surfaces; segments 7, in 1 plane, middle segment rhombic, (4.4)6.3-10(16.9) mm wide at the base [ratio segment width at the base/middle segment length = (0.10)0.13-0.18(0.22)], 10-34-lobed in distal half [ratio secondary sinus length/middle segment length = (0.19)0.21-0.27(0.36)]; petioles up to 24 cm long, without abscission zone, terete, not swollen, not deflexed in age, with retrorse, appressed, eglandular hairs 0.2-0.5 mm long; stipules 5-14 mm long, 1.3-4.5 mm wide, lanceolate, free, papery, brown, with eglandular hairs on abaxial surface and on the margin, glabrous adaxially. *Inflorescence* a dichasial cyme; cymules 2-flowered, solitary or in aggregates at the top of each branch [ratio cymule length/leaf length = (0.8)1.1-1.7]; peduncles (11)17-31(55) mm long, with patent to retrorse, eglandular hairs 0.2-0.6 mm long and, rarely, patent, glandular hairs 0.5-1.9 mm long; bracteoles 1.5-3.7 mm long, 0.4-1 mm wide, lanceolate, whorled; pedicels (3.2)6-8(18) mm long, with patent to retrorse, eglandular hairs 0.2-0.6 mm long and, usually, patent, glandular hairs 0.3-2.5 mm long. Flowers actinomorphic. *Sepals* (6.3)6.9-8.3(10.5) mm long, 2.5-5.1 mm wide, lanceolate, smooth, not accrescent, nerves 3-5, mucro (0.9)1.2-2(2.7) mm long [ratio mucro length/sepal length = 0.14-0.32], with antrorse, appressed, eglandular hairs 0.2-0.8 mm long and patent, glandular hairs 0.3-2 mm long on the abaxial surface, glabrous adaxially. *Petals* (12)12.8-18(20) mm long, (7)7.5-10(15) mm wide, erect-patent, rounded, without claw, purple, glabrous on the adaxial surface, hairy on the base of the abaxial surface, ciliate on the basal margin, with hairs 0.3-1 mm long. *Stamens* 10, both whorls bearing anthers; filaments (8.3)9.7-10.5(11.3) mm long, lanceolate, dark purple, pilose on the abaxial surface, ciliate on the proximal half, with hairs 1.5-3.2 mm long; anthers (2.1)2.2-2.6(3) mm long, blue. Nectaries 5, hemispheric, glabrous. *Gynoecium* 8.8-10 mm long, purple. *Fruit* 27-37 mm long, erect, discharge of seed-ejection type; mericarps 3.5-4.4 mm long, 2-2.5 mm wide, without a strand of fibers, not compressed at the apex, smooth, without basal beak, with a basal callus, without a basal prong, brown, with ± patent, eglandular hairs 0.1-1.1 mm long and patent, glandular hairs 0.8-1.4 mm long; rostrum 22-30 mm long, with a narrowed apex 5-7.4 mm long, not twisted, with ± patent, eglandular hairs 0.1-0.3 mm long and patent, glandular hairs 0.7-1.3 mm long; stigmatic remnants 1.6-2.3 mm long, with 5 glabrous lobes. *Seeds* 2-2.9 mm long, 1.7-1.8 mm wide, finely reticulate, uniformly colored, brown, glabrous. Cotyledons with entire margin. Fig. 116.

Pollen. *Geranium*-type (Aedo 2001a: 17; Lu & al. 1996: 320; Park & Kim 1997: 311).

Chromosome number. 2*n* = 28, 28+1-2B, 30.

Phenology. Collected in flower from June to September.

Distribution. This species ranges from eastern Siberia, northern Japan and northeastern China to northwestern America (Alaska and western Canada) (Fig. 117).

Habitat. Sandy grassy beaches, rocky shores, bogs, meadows, and alpine slopes; 0-2400 m.

Representative specimens examined. **Canada.** British Columbia: 9-Mile Mountain, Hazelton, 54º35'N, 128º0'W, 5 Aug. 1940, *McCabe 8160* (WTU); mi 38 along the Nilkitwa Forest, 55º14'N, 126º38'W, 22 July 1974, *Krajina & al. 1974* (DAO); Chilkat Pass, 59º41'N, 136º33'W, 17 July 1973, *Douglas 6017* (DAO); Haines road, mi 83, 59º50'N, 137º0'W, 6 July 1956, *Taylor & al. 926* (DAO). Yukon: Haines road km 86, Klehini River valley, 59º33'N, 136º31'W, 25 June 1979, *Douglas 11016* (WTU); Cassiar Mountains, near the Smart River Creek, 60º5'N, 131º30'W, 27 July 1952, *Poole s.n.* (DAO); Bulion Creek, 60º58'N, 138º36'W, 24 June 1970, *Pearson & Porsild 5996* (DAO). **China.** Heilongjiang: ciudad Shuang Yashan, montaña Hengtou Shan, 44º17'N, 127º54'E, 1 June 1996, *Lin 6105* (MO). **Japan.** Hokkaidō: falaises de Toi à 6 lieues d'Hakodaté, 41º43'N, 140º59'E, 29 July 1890, *Faurie 5767* (P); Ishikari province, National Park Daisetsu, Mt. Hakuum-dake, 43º25'N, 142º39'E, 30 July 1960, *Furuse s.n.* (GH); Rebun Is., Kahuhan, Momoiwa, 45º21'N, 141º0'E, July 1944, *Yamazaki 4609* (TI). Honshū: Rikuchu, 39º12'N, 141º43'E, 1 Aug. 1926, *Okada 1963* (GH); Iwate prefecture, Mts. Hayachine, Odagoe, Mt. Nakadake, 39º33'N, 141º29'E, 24 July 1978, *Murata & al. 5860* (TI); Aomori prefecture, Mutsu province, Mt. Hakkoda, Kushigamine, 41º19'N, 141º2'E, 25 July 1979, *Yamanaka & al. s.n.* (TI). **Russia.** Amur: Amurrskaia obl., 54º0'N, 128º0'E, 31 July 1956, *Socava & Lipatova s.n.* (C); Buryatiya: Jabarovskii kraj., Okrestnosti Sovetskoj Gavani, Jvojnuij les, 51º50'N, 107º42'E, 1 Sep. 1960, *Egorova & Voroshilov 9977* (C); Chita: Chitinskaya province, Jeltulaksky reg., Amur river bassin, gorge Orly, 52º0'N, 117º0'E, 22 June 1939, *Dukeovskaya s.n.* (MA). Kamchatka: cape Lopatka, 50º52'N, 156º39'E, 22 June 1920, *Hultén 88* (LE); Kluchevskoy volcano, at volcanologist station, 56º9'N, 160º48'E, 17 July 2003, *Farjon & Brummitt 558* (NY); Olyoutorskiy district, vicinity of village Tilichyki, 60º28'N, 166º5'E, 8 July 1974, *Kharkevich & al. 582a* (MO, NY). Khabarovsk: Nanayskiy district, basin of Anyuy river, Mt. Tardoki-Yani, 48º22'N, 137º22'E, 22 July 1983, *Kharkevich & al. 582* (MO); pueblo Mariinskoye, distrito Ulchskiy, 51º43'N, 140º11'E, 12 June 1976, *Baybatina s.n.* (VLA); Ayano-May-ski district, left rocky bank of Maya river, 56º0'N, 137º0'E, 21 June 1978, *Kharkevich & al. 582b* (MO, NY). Kuril Is.: Shikotan Is., Chiboi, 43º50'N, 146º54'E, 10 Aug. 1929, *Kondo s.n.* (TI); Chishima, Urup Is., 45º54'N, 149º56'E, 12 July 1983, *Yamazaki s.n.* (TI); Paramushir, 3 km S of Severo-Kurilsk, 50º37'N, 156º7'E, 1 Aug. 1996, *Gage & Semsrott BS0014* (MA). Magadan: Ola, Uzpedka, 59º36'N, 151º16'E, 12 Aug. 1970, *Dorogostayskaya s.n.* (LE); Cukotskiy, Anacuirskiy rajon, Raruitkin, r. Lesnoy, 61º49'N, 156º14'E, 5 July 1977,

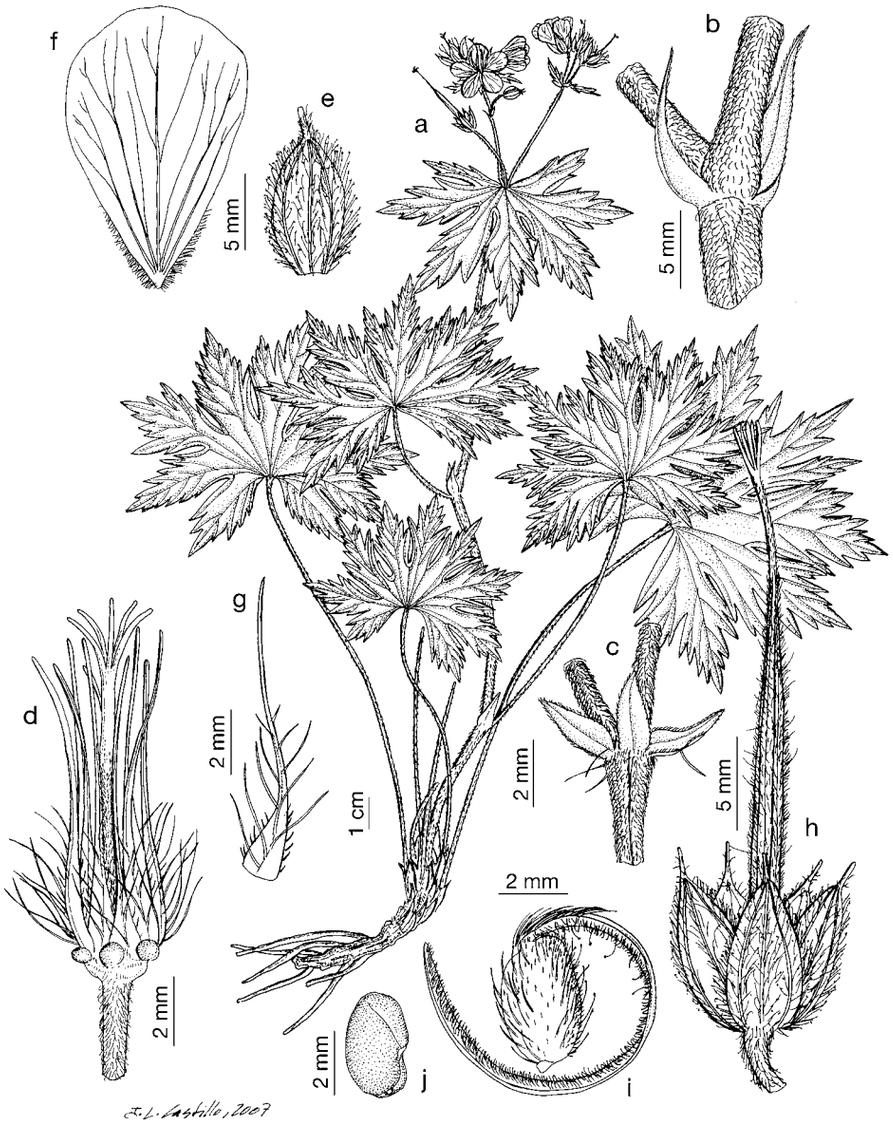


Fig. 116. *Geranium erianthum*. a. Habit. b. Stipules. c. Bracteoles. d. Flower without petals and sepals. e. Sepal. f. Petal. g. Staminal filament. h. Fruit. i. Mericarp. j. Seed. (Based on: a-c, *Kobayashi s.n., 2 July 1931,* TI; d-g, *Gage & Semsrott 14,* MA; h-j, *Togashi s.n., 6 Jul 1970,* TI).

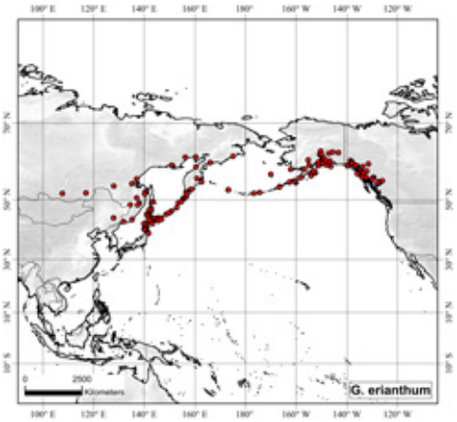


Fig. 117. Distribution of *Geranium erianthum*.

Basilbeva & al. s.n. (LE); Anastasia, 62º5'N, 175º5'E, 30 Aug. 1922, *Igawa s.n.* (TI). Primorye: Primorskaya oblast, poberechye Tatarskago proliva, Imperatorskaya Gavan, Sapadnaya ili Konstantinnovskaya, 43º6'N, 131º51'E, June 1907, *Palczewsky s.n.* (LE); Chabarovsk, district Bogorodskoe, pr. pagum Bystrinsk, 52º22'N, 140º26'E, 4 Aug. 1969, *Sohaga s.n.* (TI). Sakhalin: in herbidis Korsakof, 46º37'N, 142º46'E, July 1908, *Faurie 767* (P); central Sachalin, Taraika, 49º18'N, 143º20'E, 16 Aug. 1940, *Honda & al. s.n.* (TI). **USA.** Alaska: Prince of Wales-Outer Ketchikan, Fish Creek, beyond Hyder, 55º55'N, 130º1'W, 29 June 1924, *Whited 1294* (MO); Skagway-Angoon-Hoonah, Windham Bay, 57º34'N, 133º27'W, 28 July 1905, *Culberton & al. 4945* (MO); Bristol Bay, Naknek, 58º43'N, 157º0'W, 3 July 1952, *Schofield 1938* (DAO); Yakutat, Monterrey y Notka [probably from Puerto Mulgrave], 59º34'N, 139º47'W, *"Née s.n."* (MA); Denali, McKinley National Park, Copper Mt. Camp, 63º24'N, 150º21'W, 15 July 1928, *Mexia 2097* (MO). Aleutian Is.: Aleutians West, Adak Is., hillside behind enlisted Navy personnel Barracks, 51º52'N, 176º39'W, 7 July 1974, *Hein 106* (MO); Aleutians West, Unalaska Is., 53º40'N, 166º38'W, 25 July 1921, *Kubayashi s.n.* (TI); Aleutians West, Pribilof Is., St. Paul, 57º19'N, 170º2'W, 29 July 1897, *Tkuneais s.n.* (WTU).

Discussion. Geranium erianthum is a robust perennial species, easily recognized by its cauline leaves alternate at one or, occasionally, two middle nodes that become opposite toward the inflorescence, its dichasial inflorescence ending in umbel-like aggregates at the apex of each branch, its long hairs on staminal filaments, and its eglandular and retrorse-appressed indumentum on the stem and petioles. It is the only Asian species also present on the eastern side of the Bering Strait. I agree with Novoselova (1999) who included *G. elatum*, *G. orientale,* and *G. subumbelliforme* in the synonymy of *G. erianthum*. An alternate view is that of Tsyrenova (1985a, 1985b, 1986), who distinguished these taxa as species, mainly at the base of leaf shape.

As Yeo (1992) pointed out, *G. erianthum* is quite similar to *G. platyanthum,* as both present dark purple staminal filaments covered with long hairs. However, *G. erianthum* differs in having lower stems with retrorsely appressed eglandular hairs, as well as the more deeply divided and more acutely and profusely lobed and toothed leaves. The main and the second sinuses are deeper, and the middle segment is narrower at the base. Additionally, the sepal mucro is longer in *G. erianthum*, and the hairs of the stem and of the staminal filament are shorter. Usually, *G. erianthum* has glandular hairs restricted to the inflorescence. *Geranium platyanthum* is endemic to mainland East Asia, where *G. erianthum* also occurs. *Geranium erianthum* is also close to *G. sylvaticum*, since both share a similar inflorescence structure, alternate cauline leaves, and a similar petal indumentum. Nonetheless, *G. erianthum* has a longer narrowed apex of the rostrum and longer eglandular hairs on the staminal filaments than those that are found in *G. sylvaticum*.

32. Geranium platyanthum Duthie, Gard. Chron. ser. 3 39: 52. 1906. Type locality: "Plants were raised last summer by Messrs. J. Veitch and Sons from seed collected by Mr. Wilson in W. Hupeh (No. 1948), and near Ta chien lu in W. China (No. 3298)". Type: China. Hubei, Patung, 31°01'N, 110°19'E, cultivated at Kew from *E.H. Wilson 1948* (lectotype, designated by Yeo 1992: 176, K-00729462!; isolectotypes, A-0043670!, E-00216045!, HBG-510966 image!, LE!, NY!, P!, W!).

Geranium eriostemon Fisch. ex DC., Prodr. 1: 641. 1824, nom. illeg., non Poir. 1812. Type locality: "in betuletis Dahuriae". Type: Russia. Irkust, in betuletis apud Bouretas, in Dahuria, 52º59'N, 103º30'E, *F.E. Fischer s.n.* (lectotype, designated by Yeo 1992: 177, G-DC-215474!; isolectotypes, B destroyed, K-000729474!, P-00712147!).

Geranium eriostemon var. *caeruleum* Sweet, Geraniaceae 2, tab. 197a. 1824. Type locality: "Several plants of this species were raised in the autumn of 1822, at the Nursery of Mr. Colvill, from seeds that had been received from Dr. Fischer under the name that we have adopted, but of what country they were native nothing was said. One of those plants flowered, from which the figure with the dark blue flowers was taken". Type: Cultivated from seeds sent by Fischer (no original material located); Sweet, Geraniaceae 2, tab. 197a. 1824 (lectotype, here designated).

Geranium eriostemon var. *hypoleucum* Nakai, Bot. Mag. (Tokyo) 26: 256. 1912. *Geranium eriostemon* f. *hypoleucum* (Nakai) Y.C. Zhu, Pl. Medic. Chinae Bor.-Orient. 642. 1989. Type locality: "Korea: Kanto, Kakokusirei 8. VII. 1909 (K. Hatta)". Type: China, Jilin, Manchuria, Kanto, Kakokusirei, 41°51'N, 123°53'E, 8 July 1909, *unknown collector 17* (lectotype, here designated, TI-00011253 image!).

Geranium eriostemon var. *megalanthum* Nakai, Bot. Mag. (Tokyo) 26: 257. 1912. *Geranium eriostemon* f. *megalanthum* (Nakai) Y.C. Zhu, Pl. Medic. Chinae Bor.-Orient.: 642. 1989. Type locality: "Korea: Chöng-zin 15. VI. 1909. (T. Nakai)". Type: North Korea. Sungjin, 41°54'N, 129°24'E, 15 June 1909, *T. Nakai s.n.* (lectotype, here designated, TI-00011257!).

Geranium eriostemon var. *glabrescens* Nakai in H. Hara, J. Jap. Bot. 22: 171. 1948. *Geranium onoei* var. *glabrescens* (Nakai) Yonek., J. Jap. Bot. 80: 326. 2005. Type locality: "Korea: Shajippo, Kannan (T. Nakai, no. 15565, Aug. 18, 1935)". Type: North Korea. Shajippo, Kannan, 40°20'N, 127°33'E, 18 Aug. 1935, *T. Nakai 15565* (lectotype, here designated, TI-00011252 image!).

Perennial herbs, 29-66 cm tall. *Rootstock* 6-11 mm in diameter, ± horizontal, not tuberculate, not turnip-shaped, with thickened roots along the rootstock. *Stem* erect, leafy, not rooting at nodes, stolons absent, without vegetative stems, with patent, eglandular hairs 0.6-1.5 mm long and, usually, patent, glandular hairs 0.4-1 mm long. *Basal leaves* in a ± persistent rosette, cauline leaves alternate (usually 1) and upper opposite; leaf laminas (4.8)6.2-10.5(13.8) cm long, 6.4-16.8 cm wide, not peltate, palmatifid [ratio main-sinus length/middle segment length = 0.60-0.75(0.78)], polygonal in outline, base cordate, not coriaceous, with nerves not projected, pilose, with appressed, eglandular hairs on both surfaces; segments 5, in 1 plane, middle segment rhombic, (10.5)17-23(34) mm wide at the base [ratio segment width at the base/middle segment length = (0.26)0.29-0.36(0.44)], (6)13-17(23)-lobed in distal half [ratio secondary sinus length/middle segment length = (0.08)0.10-0.15(0.18)]; petioles up to 25 cm long, without abscission zone, terete, not swollen, not

deflexed in age, with patent, eglandular hairs 0.4-1.7 mm long and, usually, patent, glandular hairs 0.5-1.2 mm long; stipules 4.9-12 mm long, 1.6-3.3 mm wide, lanceolate, free, papery, brown, with eglandular hairs on abaxial surface and on the margin, glabrous adaxially. *Inflorescence* a dichasial cyme; cymules 2-flowered, solitary or in aggregates at the top of each branch [ratio cymule length/leaf length = (0.7)1.2-2]; peduncles (16)22-41(54) mm long, with patent to retrorse, eglandular hairs 0.3-1.3 mm long and, usually, patent, glandular hairs 0.4-1 mm long; bracteoles 0.7-4.2 mm long, 0.4-0.9 mm wide, linear-lanceolate, whorled; pedicels (2.8)8-13(16.8) mm long, with patent to retrorse, eglandular hairs 0.3-1.4 mm long and patent, glandular hairs 0.3-1.1 mm long. Flowers actinomorphic. *Sepals* (6.4)6.9-9.3(10.8) mm long, 2.8-4 mm wide, lanceolate, smooth, not accrescent, nerves 3-5, mucro (0.4)0.8-1.4(1.6) mm long [ratio mucro length/sepal length = 0.06-0.19], with antrorse, appressed, eglandular hairs 0.2-1.2 mm long and patent, glandular hairs 0.5-1.8 mm long on the abaxial surface, glabrous adaxially. *Petals* (10)12-18(19.1) mm long, (7.6)8.8-11.1(16.2) mm wide, erect-patent, rounded, without claw, purple or white, glabrous on the adaxial surface, hairy on the base of the abaxial surface, ciliate on the basal margin, with hairs 0.5-1.3 mm long. *Stamens* 10, both whorls bearing anthers; filaments (7.1)9.9-11.6(14.9) mm long, lanceolate, dark purple, pilose on the abaxial surface, ciliate on the proximal half, with hairs 2-3 mm long; anthers 2.3-2.8(2.9) mm long, blue. Nectaries 5, hemispheric, glabrous. *Gynoecium* 8.9-13.1 mm long, green to dull red. *Fruit* (28)30-37(40) mm long, erect, discharge of seed-ejection type; mericarps 3.4-4.5 mm long, 1.9-2.5 mm wide, without a strand of fibers, not compressed at the apex, smooth, without basal beak, with a basal callus, without a basal prong, brown, with ± patent, eglandular hairs 0.1-1.4 mm long and patent, glandular hairs 0.6-0.9 mm long; rostrum 23-34 mm long, with a narrowed apex 4.8-9.8 mm long, not twisted, with ± patent, eglandular hairs 0.1-0.5 mm long and patent, glandular hairs 0.4-0.8 mm long; stigmatic remnants 2.1-2.6 mm long, with 5 glabrous lobes. *Seeds* 2.6-3.2 mm long, 1.5-1.9 mm wide, finely reticulate, uniformly colored, brown, glabrous. Cotyledons with entire margin. Fig. 118.

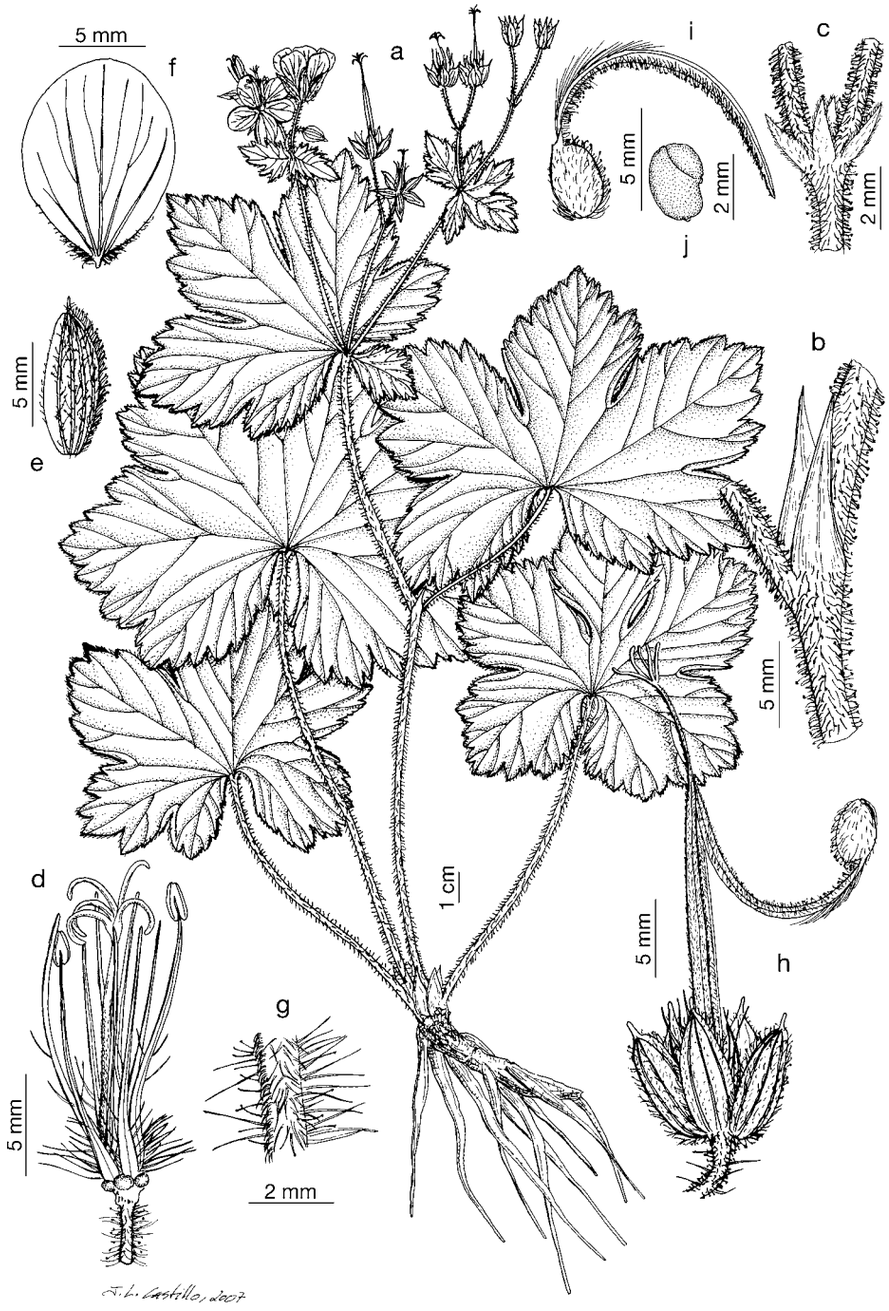


Fig. 118. *Geranium platyanthum.* a. Habit. b. Stipules. c. Bracteoles. d. Flower without petals and sepals. e. Sepal. f. Petal. g. Indumentum of peduncle. h. Fruit. i. Mericarp. j. Seed. (Based on: a-g, *Kazuo 16454,* TI; h-j, *Rock 12920,* E).

Pollen. *Geranium*-type (Bortenschlager 1967: 455 [sub *G. eriostemon*]; Lu & al. 1996: 320 [sub *G. eriostemon*]; Park & Kim 1997: 311; Tan & al. 1996: 210 [sub *G. eriostemon*]).

Chromosome number. 2*n* = 28.

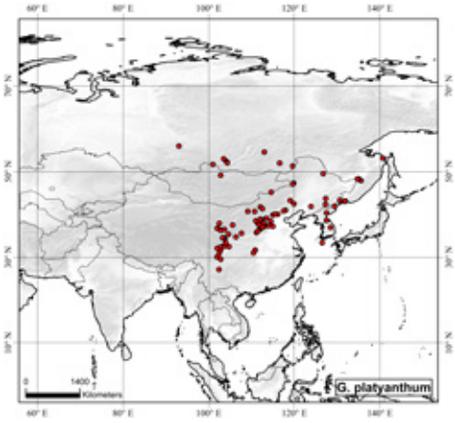


Fig. 119. Distribution of *Geranium platyanthum*.

Phenology. Collected in flower from May to September.

Distribution. This species ranges from eastern Siberia to Mongolia, central and northeastern China and Korea (Fig. 119).

Habitat. Roadsides, moist meadows, banks of stream, rocky slopes and forest edges of *Acer* L., *Carpinus* L., *Larix* Mill., *Prunus* L., *Quercus* L. and *Taxus* L.; 900-3200 m.

Representative specimens examined. **China.** Gansu: Wen Xian, Motianling Shan, Baishui Jiang Nature Reserve, Liujiaping region, Dalingliang, 32°28'N, 104°46'E, 16 May 2007, *Boufford & al. 37688* (GH, MA); SW Kansu, T'ao River basin, SE Choni, Toyuku, 34°31'N, 103°15'E, July 1925, *Rock 12920* (E); ciudad Lanzhou, distrito Yuzhong, montaña Xinglongshan, 36°28'N, 103°44'E, 2 July 1993, *Li Hua 106* (MO). Hebei: ciudad Xingtai, distrito Julu, pueblo Hongshuikou, 37°12'N, 115°1'E, 9 May 1935, *Liu Ying 10360* (MO); Tschili, Hsian Wu vai schan, Yang-kia-p'ing, Tung-lin, 40°0'N, 115°30'E, 5 Sep. 1921, *Smith 198* (UPS); Beijing city, Mentougou district, Dongling Shan, 40°2'N, 115°28'E, 18 July 1996, *Boufford & al. 27131* (GH); Tung Ling, montaña Wu Ling Shan, 40°47'N, 117°30'E, Aug. 1935, *Liu 11742* (IBSC). Heilongjiang: Hingan, 49°30'N, 126°45'E, 3 July 1925, *Dorsett 3572* (GH); Hubei: Po hua shan, 31°40'N, 110°52'E, July 1905, *Schindler 80* (E). Jilin: ciudad de Baishan, población Fusong, pueblo Manjiang, montaña Chang Baishan, 42°22'N, 127°18'E, 19 June 1962, *Temperate Forest Exped. 124* (PE); distrito Yanbian, ciudad Huichun, pueblo Chunhua, Du Huang Zi, 43°22'N, 130°40'E, 11 July 1959, *Fu Peiyun 679* (PE). Nei Mongol: ciudad Huhehaote, montaña Daqing Shan, 40°40'N, 110°45'E, 30 June 1991, *Student Group 27* (MO); Chahar, 41°18'N, 112°33'E, 4 July 1936, *Wu & Yang 2691* (PE). Ningxia: Shikong, Bao-Hsin, Moupin, 37°31'N, 105°36'E, July 1939, *Hu 1226* (GH). Qinghai: Qilian Mts., Xigou forest factory, Minhe Xian, 36°16'N, 102°49'E, 14 July 1989, *Ho 619* (CAS); Huzhu Xian, Beishan forest factory, Xiaozhanonggou, 36°43'N, 102°0'E, 6 July 1991, *Ho Ting-nong 1723* (CAS). Shaanxi: Hobei, Mt. Hsiao-Wutai, 39°4'N, 113°33'E, 31 July 1906 (TI). Shanxi: distrito Hong Tong, Mai Shan Gu, 36°15'N, 111°40'E, 27 June 1959, *Guan Chen 794* (PE); ciudad Xinzhou, distrito Ningwu, montaña Guan Cen, 38°53'N, 112°8'E, 11 July 1983, *Liu Tian Wei 1170* (MO). Sichuan: Thibet oriental, Ta-tsien-lou, principauté de Kiala, 30°3'N, 101°58'E, 1893, *Soulié 605* (P); distrito Aba, población Jiuzhaigou, 33°20'N, 103°59'E, 8 June 1963, *Lang Kai Yong & al. 1668* (KUN). **Mongolia.** Bulgan: collibus 6 km S vico Unt, 65 km NW ab oppidum Bulgan, 49°8'N, 102°49'E, 11 Aug. 1965, *Beyl & Soják 2967* (PR). Dornod: Sapadnuie otrogi B. Jingana Gora Jan-Candman'-ula, 47°5'N, 119°40'E, 1 July 1987, *Budanciev & al. 877* (LE). **North Korea.** fluvium Jumin-gan, prov. Cham-gion, 28 May 1897, *Komarov 1000* (GH). Kangwon: Taebaek city, Mt. Daesung, 38°36'N, 127°32'E, 30 May 1996, *Yamazaki 8016* (TI). **Russia.** Buryatiya: distritus Tunkin, pr. pagum Mondy, 51°40'N, 100°59'E, 14 July 1963, *Kozhevnikova s.n.* (TI); Czita, in sylva pr. acidulas Molokovsk haud procul ab opp. Czita, 54°33'N, 113°0'E, 13 July 1906, *Stukov 2940a* (G). Chita: Nertschinsky Zavod, 51°18'N, 119°37'E, 1819, *Fischer s.n.* (G); Plantae Dahuricae, Nertschinsk, 51°59'N, 116°33'E, 1889, *Karo 93* (LD, MA). Irkutsk: Zun-Murino stationary, 52°2'N, 104°21'E, 15 July 1975, *Hara s.n.* (TI); Irkutsk, 52°17'N, 104°17'E, *Augustinowiz s.n.* (G, P). Khabarovsk: pueblo Poletnoye, distrito Lazo, 47°53'N, 135°36'E, 20 June 2006, *Lenshin s.n.* (VLA); Krasnojarsk, 55°58'N, 93°3'E, 1844, *Turczicanov s.n.* (P). Primorye: insulae Nordenskljöldovy ostrovy, in insula Russkij Ostrov, 43°1'N, 131°50'E, 1920, *Liebus s.n.* (PR); circa Vladivostok, 43°7'N, 131°55'E, 1 May 1930, *Palczewsky 1000* (TI). **South Korea.** Jeju: Chejudo, Mt. Halla, 33°21'N, 126°31'E, 10 Aug. 1936, *Kazuo 16454* (TI). North Gyeongsang: Chungbak, Danyang-kun, Gagok-myon, Mt. Sobaek, 36°56'N, 128°27'E, 18 June 1999, *Chong-Wook Park & al. 10462* (KUS).

Discussion. Geranium platyanthum is a robust perennial plant that shares with *G. erianthum* and *G. reinii* its cauline leaves that are alternate at one or, occasionally, two middle nodes but become opposite toward the inflorescence, its dichasial inflorescence ending in umbel-like aggregates at the apex of each branch and its long hairs on staminal filaments. The differences between *G. erianthum* and *G. platyanthum* have been addressed under the first species. *Geranium platyanthum* is quite similar to the Japanese *G. reinii* with regard to the indumentum of the stems and petioles; both species share long, patent glandular and eglandular hairs on these organs. Their leaves, however, differ significantly. Leaves of *G. reinii* are more deeply divided because the main and second sinuses are deeper. In addition, the main segment is narrower at the base in *G. reinii*. Although with some overlap, sepals, sepal mucro, staminal hairs, mericarp hairs, and stigmatic remnants are shorter in *G. platyanthum* than in *G. reinii*.

33. Geranium reinii Franch. & Sav., Enum. Pl. Jap. 2: 304. 1878. *Geranium eriostemon* var. *reinii* (Franch. & Sav.) Maxim., Bull. Acad. Imp. Sci. Saint-Pétersbourg 26: 464. 1880. Type locality: "Hab. in monte Ibouki yama, insulae Nippon, ubi detexit cl. Rein (Savatier, n. 3678)". Type: Japan. Honshū, monte Ibouki yama, 35°25'N, 136°24'E, *P.A. Savatier 3678* (lectotype, designated by Knuth 1912: 122, P!).

Geranium onoei Franch. & Sav., Enum. Pl. Jap. 2: 303. 1878, ["Onaei"]. *Geranium eriostemon* var. *onoei* (Franch. & Sav.) Nakai, Bot. Mag. (Tokyo) 26: 255. 1912. *Geranium eriostemon* f. *onoei* (Franch. & Sav.) H. Hara, J. Jap. Bot. 22: 171. 1948. Type locality: "Hab. in provinciâ Senano, unde ex botanico Japonensi Ono accepit Dr Savatier (n. 2813)". Type: Japan. Honshū, Senano, 36°00'N, 138°00'E, *M. Ono & P.A. Savatier 2813* (lectotype, designated by Aedo 2017a: 24, P!).

Geranium eriostemon f. *yezoense* H. Hara, J. Jap. Bot. 22: 171. 1948. *Geranium onoei* f. *yezoense* (H. Hara) Yonek., J. Jap. Bot. 80: 325. 2005. Type locality: "Hokkaido: prope Sapporo (K. Miyabe, Jun. 21, 1892)". Type: Japan. Hokkaidō, prope Sapporo, 43°03'N, 141°20'E, 21 June 1892, *K. Miyabe s.n.* (lectotype, designated by Aedo 2017a: 24, GH-00351567!; isolectotype, NY!).

Geranium eriostemon f. *albiflorum* N. Yonez. J. Phytogeogr. Taxon. 29(2): 110. 1981. *Geranium onoei* f. *albiflorum* (N. Yonez.) Yonek., J. Jap. Bot. 80: 325. 2005. Type locality: "Hab. Mt. Kitadake, Ashiyasu-mura, Nakakoma-gun, Yamanashi Pref. (N. YONEZAWA; Aug. 5, 1981; Holotypus in KANA no. 100739)". Type: Japan. Honshū, Yamanashi, Nakakoma-gun, Ashiyasu-mura, Mt. Kitadake, 35°40'N, 138°15'E, 5 Aug. 1981, *N. Yonezawa s.n.* (holotype, KANA-100739).

Geranium onoei var. *alpinum* Yonek., J. Jap. Bot. 80: 325. 2005. Type locality: "JAPAN: Honshu, Nagano Pref. (Shinano), Mt. Yatsugatake (M. Okamoto s.n. (TNS exsicc. no. 1565), 23 Jul. 1957, TUS 22794 -holotype; TNS -isotype". Type: Japan. Honshū, Nagano Pref. (Shinano), Mt. Yatsugatake, 35°59'N, 138°23'E, 23 July 1957, *M. Okamoto 1565* (holotype, TUS-22794; isotypes, GH!, NY!, P!, TI!, TNS).

Perennial herbs, 41-80 cm tall. *Rootstock* 8.2-12.5 mm in diameter, ± horizontal, not tuberculate, not turnip-shaped, with thickened roots along the rootstock. *Stem* erect, leafy, not rooting at nodes, stolons absent, without vegetative stems, with patent, eglandular hairs 0.3-1.9 mm long and, usually, patent, glandular hairs 0.4-1.2 mm long. *Basal leaves* in a ± persistent rosette, cauline leaves alternate (1-2) in middle of shoot and upper opposite; leaf laminas (7.8)9.2-10.7(12.9) cm long, 8.6-22 cm wide, not peltate, palmatifid [ratio main-sinus length/middle segment length = 0.63-0.71(0.81)], polygonal in outline, base cordate, not coriaceous, with nerves not projected, pilose, with ± appressed, eglandular hairs on both surfaces; segments 5(7), in 1 plane, middle segment rhombic, (8)12.1-18.3(29.4) mm wide at the base [ratio segment width at the base/middle segment length = (0.12)0.18-0.28(0.32)], 12-26-lobed in distal half [ratio secondary sinus length/middle segment length = (0.12)0.17-0.24(0.31)]; petioles up to 44 cm long, without abscission zone, terete, not swollen, not deflexed in age, with patent, eglandular hairs 0.3-1.8 mm long and, usually, patent, glandular hairs 0.4-1.3 mm long; stipules 4.5-15.5 mm long, 2-6.3 mm wide, lanceolate, free, papery, brownish red, with eglandular hairs on both surfaces and on the margin. *Inflorescence* a dichasial cyme; cymules 2-flowered, solitary or in aggregates at the top of each branch [ratio cymule length/leaf length = (0.7)0.8-2.5]; peduncles (26)38-53(82) mm long, with patent to retrorse, eglandular hairs 0.2-2.2 mm long and patent, glandular hairs 0.4-2.4 mm long; bracteoles 2.1-6.4 mm long, 0.6-1.5 mm wide, linear-lanceolate, whorled; pedicels 11.7-26.1 mm long, with patent to retrorse, eglandular hairs 0.2-1.2 mm long and patent, glandular hairs 0.3-1.6 mm long. Flowers actinomorphic. *Sepals* (7.4)8.3-10.4(11.1) mm long, 3-5.1 mm wide, lanceolate, smooth, not accrescent, nerves 3, mucro (1.1)1.6-2.6(2.7) mm long [ratio mucro length/sepal length = 0.15-0.31], with antrorse, appressed, eglandular hairs 0.3-0.7 mm long and patent, glandular hairs 0.7-1.6 mm long on the abaxial surface, glabrous adaxially. *Petals* (12.5)13.5-16.4 mm long, (8.5)9.9-11.1(11.8) mm wide, erect-patent, rounded, without claw, purple or white, glabrous on the adaxial surface, hairy on the base of the abaxial surface, ciliate on the basal margin, with hairs 0.7-1.4 mm long. *Stamens* 10, both whorls bearing anthers; filaments (9.4)11.4-12.3(15.3) mm long, lanceolate, dark purple, pilose on the abaxial surface, ciliate on the proximal half, with hairs 1.4-4.2 mm long; anthers 2.5-2.7(2.8) mm long, yellow. Nectaries 5, hemispheric, glabrous. *Gynoecium* 8.3-15 mm long, purple. *Fruit* 29.2-40.3 mm long, erect, discharge of seed-ejection type; mericarps 4.1-5.1 mm long, 1.7-2.9 mm wide, without a strand of fibers, not compressed at the apex, smooth, without basal beak, with a basal callus, without a basal prong, brown, with ± patent, eglandular hairs 0.3-1.2 mm long and patent, glandular hairs 0.6-2.8 mm long; rostrum 22-31.9 mm long, with a narrowed apex 5.9-11.4 mm long, not twisted, with ± patent, eglandular hairs 0.2-0.4 mm long and patent, glandular hairs 0.6-1.4 mm long; stigmatic remnants 2.7-3.8 mm long, with 5 glabrous lobes. *Seeds* 3-3.4 mm long, 1.8-2.3 mm wide, finely reticulate, uniformly colored, brown, glabrous. Cotyledons with entire margin. Fig. 120.

Pollen. Ornamentation not studied.

Chromosome number. 2*n* = 28.

Phenology. Collected in flower from May to October.

Distribution. This species ranges through Honshū to Hokkaidō, in central and northern Japan (Fig. 121).

Habitat. Grassy and rocky places; 1000-2600 m.

Additional specimens examined. **Japan.** Hokkaidō: Jozanki, W of Sapporo, 42°57'N, 141°9'E, 17 June 1943, *Mizushima s.n.* (TI); Sapporo-shi, Minami-ku, Tengu-dake, 43°57'N, 142°53'E, 24 June 1988, *Takahashi & al. s.n.* (TI). Honshū: Nagano prefecture, Mt. Shishikura-Mt. Funakubo, 14 Aug. 1981, *Midorikawa s.n.* (TI); Suruga, 34°57'N, 138°22'E, 5 Aug. 1908, *Hibino 6124* (GH); Shizuoka, ascent way of Fujinomiya in Mt. Fuji, 35°18'N, 138°41'E, 17 Aug. 1957, *Hiroe 12750* (TI); Mt. Ikeguchi, the South Alps, 35°19'N, 138°2'E, 3 Aug. 1958, *Katsumata s.n.* (TI); Shizuoka prefecture, Shin-gogoume, Mt. Fuji, Fujinomiya-shi, 35°19'N, 138°43'E, 23 July 1979, *Togashi 484* (GH, NY, P); Shizuoka prefecture, Haubara-gun, Mt. Tekaridake, 35°20'N, 138°5'E, 19 Aug. 1976, *Kadota 2771* (TI); Yamanashi prefecture, Mt. Fuji, Fujinomiya-Yoshida, 35°23'N, 138°43'E, 4 Aug. 1951, *Matsuoka s.n.* (TI); Mt. Ibuki, Sakata-gun, Shiga-ken, 35°25'N, 136°24'E, 16 June 1898, *Faurie 1895* (P); Mt. Ibuki, Sakata-gun, Shiga-ken, 35°25'N, 136°24'E, 23 June 1971, *Kanai & Moritz 175* (P); Omi, Mt. Ibuki, between Joheijigoe and the summit, 35°25'N, 136°24'E, 7 July 1963, *Kitamura 2245* (TI); Mt. Ibuki, Ohmi, 35°25'N, 136°24'E, 19 June 1940, *Watanabe s.n.* (TI); Shizuoka prefecture, Arakawa-goya, 35°30'N, 138°10'E, 6 Aug. 1966, *Togashi s.n.* (TI); Yamanashi prefecture, Mt. Mitsutôge, 35°31'N, 138°50'E, 24 May 1968, *Hasegawa 10994* (P); Yamanashi prefecture, Mitsutoge-yama, 35°31'N, 138°50'E, 24 May 1968, *Ohashi 8031* (TI); Yamanashi prefecture, Kotaro-one, Kitadake, 35°40'N, 138°14'E, 5 Aug. 1967, *Togashi s.n.* (TI); Nagano prefecture, Mt. Kisogoma, 35°43'N, 137°49'E, 19 July 1959, *Hara s.n.* (TI); Tokyo, 35°43'N, 139°21'E, 7 Oct. 1903, *Hayakawa s.n.* (B); Shinano prefecture, Suwa-gun, Kamanashi-yama, Dogasawa, 35°51'N, 138°11'E, 14 June 1968, *Yamazaki 11063* (GH); Yatsugatake in Shinano, 35°59'N, 138°23'E, 23 July 1957, *Okamoto 1565* (G, GH, NY, P, TI); Senano, 36°0'N, 138°0'E,

1864, *Tschonoski s.n.* (LE); Nagano prefecture, Abo Pass, Azumi-mura, Minamiazumi-gun, 36º8'N, 137º43'E, 27 July 1964, *Kanai 8928* (TI); Nagano prefecture, Minamiazumi-gun, Azumi-mura, Yokoo, Tenguppara, Nakadake-Yarigatake, 36º19'N, 137º39'E, 29 July 1975, *Midzuma 1373* (TI); Nagano, Karuizawa foot of Mt. Yagasaki, 36º20'N, 138º38'E, 29 June 1968, *Hara s.n.* (TI); atque Niko, 36º24'N, 139º51'E, 1864, *Tschonoski s.n.* (P); Nagano, Shinano, Sugadaira Osa-mura Chiisagata-gun, 36º31'N, 138º19'E, 8 July 1960, *Furuse s.n.* (GH); Toyama prefecture, Mt. Tateyama, Raiden-Ichinokoshi, 36º34'N, 137º38'E, 26 Aug. 1993, *Yamazaki s.n.* (TI); Tochigi prefecture, Nikko, Mt. Nyohou, 36º49'N, 139º32'E, 26 July 1924, *Narita s.n.* (TI).

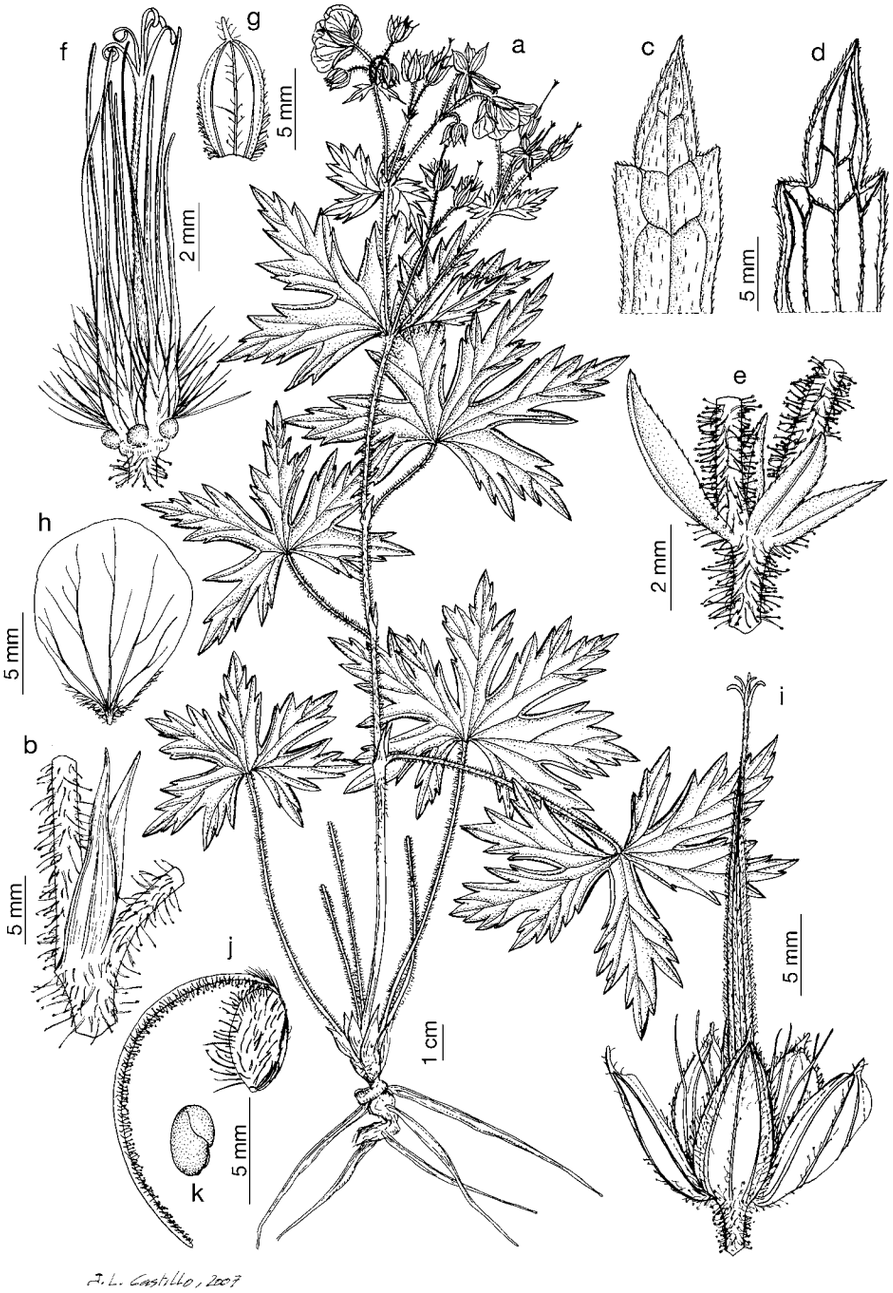


Fig. 120. *Geranium reinii*. a. Habit. b. Stipules. c. Leaf indument, adaxial surface. d. Leaf indument, abaxial surface. e. Bracteoles. f. Flower without petals and sepals. g. Sepal. h. Petal. i. Fruit. j. Mericarp. k. Seed. (Based on: a-h, *Okamoto 1565*, TI; i-k, *Kanai 8928*, TI).

Discussion. Geranium reinii is quite similar to *G. platyanthum* of mainland China with regard to the indument of the stems and petioles: both species share long, patent glandular and eglandular hairs on these organs. Their leaves, however, differ significantly. The leaves of *G. reinii* are more deeply divided with deeper main and second sinuses. In addition, the main segment is narrower at the base in *G. reinii*. Although the measurements overlap somewhat, the lengths of sepals, sepal mucro, staminal hairs, mericarp hairs, and persistent stigma lobes are consistently greater in *G. reinii* than in *G. platyanthum*. Consequently this endemic form deserves specific status, although Japanese authors have traditionally preferred to treat it at the varietal rank (Akiyama 2001; Ohwi 1965). *Geranium reinii* shares with *G. erianthum* some important features, such as the one or two alternate cauline leaves (becoming opposite toward the inflorescence), the dichasial inflorescence ending in umbel-like aggregates at the apex of each branch, and the long hairs on staminal filaments. Both species are partially sympatric in Japan: *G. reinii* occurs in Hokkaidō and Honshū while *G. erianthum* is present on Hokkaidō and in northern Honshū as well. *Geranium reinii* is easy to differentiate from *G. erianthum*, however, owing to the patent glandular and eglandular indument of the stem and petioles. In both species the leaves are more

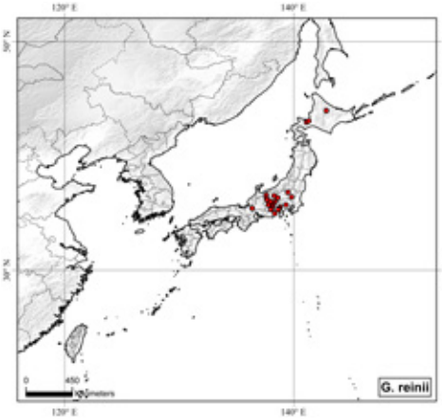


Fig. 121. Distribution of *Geranium reinii*.

deeply divided than in *G. platyanthum*. In *G. erianthum*, however, the main sinus is even deeper than in *G. reinii*. Thus the leaves of *G. reinii* are somewhat intermediate between those of *G. erianthum* and *G. platyanthum*.

The Pratense Group—This group is characterized by its opposite cauline leaves, its free stipules, 2-flowered cymules, the petals hairy only on the base, the staminal filaments with an expanded base and the nectaries with a tuft of hairs at the top.

Geranium pratense and *G. saxatile* form a subgroup well defined by the reflexed fruits when immature, and dichasial inflorescences. Yeo (2002a) recognized a "Collinum Group" that is here subsumed within the *Pratense Group*.

34. Geranium collinum Stephan ex Willd., Sp. Pl. 3(1): 705. 1800. *Geranium collinum* var. *glandulosum* Ledeb., Fl. Ross. 1(2): 467. 1842, nom. illeg. *Geranium collinum* f. *glandulosum* Ledeb. ex Şerb. in Săvul., Fl. Rep. Pop. Române 6: 134. 1958, nom. illeg. Type locality: "Habitat in Sibiria. (v. s.)". Type: Russia. Sibiria, *F.K. Stephan s.n.* (lectotype, here designated, B-W-12558-02-0 image!).

Geranium londesii Fisch. ex Link, Enum. Hort. Berol. Alt. 2: 196. 1822. Type locality: "Hab... ". Type: Russia. Volvograd, ad Wolgam inter Saratow et Sarepta, 48°30'N, 44°29'E, *F.E. Fischer s.n.* (lectotype, here designated, LE!).

Geranium longipes DC., Mém. Soc. Phys. Genève 1: 442. 1823. Type locality: "La patrie de ce Geranium m'est inconnue: je l'ai obtenu de graines provenant de divers jardins sous divers noms, la plupart appartenant à d'autres espèces, quelquefois sous celui de Ger. Londini, que je n'ai pas conservé...". Type: Cultivated, h. Genev., 6 June 1821, *unknown collector* (lectotype, here designated, G-DC-00215647!).

Geranium longipes var. *adenotrichum* Schrenk in Fisch. & C.A. Mey., Enum. Pl. Nov. 1: 90. 1841. *Geranium collinum* var. *adenotrichum* (Schrenk) Briq., Annuaire Conserv. Jard. Bot. Genève 11-12: 185. 1908. *Geranium collinum* [B] *adenotrichum* (Schrenk) Graebn. in Asch. & Graebn., Syn. Mitteleur. Fl. 7(1): 24. 1913. Type locality: "In alpibus Alatau ad fl. Baskan, ultimis diebus Junii m. decerptum". Type: Kazakhstan. Alatau, Baskan, 46°14'N, 78°56'E, 29 June, *A. Schrenk s.n.* (lectotype, here designated, LE!).

Geranium collinum var. *eglandulosum* Ledeb., Fl. Ross. 1(2): 468. 1842. *Geranium collinum* [A] *eglandulosum* (Ledeb.) Graebn. in Asch. & Graebn., Syn. Mitteleur. Fl. 7(1): 24. 1913. *Geranium collinum* f. *eglandulosum* (Ledeb.) Şerb. in Săvul., Fl. Rep. Pop. Române 6: 134. 1958. Type locality: "Hab. in Rossia media [ad super. fl. Ural (Claus), ad Wolgam (Claus) pr. Saratow! (Fisch. in herb. reg. berol.), in provinciis caucasicis [pr. acidulam Narzana! (Steven miss.), provinc. Talüsch alt. 800 hexap. (Hohenacker)] inque Sibiria altaica ad fl. Irtysch! et in deserto soongoro-kirghisico! (Fl. alt., Karel. et Kiril.)". Type: Kazakhstan. In herbosis prope Semipalatinsk, nec non in arenosis deserti Soongoro-Kirghisici prope Kokbekty et Dschartasch, 50°45'N, 78°32' E, 1840, *G.S. Karelin & I.P. Kiriloff 165* (lectotype, here designated, LE!; isolectotypes, H-1369322!, M-251498!, W!).

Geranium collinum var. *hirsutum* Trautv., Bull. Soc. Imp. Naturalistes Moscou 33(1): 459. 1860. Type locality: "In vallibus montium Ulutau 4 Jul. (flor.) obviam facta est". Type: Kazakhstan. Ulutau, 48°38'N, 66°56'E, 4 July 1842, *A. Schrenk 731* (lectotype, here designated, LE!).

Geranium collinum f. *intermedia* Kom., Trudy Imp. S.-Peterburgsk. Obšč. Estestvoisp., Vyp. 3, Otd. Bot. 26: 152. 1896. Type locality: [not indicated]. Type: Russia?, *V.L. Komarov s.n.* (no original material located).

Geranium benedictoi Pau, Not. Bot. Fl. Españ. 6: 41. 1896. *Geranium sylvaticum* var. *benedictoi* (Pau) Benedicto & Sennen in Sennen, Pl. Espagne n.° 828. 1909-10, in sched. *Geranium collinum* subsp. *benedictoi* (Pau) S.E. López, Fabregat & Mateo, Xiloca 13: 180. 1994. Type locality: "Habita en lugares húmedos de Villacadina, Monreal del Campo, J. Benedicto. Julio 1895". Type: Spain. Teruel, Monreal del Campo, Villacadima, 40°47'N, 1°21'W, July 1895, *J. Benedicto s.n.* (lectotype, here designated, MA-71472!; isolectotypes, BM-000751343!, FI! PR-955532). [The spelling of the locality is corrected according López & al. (1994)].

Geranium acutilobum Coincy, J. Bot. (Morot) 12: 56. 1898. Type locality: type locality: "Hab. Les prairies humides de Ruvena près Burgos; 15 juillet 1897". Type: Spain. Burgos, Ruvena, 42°13'N, 3°35'W, 15 July 1897, *A. Coincy s.n.* (lectotype, here designated, P!; isolectotype, MPU!).

Geranium humifusum R. Knuth, Jahresber. Schles. Ges. Vaterl. Cult. 81 II. Abt. Nat. b: 16. 1904. Type locality: "Afghanistan, Thal des Kurrum (Aitchison a. 1879!)". Type: Afghanistan. Kurrum valley, Safedkoh range and Hariab district, 33°59'N, 70°22'E, Dec. 1879, *J.E. Aitchison 600* (lectotype, here designated, C!).

Geranium collinum var. *wakhanicum* Paulsen, Bot. Tidsskr. 27: 133. 1906. *Geranium wakhanicum* (Paulsen) Ikonn., Novosti Sist. Vyssh. Rast. 8: 275. 1971. Type locality: "Pamir: Prov. Wakhan, n. 1275, in cultivated land at Langarkisht, alt. 3000m. Sept. 8. 1898; N. 1391, in a ravine at Torgus, alt. 2800m. Sept. 19. 1898; prov. Garan: N. 1501, at a stream near Darmaraght, alt. 2400 m. Oct. 10. 1898". Type: Tajikistan. Pamir, prov. Wakhan, Langarkisht, 37°03'N, 72°40'E, 8 Sep. 1898, *O. Paulsen 1275* (lectotype, here designated, C!).

Geranium pseudoaconitifolium Blatt., J. Bombay Nat. Hist. Soc. 36: 956. 1933. Type locality: "Western Tibet, Falconer (Kew Distrib. 328)". Type: India. West Tibet, *H. Falconer 328* (lectotype, here designated, K-000729343!; choice made by P. Yeo, in sched.).

Geranium nuristanicum Schönb.-Tem. in Rech. f. (ed.), Fl. Iran. 69: 19, tab. 6. 1970. Type locality: "Edelberg 744, W!... Afghanistan: E: Nuristan: Pashki, 2500 m, 28. V. 1948, Edelb. 744!...". Type: Afghanistan. E Nuristan, Pashki, 35°03, 69°24'E, 28 May 1948, *L. Edelberg 744* (holotype, W!).

Geranium pamiricum Ikonn., Novosti Sist. Vyssh. Rast. 9: 301. 1972. Type locality: "Tadshikistania, Badachschan, lacus Sarezicus, vallis Vichtonlacht, in pratis, 3350 m s. m., 16 VIII 1958, N° 8743, S. Ikonnikov (LE)". Type: Tajikistan. Badachschan, lacus Sarezicus, vallis Vichtonlacht, 38°11'N, 72°43'E, 16 Aug. 1958, *S. Ikonnikov 8743* (holotype, LE!; isotypes, G-00365767!, MW).

Perennial herbs, 18-61(100) cm tall. *Rootstock* 6-14.1 mm in diameter, ± horizontal, not tuberculate, not turnip-shaped, with thickened roots along the rootstock. *Stem* erect, leafy, not rooting at nodes, stolons absent, without vegetative stems, with retrorse, appressed, eglandular hairs 0.2-0.6 mm long and, sometimes, patent, glandular hairs 0.2-1.3 mm long. *Basal leaves* in a ± deciduous rosette, cauline leaves opposite; leaf laminas (1.6)3-5(9.7) cm long, 1.9-11.4 cm wide, not peltate, palmatifid [ratio main-sinus length/ middle segment length = (0.76)0.80-0.85(0.90)], polygonal in outline, base cordate, not coriaceous, with nerves not projected, pilose, with appressed, eglandular hairs on both surfaces; segments 5(7), in 1 plane, middle segment rhombic, (1.6)3.1-6(8.4) mm wide at the

base [ratio segment width at the base/ middle segment length = (0.09)0.13-0.17(0.25)], (4)7-10(13)-lobed in distal half [ratio secondary sinus length/ middle segment length = (0.18)0.23-0.29(0.48)]; petioles up to 37 cm long, without abscission zone, terete, not swollen, not deflexed in age, with retrorse, appressed, eglandular hairs 0.2-0.6 mm long and, sometimes, patent, glandular hairs 0.5-0.8 mm long; stipules 2.4-15 mm long, 0.9-2.1 mm wide, lanceolate, free, papery, brown, with eglandular hairs on abaxial surface and on the margin, glabrous adaxially. *Inflorescence* a monochasial cyme; cymules 2-flowered, solitary [ratio cymule length/leaf length = (1)-2-3.6(10.4)]; peduncles (26)48-107(230) mm long, with retrorse, appressed, eglandular hairs 0.2-0.5 mm long and, sometimes, patent, glandular hairs 0.2-0.8 mm long; bracteoles 2.3-7.5 mm long, 0.4-1.2 mm wide, lanceolate, whorled; pedicels (5.6)18.7-36.2(52.4) mm long, with retrorse, appressed, eglandular hairs 0.2-0.6 mm long and, sometimes, patent, glandular hairs 0.2-0.7 mm long. Flowers actinomorphic. *Sepals* (4.8)6.2-7.4(9.3) mm long, 1.9-4.4 mm wide, lanceolate, smooth, not accrescent, nerves 3(5), mucro (0.7)0.9-1.6(2.8) mm long [ratio mucro length/sepal length = 0.11-0.38], with antrorse, ± appressed, eglandular hairs 0.2-0.5 mm long and, sometimes, patent, glandular hairs 0.3-1.1 mm long on the abaxial surface, glabrous adaxially. *Petals* (8.3)9.9-14.1(17.9) mm long, (3.9)5-9(11.8) mm wide, erect-patent, rounded, without claw, purple, glabrous on both surfaces, ciliate on the basal margin, with hairs 0.2-0.6 mm long. *Stamens* 10, both whorls bearing anthers; filaments (3.9)5.8-7.5(10.9) mm long, lanceolate with a broad triangular base and an abruptly narrowed apex, pink, glabrous except for a some cilia 0.1-0.6 mm long on the proximal half; anthers (0.9)1.6-2.2(3.1) mm long, yellow or pink. Nectaries 5, hemispheric, with a tuft of hairs at the top, dorsally glabrous. *Gynoecium* 3.5-10.6 mm long, pink. *Fruit* (21.7)24-29(31.7) mm long, erect, discharge of seed-ejection type; mericarps 2.6-4.3 mm long, 1.2-2.1 mm wide, without a strand of fibers, not compressed at the apex, smooth (usually with 1-2 transverse veins at the apex), without basal beak, with a basal callus, without a basal prong, brown, with ± appressed, eglandular hairs 0.1-0.6 mm long and, rarely, patent, glandular hairs 0.5-0.7 mm long; rostrum 15.7-23.8 mm long, with a narrowed apex 2.8-7.6 mm long, not twisted, with ± patent, eglandular hairs 0.1-0.4 mm long and, rarely, patent, glandular hairs 0.4-0.7 mm long; stigmatic remnants 1.3-2.5 mm long, with 5 glabrous lobes. *Seeds* 2.4-2.9 mm long, 1.4-1.8 mm wide, reticulate, uniformly colored, brown, glabrous. Cotyledons with entire margin. Fig. 122, 123.

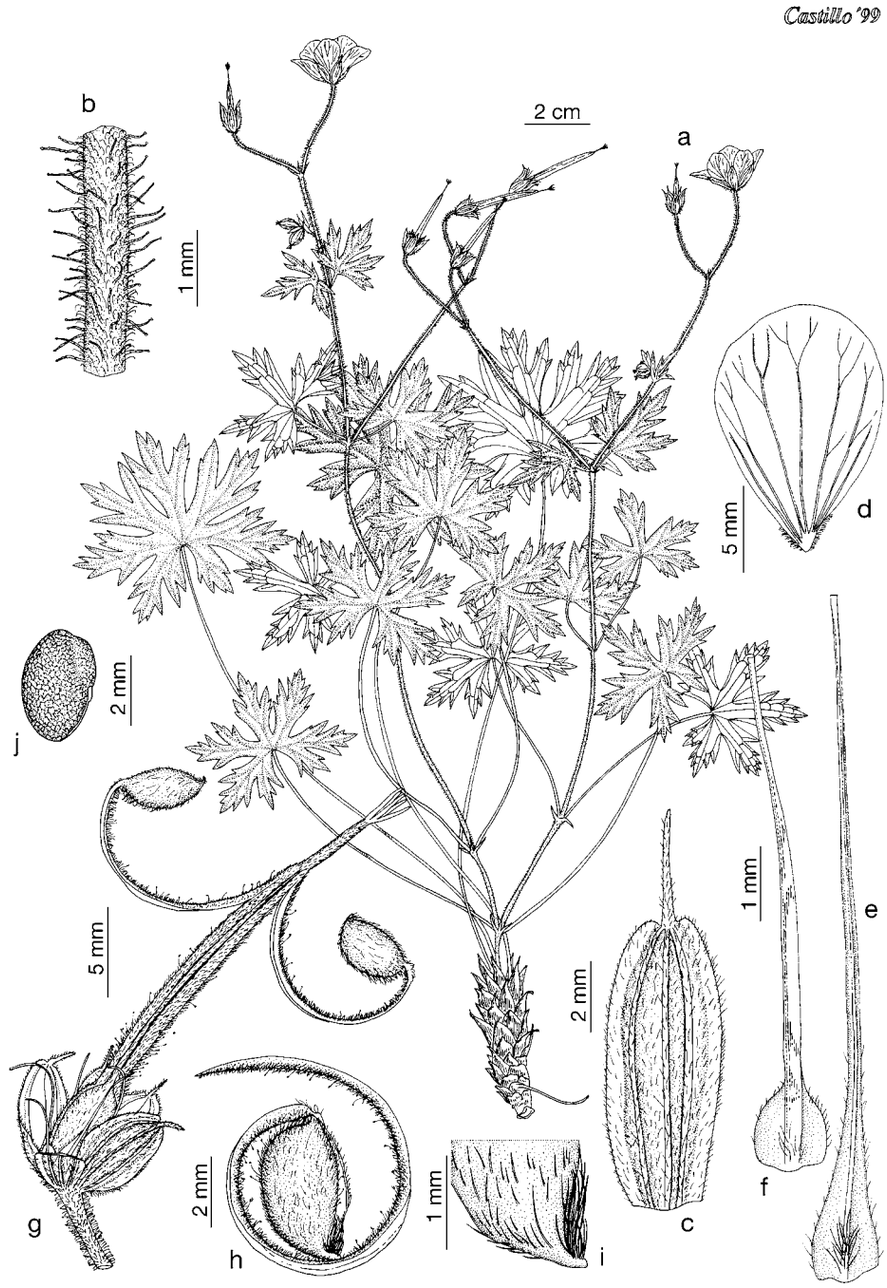


Fig. 122. *Geranium collinum*. a. Habit. b. Peduncle. c. Sepal. d. Petal. e, f. Staminal filaments. g. Fruit. h. Mericarp. i. Detail of mericarp base. j. Seed. (Based on: a, *Arán & Toha 19-02-05a,* MA; b, *Benedicto & Sennen 828,* MA; c, e-j, *Benedicto s.n.,* MA-71471; d, *Villar s.n.,* MA-252702).

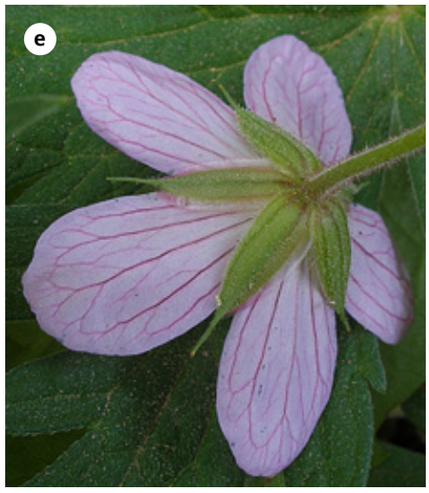


Fig. 123. *Geranium collinum* (Based on: a, b, *Aedo & Molina 15764*, MA; c-g, *Aedo 16716,* MA).

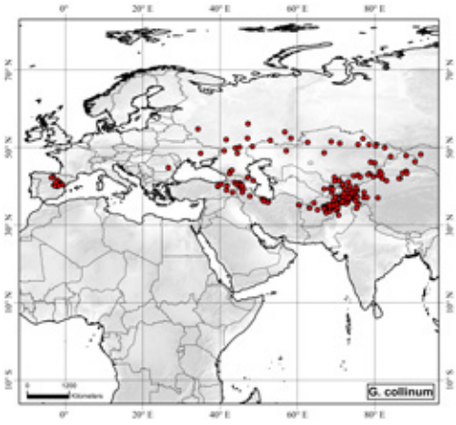


Fig. 124. Distribution of *Geranium collinum*.

Pollen. *Geranium*-type (Bortenschlager 1967: 431; Perveen & Gaiser 1999: 267; Velasco 1992b: 54 [sub *G. benedictoi*]).

Chromosome number. 2*n* = 28.

Phenology. Collected in flower from May to October.

Distribution. This species ranges from Spain and Romania, through Russia, Caucasus and Iran to western Himalayas and northwestern China and Mongolia (Fig. 124).

Habitat. Moist meadows, river and lake shores, megaphorb formations, shurbland and forest edges of *Betula* L., *Populus* L., and *Salix* L.; 50-3900 m.

Representative specimens examined. **Afghanistan.** Bamyan: Nawa-i-Surkhjoy bei Takhak, 34°14'N, 66°54'E, 27 July 1970, *Podlech 18873* (G). Ghazni: Jaghuri, 35 km E Loman, 33°7'N, 67°27'E, 25 July 1968, *Freitag 3480* (M). Nuristan: Linar valley, 35°21'N, 70°8'E, 12 Aug. 1956, *Thesiger 1513* (BM); Kunar, Bashgal-Tal bei Barge Matal, 35°40'N, 71°20'E, 22 Aug. 1969, *Podlech 16185* (G, M). **Armenia.** Gegharkunik: prope urbem Novo-Bajazet, 40°21'N, 45°7'E, 18 July 1928, *Grossheim 9313* (ERE). Shirak: Akhuryan distr., left slope of gorge NE of Krashen, 49°52'N, 43°58'E, 26 June 2004, *Vitek & al. 04-1646* (MA, W). Vayots Dzor: 8 km al paso de Selim, 39°56'N, 45°14'E, 23 June 2005, *Herrero & al. 2689* (MA). **Azerbaijan.** Quba-Khachmaz: región Kuzunskiy, Leze. Monte Dokkuzu, 41°30'N, 48°37'E, 25 Sep. 1933, *Antonov s.n.* (GH). **China.** Xinjiang: Yecheng Xian, Paolong, N side of the Kulun mt, 37°5'N, 77°7'E, 30 June 2001, *Bartholomew & al. 8384* (MO); along river Wulumuchi, 43°25'N, 87°13'E, 14 July 1991, *Watanabe 1447* (TI); ciudad de Wu Lu Mu Gi, 80 km al SSE del lago Tianchi, 43°53'N, 88°7'E, 2 July 1974, *Lin You Run 74080a* (IBSC); distrito Aletai, población Aletai, pueblo Xiaochegou, 47°52'N, 88°7'E, 21 Aug. 1989, *Xu Langran 1566* (PE). Xizang: Nord Tibet, Sarik-kol, 38°37'N, 74°29'E, 5 Aug. 1896, *Hedin s.n.* (LD). **Georgia.** Samegrelo-Zemo

Svaneti: prope col. Karass, 43º12'N, 42º27'E, 1843, *Hohenacker s.n.* (WRSL). **India.** Jammu-Kashmir: Thajiwas, 34º18'N, 75º16'E, 7 June 1971, *Robson 2002* (BM); Sonamarg, 34º18'N, 75º17'E, 20 July 1921, *Stewart 6376* (S). **Iran.** East Azerbaijan: 9 km SE Marand, 38º25'N, 45º46'E, 16 July 1964, *Grant 16249* (MO). Razavi Khorasan: Khorasan, in monte Kuh-e Bizg, 35º11'N, 60º20'E, 4 July 1937, *Rechinger 1407* (LD, S). Tehran: Elburz, 35º57'N, 52º32'E, 14 June 1937, *Gauba 1455* (B). **Kazakhstan.** Akmola: ciudad de Akmolinsk, cerca de riachuelo por las colinas, cerca del río Sary-Uzen, 51º4'N, 70º58'E, 23 July 1908, *Smirnow & al. s.n.* (US). Pavlodar: Semipalaminskaya obl., Pawlodar distr., 52º17'N, 76º58'E, 26 June 1913, *Kutscherovskaja 1059* (MO). South Kazakhstan: Tschimkent district, Syr-Darja, Dchebakiy, 42º19'N, 69º35'E, 31 July 1908, *Knorring 1083* (S). **Kyrgyzstan.** Chuy: Alpes Alexanfri, ripa flumen Kaschkara, 42º48'N, 75º40'E, 3 June 1896, *Brotherus 126* (H). Jalal-Abad:16 km SE of Chapchyma pass, 41º31'N, 70º48'E, 8 July 2008, *Osborne 486* (MO). **Mongolia.** Bayan-Ölgii: Sapadnaia Mongolia, Djungarskaia Gobi, Severnaia okraina pos Bulgan kobdoskogo aymaka, 46º55'N, 91º5'E, 17 1893, *Gubanov & al. 2434* (LE). Khovd: Kobdosski, r. Buyantu, Bulungunski rajon, 48º13'N, 91º53'E, 1930, *Baranov s.n.* (GB). **Pakistan.** Gilgit-Baltistan: Dihe valley, Dihe village, 36º52'N, 74º59'E, 10 Aug. 2000, *Eberhardt 9260* (M). Punjab: Northern areas, Sultanabad, 32º32'N, 70º39'E, 3 Aug. 1990, *Stöber 69* (M); Chitral, Yarkhun, 36º30'N, 72º40'E, 15 June 1958, *Bowes Lyon 917* (C). **Romania.** Sud-Muntenia: Ialomita, vallis Cotorca pr. pagum Ciocârlia, 44º48'N, 26º40'E, 6 July 1922, *Grintescu 262* (C, G, GH, H, MO, P, PR, RO, S, WU). **Russia.** Bashkiriya: Baimak district, between Baimak and Yuldybaevo, 52º23'N, 58º21'E, 24 July 1953, *Kutcherov s.n.* (MO). Chuvashiya: Kazan, Czeboksary distr., 56º7'N, 47º15'E, 25 July 1882, *Ostankow s.n.* (G). Dagestan: Kuma, 42º16'N, 47º8'E, 1802, *Steven s.n.* (H). Orenburg: Ilekski distr., village Vjazovski on the Vjazovka valley, 51º49'N, 53º0'E, 25 July 1928, *Borisova 1057* (S). Rostov: Novopokrovskiy, Novotscherkassk, 49º8'N, 41º4'E, 7 July 1911, *Jakuschev 122* (C, M). Saratov: Kamyschin distr., in pratis flumen Medweditzam, prope pagum Chomenki, 50º15'N, 48º22'E, 29 June 1895, *Zinger s.n.* (B, G, WU). Smolensk: Ugra distr., in viciniis Vertekhovo, 54º46'N, 34º19'E, 1 Aug. 1982, *Skvortsov s.n.* (B). Stavropol: Nartsana, 43º52'N, 42º45'E, 1800, *Steven s.n.* (H). Volvograd: pr. Sarepta, 48º31'N, 44º30'E, June 1877, *Becker 1331* (B, GB, H, M, S). **Spain.** Burgos: Rubena, orilla río Vena, 42º13'N, 3º35'W, 1 Aug. 2006, *Alejandre & Escalante 1097/06* (MA). Cuenca: Arcas del Villar, laguna de Arcas, 39º59'N, 2º6'W, 16 June 2006, *García Cardo s.n.* (MA). Soria: Esteras de Medinaceli, 41º6'N, 2º26'W, 12 July 2008, *Aedo & Molina 15764* (MA). Teruel: Alcalá de la Selva, 40º22'N, 0º43'W, 24 June 1998, *Aedo & al. 4653* (MA). Zaragoza: Berdejo, 41º34'N, 1º57'W, 23 June 1968, *Segura Zubizarreta s.n.* (MA). **Tajikistan.** Gorno-Badakhshan: Pamir, Wakhan, pr. Jorgus, 37º3'N, 72º40'E, 19 Sep. 1898, *Paulsen 1391* (C); Pamir, vallis Jersil, 39º20'N, 73º35'E, 10 July 1930, *Persson 82* (LD, S). Sughd: Montes de Zeravshan, prado a lo largo del arroyo Liria, pendientes sur por el río Iskodar-darya, 39º27'N, 68º28'E, Aug. 1932, *Ovczinnikov 1866* (GH). **Turkey.** Bayburt: Baibout, 40º32'N, 40º15'E, 24 June 1862, *Bourgeau s.n.* (UPS). Muş: 17 km S Varto Richtung Mercimekkale und Mus, 3 km S Tepekoy, 38º58'N, 41º40'E, 20 July 1978, *Ehrendorfer 787-83-2* (WU). Van: Edremit, Sehir cevresi, 38º25'N, 43º15'E, 4 Sep. 1996, *Dönmez 5594* (HUB). **Uzbekistan.** Fergana: Margelan distr., Alaisk valley at Ir-dschar, 40º28'N, 71º43'E, 29 June 1913, *Dessiatoff 1475* (S). Samarkand: Urgut, Aman-Kutan, 39º18'N, 66º55'E, 15 July 2004, *Islomov 277* (MO). Tashkent: reserva natural de Parkent, 41º17'N, 69º40'E, 7 July 1960, *Jojryakov s.n.* (H).

Discussion. *Geranium collinum* is an erect perennial herb with leaves of medium size, short petals, staminal filaments with an expanded base, and erect fruits. The rootstock is usually ± horizontal and with thickened roots along it. The presence of glandular hairs varies considerably. Some specimens have abundant glandular hairs on the stem base, petioles, and inflorescence, while others have only few or no glandular hairs on the inflorescence. The inflorescence of well-developed specimens is monochasially arranged. The peduncles are noticeably long in the basal nodes. In small specimens, these basal peduncles can be as long as the whole plant.

This species is usually difficult to differentiate from *G. pratense* and *G. saxatile* if fruits are not available. *Geranium pratense* and *G. saxatile* have fruits reflexed in the early stage of development, while *G. collinum* has erect fruits. Leaves of *G. collinum* are usually with five segments, and they are shorter and less divided than *G. pratense* and *G. saxatile.* Additionally, sepals, petals, staminal filaments, and fruits are also shorter in *G. collinum* than the previously mentioned species, although with some overlap.

The small specimens with long peduncles are especially common in Asian mountains. Their general appearance is quite different from plants in the lowlands of Europe, but are connected by a continuum of intermediates, which suggests that they do not deserve taxonomic recognition.

The date indicated in the prologue of *G. benedictoi* is "July 1895" while the one that appears on C. Pau's label is "VII 1896". This inconsistency may be due to a labeling error of the plants sent by J. Benedicto. The *Notas Botánicas* was published by C. Pau in 1896 [according to G. López (2001), perhaps in the last third of the year], with a prologue dated July 16, 1895. The time period to study plants collected in "VII 1896", write about them and publish them that same year is too small, which would support that the actual collection date is "July 1895". Herbarium of C. Pau was integrated into MA and the sheet MA-71472 is the only one consistent with the protologue, which would further support that the inconsistency in the date would be a mere error.

35. Geranium pratense L., Sp. Pl.: 681. 1753. Type locality: "Habitat in Europae borealis pratis". Type: "Habitat in Europae borealis pratis" (lectotype, designated by Novoselova 1996: 87, LINN-858.66 image!).

Geranium pratense var. *album* Weston, Bot. Univ. 2: 352. 1771. Type locality: [not indicated]. Type: unknown locality, *R. Weston s.n.* (no original material located).

Geranium pratense var. *variegatum* Weston, Bot. Univ. 2: 352. 1771. Type locality: [not indicated]. Type: unknown locality, *R. Weston s.n.* (no original material located).

Geranium batrachioides Cav., Diss. 4: 211, tab. 85 fig. 2. Aug. 1787. *Geranium sylvaticum* var. *batrachioides* (Cav.) Steud., Nom. 1: 365. 1821. *Geranium sylvaticum* [2] *batrachioides* (Cav.) Graebn. in Asch. & Graebn., Syn. Mitteleur. Fl. 7(1): 13. 1913. Type locality: "Habitat in Alpibus. V.V. in R.H.P.". Type: Cultivated at Paris Botanical Garden, 1787, *A.J. Cavanilles s.n.* (lectotype, here designated, P!).

Geranium affine Ledeb., Fl. Altaic. 3: 229. 1831. *Geranium pratense* var. *affine* (Ledeb.) Krylov, Fl. Altaya 1: 195. 1908. Type locality: "Hab. in pratis fertilibus ad fl. Irtysch (L.M.)". Type: Russia. Irkutsk, 52°17'N, 104°11'E, 9 Aug., *C.F. Ledebour s.n.* (*herb. Ledebour 1066*) (lectotype, designated by Ivleva 2013: 231, LE!).

Geranium pratense var. *albiflorum* Gaudin, Syn. Fl. Helv.: 576. 1836. Type locality: "In montibus Iuranis; supra Nevidunum? Iun. Iul.". Type: Switzerland. mt. Jura, supra Nyon, 46°23'N, 6°13'E, *J.F. Gaudin s.n.* (no original material located).

Geranium pratense [1] *albiflorum* Opiz ex Graebn. in Asch. & Graebn., Syn. Mitteleur. Fl. 7(1): 11. 1913, nom. illeg.. Type locality: [not indicated]. Type: unknown locality, *P.M. Opiz s.n.* (no original material located).

Geranium alpinum Kit. ex Kanitz, Verh. K.K. Zool.-Bot. Ges. Wien 13: 531. 1863, nom. illeg., non Burm. f. 1759. Type locality: "Inter Pinum Pumilionem in alpe Plissivica". Type: Croatia. Plešivica, 45°44'N, 15°40'E, *P. Kitaibel s.n.* (no original material located).

Geranium acknerianum Schur, Enum. Pl. Transsilv.: 136. 1866. *Geranium pratense* [1] *acknerianum* (Schur) Graebn. in Asch. & Graebn., Syn. Mitteleur. Fl. 7(1): 11. 1913. Type locality: "Ich kenne dieses Geranium nur aus Gärten, wo es häufig als Zierpflanze gezogen wird. Meine Pflanze stammt aus dem Garten des Herrn Pfarrer Ackner in Hammersdorf und sie soll aus Siebenbürgen herstammen.- Ich habe sie mehrere Jahre in meinem Garten kultivirt, konnte aber keine reifen Früchte erzielen". Type: Romania. cultivated from Hammersdorf, 45°49'N, 24°11'E, 1847, *F. Schur s.n.* (lectotype, here designated, LW-205572 image!).

Geranium pratense var. *piloso-canescens* Schur, Enum. Pl. Transsilv.: 137. 1866. *Geranium pratense* [D] *pilosicanescens* (Schur) Graebn. in Asch. & Graebn., Syn. Mitteleur. Fl. 7(1): 10. 1913. Type locality: "Auf der Pojana bei Kronstadt. Jun.". Type: Romania. Pojana bei Kronstadt, 46°27'N, 22°35'E, *F. Schur s.n.* (no original material located).

Geranium pratense var. *subalpinum* Schur, Enum. Pl. Transsilv.: 136. 1866. *Geranium pratense* [II] *subalpinum* (Schur) Graebn. in Asch. & Graebn., Syn. Mitteleur. Fl. 7(1): 11. 1913. Type locality: "Auf Bergewiesen, auf dem Wege zum Gäser am Fuss der Fromoasze, Glimmerschiefer. 4000'. Jul.". Type: Romania. mt. Cibinului, 45°35'N, 23°55'E, July 1847, *F. Schur s.n.* (lectotype, here designated, LW-205573 image!).

Geranium pratense var. *valde-pilosum* Schur, Enum. Pl. Transsilv.: 137. 1866. *Geranium pratense* [D] *valde-pilosum* (Schur) Graebn. in Asch. & Graebn., Syn. Mitteleur. Fl. 7(1): 10. 1913. Type locality: "Auf Waldwiesen oberhalb Michelsberg gegen den Götzenberg. Jul. 1848". Type: Romania. Michelsberg, Götzenberg, 45°42'N, 24°06'E, 30 June 1849, *F. Schur s.n.* (lectotype, here designated, LW-205574 image!).

Geranium batrachioides var. cyanostemon Rupr., Mém. Acad. Imp. Sci. Saint Pétersbourg ser. 7 15(2): 273. 1869. *Geranium pratense* var. *cyanostemon* (Rupr.) Boiss., Fl. Orient. Suppl. 143. 1888. *Geranium pratense* f. *subhirtum* Rupr. ex Woronow in Kusn., N. Busch & Fomin, Fl. Cauc. Crit. 3(7): 53. 1908. Type locality: "Sat ferquens in Dagestania et Caucaso orientali, in reg. sylvatica sed plerumque locis apricis, alt. 1100 (raro 1290)-780 hex. In m. Gudgora (Hohen. teste Boiss., hinc forte M. Bieb. G. pratense suum verum vidit, sed non asservavit, confer G. gumnocaulon). Dagestania, ipse seqq. locis collegi: Dido, pr. Inucho alt. 1000 hex. 12 Aug. fl. primis, humile petalis 7 lin. cum sepalis 3 lin. ut plerumque. Kaputscha, ad fl. Simur alt. 860-870 hex. 9 Aug. fl. et sem. matur.; eadem supra Beshita alt. 970-850 hex. 10 Aug. defl. carpellis rugulosis. Ilanchewi ad pedem m. Botschog in limite reg. sylv. secus semitam alt. 1290 hex. 14 Aug. sem. mat. et petalis 6-8 lin. Tindi, ad pedem m. Bogos alt. 1070-1110 hex. 12 Jul. var. pilis caulinis paulo longioribus retrorsis quidem sed non adpressis, petalis 8-9 lin. cum sepalis 5 lin.; non est var. hirta altaica quae pilos divaricatos offert; inter Aknada et Tindi alt. 870-850 hex. 7 Jul. fl. et defl.; inter Tindi et Chuschtada alt. 900-800 hex. 6 Jul. fl. primis, caule humili diffuso tortuoso semipedali, foliis minoribus. In m. Gunib alt. 800-900 hex. 27 Jun. fl. primis, tantum ad calyces glandulosum. Gumbet pr. pag. Danuch quod 891 hex. altum 26 Jul. fl. legit D. Owerin. Salatavia ad fontem Goge mejer alt. 780 hex. 1 Jul. fl. primis leg. Owerin: longipes, grandiflorum petalis 10 lin., pedunculo ultra 5 poll. longo. Cauc. orient. ad fl. Samur inter Kussur et Kürgüll alt. 1040 hex. 15 Jul. fl. legi caule humiliori tortuoso; idem pr. Baschmuchach alt. 1050-1080 hex. 29 Jul. legi. In m. Schachdagh (Abich ex Bunge sub G. pratensi).-In Cauc. minori solus Ledeb. apud Eichwald p. 29 ex Alawersk". Type: Russia. Dagestan, Tindal, montes Bogos, 42°22'N, 46°17'E, 12 July 1861, *F.J. Ruprecht s.n.* (lectotype, here designated, LE!).

Geranium pratense var. *eglandulosum* Čelak., Prodr. F. Böhmen 3: 531. 1875. Type locality: "in einem Sumpfe bei Gottesgab (Hofmann)!". Type: Czech Republic. Gottesgab, 50°25'N, 12°53'E, *E. Hofmann s.n.* (no original material located).

Geranium pratense var. *lilacinum* Čelak., Prodr. F. Böhmen 3: 531. 1875. Type locality: "... in Ostböhmen bei Leitomyšl, Hohenmauth, Hrochovtejnic und Dašic, meist auf Kalkmergel, bei Leitomyšl allein herrschend, bei Hohenmauth mit der blauen". Syntypes: Czech Republic. Leitomys, 49°52'N, 16°21'E, *L.F. Čelakovsky s.n.* Czech Republic. Hohenmauth, 49°57'N,16°10'E, *L.F. Čelakovsky s.n.* Czech Republic. Hrochovtejnic, 49°57'N,15°54'E, *L.F. Čelakovsky s.n.* Czech Republic. Da šic, 50°03'N,15°53'E, *L.F. Čelakovsky s.n.* (no original material located).

Geranium finitimum Woronow in Kusn., N. Busch & Fomin, Fl. Cauc. Crit. 3(7): 50. 1908. *Geranium pratense* subsp. *finitimum* (Woronow) R. Knuth in Engl., Pflanzenr. IV.129 (Heft 53): 129. 1912. Type locality: "Hab. in pratis montanis et subalpinis Armeniae Rossicae occid.- X. A. Tureckaja granjica. VIII. 67. nº 268. fl. fr. jun. Radde! (sub G. pratensi in h. P.). Sarykamysch. 27. VII. fl. Masal'skij! Soganlugskij... Karsskaja obl. Ardaganskij okr. Merdeneka Luga 12. VI.07. fl. Sagunjina! (f. subeglandulosum m.--inflorescentia subeglandulosa". Type: Turkey. Prov. Kars, Sarycamysch, 40°19'N, 42°35'E, 27 July 1885, *W. Massalsky s.n.* (lectotype, designated by Novoselova 1998: 149, LE!).

Geranium finitimum f. *subeglandulosum* Woronow in Kusn., N. Busch & Fomin, Fl. Cauc. Crit. 3(7): 51. 1908. Type locality: "... Ardaganskij okr. Merdeneka Luga 12. VI.07. fl. Sagunjina! (f. subeglandulosum m.--inflorescentia subeglandulosa". Type: Russia. Stavropol'skiy Kray, Ardaganskij okr. Merdenekă Lugă, 43°58'N, 44°13'E, 12 June 1907, *unknown collector s.n.* (no original material located).

Geranium pratense var. *litwinowi* Woronow in Kusn., N. Busch & Fomin, Fl. Cauc. Crit. 3(7): 51. 1908. *Geranium pratense* [B] *litwinowi* (Woronow) Graebn. in Asch. & Graebn., Syn. Mitteleur. Fl. 7(1): 10. 1913. Type locality: "... v.s. in h. A. Hab. in pratis montanis prov. Kubanensis in valle fl. Teberda. 4200'.-S.K. Kubanskaja obl. Teberda. Daci, lug'. 4200'. 2. VII. 05. fl. fr. jun. Litvinov!". Type: Russia. Krasnodar, Kuban, Teberda, 43°28'N, 41°46'E, 2 July 1905, *D. Litvinov 145* (lectotype, here designated, LE!).

Geranium pratense subsp. *ruprechtii* Woronow in Kusn., N. Busch & Fomin, Fl. Cauc. Crit. 3(7): 52. 1908. *Geranium ruprechtii* (Woronow) Grossh., Fl. Kavk. 3: 7. 1932. Type locality: "Hab. in pratis montanis, subalpinis et alpinis Caucasi Magni. 4000-12000'." [and many other localities in Russian]. Type: Russia. Caucasus orient., Dagestania superior montosa ad fontes fl. Ilan-chewi, ad pedem m. Botschog, 41°56'N, 46°28'E, 14 Aug. 1860, *F.J. Ruprecht s.n.* (lectotype, designated by Novoselova 1998: 148, LE!).

Geranium pratense var. *pallescens* Woronow in Kusn., N. Busch & Fomin, Fl. Cauc. Crit. 3(7): 52. 1908. *Geranium pratense* [C]

pallescens (Woronow) Graebn. in Asch. & Graebn., Syn. Mitteleur. Fl. 7(1): 10. 1913. Type locality: "... v. s. in h. P. J. K. ... Hab. in pratis montanis et subalpinis Caucasi septentr. et centr. ad 8000.-S. T. Kislovodsk'. 1886. fl. Akinf.! Gora Dzinal' oliz' Kislovodska. 4500'. 17. VII. 89. fl. fr. imm. Akinf.!- A.W. Verchov'ja r. Kubani. Uckulan! Luga i kustarniki do 8000'. VII. 00. fl. Desulavi! (specimen... glandulosis).-A.M. Balkarija. Stulu. VII.01. fl. Desulavi! Becoskij pereval'. Severnyj sklon! fl. Akinf.!". Type: Russia. Stavropol, Caucasus, mount Bermamut near Kislovodsk, 43°53'N, 42°43'E, 28 July 1886, *I. Akinfiew s.n*. (lectotype, here designated, LE!).

Geranium pratense var. *buschianum* Woronow in Kusn., N. Busch & Fomin, Fl. Cauc. Crit. 3(7): 52. 1908. Type locality: "v.s. in h. P. Hab. in pratis subalpinis Daghestaniae,- X.D. Sulalpijskie luga mezdu sel. Saitlv perecalom' k' sel. Honok'. 9 VII. 04. fl. Busch! Skaly Vv uscel'e Iljan-chevi vysce Saitlja. 9 VII. 04. fl. Busch!". Type: Russia. Daghestan, between Shaitl village and mountain pass to Khonok village, 42°19'N, 46°07'E, 9 July 1904, *N.A. Busch s.n.* (lectotype, here designated, LE!).

Geranium pratense f. *subeglandulosum* Rupr. ex Woronow in Kusn., N. Busch & Fomin, Fl. Cauc. Crit. 3(7): 52. 1908. Type locality: "X.D. Vostocnyi Kavkaz' Verchnij Dagestan' Dido. Bliz' Inucho. 7000'. 12. VIII. 60. fl. Rupr.!". Type: Russia. Dagestan. Vostocnyi Kavkaz' Verchnij Dagestan' Dido. Bliz' Inucho,12 Aug. 1860, *F.J. Ruprecht s.n.* (no original material located).

Geranium pratense var. *diffusum* Woronow in Kusn., N. Busch & Fomin, Fl. Cauc. Crit. 3(7): 53. 1908. Type locality: "Hab. in pratis montanis et subalpinis Daghestaniae. - X.D. Dagestan'. Samurskij okrug'. Na chrebte Buga-dag' mezdu ss. Fija i Maza. Na lugach'. 8200'. 19. VIII. 00. n° 7397. fl. Alekx.! Central'nyj Dagestan'. Mezdu ss. Chustada i Tindi. 4800-5400'. 6. VII. 61. fl. Rupr.! Mezdu Tindi i Angyda, pereval'. 23. VII. 04. fl. Busch!". Type: Russia. Dagestan. Samur, in jugo Buga dag inter pagos Fija et Maza, 41°20'N, 47°34'E, 19 Aug. 1900, *F.N. Alexeenko 7397* (lectotype, here designated, LE!).

Geranium rovirae Sennen, Pl. Espagne 1926 n.° 5685. 1927, in sched. Type locality: "Cerdagne: Llivia, bords des fossés, 1200 m. 1-VII". Type: Spain. Cerdagne, Llivia, 42°27'N, 1°58'E, 1 July 1926, *fr. Sennen s.n.* (lectotype, here designated, BC-12390!; isolectotypes, BC-115534!, FI!, MA-471212!, MAF-58796!, P!).

Geranium rovirae var. *purpureum* Sennen, Pl. Espagne 1926 n.° 5686. 1927, in sched. Type locality: "Cerdagne: Llivia, bords des prairies, 1200 m". Type: Spain. Cerdagne, Llivia, 42°27'N, 1°58'E, 12 July 1926, *fr. Sennen s.n.* (lectotype, here designated, BC-12391!; isolectotypes, BM!, MAF-58795!).

Geranium mariae Sennen, Diagn. Nouv. Pl. Espagne Maroc 1928: 12. 1928. Type locality: "Hab.-Cerdagne: Val de Llo, dans les Gorges et à la Coulasse, 1400-1800 m". Type: France. Cerdagne, Val de Llo, depuis les 'Gorges' jusqu'à la Coulasse, 42°27'N, 2°03'E, 1 Aug. 1928, *fr. Sennen s.n.* (lectotype, here designated, BC!; isolectotypes, FI!, MA-425086!, MAF-25312!, W!).

Geranium transbaicalicum Serg., Sist. Zametki Mater. Gerb. Krylova Tomsk. Gosud. Univ. Kiybyševa 1934(1): 4. 1934. *Geranium pratense* var. *transbaicalicum* (Serg.) Popov in Popov & Bussik, Cons. Fl. Baical: 213. 1966. *Geranium palustre* subsp. *transbaicalicum* (Serg.) Gubanov, Fl. Vost. Khangaya: 141. 1983. Type locality: "Transbaicalia. Byrkinskij aimak. Prope pag. Kliczki, in pratis. 28.VI.1931, fl. Leg. B. Zamoschnikov; Aleksanbro-Zavodskij aimak. Prope pag. Klin, in pratis stepposis, fl. 6.VIII.1931. Leg. A. Vinogradova et E. Czebackova; pag. Schonoktui, [i]n pratis. 2.VII.1931. Leg. A. Vinogradova. Aginskij aimak. Circa ulus Chila, in decliviis herbosis, fl. 29.VI.1931. Leg. P. N. Krylov et L. Sergievskaja; Prope ulus Taptany, 14.VII.1930. Leg. M. Varlakov et Schvetzova; in valle flum. Ili, in pratis 8.VII.1931. Leg. E. Kolczeva". Type: Russia. Chita, Eastern Transbaikalia, Byrkinskiy district, Klichki village, 50°17'N, 117°43'E, 28 June 1931, *B.D. Zamoshnikov s.n.* (lectotype, designated by Troschkina 2015: 122, TK-001211 image!).

Geranium transbaicalicum var. *turczaninovii* Serg., Sist. Zametki Mater. Gerb. Krylova Tomsk. Gosud. Univ. Kiybyševa 1934(1): 4. 1934. *Geranium transbaicalicum* subsp. *turczaninovii* (Serg.) Peschkova, Fl. Siberia 10: 20. 1996. Type locality: [not indicated]. Type: Russia. Chita, Aginsky district, near Khila village, steppe meadow on the slope, 50°57'N, 115°00'E, 29 June 1931, *P.N. Krylov* & *L. Sergievskaya* (lectotype, designated by Polozhiy & Balashova 1989: 26, TK-0012112 image!).

Geranium pratense f. *rigidulum* Serg., Sist. Zametki Mater. Gerb. Krylova Tomsk. Gosud. Univ. Kiybyševa 1934(1): 3. 1934. Type locality: [not indicated]. Type: Russia. West Siberia, former Khakassian okrug, Chebakovsky district, 54°45'N, 89°50'E, 23-24 July 1931, *V.P. Golubintseva s.n.* (lectotype, designated Gureyeva & Balashova 2017: 15, TK-001247 image!).

Geranium pratense f. *molle* Serg., Sist. Zametki Mater. Gerb. Krylova Tomsk. Gosud. Univ. Kiybyševa 1934(1): 3. 1934. *Geranium pratense* subsp. *sergievskajae* Peschkova, Fl. Siberia 10: 16. 1996. *Geranium sergievskajae* (Peschkova) Troschkina, Novosti Sist. Vysssh. Rast. 47: 32 (2016). Type locality: [not indicated]. Type: Russia. Krasnoyarsk territory, Minusinsk, near the river Yenisei, 53°42'N, 91°41'E, 9 July 1930, *S. Dikovskaya s.n.* (lectotype, designated by Troschkina 2015: 122, TK-001239 image!).

Geranium pratense var. *dissectum* Serg., Sist. Zametki Mater. Gerb. Krylova Tomsk. Gosud. Univ. Kiybyševa 1934(1): 3. 1934. *Geranium asiaticum* var. *dissectum* (Serg.) Krylov in Krylov & al., Fl. Zap. Sibir. 8: 1827. 1935. Type locality: [not indicated]. Type: Russia. Altai, village Tyudraly, 53°19'N, 81°29'E, 1903, *L. Tyumentsevy s.n.* (lectotype, designated by Polozhiy & Balashova 1989: 25, TK-001237 image!).

Geranium pratense var. *longebracteatum* Serg., Sist. Zametki Mater. Gerb. Krylova Tomsk. Gosud. Univ. Kiybyševa 1934(1): 4. 1934. Type locality: [not indicated]. Type: Russia. Tomsk, Narymskiy krai, 57°43'N, 82°39'E 23 June 1912, *K. Onisimov s.n.* (lectotype, designated Gureyeva & Balashova 2017: 15, TK-001264 image!).

Geranium pratense var. *alpestre* Krylov in Serg., Sist. Zametki Mater. Gerb. Krylova Tomsk. Gosud. Univ. Kujbyševa 1: 4. 1934. Type locality: [not indicated]. Type: Russia. Altai, Biyskiy district, Chuyskiy trakt, Kenga village, 52°26'N, 85°29'E, 3 Aug. 1934, *E. Klements 549* (lectotype, designated by Troschkina 2015: 121, TK-001238 image!).

Geranium kemulariae Kharadze in Grossh., Fl. Kavk. ed. 2, 6: 19. 1962. Type locality: "Caucasus borealis, prope Madnischevi (Uczkulan)". Type: Georgia. Distr. Kluchori, pr. Uchkulan, 43°14'N, 41°51'E, 13 Aug. 1946, *L. Kemularia-Nathadze & L. Chinthibidze s.n.* (lectotype, here designated, TBI-1025292 image!).

Geranium clarkei Yeo, Hardy Geraniums: 188, 86 fig. 9.22, photo 11. 1985. Type locality: "Hirpoor, Kashmir, 9 July 1876, C.B. Clarke, no. 28663A (K)". Type: India. Jammu and Kashmir, Hirpoor, 33°28'N, 74°32'E, 9 July 1876, *C.B. Clarke 28663A* (holotype, K-000729513!).

Geranium kashmirianum Sapru & Raina, Geobios, New Rep. 5(1): 63, 64 figs. 1-12. 1986. Type locality: "Gulmarg, alt, 2500 m. 16-7-1983 SKR 948 (Holotypus--KASH); Khillanmarg alt. 2950 m. 18-8-1983 SKR 596 (Paratypus--KASH)". Type: India. Jammu and Kashmir, Gulmarg, 34°02'N, 74°22'E, 16 July 1983, *B.L. Sapru & S.K. Raina 948* (holotype, KASH image!).

Geranium lahulense V. Wagh & Hurrah, Phytotaxa 452(1): 76, 78 fig. 2, 79 fig. 3, 80 fig. 4. 2020. Type locality: "INDIA, Himachal Pradesh: Lahul & Spiti, on way to Keylong from Koksar, 32.50440º N, 77.04940º E, 3195m. 25 July 2018, Imtiyaz A. Hurrah & Rayees A. Ione 319706 (holotype: LWG!)". Type: India. Himachal Pradesh: Lahul & Spiti, on way to Keylong from Koksar, 32º30'N, 77º02'E, 25 July 2018, *I. Hurrah & R.A. Ione 319706* (holotype, LWG image!).

Perennial herbs, 23-84(150) cm tall. *Rootstock* 7-17 mm in diameter, ± horizontal, not tuberculate, not turnip-shaped, with thickened roots along the rootstock. *Stem* erect, leafy, not rooting at nodes, stolons absent, without vegetative stems, with patent to retrorse, eglandular hairs 0.2-1.7 mm long and, sometimes, patent, glandular hairs 0.4-1.2 mm long. *Basal leaves* in a ± deciduous rosette, cauline leaves opposite; leaf laminas (4.2)7-10.6(16.5) cm long, 5-19.8 cm wide, not peltate, palmatifid [ratio main-sinus length/middle segment length = (0.81)0.87-0.91(0.94)], polygonal in outline, base cordate, not coriaceous, with nerves not projected, with appressed, eglandular hairs on both surfaces; segments (5)7(9), in 1 plane, middle segment rhombic, (2.2)4-6.3(10.7) mm wide at the base [ratio segment width at the base/middle segment length = (0.05)0.07-0.10(0.17)], (10)16-23(28)-lobed in distal half [ratio secondary sinus length/middle segment length = (0.19)0.27-0.35(0.44)]; petioles up to 61 cm long, without abscission zone, terete, not swollen, not deflexed in age, with retrorse to patent, eglandular hairs 0.2-0.9 mm long and, sometimes, patent, glandular hairs 0.4-1.1 mm long; stipules 6.7-19.6 mm long, 1.5-5.5 mm wide, lanceolate, free, papery, brown, with eglandular hairs on abaxial surface and on the margin, usually glabrous adaxially. *Inflorescence* a dichasial cyme; cymules 2-flowered, solitary [ratio cymule length/leaf length = (0.8)1.8-2.5(4.4)]; peduncles (13)33-73(103) mm long, with patent to retrorse, eglandular hairs 0.1-0.9 mm long and, usually, patent, glandular hairs 0.4-1 mm long; bracteoles 4.5-15.3 mm long, 0.5-2.3 mm wide, lanceolate, whorled; pedicels (2.7)8-13.7(25.9) mm long, with patent to retrorse, eglandular hairs 0.1-0.4 mm long and patent, glandular hairs 0.3-1.2 mm long. Flowers actinomorphic. *Sepals* (6.7)8.8-10.1(11) mm long, 2.8-5.4 mm wide, lanceolate, smooth, not accrescent, nerves (3)5, mucro (1.7)2.3-3.1(4.3) mm long [ratio mucro length/sepal length = 0.17-0.43], with patent eglandular hairs 0.2-0.8 mm long and patent glandular hairs 0.2-1 mm long on the abaxial surface, glabrous adaxially. *Petals* (12.6)14.8-19.2(22.6) mm long, (7)9-13(16.4) mm wide, erect-patent, rounded, without claw, blue, sometimes purple or white, glabrous on both surfaces, ciliate on the basal margin, with hairs 0.3-0.7 mm long. *Stamens* 10, both whorls bearing anthers; filaments (7.2)8.7-10.3(10.7) mm long, lanceolate with a broad triangular base and an abruptly narrowed apex, pink to dark violet, glabrous on the abaxial surface, ciliate on the proximal third, with hairs 0.1-0.6 mm long; anthers (1.8)2.2-2.6(3.1) mm long, dark violet to blue black. Nectaries 5, hemispheric, with a tuft of hairs at the top, dorsally glabrous. *Gynoecium* 6.3-13.3 mm long, pink to dark purple. *Fruit* (29)32-35(37.8) mm long, reflexed when immature, discharge of seed-ejection type; mericarps 3.5-5.4 mm long, 1.3-2.5 mm wide, without a strand of fibers, not compressed at the apex, smooth (usually with 1-2 transverse veins at the apex), without basal beak, with a basal callus, without a basal prong, brown, with ± appressed eglandular 0.2-0.8 mm long and patent glandular hairs 0.4-1 mm long (mainly at the apex); rostrum 22-29 mm long, with a narrowed apex 4.8-9.9 mm long, not twisted, with ± patent, eglandular hairs 0.1-0.4 mm long and patent, glandular hairs 0.3-1 mm long; stigmatic remnants 2-3.4 mm long, with 5 glabrous lobes. *Seeds* 2.7-3.6 mm long, 1.5-2 mm wide, reticulate, uniformly colored, brown, glabrous. Cotyledons with entire margin. Fig. 125, 126.

Pollen. *Geranium*-type (Bortenschlager 1967: 429; Gagnepain 1903: 88 [sub *G. affine*]; Lu & al. 1996: 320; Park & Kim 1997: 311; Stafford & Blackmore 1991: 70; Tan & al. 1996: 210; Velasco 1992b: 54).

Chromosome number. 2*n* = 24?, 26?, 28, 28+B.

Phenology. Collected in flower from April to October.

Distribution. This species ranges through Europe (from Ireland to Ural Mountains) and Asia (from Caucasus and Turkey to eastern Siberia, through Afghanistan, northern India, Nepal, China, Kazakhstan and Mongolia) and it is introduced in southeastern Canada and northweastern U.S.A. (Fig. 127).

Habitat. Roadsides, fields, waste grounds, dunes, damp meadows and edge of deciduous or mixed forests; 0-4300 m.

Representative specimens examined. **Andorra**. San Julià de Lòria: de borda del Sabater a Tolse, 42°26'N, 1°28'E, 27 Aug. 2002, *Aedo & al. 8446* (MA). **Armenia.** Ararat: Khosrov reserve, 24.6 km ENE Vedi, 39°56'N, 45°0'E, 28 June 2011, *Vitek & al. 11-091* (MA). Syunik: SSE Sisian, above village Shenatagh, 39°21'N, 46°8'E, 14 June 2007, *Oganesian & al. 07-0409* (MA). **Austria.** Burgenland: Leithagebirges, 47°50'N, 16°40'E, 26 July 2008, *Barta s.n.* (MA). Upper Austria: Baumberg, 48°21'N, 14°41'E, 16 June 1912, *Lang s.n.* (MA). **Belgium.** Wallonia: Natoye, prov. Namur, 50°20'N, 5°4'E, 14 Sep. 1979, *Lawalrée 21917* (MA). **Belorussiya.** Brest: Stawiozcze, 52°29'N, 23°22'E, 1868, *Andrzejowski 60* (P). **Bulgaria.** Okolnostite ni g Bo?ok Pibinskoto bodojraniliste, 23 June 1989, *Vbluev s.n.* (SOM). **Canada.** Alberta: along Atabasca River, Jasper Park, 52°53'N, 118°5'W, 25 July 1948, *Halpin 29* (DAO). Labrador: North West River, 53°32'N, 60°9'W, 30 July 1950, *Gillett & Findlay 5528* (DAO, GH, NY). New Brunswick: Queens Co., Petersville, 45°30'N, 66°25'W, 26 June 1964, *Squires s.n.* (DAO). Newfoundland Is.: Avalon, Conception Bay, Salmon Cove, 47°30'N, 53°30'W, 30 July 1982, *Crow & al. 82-744* (DAO). Nova Scotia: Yarmouth Co., Yarmouth, 43°50'N, 66°7'W, 19 Aug. 1920, *Bissell & Graves 21739* (GH, PH). Ontario: Wellington Co., Guelph Goldie's, 43°33'N, 80°15'W, 4 Aug. 1914 (DAO). Prince Edward Is.: Queens Co., Brackley Point, Blythe Hurst's, 46°26'N, 63°14'W, 22 Aug. 1953, *Erskine & Smith 2441* (DAO). Québec: Sainte Adelaide, 48°50'N, 64°30'W, 12 Aug. 1933, *Proulx s.n.* (MA). **China.** Gansu: SW Kansu, Tao river basin, valley opposite Choni, 34°35'N, 103°30'E, July 1925, *Rock 12855* (E). Hebei: Tschili, Hsiau Wu Tai, 38°24'N, 114°34'E, 23 Aug. 1917, *Limpricht 3013* (WRSL). Nei Mongol: Naima, 42°57'N, 120°50'E, 28 June 1935, *Eriksson 1031* (S). Qinghai: Yushu Xian, Jiangxi Gou, E of Jiangxi forest station on side E of Zi Qu, 32°4'N, 97°3'E, 29 Aug. 1996, *Ho & al. 2669* (CAS, GH, MO, TI). Shaanxi: Chiao Chen Hsien, 34°29'N, 107°8'E, 6 Aug. 1925, *Ling 9547* (US). Shanxi:

ciudad Taiyuan, distrito Loufan, presa Fen He, 35°33'N, 110°49'E, 17 July 1991, *Liu Tian Wei 241* (MO). Sichuan: prefectura Aba, distrito Hong Yuan, templo Shua Jing Si, 32°0'N, 102°36'E, 28 June 1957, *Zhang Zeyun 22609* (IBSC). Xinjiang: Burqin Xian, Kanas nature Reserve on slopes SE Kanas Cun, 48°41'N, 87°2'E, 7 July 2004, *Bartholomew & al. 9169* (CAS). Xizang: valley of Du Chu, Pasho district, Kham, 28°18'N, 88°32'E, 12 July 1936, *Hanbury-Tracy 32* (BM). **Czech Republic.** Hradec Králové: Sudetes, Narodni Prirovni reservaces Adrspach-Treplicke Staly, 50°37'N, 16°7'E, 9 Sep. 2000, *Castroviejo 15660* (MA). South Bohemian: Trebon, 49°0'N, 14°45'E, 11 Aug. 2010, *Calvo 4956* (MA). **Denmark.** Midtjylland: Thyboron, Jyllandiae, 56°42'N, 8°13'E, July, *Ujorb[?]lluy s.n.* (MA). **Estonia.** Lääne-Viru: Haapsalu, Kiideva ja Puise, 58°46'N, 23°33'E, 14 June 2010, *Calvo 4864* (MA). Saare: Livland, insel Oesel, 58°24'N, 22°29'E, 3 July 1902, *Kupffer 15931* (GB). **Finland.** Kanta-Häme: South Häme, Hämeenlinna, Poltinaho, 60°59'N, 24°26'E, 12 July 1990, *Lampinen 8905* (MA). Lapland: Kuusamo, Paanajärvi, Kauppila, 66°0'N, 29°15'E, 22 Aug. 1902, *Backman 284* (S). **France.** Occitanie: Alta Cerdanya, Llo, gorges del Segre, 42°25'N, 2°5'E, 19 Aug. 2009, *Calvo 4088* (MA): Bourgogne-Franche-Comté: Monts-Jura, pr. Boujeailles (Doubs), 46°53'N, 6°5'E, July, *Genty 600* (MA). Grand Est: Bas-Rhin dep., Wintzenbach, 48°55'N, 8°5'E, 17 Aug. 1980, *Schneider s.n.* (MA). **Georgia.** Mtskheta-Mtianeti: Mtiuleti, Khevi, Kazbegi, along road from Juta to Sno, 42°33'N, 44°44'E, 2 July 1999, *Merello & al. 2419* (MA, MO); Kasbegi region, 3 kmE of Kasbegi to Kuro mountain, 42°39'N, 44°40'E, 19 Aug. 1998, *Merello & Chiboshvili 2825* (G, MO). **Germany.** Baden-Württemberg: Ulm, Au (Donautal), pr. power station, 48°43'N, 8°1'E, 17 July 1979, *Stud. Biol. Univ. Turicensis s.n.* (MA). Bavaria: Bayern, Mittelfranken, Weibenburg, 49°56'N, 11°43'E, 28 July 1977, *Bochter s.n.* (MA). Hesse: Wiesbaden, 50°4'N, 8°14'E, 19 June 1901, *Dihm s.n.* (MA). **Great Britain.** England: Coates, pr. Cirencester, 51°42'N, 2°2'W, 5 June 1996, *Aedo 3858* (MA); Black Harry, near Longstone Edge, Bakewell, Derbyshire, 53°11'N, 1°40'E, 2 Aug. 1960, *Ball s.n.* (MA). Northern Ireland: Antrim, White Park Bay, 5 milles NE of Bushmills, 55°12'N, 6°32'W, 28 Aug. 1961, *Brummitt 1447* (MA). **Hungary.** Hajdú-Bihar: Brasso, 47°42'N, 21°23'E, 4 Aug. 1903, *Degen s.n.* (GB); Nyitra, Zambokrit, 48°0'N, 21°50'E, 23 May 1910, *Giuzery s.n.* (BC). **India.** Jammu-Kashmir: Kashmir, Sinthan pass, 33°34'N, 75°30'E, 28 July 1917, *Stewart 3103* (MO); Tulion above Pahlgam, 34°0'N, 75°21'E, 30 Aug. 1945, *Stewart 21868* (US). **Ireland.** Connacht: Galway City, near and on the University College Galway campus, 53°22'N, 8°45'W, 18 July 1997, *Nee 47121* (NY). **Italy.** Trentino-Alto Adige: Bolzano, Siusi, castell Salego, 46°32'N, 11°33'E, 12 Aug. 2019, *Aedo 26731* (MA); Vipiteno, 46°54'N, 11°26'E, 30 July 1926, *Ball s.n.* (GB). **Kazakhstan.** East Kazakhstan: deserti Soongoro-Kirghisici, ad rivulum Tschar, inter Ustkamenogorsk et Buchtarminsk, 49°51'N, 82°27'E, 1840, *Karelin & Kiriloff 658* (GH, W); Kazajistán oriental, región Shemanayjinskiy, a 10 km al N de Pianoyarskiy, 50°37'N, 81°54'E, 1 Aug. 1932, *Yakubova s.n.* (MA). **Mongolia.** Bayan-Ölgii: Sapadnaia Mongolia, Mongolisky Altai Basseyn r. Sanginil-gol, Daian-Nur Baian-Ulegeyskogo, 48°58'N, 89°57'E, 16 July 1988, *Kamelin 1676* (LE). Ulaanbaatar: Manzhir on the way up to the new monastery, 47°48'N, 106°59'E, 16 Aug. 1992, *Bartholomew 15* (CAS); Ulan-Bator, 47°55'N, 106°55'E, 27 Aug. 1974, *Sakiyama s.n.* (TI). **Nepal.** Bagmati: between Chutta and Sialgarhi, E of Gumba, 27°46'N, 85°22'E, 29 July 1952, *Polunin & al. 4937* (BM). **Netherlands.** Gelderland: Veenendaal de Klomp, 52°3'N, 5°35'E, 5 July 1962, *Schouten s.n.* (MA). **Norway.** Agder: Vest-Agder, Farsund, Vigan, 58°5'N, 6°47'E, 23 Aug. 1968,

Fig. 125. *Geranium pratense*. a, b. Habit. c. Inflorescence. d. Bracteoles. e. Flower without petals and sepals. f. Sepal. g. Petal. h. Stamen. i. Fruit. j. Mericarp. k. Seed. (Based on: a, d, *Sunding s.n.,* MA-724170; b, c, e-h, *Aedo 2381,* MA; i-k, *Aedo 16748,* MA).

Fig. 126. *Geranium pratense* (Based on: a, *Aedo 16748,* MA; b-d, *Aedo 16799,* MA; e, *Calvo 4864*, MA, photo: J. Calvo).

Hoiland s.n. (O); Trøndelag: Sor-Trondelag, Stjordal, 63°28'N, 10°56'E, 20 July 1900, *Hiorthay s.n.* (O). **Poland.** Pomeranian: Danzig, 54°21'N, 18°37'E (P). Subcarpathian: Regio Subcarpatica, Jaslo, 49°44'N, 21°28'E, 26 Aug. 1969, *Frey & Piekos s.n.* (FI, GB, MO). **Romania.** Nord-Est: Arges, Cheile Rucarului, 46°50'N, 25°50'E, 7 July 1998, *Güemes & Bacchetta 2359* (MA). Sud-Muntenia: Prahova, pr. Cheia, 45°27'N, 25°55'E, 7 Aug. 2009, *Aedo 16748* (MA). **Russia.** Altay: lago Teleskoje, Chiri, 51°21'N, 87°49'E, 8 Aug. 1996, *Castroviejo & al. 13862SC* (MA). Arkhangelsk: islas Solovetsky, Gran Solovetsky, castillo y lago Sviatoe, 65°1'N, 35°43'E, 19 July 2012, *Quintanar & al. 4914* (MA). Bashkiriya: Ufa, 54°47'N, 56°2'E, 28 July 1953, *Muryseva s.n.* (M). Buryatiya: pr. la ciudad de Verjneudinsk, Ulán-Udé, 51°49'N, 107°36'E, 17 July 1927, *Ikonnikov 47* (S). Chita: Kalganskia rajon, Kalgi, 50°58'N, 118°54'E, 24 June 1953, *Romanova s.n.* (H). Dagestan: Upper Gunib, 42°23'N, 46°57'E, 3 Aug. 1904, *Busch s.n.* (MA). Kabardino-Balkaria: Kaukasus, Elbrus-Gebiet, Baksan-Tal nahe Itkal, 43°41'N, 43°32'E, 24 July 1967, *Quasdorf s.n.* (B). Kaluga: Juchnov, pr. pagum Palatki ad flum. Ugra, 54°44'N, 35°22'E, 3 June 1974, *Skvortsov s.n.* (M). Karachayevo-Cherkasskaiya: Kaukasus, Teberda, Dshamagattal, 43°46'N, 41°55'E, 15 July 1977, *Beurton s.n.* (B). Karelia: Karelia Onegensis, Dvorets, 62°9'N, 33°54'E, 13 July 1870, *Norrlin s.n.* (H). Khabarovsk: Khabarovsk, 48°28'N, 135°5'E, 12 Aug. 1980, *Murata s.n.* (TI). Krasnodar: Maly-Minussa, 3 km ESE Kirche, 53°43'N, 91°49'E, 30 July 1997, *Hand s.n.* (B). Krasnoyarsk: Jenisei, Dudino, 52°45'N, 84°21'E, 9 June 1875, *Lundström s.n.* (S). Kursk: Kursk, 51°44'N, 36°11'E, 1866, *Eberwein s.n.* (G). Mari: prov. Kasan, distr. Kosmodemianak, pr. Korotni, 56°21'N, 46°32'E, *Busch s.n.* (WU). Mordoviya: ciudad de Insar, 53°51'N, 44°22'E, 15 June 1994, *Skvortsov s.n.* (B). Moscow: región de Stupinskiy, localidad Myshenskoe, 55°1'N, 37°44'E, 3 June 1990, *Savenok s.n.* (B). Murmansk: Lapponia Imandrae, ad pagum Umba, 66°41'N, 34°20'E, 21 Aug. 1892, *Kihlman 293* (H, S). Nizhny Novgorod: alrededores de la ciudad de Gorkiy, praderas cerca río Volga, 56°19'N, 44°0'E, 16 June 1968 (M). Orlov: Orel-Mtsensko, 52°58'N, 36°4'E, 27 June 1969, *Rintanen s.n.* (H). Perm: Permsk, 61°8'N, 58°56'E, 7 June 1883, *Teploukov 90* (M). Rostov: Poltava, 49°23'N, 40°10'E, 27 July 1891, *Paczoski*

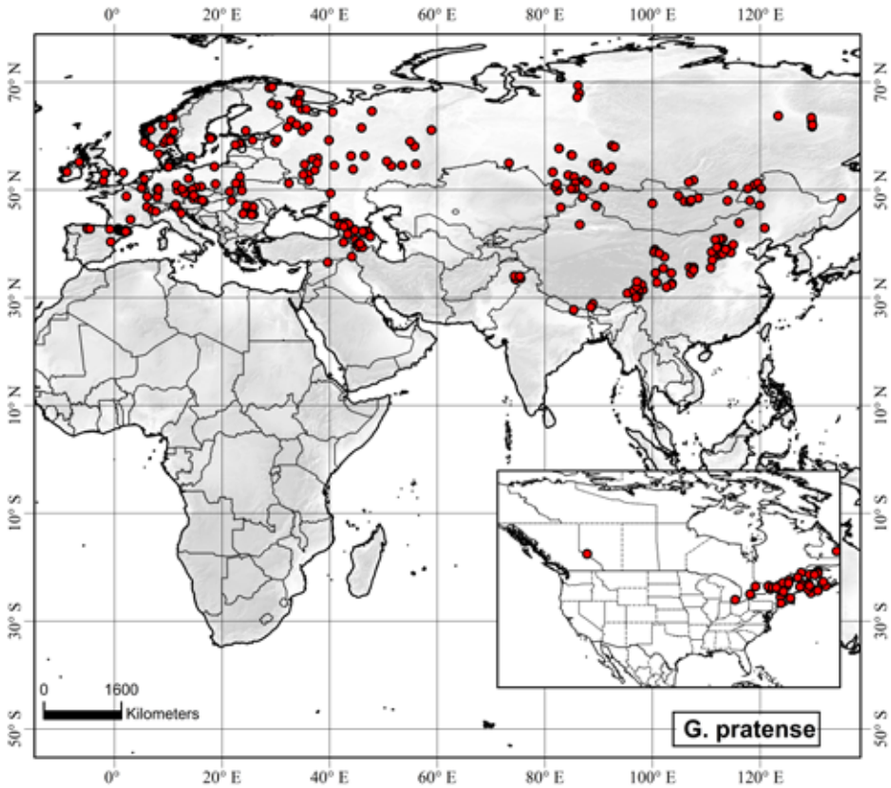


Fig. 127. Distribution of *Geranium pratense*.

s.n. (G). Ryazan: E de la aldea de Izhevskoye, 54º33'N, 40º52'E, 25 June 1992, *Tikhomirov & al. s.n.* (B). Samara: Shentela raion, 2.5 km S of the village of Timiashevo, 54º27'N, 51º29'E, 3 July 1990, *Salo s.n.* (H). St. Petersburg: región Luzhskiy, alred. de Tolmachevo, en el valle del río Luga, 58º51'N, 29º54'E, 28 Apr. 1959, *Ber s.n.* (H). Stavropol: lake Tambukan near Pyatigorsk, 43º56'N, 43º8'E, 13 July 1975, *Degener 34048* (NY). Tatariya: Kasan, distr. Tschistopol, 55º21'N, 50º38'E, 12 Aug. 1884, *Korshinsky s.n.* (G). Tula: Plavsk, 53º42'N, 37º17'E, 27 June 1969, *Rintanen s.n.* (H). Tuva: Khakas, Ordzhonikidzevsk Distr., Agaskir, 54º46'N, 89º0'E, 16 July 1992, *Wakabayashi & al. 9328418* (TI). Vologda: Wologda, 59º13'N, 39º53'E, *Ubamuskin s.n.* (B). West Siberia: Omsk, 55º0'N, 73º20'E, *Slowzow s.n.* (S). Yakutiya: Myachey-Sise range, SE slopes, 5 km S of Tabaga, 61º46'N, 129º39'E, 1 June 2002, *Väre 13430* (H). **Spain.** Gerona: El Ripollès, pr. Fornells de la Muntanya, 42º19'N, 2º3'E, 11 July 2014, *Calvo & Ross 6641* (MA). Palencia: Dehesa de Montejo, bajo el Alto de la Cruz, pr. Colmenares, 42º48'N, 4º31'W, 2 July 1997, *Sánchez Pedraja MM78/97* (MA). Teruel: Sierra de Gúdar, Valdelinares, pr. Morrón del Bolage, al SW, 40º23'N, 0º38'W, 23 July 2005, *Arán & Tohá 6179* (MA). **Sweden.** Skåne: Bokelund, 56º7'N, 14º19'E, 20 Aug. 1916, *Olson s.n.* (GB). Uppsala: Upsala, 59º51'N, 17º38'E, 16 July 1859, *Zetterstedt s.n.* (P). **Switzerland.** Valais: 600 m NE vom Bahnhof Zermatt, 46º1'N, 7º44'E, 29 July 1949, *Büel s.n.* (FI, M). Vaud: Bex, 46º14'N, 7º1'E, 1898 (MO). **Turkey.** Hakkâri: Yüksekova›dan Hakkari›ye, 37º37'N, 44º9'E, 13 July 2001, *Dönmez 9709* (HUB). Kars: Sarikamis, 40º19›N, 42º35'E, 7 July 1957, *Davis 30772* (BM). **Ukraine.** Chernivtsi: Czernigov, pr. opp. Borsna, in vicinitate pag. Evlaschovka, 51º15'N, 32º26'E, 23 Aug. 1907, *Lochanjko 3434b* (A, C, G, MO, S, US). Lviv: Galizien, Las mai Janow, 49º55'N, 23º43'E, 21 Sep. 1939, *Merxmüller 11426* (M). **USA.** Connecticut: New Haven Co., Naugatuck, 41º29'N, 73º3'W, 16 July 1905, *Bristol 4837* (GH); Maine: Aroostook Co., Silver Ridge, 45º48'N, 68º19'W, 11 July 1939, *Perkins s.n.* (VT); Massachusetts: Essex Co., Ipswich River Wildlife Sanctuary, 42º39'N, 70º53'W, 13 June 1955, *Harris & Bean 9954* (GH); Michigan: Washtenaw Co., Ann Arbor, 42º16'N, 83º43'W, 21 July 1954, *Carothers s.n.* (MICH); Vermont: Bennington, 42º52'N, 73º11'W, 1 Aug. 1937, *Ridlon s.n.* (VT).

Discussion. *Geranium pratense* is a robust species with a well-developed ± horizontal rootstock covered by thickened roots. The leaves are normally of great size, opposite, deeply divided, and usually with seven segments that are clearly distinguishable. The degree of division of the leaves is variable throughout the area of the species. The pedicels are usually short and more or less reflexed, at least when the fruits are immature. The sepals have a long mucro. Petal size and color are also highly variable. This species usually has blue petals, but more or less dark purple or even white petals can be found. Staminal filaments color and stigma color also vary in a similar way, with the occasional appearance of specimens with very dark stamens and stigma. The indumentum of *G. pratense* comprises glandular and eglandular hairs on the inflorescence, while in the lower parts of the plant it is predominantly eglandular. The glandular indumentum varies sometimes in the same specimen, in which some peduncles and sepals have few or no glandular hairs.

Bobrov (1949) accepted as species two forms from the Caucasus mountains, based mainly on the color of their petals: *G. finitimum* and *G. ruprechtii,* and a form of deeply dissected leaves from Eastern Siberia and Mongolia: *G. transbaicalicum*. Novoselova (1998) in her study of Caucasian species, assumes Bobrov's treatment, adding some quantitative differences in petal length and rostrum narrowed apex length. However, she indicated that there is a significant variability of the features that could differentiate *G. pratense* from these local Caucasian forms. Peschkova (1996) recognized from Siberia a variant of white petals, *G. affine,* and some forms of *G. pratense* and *G. transbaicalicum* based on different indumentum arrangement. Yeo (2002a) considered *G. pratense* as a very variable species with some regional variants part of which were recognized with informal names (i.e., "European Form" or "Nepal Form") or accepted as species with doubts. The latter is the case of *G. transbaicalicum,* about which Yeo (2002a) indicated: "There is in fact a series of plants progressively more like the "European Form" of *G. pratense* that makes me reluctant to accept *G. transbaicalicum* as deserving specific rank."

Geranium pratense is distributed over a large area with more than 8000 km between the westernmost localities in Ireland and Spain, and the easternmost in northeastern China, and consequently occurs in very different habitats and climatic conditions. This species displays a wide variability in leaf shape, indumentum and flower color. Leaf blades of *G. pratense* are deeply divided with a deeper main and second sinuses. The extreme leaf-divided forms have been segregated as *G. transbaicalicum*. However, these plants can be found along the area of *G. pratense* intermixed with normal forms. Petal color is usually bluish but it also varies from white to purplish and is not related to leaf division or other characters which suggests that it has little taxonomic importance. A continuum of intermediates suggests that these forms do not deserve taxonomic recognition. Petal size also shows a remarkable range in variation, but it is not correlated with leaf shape, petal color, or indumentum.

According to Van Loon (1984b: 270) the chromosome number 2*n* = 24 attributed to this species should be confirmed. Likewise, the number 2*n* = 26 attributed to this species (Martin & al. 2022) should be confirmed.

Geranium pratense is widely used in gardens and occasional or naturalized in Australia, New Zealand, Canada and U.S.A. Its presence in Australia, probably as garden-escape, is based on a specimen at AD could not be studied, while its presence in New Zealand is recorded by Webb & al. (1988: 729).

36. Geranium saxatile Kar. & Kir., Bull. Soc. Imp. Naturalistes Moscou 15(1): 177. 1842. *Geranium collinum* var. *saxatile* (Kar. & Kir.) Regel, Trudy Imp. S.-Peterburgsk. Bot. Sada 5: 252. 1877. Type locality: "195. Geranium saxatile Kar. et Kir. ... Hab. in subalpinis et alpinis lapidosis Alatau ad fl. Lepsa, Baskan et Sarchan. Fl. Junio, Julio".

Type: Kazakhstan. Alatau ad fl. Lepsa, Baskan et Sarchan, 46°14'N, 78°56'E, 1841, *G.S. Karelin & I.P. Kiriloff, Plantae Karelinianae 195* (lectotype, designated by Novoselova 1996: 87, LE!).

Geranium grandiflorum Edgew., Trans. Linn. Soc. London 20: 42. 1846, nom. illeg., non L. 1753. Type locality: "Hab. Himala, in pascuis elatis alt. ped. 9000-12,000. Mána, Jauglig, & c.". Type: India. Uttaranchal, Himala, Mána, 31º04'N, 79º24'E, 1844, *M.P. Edgeworth 321* (lectotype, here designated, K-000729337!).

Geranium himalayense Klotzsch in Klotzsch & Garcke, Bot. Ergebn. Reise Waldemar: 122, Taf. 16. 1862. Type locality: "Dr. Hoffmeister sammelte sie im Himalaya". Type: Klotzsch & Garcke, Bot. Ergebn. Reise Waldemar, Taf. 16. 1862 (lectotype, here designated).

Geranium collinum var. *alpinum* Regel, Trudy Imp. S.-Peterburgsk. Bot. Sada 5: 253. 1877. *Geranium grandiflorum* var. *alpinum* (Regel) R. Knuth in Engl., Pflanzenr. IV.129 (Heft 53): 188. 1912. *Geranium regelii* Nevski, Trudy Bot. Inst. Akad. Nauk SSSR, Ser. 1, Fl. Sist. Vyss. Rast. 4: 304. 1937. Type locality: "In alpibus turkestanicis altitudine 6-11,000' satis frequens". Type: Kyrgyzstan. W Alatau, Karaburapass, 42°12'N, 71°35'E, Aug. 1876, *A. Regel s.n.* (lectotype, here designated, LE!).

Geranium collinum var. *viscosum* Regel, Trudy Imp. S.-Peterburgsk. Bot. Sada 5: 253. 1877. Type locality: "Vidi specimen unicum a Cl. Sewerzowio in trajectu Kurmety (Alatau) lecta". Type: Kazakhstan. Alatau, Kurmety, 43°01'N, 78°17'E, *N.A. Sewerzoff s.n.* (lectotype, here designated, LE!).

Geranium candidum Kom., Trudy Imp. S.-Peterburgsk. Obšč. Estestvoisp., Vyp. 3, Otd. Bot. 26: 151. 1896. *Geranium collinum* var. *candidum* (Kom.) B. Fedtsch., Trudy Bot. Sada Akad. Nauk S.S.S.R. 23(2): 509. 1904. Type locality: "... Sobrano u perevalov Duk'-Don, Kafaraca, Ruzui-rabat', Sigdi" [in Russian]. Type: Tajikistan. Flora Seravschanica, fl. Djidjik-rut, ad trajectum Schutur-Gardon (Sigdi), 39º15'N, 68º40'E, 14 July 1892, *V.L. Komarov s.n.* (lectotype, here designated, LE!; choice made by Novoselova, in sched.).

Geranium meeboldii Briq., Annuaire Conserv. Jard. Bot. Genève 11-12: 184. 1908. Type locality: "Himalaya bor.-occ.: ad pedem montis Kangilá supra Kangi, jull. 1905 (Meebold n. 3034)". Type: India. Jammu and Kashmir, Kangi, montis Kangilá, 34°15'0"N,76°35'E, July 1905, *A.K. Meebold 3034* (lectotype, designated by Bobrov 1949: 45, G-00415308!).

Geranium collinum var. *himalaicum* R. Knuth, Repert. Spec. Nov. Regni Veg. 34: 144. 1933. Type locality: "West-Himalaya: Prov. Lohol, Bhaga valley (Schlagintweit a. 1886 n. 2783!), Kyelang (Koelz a. 1930 n. 402!)". Type: India. Himachal Pradesh, West-Himalaya, prov. Lohol, Bhaga valley, 32°41'N, 77°14'E, 15 June 1856, *A. Schlagintweit 2783* (lectotype, here designated, M-0251580!; isolectotype, WRSL!).

Geranium sophiae Fed., Bot. Zhurn. S.S.S.R. 33: 28, 29 tab. 1. 1948. Type locality: "Habitat in lapidosis mobilibus ad pedes rupium marmorearum, in summis montibum Alaschtau, Baubaschata, Untama jugi Ferganici, in regione subnivali, non raro juxta glaciem nivesque. 18 VII, 19 VIII, 2 IX 1946 a me lecta... Specimina authentica in herb. Inst. Bot. nom. V. L. Komarovii Acad. Sci. URSS in Leningrad conservantur". Type: Kyrgyzstan. Baubaschata in monte Untama jugi Ferganici, 41°25'N, 73°00'E, 2 Sep. 1945, *A. Fedorov s.n.* (lectotype, here designated, LE!).

Geranium ferganense Bobrov in Kom. & al. (eds.), Fl. URSS 14: 713. 1949. Type locality: "Fergana septentrionalis, in trajectu Aflatun 8 VII 1908, leg V. Rovinsky; in Inst. Bot. Ac. Sc. URSS asservatur". Type: Kyrgyzstan. Fergana septentrionalis, in trajectu Aflatun, 41°38'N, 71°56'E, 8 July 1908, *V. Rovinsky s.n.* (holotype, LE!).

Geranium exul Rech. f. & Riedl, Ann. Naturhist. Mus. Wien 65: 32, Taf. 1 Fig. 2. 1962. Type locality: "NE-Afghanistan: Koul-Choghnan, Yelgah Pam Darreh, commum, 7.8.1960 (K. Lindberg 919, Holotypus, W)". Type: Afghanistan. Koul-Choghnan, Yelgah Pam Darreh, 36°36'N, 70°09' E, 7 Aug. 1960, *K. Lindberg 919* (holotype, W!).

Geranium minutum Ikonn. in Ikonn. & Czerep., Definitorium Plantarum Vascularium Badachschaniae: 243. 1979. Type locality: "Tadshikistania, distr. Vachan-Ischkaschim, in declive austro-orientali vallis fl. Abcharv, 3140 m s.m., 5 VII 1935, N 981, leg. P. Ovczinnikov et K. Afanassiev (LE)". Type: Tajikistan. Vachan-Ischkaschim, in declive austro-orientali vallis fl. Abcharv, 37°40'N, 68°50'E, 5 July 1935, *P. Ovczinnikov & K. Afanassiev 981* (holotype, LE!).

Geranium aconitifolium var. *album* B. Ghosh & U.C. Bhattach., J. Econ. Taxon. Bot. 10(2): 312. 1988. *Geranium pseudoaconitifolium* var. *album* (B. Ghosh & U.C. Bhattach.) Aswal & Mehrotra, Indian J. Forest. 13(1): 66. 1990. Type locality: "INDIA: Himachal Pradesh, Thumla, Spiti, valley, 4200 m, 1-8-1972, U.C. Bhattacharyya 49241A (CAL-Holotype); 49241 B, 49241C and 49241D (BSD-Isotype)". Type: India. Himachal Pradesh, Thumla, Spiti, 33°49'N, 74°56'E, 1 Aug. 1972, *U.C. Bhattacharyya 49241A* (holotype, CAL!; isotype, BSD).

Geranium aedonianum Hurrah & V. Wagh, Phytotaxa 489(3): 243. 2021. Type locality: "India, Ladakh, Kargil district, Suru valley, Panikhar village, 34º07´184" N, 75º57'121" E, 3252 m. 15 July, 2018. Imtiyaz A. Hurrah 303976 (holotype: LWG!)". Type: India. Ladakh, Kargil district, Suru valley, Panikhar village, 32º07'N, 75º57'E, 15 July 2018, *I. Hurrah 303976* (holotype, LWG image!).

Perennial herbs, 9-30(48) cm tall. *Rootstock* 5.5-11 mm in diameter, ± horizontal, not tuberculate, not turnip-shaped, with thickened roots along the rootstock. *Stem* erect, leafy, not rooting at nodes, stolons absent, without vegetative stems, with patent to retrorse, eglandular hairs 0.1-0.8 mm long and, sometimes, patent, glandular hairs 0.2-1.4 mm long. *Basal leaves* in a ± persistent rosette, cauline leaves opposite; leaf laminas (1.4)3-4.4(6.2) cm long, 1.5-8.1 cm wide, not peltate, palmatifid [ratio main-sinus length/middle segment length = (0.63)0.76-0.83(0.89)], polygonal in outline, base cordate, not coriaceous, with nerves not projected, pilose, with appressed, eglandular hairs on both surfaces; segments 5, in 1 plane, middle segment rhombic, (2)3.7-7.2(9.8) mm wide at the base [ratio segment width at the base/middle segment length = (0.12)0.17-0.24(0.41)], (6)8-13(19)-lobed in distal half [ratio secondary sinus length/middle segment length = (0.13)0.23-0.29(0.34)]; petioles up to 28 cm long, without abscission zone, terete, not swollen, not deflexed in age, with retrorse to patent, eglandular hairs 0.1-0.7 mm long and, sometimes, patent, glandular hairs 0.4-1.6 mm long; stipules 3.6-11 mm long, 0.7-3.2 mm wide, lanceolate, free, papery, brown, with eglandular hairs on abaxial surface and on the margin, glabrous adaxially. *Inflorescence* a dichasial cyme with monochasial branches; cymules 2-flowered, solitary [ratio cymule length/leaf length = (1.1)1.8-3.7(7.4)]; peduncles (20)40-107(230) mm long, with retrorse, appressed, eglandular hairs 0.1-0.6 mm long and, usually, patent, glandular hairs 0.2-2.6 mm long; bracteoles 3.5-9.5 mm long, 0.5-1.6 mm wide, lanceolate, whorled; pedicels (1.2)5.9-21.8(83) mm long, with retrorse, uncinate, eglandular hairs 0.1-0.6 mm long and, usually, patent, glandular hairs 0.2-2.1 mm long. Flowers actinomorphic. *Sepals* (6.7)8-9.7(11.3) mm long, 2.6-4.6 mm wide, lanceolate,

smooth, not accrescent, nerves 3-5, mucro (0.6)0.9-1.6(2.5) mm long [ratio mucro length/sepal length = 0.08-0.25], with ± patent, eglandular hairs 0.1-0.6 mm long and usually patent, glandular hairs 0.3-1 mm long on the abaxial surface, glabrous adaxially. *Petals* (12)15.4-21.1(27.7) mm long, (5.6)8-12(16.3) mm wide, erect-patent, rounded or rarely slightly emarginate (notch 0.3-1 mm deep), without claw, purple, glabrous on both surfaces, ciliate on the basal margin, with hairs 0.2-1 mm long. *Stamens* 10, both whorls bearing anthers; filaments (7.4)8.8-10.5(14.3) mm long, lanceolate with a broad triangular base and an abruptly narrowed apex, lilac, glabrous except for a some cilia 0.1-0.5 mm long on the proximal half; anthers (1.9)2.1-2.6(2.9) mm long, dark blue. Nectaries 5, hemispheric, with a tuft of hairs at the top, dorsally glabrous. *Gynoecium* 6-15 mm long, purple. *Fruit* (27)29-36(37) mm long, reflexed when immature, discharge of seed-ejection type; mericarps 3.3-5.1 mm long, 1.4-2.1 mm wide, without a strand of fibers, not compressed at the apex, smooth (usually with 1-2 transverse veins at the apex), without basal beak, with a basal callus, without a basal prong, brown, with ± appressed, eglandular 0.1-0.4 mm long and patent, glandular hairs 0.2-0.7 mm long (mainly at the top of the mericarp); rostrum 21-30 mm long, with a narrowed apex 7.7-10.9 mm long, not twisted, with ± patent, eglandular hairs 0.1-0.2 mm long and patent, glandular, hairs 0.4-0.9 mm long; stigmatic remnants 1.9-3.3 mm long, with 5 glabrous lobes. *Seeds* 2.3-3.4 mm long, 1.5-1.9 mm wide, reticulate, uniformly colored, brown, glabrous. Cotyledons with entire margin. Fig. 128.

Pollen. *Geranium*-type (Perveen & Gaiser 1999: 265 [sub *G. himalayense*]).

Chromosome number. 2*n* = 28.

Phenology. Collected in flower from April to October.

Distribution. This species ranges through Afghanistan, Pakistan, northern India (Himachal Pradesh, Jammu-Kashmir and Uttaranchal), Nepal, eastern Kazakhstan, Kyrgyzstan, Tadzhikistan and Uzbekistan to western China (Xinjiang and Xizang) (Fig. 129).

Habitat. Meadows, river banks, grassy slopes, steep hillsides with shrubs and edge of *Picea* A. Dietr., and *Pinus* L. forests; 1900-5000 m.

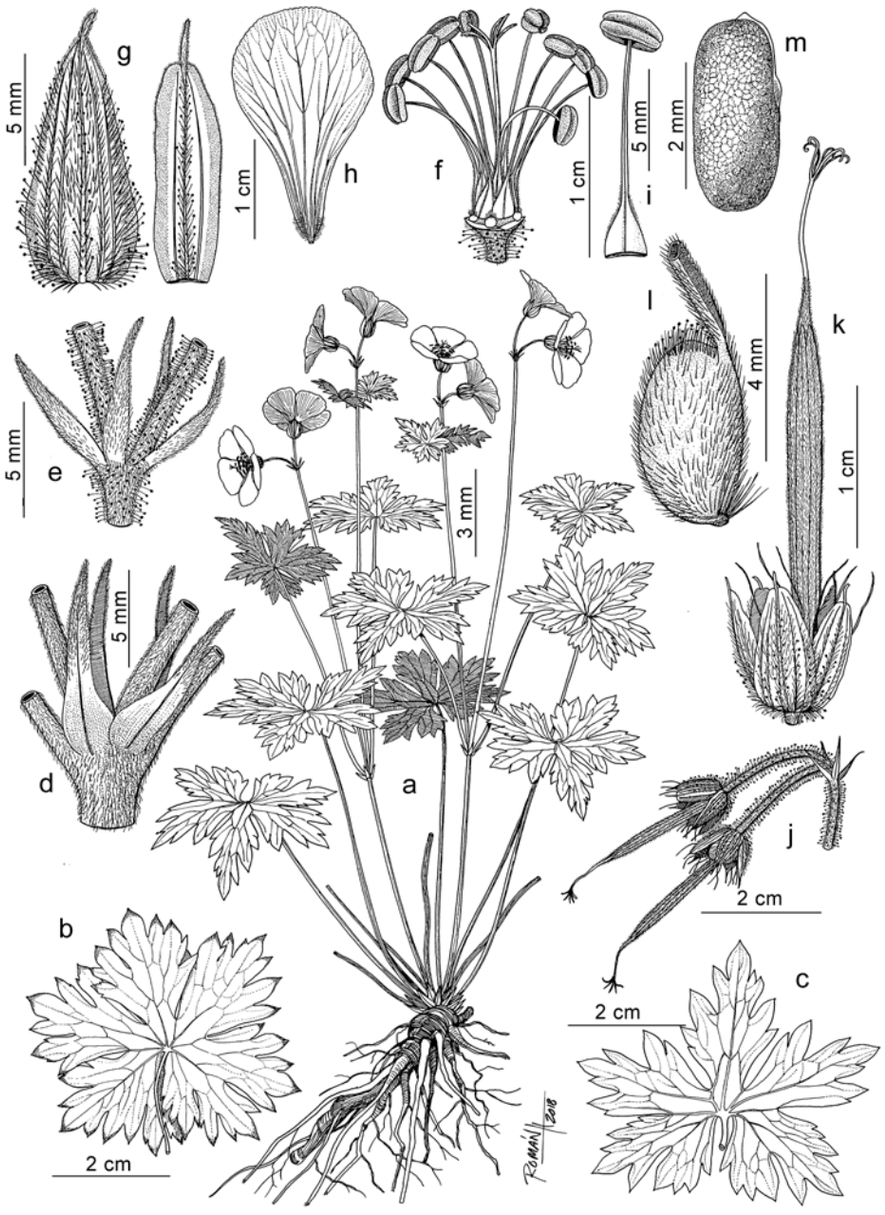


Fig. 128. *Geranium saxatile*. a. Habit. b, c. Leaves. d. Stipules. e. Bracteoles. f. Flower without petals and sepals. g. Sepals. h. Petal. i. Stamen. j. Cymule in fruit. k. Fruit. l. Mericarp. m. Seed. (Based on: a, c, d, f-i, *Brotherus 671bis,* H-1293323; b, e, *Kaletkina 6683,* MO; j, k, *Merce s.n.,* MA-784239; l, m, *Al-Shehbaz & Hisoriev 6117,* MO).

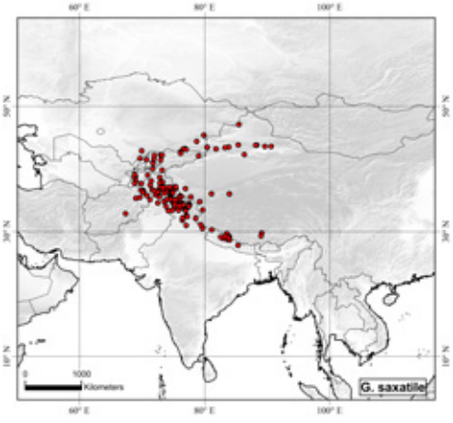


Fig. 129. Distribution of *Geranium saxatile*.

Representative specimens examined. **Afghanistan.** Badakhshan: N bay point lake Shewa, 37°25'N, 71°19'E, 29 June 2008, *Schloeder & Jacobs 1763* (M). Baghlan: N Salang pass near first tunnel, 35°18'N, 69°2'E, 6 July 1969, *Ekberg 9559* (GB). Nuristan: Chamar pass, S side, 35°4'N, 71°17'E, 4 Aug. 1956, *Thesiger 1395* (BM). Takhar: Khost-o-Fereng, oberes Echani-Tal, 36°14'N, 70°10'E, 16 July 1965, *Podlech 11830* (G, M). Zabul: Sangcharak, 40 km SSW mountains above Damardan, 32°51'N, 67°23'E, 3 Aug. 1969, *Freitag 6636* (M). **China.** Xinjiang: in montibus Karakorum, pr. Drugub, 35°30'N, 77°49'E, 13 Aug. 1933, *Ambolt 6262* (S); Turkestania sinensis, in montibus Kuln-un, camp 710 ad obo 41, 36°0'N, 83°59'E, 2 July 1933, *Ambolt 6080* (S); S of Taxkorgan, above Mazar, W of KKH, 37°10'N, 75°23'E, 3 Aug. 1991, *Miehe & Miehe 5674* (M); prefectura Yili, distrito Ba Yin Gui Leng, población Hejing, pueblo Gong Naisi, 42°18'N, 86°22'E, 26 July 1989, *Xu Langran 1555* (PE); Tian Shan, upper Koksu Takkes, 43°11'N, 81°51'E, 27 June 1930, *Ludlow 704* (BM); E Tian Shan, Narat range, N slopes Manas, valley 4 km lower pass Danudaban, 43°50'N, 85°25'E, 23 July 1957, *Junatov & Yuan I-fen 1044* (MO). Xizang: distrito Rikaze, población Nie La Mu, XiaoGu Ling, 29°17'N, 89°3'E, 21 June 1975, *Qinghai-Tibet Exped. 5783* (KUN); Mt. Bogoda in Tien Shan Mts., 43°48'N, 88°21'E, 19 June 1981, *Nakajima s.n.* (KYO). **India.** Himachal Pradesh: Srinagar, Ratigham forest, 30°57'N, 77°5'E, 26 Apr. 1970, *Freitag 7917* (M); Punjab, Kangra, Lahul, Drokpo Yokma, 32°10'N, 76°30'E, 30 Aug. 1933, *Koelz 6878* (US); Lahol, Rotang Pass to Koksar, N slopes of the pass, 32°22'N, 77°14'E, 9 June 1856, *Schlagintweit 2975* (US). Jammu-Kashmir: Zanskar Mts., valley of Tsarap Lingti Chu river, Ichar village, camping site at river, 33°18'N, 77°0'E, 11 July 2004, *Suková 60* (PRC); Ladakh, Sammodangsa, Suru Vy., 34°6'N, 75°57'E, 28 Aug. 1976, *Hartmann 2037* (G); in valle glaciali Thajiwas S Sonamarg, 34°17'N, 75°15'E, 28 Aug. 1986, *Rechinger 62220* (M). Uttaranchal: Garhwal-Himalaja, Ramani Gletscher-Gebiet, Rishi-Ganga, wiese am fluss, 30°29'N, 79°41'E, June 1939, *Roch s.n.* (S). **Kazakhstan.** Almaty: Tien-Shan, Malaja Almaatink-Tal, Sailijski Alatau, Met. Stat. Worota, 43°5'N, 77°4'E, July 1976, *Krügel s.n.* (JE); Alatau transiliensis, in valle fl. Kaskelen, 43°11'N, 76°37'E, 21 June 1896, *Brotherus 671* (H); in declivitas septentrionalis jugi Ketmenj, in faucibus fl. Kul-Saj, 43°27'N, 80°26'E, 29 June 1964, *Roldugin 4826* (GH, K, S). East Kazakhstan: dist. Saisank, montes de Saur, divisoria entre ríos G. y M. Zhemeney, 47°5'N, 85°30'E, 6 July 1930, *Goncharov & Borisova s.n.* (GH). South Kazakhstan: montes Karatau et Talas Alatau, 42°53'N, 69°58'E, 28 July 1931, *Pavlov 794* (B); **Kyrgyzstan.** Batken: Ferghana, at Issik Bulak near the river Langar, 40°1'N, 71°45'E, 16 June 1898, *Paulsen 358* (C); Issyk-Kul: Tianschan, valée de Kaindy, 42°3'N, 79°4'E, 25 July 1901, *Brocherel 221* (G); Kungel Alatau, Kokoviok ad fontes fl. Kebin majoris, 42°45'N, 76°13'E, 13 July 1896, *Brotherus 401* (H). Talas: montes de Talas, región Kara-Buura, 42°10'N, 72°0'E, 30 July 2005, *Lazhigov s.n.* (MA); Jalal-Abad, Chichkan, 42°14'N, 72°59'E, 29 July 2004, *Sosombekov & Rogova 187* (MO). **Nepal.** Bagmati: Phakurji Lekh, S of Gumba, 27°46'N, 85°22'E, 18 July 1952, *Polunin & al. 4752* (BM); Gandaki: Dhawalagiri Zone, Mustang district, at Lo-Manthang, a pass 4 km N of Ghar Gompa, 29°10'N, 83°57'E, 5 July 2003, *Iokawa & al. 40088* (MO). Karnali: m. Tarakof, 28°52'N, 82°59'E, 22 June 1973, *Einarsson & al. 1049* (LD, UPS); Dolpo, Tineje, 29°14'N, 83°18'E, 29 June 1963, *Stainton 4284* (BM). **Pakistan.** Gilgit-Baltistan: Northern Areas, Nanga Parbat, oberes Rupal Tal, lower Mazeno base camp, 35°13'N, 74°42'E, 19 July 1994, *Nüsser 1533* (B); Northern Areas, Nanga Parbat, Martal, Gor-region, 35°31'N, 74°28'E, 17 June 1994, *Nüsser 1083* (B); upper Bagrot valley, Karakorum, above Gutumi Nullah, 36°5'N, 73°35'E, 5 Aug. 1992, *Schickhoff 577* (M); upper part of Boihel village, 36°59'N, 74°48'E, 18 July 2000, *Eberhardt 8235* (M). Khyber Pakhtunkhwa: Chitral, Yarkhun, 36°30'N, 72°40'E, 22 Aug. 1954, *Schmid 2326* (G). Punjab: Hazara, between Gitidas and Babusar top, 34°33'N, 72°32'E, 10 Sep. 1971, *Kazmi 3625* (M); Gilgit, 8 km from Babusar village, 35°8'N, 74°2'E, 5 Sep. 1988, *Omar & Qaisu 2644* (MO). **Tajikistan.** Gorno-Badakhshan: Severo-Alitjurskij chrebet, 37°54'N, 73°19'E, 6 July 1983, *Aschirmuchamedov 2* (GB); Gorno-Badakhshan, E Pamir, Takhtakorum, Uruchbulak-Ailutek, Gudara Mts., 38°38'N, 72°51'E, 8 Sep. 2002, *Dickoré 17943* (M). Khatlon: Pamir, Shugnansky Range, pr. Dzhalalady village, 37°39'N, 69°51'E, 2 Aug. 2000, *Khisoriev s.n.* (MO). Sughd: Turkestania, Sigdy inter Dschambe et Sarawschan, 38°40'N, 68°46'E, Aug. 1883, *Regel s.n.* (US); Anzob Pass, 85 km N of Dushanbe, 39°5'N, 68°51'E, 17 Aug. 2006, *Al-Shehbaz & Hisoriev 6108* (MO). **Uzbekistan.** Andijan: Thian Scahn, ad fontes fl. Narinkol, 40°54'N, 71°45'E, 25 Aug. 1896, *Brotherus 306* (H). Tashkent: 80 km NE Tashkent, Chimgan mountain, 41°40'N, 69°42'E, 23 July 1985, *Elias & al. 9807* (C).

Discussion. Geranium saxatile is an erect perennial herb, easily identified by its leaves of medium size and not deeply divided, its long petals, its staminal filaments with an expanded base, and its reflexed immature fruits. The rootstock is usually ± horizontal and with thickened roots along it. The presence of glandular hairs varies considerably. Some specimens have abundant glandular hairs on the stem base, petioles, and inflorescence, while others have only few glandular hairs on the inflorescence. The inflorescence of well-developed specimens is a dichasially arranged cyme with monochasial branches. In small specimens, the inflorescence may be reduced to one terminal cymule borne on a short stem or, in extreme cases, directly on the rootstock. The petals and the leaves vary in size considerably, being shorter in small specimens. The petals have hairs on the basal margins and, sometimes, slightly notched apex. These small specimens have been recognized taxonomically with different names (i.e., *Geranium collinum* var. *alpinum, G. minutum, G. exul*, *G. sophiae*). Novoselova (1996: 88) firstly suggested that these morphological variations are related to different habitats where *G. saxatile* occurs and, consequently, that it does not deserve taxonomic recognition. This is also supported by a continuum of intermediates.

Geranium saxatile is quite similar to *G. pratense*. They share the staminal filaments with a broad triangular base and an abruptly narrowed apex, the hairy nectaries and the immature reflexed fruits. The latter, however, is usually a more robust plant with longer leaf blades that have more segments, longer sepals, and longer sepal mucro, although with some overlap.

Schönbeck-Temesy (1970: 15) typified *Geranium himalayense* on an *Edgeworth's* specimen at K that is not mentioned in the protologue. Thus, according to art. 9.19 of the Shenzhen Code, this choice should be superseded. The lectotype has been selected on the drawing mentioned in the protologue because no original specimen has been located.

The Wallichianum Group— This group is characterized by the trailing

habit, the opposite cauline leaves, the 2-flowered cymules, the monochasially branched inflorescence, the petals hairy only on the base, the black and lanceolate (without expanded base) staminal filaments, and the black anthers and stigmas. Some species have connate stipules.

Yeo (2002a) recognized *G. rubifolium* in this group, which has been transferred to the "Other species from Eurasia", along with other species of unclear affinities.

37. Geranium christensenianum Hand.-Mazz., Symb. Sin. 7: 621, taf. 10 abb. 2. 1933. Type locality: "Y.: Beyendjing, in Wäldern des Betsao-ling, 25. IX. 1919 (Ten 1392)". Type: China. Yunnan, silvis Pe tsao lin, 23º47'N, 105º13'E, 25 Sep. 1919, *S. Tén 1392* (holotype, C-10012687!).

Perennial herbs, 48-100 cm tall. *Rootstock* 5-6 mm in diameter, ± horizontal, not tuberculate, not turnip-shaped, unknown roots. *Stem* trailing, leafy, not rooting at nodes, stolons absent, without vegetative stems, with patent, eglandular hairs 0.3-1.3 mm long and patent, glandular hairs 0.5-1.1 mm long. *Basal leaves* unknown, cauline leaves opposite; leaf laminas 3.9-5.3 cm long, 4.8-6.2 cm wide, not peltate, palmatifid [ratio main-sinus length/middle segment length = 0.73-0.80], polygonal in outline, base cordate, not coriaceous, with nerves not projected, pilose, with appressed, eglandular hairs and ± patent, glandular hairs on both surfaces; segments 3(5), in 1 plane, middle segment rhombic, 8.6-10.8 mm wide at the base [ratio segment width at the base/middle segment length = 0.25-0.30], 5-13-lobed in distal half [ratio secondary sinus length/middle segment length = 0.15-0.20]; petioles up to 15 cm long, without abscission zone, terete, not swollen, not deflexed in age, with patent, eglandular hairs 0.2-1.1 mm long and patent, glandular hairs 0.2-1.4 mm long; stipules 4.7-11.4 mm long, 1.6-4.6 mm wide, lanceolate, free, papery, brown, with scattered, eglandular and glandular hairs on both surfaces and on the margin. *Inflorescence* a monochasial cyme; cymules 2-flowered, solitary [ratio cymule length/leaf length = 1.8-2.6]; peduncles 21-153 mm long, with patent, eglandular hairs 0.2-0.9 mm long and patent, glandular hairs 0.2-1.3 mm long; bracteoles 6.3-7.8 mm long, 1-1.3 mm wide, lanceolate, whorled; pedicels 8.5-16.9 mm long, with patent, eglandular hairs 0.2-0.6 mm long and patent, glandular hairs 0.3-1.2 mm long. Flowers actinomorphic. *Sepals* 8.4-12.2 mm long, 3.7-4.7 mm wide, lanceolate, smooth, not accrescent, nerves 3-5, mucro 1.6-2.8 mm long [ratio mucro length/sepal

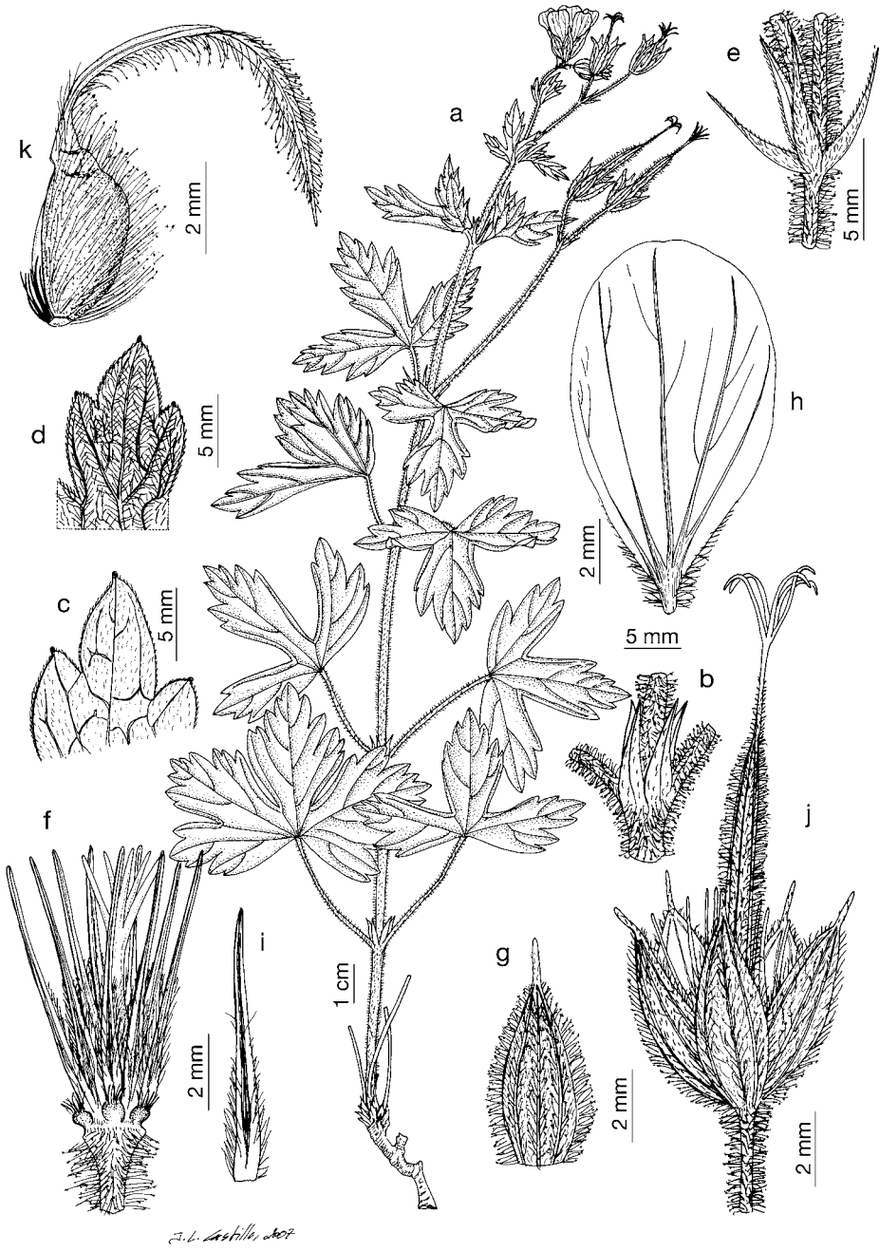


Fig. 130. *Geranium christensenianum*. a. Habit. b. Stipules. c. Leaf indumentum on adaxial side. d. Leaf indumentum on abaxial side. e. Bracteoles. f. Flower without petals and sepals. g. Sepal. h. Petal. i. Staminal filament. j. Fruit. k. Mericarp. (Based on: a-e, j, *Ten 1392,* C; f-i, k, *Exp. Pl. Oleag. 65-0417,* KUN-276615).

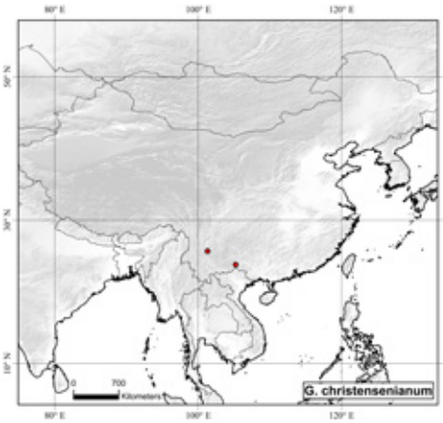


Fig. 131. Distribution of *Geranium christensenianum*.

length = 0.19-0.22], with antrorse to patent, eglandular hairs 0.2-0.8 mm long and ± patent, glandular hairs 0.5-1.7 mm long on the abaxial surface, glabrous adaxially. *Petals* 12.3-13.6(16) mm long, 8-9 mm wide, erect-patent, rounded, without claw, white, with fine dark purple veins, hairy on the base of the adaxial surface, ciliate on the basal margin, with hairs ca. 1 mm long. *Stamens* 10, both whorls bearing anthers; filaments 7.8-10.2 mm long, lanceolate, black except the base, covered ± abundantly hairs 0.2-0.8 mm long on the abaxial surface and margin, hairless towards the tip; anthers 2.1-2.5 mm long, black. Nectaries 5, hemispheric, with a tuft of hairs at the top, dorsally glabrous. *Gynoecium* 8.1-9.7 mm long, black. *Fruit* 32 mm long, erect, discharge of seed-ejection type; mericarps 4.3 mm long, 1.6 mm wide, without a strand of fibers, not compressed at the apex, smooth (sometimes with 1-2 transverse veins at the apex), without basal beak, with a basal callus, without a basal prong, brown, with ± patent, eglandular hairs 0.3-1 mm long and patent, glandular hairs 0.6-1.6 mm long; rostrum 21-22 mm long, with a narrowed apex 4-5 mm long, not twisted, with ± patent, eglandular hairs 0.2-0.4 mm long and patent, glandular hairs 0.4-1.4 mm long; stigmatic remnants 5.9-6.2 mm long, with 5 glabrous lobes. *Seeds* unknown. Cotyledons not studied. Fig. 130.

Pollen. Ornamentation not studied.

Chromosome number. Unknown.

Phenology. Collected in flower from July to September.

Distribution. This species is endemic to Yunnan, in south-central China (Fig. 131).

Habitat. Forest edges; 1300-1900 m.

Additional specimens examined. **China.** Yunnan: distrito Chuxiong, población Dayao, pueblo Santai, 25º41'N, 101º18'E, 11 July 1965, *Pl. Oleag. Exped. 65-0417* (KUN).

Discussion. Geranium christensenianum is only known from the holotype and an additional collection. Consequently, some features are not known or poorly described because of the scarcity of available material. This species resembles *G. lambertii* in some aspects. Both usually have white petals and black staminal filaments, anthers and stigmas, and free stipules. *Geranium christensenianum* has, however, leaf blades mostly with three segments, although some cultivated specimens could have basal leaves with five segments. Additionally, *G. christensenianum* further differs from *G. lambertii* in its shorter sepals and petals and in its glandular indumentum on the stem, petioles, and inflorescence.

38. Geranium lambertii Sweet, Geraniaceae 4, tab. 338. 1827, ["Lamberti"]. Type locality: "This fine new species is a native of Nepal; the one from which our drawing was made, was raised from seed in our garden, that was procured by Mr. David Don, from a specimen in Mr. Lambert's Herbarium that had been sent by Dr. Wallich". Type: Sweet, Geraniaceae 4, tab. 338. 1827 (lectotype, here designated). Nepal. Sagarmatha zone, Solukhumbu distr., Kurki-Pangkongma La-Kharikhola, 27º36'N, 86º45'E, 29 Aug. 1997, *M. Wakabayashi & al. 9730378* (epitype, here designated, MO!).

Geranium grevilleanum Wall., Pl. Asiat. Rar. 3: 4, tab. 209. 1831. Type locality: "Crescit in alpibus prope Gossain Than Himalayae, florens mense Octobris". Type: Nepal. Gosainkund, Gossain Than, 28°05'N, 85°24'E, *N. Wallich 8559* [*Bharut Singh*] (lectotype, designated by Nasir 1983: 16, and Wagh & Hurrah 2019: 248 in second step, K-000729550!).

Geranium backhousianum Regel, Trudy Imp. S.-Peterburgsk. Bot. Sada 2: 432. 1873. *Geranium lambertii* var. *backhousianum* (Regel) H. Hara, Bull. Univ. Mus. Univ. Tokyo 2: 68. 1971. Type locality: "Patria ignota ut videtur Nepaulia". Type: from cultivated plants originated probably in Nepal, *A. Regel s.n.* (no original material located).

Geranium chumbiense R. Knuth, Repert. Spec. Nov. Regni Veg. 19: 228. 1923. Type locality: "Himalaya: Chumbi, Lu-wapoo (King's Coll. a. 1884 no. 517 sub G. Grevilleano - Typus)". Type: China. Xizang, Chumbi, Lu-Ma-poo, 27°31'N, 88°58'E, 20 July 1884, *G. King 517* (lectotype, here designated, K-000729548!; isolectotype, G-00420977!).

Perennial herbs, 50-58 cm tall. *Rootstock* 14-15 mm in diameter, ± vertical, not tuberculate, not turnip-shaped, unknown roots. *Stem* trailing and ascending, leafy, not rooting at nodes, stolons absent, without vegetative stems, with patent to retrorse, eglandular hairs 0.4-1.4 mm long. *Basal leaves* not present (no rosette), cauline leaves opposite; leaf laminas (3.2)3.9-6.7(8.8) cm long, 3.5-8.7 cm wide, not peltate, palmatifid [ratio main-sinus length/middle segment length = (0.69)0.73-0.79(0.83)], polygonal in outline, base cordate, not coriaceous, with nerves not projected, pilose, with appressed, eglandular hairs on both surfaces; segments 5, in 1 plane, middle segment rhombic, (5.2)8.4-13(15.4) mm wide at the base [ratio segment width at the base/middle segment length = (0.21)0.23-0.30(0.33)], (7)8-13(15)-lobed in distal half [ratio secondary sinus length/middle segment length = (0.17)0.21-0.25(0.26)]; petioles up to 20 cm long, without abscission zone, terete, not swollen, not deflexed in age, with patent to retrorse, eglandular hairs 0.2-1.2 mm long; stipules 5.9-14.1 mm long, 2.2-4.6 mm wide, lanceolate, free, papery, brown, with eglandular and glandular hairs on abaxial surface and on the margin, usually glabrous adaxially. *Inflorescence* a monochasial cyme; cymules 2-flowered, soli-

tary [ratio cymule length/leaf length = (1)1.5-2.2(2.9)]; peduncles (82)113-215(255) mm long, with patent to retrorse, eglandular hairs 0.3-1.2 mm long; bracteoles 8.9-15.1 mm long, 0.7-2.6 mm wide, lanceolate, whorled; pedicels (15)31-45(68) mm long, with patent to retrorse, eglandular hairs 0.4-1.2 mm long. Flowers actinomorphic. *Sepals* (10.6)10.9-12.8(14.6) mm long, 4.1-6 mm wide, lanceolate, smooth, not accrescent, nerves 5(7), mucro (0.7)1.1-1.8(1.9) mm long [ratio mucro length/sepal length = 0.06-0.17], with antrorse to patent, eglandular hairs 0.3-1.2 mm long and ± patent, glandular hairs 0.5-1.2 mm long on the abaxial surface, glabrous adaxially. *Petals* (20.4)21.9-24.3(25.4) mm long, (13.1)14.9-17.9(19.8) mm wide, erect-patent, rounded, without claw, pale pink or white, hairy on the base of the adaxial surface, ciliate on the basal margin, with hairs 1-2 mm long. *Stamens* 10, both whorls bearing anthers; filaments (8.3)9.9-12.3(14) mm long, lanceolate, black except the base, covered densely with hairs 1.1-2.2 mm long on the abaxial surface and margin, hairless towards the tip; anthers 2.4-2.7(2.8) mm long, black. Nectaries 5, hemispheric, with a tuft of hairs at the top, dorsally glabrous. *Gynoecium* 9.8-13.6 mm long, black. *Fruit* 29-35 mm long, erect, discharge of seed-ejection type; mericarps 4-5 mm long, 1.8-2 mm wide, without a strand of fibers, not compressed at the apex, smooth, without basal beak, with a basal callus, without a basal prong, brown, with ± patent, eglandular hairs 0.8-0.9 mm long and patent, glandular hairs 1.1-1.2 mm long; rostrum 17-26 mm long, with a narrowed apex 3-4 mm long, not twisted, with patent, eglandular hairs 0.5-0.6 mm long and patent, glandular hairs 1.1-1.2 mm long; stigmatic remnants 5-7 mm long, with 5 glabrous lobes. *Seeds* unknown. Cotyledons not studied. Fig. 132.

Pollen. Ornamentation not studied.

Chromosome number. 2*n* = 30, 32.

Phenology. Collected in flower from June to September.

Distribution. This species ranges from central Nepal, through China (Xizang) and India (Sikkim) to Bhutan (Fig. 133).

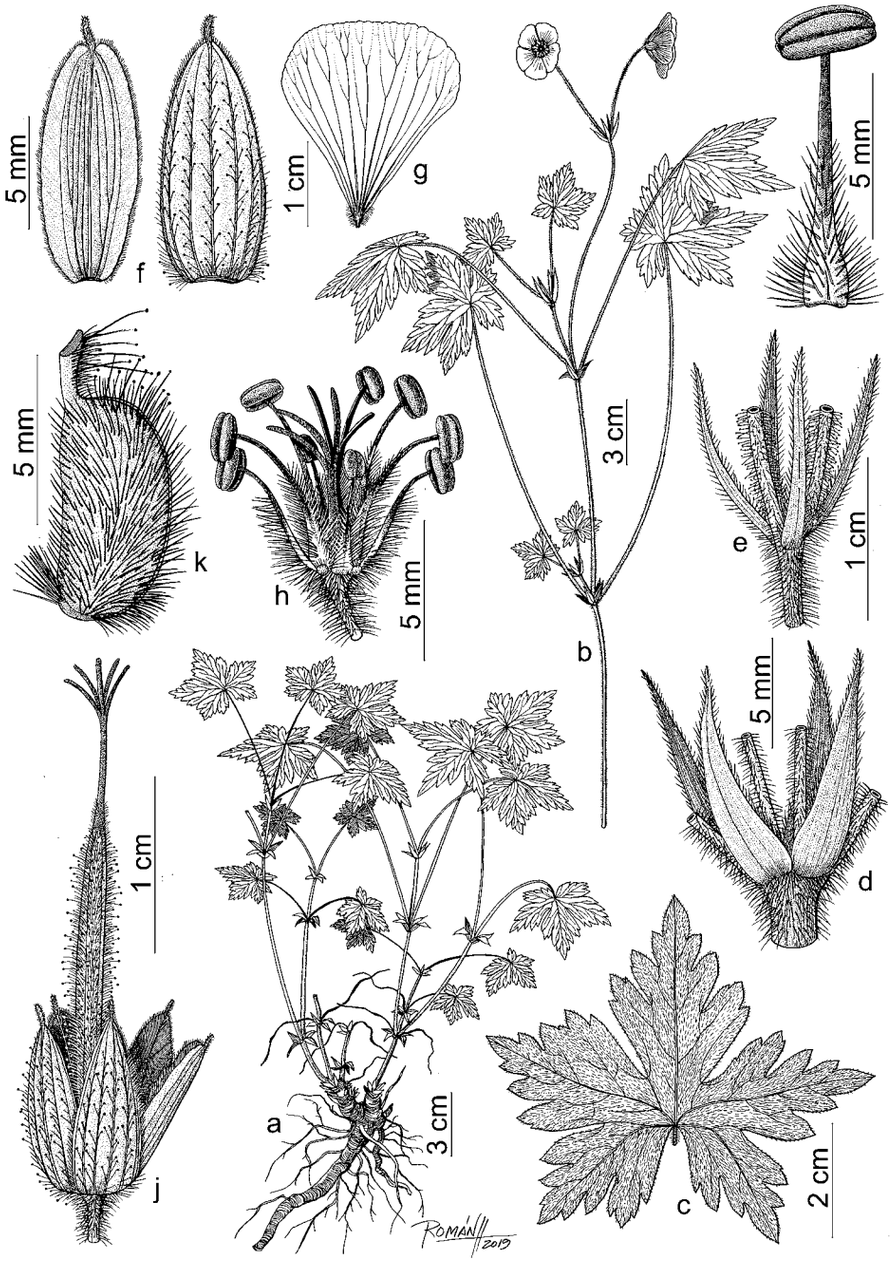


Fig. 132. *Geranium lambertii*. a, b. Habit. c. Leaf. d. Stipules. e. Bracteoles. f. Sepals. g. Petal. h. Flower without petals and sepals. i. Stamen. j. Fruit. k. Mericarp. (Based on: a, e, g, j, k, *Wakabayashi & al. 9730378,* MO; b, c, d, f, h, i, *Lange 56,* B).

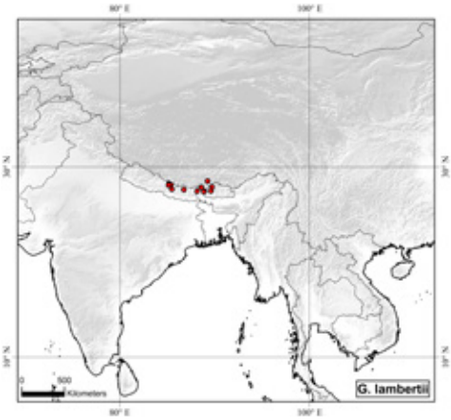


Fig. 133. Distribution of *Geranium lambertii*.

Habitat. Meadows with scattered shrubs, rockwall along trails and nitrophil areas with *Rhododendron* L. thickets; 2400-4050 m.

Additional specimens examined. **Bhutan.** Gasa: Bele-La, 27°53'N, 89°43'E, 9 July 1938, *Gould 969* (K). Thimphu: pr. Moti thang, 27°28'N, 89°36'E, 23 July 1971, *Bedi 1270* (K). **China.** Xizang: Natu la to Chumpitang, 27°24'N, 88°51'E, 1 Aug. 1936, *Chapman 441* (K); Chumbithang, 27°26'N, 88°55'E, 20 Sep. 1916, *Cave s.n.* (GH); Yatung, Tibet, 27°51'N, 88°35'E, 1897, *Hobson s.n.* (K); distrito Rikaze, población Jilong, pueblo Zha, 28°30'N, 89°15'E, 18 July 1975, *Qinghai-Tibet Exped. 7003* (KUN). **India.** Sikkim: Pay-king la, 27°27'N, 88°9'E, July 1889, *King s.n.* (G, P). **Nepal.** Larumi Ghiang, 17 June 1914, *Lal Dhoj 44* (MO); Nepal, *Scully s.n.* (UPS). Bagmati: Kali Kandaki Tal, SW Tukuche, 27°39'N, 85°29'E, 1 Sep. 1967, *Lange 56* (B); C Nepal, Pang Sang pass, 28°5'N, 85°8'E, 20 Aug. 1974, *Yon 415* (BM); along a trail from Gosaïkund to Svabrubensi, 28°6'N, 85°23'E, 16 Aug. 1974, *Haas 2309* (Z); E of Mailung Khola, 28°12'N, 85°13'E, 20 Aug. 1974, *Haas 2434A* (Z); C Nepal, Bagmati zone, Rasuwa distr., Kharka-Pati Kharka, 28°15'N, 85°10'E, 4 Aug. 1994, *Miyamoto 9420159* (MO).

Discussion. Geranium lambertii is a trailing and ascending herb not rooting in the nodes. Its underground parts are poorly known through the scarce herbarium material available. One incomplete sheet shows a narrow, vertical rootstock with thickened roots. The mature stems are naked toward the base, apparently without rosette. According to Yeo (2002a: 91), *G. lambertii* is a plant with very few basal leaves. This species is easily distinguished by its densely hairy staminal filaments, which are hairless toward the tip. The staminal filaments are black especially on the upper part, as are the anthers and stigmas. *Geranium christensenianum* and *G. procurrens* also have hairy and black staminal filaments, but not as densely hairy as *G. lambertii*. Additionally, *Geranium lambertii* further differs from the previously mentioned species in its noticeably long peduncles, petals, and sepals, as well as in its free stipules and its predominantly eglandular indumentum. Scattered glandular hairs appear on stipules and sepal base as well as on the fruit. Fruit variability is, however, poorly known because of the scarcity of available material.

Geranium lambertii was described from a cultivated plant raised from seeds "... that was procured by Mr. David Don, from a specimen in Mr. Lambert's Herbarium that had been sent by Dr. Wallich" from Nepal. Since no specimen of such cultivated plants has been preserved, I selected the drawing as lectotype. An epitype is also designated for purposes of the precise application of the name. According to Yeo (1973b), *Geranium backhousianum* was described from a cultivated plant raised at Leningrad from seeds obtained from England, the stock being suspected of having originated in Nepal. Apparently, none of these specimens is preserved.

39. Geranium procurrens Yeo, Bot. Mag. 179(3), tab. 644. 1973. Type locality: "Nepal, N. of Kathmandu, Thare Pati, alt. 3350 m. (11,000 ft.) 25 July 1967, G.A.C. Herklots, cult. in hort. Wakehurst Place, Sussex, 16 Aug. 1972, sub Kew accn. no. 000-69.30616 (K, holotypus; CGG, isotypus)". Type: Nepal. N of Kathmandu, Thare Pati, 28°00'N, 85°29'E, 25 July 1967, *G.A. Herklots s.n.* (holotype, K-000729511!; isotypes, CGG, US-2839963!).

Perennial herbs, 25-150 cm tall. *Rootstock* 21-101 mm in diameter, ± vertical, not tuberculate, not turnip-shaped, unknown roots. *Stem* trailing and ascending, leafy, rooting at nodes, stolons absent, without vegetative stems, with patent, eglandular hairs 0.3-1.3 mm long and, usually, patent, glandular hairs 0.5-1.4 mm long. *Basal leaves* not present (no rosette), cauline leaves opposite; leaf laminas (2.6)3.7-5.9(8) cm long, 3.1-8.7 cm wide, not peltate, palmatifid [ratio main-sinus length/middle segment length = (0.74)0.76-0.81(0.85)], polygonal in outline, base cordate, not coriaceous, with nerves not projected, pilose, with ± appressed, eglandular hairs on both surfaces and, usually, with scattered glandular hairs abaxially; segments 5, in 1 plane, middle segment rhombic, (5.2)6.8-11.9(15) mm wide at the base [ratio segment width at the base/middle segment length = (0.16)0.24-0.28(0.33)], (7)8-11(15)-lobed in distal half [ratio secondary sinus length/middle segment length = (0.13)0.15-0.20(0.22)]; petioles up to 7.5 cm long, without abscission zone, terete, not swollen, not deflexed in age, with patent, eglandular hairs 0.3-1.4 mm long and patent, glandular hairs 0.3-1.1 mm long; stipules 3.1-12.5 mm long, 1.6-6.4 mm wide, broadly lanceolate, free or partially connate, papery, brown, with eglandular and glandular hairs on abaxial surface and on the margin, usually glabrous adaxially. *Inflorescence* a monochasial cyme; cymules 2-flowered, solitary [ratio cymule length/leaf length = (1.1)1.6-2.7(6.5)]; peduncles (30)39-62(80) mm long, with patent, eglandular hairs 0.2-0.9 mm long and patent, glandular hairs 0.5-1.9 mm long; bracteoles 2-5.4 mm long, 0.4-1.3 mm wide, lanceolate, whorled; pedicels (22)23-29(38) mm long, with patent, eglandular hairs 0.2-0.6 mm long and patent, glandular hairs 0.3-1.4 mm long. Flowers actinomorphic. *Sepals* (5.7)5.8-7.6(8.6) mm long, 2.3-3.9 mm wide, lanceolate, smooth, not accrescent, nerves 3, mucro (0.5)0.7-1.1(1.6) mm long [ratio mucro length/sepal length = 0.09-0.22], with ± patent, eglandular hairs 0.2-0.5 mm long and patent, glandular hairs 0.5-1.5 mm long on the abaxial surface, glabrous adaxially. *Petals* (11.8)13.1-15.1(19.7) mm long, (6.5)7.4-10.5(13.1) mm wide, erect-patent, rounded or slightly emarginate (notch 0.5-0.9 mm deep), without claw, purple with a dark basal spot, hairy on the base of the adaxial surface, ciliate on the basal margin, with hairs 0.6-1.2 mm long. *Stamens* 10, both whorls bearing anthers; filaments (5.5)6.4-7.5(8) mm long, lanceolate, black, pilose on the abaxial surface, ciliate on the proximal half, with hairs 0.6-1.5 mm long; anthers (1.2)1.3-1.9 mm long, purple. Nectaries

5, hemispheric, with a tuft of hairs at the top, dorsally glabrous. *Gynoecium* 5.7-11 mm long, black. *Fruit* 24-32 mm long, erect, discharge of seed-ejection type; mericarps 3.7-4.2 mm long, 1.6-2.2 mm wide, without a strand of fibers, not compressed at the apex, smooth, without basal beak, with a basal callus, without a basal prong, brown, with ± patent, eglandular hairs 0.8-1 mm long and patent, glandular hairs 1-1.3 mm long; rostrum 16-22 mm long, with a narrowed apex 2.5-3.3 mm long, not twisted, with patent, eglandular hairs 0.2-0.4 mm long and patent glandular hairs 0.6-1.1 mm long; stigmatic remnants 4.1-5.4 mm long, with 5 lobes hairy at the base. *Seeds* 2.6-3.3 mm long, 1.4-1.9 mm wide, finely reticulate, uniformly colored, brown, glabrous. Cotyledons with entire margin. Figs. 134, 135.

Pollen. Ornamentation not studied.

Chromosome number. Unknown.

Phenology. Collected in flower from July to October.

Distribution. This species ranges from central Nepal to northeastern India, through China (Xizang) and Bhutan (Fig. 136).

Habitat. Shady slopes, open rocky places, among shrubs and forest edges; 2150-4000 m.

Additional specimens examined. **Bhutan.** Gasa: Upper Mo Chu distr., Gasa Dzong, 27º55'N, 89º46'E, 14 Sep. 1984, *Sinclair & Long 4985* (K). Trashiyangtse: Sano Samp, 27º27'N, 91º36'E, 25 Aug. 1971, *Bedi 966* (K). **China.** Xizang: Nielamu Xian, ca 16 km from Zhangmu toward Nielamu, 28º2'N, 85º59'E, 13 Sep. 2006, *Tibet-MacArthur 876* (US). **India.** Arunachal Pradesh: Assam, Lagam, 27º24'N, 92º24'E, 23 July 1938, *Kingdon Ward 13983* (BM). Sikkim: Jumlok, 9 Oct. 1870, *Clarke 12768*

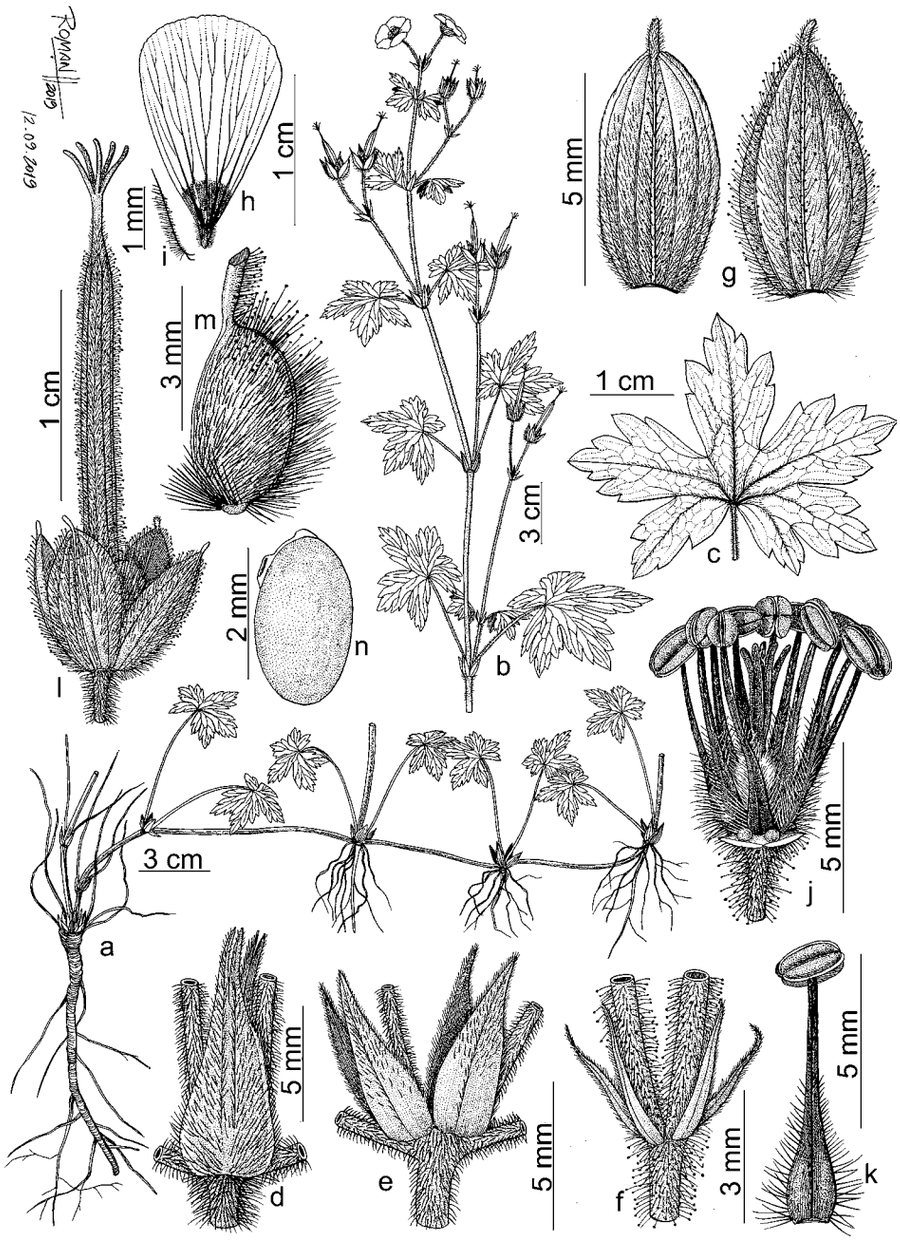


Fig. 134. *Geranium procurrens*. a, b. Habit. c. Leaf. d, e. Stipules. f. Bracteoles. g. Sepals. h. Petal. i. Base of petal margin. j. Flower without petals and sepals. k. Stamen. l. Fruit. m. Mericarp. n. Seed. (Based on: a, *Wakabayashi & al. 9730389,* GH; b, *Hooker fil. s.n.,* K; c, J-N, *Schwabe s.n.,* B-100763818; d, *Dobremez 312,* BM; e, *Bedi 966,* K; f-i, *Haas 2692*, Z).

Fig. 135. *Geranium procurrens* (without voucher, from Berlin Botanical Garden, photo: M.Á. García).

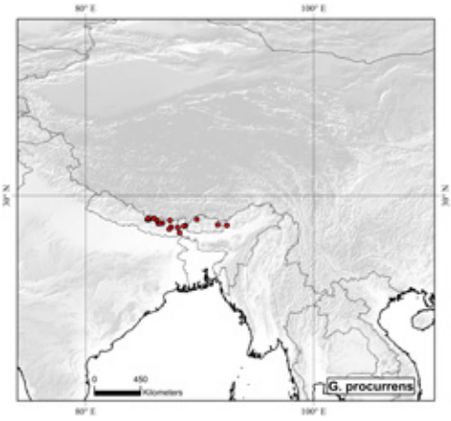


Fig. 136. Distribution of *Geranium procurrens*.

(K); Blumbo, 24 Oct. 1875, *Clarke 25514* (K); Kalpinispi, Aug. 1888, *King s.n.* (BM, C, K); Sikkim, 17 Dec. 1937, *Prain 20* (WRSL); Chowbhajan, 27°13'N, 88°5'E, 1913, *Ribu & Rhomoo 6706* (GH); Sikkim, 27°20'N, 88°37'E, 1892, *Gammie s.n.* (C, K, WU); Sikkim, 27°20'N, 88°37'E, *Hooker s.n.* (C, FI, G, K, LD, MA, NY, P, S, US); Jhangu, 27°22'N, 88°45'E, Sep., *Prain s.n.* (W). West Bengal: Darjeeling, 26°45'N, 88°15'E, 1 Oct. 1869, *Clarke 9367A* (K). **Nepal.** Bagmati: Simigaon au col, 27°52'N, 86°14'E, 15 Sep. 1954, *Zimmermann 1315* (G); NW of Timbu, trail from Taramarane, 27°55'N, 85°34'E, 7 Sep. 1974, *Haas 2692* (Z); Bagmati bei Chautara, 27°55'N, 85°25'E, 11 Oct. 1979, *Schwabe s.n.* (B); C Nepal, Mangen-Khodang Danda, 27°59'N, 85°29'E, 28 Aug. 1972, *Kanai & al. 723903* (MO). Province No. 1: C Nepal, Khare Khola, Patale Pokhari-Phedi Kharka, 27°4'N, 87°20'E, 13 Sep. 1983, *Ohba & al. 8332061* (GH); E Nepal, Milke Danda, 27°15'N, 87°30'E, 10 Sep. 1967, *Williams & Stainton 8436* (BM, K); E Nepal, Sagarmatha Zone, Solukhumbu distr., Sete-Kata Bisana-Goyem-Lamjura Bhanjyang-Taktor, 27°34'N, 86°26'E, 19 Aug. 1985, *Ohba & al. 8571814* (GH); E Nepal, Lelepu, 27°34'N, 86°23'E, 9 Sep. 1963, *Tuyama 6300412* (GH); E Nepal, Sagarmatha Zone, Solukhumbu distr., Taktor-Junbesi-Ringmo, 27°34'N, 86°31'E, 31 July 1997, *Wakabayashi & al. 9720056* (MO); E Nepal, Sagarmatha Zone, Solukhumbu distr., Taktor-Junbesi-Ringmo, 27°34'N, 86°31'E, 31 July 1997, *Wakabayashi & al. 9730042* (GH); Kharte, 27°36'N, 86°42'E, 4 July 1970, *Dobremez 312* (BM); E Nepal, Sagarmatha Zone, Solukhumbu distr., Kurki-Pangkongma La-Kharikkhola, 27°36'N, 86°45'E, 29 Aug. 1997, *Wakabayashi & al. 9730389* (GH); Koshi zone, Sankhuwasabha distr., Chyangrima-Chhokam Khola, 27°50'N, 87°24'E, 21 Aug. 1998, *Noshiro & al. 9830091* (GH).

Discussion. Geranium procurrens is a trailing herb with very long internodes and rooting in the nodes. Its underground parts are poorly known through the scarce herbarium material available. Two incomplete sheets show a narrow, vertical rootstock without roots. The mature stems are naked toward the base, apparently without rosette. Nevertheless, the lack of rosette should be confirmed in young plants. The stipules may be free or connate but with the tip remaining free. Both types can be found on the same plant. The indumentum consists of eglandular and glandular hairs, the latter are especially copious on peduncles, pedicels and sepals. The inflorescence is formed by 2-flowered cymules, monochasially arranged. The sepals have a short mucro and are densely hairy on the abaxial surface. The petals are long, with a basal black spot, and with hairs on the base and basal margin. The staminal filaments and stigmas are black. The anthers, however, seem to be clearer on dry specimens.

Geranium procurrens shares with *G. wallichianum* the trailing habit and the black staminal filaments and stigmas. The former is, however, easily identified by its black basal petal spot. *Geranium procurrens* further differs from *G. wallichianum* in having narrower stipules that are never completely connate and in rooting at the nodes. As Yeo (1973b) explained in detail, the specimens of *G. procurrens* have been repeatedly confused with *G. lambertii* and its synonyms. The latter has pale pink or white petals, without a basal black spot, and more hairy staminal filaments.

---

40. Geranium wallichianum D. Don in Sweet, Geraniaceae 1, tab. 90. 1821. Type locality: "D. Don prodr. Fl. Nepalens. ined. / Habitat in Nepaliae alpibus. D. Wallich". Type: Nepal. Goshain Than, 28°05'N, 85°24'E, *N. Wallich 8558c [Bharut Singh]* (lectotype, designated by Schönbeck-Temesy 1970: 25, W; isolectotypes, BM-000047209 image!, E-00438230 image!, G-00421009!, K-001125853!, P-005124844!).

Geranium scullyi R. Knuth, Repert. Spec. Nov. Regni Veg. 19: 230. 1923, [30 Sep. 1923]. Type locality: "Nepal (Scully, Fl. Nepal. sub G. Grevilleano Wall.!)". Type: Nepal. *J. Scully 127* (lectotype, here designated, P-05124850!).

Perennial herbs, 24-75 cm tall. *Rootstock* 2.2-18.7 mm in diameter, ± vertical, not tuberculate, not turnip-shaped, with thickened roots along the rootstock. *Stem* trailing and ascending, leafy, not rooting at nodes, stolons absent, without vegetative stems, with patent to retrorse, eglandular hairs 0.3-1.7 mm long and, rarely, scattered, patent, glandular hairs 1.4-2 mm long. *Basal leaves* not present (no rosette), cauline leaves opposite; leaf laminas (2.8)4.1-6.3(7.4) cm long, 3.5-9.4 cm wide, not peltate, palmatifid [ratio main-sinus length/middle segment length = (0.71)0.76-0.82(0.87)], polygonal in outline, base cordate, not coriaceous, with nerves not projected, pilose, with appressed, eglandular hairs on both surfaces; segments 5, in 1 plane, middle segment rhombic, (5.5)8.6-12.5(13.9) mm wide at the base [ratio segment width at the base/middle segment length = (0.21)0.24-0.29(0.36)], (9)11-15(19)-lobed in distal half [ratio secondary sinus length/middle segment length = (0.10)0.17-0.22(0.24)]; petioles up to 15 cm long, without abscission zone, terete, not swollen, not deflexed in age, with patent to retrorse, eglandular hairs 0.4-1.5 mm long and, rarely, scattered, patent, glandular hairs 1.5-2 mm long; stipules 6.5-19.1 mm long, 4-13 mm wide, broadly ovate, connate, papery, brown, with scattered, eglandular hairs on both surfaces and on the margin. *Inflorescence* a monochasial cyme; cymules 2-flowered, solitary [ratio cymule length/leaf length = (1)1.4-3.1(5.7)]; peduncles (33)66-114(153) mm long, with patent to retrorse, eglandular hairs 0.2-1.4 mm long; bracteoles 6.7-12.9 mm long, 1.3-3.7 mm wide, broadly lanceolate, whorled; pedicels (26)36-53(81) mm long, with patent to retrorse, eglandular hairs 0.2-1.5 mm long and, rarely, scattered, patent, glandular hairs 1.5-2.1 mm long. Flowers actinomorphic. *Sepals* (6.3)7.5-9.5(10.2) mm long, 2-4.7 mm wide, lanceolate, smooth, not accrescent, nerves 3, mucro (1.6)2.3-3.7(4.6) mm long [ratio mucro length/sepal length = 0.20-0.58], with antrorse, ± appressed, eglandular hairs 0.6-1.5 mm long on the abaxial surface, glabrous adaxially. *Petals* (12.2)15-19.6(21.8) mm long, (6.4)9.9-12.4(17.2) mm wide, erect-patent, emarginate (notch 0.4-1.4 mm deep), without claw, deep pink to purple or blue, hairy on the base of

the adaxial surface, ciliate on the basal margin, with hairs 0.3-1 mm long. *Stamens* 10, both whorls bearing anthers; filaments (5.1)6.7-7.6(9.3) mm long, lanceolate, black at least at tip, pilose on the abaxial surface, ciliate on the proximal half, with hairs 0.1-0.7 mm long; anthers (1.6)2.1-2.8(3) mm long, black. Nectaries 5, hemispheric, with a tuft of hairs at the top, dorsally glabrous. *Gynoecium* 6-10 mm long, black to dark purple. *Fruit* (25)32-38(44) mm long, erect, discharge of seed-ejection type; mericarps 4.1-5.6 mm long, 1.8-2.8 mm wide, without a strand of fibers, not compressed at the apex, smooth (usually with 1-2 transverse veins at the apex), without basal beak, with a basal callus, without a basal prong, brown, with ± patent, eglandular hairs 0.6-1.6 mm long; rostrum 17-28 mm long, with a narrowed apex 2.2-4.6 mm long, not twisted, with ± patent, eglandular hairs 0.1-0.4 mm long; stigmatic remnants 2.6-7.6 mm long, with 5 usually glabrous lobes. *Seeds* 3.1-4.8 mm long, 1.6-2.7 mm wide, finely reticulate, uniformly colored, brown, glabrous. Cotyledons with entire margin. Figs. 137, 138.

Pollen. *Geranium*-type (Perveen & Gaiser 1999: 267).

Chromosome number. 2*n* = 26, 28.

Phenology. Collected in flower from March to December.

Distribution. This species ranges from Afghanistan and Pakistan through northern India (Himachal Pradesh, Jammu-Kashmir, Uttar Pradesh and Uttaranchal) and Nepal to China (Xizang) (Fig. 139).

Habitat. Open fields, grassy hilsides, streams and edge of *Acer* L., *Picea* A. Dietr., *Pinus* L. and *Quercus* L. forests; 1700-4350 m.

Representative specimens examined. **Afghanistan.** Kunar: Dewagal Darrah, Tal W Chalas, Pass gegen das Darrah-e Mazar, 34º36'N, 70º46'E, 31 Aug. 1973, *Anders 11127* (G). Nangarhar: Kurrum valley, 33º59'N, 70º22'E, 20 June 1880, *Aitchison 187* (P, S); Kurrum valley, 33º59'N, 70º22'E, 1879, *Aitchison 761* (C, G-BOIS, P, S). Nuristan: Ashpeï, 35º18'N, 71º22'E, July 1949, *Edelberg 1753* (C). **China.** Xizang: alrededor del pueblo de Zhangmu, 27º58'N, 85º58'E, 5 Sep. 1981, *Ni Zhicheng 2002* (PE); distrito Rikaze, población Jilong, pueblo Zhaxiang, 28º15'N, 86º49'E, 17 July 1975, *Qinghai-Tibet Exped. 6939* (PE); distrito Rikaze, población Jilong, pueblo Zhacun, 28º23'N, 85º22'E, 17 July 1975, *Qinghai-Tibet Exped. 1939* (KUN). **India.** Himachal Pradesh: Sirmore, 30º33'N, 77º17'E, 1849, *8558* (FI); ad montem Hattu, ultra Shimla, 31º6'N, 77º10'E, 18 Aug. 1885, *Drummond 2011* (K); Rothang pass, 32º22'N, 77º14'E, 30 July 1951, *Douglas s.n.* (US). Jammu-Kashmir: Tsamba, Kali pass to Tsamba, 33º8'N, 76º8'E, 28 June 1856, *Schlagintweit 3321* (S); Traghol, 34º29'N, 74º37'E, 26 July 1919, *Stewart 4660* (K). Uttar Pradesh: Mussoorie, below Charleville hotel, 30º27'N, 78º4'E, 11 Sep. 1927, *Gupta s.n.* (G, US); Mussoorie, Landour, 30º28'N, 78º6'E, Sep. 1929, *Cleland 25* (US). Uttaranchal: Nainital, 29º21'N, 79º30'E, Sep. 1953, *Chahya s.n.* (G, US); Khajiar, Chamba State, 32º38'N, 75º7'E, 11 July 1936, *Koelz 8837* (NY). **Nepal.** Bagmati: C Nepal, Bagmati zone, Ra-

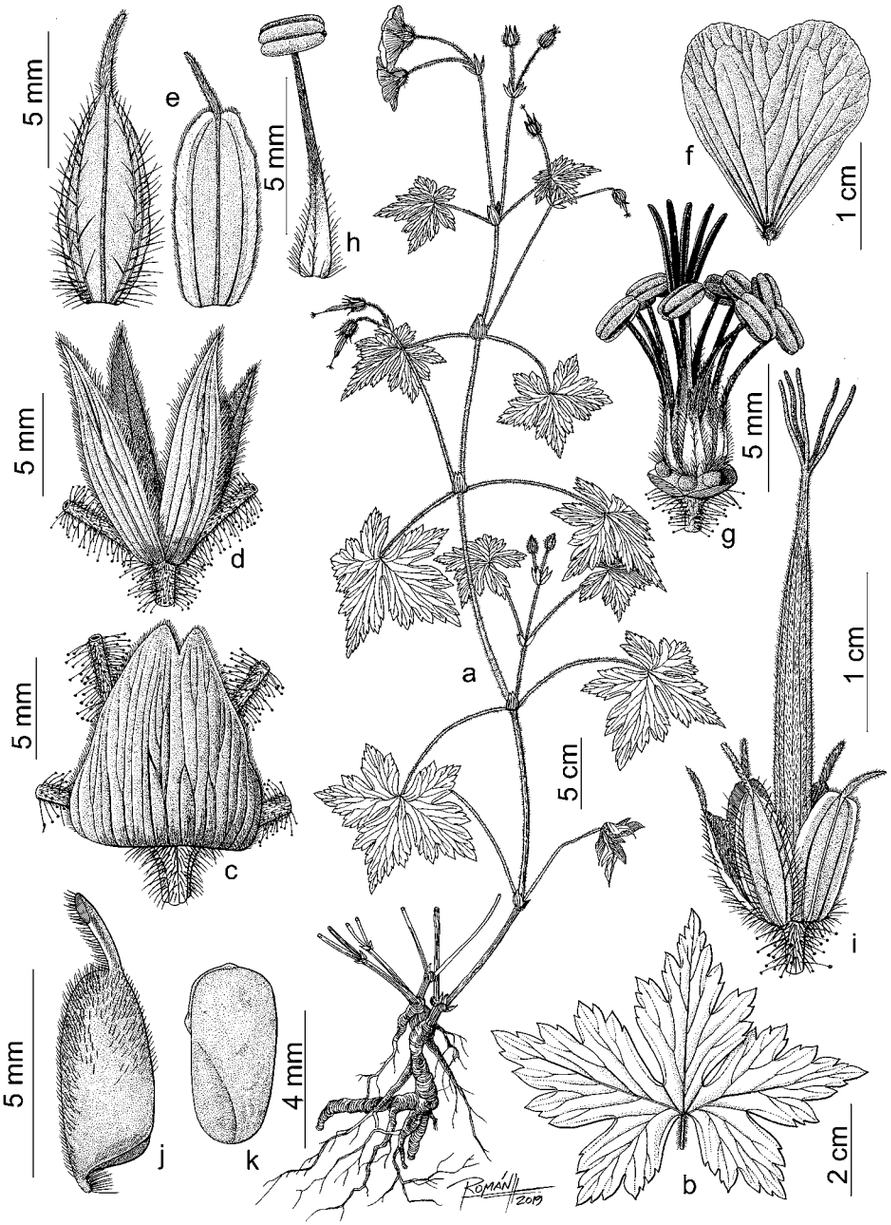


Fig. 137. *Geranium wallichianum*. a. Habit. b. Leaf. c. Stipules. d. Bracteoles. e. Sepals. f. Petal. g. Flower without petals and sepals. h. Stamen. i. Fruit. j. Mericarp. k. Seed. (Based on: a, b, d, g, h, *Aitchison 2,* K; c, e, f, i-k, *Maas 14112,* C).

Fig. 138. *Geranium wallichianum* (Based on: *Aedo 15739,* MA).

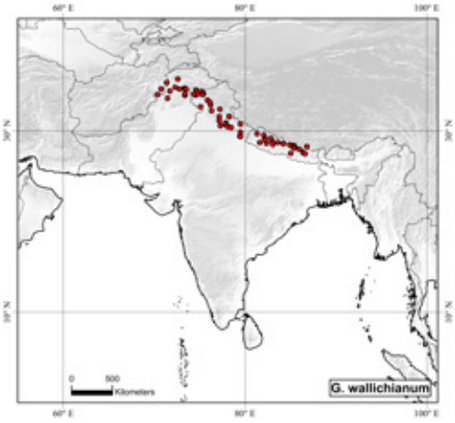


Fig. 139. Distribution of *Geranium wallichianum*.

suwa distr., Syabru Bensi-Parbati Kund, 28°9'N, 85°30'E, 24 July 1994, *Miyamoto & al. 9420002* (GH). Karnali: W Nepal, Dhawalagiri zone, Myagdi distr., valley of Konaban Khola, Dobang, 28°37'N, 82°22'E, 8 Sep. 1996, *Mikage & al. 9684091* (GH); C Nepal, Karnali zone, Jumla distr., Bibeya-Chakare Pani-Deula Deuli, 29°10'N, 82°10'E, 17 Sep. 1991, *Minaki & al. 9108073* (GH). Province No. 1: Dhumpno, Lumle, 27°28'N, 86°37'E, 8 Oct. 1969, *Flatt 109* (BM). **Pakistan.** Khyber Pakhtunkhwa: about 30 mi from Chakmal on way to Pindu, 33°35'N, 71°28'E, 25 Sep. 1970, *Farooqi 2914* (B); 2 mi from Nathiagali on way to Abbola, 34°4'N, 73°23'E, 6 July 1977, *Kamal 116* (B); Hazara, Kaghan valley, above Shogran, 34°36'N, 73°30'E, 17 Sep. 1983, *Ewald & Zetterlund 6244* (GOET); Kulalan, 34°47'N, 72°18'E, 13 Oct. 1964, *Salim 184* (K).

Discussion. Geranium wallichianum is a trailing herb with thickened roots along a robust, vertical rootstock. The mature stems are naked toward the base, apparently without rosette. Nevertheless, the lack of rosette should be confirmed in young plants. This species is easily distinguished by its broadly ovate, connate stipules, present in all nodes of the stem. They have a cordate base and an obtuse apex. The indumentum mainly consists of eglandular hairs. Rarely, scattered glandular hairs have also been found on the stem, petioles, and pedicels. The inflorescence is formed by 2-flowered cymules, monochasially arranged. The bracteoles are appreciably wide and often connate in their basal half. The sepals have a long mucro and are hairy mainly on the nerves. The petals are long, without a basal dark spot, and with hairs on the base and basal margin. The staminal filaments are black, at least toward the apex, as are the anthers and stigmas. The mericarp callus is small and with few hairs. As Yeo (2002a: 90) indicated, the mericarps have an unusually widely open base.

Geranium wallichianum shares with *G. koreanum* distinctive broadly ovate stipules. They have very separate areas of distribution and some other important differentiating morphological features mentioned in the key. Additionally, *G. wallichianum* has black filaments, anthers, and stigmas, and broad bracteoles, not found in *G. koreanum*. Knuth (1912: 195) records of *G. wallichianum* from Korea [*Taquet 608* (E), *Taquet 609* (E, G)] should be referred as *G. koreanum*.

Sweet (1821, tab. 90) attributed *G. wallichianum* to D. Don because he transcribed the description from Don's unpublished *Prodromus Florae Nepalensis* (Don 1825: 207), although he did not provide the specific locality where the plants were collected ("Habitat in Nepaliae alpibus. D. Wallich"). Don (1825), however, indicated a precise location for his plant: "Hab. in Gosaingsthan. Wallich." Wallich (1848) mentioned under the number 8558 four collections for *G. wallichianum*: a) Sirmore G. Govan. / b) Ibid. Gerard. / c) Goshain Than, Bharut Singh. / d) Kamaon R. Blinkworth" Schönbeck-Temesy (1970: 25) right-

ly selected the type as *Wallich 8558c*, the only locality mentioned by Don (1825). Consequently, according to art. 9.19c of the Shenzhen Code, the choice of Knuth (1912: 195) of *Wallich 8558d* (B) should be superseded.

Its presence in New Zealand, probably as garden-escape, is based on a specimen at AK could not be studied.

The Refractum Group—This group of perennial species with thickened roots along the rootstock is characterized by the presence of opposite leaves, usually broad and connate stipules, and usually reflexed petals and immature fruits. The cymules are 2-flowered and arranged in a monochasial inflorescence.

41. Geranium delavayi Franch., Bull. Soc. Bot. France 33: 442. 1887. Type locality: "Yunnan, in silvis ad collum Koua-la-po, supra Hokin, alt. 3000 m.; fl. 4 aug. 1885 (Delav. n. 1945)". Type: China. Yunnan, ad collum Koua-la-po, supra Hokin, 26°26'N, 100°06'E, 4 Aug. 1885, *J.M. Delavay 1945* (lectotype, designated by Yeo 1992: 165, P-00712068!; isolectotype, MA-628483!).

Geranium forrestii R. Knuth in Engl., Pflanzenr. IV.129 (Heft 53): 578. 1912. Type locality: "West-Yunnan: Tali Kette, um 3000-3300 m, auf dem östlichen Hange, in lichten Gebüschen der Kiefernwälder (Forrest, Pl. East. Tibet a. S. W. China a. 1906 n. 4282 - Typus in herb. Edinburgh!)". Type: China. West-Yunnan, Tali Kette, 25°40'N, 100°05'E, Aug. 1906, *G. Forrest 4282* (holotype, E; isotype, P-00712071!).

Geranium kariense R. Knuth in Engl., Pflanzenr. IV.129 (Heft 53): 577. 1912. Type locality: "Yunnan: Westhang des Kari-Passes zwischen Mekong und Yangse, 3600-4200 m, in Kiefernwäldern (Forrest a. 1906 n. 97- Typus in herb. Edinburgh!)". Type: China. Yunnan, Westhang des Kari-Passes zwischen Mekong und Yangse, 27°40'N, 99°20'E, 1906, *G. Forrest 97* (holotype, E-216584!).

Geranium limprichtii Lingelsh. & Borza, Repert. Spec. Nov. Regni Veg. 13: 387. 1914. Type locality: "No 1081. China. Yünnan, Talifu, Bergwiesen des Tsang-schan, 2800-3000 m, 9. VIII. 1913, Dr. Limpricht". Type: China. Yunnan, Talifu, Bergwiesen des Tsang-schan, 25°35'N, 100°12'E, 9 Aug. 1913, *H.W. Limpricht 1081* (holotype, WRSL!).

Geranium calanthum Hand.-Mazz., Anz. Akad. Wiss. Wien, Math.-Naturwiss. Kl. 62: 224. 1925. Type locality: "Prov. Setschwan austro-occ.: In apertis lapidosis silvae frigide temperatae ad pascuun Bädö supra monasterium Muli, s. calceo, 3900 m legi 29. VII. 1915 (Nr. 7289) et probabiliter in silvis et pratis circa praedium Alo prope vicum Hsiao-Dschungdien in prov. Yünnan finitima 3400 m". Type: China. Setschwan austro-occ., supra monasterium Muli ad septentr. pagi Yünnanensis Yunging, ad pascuun Bädö, 28°12'N, 101°10'E, 29 July 1915, *H.F. Handel-Mazzetti 7289* (lectotype, designated by Yeo 1992: 165, W!; isotype, E-216066!).

Perennial herbs, 23-85 cm tall. *Rootstock* 6.9-18.1 mm in diameter, ± vertical, not tuberculate, not turnip-shaped, with thickened roots along the rootstock. *Stem* erect, leafy, not rooting at nodes, stolons absent, without vegetative stems, with patent to retrorse, eglandular hairs 0.2-0.7 mm long and, rarely, patent, glandular hairs 1-1.1 mm long. *Basal leaves* in a ± persistent rosette, cauline leaves opposite; leaf laminas (3.2)4.6-7.2(10.1) cm long, 3.8-14.4 cm wide, not peltate, palmatifid [ratio main-sinus length/middle segment length = (0.81)0.85-0.91(0.94)], polygonal in outline, base cordate, not coriaceous, with nerves not projected, pilose, with appressed, eglandular hairs on both surfaces; segments 5, in 1 plane, middle segment rhombic, (3.3)4.6-7.3(11) mm wide at the base [ratio segment width at the base/middle segment length = (0.10)0.11-0.14(0.16)], (9)13-18(26)-lobed in distal half [ratio secondary sinus length/middle segment length = (0.13)0.17-0.23(0.33)]; petioles up to 43 cm long, without abscission zone, terete, not swollen, not deflexed in age, with patent to retrorse, eglandular hairs 0.3-0.9 mm long and, rarely, patent, glandular hairs 0.4-0.5 mm long; stipules 5.5-19.4 mm long, 1.8-6.3 mm wide, broadly lanceolate, connate (at least at the base), papery, brown, with eglandular hairs on abaxial surface and on the margin, glabrous adaxially. *Inflorescence* a monochasial cyme; cymules 2-flowered, solitary or in aggregates at the top of each branch [ratio cymule length/leaf length = (1.4)2-3.9(6)]; peduncles (20)40-111(125) mm long, with patent to retrorse, eglandular hairs 0.2-0.6 mm long and, sometimes, patent, glandular hairs 1-2.1 mm long; bracteoles 2.9-14.1 mm long, 0.1-0.7 mm wide, filiform, whorled; pedicels (7.3)16-25(34) mm long, with patent to retrorse, eglandular hairs 0.2-0.5 mm long and, sometimes, patent (colourless), glandular hairs 0.9-1.5 mm long. Flowers actinomorphic. *Sepals* (6.5)7.1-8.8(10) mm long, 2.3-4.2 mm wide, lanceolate, smooth (with a small dark purple zone at the base), not accrescent, nerves 3(5), mucro (0.9)1.2-1.6(2.6) mm long [ratio mucro length/sepal length = 0.12-0.34], with antrorse, ± appressed, eglandular hairs 0.3-1.1 mm long and, sometimes, patent, glandular hairs 0.6-2.2 mm long on the abaxial surface, glabrous adaxially. *Petals* (6.1)8-11(12.3) mm long, (3.2)3.9-5.5(6.6) mm wide, reflexed, rounded, with claw 0.4-1.3 mm long, blackish red to pink with a whitish base, usually hairy on the base of the adaxial surface and sometimes on the abaxial surface, with a dense tuft of hairs on the basal margin, with hairs 0.6-2.3 mm long. *Stamens* 10, both whorls bearing anthers; filaments (7.7)9.1-11(11.3) mm long, lanceolate, reddish purple, sparsely pilose on the abaxial surface, ciliate on the proximal half, with hairs 0.3-0.8(1.1) mm long; anthers (1.9)2.1-2.3(2.5) mm long, blue black. Nectaries 5, hemispheric, with a tuft of hairs at the top, dorsally glabrous. *Gynoecium* 5.5-11.7 mm long, purple. *Fruit* (23.9)24.3-28.3(29.9) mm long, reflexed when immature, discharge of seed-ejection type; mericarps 3-4.2 mm long, 1.2-1.9 mm wide, without a strand of fibers, not compressed at the apex, smooth, without basal beak, with a basal callus, without a basal prong, brown, with ± patent, eglandular hairs 0.2-0.8 mm long; rostrum 17-

22.1 mm long, with a narrowed apex 3.6-6.2 mm long, not twisted, with ± patent, eglandular hairs 0.2-0.7 mm long; stigmatic remnants 1.8-3.4 mm long, with 5 glabrous lobes. *Seeds* 2.2-2.8 mm long, 1.1-1.8 mm wide, smooth, uniformly colored, brown, glabrous. Cotyledons with entire margin. Fig. 140.

Pollen. *Geranium*-type (Bortenschlager 1967: 429; Park & Kim 1997: 312; Tan & al. 1996: 210).

Chromosome number. Unknown.

Phenology. Collected in flower from May to October.

Distribution. This species ranges through south-central China (Sichuan, Xizang, Yunnan) (Fig. 141).

Habitat. Meadows, grassy slopes, bamboo formations and edge of *Abies* Mill., *Pinus* L., and *Quercus* L. forests; 2000-4600 m.

Representative specimens examined. **China.** Sichuan: distrito Linzhi, población Chayu, pueblo Chawalong, Qin Na Tong, Aug. 1935, *Wang 65283* (PE); Muli, 27º50'N, 101º15'E, 17 Aug. 1921, *Kingdon Ward 4827* (E); distrito Liangshan, población Muli, pueblo Tang Yang Bu Chang, 27º50'N, 101º15'E, 11 Sep. 1983, *Qinghai-Tibet Exped. 13912* (KUN); Kaushu shan, Leiliung, Leirong, SW of Muli, 27º54'N, 101º15'E, Oct. 1932, *Rock 24104* (E, GH); S Muli, Gi Bo Shan, 27º55'N, 101º16'E, 6 Aug. 1937, *Yü 7621* (PE); distrito Ganzi, población Derong, 28º42'N, 99º17'E, 4 Aug. 1981, *Qinghai-Tibet Exped. 3222* (KUN); Derong Xian, Gajingxue Shan, NNW city of Derong, 28º52'N, 99º14'E, 19 July 2004, *Boufford & al. 30820* (MA); Jiulong Xian, Tanggu Cun, from Sida Niuchang, N of Tanggu Xian, 29º9'N, 101º31'E, 19 July 2005, *Boufford & al. 33151* (MA); mountains between the Litang and Shou-Chu rivers, between Wa-Erh-Dje and Garu, 29º10'N, 99º29'E, July 1928, *Rock 16745* (GH, P); ciudad Leshan, distrito Jinkouhe, montaña Shouping Shan, 29º18'N, 103º4'E, 20 July 1995, *Xu Honggui 5559* (MO); Mt. Omei, 29º30'N, 103º18'E, July 1931, *Wang 23453a* (PE); Kangting, Tachienlu, Yulingkong, Yachiang Mts., 29º51'N, 102º15'E, 24 July 1934, *Smith 10605* (UPS); montaña E Meishan, 30º2'N, 103º50'E, 20 July 1996, *Xu Honggui 6080* (MO). Xizang: Salween-Kiukiang divide, Parolaka, 28º40'N, 98º15'E, 11 Oct. 1938, *Yü 20635* (E). Yunnan: Yunnan, Mengzi Mts. to N, 23º21'N, 103º26'E, *Henry 10228a* (MO); pr. pagum Yungning, sub jugo Fongkou, 24º16'N, 102º23'E, 1914, *Handel-Mazzetti 7063* (W); Talifu, Bergwiesen des Tsang-

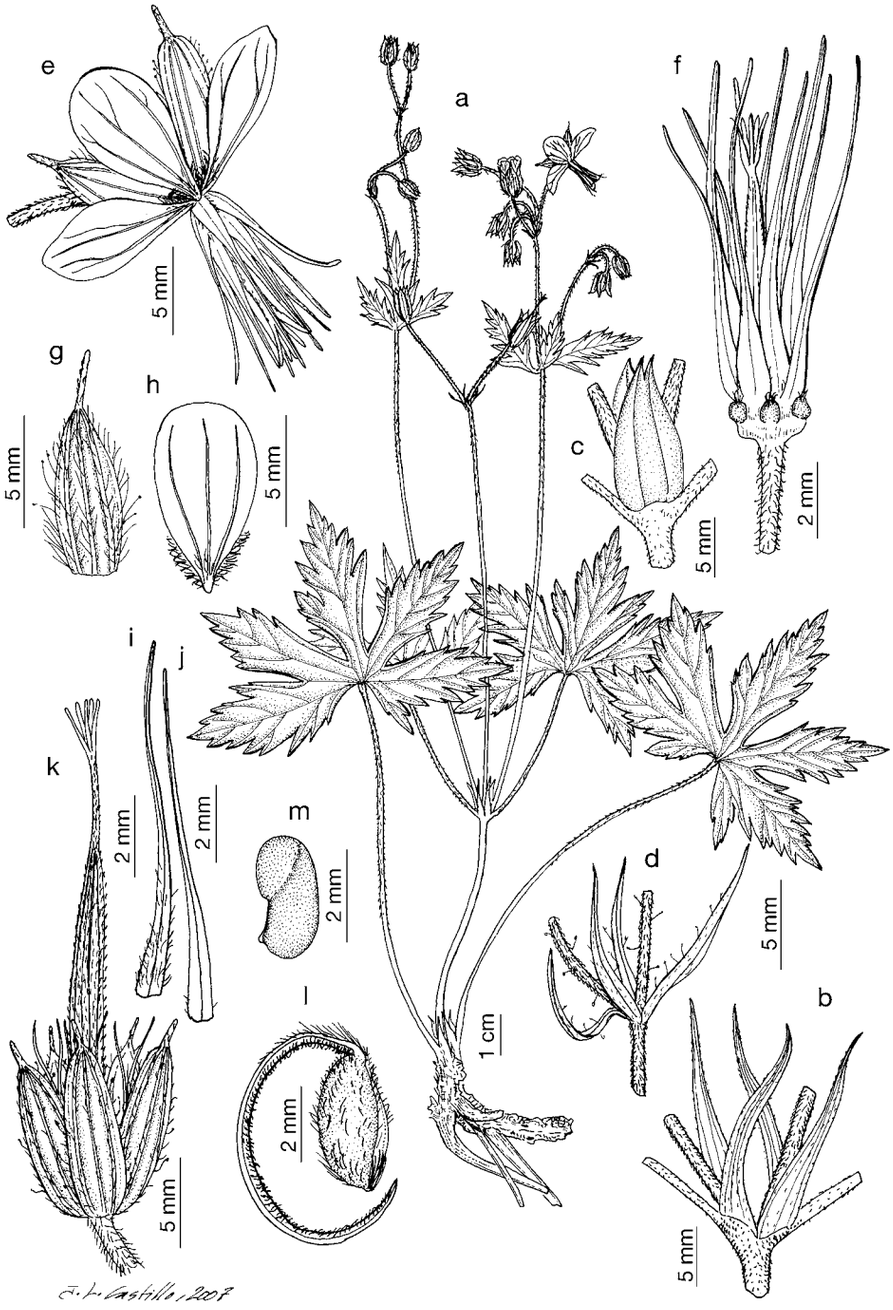


Fig. 140. *Geranium delavayi*. a. Habit. b, c. Stipules. d. Bracteoles. e. Flower. f. Flower without petals and sepals. g. Sepal. h. Petal. i, j. Staminal filaments. k. Fruit. l. Mericarp. m. Seed. (Based on: a, d-h, *Handel-Mazzetti 7289,* E; b, *Forrest 4282,* E; c, *Henry 10228,* E; i-m, *Edinb. Exped. Deqen 262,* E).

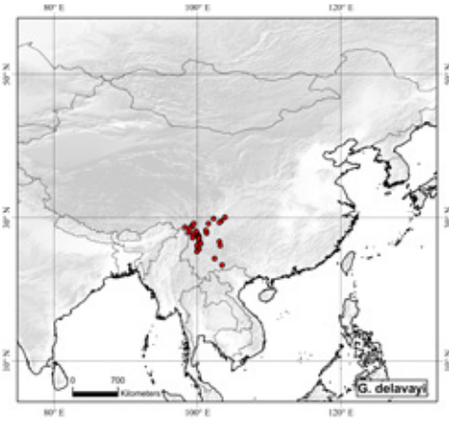


Fig. 141. Distribution of *Geranium delavayi*.

schan, 25º40'N, 100º5'E, 9 Aug. 1913, *Limpricht 984* (WRSL); Dali Xian, Diancang Shan mountain, Xiaohuadianba, pr. Huadianba medicinal farm, 25º53'N, 100º1'E, 19 July 1984, *Sino-Amer. Bot. Exped. 1179* (CAS, GH); Tongchuan, 26º5'N, 103º10'E, *Maire s.n.* (E); Lichang, Nguluko, 26º21'N, 100º28'E, 11 Aug. 1937, *Yü 15426* (E, PE); distrito Heqing, población Huangping, Bishan, 26º34'N, 100º12'E, 24 Aug. 1929, *Ching 24058* (PE); Dongchuan, 26º39'N, 103º3'E, 1914, *Maire s.n.* (E); NW Likiang, Ah-s-chi, 26º53'N, 100º14'E, 25 June 1939, *Ching 20890* (GH); distrito Lijiang, montaña Yulong, 27º7'N, 100º10'E, 2 Aug. 1960, *China-RSSS Exped. 6310* (PE); Lijiang, E side of Mt. Yulong-shui-shan, between Ma-huang-ba and Wu-dou-di, 27º7'N, 100º10'E, 17 Aug. 1990, *Murata & al. 581* (GH); Wei-si Hsien, 27º11'N, 99º19'E, Aug. 1935, *Wang 67664* (GH); Yangtze watershed, Likiang, E slopes of Likiang Snow range, Lu Kgo, 27º20'N, 100º8'E, June 1922, *Rock 4749* (E); Yunnan, E slopes of Likiang Snow Range, Yangtze watershed, 27º20'N, 100º8'E, July 1923, *Rock 9453* (E, P); distrito Diqing, población Deqin, montaña Baimashan, 27º20'N, 100º13'E, 11 Aug. 1937, *Yü 9531* (KUN, PE); E flank of Lichiang Range, 27º25'N, 100º8'E, Aug. 1910, *Forrest 6302* (E); Shangrila Xian, Xiao Zhongdian, near Tormula village, 9 km SE of Zhongdian Xian along the road from Zhongdian to Lijiang, 27º28'N, 99º52'E, 21 July 2007, *Tibet-MacArthur 1065* (US); Zhongdian Xian, road from Zhongdian to Haba Cun, 27º41'N, 100º1'E, 20 July 2006, *Boufford & al. 35006* (MA); Chungtien valley, Hsiachungtien, 27º49'N, 99º42'E, 25 June 1939, *Feng 1402* (GH); Mekong-Salween divide, Sewalongba, 27º57'N, 98º45'E, 26 Aug. 1938, *Yü 22498* (E); prefectura Diqing, distrito Xianggelila, Shangri-la, 28º3'N, 99º50'E, 3 Sep. 1959, *Feng Guomei 23443* (E, IBSC); prefectura Diqing, distrito Xianggelila, Shangri-la, templo Da Bao Si, 28º3'N, 99º50'E, 2 Aug. 1937, *Yü 12583* (IBSC); Dequen Zang Aut Pref., SW Dechin, at viewpoint of Kagur Pu, 28º26'N, 98º52'E, 16 Sep. 1995, *Edinb. Exped. Deqen 262* (E).

Discussion. *Geranium delavayi* share a similar habit, connate stipules, nodding flowers and immature fruits, and narrow and reflexed petals with *G. refractum* and *Geranium sinense.* The glandular hairs of the inflorescence, when present, are similar to those of *G. sinense*, as well as the filiform bracteoles and the inflorescence with aggregate of cymules toward the apex of each branch. Leaves of *G. delavayi* and *G. sinense* have a middle segment which resembles those of *G. nodosum* or *G. versicolor*. Petals of *Geranium delavayi* are shorter than in *G. refractum* and *G. pogonanthum*, and they are blackish red to pink with a whitish base. They resemble those of *G. sinense*, but with a dense tuft of hairs on the basal margin. The almost glabrous filaments are also useful to differentiate *G. delavayi* from *G. pogonanthum*, and the distinct nectaries from *G. sinense*.

Geranium calanthum is sometimes differentiated by pale yellow petals. However, neither original description nor type specimen supports this opinion. *Geranium kariense* and *G. limprichtii* are differentiated by the nonglandular pedicels and petal size, which are variable features in *G. delavayi*.

---

42. Geranium pogonanthum Franch., Pl. Delavay.: 111. 1889. Type locality: "Yun-nan, in monte Fang-yang-tchang (Delavay)". Type: China. Yunnan, in monte Fang-yang-tchang, 26°52'N, 100°13'E, *J.M. Delavay s.n.* (lectotype, designated by Yeo 1992: 169, P-00712149!; isolectotype, K-000729356!).

Geranium palustre var. *stipulaceum* Franch., Pl. Delavay.: 109. 1889. *Geranium lankongense* H.W. Li, Vasc. Pl. Hengduan Mount. 1: 1028. 1993, nom. nov. Type locality: "Yun-nan, in monte Hee-chan-men (Delavay)". Type: China.Yun-nan, in monte Hee-chan-men, 26°06'N, 99°57'E, *J.M. Delavay s.n*. (lectotype, designated by Yeo 1992: 169, P-00172152!).

Geranium meiguense Z.M. Tan, Bull. Bot. Res., Harbin 6(2): 47, lam. 1. 1986. Type locality: "Sichuan: Meigu, Dafengding alt. 3300m, July 11, 1979, Meigu Exped. 410 (Type, fl. ICD)". Type: China. Sichuan, Meigu, Dafengding, 28°36'N, 103°17'E, 11 July 1979, *Meigu Exped. 410* (holotype, SM).

Perennial herbs, 22-62 cm tall. *Rootstock* 4.2-15.6 mm in diameter, ± vertical, not tuberculate, not turnip-shaped, with thickened roots along the rootstock. *Stem* erect, leafy, not rooting at nodes, stolons absent, without vegetative stems, with patent to retrorse, eglandular hairs 0.2-2.5 mm long and, rarely, patent, glandular hairs 1-1.9 mm long. *Basal leaves* in a ± persistent rosette, cauline leaves opposite; leaf laminas (3.9)5.1-6.9(9.3) cm long, 5.1-11.1 cm wide, not peltate, palmatifid [ratio main-sinus length/middle segment length = (0.69)0.82-0.89(0.93)], polygonal in outline, base cordate, not coriaceous, with nerves not projected, pilose, with ± appressed, eglandular hairs on both surfaces; segments 5, in 1 plane, middle segment rhombic, (4.7)6.4-9.5(10.1) mm wide at the base [ratio segment width at the base/middle segment length = (0.10)0.15-0.22(0.32)], (7)13-18(29)-lobed in distal half [ratio secondary sinus length/middle segment length = (0.18)0.20-0.31(0.35)]; petioles up to 32 cm long, without abscission zone, terete, not swollen, not deflexed in age, with patent to retrorse, eglandular hairs 0.3-1.1 mm long; stipules 7.1-16.3 mm long, 2.1-7.3 mm wide, broadly lanceolate, connate (at least at the base), papery, brown, with eglandular hairs on abaxial surface and on the margin, usually glabrous adaxially. *Inflorescence* a monochasial cyme; cymules 2-flowered, solitary [ratio cymule length/leaf length = (1.5)2.2-3.3(5.4)]; peduncles (22)49-101(110) mm long, with patent to retrorse, eglandular hairs 0.2-1 mm long and, sometimes, patent, glandular hairs 0.4-0.9 mm long; bracteoles 4.5-10.7 mm long, 0.3-1.7 mm wide, filiform to lanceolate, whorled; pedicels (9.9)16-29(34) mm long, with patent to retrorse, eglandular hairs 0.3-0.8 mm long and, sometimes, patent (colourless), glandular hairs 0.2-0.9 mm long. Flowers actinomorphic. *Sepals* (6.9)7.8-10.6(11.1) mm long, 2.1-3.8 mm wide, lanceolate, smooth (with a small dark purple zone at the base), not accrescent, nerves 3-5, mucro (1.1)1.2-1.9(2.3) mm long [ratio mucro length/sepal length = 0.10-0.25], with ± patent, eglandular hairs 0.1-1.6 mm long and sometimes, patent, glandular hairs 0.8-1.4 mm long on

the abaxial surface, glabrous adaxially. *Petals* (9.5)11.7-13.9(16.7) mm long, (4.8)5.3-7(8.6) mm wide, reflexed, rounded, with claw 0.4-0.9 mm long, white to pink or purple, hairy on the base of the adaxial surface and sometimes on the abaxial surface, with a dense tuft of hairs on the basal margin, with hairs 0.8-2.8 mm long. *Stamens* 10, both whorls bearing anthers; filaments (6.7)8.5-12.5(13.2) mm long, lanceolate, pink to purple, densely pilose on the abaxial surface, ciliate on the proximal half, with hairs 1-1.8 mm long; anthers (1.5)1.7-2.5(3.1) mm long, blue black. Nectaries 5, hemispheric, with a tuft of hairs at the top, dorsally glabrous. *Gynoecium* 6.5-13 mm long, purple. *Fruit* (21.8)23.2-31(36) mm long, reflexed when immature, discharge of seed-ejection type; mericarps 2.3-4.3 mm long, 1.5-2.1 mm wide, without a strand of fibers, not compressed at the apex, smooth, without basal beak, with a basal callus, without a basal prong, brown, with ± patent, eglandular hairs 0.4-0.8 mm long; rostrum 14-28.4 mm long, with a narrowed apex 5.6-6.2 mm long, not twisted, with ± patent, eglandular hairs 0.3-0.5 mm long; stigmatic remnants (2.3)2.6-3.6(3.9) mm long, with 5 glabrous lobes. *Seeds* 2.5-3.5 mm long, 1-1.2 mm wide, finely reticulate, uniformly colored, brown, glabrous. Cotyledons not studied. Fig. 142.

Pollen. *Geranium*-type (Tan & al. 1996: 210 [sub *G. meiguense*]).

Chromosome number. Unknown.

Phenology. Collected in flower from May to September.

Distribution. This species ranges through Sichuan and Yunnan, in south-central China to Burma (Fig. 143).

Habitat. Meadows, grassy or rocky slopes and edge of *Juniperus* L. and *Pinus* L. forests; 1500-4300 m.

Additional specimens examined. **Burma.** Kachin: Laktang, 26°13'N, 98°25'E, 21 July 1919, *Kingdon Ward 3354* (E). **China.**

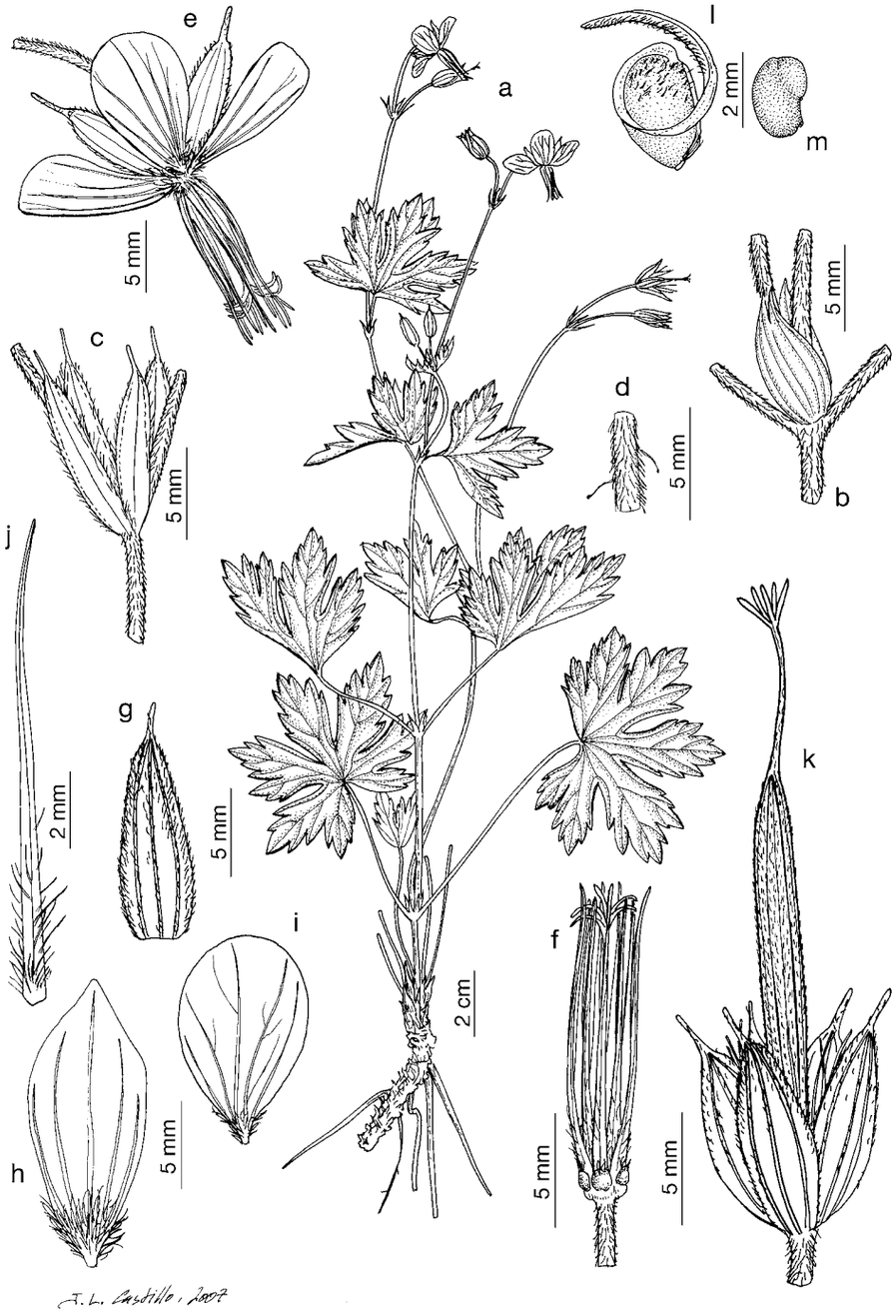


Fig. 142. *Geranium pogonanthum*. a. Habit. b. Stipules. c. Bracteoles. d. Pedicel indumentum. e. Flower. f. Flower without petals and sepals. g. Sepal. h, i. Petals. j. Staminal filament. k. Fruit. l. Mericarp. m. Seed. (Based on: a, b, d, *Rock 24106,* E; c, e-g, i-j, *Yü 16948,* E; h, *Rock 4924,* E; k-m, *Schneider 3291,* GH).

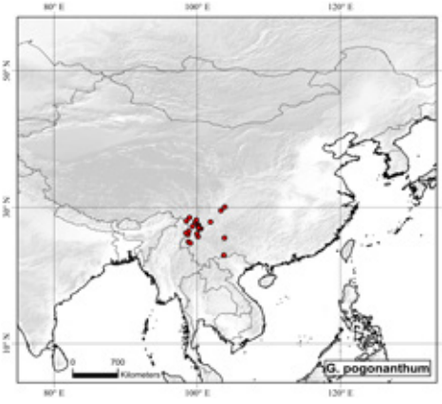


Fig. 143. Distribution of *Geranium pogonanthum*.

Sichuan: Muli, 27º50'N, 101º50'E, 1932, *Rock 24106* (E, GH); Mt. Omei, Omei hsien, 29º30'N, 103º18'E, 15 Aug. 1928, *Fang 2996* (E, K); montaña E Mei Shan, Qian Fo Ding, 30º2'N, 103º50'E, 3 July 1957, *Xiong JiHua 31452* (IBSC). Yunnan: Ta hai, *Maire s.n.* (E). Yunnan: in reg Lichiang, pr. pagum Ngu Leh keh, July 1914, *Schneider 1998* (G, GH, US); Liang-shan, A'Ho A'No, 18 Aug. 1932, *Tsai 51317* (GH); Ping-pien Hsien, 22º58'N, 103º42'E, 18 Aug. 1934, *Tsai 62752* (GH); Tsekou, Sila Thrhana, 24º44'N, 99º2'E, 15 July 1898, *Delavay 1312* (P); Shweli-Salween divide, Longchuan Jiang- Nu Jiang, 24º55'N, 98º45'E, Aug. 1912, *Forrest 9070* (E); ciudad Qujing, población Huize, Xiao Xi Niu Tou, 25º29'N, 103º47'E, 22 July 1964, *NE Yunnan Exped. 288* (KUN); bois de Kan-ho, pres Tang yang chang, 25º40'N, 100º6'E, 5 Sep. 1887, *Delavay s.n.* (P); Nujiang Lisu pref., Lushui co., Pian Ma Ya Kou, summit of road from Liuku to Pian Ma, 25º58'N, 98º41'E, 4 Oct. 1997, *Li Heng 9974* (E, MO); Lushui Xian, Luobenzhuo Xiang, E'ga Cun, 26º28'N, 98º48'E, 8 Aug. 2005, *Gaoligong Shan Biod. Survey 25760* (CAS); ciudad Lijiang, población Baiyuhu, pueblo Xue Song, Ma Huang Ba, 26º48'N, 100º16'E, 1 Sep. 1955, *Feng Guomei 21269* (KUN); Lijiang, Lijiang gebirge, ca. 20 km N Lijang, 26º51'N, 100º30'E, 31 July 1996, *Podlech 54435* (MSB); NW Likiang, between Tamichung and Tuchi, 26º53'N, 100º14'E, 22 Oct. 1939, *Ching 21915* (GH); pr urbis Lidjiang (Likiang), rivum Beschui, 26º53'N, 100º14'E, 10 July 1915, *Handel-Mazzetti 7013* (W); in decliv. Lorbos collium occiden. pr. Likiang, 26º53'N, 100º14'E, Sep. 1914, *Schneider 3291* (G, GH); Hsi-chang Hsien, 26º53'N, 100º14'E, 10 Aug. 1932, *Yü 1309* (GH); pr. Lichiang, 27º0'N, 100º10'E, 2 Sep. 1914, *Schneider 3354* (G, GH); Likiang Snow range, 27º5'N, 100º10'E, 28 July 1939, *Ching 30419* (GH); Chengkang, Snow range, 27º5'N, 100º10'E, 24 July 1938, *Yü 16948* (E, GH); Wei-si Hsien, Yeh-Chih, 27º11'N, 99º19'E, Aug. 1935, *Wang 68376* (GH); Yangtze watershed, Likiang, E slopes of Likiang Snow range, 27º20'N, 100º8'E, May 1922, *Rock 4924* (E, M, NY); E flank of Lichiang Range, 27º25'N, 100º8'E, July 1910, *Forrest 6058* (E); Chungtien valley, 27º49'N, 99º42'E, 9 Aug. 1939, *Feng 1934* (GH); Gongshan, Bingzhongluo, 2.6 km SSW of Gawagapu mountain, and 15.5 km WSW of Bingzhongluo in the next basin to the E of Chukuai lake, E side of Gaoligong Shan, 27º59'N, 98º28'E, 25 Aug. 2006, *Gaoligong Shan Biod. Survey 31431* (GH, MA); Shangrila Xian, Hongshan, on the way from Geza to Hongshan Pass near milestone 14, 28º7'N, 99º52'E, 23 July 2007, *Tibet-MacArthur 1206* (US); A-tun-tze, 28º29'N, 98º54'E, Sep. 1935, *Wang 69968* (GH).

Discussion. Geranium pogonanthum is a species quite similar to *G. delavayi*. Both share a similar habit, broadly lanceolate and connate stipules, nodding flowers and reflexed immature fruits, and narrow and reflexed petals. This species is difficult to differentiate from *G. delavayi* when fresh petals are not available to observe their colors. However, *G. pogonanthum* has staminal filaments with longer and abundant hairs and longer petals. Glandular indumentum is also variable in *G. pogonanthum*, being sometimes just present on the stem base and other times only on the inflorescence. Bracteoles are sometimes filiform, as in *G. delavayi*, and other times lanceolate as in *G. yunnanense*. Seed measurements are from Yeo (1992).

43. Geranium refractum Edgew. & Hook. f. in Hook. f., Fl. Brit. India 1: 428. 1874. Type locality: "Sikkim Himalaya; Tungu, alt. 12-13,000 ft., J.D.H.". Type: India. Sikkim. Tungu, 27°43'N, 88°33'E, 23 July 1849, *J.D. Hooker 15* (lectotype, designated by Yeo 1992: 163, K-000729346!).

Geranium melanandrum Franch., Pl. Delavay.: 112. 1889. Type locality: "Yun-nan, in monte Fang-yang-tchang, supra Moso-yn; 14 oct. 1887 (Delavay); ad collum Yen-tze-hay; 19 jul. 1887 (id.)". Type: China. Yun-nan, Yen-tze-hay, 26°21'N, 100°06'E, 19 July 1887, *J.M. Delavay s.n.* (lectotype, designated by Novoselova 2004: 506, LE!; isolectotypes, LE!, K-000729459!, MA-628479!, MPU-018480!, P-00712125!).

Geranium batangense Pax & K. Hoffm., Repert. Spec. Nov. Regni Veg. Beih. 12: 430. 1922. Type locality: "Ost-Tibet: Bejü-Batang. Nadelholzwälder des Passes Ngu pa la to ti zwischen Ssama und Maoschi, 4200 m (n. 2184)". Type: China. Sichuan, Ost-Tibet: Bejü-Batang, Nadelholzwälder des Passes Ngu pa la to ti zwischen Ssama und Maoschi, 30°01'N, 99°14'E, *H.W. Limpricht 2184* (lectotype, designated by Yeo 1992: 163, WRSL!).

Geranium refractoides Pax & K. Hoffm., Repert. Spec. Nov. Regni Veg. Beih. 12: 430. 1922. Type locality: "Ost-Tibet: Ta tsien lu-Dawo, Gata, unter Gebüsch im Tale on Tschin tschwan nordwestlich des Dshara, 3800 m (n. 1895)". Type: China. Sichuan, Ost-Tibet, Ta tsien lu-Dawo, Gata, unter Gebüsch im Tale on Tschin tschwan nordwestlich des Dshara, 30°03'N, 102°02'E, *H.W. Limpricht 1895* (lectotype, designated by Yeo 1992: 163, WRSL!).

Geranium angustilobum Z.M. Tan, Bull. Bot. Res., Harbin 6(2): 48, lam. 2. 1986. Type locality: "Sichuan: Xiangcheng, ongrassland near Rewo, alt. 4500 m, July 28, 1973, Xiangcheng Exped. 2888 (Type, CDBI)". Type: China. Sichuan, Xiangcheng, near Rewo, 32°23'N, 103°28'E, 28 July 1973, *Xiangcheng Exped. 2888* (holotype, CDBI-0172127 image!).

Perennial herbs, 16-58 cm tall. *Rootstock* 5-18 mm in diameter, ± vertical, not tuberculate, not turnip-shaped, with thickened roots along the rootstock. *Stem* erect, leafy, not rooting at nodes, stolons absent, without vegetative stems, with patent to retrorse, eglandular hairs 0.2-1.3 mm long and, rarely, patent, glandular hairs 0.7-0.8 mm long. *Basal leaves* in a persistent rosette, cauline leaves opposite; leaf laminas (3)3.5-4.8(6.8) cm long, 3.3-7.8 cm wide, not peltate, palmatifid [ratio main-sinus length/middle segment length = (0.73)0.82-0.87(0.89)], polygonal in outline, base cordate, not coriaceous, with nerves not projected, pilose, with appressed, eglandular hairs and, rarely, patent, glandular hairs on both surfaces; segments 5, in 1 plane, middle segment rhombic, (2.3)4.1-5.4(7.5) mm wide at the base [ratio segment width at the base/middle segment length = (0.10)0.14-0.20(0.22)], 6-13(18)-lobed in distal half [ratio secondary sinus length/middle segment length = (0.18)0.23-0.28(0.32)]; petioles up to 20 cm long, without abscission zone, terete, not swollen, not deflexed in age, with patent to retrorse, eglandular hairs 0.3-1.3 mm long and, rarely, patent, glandular hairs 0.7-0.8 mm long; stipules 5.1-11.8 mm long, 2.6-5.6 mm wide, broadly lanceolate, connate (at least at the base), papery, brown, with eglandular hairs on abaxial surface and on the margin, usually glabrous adaxially. *Inflorescence* a monochasial cyme; cymules 2-flowered, solitary [ratio cymule length/leaf length = (1.1)2-4.1(5.5)]; peduncles (39)53-73(200) mm long, with uncinate and patent,

eglandular hairs 0.2-1.3 mm long and patent (purplish), glandular hairs 0.4-0.9 mm long; bracteoles 2.3-6.8 mm long, (0.4)0.6-1.1 mm wide, linear-lanceolate, whorled; pedicels (4)16-28(40) mm long, with uncinate and patent, eglandular hairs 0.4-0.9 mm long and patent (purplish), glandular hairs 0.4-0.8 mm long. Flowers actinomorphic. *Sepals* (7.4)8.8-9.3(10.8) mm long, 2.9-5.2 mm wide, lanceolate, smooth (with a small dark purple zone at the base), not accrescent, nerves 3-5, mucro (0.8)0.9-1.3(2.2) mm long [ratio mucro length/sepal length = 0.09-0.22], with antrorse, ± appressed, eglandular hairs 0.3-1.3 mm long and patent (purplish), glandular hairs 0.3-1.1 mm long on the abaxial surface, glabrous adaxially. *Petals* (10.4)12.2-14.6(20.4) mm long, (3.7)5.1-6(8.4) mm wide, reflexed, rounded, with claw 0.3-0.9 mm long, white or pale pink, usually hairy on the base of the adaxial surface and sometimes on the abaxial surface, with a dense tuft of hairs on the basal margin, with hairs 0.6-1.7 mm long. *Stamens* 10, both whorls bearing anthers; filaments (9.1)10.6-12(15.1) mm long, lanceolate, reddish purple to pink, sparsely pilose on the abaxial surface, ciliate on the proximal half, with hairs 0.2-1.1(1.6) mm long; anthers (1.8)2.1-2.5(2.6) mm long, blue black. Nectaries 5, hemispheric, with a tuft of hairs at the top, dorsally glabrous. *Gynoecium* 8.4-13.6 mm long, pale pink to purple. *Fruit* (25)26-28(31.6) mm long, reflexed when immature, discharge of seed-ejection type; mericarps 3.2-4.2 mm long, 1.6-2.3 mm wide, without a strand of fibers, not compressed at the apex, smooth, without basal beak, with a basal callus, without a basal prong, brown, with ± patent, eglandular hairs 0.5-1 mm long; rostrum 17-22.2 mm long, with a narrowed apex 5.2-6.6 mm long, not twisted, with ± patent, eglandular hairs 0.2-0.6 mm long; stigmatic remnants (2.6)2.7-3.3 mm long, with 5 glabrous lobes. *Seeds* 2.7-3 mm long, 1.3-1.8 mm wide, smooth, slightly mottled, brown, glabrous. Cotyledons with entire margin. Fig. 144.

Pollen. *Geranium*-type (Bortenschlager 1967: 429; Park & Kim 1997: 312).

Chromosome number. 2*n* = 28.

Phenology. Collected in flower from June to September.

Distribution. This species ranges from Nepal to central China (Sichuan, Xizang and Yunnan) (Fig. 145).

Habitat. Meadows, grassy slopes, *Juniperus* L. and *Rhododendron* L. thickets, and edge of *Abies* Mill., *Larix* Mill., *Picea* A. Dietr., *Quercus* L., and *Salix* L. forests; 2900-4800 m.

Representatives specimens examined. **China.** Sichuan: Muli, mountains of Kulu, 27º50'N, 101º15'E, July 1929, *Rock 18014* (E, GH, P); Kaushu shan, Leiliung, Leirong, 27º54'N, 101º15'E, Oct. 1932, *Rock 24486* (E, GH, NY); distrito Liang Shan, población Muli, 27º55'N, 101º16'E, 12 Sep. 1983, *Xinghai-Tibet Exped. 14758* (PE); Litang-Yalung divide, 28º1'N, 101º58'E, 6 July, *Kingdon Ward 4384* (E); Mianning Xian, Lamagetou Nature Reserve, Niuchang, upstream from Yele Dam, 28º57'N, 102º6'E, 9 July 2005, *Boufford & al. 32707* (MA); Xiangcheng Xian, Haizi lake on road between Sandui and Litang, 29º6'N, 100º1'E, 12 July 1998, *Boufford & al. 28606* (CAS, GH, MO); Xiangcheng Xian, pr. Reda, Rizhao Shen Shan from gorge behind Silong village, 29º6'N, 99º40'E, 16 July 2004, *Boufford & al. 30678* (MA); Xiangcheng Xian, between towns of Xiangcheng and Sandui, 29º7'N, 99º58'E, 12 July 1998, *Boufford & al. 28652* (CAS, GH, MO); Daocheng Xian, Suocong, between Sandui and Daocheng, 29º8'N, 100º9'E, 2 July 1998, *Boufford & al. 28109* (CAS, GH, MO); Derong Xian, NNW of city of Derong, Dimu Caodi pass, 29º8'N, 99º20'E, 20 July 2004, *Boufford & al. 30929* (MA); Jiulong Xian, Tanggu Cun, Sida Niuchang, N of Tanggu Xiang, 29º12'N, 101º32'E, 18 July 2005, *Boufford & al. 33097* (MA); Jiulong Xian, Tanggu Cun, vicinity of Dingtianzhou Shan, 29º13'N, 101º30'E, 18 July 2005, *Boufford & al. 33190* (MA); Kangting, Tachienlu, Yulingkong, Yachiang Mts., 29º51'N, 101º15'E, 24 July 1934, *Smith 10605* (CAS, S, TI); Kangding Xian, between cities of Yajiang and Xinduqiao off highway 318, 30º1'N, 101º23'E, 5 Aug. 2006, *Boufford & al. 35762* (MA); Mupin, 30º10'N, 102º56'E, 1 Jan. 1914, *Wilson 4658* (K); Daofu Xian, SE city Danba on highway 303 to Daofu and Kangding just NE of pass at border with Daofu Xian, 30º32'N, 101º35'E, 24 July 2007, *Boufford & al. 38051* (GH, MA); Xiaojin Xian, SE side of city Xiaojinon at Balong Shan on S side of pass, 30º55'N, 102º53'E, 29 July 2007, *Boufford & al. 38602* (GH, MA); Baiyu Xian, road from Baiyu to Batang at first pass from Baiyu, 30º58'N, 98º58'E, 22 Aug. 2006, *Boufford & al. 37097* (MA); Baiyu Xian, road from Baiyu to Batang on N side of first pass from Baiyu and S of Xieda village, 31º0'N, 98º54'E, 22 Aug. 2006, *Boufford & al. 37083* (MA); prefectura Ganzi, distrito Danba, Hai Zi Ping, 31º11'N, 102º1'E, 24 Aug. 1958, *Bot. Exped. Sichuan 2587* (IBSC); Rangtang Xian, S of the city Rangtang then E on one track dirt road along tributary of Du-ke He at Zhangla Cun, 32º4'N, 101º4'E, 8 Aug. 2007, *Boufford & al. 39280* (GH, MA). Xizang: Tsangpo, 4 Sep. 1935, *Kingdon Ward 12304* (BM); Nambu La, 19 July 1947, *Ludlow & Sherriff 15470* (E); Mala pass, Bejü-Batang, 28º30'N, 90º6'E, 13 Aug. 1914, *Limpricht 2209* (WRSL); Tsarung prov., N slopes Mt. Kenichunpo, N of Sikitung, Upper Salwin river, 28º30'N, 98º20'E, June 1932, *Rock 22142* (BM, E, GH); Salween-Kiukiang divide, Netahtsu, 28º40'N, 98º15'E, 20 Oct. 1938, *Yü 20804* (E, GH); SE Tibet, Nambu La, 30º0'N, 94º10'E, 29 Aug. 1938, *Ludlow & Sherriff 6938* (BM); Riwoqe Xian, W side of Zhuoga-La on road from Changdu to Riwoqe, 31º4'N, 96º56'E, 13 Aug. 2004, *Boufford & al. 32268* (MA); Riwoqe Xian, W side of Zhuoga-La on road from Changdu to Riwoqe, 31º6'N, 96º52'E, 13 Aug. 2004, *Boufford & al. 32323* (MA); Changdu Xian, old road from Changdu to Jiangda on Damala Shan, 31º11'N, 97º19'E, 25 July 2009, *Boufford & al. 41134* (MA); Changdu Xian, old road from Changdu to Jiangda on Damala Shan, 31º14'N, 97º18'E, 25 July 2009, *Boufford & al. 41065* (MA); Jiangda Xian, W city Jiangda on road to Changdu, pass at Leijila Shan, 31º20'N, 98º3'E, 1 Aug. 2004, *Boufford & al. 31503* (MA); Changdu Xian, road from Changdu to Jiangda along Zha Qu W of the Toba, 31º24'N, 97º28'E, 29 July 2009, *Boufford & al. 41370* (MA); Changdu Xian, road from Changdu to Jiangda along Zha qu river, W of Toba, 31º30'N, 97º20'E, 17 Aug. 2004, *Boufford & al. 32538* (MA); Yunnan: mountains of Nakala, E of Yuragan, Mekong-Salween divide, 23º50'N, 99º50'E, Aug. 1932, *Rock 23418* (E); upper Kiukiang valley, Clulung, S of Lungtsahmuru, 23º53'N, 97º39'E, 10 Aug. 1938, *Yü 19883* (E, GH); Mekong-Salween divide, Sila, 24º44'N, 99º2'E, 19 Aug. 1938, *Yü 22423* (E, PE); Fang-yang-tchang, supra Mo-so-y, 26º52'N, 100º13'E, 14 Oct. 1887, *Delavay s.n.* (P); Wei-si Hsien, Yah Chih, 27º11'N, 99º19'E, Aug. 1935, *Wang 68642* (GH); Weihsi, Tungchuling, Tsidang, 27º11'N, 99º19'E, 14 July 1937, *Yü 8983* (GH, PE); distrito Diqing, población Deqin, pueblo Cizhong, 27º20'N, 100º13'E, 12 Oct. 1959, *Feng Guomei 24085* (KUN); Zhongdian, Wensui, Da Xue Shan (Big Snow

mountains), E of pass, 28°34'N, 99°49'E, 10 June 1994, *Alpine Garden Soc. Exped. 1793* (E); Zhongdian Xian, S of Zhongdian Daxue Shan, 28°34'N, 99°48'E, 25 July 1998, *Boufford & al. 29168* (MO). **India.** Sikkim: Changu, 29°38'N, 98°8'E, 25 July 1913, *Cooper & Bulley s.n.* (GH). **Nepal.** Bagmati: C Nepal, Janakpur zone, Ramechhap distr., Koshing Kharkal-Thare Og, 27°44'N, 86°26'E, 22 July 1985, *Ohba & al. 8570661* (GH); C Nepal, Janakpur zone, Ramechhap distr., around Thara, 27°45'N, 86°28'E, 23 July 1985, *Ohba & al. 8580422* (GH). Gandaki: C Nepal, Dhaulagiri zone, Parbat distr., Ghandruk Deorali--Banthati, 28°7'N, 84°8'E, 11 July 1983, *Ohba & al. 8350238* (GH); C Nepal, Gandaki zone, Manang distr., Gunsang, 28°39'N, 84°0'E, 17 Aug. 1994, *Mikage & al. 9460376* (BM). Province No. 1: C Nepal, Sagaramatha zone, Solukhumbu distr., Loding-Pike-buk-Pike Bhanjyang, 27°32'N, 86°32'E, 5 Sep. 1985, *Ohba & al. 8572318* (GH).

Discussion. Geranium refractum is an erect herb with a short vertical rootstock that bears thickened and more or less grouped roots. It has opposite leaves with broadly lanceolate and connate stipules that sometimes have a free apex. The stipules are not as broad as in *G. sinense*. The flowers are nodding, as are the immature fruits that finally become erect. Petals are very narrow and reflexed. They are densely hairy on the basal margins and usually on the base of the adaxial surface and, more rarely, also on the base of the abaxial one. The staminal filaments are sparsely hairy and, occasionally, with long hairs.

Purplish glandular hairs on the inflorescence are usually enough to identify this species unequivocally. In old herbarium specimens, a purplish pigment is sometimes restricted to the apical cell and septa of the glandular hairs. Yeo (1992: 165) suggested that plants from Xizang have whitish flowers, whereas those from Sichuan and Yunnan have pinkish flowers. *Geranium melanandrum* and *G. refractoides* have been differentiated on this basis and by their more obscure stamens and styles. However, these color features are very variable and do not allow for the recognition of different species.

Fig. 144. *Geranium refractum*. a. Habit. b. Leaf indumentum on adaxial side. c. Leaf indumentum on abaxial side. d, e. Stipules. f. Bracteoles. g. Flower. h. Flower without petals and sepals. i. Sepal. j. Petal. k. Staminal filament. l. Fruit. m. Mericarp. n. Seed. (Based on: a-k, *Boufford & al. 31503,* MA; l-n, *Bot. Exp. Sichuan 2587,* IBSC).

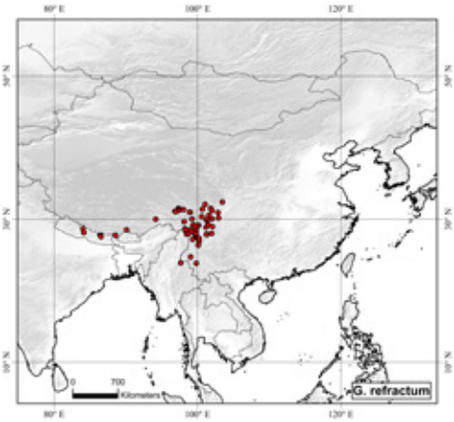


Fig. 145. Distribution of *Geranium refractum*.

44. Geranium shensianum R. Knuth, Repert. Spec. Nov. Regni Veg. 28: 5. 1930. Type locality: "China: Prov. Nord-Shensi, Lun-san-huo (Giraldi a. 1895 n. 518 sub G. Vlassoviano -- Typus in herb. Berol.!) --Blühend und fruchtend August". Type: China. Shaanxi, Nord-Shensi, Lun-san-huo, 34°37'N, 106°42'E, 1895, *G. Giraldi 518* (holotype, B destroyed). China. Taipaishan, ravine to the W of Pinganszu, 33°57'N, 107°45'E, 20 July 1938, *Liou & Tscong 2522* (neotype, here designated, KUN-280651!).

Geranium retectum Yeo, Edinburgh J. Bot. 49(2): 179, 180 fig. 9. 1992. Type locality: "Western Szechuan, vii 1908, Wilson 2442 (holo. GH, iso. BM, K) [Wilson was in area: Mupin - Dajian Lu at this time (Howard, 1980)]". Type: China. Western Szechuan, 30°10'N,102°56'E, July 1908, *E.H. Wilson 2442* (holotype, GH-00219539!; isotypes, BM-000796481!, K-00729348!, US-599545!).

Perennial herbs, 80-85 cm tall. *Rootstock* 10-11 mm in diameter, ± horizontal, not tuberculate, not turnip-shaped, unknown roots. *Stem* erect, leafy, not rooting at nodes, stolons absent, without vegetative stems, with patent to retrorse, eglandular hairs 0.3-0.4 mm long. *Basal leaves* in a deciduous rosette, cauline leaves opposite; leaf laminas 9-10.9 cm long, 11-14 cm wide, not peltate, palmatifid [ratio main-sinus length/ middle segment length = 0.77-0.85], polygonal in outline, base cordate, not coriaceous, with nerves not projected, pilose, with appressed, eglandular hairs on both surfaces; segments 5, in 1 plane, middle segment rhombic, 13.2-19.5 mm wide at the base [ratio segment width at the base/middle segment length = 0.20-0.23], 17-21-lobed in distal half [ratio secondary sinus length/ middle segment length = 0.05-0.18]; petioles up to 9 cm long, without abscission zone, terete, not swollen, not deflexed in age, with patent, eglandular hairs 0.2-0.5 mm long and, sometimes, patent, glandular hairs 0.8-1.1 mm long; stipules 10.4-17.4 mm long, 4.5-5 mm wide, lanceolate,

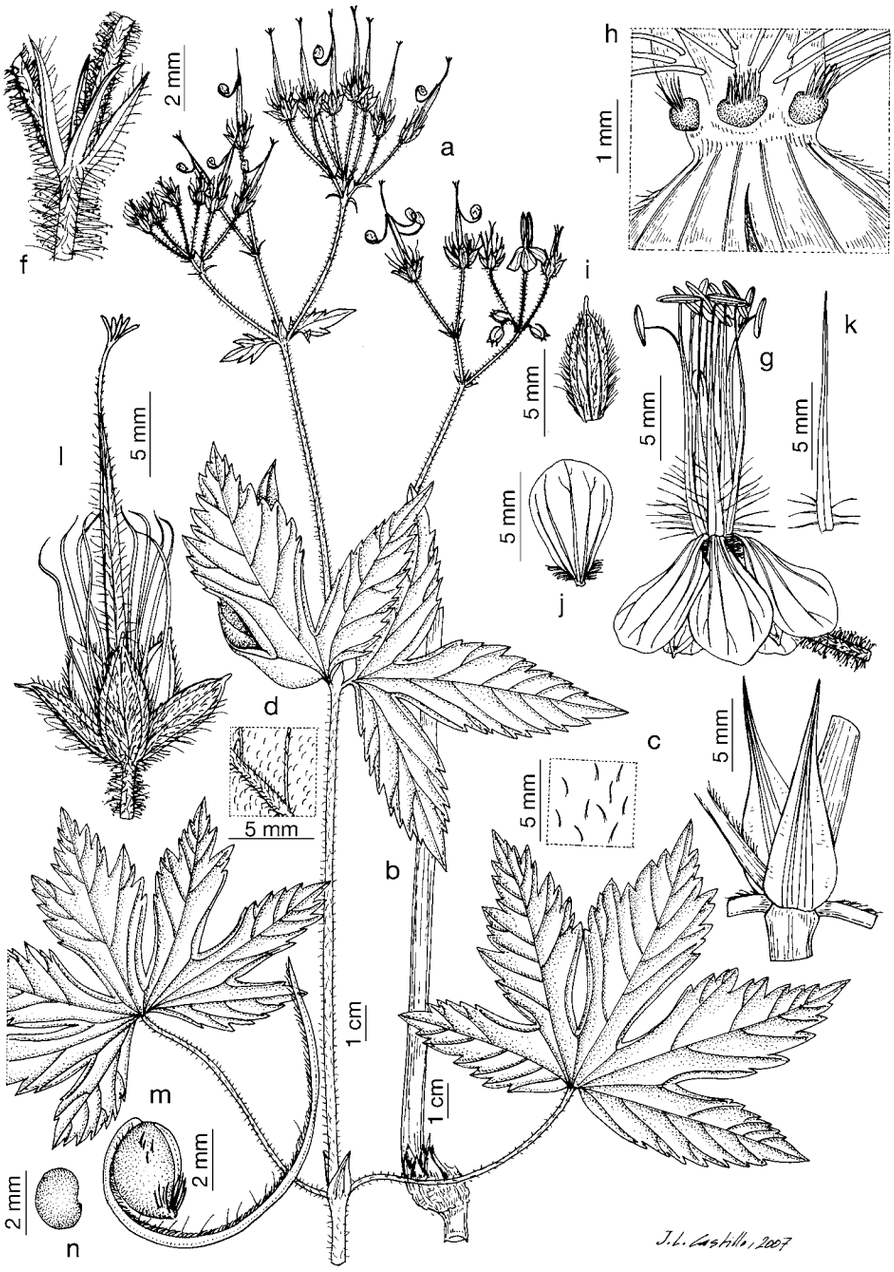


Fig. 146. *Geranium shensianum*. a. Inflorescence. b. Stem base. c, d. Leaf indument. e. Stipules. f. Bracteoles. g. Flower. h. Nectaries. i. Sepal. j. Petal. k. Staminal filament. l. Fruit. m. Mericarp. n. Seed. (Based on: a-f, *Liou & Tscong 2522,* KUN; g-n, *Wilson 2442,* GH).

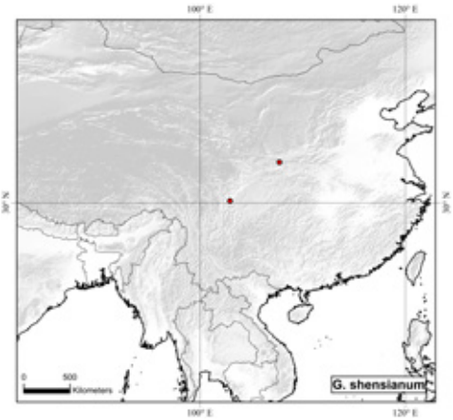


Fig. 147. Distribution of *Geranium shensianum*.

connate (at least at the base), papery, brown, with eglandular hairs on abaxial surface and on the margin, usually glabrous adaxially. *Inflorescence* a monochasial cyme; cymules 2-flowered, solitary or in aggregates at the top of each branch [ratio cymule length/leaf length = 1.5-2]; peduncles 14-95 mm long, with patent, eglandular hairs 0.3-0.4 mm long and patent, glandular hairs 0.3-1.3 mm long; bracteoles 1.9-3.7 mm long, 0.3-0.5 mm wide, linear-lanceolate, whorled; pedicels 18-26 mm long, with patent, eglandular hairs 0.3-0.5 mm long and patent (colourless), glandular hairs 0.4-1.9 mm long. Flowers actinomorphic. *Sepals* 7.2-7.8 mm long, 2.8-3 mm wide, lanceolate, smooth, not accrescent, nerves 3, mucro 0.4-1.5 mm long [ratio mucro length/sepal length = 0.05-0.18], with antrorse, ± appressed, eglandular hairs 0.3-0.4 mm long and patent, glandular hairs 0.4-1.6 mm long on the abaxial surface, glabrous adaxially. *Petals* 7.3-8.6 mm long, 3.9-5.1 mm wide, reflexed, rounded, with claw 0.5-0.7 mm long, white, glabrous on both surfaces, with a dense tuft of hairs on the basal margin, with hairs 0.6-0.7 mm long. *Stamens* 10, both whorls bearing anthers; filaments 10.1-11.9 mm long, lanceolate, reddish purple, sparsely pilose on the abaxial surface, ciliate on the proximal half, with hairs 2.1-2.9 mm long; anthers 2.4-2.7 mm long, blue. Nectaries 5, hemispheric, with a tuft of hairs at the top, dorsally glabrous. *Gynoecium* 10.2-12.9 mm long, green. *Fruit* 24.4-28.6 mm long, erect, discharge of seed-ejection type; mericarps 2.6-2.7 mm long, 1.5-1.8 mm wide, without a strand of fibers, not compressed at the apex, smooth, without basal beak, with a basal callus, without a basal prong, brown, with ± patent, eglandular hairs 0.5-0.7 mm long and patent, glandular hairs 0.3-0.9 mm long; rostrum 18-21.9 mm long, with a narrowed apex 5-6 mm long, not twisted, with ± patent, eglandular hairs 0.2-0.3 mm long and patent, glandular hairs 1-1.2 mm long; stigmatic remnants 1.7-1.8 mm long, with 5 glabrous lobes. *Seeds* 1.9-2 mm long, 1.5-1.6 mm wide, finely reticulate, uniformly colored, brown, glabrous. Cotyledons with entire margin. Fig. 146.

Pollen. Ornamentation not studied.

Chromosome number. Unknown.

Phenology. Collected in flower from July to August.

Distribution. This species is endemic to central China (Sichuan and Shaanxi) (Fig. 147).

Habitat. Unknown; ca. 700 m.

Discussion. Geranium shensianum is a representative of the *Refractum Group* because of its connate stipules, nodding flowers, and reflexed petals. The stipules are not as broad as in others species of the group. The leaves of *G. shensianum* have a middle segment rhombic, similar to those of *G. delavayi* or *G. sinense.* The bracteoles are intermediate between those filiform of *G. delavayi* or *G. sinense* and the lanceolate ones of *G. yunnanense*. The glandular indumentum of the inflorescence is similar to that of *G. delavayi.* The staminal filaments have long hairs similar to *G. pogonanthum* and *G. yunnanense*. *Geranium shensianum* also resembles *G. platyanthum* at first sight by the leaf aspect, long hairs of staminal filaments, and cymules partially in aggregates at the top of each branch. However, *G. shensianum* has reflexed and shorter petals, nectaries with hairs, and connate stipules, which are never present in the former.

Geranium shensianum is a rare species known from a couple of collections. Its holotype was destroyed in the Berlin herbarium fire and I was not able to locate any duplicate of that collection. The neotype here chosen matches the original description, and was collected in the same region as indicated in the protologue. Additional collections and a focused field study may help to elucidate the variability of this species. It has been recently collected in China (D. Victor, *in litt.*) by gardeners but it is not known where exactly.

45. Geranium sinense R. Knuth in Engl., Pflanzenr. IV.129 (Heft 53): 577. 1912. *Geranium platypetalum* Franch., Pl. Delavay.: 111. 1889, [syn. subst.], nom. illeg., non Fisch. & C.A. Mey. 1835. Type locality: "Yun-nan, in pascuis montis Fang-yang-tchang, supra Mo-so-yn; fl. fr. 5 sept. 1887 (Delavay)". Type: China. Yunnan, in monte Fang-yang-tchan, 26º52'N, 100º13'E, 5 Sep. 1887, *J.M. Delavay s.n.* (lectotype, designated by Yeo 1992: 167, P-00757901!; isolectotypes, K-000729461!, LE!, MPU!).

Geranium mairei H. Lév., Repert. Spec. Nov. Regni Veg. 12: 282. 1913. Type locality: "Yun-Nan: Herbages des hauts sommets à Tong-Tchouan, 2800 m, juill. 1912 (E. E. Maire)". Type: China. Yunnan, Tong-Tchouan, 26º05'N, 103º10'E, July 1912, *E.E. Maire s.n.* (lectotype, designated by Lauener 1967: 265, E-00216593!; isolectotypes, BM!, G!, W!).

Geranium pinetorum Hand.-Mazz., Symb. Sin. 7: 619. 1933. Type locality: "Y.: Föhrenwaldhänge der wtp. und tp. St. zwischen Dschaoping und Boloti n von Yungbei, Sandstein, 2700-3000 m, 30. VI. 1914 (3353). Wahrscheinlich auch dieses im NW in Fichtenwäldern und auf Wiesen bis in die ktp. St. auf Kalk bei Alo (phot.), Latsa und auf dem Patü-la se von Dschungdien, 3350-3900 m". Type: China. Yunnan, pr. Yungbei inter vic. Dschaoping et Boloti, 24º16'N, 102º23'E, 30 June 1914, *H. Handel-Mazzetti 3353* (lectotype, designated by Yeo 1992: 169, W!; isolectotypes, E-00216581!, LE!).

Perennial herbs, 30-89 cm tall. *Rootstock* 6.6-13 mm in diameter, ± horizontal, not tuberculate, not turnip-shaped, with thickened roots along the rootstock. *Stem* erect, leafy, not rooting at nodes, stolons absent, without vegetative stems, with retrorse, ± appressed, eglandular hairs 0.3-0.8(1.7) mm long and, sometimes, patent, glandular hairs 0.3-1.5 mm long. *Basal leaves* in a ± persistent rosette, cauline leaves opposite; leaf laminas (4.2)4.8-7.3(12) cm long, 6.5-16.7 cm wide, not peltate, palmatifid [ratio main-sinus length/middle segment length = (0.80)0.83-0.88(0.90)], polygonal in outline, base cordate, not coriaceous, with nerves not projected, pilose, with appressed, eglandular hairs on both surfaces; segments 5, in 1 plane, middle segment rhombic,

(4)5.5-8.4(11.1) mm wide at the base [ratio segment width at the base/ middle segment length = (0.09)0.12-0.20(0.23)], (9)11-17(25)-lobed in distal half [ratio secondary sinus length/ middle segment length = (0.06)0.12-0.18(0.20)]; petioles up to 38 cm long, without abscission zone, terete, not swollen, not deflexed in age, with retrorse, appressed, eglandular hairs 0.3-0.6(2.3) mm long; stipules 8-20.3 mm long, 2.7-10.7 mm wide, broadly lanceolate, connate (at least at the base), papery, brown, with eglandular hairs on abaxial surface and on the margin, usually glabrous adaxially. *Inflorescence* a monochasial cyme; cymules 2-flowered, solitary or in aggregates at the top of each branch [ratio cymule length/leaf length = (1.2)1.7-2.5(2.7)]; peduncles (17)35-69(82) mm long, with uncinate, eglandular hairs 0.2-0.5 mm long and patent, glandular hairs 0.7-1.7 mm long; bracteoles 2.2-9.2 mm long, 0.2-0.6 mm wide, filiform, whorled; pedicels (5)16-26(29) mm long, with uncinate, eglandular hairs 0.3-0.5 mm long and patent, glandular hairs 0.2-1.6 mm long. Flowers actinomorphic. *Sepals* (4.8)6.8-7.7(9.3) mm long, 2.5-3.6 mm wide, lanceolate, smooth (with a small dark purple zone at the base), not accrescent, nerves 3(5), mucro (0.8)1.3-1.7(2) mm long [ratio mucro length/ sepal length = 0.13-0.40], with antrorse, ± appressed, eglandular hairs 0.2-0.8 mm long and patent, glandular hairs 0.4-1.6 mm long on the abaxial surface, glabrous adaxially. *Petals* (6.7)7-8.1(9.3) mm long, (5)5.2-6(8.5) mm wide, reflexed, rounded, with claw 0.2-0.9 mm long, blackish red with pale pink base, glabrous on both surfaces, rarely with few hairs on the abaxial surface, sparsely ciliate on the basal margin, with hairs 0.6-1 mm long. *Stamens* 10, both whorls bearing anthers; filaments (7.2)9.7-10.3(11.4) mm long, lanceolate, dark red, glabrous or sparsely pilose on the abaxial surface, ciliate on the proximal half, with hairs 0.2-0.4(0.8) mm long; anthers (2.1)2.2-2.3(2.5) mm long, blue black. Nectaries forming a ring around flower, glabrous. *Gynoecium* 6.9-11.3 mm long, dark red. *Fruit* (23.9)24-27(29.5) mm long, reflexed when immature, discharge of seed-ejection type; mericarps

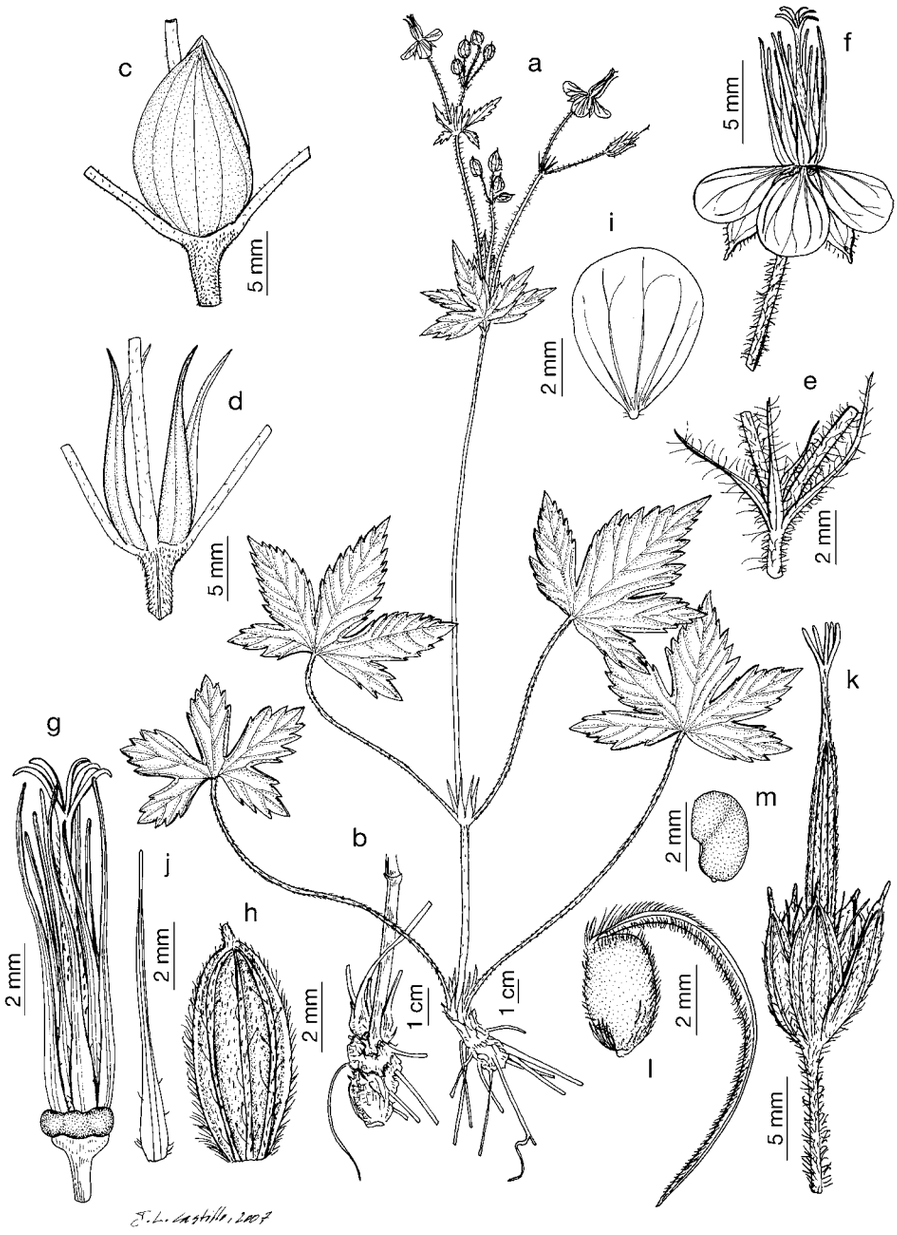


Fig. 148. *Geranium sinense*. a. Habit. b. Rootstock. c, d. Stipules. e. Bracteoles. f. Flower. g. Flower without petals and sepals. h. Sepal. i. Petal. j. Staminal filament. k. Fruit. l. Mericarp. m. Seed. (Based on: a, c-j, *Ducloux 5779,* MA; b, *Forrest 6829,* E; k-m, *Zhu Zhiping 266,* PE).

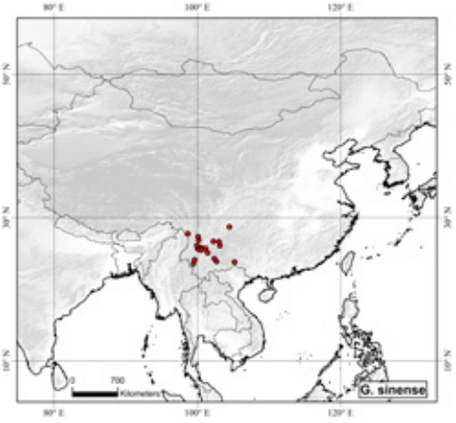


Fig. 149. Distribution of *Geranium sinense*.

3.4-4.4 mm long, 1.2-2.4 mm wide, without a strand of fibers, not compressed at the apex, smooth, without basal beak, with a basal callus, without a basal prong, brown, with ± patent, eglandular hairs 0.4-1.2 mm long; rostrum 16.2-22 mm long, with a narrowed apex 5.2-6.6 mm long, not twisted, with ± patent, eglandular hairs 0.4-0.6 mm long; stigmatic remnants 1.9-2.5 mm long, with 5 glabrous lobes. *Seeds* 2.7-3 mm long, 1.6-1.7 mm wide, smooth, uniformly colored, brown, glabrous. Cotyledons with entire margin. Fig. 148.

Pollen. *Geranium*-type (Bortenschlager 1967: 429; Tan & al. 1996: 210).

Chromosome number. 2*n* = 28.

Phenology. Collected in flower from May to September.

Distribution. This species ranges through south-central China (Sichuan and Yunnan) (Fig. 149).

Habitat. Grassy slopes and at shady of *Pinus* L. forests; 1800-4000 m.

Additional specimens examined. **China.** Sichuan: Huei-li Hsien, 26º41'N, 102º15'E, 17 Sep. 1932, *Yü 1537* (GH, PE). Yunnan: Lao Kong Chan pres My le, 8 July 1906, *Ducloux 4055* (P); Nieou Ko chan près Pin Tchouay, 26 Aug. 1906, *Ducloux 4865* (P); La Kou, July 1912, *Maire s.n.* (E); E Yunnan, Lo Shiueh mt, 1936, *McLaren 84* (E); Yunnan, 12 July 1973, *Sun Bixing 898* (PE); Son Pin Chao, 24 Aug. 1919, *Tén 1237* (C); Linang Shan, Chio Kia Hsien, 13 Sep. 1932, *Tsai 52023* (KUN, GH); Lou Choei Tong (Yunpe), 23º34'N, 99º28'E, 1920, *Tén 89* (E); Be tsao ling, 23º47'N, 105º13'E, 24 Sep. 1919, *Tén 1368* (C); Ta Long tan, 23º52'N, 102º42'E, 17 Sep. 1888, *Delavay s.n.* (P); montaña Da Xue Shan, Yan Fang, 24º6'N, 99º38'E, 7 Oct. 1958, *Zhu Zhiping 266* (PE); Cuxung Yi tribe's Autonomous Region, Cuxung City, the Mt. Zixi Nature Reserve, 25º5'N, 101º27'E, 28 Aug. 1994, *Konta & Takahashi 3875* (GH); Yun-nan sen, herbages des hautes montagnes au nord de la ville, 25º28'N, 100º33'E, 30 Sep. 1908, *Ducloux 5779* (MA, P); ciudad Dali, 25º35'N, 100º12'E, 17 Aug. 1933, *Tsiang 11374* (IBSC); Tali range, 25º40'N, 100º5'E, Aug. 1929, *Forrest 28195* (E); E flank of Tali Range, 25º40'N, 100º5'E, Aug. 1906, *Forrest 4283* (E); pr. Tali, 25º40'N, 100º5'E, Sep. 1914, *Schneider 2878* (G, GH); Da Li Xian, Mt. Cang Sahn, N slope of San Yang Feng peak, 25º41'N, 101º11'E, 8 Sep. 1982, *Koyama & al. 668* (KYO); distrito Dali, población Binchuan, pueblo Jizu Shan, 25º49'N, 100º34'E, 28 Sep. 1929, *Ching 24957* (PE); Teng Chuan valley or Sung Kwei valley, 25º59'N, 100º5'E, Sep. 1904, *Forrest 66* (E); Tong tchouan, 26º5'N, 103º10'E, July 1909, *Ducloux 1441* (E); Yun-nan sen, Ou Kia Tsen, pref. de Tong tchouan, 26º5'N, 103º10'E, Aug. 1906, *Ducloux 4054* (MA, P); Tong tchouan, 26º5'N, 103º10'E, July 1909, *Ducloux 6426* (P); NE Yunnan, Tong-Tchouan, 26º5'N, 103º10'E, *Maire s.n.* (W); montagnes à Tong-Tchouan, 26º5'N, 103º10'E, July 1913, *Maire s.n.* (G, P); col du Hu Chan men, 26º6'N, 99º57'E, 4 Sep. 1888, *Delavay s.n.* (P); ciudad Dongchuan, población Yinmin, pueblo Ganchong, Shi Zaobi, 26º39'N, 103º3'E, 14 Aug. 1984, *Lan Shunbin 114* (PE); Yangtze watershed, district of Likiang, E slope of Likiang Snow range, Peshwe river, 27º20'N, 100º8'E, 1 Aug. 1922, *Rock 5288* (E); on the middle of Kung Hsien bridge of Yueh Hsien, 27º45'N, 98º42'E, 9 May 1935, *McLaren 98* (E); ad viam Yunnanfu-Suifu, 28º42'N, 104º30'E, 4 Sep. 1914, *Mell s.n.* (W).

Discussion. Geranium sinense is a species quite similar to *G. refractum*. Both share a similar habit, nodding flowers and immature fruits, and narrow and reflexed petals. *Geranium sinense* is the only species in the genus with a nectary forming a ring all around the flower. Flower features such as blackish petals, with sparse hairs on the margin, and almost glabrous staminal filaments, further help to identify *G. sinense*. Glandular hairs are finer than in *G. refractum* and are not purple, except for the head. Additionally, the stipules are usually broader than in *G. refractum* and, in contrast, the bracteoles are filiform, not linear-lanceolate as in the latter. The petals are shorter than in *G. refractum*. The inflorescence has 2-flowered cymules on the lower nodes and sometimes an aggregate of cymules toward the apex of each branch. In these aggregates the peduncles are usually short or absent. This feature is shared with *G. delavayi*.

The type of *G. pinetorum* shows all of these characters. Pollen has no deformation and fruit are well developed, which does not support Yeo's view (1992: 169) that *G. pinetorum* could be a hybrid. For these reasons, it is here considered as a synonym of *G. sinense*. The specimen *McLaren 98* (E) lacks glandular hairs on the inflorescence, but otherwise agrees with *G. sinense*.

46. Geranium yunnanense Franch., Pl. Delavay.: 114. 1889. Type locality: "Yun-nan, ad montis Tsang-chan cacumina, alt. 4000 m.; 19 aug. 1887 (Delavay, n. 2647)". Type: China. Yunnan, Tsang-chan, 25°40'N, 100°06'E, 19 Aug. 1887, *J.M. Delavay 2647* (lectotype, designated by Yeo 1992: 171, P-00757980!; isolectotypes, BM-00624052!, E-00216854!, G-00365993!, LE!, K-00729444!, MA-724621!, MPU-017679!, P-00757981!).

Geranium candicans R. Knuth in Engl., Pflanzenr. IV.129 (Heft 53): 581. 1912. Type locality: "Yunnan: Tali-Kette, um 3300-3600 m an dem östlichen Hange; an belichteten grasigen Stellen von Kiefernwäldern (Forrest, Pl. East. Tibet a. S. W. China a. 1906 n. 1879 - Typus in herb. Edinburgh!)". Type: China. Yunnan, eastern flamk of Tali Range, 25°40'N, 100°05'E, June 1906, *G. Forrest 1879* (holotype, E-216854!; isotypes, K-000729443!, P-00712063!).

Perennial herbs, 28-84 cm tall. *Rootstock* 7.6-12.9 mm in diameter, ± vertical, not tuberculate, not turnip-shaped, with thickened roots along the rootstock. *Stem* erect, leafy, not rooting at nodes, stolons absent, without vegetative stems, with retrorse, ± appressed, eglandular hairs 0.3-0.5 mm long. *Basal leaves* in a ± deciduous rosette, cauline leaves opposite; leaf laminas (2.6)4.3-6(7.5) cm long, 4.1-8.7 cm wide, not peltate, palmatifid [ratio main-sinus length/middle segment length = (0.72)0.80-0.85(0.87)], polygonal in outline, base cordate, not coriaceous, with nerves not projected, pilose, with appressed, eglandular hairs on both surfaces; segments 5, in 1 plane, middle segment rhombic, (3.9)5.2-9.6(11.5) mm wide at the base [ratio segment width at the base/middle segment length = (0.12)0.15-0.25(0.28)], (5)10-12(16)-lobed in distal half [ratio secondary sinus length/middle segment length = (0.19)0.20-029(0.32)]; petioles up to 32 cm long,

without abscission zone, terete, not swollen, not deflexed in age, with retrorse, ± appressed, eglandular hairs 0.3-0.7 mm long; stipules 5.6-15.6 mm long, 1.7-6.9 mm wide, broadly lanceolate, connate (at least at the base), papery, brown, with eglandular hairs on abaxial surface and on the margin, usually glabrous adaxially. *Inflorescence* a monochasial cyme; cymules 2-flowered, solitary [ratio cymule length/leaf length = (1.1)1.5-3.1(4.6)]; peduncles (37)44-86(128) mm long, with retrorse, ± appressed, eglandular hairs 0.4-0.9 mm long; bracteoles 6.4-14.3 mm long, 1.1-3.2 mm wide, lanceolate, whorled; pedicels (11.3)17-26(36.4) mm long, with retrorse, ± appressed, eglandular hairs 0.3-0.7 mm long. Flowers actinomorphic. *Sepals* (6.6)8.7-11.4(13.2) mm long, 2.6-5.3 mm wide, lanceolate, smooth (with a small dark purple zone at the base), not accrescent, nerves 3-5, mucro (1)1.3-1.7(1.9) mm long [ratio mucro length/sepal length = 0.09-0.25], with antrorse, ± appressed, eglandular hairs 0.3-1.2 mm long and, rarely, patent, glandular hairs 0.9-1 mm long on the abaxial surface, glabrous adaxially. *Petals* (12.9)15.9-18.7(20.6) mm long, (7)7.8-13(18.7) mm wide, erect-patent, rounded, with claw 0.3-0.8 mm long, pink to purple, with a dense tuft of hairs on the base of both surfaces and on the basal margin, with hairs 0.5-2.2 mm long. *Stamens* 10, both whorls bearing anthers; filaments (6.4)7.3-12(12.4) mm long, lanceolate, purple to white, densely pilose on the abaxial surface, ciliate on the proximal half, with hairs 1.2-2 mm long; anthers 1.9-2.7 mm long, blue black. Nectaries 5, hemispheric, with a tuft of hairs at the top, dorsally glabrous. *Gynoecium* 6.1-12.6 mm long, purple. *Fruit* (22.2)23-31(32.6) mm long, reflexed when immature, discharge of seed-ejection type; mericarps 2.9-4 mm long, 1.4-2 mm wide, without a strand of fibers, not compressed at the apex, smooth, without basal beak, with a basal callus, without a basal prong, brown, with ± patent, eglandular hairs 0.4-1 mm long; rostrum 13.5-23.5 mm long, with a narrowed apex 2.3-7.7 mm long, not twisted, with ± patent, eglandular hairs 0.4-0.7 mm long; stigmat-

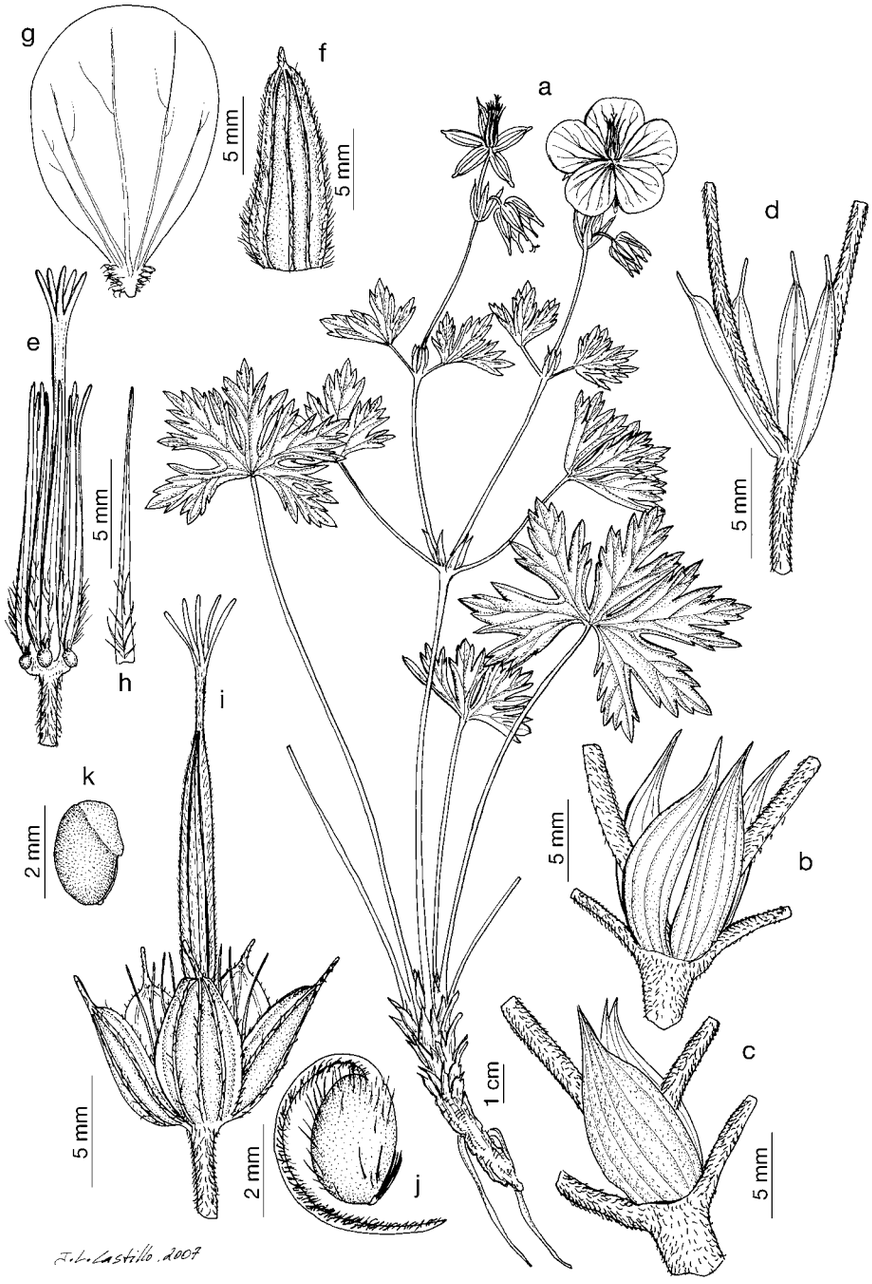


Fig. 150. *Geranium yunnanense*. a. Habit. b, c. Stipules. d. Bracteoles. e. Flower without petals and sepals. f. Sepal. g. Petal. h. Staminal filament. i. Fruit. j. Mericarp. k. Seed. (Based on: a, b, d-h, *Rock 6263,* E; c, i-k, *Gaoligong Shan Exped. 8275,* E).

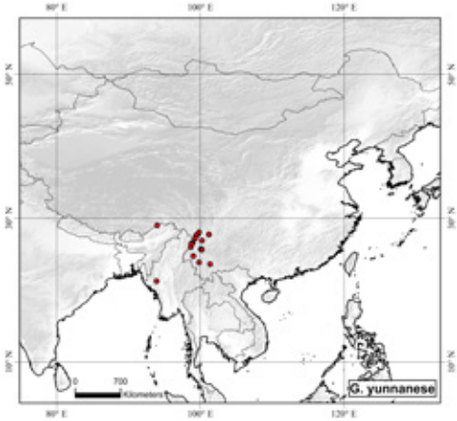


Fig. 151. Distribution of *Geranium yunnanense*.

ic remnants 2.4-4.2 mm long, with 5 glabrous lobes. *Seeds* 2.4-3 mm long, 1.3-1.8 mm wide, smooth, uniformly colored, brown, glabrous. Cotyledons with entire margin. Fig. 150.

Pollen. *Geranium*-type (Tan & al. 1996: 211).

Chromosome number. Unknown.

Phenology. Collected in flower from April to October.

Distribution. This species ranges from southern China (Sichuan, Xizang and Yunnan) to Burma (Fig. 151).

Habitat. Moist meadows, rocky outcroops, bamboo formations, *Rhododendron* L. thickets and forest edges of *Pinus* L.; 2540-4300 m.

Additional specimens examined. **Burma.** Chin: Southern Chin Hills, Mt. Victoria, 21°14'N, 93°55'E, 28 Oct. 1956, *Kingdon Ward 22796* (GB). Kachin: Upper Burma, W flank of the N'Maikha-Salwin divide, 26°24'N, 98°48'E, July, *Forrest 26996* (NY, W). **China.** Sichuan: Muli Xian, Xiamaidi Xiang, Mianbu village, 41 km S of Muli, 27°44'N, 101°12'E, 6 Aug. 2007, *Tibet-MacArthur 1920* (US). Xizang: Tha Chu valley, 16 July 1950, *Kingdon Ward 19651* (BM); SE Tibet, Tum La, Nayü, 29°0'N, 94°0'E, 7 July 1938, *Ludlow & Sherriff 5781* (BM). Yunnan: Yunnan, 1930, *Forrest 28764* (MO); Yunnan, 1930, *Forrest 28828* (MO); W range of Mekong on Kaakerpo, Dokerla and Tsarung, June 1932, *Rock 23052* (GH); Tsarung border, Yundshi mountain, Oct. 1932, *Rock 23464* (E, GH); Central Yunnan, mountains of the Yangi River drainage basin, Aug. 1922, *Rock 6263* (E, W); inter flum. Yangze et Chungsien, Aug. 1914, *Schneider 2362* (G, GH); Guma Dian, 23°36'N, 101°23'E, 27 July 1937, *Yü 7386* (IBSC); mountains of Nakala, E of Yuragan, Mekong-Salween divide, 23°50'N, 99°50'E, June 1932, *Rock 21119* (E); Mekong-Salween divide, Sila, 24°44'N, 99°2'E, 18 Aug. 1938, *Yü 22393* (E, GH, PE); Ta-li Hsien, 25°35'N, 100°12'E, 31 July 1933, *Tsai 53958* (GH); ciudad Dali, montaña Ding Xi Ling, 25°35'N, 100°12'E, 1942, *Wang Hanchen 2587* (IBSC, KUN); E flank of Tali Range, 25°40'N, 100°5'E, July 1906, *Forrest 4281* (E); Dali, Changshan W Dali, N des Zhonghe Piks, 25°41'N, 100°11'E, 29 July 1996, *Podlech 54326* (MSB); Dali Xian, E side Diancang Shan mountain, pr. Yinglofeng, W city of Dali, 25°42'N, 100°7'E, 11 July 1984, *Sino-Amer. Bot. Exped. 979* (CAS, GH); Nujiang Lisu prefec., Lushui co., summit of road from Yao Jia Ping to Pian Ma, 25°58'N, 98°41'E, 29 Oct. 1996, *Gaoligong Shan Exped. 8275* (E); Lushui Xian, Luobenzhuo Xiang, E'ga Cun, 26°27'N, 98°45'E, 6 Aug. 2005, *Gaoligong Shan Biod. Survey 25649* (GH); Che-tse-lo, 26°33'N, 98°56'E, 18 Aug. 1934, *Tsai 58085* (GH); Chih-tze-lo Hsien, 26°33'N, 98°56'E, 15 Sep. 1943, *Tsai 58637* (GH, PE); NW Linkiang, Tamichung, 26°53'N, 100°14'E, 24 Aug. 1939, *Ching 21446* (GH); Kiabg-pu, Wei-si Hsien, 27°11'N, 99°19'E, July 1935, *Wang 64623* (GH); Wei-si Hsien, Yeh-Chih, 27°11'N, 99°19'E, Aug. 1935, *Wang 68451* (GH); distrito de Qing, población de Weixi, 27°11'N, 99°16'E, 7 Aug. 1937, *Wu 8847* (KUN); Mekong Yangtze divide, N of Pien-tien go, 27°36'N, 99°25'E, June 1924, *Forrest 25519* (E, P, TI); Yunnan bor.-occid., inter vicos Bödö (Peti) et Alo austro-orient. pagi Dschungdien (Chungtien), 27°49'N, 99°42'E, 7 Aug. 1914, *Handel-Mazzetti 4523* (E, W); Mt. Swemenkan, between the Chungtien river and the Yangtse, NW Linkinag Snow range, 28°3'N, 99°50'E, July 1933, *Rock 9733* (GH, P).

Discussion. Geranium yunnanense shares a similar habit, broadly lanceolate and connate stipules, nodding flowers, blackish anthers and fruit nodding when immature with *G. refractum*, *G. sinense*, *G. delavayi*, and *G. pogonanthum*. However, it has longer, broader, and not reflexed petals with abundant hairs. Other important characters of this species are its broad bracteoles (sometimes also found in *G. pogonanthum*) and its staminal filaments with abundant long hairs. The indumentum of *G. yunnanense* is essentially eglandular. The specimen *Rock 6263* (E) has few glandular hairs at the sepal base, but otherwise agrees with *G. yunnanense*.

The Pylzovianum Group—The five species here assembled are dwarf alpine plants with long petals and a similar habit and leaf shape. They also share free stipules, 2-flowered cymules and lanceolate staminal filaments. *Geranium pylzowianum* and *G. canopurpureum* share some important features such as a horizontal rootstock consisting of some subglobose tubercles joined by thin and long non-tuberous separations, glabrous nectaries, alternate leaves along the stem, and monochasial inflorescence. In contrast, *G. donianum* and *G. farreri* have a horizontal rootstock with thickened roots along it, hairy nectaries, opposite leaves, and dichasial inflorescence. *Geranium napuligerum* falls better in the latter subgroup, although it differs in its short vertical rootstock covered by short, thickened and napiform roots and glabrous nectaries.

Stapf (1926) suggested the species here assembled form a "very natural group" but did not support this statement with a relation of shared characters. In contrast Yeo (2002a) separated them in three groups ("Farreri Group", "Stapfianum Group" and *Pylzowianum Group*).

47. Geranium canopurpureum Yeo, Edinburgh J. Bot. 49(2): 138, 139 fig. 3. 1992. Type locality: "Yunnan, 193?, Yü 7742 (holo. A)". Type: China. Sichuan, Muli Zhangzu Zhizhixian, between Guma Dian and Shaoxiang Liang, 28°16'N, 101°21'E, 8 Aug. 1937, *T.T. Yü 7742* (holotype, A-00263536!).

Perennial herbs, 7-9 cm tall. *Rootstock* ± horizontal, tuberculate, with tubercles subglobose, 3.7-4 mm long, 2.9-3.5 mm wide, with non-tuberous separations 4-16 mm long, 0.6-1 mm wide, not turnip-shaped, without thickened roots. *Stem* erect, leafy, not rooting at nodes, stolons absent, without vegetative stems, with retrorse to appressed, eglandular hairs 0.2-0.3 mm long. *Basal leaves* in a ± persistent rosette, cauline leaves alternate (usually 1) and upper opposite; leaf laminas 0.7-1.4 cm long, 1.2-1.9 cm wide, not peltate, palmatifid [ratio main-sinus length/middle segment length = 0.73-0.80], polygonal in outline, base cordate, not coriaceous, with nerves not projected, pilose, with appressed, eglandular hairs on the adaxial surface and ± sericeous abaxially; segments 5, in 1 plane, middle segment obtriangular, 1.2-1.5 mm wide at the base [ratio segment width at the base/middle segment length = 0.15-0.27], 1-3-lobed in distal half [ratio secondary sinus length/

middle segment length = 0.19-0.26]; petioles up to 5 cm long, without abscission zone, terete, not swollen, not deflexed in age, with retrorse to appressed, eglandular hairs 0.2-0.4 mm long; stipules 1.8-2.8 mm long, 0.7-0.9 mm wide, lanceolate, free, papery, dark purplish, with scattered, eglandular hairs on both surfaces and on the margin. *Inflorescence* a monochasial cyme; cymules 2-flowered, solitary [ratio cymule length/leaf length = 1.7-3]; peduncles 29-47 mm long, with retrorse to appressed, eglandular hairs 0.2-0.3 mm long; bracteoles 3.9-5.2 mm long, 0.5-0.6 mm wide, lanceolate, whorled; pedicels 20-34 mm long, with retrorse to appressed, eglandular hairs 0.2-0.3 mm long. Flowers actinomorphic. *Sepals* 5.3-6.3 mm long, 1.8-2.1 mm wide, lanceolate, smooth, not accrescent, nerves 3, mucro 0.7-0.8 mm long [ratio mucro length/sepal length = 0.11-0.15], with antrorse to patent, eglandular hairs 0.1-0.4 mm long on the abaxial surface, glabrous adaxially. *Petals* 8.4-11.9 mm long, 4.5-5 mm wide, erect-patent, rounded, without claw, reddish purple, glabrous on both surfaces, ciliate on the basal margin, with hairs 0.3-0.6 mm long. *Stamens* 10, both whorls bearing anthers; filaments 3.8-5.9 mm long, lanceolate, pink, pilose on the abaxial surface, ciliate on the proximal half, with hairs 0.3-0.8 mm long; anthers 1.1-1.3 mm long, unknown color. Nectaries 5, hemispheric, glabrous. *Gynoecium* 4.9-6.8 mm long, dark purple.*Fruit* unknown. *Seeds* unknown. Cotyledons not studied. Fig. 152.

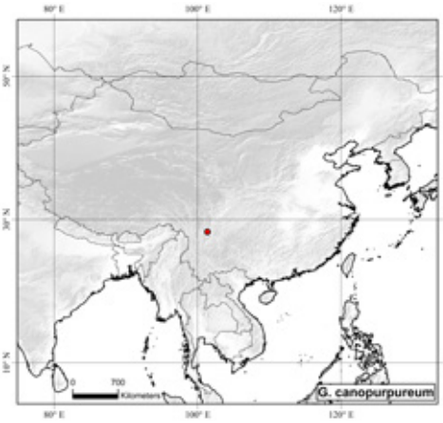


Fig. 153. Distribution of *Geranium canopurpureum*.

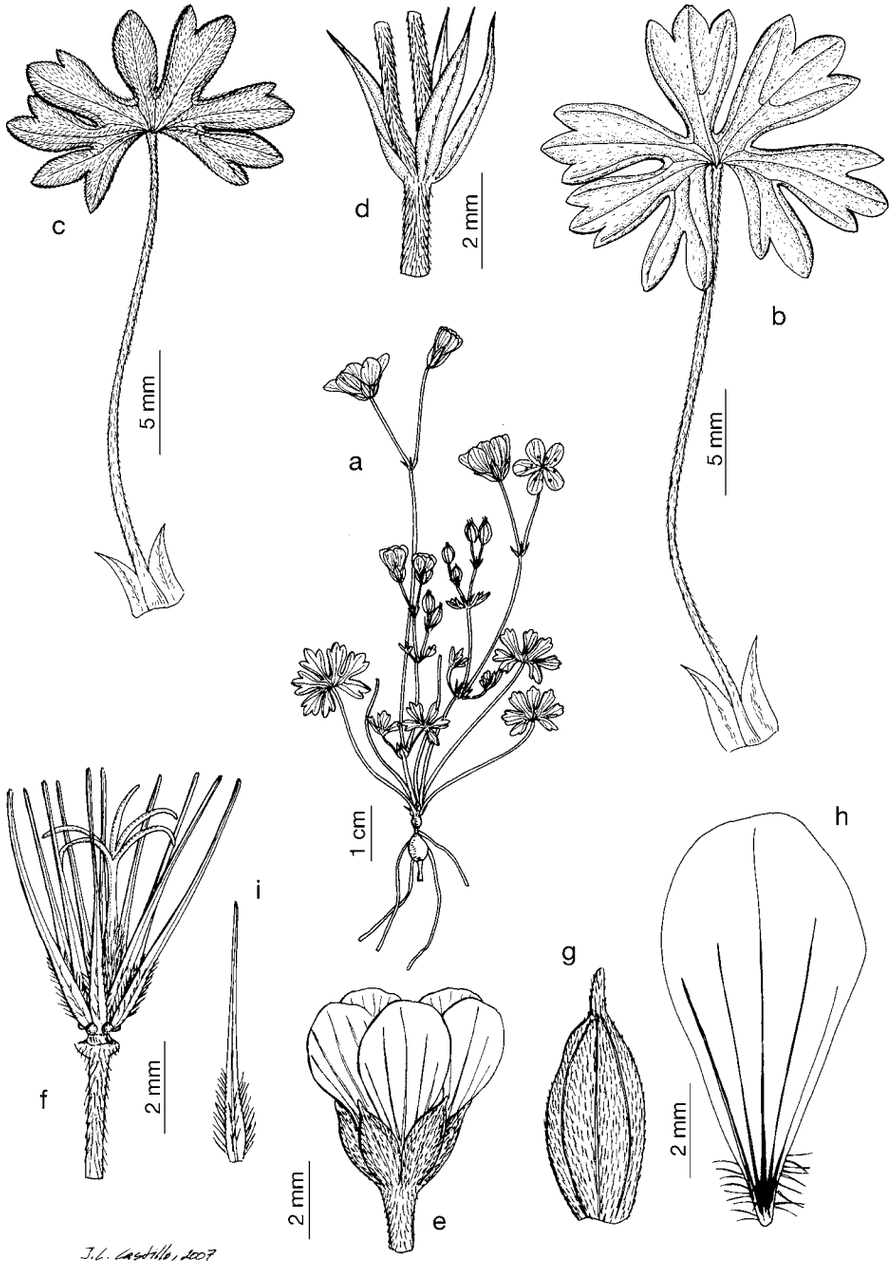


Fig. 152 *Geranium canopurpureum*. a. Habit. b, c. Leaves. d. Bracteoles. e. Flower. f. Flower without petals and sepals. g. Sepal. h. Petal. i. Staminal filament. (Based on: *Yü 7742,* GH).

Pollen. Ornamentation not studied.

Chromosome number. Unknown.

Phenology. Collected in flower in August.

Distribution. This species is endemic to Sichuan, in south-central China (Fig. 153).

Habitat. Forest edges; ca. 3500 m.

Discussion. At first sight, *Geranium canopurpureum* could be considered as a reduced form of *G. pylzowianum*. Both species share a similar rootstock and inflorescence structure. However, *G. canopurpureum* has leaves

that are not as divided as *G. pylzowianum* and ± sericeous on the abaxial surface, petals that are attenuate (without a claw) and without hairs on the adaxial surface, and stipules and bracteoles that are dark purplish. In small specimens of *G. pylzowianum*, petal length is not reduced, and these other characters of *G. canopurpureum* are not present, which also supports the independence of the latter.

This species is known only by the type specimen, which lacks fruits. In *G. canopurpureum* glandular hairs has not been found but the scarcity of the sampling prevents against any definitive conclusion. The protologue incorrectly indicated that the holotype was from Yunnan. The correct information, based on records at PE, is that the collection was made in Muli, Sichuan (H.N. Qin, *pers. comm.*).

48. Geranium donianum Sweet, Geraniaceae 4, sub tab. 338. 1827. *Geranium multifidum* D. Don, Prodr. Fl. Nepal.: 207. 1825, [syn. subst.], nom. illeg., non Andrews, 1805. Type locality: "Hab. in Gosaingsthan. Wallich". Type: Nepal. Gosaingsthan, 28°04'N, 85°24'E, *N. Wallich 8565A* (lectotype, designated by Hara 1979: 76, K-001125865!; isolectotype, BM-000796451 image!).

Geranium stapfianum Hand.-Mazz., Symb. Sin. 7: 620. 1933. *Geranium forrestii* Stapf, Bot. Mag. 151, sub tab. 9092. 1926, [syn. subst.], nom. illeg., non R. Knuth, 1912. Type locality: "I know it only from Delavay's original from the Yen-tze-hay Pass above Langkong north of Tali (No. 2328). Forrest (Nos. 6198, 6420) and Schneider (Nos. 1869, 1938) collected in the Lichiang range... ". Type: China. Yunnan, Lichian Range, 27°25'N, 100°08'E, 4 July 1910, *G. Forrest 6198* (lectotype, designated by Yeo 1992: 160, K-000729454!; isolectotypes, BM!, E- 216901!, P-00757905!, W!).

Geranium stenorrhizum Stapf, Bot. Mag. 151, sub tab. 9092. 1926. Type locality: "West-Himalaya: Sikkim, 3000-4200 m (Hooker in Herb. Ind. orient. Hook. f. et Thoms. n. 7!)... ". Type: India. Sikkim, Lachoong, 27°35'N, 88°30'E, *J.D. Hooker & T. Thomson s.n.* (lectotype, designated by Yeo 1992: 162, K-000729339!).

Perennial herbs, (8)10-20(35) cm tall. *Rootstock* 1.4-4.4(5.7) mm in diameter, ± horizontal, not tuberculate, not turnip-shaped, with thickened roots along the rootstock. *Stem* erect, leafy, not rooting at nodes, stolons absent, without vegetative stems, with retrorse to appressed, eglandular hairs 0.1-0.6 mm long and, rarely, patent, glandular hairs 1-1.3 mm long. *Basal leaves* in a ± deciduous rosette, cauline leaves opposite; leaf laminas (1.4)1.7-2.7(3.6) cm long, 1.8-5.2 cm wide, not peltate, palmatifid [ratio main-sinus length/middle segment length = (0.76)0.80-0.83(0.90)], polygonal in outline, base cordate, not coriaceous, with nerves not projected, pilose, with appressed, eglandular hairs on both surfaces; segments 5, in 1 plane, middle segment rhombic to obtriangular, (1.5)1.9-2.9(5.1) mm wide at the base [ratio segment width at the base/ middle segment length = (0.14)0.16-0.19(0.21)], 3-8(9)-lobed in distal half [ratio secondary sinus length/ middle segment length = (0.24)0.30-0.37(0.44)]; petioles up to 17 cm long, without abscission zone, terete, not swollen, not deflexed in age, with retrorse to appressed, eglandular hairs 0.3-0.9 mm long and, rarely, patent, glandular hairs 1-1.3 mm; stipules 3.3-7.5 mm long, 0.6-1.7 mm wide, lanceolate, free, papery, brown, with eglandular hairs on both surfaces and on the margin. *Inflorescence* a dichasial cyme; cymules 2-flowered, solitary [ratio cymule length/leaf length = (1.1)1.3-1.7(3.2)]; peduncles (27)41-105(180) mm long, with retrorse to appressed, eglandular hairs 0.2-0.7 mm long; bracteoles 3.7-8 mm long, 0.6-1.2 mm wide, lanceolate, whorled; pedicels (17)28-46(69) mm long, with retrorse to appressed, eglandular hairs 0.2-0.6 mm long. Flowers actinomorphic. *Sepals* (5.7)7.4-9(9-6) mm long, 2.6-4.4 mm wide, lanceolate, smooth, not accrescent, nerves 3(5), mucro (0.4)0.7-1(1.2) mm long [ratio mucro length/sepal length = 0.05-0.15], with antrorse to patent, eglandular hairs 0.3-1 mm long on the abaxial surface, almost glabrous adaxially. *Petals* (9)14.7-18.7(23.2) mm long, (4.9)9.3-12.3(15.1) mm wide, erect-patent, usually emarginate (notch 0.7-4.5 mm deep), without claw, deep purple, hairy on the base of the adaxial surface, glabrous abaxially, ciliate on the basal margin, with hairs 0.4-0.9 mm long. *Stamens* 10, both whorls bearing anthers; filaments (5.6)7.5-9.1(10.4) mm long, lanceolate, dark red distally, paler at base, pilose on the abaxial surface, ciliate on the proximal half, with hairs 0.4-0.8(1.2) mm long; anthers (1.8)2-2.3(2.8) mm long, reddish. Nectaries 5, hemispheric, usually with a tuft of hairs at the top, dorsally glabrous. *Gynoecium* 7.1-11.2 mm long, dark red. *Fruit* 21.7-24(25.7) mm long, erect, discharge of seed-ejection type; mericarps 2.4-3.6 mm long, 1.2-1.7 mm wide, without a strand of fibers, not compressed at the apex, smooth, without basal beak, with a basal callus, without a basal prong, brown, with erect to patent, eglandular hairs 0.4-0.6 mm long; rostrum 15.5-18.7 mm long, with a narrowed apex 2.6-4.1 mm long, not twisted, with ± patent, eglandular hairs 0.2-0.7 mm long; stigmatic remnants 2.8-4.5 mm long, with 5 glabrous lobes. *Seeds* 2.2-2.4 mm long, 1-1.6 mm wide, finely reticulate, uniformly colored, brown, glabrous. Cotyledons with entire margin. Fig. 154.

Pollen. *Geranium*-type (Tan & al. 1996: 212 [sub *G. stapfianum*]).

Chromosome number. Unknown.

Phenology. Collected in flower from February to December.

Distribution. This species ranges from northern India (Uttaranchal and Sikkim) and Nepal to south-central China (Sichuan, Xizang, Yunnan) (Fig. 155).

Habitat. Meadows, rocky outcroops, shady banks under *Rhododendron* L. scrub and edge of *Abies* Mill., *Picea* A. Dietr., *Pinus* L., and *Tsuga* (Endl.) Carrière forests; 2800-5300 m.

Additional specimens examined. **China.** Sichuan: Kiu-ling, Meti-konga, Tsangpi, 5 July 1937, *Yü 6805* (KUN); Muli, Mt. Siga, NE of Kulu, 27°50'N, 101°15'E, June 1929, *Rock 17949* (GH, P); Muli, Muti Konka, a snow range E of the Yalung, Mutirong, 27°50'N,

101°15'E, June 1932, *Rock 23673* (GH); supra monasterium Muli, ad septr. Yungning, ad pascuum Bado, 28°12'N, 101°10'E, 29 July 1915, *Handel-Mazzetti 7271* (E); 10 km W of Liuba by side of Pa La river, Kangding county, 29°27'N, 101°27'E, 27 Sep. 2001, *Sichuan Exped. 2242* (CAS); environs de Tatsienlou [Dajian Lu], 30°3'N, 101°58'E, 1897, *Mussot 71* (P); Danba Xian, SW city Danba on highway 303 to Daofu and Kangding at Maoniu Cun along Maoniu river, 30°42'N, 101°45'E, 23 July 2007, *Boufford & al. 37970* (GH, MA); Xiaojin Xian, E of city of Xiaojin on road to Shawu Xiang, 30°52'N, 102°27'E, 27 July 2007, *Boufford & al. 38385* (GH, MA); prefectura Aba, distr. Jinchuan, pueblo Kasa, montaña Kongkashan, 31°14'N, 102°5'E, 29 July 1958, *Exped. Bot. Sichuan 3538* (IBSC); distrito Aba, población Wenchuan, pueblo Wo Long, 31°29'N, 103°35'E, 18 Aug. 1982, *Lang Kai Yong 1164* (PE); prefectura Aba, montaña Zhegushan, 31°29'N, 103°35'E, 28 June 195?, *Zhang Zeyun & Zhou Hongfu 22449* (IBSC); Sung-pan-hsien, 32°38'N, 103°35'E, *Young 65* (GH); Xizang: Tsang (Shang), Uyug Numagang, 2 Aug. 1951, *Aufschnaiter s.n.* (BM). Xizang: distr. Nie Gui Mu, 14 June 1966, *Zhang Yongjian & Lang Kaiyong 4229* (PE); Tsarong, on Doker La, Mekong-Salween divide, 25°15'N, 99°55'E, Aug. 1917, *Forrest 14675* (E); Tibet, Chumbi, 27°26'N, 88°55'E, 26 Aug. 1913, *Cooper 657* (BM); distrito Cuona, pr. estacion de radar, 27°42'N, 92°50'E, 17 July 1975, *Wu Zhegyi 75-873* (PE); N slopes of Mt. Kenichunpo, N of Sikitung, Upper Salween divide, Upper Irriwadi, 28°30'N, 98°20'E, June 1932, *Rock 22165* (E, GH); Salween-Kiu Chiang divide, Tsarong, 28°40'N, 98°15'E, July 1919, *Forrest 19037* (E); distr. Milin, pueblo Pai, garganta de la montaña Duoxiongla, 29°24'N, 94°54'E, 13 Sep. 1974, *Qinghai-Tibet Exped. 74-4892* (PE); Linzhi Xian, Lulang Zhen, near Ecological Station of the Chinese Academy of Sciences, 29°44'N, 94°43'E, 27 June 2099, *Tibet-MacArthur 2943* (US); Lhasa Shi, Cheng-guan Xiang, Geri Temple, 29°44'N, 91°6'E, 4 July 2009, *Tibet-MacArthur 3298* (US); población Linzhi, pueblo Linzhi, Bayi, 29°46'N, 94°22'E, 27 May 1972, *Medic. Tibet Exped. 3043* (PE); población Linzhi, en el camino del pueblo Pikang al pueblo Songduo, 29°46'N, 94°22'E, 7 Aug. 1965, *Zhang Yong Tian 1367* (PE); distr. Bomi, pueblo Gu, 29°52'N, 95°45'E, 16 June 1965, *Ying Junsheng & Hong Deyuan 650253* (PE); E Tibet, Showa Dzong, 29°55'N, 95°27'E, 7 June 1947, *Ludlow & Sherriff 13099* (BM); SE Tibet, Kongbo, Dzala, Pasum Chu, 30°4'N, 94°0'E, 20 June 1947, *Ludlow & Sherriff 13944* (BM); Tibet, Nyenchengtangla, 30°10'N, 90°29'E, 21 June 1943, *Ludlow & Sherriff 9662* (BM); Tibet, Reting, Gomdes Nohhasa, 30°21'N,

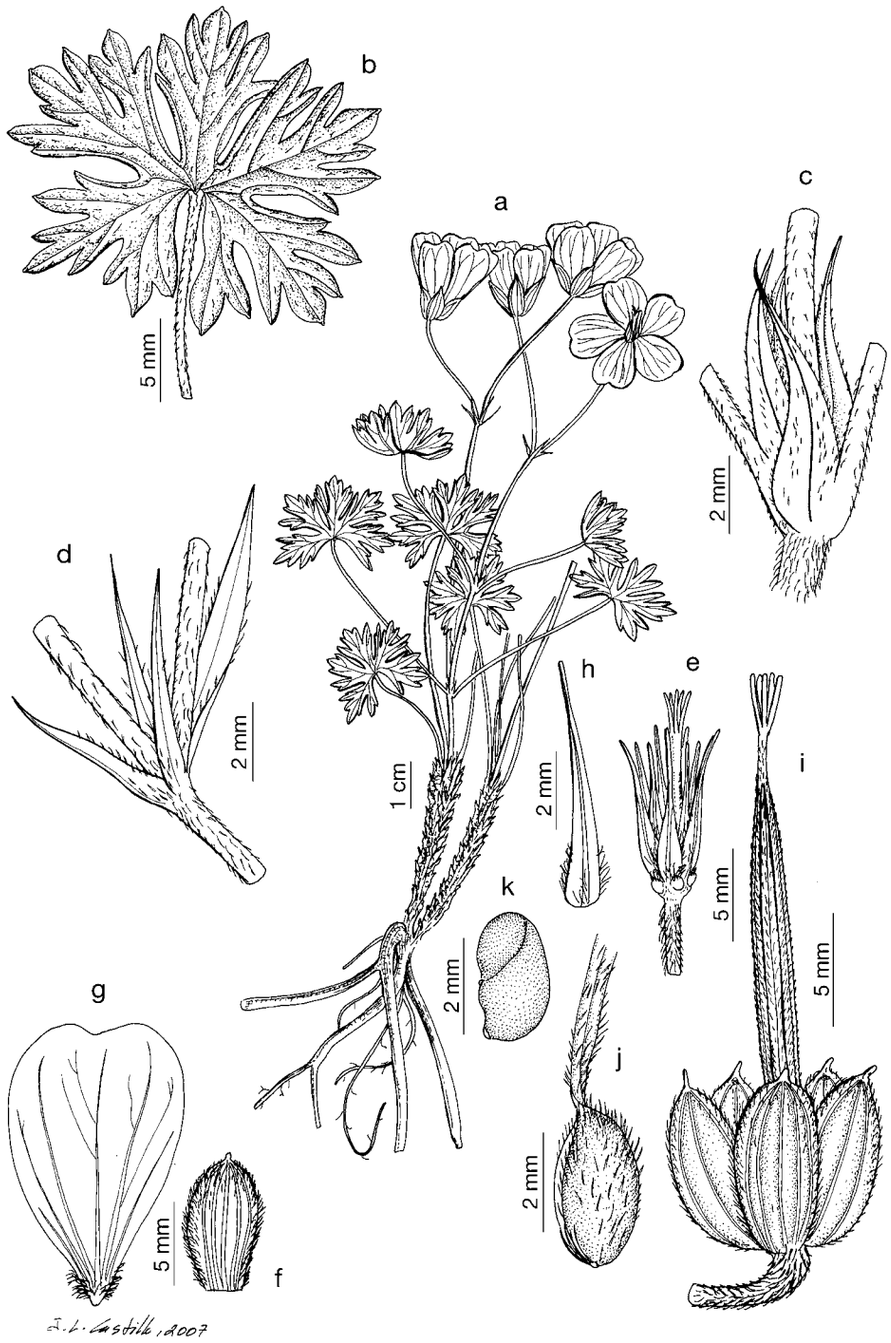


Fig. 154. *Geranium donianum*. a. Habit. b. Leaf on adaxial side. c. Stipules. d. Bracteoles. e. Flower without petals and sepals. f. Sepal. g. Petal. h. Staminal filament. i. Fruit. j. Mericarp. k. Seed. (Based on: a-d, *Forrest 6420,* E; e-h, *Rock 5018,* E; i-k, *Rock 5399,* E).

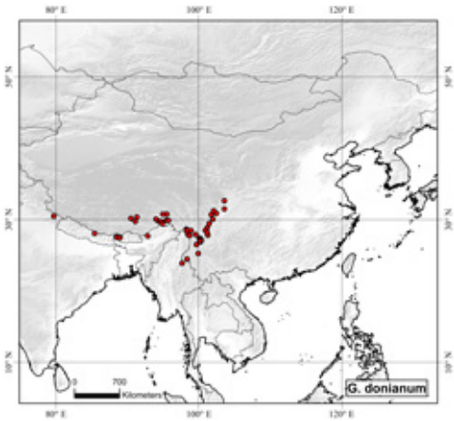


Fig. 155. Distribution of *Geranium donianum*.

91°20'E, 30 July 1942, *Ludlow & Sherriff 8948* (BM); Tibet, Reting, 60 mi N Lhasa, 30°21'N, 91°20'E, 13 July 1944, *Ludlow & Sherriff 9996* (BM); Bianba Xian, first pass from the city of Bianba to Luolong on higway 303, 30°45'N, 94°58'E, 21 July 2009, *Boufford & al. 40869* (MA); Luolong Xian, between the cities of Luolong and Bianba on higway 303, Dayong Shan, 30°46'N, 95°31'E, 20 July 2009, *Boufford & al. 40841* (MA). Yunnan: glacier lake Camp Litang R. divide, 24°29'N, 98°21'E, 18 June 1921, *Kingdon Ward 4220* (E); Chienchuan-Daekong, 26°30'N, 99°40'E, Aug. 1922, *Forrest 23172* (E, P); NE Likiang Ta-koo, Tachi, on Yangtze, 26°53'N, 100°14'E, 24 July 1939, *Ching 21209* (GH); Lichiang, Nguluko, 27°0'N, 100°10'E, 7 Aug. 1937, *Yü 15410* (PE); Likiang Snow Range, 27°5'N, 100°10'E, 3 Aug. 1939, *Ching 30460* (GH); pr. Likiang, Mt. Yülung-schan, 27°10'N, 100°20'E, *Handel-Mazzetti 3796* (W); Yangtze watershed, prefectural distric of Likiang, W slopes of Likiang Snow range, 27°20'N, 100°8'E, 13 July 1922, *Rock 5018* (E); Yangtze watershed, W slopes of Likiang Snow range, Ashi road, 27°20'N, 100°8'E, July 1922, *Rock 5399* (E, GH, P); E slopes of Likiang Snow range, Yangtze watershed, 27°20'N, 100°8'E, Aug. 1923, *Rock 9902* (E, MA); E flank of Lichiang Range, 27°25'N, 100°8'E, July 1906, *Forrest 2637* (E, P); Lichiang range, 27°25'N, 100°8'E, July 1929, *Forrest 27844* (E); Si-Kang, Doola, Tsa-wa-rung, 27°45'N, 98°42'E, 1935, *Wang 65528* (GH); Si-Kang, Hi-ma-la, Tsa-wa-rung, 27°45'N, 98°42'E, Aug. 1935, *Wang 65618* (GH); Si-Kang, sacred Mt. Kar-war-kar-boo, Tsa-wa-rung, 27°45'N, 98°42'E, Sep. 1935, *Wang 66277* (GH); prefectura Diqing, distrito Qin, 27°55'N, 99°32'E, 22 Aug. 1937, *Yu De Jun 9738* (MO); Gongshan, Bingzhongluo, 2.6 km SW of Gawagapu mountain,and 16.3 km WSW of Bingzhongluo, in the next basin to the E of Chukuai lake, E side of Gaoligong Shan, 27°59'N, 98°27'E, 29 Aug. 2006, *Gaoligong Shan Biod. Survey 31609* (CAS, GH, MA); Gongshan, Bingzhongluo, ridge top of Gaoligong Shan, 1.5 km SW of Gawagapu Mt. along SW ridge leading to the peak and 15.3 km WSW of Bingzhongluo, 27°59'N, 98°28'E, 30 Aug. 2006, *Gaoligong Shan Biod. Survey 31659* (CAS, GH, MA); Gongshan, Bingzhongluo, 2.1 km S of Gawagapu mountain, and 15.2 km WSW of Bingzhongluo in the next basin to the E of Chukuai lake, E side of Gaoligong Shan, 27°59'N, 98°28'E, 28 Aug. 2006, *Gaoligong Shan Biod. Survey 32790* (CAS, GH, MA); NW Yunnan and E Tibet, A-tun-tsi, 28°29'N, 98°54'E, 30 Feb. 1913, *Kingdon Ward 922* (E); Atuntze, Mt. Paimashan, 28°29'N, 98°54'E, 12 Aug. 1937, *Yü 9607* (PE). **India.** Sikkim: Sikkim, 27°30'N, 88°30'E, *Hooker s.n.* (W). Uttaranchal: Garhwal-Himalaja, Ramani Gletscher-Gebiet, Rishi-Ganga, wiese am fluss, 30°29'N, 79°41'E, June 1939, *Roch s.n.* (S).

Discussion. Geranium donianum is a small plant with a horizontal rootstock that bears thickened roots distributed along it. It has opposite leaves and free stipules. Occasionally, some cymules arising directly from the rootstock have been observed. The indumentum of the whole plant is usually eglandular. The long petals are hairy on the base of the adaxial surface. They are usually emarginate at the apex and without a distinct claw. The nectaries are dorsally glabrous, with a tuft of hairs at the top; rarely, they appear almost glabrous. The specimen *MacArthur 2943* (US) has scattered glandular hairs on the stem and petioles, but otherwise it falls within the variability of the species.

Geranium stapfianum is considered by Stapf (1926) and Yeo (1992: 162) to be a different species endemic to Sichuan and Yunnan, *G. donianum* thus being a Himalayan plant. In order to support such a distinction, a more robust rootstock and habit are attributed to western specimens of *G. donianum*. However, a great variability in these features has been observed throughout the whole area of *G. donianum*, and this does not support such a division. The rootstock could rarely have some thickened areas that are not clearly differentiated, which should not be mistaken with the tubercles of *Geranium pylzowianum*. Additionally, *G. pylzowianum* has glandular indumentum, glabrous nectaries, and usually some alternate leaves and entire petal apex.

49. Geranium farreri Stapf, Bot. Mag. 151, tab. 9092. 1926. Type locality: "The second form [F. 170] is the plant figured here... China; Min-shan on the border of Kansu and Szechuan, 3,900-4,500 m". Type: China. Cultivated at Kew from Min-shan on the border of Kansu and Szechuan, 34°26'N, 103°58'E, *R.J. Farrer 170F p.p.* (lectotype, designated by Yeo 1992: 173, K-000729508!).

Geranium pylzowianum var. *alpinum* Farrer, On the Eaves of the World 2: 172-173, 321. 1917. Type locality: "(F. 201)". Type: China. Gansu, Bei Ling, 35°27'N, 102°53'E, 5 Aug. 1914, *R.J. Farrer 201* (lectotype, here designated, MO-251005!; isolectotypes, CAS!, E!, P-5095483!).

Perennial herbs, 9-16(19) cm tall. *Rootstock* 3.7-4.3(6.7) mm in diameter, ± vertical, not tuberculate, not turnip-shaped, with thickened roots along the rootstock. *Stem* erect, leafy, not rooting at nodes, stolons absent, without vegetative stems, with sparse, retrorse, not appressed, eglandular hairs 0.2-0.3 mm long. *Basal leaves* in a ± deciduous rosette, cauline leaves opposite; leaf laminas (1.3)1.5-1.9 cm long, 1.9-3.7 cm wide, not peltate, palmatifid [ratio main-sinus length/middle segment length = 0.74-0.82(0.84)], polygonal in outline, base cordate, not coriaceous, with nerves not projected, pilose, with appressed, eglandular hairs on both surfaces; segments 5, in 1 plane, middle segment rhombic, (1.8)2-2.5(2.9) mm wide at the base [ratio segment width at the base/middle segment length = 0.15-0.21], 3-5-lobed in distal half [ratio secondary sinus length/middle segment length = (0.23)0.25-0.28(0.33)]; petioles up to 10 cm long, without abscission zone, terete, not swollen, not deflexed in age, with retrorse, ± appressed, eglandular hairs 0.3-0.4 mm long; stipules 4.6-7.4 mm long, 0.9-2.9 mm wide, lanceolate, free, papery, brown, with scattered, eglandular hairs on both surfaces and on the margin. *Inflorescence* a dichasial cyme; cymules 2-flowered, solitary [ratio cymule length/leaf length = (1.3)1.4-2.1(2.7)]; peduncles (32)36-54(69) mm long, with retrorse, not appressed, eglandular hairs 0.3-0.5 mm long; bracteoles 3.5-5.7 mm long, 0.7-1.5 mm wide, lanceolate, whorled; pedicels (24)30-35(44) mm long, with retrorse, not appressed, eglandular hairs 0.2-0.5 mm long. Flowers actinomorphic. *Sepals* (7.9)8-8.9(9.2) mm long, 3.2-4.3 mm wide, lanceolate, smooth, not accrescent, nerves 3, mucro 0.4-0.6(0.7) mm long [ratio

mucro length/sepal length = 0.05-0.09], with antrorse, ± appressed, eglandular hairs 0.4-0.6 mm long on the abaxial surface, almost glabrous adaxially. *Petals* 14.6-16(16.7) mm long, (9.7)10.1-12.6(12.9) mm wide, erect-patent, rounded (rarely retuse), with claw 2.3-6.1 mm long, pale pink, hairy on the base of the adaxial surface, glabrous abaxially, ciliate on the basal margin, with hairs 0.2-0.6 mm long. *Stamens* 10, both whorls bearing anthers; filaments 9-11.8 mm long, lanceolate, white, pilose on the abaxial surface, ciliate on the proximal half, with hairs 0.2-0.4 mm long; anthers (2.1)2.2-2.4(2.6) mm long, dull purple to blackish. Nectaries 5, hemispheric, with a tuft of hairs at the top, dorsally glabrous. *Gynoecium* 8-13.3 mm long, pink. *Fruit* ca. 23 mm long, erect, discharge of seed-ejection type; mericarps 3.5-4 mm long, 1.2 mm wide, without a strand of fibers, not compressed at the apex, smooth, without basal beak, with a basal callus, without a basal prong, brown; stigmatic remnants with 5 glabrous lobes. *Seeds* 2.8-3 mm long, 1.5 mm wide. Cotyledons not studied. Fig. 156.

Pollen. *Geranium*-type (Park & Kim 1997: 314).

Chromosome number. Unknown.

Phenology. Collected in flower from July to August.

Distribution. This species is endemic to Gansu, in central China (Fig. 157).

Habitat. Bluffs and limestone outcroppings; 4300-4600 m.

Additional specimens examined. **China.** Gansu: Schr Hsia, in latere N montis Min-shan, 34º26'N, 103º58'E, 24 July 1930, *Hummel 4415* (S); Tao river basin, N of Chabaku pass, 35º40'N, 103º36'E, Aug. 1925, *Rock 13184* (E, GH, NY, US). **Unknown origin.** Farrer expedition to Burma 1919 or Kansu / Tibet 1914-15, July, *Farrer Exped. s.n.* (E).

Discussion. Geranium farreri is quite similar to *G. donianum*, although it is well characterized by its petals: they have a rounded or retuse apex and a distinct claw. Fruit features are poorly known because of the scarcity of available material. The geographical separation of *G. farreri* also supports its independence.

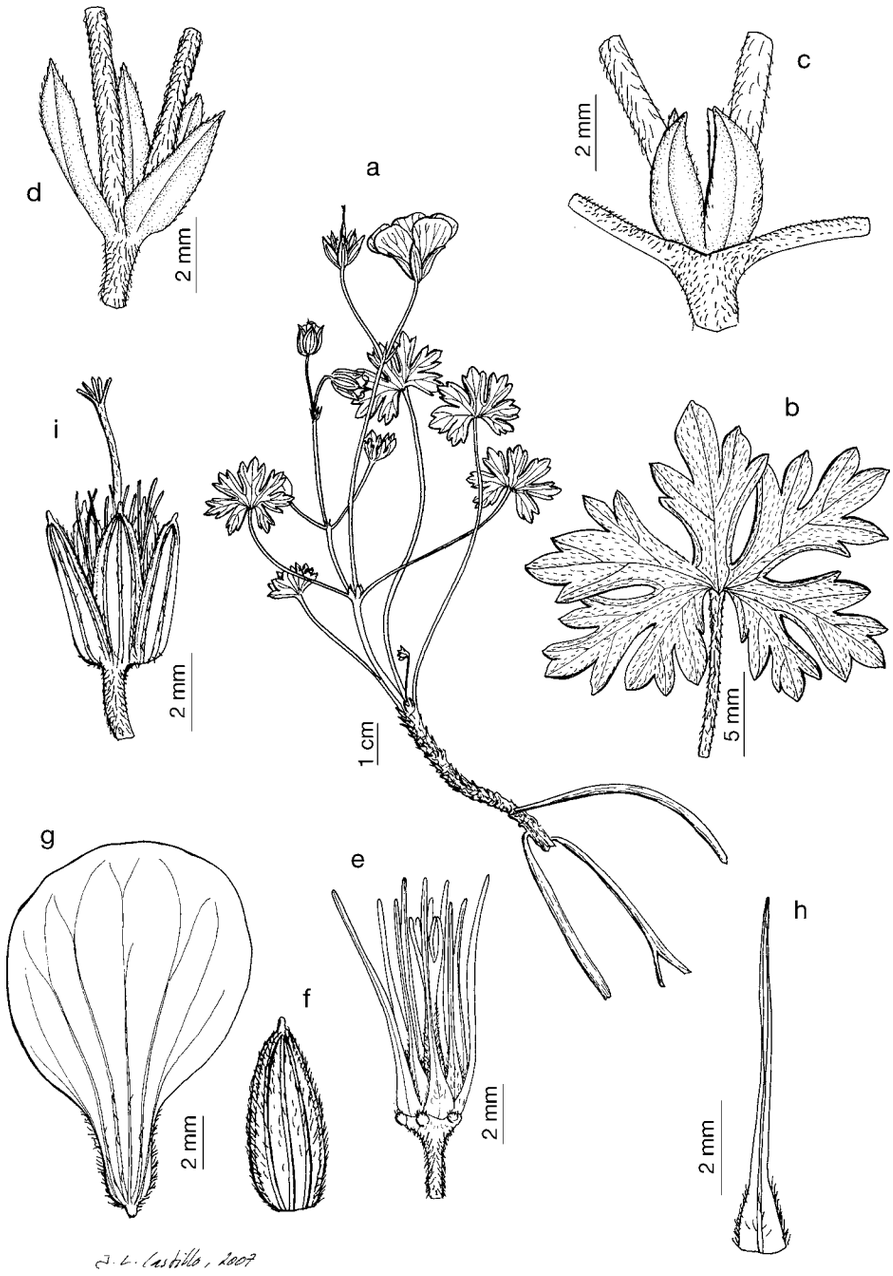


Fig. 156. *Geranium farreri*. a. Habit. b. Leaf on adaxial side. c. Stipules. d. Bracteoles. e. Flower without petals and sepals. f. Sepal. g. Petal. h. Staminal filament. i. Immature fruit. (Based on: a-i, *Farrer Exped. s.n.,* E-216824).

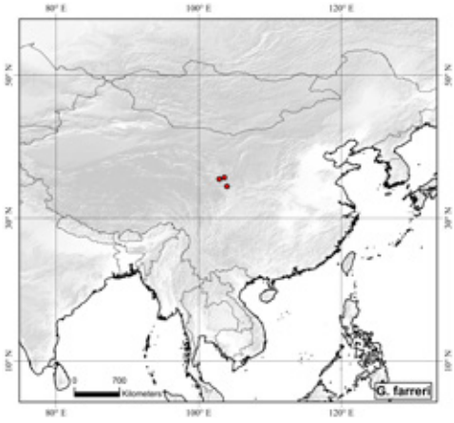


Fig. 157. Distribution of *Geranium farreri*.

50. Geranium napuligerum Franch., Pl. Delavay.: 115. 1889. Type locality: "Yun-nan, in pascuis et saepibus ad collum Yen-tze-hay (Lan-kong,) alt. 3200 m.; fl. fr. immat. 27 aug. 1886 (Delavay, n. 2328); in pascuis ad Fang-yang-tchang, alt. 3000 m. (Delav. n. 2969)". Type: China. Yunnan, Lan-kong, 26º06'N, 99º57'E, 27 Aug. 1886, *J.M. Delavay 2328* (lectotype, designated by Yeo 1992: 158, P-00712127!; isolectotypes, K-000729457!, MA-628493!).

Perennial herbs, 4-17(25) cm tall. *Rootstock* 2-3.3 mm in diameter, ± vertical, not tuberculate, not turnip-shaped, with napiform roots clustered round the rootstock. *Stem* erect, leafy, not rooting at nodes, stolons absent, without vegetative stems, with retrorse, appressed, eglandular hairs 0.2-0.6 mm long and, rarely, patent, glandular hairs 0.3-0.7 mm long. *Basal leaves* in a ± deciduous rosette, cauline leaves opposite; leaf laminas (0.6)1.3-1.8(2.1) cm long, 0.9-2.3 cm wide, not peltate, palmatifid [ratio main-sinus length/middle segment length = 0.79-0.82(0.85)], suborbicular in outline, base cordate, not coriaceous, with nerves not projected, pilose, with appressed, eglandular hairs on both surfaces and ± patent, glandular hairs abaxially; segments 5, in 1 plane, middle segment obtriangular, (1)1.5-2 mm wide at the base [ratio segment width at the base/middle segment length = (0.14)0.17-0.22(0.24)], 3-4(7)-lobed in distal half [ratio secondary sinus length/middle segment length = (0.29)0.33-0.42(0.47)]; petioles up to 11 cm long, without abscission zone, terete, not swollen, not deflexed in age, with retrorse, ± appressed, eglandular hairs 0.3-0.7 mm long and, usually, patent, glandular hairs 0.4-0.7 mm long; stipules 1.7-4.4 mm long, 0.5-1.5 mm wide, lanceolate, free, papery, brown, with eglandular and glandular hairs on abaxial surface and on the margin, usually glabrous adaxially. *Inflorescence* a dichasial cyme; cymules 2-flowered, solitary [ratio cymule length/leaf length = (1.7)2-4.4(4.7)]; peduncles (13)18-63(69) mm long, with

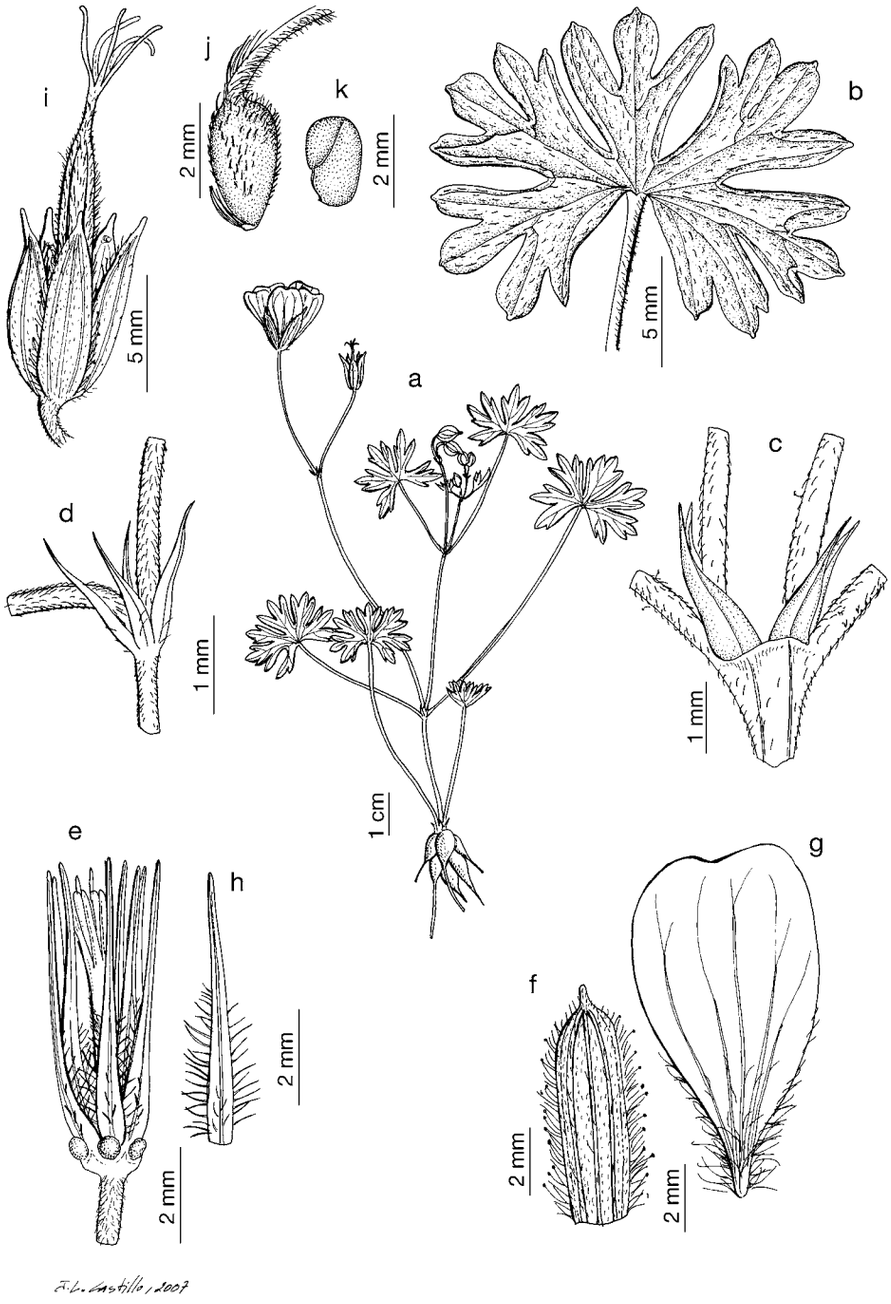


Fig. 158. *Geranium napuligerum*. a. Habit. b. Leaf on adaxial side. c. Stipules. d. Bracteoles. e. Flower without petals and sepals. f. Sepal. g. Petal. h. Staminal filament. i. Fruit. j. Mericarp. k. Seed. (Based on: a-e, h, *Boufford & al. 28622,* CAS; i-k, *Delavay 2328,* MA; f-g, *Forrest 21989,* E).

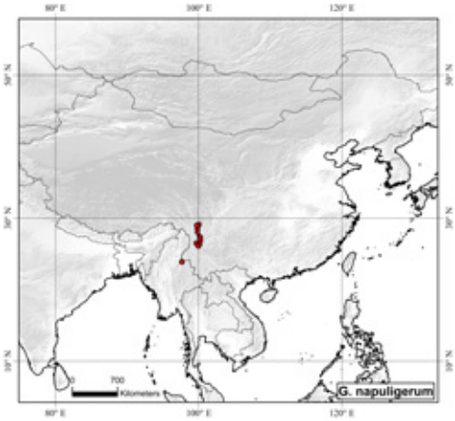


Fig. 159. Distribution of *Geranium napuligerum*.

retrorse, appressed, eglandular hairs 0.2-0.6 mm long and, rarely, patent, glandular hairs 0.4-0.5 mm long; bracteoles 2.1-3.3 mm long, 0.5-0.9 mm wide, lanceolate, whorled; pedicels (11)16-36(42) mm long, with retrorse, appressed, eglandular hairs 0.3-0.6 mm long and, rarely, patent, glandular hairs 0.2-0.3 mm long. Flowers actinomorphic. *Sepals* (6)6.3-7(7.6) mm long, 2-3.1 mm wide, lanceolate, smooth, not accrescent, nerves 3, mucro 0.6-0.7(0.8) mm long [ratio mucro length/sepal length = 0.09-0.11], with antrorse, ± appressed, eglandular hairs 0.2-0.7 mm long and patent, glandular hairs 0.7-1.6 mm long on the abaxial surface, glabrous adaxially. *Petals* 11.1-13.9(15) mm long, 5.4-7.6(8) mm wide, erect-patent, rounded or slightly emarginate (notch 0.1-0.3 mm deep), with claw 0.6-5.8 mm long, deep pink, hairy on the base of both surfaces, ciliate on the basal margin, with hairs 0.9-1.3 mm long. *Stamens* 10, both whorls bearing anthers; filaments (5.6)5.7-6.5 mm long, lanceolate, yellow, pilose on the abaxial surface, ciliate on the proximal half, with hairs 0.4-1.1 mm long; anthers 1.4-1.5(1.7) mm long, yellow. Nectaries 5, hemispheric, glabrous. *Gynoecium* 5.8-7.3 mm long, purple. *Fruit* 17.4-19.5 mm long, reflexed, discharge of seed-ejection type; mericarps 2.6-2.9 mm long, 1.1-1.4 mm wide, without a strand of fibers, not compressed at the apex, smooth, without basal beak, with a basal callus, without a basal prong, brown, with ± patent, eglandular hairs 0.4-0.8 mm long and, sometimes, glandular hairs 0.4-0.5 mm long; rostrum 10.2-12.3 mm long, with a narrowed apex 2.1-2.8 mm long, not twisted, with ± patent, eglandular hairs 0.3-0.4 mm long and patent, glandular hairs 0.4-1.1 mm long; stigmatic remnants 3.1-3.8 mm long, with 5 glabrous lobes. *Seeds* 1.8-1.9 mm long, 1.2-1.3 mm wide, finely reticulate, uniformly colored, brown, glabrous. Cotyledons not studied. Fig. 158.

Pollen. *Geranium*-type (Bortenschlager 1967: 429; Park & Kim 1997: 313; Tan & al. 1996: 211).

Chromosome number. 2*n* = 28.

Phenology. Collected in flower from July to September.

Distribution. This species ranges through south-central China (Sichuan and Yunnan) (Fig. 159).

Habitat. Alpine grassland, open slopes, meadows and dwarf *Rhododendron* L. scrubs; 3200-4350 m.

Additional specimens examined. **China.** Sichuan: Xiangcheng Xian, pass between Xiangcheng and Reda over Maan Shan, 29º0'N, 99º44'E, 20 July 1998, *Boufford & al. 28989* (GH); Xiangcheng Xian, Haizi lake on road between Sandui and Litang, 29º6'N, 100º1'E, 12 July 1998, *Boufford & al. 28622* (CAS, GH). Yunnan: Yunnan, *Forrest 30842* (E); upper Kiukiang valley (Clulung) Lungtaahmuru, 23º53'N, 97º39'E, 9 Aug. 1938, *Yü 19848* (E, GH); Chien Chuan-Mekong divide, 26º30'N, 99º40'E, Aug. 1922, *Forrest 21989* (E, P); distrito Diqing, población Deqin, montaña Baimashan, 27º20'N, 100º13'E, 23 Sep. 1986, *Sun Hang 790* (KUN); distrito de Xiang Ge Li La, montaña Haba, 27º23'N, 100º8'E, *[illegible] 1092* (PE); prefectura Diqing, distrito Xiang Ge Li La, Re Rong Ba, 28º3'N, 99º50'E, 26 July 1981, *Tang Zongxiao 701* (PE); prefectura Diqing, distrito Xiang Ge Li La (Sangri-La), 28º3'N, 99º50'E, 24 July 1937, *Yü 12400* (IBSC); Zhongdian, Beimashan (White Horse Snow Mountains) von Zhongdian nach Deqen, 67 km NW Benzilan, 28º34'N, 99º49'E, 3 Aug. 1996, *Podlech 54530* (MSB).

Discussion. At first sight, *G. napuligerum* resembles *G. donianum* in habit, leaf shape, and inflorescence structure. *Geranium napuligerum*, however, is well characterized by its short, thickened, and napiform roots. The short rootstock is usually covered by the roots. In this feature it resembles *G. dahuricum*, but the latter is a more robust plant that has roots in a fascicle and they are appreciably longer. Glandular hairs also support the distinctiveness of *G. napuligerum* against *G. donianum.* They are usually restricted to stipules, sepal and bracteole bases, mericarps, and the abaxial surface of leaves. More rarely, there are glandular hairs on the stem, peduncles, and pedicels.

Geranium napuligerum is an endemic from Yunnan and Sichuan. Knuth (1912: 143) recorded it in Korea on the basis of the specimen *Faurie 1760*, which is *Geranium dahuricum.*

51. Geranium pylzowianum Maxim., Bull. Acad. Imp. Sci. Saint-Pétersbourg 26: 466. 1880. Type locality: "China occidentalis: prov. Kansu, in vallibus rivulorum alpium secus fl. Tetung (Przewalski)". Type: China. Gansu, Terra Tangutorum (prov. Kansu), jugum N a fl. Tetung, 33º14'N, 104º52'E, 22 June / 4 July 1872, *N.M. Przewalski 131* (lectotype, designated by Novoselova 2004: 506, LE!).

Geranium orientali-tibeticum R. Knuth, Repert. Spec. Nov. Regni Veg. 19: 230. 1923. Type locality: "Ost-Tibet: Ta-tsien-lu (Soulié a. 1894 no. 2041 sub G. Vlassovianum - Typus in herb. Berol.!)". Type: China. Ost-Tibet, Ta-tsien-lu, 1894, *J. A. Soulié 2041* (holotype, B destroyed). China. Sichuan. Ost-Tibet, Ta-tsien-lou, 30º03'N, 101º58'E, 1893, *J.A. Soulié 616* (neotype, designated by Yeo 1992: 137, K-000729349!).

Perennial herbs, (8)16-28(48) cm tall. *Rootstock* ± horizontal, tuberculate, with tubercles subglobose, 3.7-6.9(17.5) mm long, 2.4-7 mm wide, with non-tuberous separations 6-52 mm long, 0.4-1 mm wide, not turnip-shaped, without thickened roots. *Stem* erect, leafy, not rooting at nodes, stolons absent, without vegetative stems, with retrorse to appressed, eglandular hairs 0.2-0.5 mm long and, usually, scattered, patent, glandular hairs 0.5-1.6 mm long. *Basal leaves* in a ± persistent rosette, cauline leaves alternate (1-2) and upper opposite; leaf laminas (1.5)2.4-3.9(5.1) cm long, 1.9-6.6 cm wide, not peltate, palmatifid [ratio main-sinus length/middle segment length = (0.78)0.86-0.92(0.95)], polygonal in outline, base cordate, not coriaceous, with nerves not projected, pilose, with appressed, eglandular hairs on both surfaces; segments 5, in 1 plane, middle segment rhombic to obtriangular, (1.2)1.7-3(4.3) mm wide at the base [ratio segment width at the base/middle segment length = (0.07)0.09-0.13(0.18)], 3-6(8)-lobed in distal half [ratio secondary sinus length/middle segment length = (0.26)0.33-0.43(0.47)]; petioles up to 15 cm long, without abscission zone, terete, not swollen, not deflexed in

age, with retrorse to appressed, eglandular hairs 0.2-0.6 mm long and, sometimes, patent, glandular hairs 0.5-1.2 mm long; stipules 1.6-8.3 mm long, 0.8-1.9 mm wide, lanceolate, free, papery, brown, with scattered, eglandular hairs on both surfaces and on the margin. *Inflorescence* a monochasial cyme; cymules 2-flowered, solitary [ratio cymule length/leaf length = (1.4)1.7-3.4(7.6)]; peduncles (26)55-98(155) mm long, with retrorse to appressed, eglandular hairs 0.2-0.6 mm long and, rarely, patent, glandular hairs 0.7-0.8 mm long; bracteoles 2-9.3 mm long, 0.5-1.5 mm wide, lanceolate, whorled; pedicels 12-56(70) mm long, with retrorse to appressed, eglandular hairs 0.2-0.6 mm long. Flowers actinomorphic. *Sepals* (6.9)7.8-9.6(11.1) mm long, 2.3-4.2 mm wide, lanceolate, smooth, not accrescent, nerves 3, mucro (0.5)0.8-1.2 mm long [ratio mucro length/sepal length = 0.08-0.15], with antrorse to patent, eglandular hairs 0.5-1.2 mm long on the abaxial surface, glabrous adaxially. *Petals* (15.5)15.8-17.2(18.2) mm long, 9-12.7(14.3) mm wide, erect-patent, rounded or rarely emarginate (notch 0.2-0.3 mm deep), with claw 1.3-3.7 mm long, deep rose-pink with a whitish base, hairy on the basal 1/3 of their adaxial surface, glabrous abaxially, ciliate on the basal margin, with hairs 0.7-1.3 mm long. *Stamens* 10, both whorls bearing anthers; filaments 5.5-6.8(8.9) mm long, lanceolate, pink distally, paler at base, pilose on the abaxial surface, ciliate on the proximal half, with hairs 0.3-0.9 mm long; anthers (1.7)2.1-2.4 mm long, white, tinged with bluish. Nectaries 5, hemispheric, glabrous. *Gynoecium* 5.3-8.5 mm long, pink to orange red. *Fruit* (22.9)23-25(29.4) mm long, erect, discharge of seed-ejection type; mericarps 2.3-3.1 mm long, 1.2-1.7 mm wide, without a strand of fibers, not compressed at the apex, smooth, without basal beak, with a basal callus, without a basal prong, brown, with erect to patent, eglandular hairs 0.3-1.1 mm long; rostrum 15.7-21.7 mm long, with a narrowed apex 1.6-4.5 mm long, not twisted, with ± patent, eglandular hairs 0.2-0.8 mm long; stigmatic remnants 2.6-3.5 mm long, with 5 usually glabrous lobes. *Seeds* 1.7-2.2 mm long, 1.3-1.6 mm wide, finely reticulate, uniformly colored, brown, glabrous. Cotyledons with entire margin. Fig. 160.

Pollen. *Geranium*-type (Bortenschlager 1967: 429; Tan & al. 1996: 211).

Chromosome number. 2*n* = 28.

Phenology. Collected in flower from April to December.

Distribution. This species ranges from northern India (Uttaranchal)

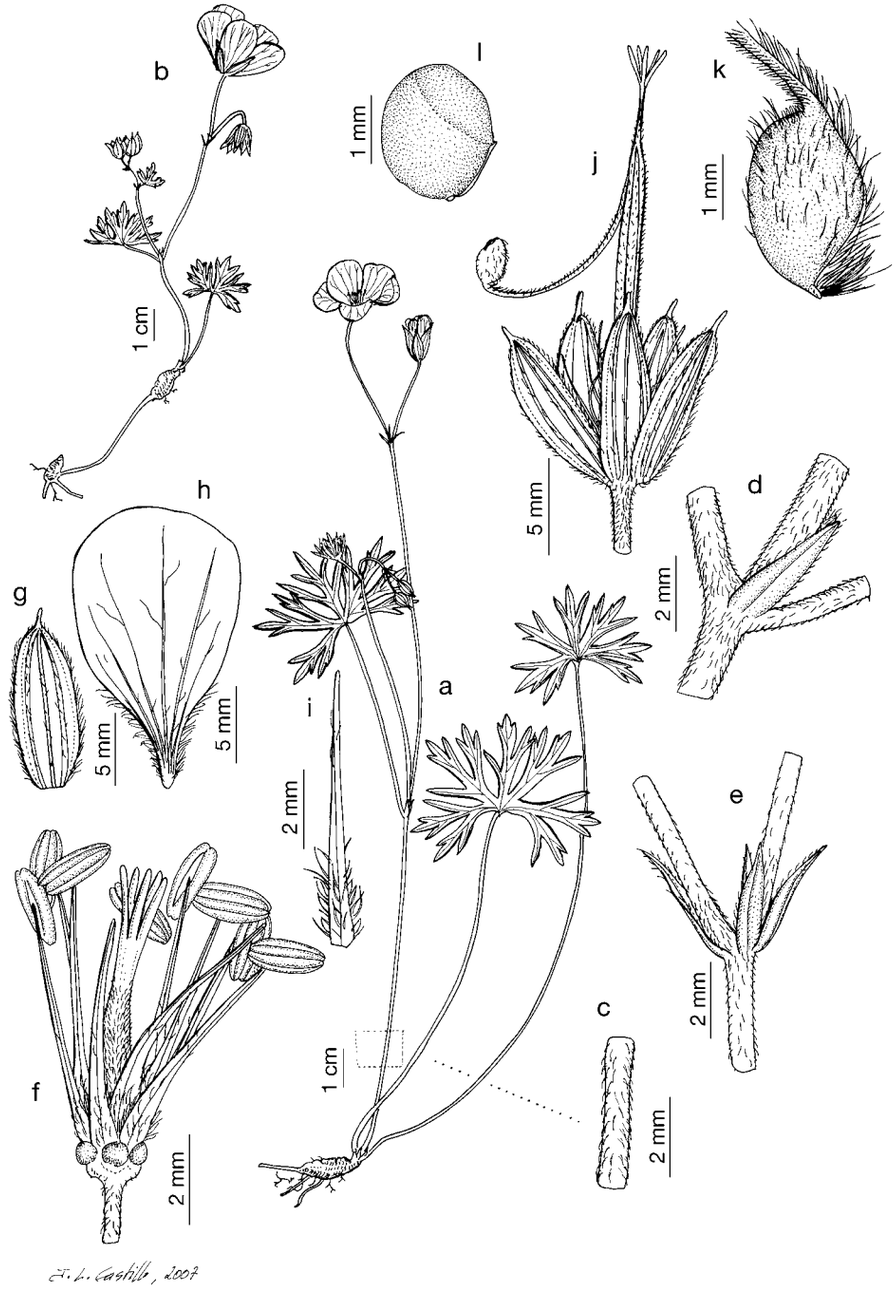


Fig. 160. *Geranium pylzowianum*. a, b. Habit. c. Stem indumentum. d. Stipules. e. Bracteoles. f. Flower without petals and sepals. g. Sepal. h. Petal. i. Staminal filament. j. Fruit. k. Mericarp. l. Seed. (Based on: a, c, *Boufford & al. 32539,* MA; b, *Boufford & al. 30436,* MA; d-i, *Boufford & al. 30812,* MA; j-l, *Ho & al. 2638,* MO).

and Nepal to central China (Gansu, Ningxia, Qinghai, Shaanxi, Sichuan, Xizang and Yunnan) (Fig. 161).

Habitat. Roadsides, alpine meadows, grassy slopes, shady banks under bushes, streams, *Rhododendron* L. thickets and edge of *Betula* L., *Picea* A. Dietr., *Pinus* L., *Quercus* L. and *Tsuga* (Endl.) Carrière forests; 2300-4500 m.

Representative specimens examined. **China.** Gansu: prefectura Diebu, pueblo Lazikou, 34º3'N, 103º53'E, 6 Aug. 1993, *Xu Langran 2250* (MO); Tao River basin, W Choni along stream of Kwadjaku beyond Tatsuto, 34º31'N, 103º30'E, June 1925, *Rock 12450* (GH); Kansu occidental, Sin Long Han et Ma Ho Chan, 35º21'N, 104º38'E, 10 July 1918, *Licent 4196* (GH, P); ciudad Lanzhou, población Xigu, Heiyougao, ShanShenye Liang, 36º6'N, 103º36'E, 19 July 1951, *Wang Zuobin 14421* (KUN); Lianhuashan, Kangle Xian, 37º55'N, 102º29'E, 20 June 1991, *Wang 91028* (MO). Ningxia: Shikong, Baohsin, Moupin, 37º41'N, 105º33'E, July 1939, *Hu 1374* (GH). Qinghai: Yushu Xian, Jiangxi Gou, E of Jiangxi forest station on E side of the Zi Qu, SE of Mozhong, 32º4'N, 97º3'E, 26 Aug. 1996, *Ho & al. 2638* (CAS, GH, MO); Chindu Xian, town of Xiewu, 33º6'N, 97º18'E, 1 July 1995, *Boufford & al. 26876* (CAS, GH); Tongde Xian, Longmuer Gongma, between Jungong and Hebei, 34º42'N, 100º42'E, 22 July 1993, *Ho & al. 153* (CAS, GH, MO); prefectura Huangnan, distrito Zeku, pueblo Maixiu, 35º2'N, 101º27'E, 3 Aug. 1998, *Yao 60* (MO); Duowa Xiang, Tongren Xian, 35º29'N, 102º9'E, 10 July 1970, *Liu Shang-wu 1207* (CAS); distrito Hainan, población Guide, pueblo Galang, 35º46'N, 102º34'E, 24 July 1989, *Liu Shang-wu 3306* (PE); Shangwuchung, Sining, Kokonor, 36º55'N, 100º9'E, 3 Aug. 1930, *Hopkinson s.n.* (S). Shaanxi: Tai Bai Shan, Dadian, 33º57'N, 107º45'E, 23 July 1987, *Tsung-Shen Ying & al. 0329* (GH); montaña Tai Bai Shan, 33º57'N, 107º45'E, 20 June 1992, *Wu Zhen Hai 92-933* (MO). Sichuan: Muli, Deongomba, 27º50'N, 101º15'E, 5 June 1937, *Yü 6242* (IBSC, PE); Daocheng Xian, S of Bowa Shan, 28º44'N, 100º16'E, 4 July 1998, *Boufford & al. 28245* (CAS, GH, MO); Derong Xian, Gajingxue Shan NNW of Derong, 28º52'N, 99º14'E, 4 July 1998, *Boufford & al. 30812* (MA); Xiangcheng Xian, Xiangcheng, Maan Shan, along road from Xiangcheng to reda on Xiangcheng side of pass Maan Shan, 28º57'N, 99º45'E, 8 July 2004, *Boufford & al. 30436* (MA); Xiangcheng Xian, between Xiangcheng and Sandui, near the village of Riyin, S of Wuming Shan, 29º8'N, 99º55'E, 8 July 1998, *Boufford & al. 28375* (CAS, GH, MO); Derong Xian, NNWof Derong, Dimu Caodi pass, 29º8'N, 99º20'E, 20 July 2004, *Boufford & al. 30947* (MA); Daocheng Xian, E side of Wuming Shan, 29º9'N, 100º5'E, 2 July 1998, *Boufford & al. 28139* (CAS); Jiulong Xian, Tanggu Cun, from Sida Niuchang, N of Tanggu Xiang, 29º9'N, 101º31'E, 19 July 2005, *Boufford & al. 33166* (MA); distrito Liang Shan, Huang Mao Geng, 29º25'N, 103º53'E, 19 June 1959, *Guan Zhong Tian 8571* (IBSC, PE); Tahsiangling, 29º30'N, 102º50'E, 26 June 1934, *Smith 10191* (MO, S, UPS); Ya chou fu, von Pan gou, 29º59'N, 102º59'E, 10 June 1914, *Limpricht 1060* (WRSL); montaña E'Mei Shan Jin Ding, 30º2'N, 103º50'E, 9 Aug. 1964, *Sichuan Exped. 4021* (MO); Tatsienlu, 30º3'N, 101º58'E, 1923, *Cunningham 104* (E); distrito Ganzi, pueblo Kangding, 30º3'N, 101º58'E, 13 July 1963, *Guan Ke Jian 28* (PE); Baurong to Tachienlu, via Hadjaha, 30º3'N, 101º58'E, June 1929, *Stevens 146* (E, NY, W); Danba Xian, SE city Danba on highway 303 to Daofu and Kangding at Dingguo Shan, 30º36'N, 101º45'E, 24 July 2007, *Boufford & al. 38035* (GH, MA); Xiaojin Xian, S side of Mengbi Shan on highway 210, km 36-37 (road between Maerkang and Xiaojin), 31º39'N, 102º19'E, 14 Aug. 2007, *Boufford & al. 39646* (GH, MA); Barkam Xian, Zhegu Shan, between Barkam and Li Xian, 31º51'N, 101º40'E, 8 Sep. 1997, *Boufford & al. 28000* (MA); Aba Xian, SE of the city Aba on highway 301 at Ayila Shan, km 1084-1086, 32º43'N, 102º6'E, 10 Aug. 2007, *Boufford & al. 39421* (GH, MA); Ruoergai Xian, E of Ruoergai on highway 213, then E on Xian-dao Jiu-Ruo-Lu (Jiuzhaigou-Ruoergai road) to Lamaling Yakou (pass), 33º38'N, 102º30'E, 22 Aug. 2007, *Boufford & al. 40263* (GH, MA). Xizang: Markam Xian, Hong La, N side of pass, S of Markam, 29º16'N, 98º40'E, 12 July 2000, *Boufford & al. 29392* (MA); Zuogong Xian, S of the city of Zuogong along the Yu Qu, 29º33'N, 97º54'E, 18 July 2009, *Boufford & al. 40654* (MA); Mangkang Xian, between Mangkang and the Jinsha Jiang on highway 318 along Xi Qu river, 29º43'N, 98º46'E, 16 July 2009, *Boufford & al. 40615* (MA); Mangkang Xian, between Mangkang and the Jinsha Jiang on highway 318, 29º44'N, 98º40'E, 16 July 2009, *Boufford & al. 40557* (MA); Gongjue Xian, Doba Cun, ca. 13.9 km in a straight line NE of Gongjue, 30º58'N, 98º19'E, 31 July 2009, *Boufford & al. 41555* (MA); Jiangda Xian, WSW of city Jiangda along river Changdu, 31º19'N, 98º7'E, 30 July 2004, *Boufford & al. 31353* (MA); Riwoqe Xian, road from Changdu to Nancang Jiang, on road to Riwoqe via Machala coal mine, 31º28'N, 96º46'E, 24 July 2009, *Boufford & al. 40992* (MA); Changdu Xian, road 317 from Changdu to Jiangda, along Zha Qu river, 31º30'N, 97º20'E, 17 Aug. 2004, *Boufford & al. 32539* (MA); Jiangda Xian, along road from Jiangda to Dege, W side of Leijila Shan, 31º38'N, 98º23'E, 2 Aug. 2004, *Boufford & al. 31566* (MA). Yunnan: Ta-hai-tse, 1913, *Maire s.n.* (E); ciudad Dong Chuan, montaña Yinmin, Compuerta del Viento, 26º39'N, 103º3'E, 21 July 1985, *Lan Shunbin 476* (PE); NW Yunnan, A-tun-tsi, 28º29'N, 98º54'E, July 1911, *Kingdon Ward s.n.* (E); Tehching, Atuntze, Paimashan, 28º29'N, 98º54'E, 6 July 1937, *Yü 8775* (MO, PE); distr. Di QIng, población Deqin, 28º29'N, 98º54'E, 9 Dec. 1937, *Yu De Jun 9607* (KUN, PE). **India.** Uttaranchal: Kumaon, Kutti valley, 29º50'N, 79º30'E, 1 Aug. 1886, *Duthie 5407* (WU); Theri-Garhwal, Rhudughera, 30º23'N, 78º29'E, 20 July 1883, *Duthie 958* (G). **Nepal.** Bagmati: Rolwalin, Beding, 27º48'N, 86º12'E, 17 Aug. 1974, *Sacheret s.n.* (E); Nuwakot, Salme, Larkyap, 28º3'N, 85º8'E, 11 Aug. 1981, *Wiart 110* (E). Gandaki: Manangbhot, Naur Khola, orogr. linke Talseite SW des Kang Guru, 28º40'N, 84º1'E, 7 July 1955, *Lobbichler 97* (M).

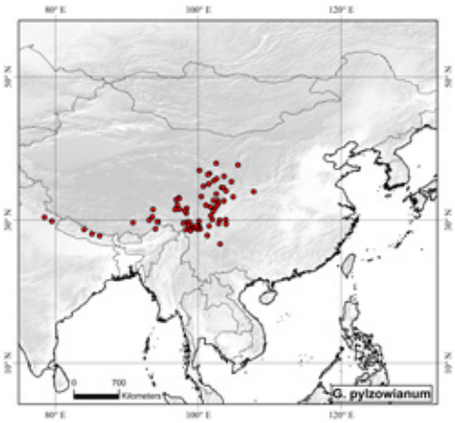


Fig. 161. Distribution of *Geranium pylzowianum*.

Discussion. Geranium pylzowianum is a small plant with a horizontal rootstock consisting of some subglobose tubercles joined by thin and long non-tuberous separations. It usually has 1(or 2) alternate leaves along the stem and some opposite at the inflorescence. In some specimens, cauline leaves are all opposite, and then the inflorescence is branched from the basal node monochasially. Occasionally some cymules arising directly from the rootstock have been observed. The indumentum is predominantly eglandular, but scattered glandular hairs usually appear on the stem base, petioles, and peduncles. The petals are hairy on the basal third

of the adaxial surface and have a rounded or slightly emarginate apex and a short claw.

Yeo (1992) recognized *Geranium orientalitibeticum* by its broad leaf blade segments, petals with a paler base, and longer stigmatic remnants. These features are, however, included in the variability of *G. pylzowianum*.

Geranium pylzowianum has sometimes been confused with *G. donianum* and *G. farreri,* which are quite similar in appearance but with rootstock without tubers and always opposite leaves. Additionally, in *G. pylzowianum* there are usually glandular hairs on the stem base, petiole, or inflorescence.

The Palustre Group—Members of this group are erect perennial herbs with an essentially eglandular indumentum, usually with connate stipules and sometimes with fasciculate roots, moderately divided leaves, lanceolate stamens, and large petals that are hairy usually on the base of the adaxial surface. The cymules are 2-flowered and usually arranged in a monochasial inflorescence.

Yeo (2002a: 101) assembled the *Palustre Group* with *G. palustre*, *G. wlassovianum*, *G. donianum*, *G. shikokianum,* and *G. koreanum*. He stated that is very closely related to the *Krameri Group* and that it is mainly distinguished from the latter by the absence of hairs over an extensive area of the adaxial surface (except in *G. koreanum*) of the petal. They share a predominantly eglandular indumentum and stipules at least partially connate, which suggest their close relation. *Geranium donianum* is transferred here to the *Pylzovianum Group* because of its close similarity with *G. farreri.*

52. Geranium koreanum Kom., Trudy Imp. S.-Peterburgsk. Bot. Sada 18(6): 433. 1901. Type locality: "Crescit in silvis montium secus fluvii Julu-dsian decursum medium. Legi: 1) 21/VIII 1897. Ad trajectum Andori; Koreae septentr. provincia Kenge, distr. Chu-czan. 2) 2/IX 1897. In valle fl. Jalu-dsian ad trajectum Czaschin-gan; provincia Kenge, distr. Czaschin (Cze-song)". Type: North Korea. Provincia Pennian, districtum Kenge, subdist. Chu-czan, flumen Amnok-gan (Jalu-dsian), Andori valley, 41°27'N, 126°38'E, 21 Aug. 1897, *V.L. Komarov s.n.* (lectotype, designated by Novoselova 2004: 506, LE!).

Geranium koreanum var. *hirsutum* Nakai, Bot. Mag. (Tokyo) 23: 102. 1909. *Geranium koreanum* f. *hirsutum* (Nakai) M. Kim, Korean Endemic Pl.: 548 (2017). Type locality: "Korea: Namsan 30. VII.1902. (T. Uchiyama) specimina testa 10" [according to Nakai in Bot. Mag. (Tokyo) 26: 259 (1912)]. Type: North Korea. Namsan, 38°08'N, 125°46'E, 30 July 1902, *T. Uchiyama s.n.* (lectotype, here designated, TI!).

Geranium knuthii Nakai, Bot. Mag. (Tokyo) 26: 263. 1912. Type locality: "Hab. In herbidis Corea-mediae 6. IX. 1901. n. 228., 4 IX. 1901. n. 230, in herbidis montium Hoang Haito VIII. 1906. n. 581. (Faurie)". Type: South Korea. Corea-mediae, 6 Sep. 1901, *U. Faurie 228* (lectotype, here designated, P-712098!; isolectotype, G!).

Geranium tsingtauense Y. Yabe, Prelim. Rep. Fl. Tsing-Tau-Reg.: 70, pl. 1 fig. 1. 1918. Type locality: "Loc. Laushan; Lauting". Type: China. Shandong, Laushan, Lauting, 36°11'N, 120°35'E, *Y. Yabe s.n.* (no original material located).

Geranium lauschanense R. Knuth, Repert. Spec. Nov. Regni Veg. 28: 6. 1930. Type locality: "China: Kiautschau, Kap Yaten (Zimmermann a. 1901 n. 456 sub G. krameri -- Typus! Kaiserliches Forstamt a. 1903 n. 623!). Lauschangebirge (Krug a. 1910 n. 380 sub G. Krameri -- Typus!). Chefoo Mts. (Faber a. 1891 sub G. Krameri!) -- Blühend und fruchtend September bis Oktober". Type: China. Shandong, Kiautschau, Kap Yaten, 36°07'N, 120°14'E, 28 July 1902, *C.R. Zimmermann 456* (lectotype, here designated, K-000729350!).

Geranium tsingtauense f. *album* F.Z. Li, Acta Phytotax. Sin. 22: 152. 1984. Type locality: "Shandong: Meng Shan, 14 VIII 1981, F. Z. Li 81050 (Type, in Herb. Fores. School, Shandong)". Type: China. Shandong, Meng Shan, 35°24'N, 117°57'E, 14 Aug. 1981, *F.Z. Li 81050* (holotype, SDFS).

Geranium taebaek S.J. Park & Kim, Korean J. Pl. Taxon. 27(2): 189, 191 fig. 1. 1997. Type locality: "Mt. Taebaek in Prov. Kangwondo, Korea. Sept. 12 1995. S. Park & Y. Kim 95015 (holotype, KUS: Isotypes, KUS)". Type: North Korea. Kangwondo, Mt. Taebaek, 38°36'N, 127°32'E, *S. Park & Y. Kim 95015* (holotype, KUS).

Perennial herbs, 34-87 cm tall. *Rootstock* 8-15 mm in diameter, ± vertical, not tuberculate, not turnip-shaped, with thickened roots along the rootstock. *Stem* erect, leafy, not rooting at nodes, stolons absent, without vegetative stems, with retrorse, appressed or patent, eglandular hairs 0.1-1.8 mm long. *Basal leaves* in a ± deciduous rosette, cauline leaves opposite; leaf laminas (6.3)7.6-9.2(10) cm long, 7.7-13.8 cm wide, not peltate, palmatifid [ratio main-sinus length/middle segment length = (0.65)0.72-0.79(0.80)], polygonal in outline, base cordate, not coriaceous, with nerves not projected, pilose, with appressed, eglandular hairs on both surfaces; segments 5, in 1 plane, middle segment rhombic, (10.7)16-19(26.1) mm wide at the base [ratio segment width at the base/middle segment length = (0.21)0.25-0.30(0.40)], (8)9-13(14)-lobed in distal half [ratio secondary sinus length/middle segment length = (0.09)0.13-0.15(0.20)]; petioles up to 21 cm long, without abscission zone, terete, not swollen, not deflexed in age, with retrorse, appressed or patent, eglandular hairs 0.2-1.7 mm long; stipules 5.9-15.6 mm long, 2.9-10.9 mm wide, broadly ovate, usually connate, papery, brown, with scattered, eglandular hairs on both surfaces and on the margin. *Inflorescence* a monochasial cyme; cymules 2-flowered, solitary [ratio cymule length/leaf length = (1.4)2-2.6(3)]; peduncles (25)39-87(103) mm long, with retrorse, appressed or patent, eglandular hairs 0.1-0.8 mm long; bracteoles 1.8-9.4 mm long, 0.5-2 mm wide, lanceolate, whorled; pedicels (14)20-33(36) mm long, with retrorse, appressed or patent, eglandular hairs 0.1-0.7 mm long. Flowers actinomorphic. *Sepals* (7.4)7.7-10(11.5) mm long, 2.5-4.6 mm wide, lanceolate, smooth, not accrescent, nerves 3-5, mucro (1.3)1.7-2.7(3.9) mm long [ratio mucro length/sepal length = 0.15-0.40], with antrorse, ± appressed, eglandular hairs 0.1-1 mm long on the abaxial surface, glabrous adaxially. *Petals* (11.9)14.7-16.5(21.1) mm long, (6.1)8.1-10.1(13)

mm wide, erect-patent, rounded, without claw, bright pink, hairy on the basal 1/3 of their adaxial surface and on the base of the abaxial surface, ciliate on the basal margin, with hairs 0.5-0.7 mm long. *Stamens* 10, both whorls bearing anthers; filaments (6.4)8.8-10.5(11) mm long, lanceolate, pink, almost glabrous, with scattered hairs 0.1-0.5 mm long on the abaxial surface and margin; anthers (1.9)2.1-2.8(2.9) mm long, blue. Nectaries 5, hemispheric, with a tuft of hairs at the top, dorsally glabrous. *Gynoecium* 7.5-13.3 mm long, dull red. *Fruit* (26.7)27.1-30.1(39.9) mm long, erect, discharge of seed-ejection type; mericarps 3.4-4.7 mm long, 2-2.4 mm wide, without a strand of fibers, not compressed at the apex, smooth, without basal beak, with a basal callus, without a basal prong, brown, with ± patent, eglandular hairs 0.2-0.4 mm long and, rarely, patent glandular hairs 0.6-0.8 mm long (mainly at the top of the mericarp); rostrum 17.4-23.8 mm long, with a narrowed apex 2.3-5.1 mm long, not twisted, with ± patent, eglandular hairs 0.1-0.3 mm long and, rarely, patent, glandular hairs 0.5-0.6 mm long; stigmatic remnants (4.8)5-6.3(8.8) mm long, with 5 glabrous lobes. *Seeds* 2.6-3 mm long, 1.3-2.2 mm wide, finely reticulate, uniformly colored, brown, glabrous. Cotyledons with entire margin. Fig. 162.

Pollen. *Geranium*-type (Lu & al. 1996: 320; Park & Kim 1997: 314).

Chromosome number. 2*n* = 28+2B.

Phenology. Collected in flower from June to November.

Distribution. This species ranges from eastern China (Anhui and Shandong) to South Korea (Fig. 163).

Habitat. Roadsides and open fields; 550-1800 m.

Additional specimens examined. **China.** Anhui: Wang Shan, Sze Tze Ling, 29°30'N, 118°8'E, 11 Aug. 1924, *Steward 7177* (US); Huang Shan, 31°5'N, 117°8'E, July 1925, *Ching 8647* (E); Nganhui, Huang Shan, 31°5'N, 117°8'E, 1930, *Wissmann 8647* (W). Shandong: Meng Shan, Fei Hsien, 35°32'N, 117°55'E, Aug. 1936, *Cheo & Yen 310* (GH, P, W); Qingdao co., Laoshan, 36°10'N,

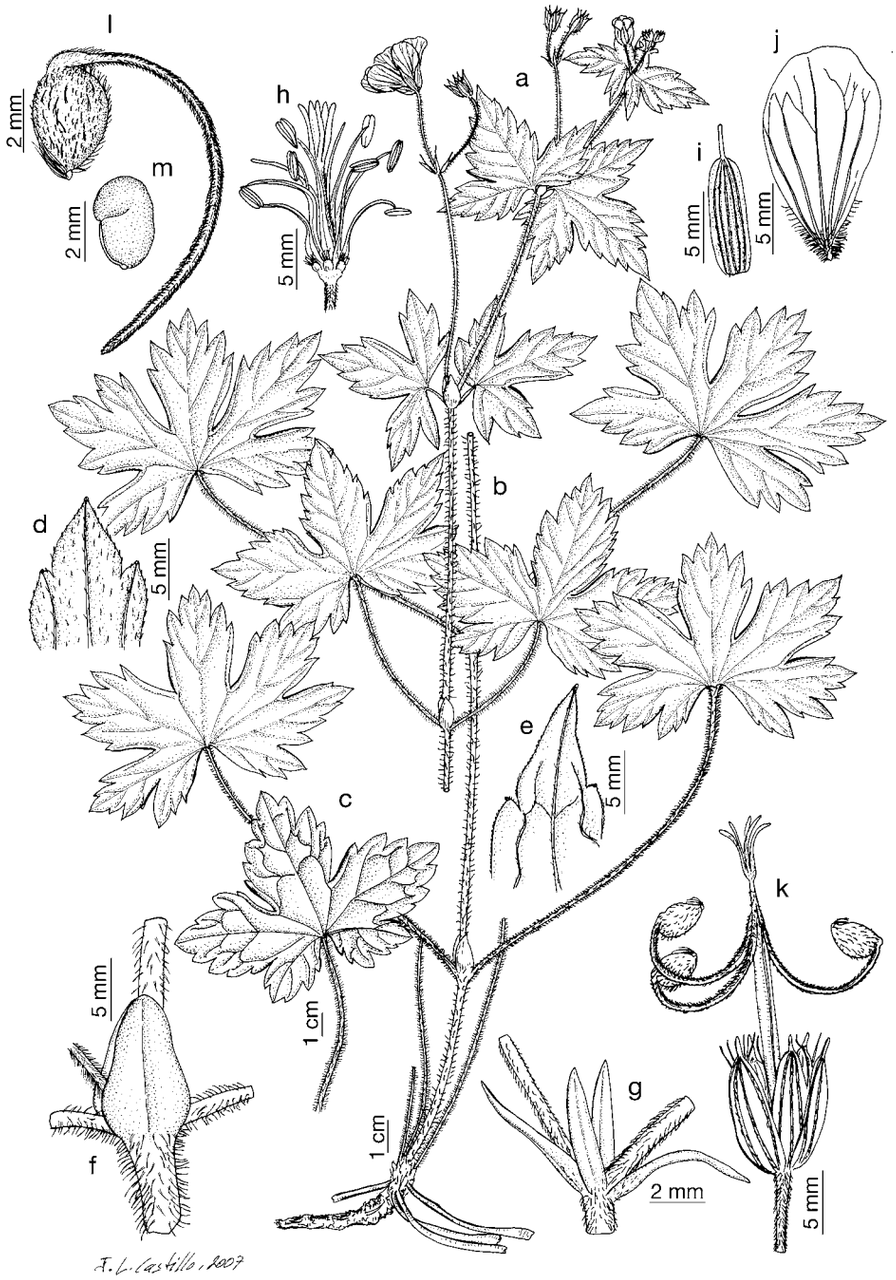


Fig. 162. *Geranium koreanum*. a, b. Habit. c. Cauline leaf. d. Leaf indumentum on adaxial side. e. Leaf indumentum on abaxial side. f. Stipules. g. Bracteoles. h. Flower without petals and sepals. i. Sepal. j. Petal. k. Fruit. l. Mericarp. m. Seed. (Based on: a, b, f, g, *Yamazaki 3282,* TI; c-e, h-j, *Uchiyama s.n., 30 July 1902*, TI; k-m, *Roh s.n., 25 Sep. 1990*, KUS).

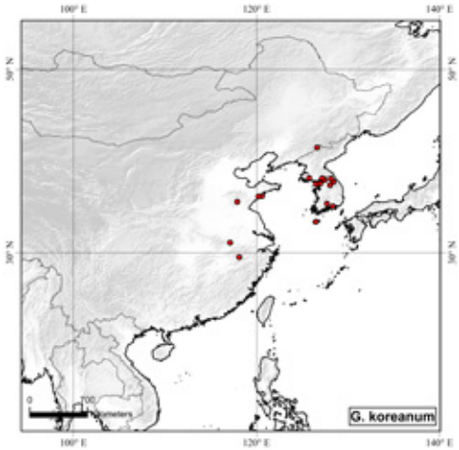


Fig. 163. Distribution of *Geranium koreanum*.

120°37′E, 19 Aug. 1998, *Hou Yuan-tong & al. 98225-4* (CAS). **South Korea.** Mt. Dae Woo, 24 June 1967, *Lee & Lee 203* (TI). Gangwon: Kangwon, Mt. Chiak, 37°21′N, 128°3′E, 29 Sep. 1973, *[illegible] 47904* (KUS); Kangwon-do, Pyongchang-gun, Yongpyong-myon, Mt. Kyebang, 37°43′N, 128°27′E, 25 Sep. 1998, *Ja-won Kim 39* (KUS); Kangwon, Mt. Taeam-san, 15 km N Inje, 38°3′N, 128°10′E, 4 July 1967 (KUS). Gyeonggi: Kyunggi-do, Kapyung-gun, Pukmyun, Mt. Myungji, 37°56′N, 127°29′E, 13 July 1995, *Roh 358* (KUS); Mt. Hyang No Bong, 38°6′N, 127°11′E, 17 Aug. 1967, *Lee & Lee 331* (TI). Incheon: Kangwon, Wonju-kun, Hungup-myon, Maeji-ri, Mt. Baekun, hoechon to Choduchi, 37°29′N, 126°31′E, 27 Aug. 1993, *Won 93-8-68* (KUS). Jeju: Quelpaert in herbifis Hallaisan, 33°22′N, 126°30′E, 7 Sep. 1908, *Taquet 608* (E); Quelpaert in herbifis Hallaisan, 33°22′N, 126°30′E, 7 Sep. 1908, *Taquet 609* (E, G); Seoul: Seul, Mt. Mamsan, Mt. Nam, 37°32′N, 126°59′E, 20 Sep. 1947, *Lee Yong s.n.* (MO); Seoul, Kyengki prov., 37°40′N, 127°0′E, 27 Aug. 1933, *Smith s.n.* (GH). South Gyeongsang: Jeonam, Mt. Chiri, Imgeolryong, 35°20′N, 127°43′E, 25 Sep. 1990, *Roh s.n.* (KUS).

Discussion. Geranium koreanum is an erect herb quite similar to *G. shikokianum*. Both species share a ± vertical rootstock with thickened roots along it (not fasciculate) and broad and connate stipules. The stipules of *G. koreanum* are noticeably broad, resembling those of *G. wallichianum*, a species of Central Himalayas that has been erroneously recorded in Korea (Knuth 1912: 195). The latter, however, has blackish filaments, anthers, and stigma, and broad bracteoles, not found in *G. koreanum*. The petals of *G. koreanum* are hairy on the basal third of the adaxial surface, while in *G. shikokianum* they are hairy only on the base. The latter has more deeply primary and secondary leaf sinus. The connate stipules of *G. maximowiczii* and *G. wlassovianum* are not so broad and are sometimes not fused at the apex.

53. Geranium maximowiczii Regel & Maack in Regel, Tent. Fl.-Ussur.: 39, tab. 3 figs. 4-6 c, f, g. 1861. Type locality: "Mandschurei: Ussuri-Gebiet bei Kap Khofäla und im Sumur-Gebirge am mittleren Ussuri (Maack nach Regel und Maack-Typus)". Type: Russia. Primorye, Sumur-Gebirge ad fl. Ussuri [Strelnikova ridge], 46°39′N, 134°07′E, 1859, *R. Maack s.n.* (lectotype, designated by Novoselova 1999: 131, LE!).

Geranium koraiense Nakai, Bot. Mag. (Tokyo) 25: 54. 1911. Type locality: "Korea: Kyöng-geui: Chemulpo Nov. 1. 1900 fructiferum (T. Uchiyama). Phyöng-an: Phyöngyang Aug. 25. 1909 floriferum (H. Imai)". Type: North Korea. Phyöng-an: Phyöngyang, 39°01′N, 125°45′E, 25 Aug. 1909, *H. Imai s.n.* (lectotype, here designated, TI!).

Geranium hattae Nakai, Bot. Mag. (Tokyo) 26: 263. 1912, ["Hattai"]. *Geranium vlassovianum* var. *hattae* (Nakai) Z.H. Lu, Bull. Bot. Res., Harbin 14: 360. 1994. Type locality: "Hab. Korea sept. Sandō 8. VII. 1909. (K. Hatta)". Type: North Korea. Sando, 40°39′N, 128°29′E, 8 July 1909, *K. Hatta s.n.* (lectotype, here designated, TI!).

Perennial herbs, 29-75 cm tall. *Rootstock* 5-12.7 mm in diameter, ± vertical, not tuberculate, not turnip-shaped, with a fascicle of long and thickened roots. *Stem* erect, leafy, not rooting at nodes, stolons absent, without vegetative stems, with patent (rarely retrorse, appressed), eglandular hairs 0.5-1.6 mm long. *Basal leaves* in a ± deciduous rosette, cauline leaves opposite; leaf laminas (3.1)5.8-7.2(9.7) cm long, 4.6-11.5 cm wide, not peltate, palmatifid [ratio main-sinus length/middle segment length = (0.59)0.66-0.78(0.84)], polygonal in outline, base cordate, not coriaceous, with nerves not projected, pilose, with appressed, eglandular hairs on both surfaces; segments 5, in 1 plane, middle segment rhombic, (8.3)11.8-16(19) mm wide at the base [ratio segment width at the base/middle segment length = (0.19)0.25-0.33(0.43)], (4)6-7(8)-lobed in distal half [ratio secondary sinus length/middle segment length = (0.11)0.15-0.18(0.25)]; petioles up to 11 cm long, without abscission zone, terete, not swollen, not deflexed in age, with usually patent, eglandular hairs 0.5-1.6 mm long; stipules 2.9-7 mm long, 1.2-3.5 mm wide, lanceolate, free or connate (at least at the base), papery, brown, with scattered, eglandular hairs on both surfaces and on the margin. *Inflorescence* a monochasial cyme; cymules 2-flowered, solitary [ratio cymule length/leaf length = (1.2)2-3.2(8.4)]; peduncles (35)54-101(146) mm long, with patent, eglandular hairs 0.2-1.6 mm long; bracteoles 1.7-6.7 mm long, 0.3-1 mm wide, lanceolate, whorled; pedicels (15.5)26-41(67) mm long, with usually retrorse, ± appressed, eglandular hairs 0.1-1.1 mm long. Flowers actinomorphic. *Sepals* (5.6)6.6-7.8(8) mm long, 1.8-3.6 mm wide, lanceolate, smooth, not accrescent, nerves 5, mucro (0.9)1.2-2.1(3.2) mm long [ratio mucro length/sepal length = 0.10-0.40], with antrorse, ± appressed, eglandular hairs 0.1-0.3 mm long and ± patent, eglandular hairs 0.3-2.2 mm long on the abaxial surface, glabrous adaxially. *Petals* (9.1)11.4-14.1(15.2) mm long, (3.7)5.2-7.1(9.5) mm wide, erect-patent, rounded, without claw, deep purple magenta, hairy on the base of the adaxial surface, ciliate on the basal margin, with hairs 0.4-0.9 mm long. *Stamens* 10, both whorls bearing anthers; filaments (6.1)6.8-8.2(9.6) mm long, lanceolate, pink, sparsely pilose on the abaxial surface, ciliate on the proximal half, with hairs 0.1-0.6(1.1) mm long; anthers (1.1)1.3-1.8(1.9) mm long, blue. Nectaries 5, hemispheric, glabrous. *Gynoecium* 5.8-9.8 mm long, purple. *Fruit* (22)23-28(33) mm long, erect, discharge of seed-ejection type; mericarps 2.8-4.2 mm long, 1.5-2 mm wide, without a strand of fibers, not compressed at the apex, smooth, without basal beak, with a basal callus, without a basal prong, brown, with ± patent, eglandular hairs 0.1-0.7 mm long and, usually, patent, glandular hairs 0.5-1 mm long (mainly at the top of the mericarp); rostrum 13.9-24.3 mm long, with a narrowed apex 1.9-4.5 mm long, not twisted, with ± patent, eglandular hairs 0.1-0.3 mm long and, usually, patent, glandular hairs 0.5-0.7 mm long; stigmatic remnants (3.3)3.6-4.6(5.3) mm long, with 5 glabrous lobes. *Seeds* 2.2-2.6 mm long, 1.2-1.7 mm wide, finely reticulate, uniformly colored, brown, gla-

brous. Cotyledons with entire margin. Fig. 164.

Pollen. *Geranium*-type (Lu & al. 1996: 320).

Chromosome number. 2*n* = 28.

Phenology. Collected in flower from May to September.

Distribution. This species ranges from eastern Siberia (Amur, Khabarovsk and Primorye) and Korea to northeastern China (Hebei, Heilongjiang and Nei Mongol) (Fig. 165).

Habitat. Meadows, shrubby formations and mixed and conifers forest edges; 0-1800 m.

Additional specimens examined. **China.** Hebei: Hsiao-wu-tai-shan, Yang-kia-p'ing, Tung-lin, 40º0'N, 115º30'E, 6 Sep. 1921, *Smith 1120* (UPS). Heilongjiang: Heilongjiang, 47º45'N, 128º0'E, 1959, *Mu Dan Jiang Exped. 117* (PE). Nei Mongol: ciudad Chifeng, distrito Ningwu, 42º16'N, 118º57'E, 1 Sep. 1997, *Liu Tiezhi 237* (MO); ciudad Hulun Bei Er, municipio E'Erguna, 48º57'N, 117º46'E, 2 Aug. 1951, *Wang Zhan 1650* (MO). **North Korea.** Ryanggang: prov. Cham-gion, flum. Jumin-yan, 41º12'N, 128º12'E, 10 June 1897, *Komarov 996* (FI, P, W). **Russia.** Amur: prov. Amuriensis, vallis Mutnaja non procul statione Paschkova, 48º52'N, 130º39'E, 2 July 1895, *Komarov 996b* (GH, TI); Amurskaia obl., Amur-Zejskoje plateau, 16 km on the route Zeja-Zolotaja gora, 54º16'N, 126º37'E, 27 Aug. 1957, *Nepli s.n.* (C). Khabarovsk: prov. Amur in monte Henzien prope stationen ferream Korfowskaja, 40 km procul ab oppidum Chabarowsk, 48º13'N, 135º4'E, 3 Aug. 1913, *Enander s.n.* (S); est. Jejtsir, km. 19 de la carretera de Vladivostok, 48º17'N, 135º5'E, 24 July 2004, *Tsirenova s.n.* (VLA); pueblo Petropavlovka, 48º41'N, 135º32'E, 17 June 1969, *Novichkova s.n.* (VLA); pueblo Vyatskoye del Amur, distrito Nanayskiy, 48º44'N, 135º43'E, 29 June 1972, *Baitsova s.n.* (VLA); pueblo Vyatskoye, 48º44'N, 135º43'E, 22 June 1973, *Bren s.n.* (VLA). Primorye: Vladivostok, 43º7'N, 131º55'E, May 1919, *Topping 2299* (US); Vladivostok, 43º7'N, 131º55'E, May 1919, *Topping 2377* (US); Vladivostok, 43º7'N, 131º55'E, May 1919, *Topping 2503* (US). **South Korea.** Gyeonggi: Jinsen, 37º27'N, 126º43'E, 11 Nov. 1900, *Uchiyama s.n.* (LD).

Discussion. Geranium maximowiczii is a species quite similar and sometimes difficult to differentiate from *G. wlassovianum.* Both share a short vertical rootstock with a fascicle of thickened roots, shallowly divided leaves,

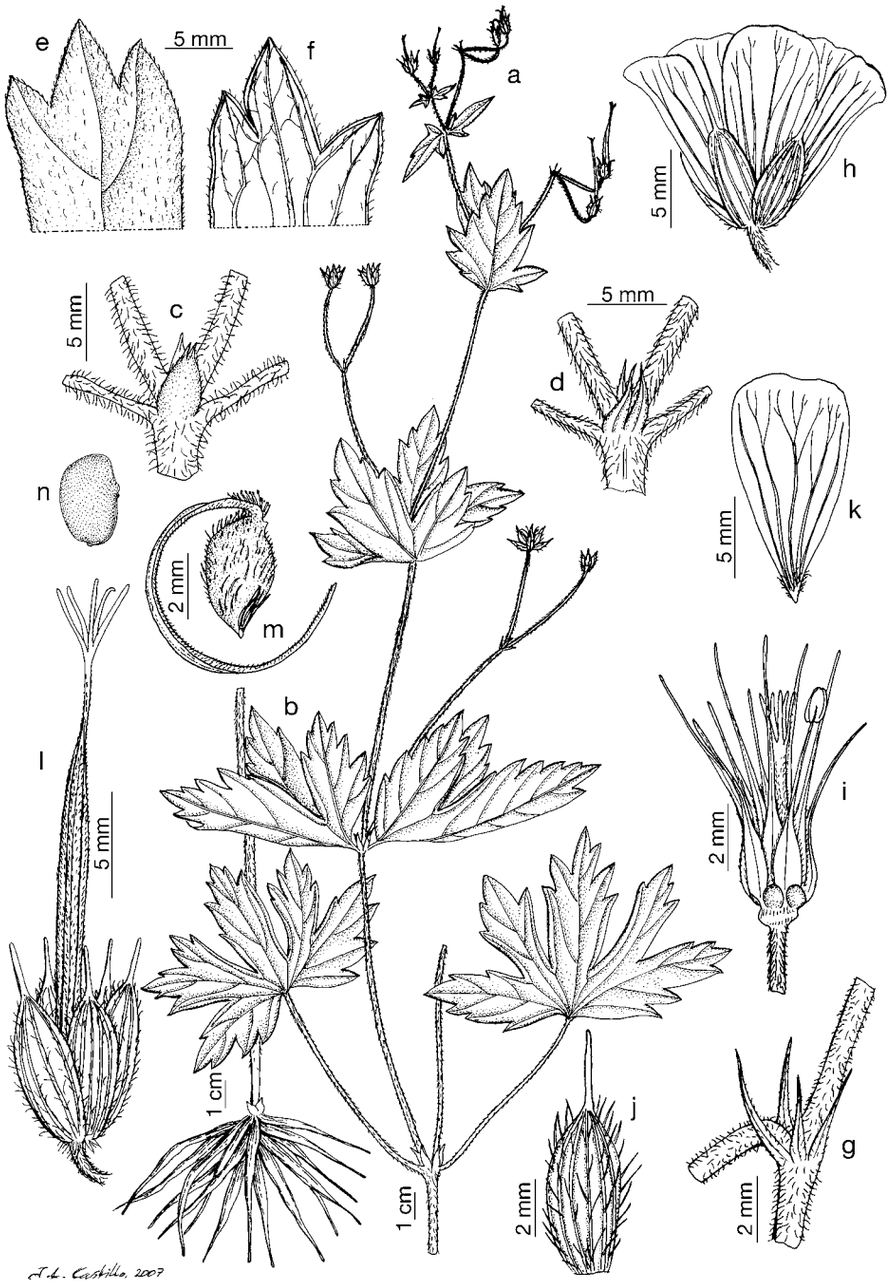


Fig. 164. *Geranium maximowiczii*. a, b. Habit. c, d. Stipules. e. Leaf indumentum on adaxial side. f. Leaf indumentum on abaxial side. g. Bracteoles. h. Flower. i. Flower without petals and sepals. j. Sepal. k. Petal. l. Fruit. m. Mericarp. n. Seed. (Based on: a, *Komarov 996,* GH; b, *Mu Dan Jiang Exped. 117,* PE; c-f, *Nakai 3628,* TI; g, l-n, *T. Z. Liu 237,* MO; h-k, *Hatta s.n., 8 July 1909*, TI).

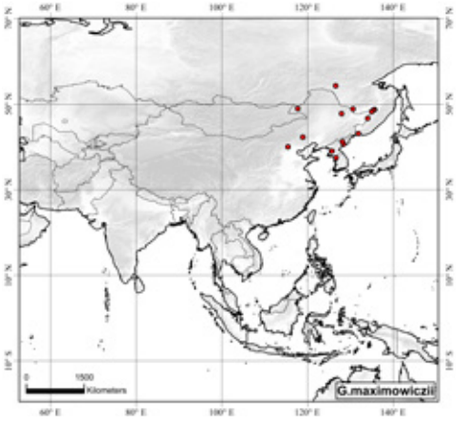


Fig. 165. Distribution of *Geranium maximowiczii*.

paler on the abaxial surface, and petals with hairs only on the base. Sepals, petals, and stigmatic remnants are shorter in *G. maximowiczii*, although with some overlap. Additionally, in G. *maximowiczii*, the anthers, gynoecium, fruit, and staminal filaments are shorter. The indumentum of staminal filaments varies in density but is never as dense as in *G. wlassovianum.* Hairs on the stem and inflorescence are a bit longer and, usually appressed.

54. Geranium palustre L., Cent. Pl. II: 25. 1756. Type locality: "Habitat in Russia, Germania". Type: "Habitat in Russia, Germania" (lectotype, designated by Novoselova 1998: 150, LINN 858.65 image!).

Geranium palustre var. *minus* Besser, Enum. Pl.: 28. 1822. *Geranium palustre* [C] *minus* (Besser) Graebn. in Asch. & Graebn., Syn. Mitteleur. Fl. 7(1): 22. 1913. Type locality: "In Volhynia". Type: Ukraine. Volhynia, 51º00'N, 26º00'E, *W.S. Besser s.n.* (lectotype, here designated, H-1293293 image!).

Geranium palustre var. *turfosum* Peterm., Fl. Lips. Excurs.: 510. 1838. *Geranium palustre* [F] *turfosum* (Peterm.) Graebn. in Ach. & Graebn., Syn. Mitteleur. Fl. 7(1): 22. 1913. Type locality: "in pratis turfosis ad pagum Schönfeld". Type: Germany. Saxony, Schönfeld, 51º17'N, 13º43'E, *W.L. Petermann s.n.* (no original material located).

Geranium duplicatum Kanitz, Linnaea 32: 567. 1864 Type locality: "Habitat in silvis Croatiae". Type: Croatia. *A. Kanitz s.n.* (no original material located).

Geranium palustre var. *tuberosum* Schur, Enum. Pl. Transsilv.: 137. 1866. *Geranium palustre* [B] *tuberosum* (Schur) Graebn. in Asch. & Graebn., Syn. Mitteleur. Fl. 7(1): 22. 1913. Type locality: "Auf Waldwiesen. Im jungen Wald bei Hermannstadt gegen Resinár. Aug.". Type: Romania. Hermannstadt, Resinár, 45º42'N, 24º04'E, *F. Schur s.n.* (no original material located).

Geranium palustre var. *subsylvaticum* Rupr., Mém. Acad. Imp. Sci. Saint Pétersbourg ser. 7 15(2): 266. 1869. *Geranium pratense* [F] *subsylvaticum* (Rupr.) Graebn. in Asch. & Graebn., Syn. Mitteleur. Fl. 7(1): 11. 1913. Type locality: "In promont. boreali: vallibus fl. Argun inter Schatojewsk et Kei flor. primis legit D. Bayern... fere eandem forman in sylvis pr. Weden alt. 390 hex. 24 Jun fl. primis D. Owerin. Indicatur in Radscha ad limites Imeretiae in m. Nakkerala ad pedem declivitatis borealis, alt. 575 hex. 11 Jun. (Radde p. 27; ibi 12 Sept. G. gracile Led. vidi). Ex Iberia a Wilhelms lectum vidit Ledebour". Type: Russia. Chechenia, Weden, 42º58'N, 46º05'E, 24 June 1861, *A.P. Owerin s.n.* (lectotype, here designated, LE!).

Geranium palustre var. *albiflora* Lange, Haandb. Danske Fl. ed. 4: 721. 1887. Type locality: [not indicated]. Type: Denmark. Without definite locality, *J. Lange s.n.* (no original material located).

Geranium palustre var. *nemorosum* Brügger ex Syr. & Petunn. in Syr., Ill. Fl. Mosk. Gub. 2: 325. 1907. *Geranium palustre* [E] *nemorosum* (Brügger ex Syr. & Petunn.) Graebn. in Asch. & Graebn., Syn. Mitteleur. Fl. 7(1): 22. 1913. Type locality: [not indicated]. Type: Russia?, *A.N. Petunnikov s.n.* (no original material located).

Geranium palustre var. *trifidum* Litv. ex Syr. & Petunn. in Syr., Ill. Fl. Mosk. Gub. 2: 326. 1907. *Geranium palustre* [G] *trifidum* (Litv. ex Syr. & Petunn.) Graebn. in Ach. & Graebn., Syn. Mitteleur. Fl. 7(1): 22. 1913. Type locality: [not indicated]. Type: Russia. Moskov, Pushkino, 55°59'N, 37°54'E, *A.N. Petunnikov s.n.* (lectotype, here designated, MW-0423367 image!).

Geranium palustre var. *glabrum* Murr, Allg. Bot. Z. Syst. 16: 186. 1910. *Geranium palustre* [D] *glabrum* (Murr) Graebn. in Asch. & Graebn., Syn. Mitteleur. Fl. 7(1): 22. 1913. *Geranium palustre* f. *glabrum* (Murr) Gams in Hegi, Ill. Fl. Mitt.-Eur. 4(3): 1694. 1924. Type locality: "Kitzbühel (Traunsteiner als G. palustre? var. glabra?)". Type: Austria. Kitzbühel, 47°27'N, 12°22'E, *J. Murr s.n.* (no original material located).

Geranium palustre var. *brachyanthum* Wacht. ex Murr, Neu. Übers. Bl.-Pfl. Vorarlberg: 186. 1923. Type locality: "Levner Weiher bei Feldkirch". Type: Austria. Feldkirch, 47°14'N, 9°36'E, *J. Murr s.n.* (no original material located).

Geranium palustre f. *lilacinum* Murr, Neu. Übers. Bl.-Pfl. Vorarlberg: 187. 1923. Type locality: "Tisis, Uebersaxen". Type: Austria. Tisis, 47°14'N, 9°34'E, 1 Aug. 1911, *J. Murr s.n.* (lectotype, here designated, IBF-120750 image!).

Geranium palustre f. *albiflorum* Panţu, Mem. Sect. Şti. Acad. Română 8: 57. 1931. Type locality: "... a acestei noi forme de către amicul nostru Dr. Marcel Brandza... înjudeţul Neamţu, la Mânăstirea Neamţului, unde creşte în abundenţă". Type: Romania. Neamţu, la Mânăstirea Neamţului, 47°16'N, 26°12'E, *Z. Panţu s.n.* (no original material located).

Geranium palustre f. *obtusatum* Németh, Contr. Bot. Cluj 2(2): 1, figs. 1A, 1B & 2A. 1933. Type locality: "Hab. Romania, distr. Mureş. Mont. Gurghiensis. In pratis paulo humidis soli expositis, ad rivum Gurghium; sparse in societate Geranii pratensis. Ad pagum Lăpuşna, alt. ca. 8000 m. s. m., solo andesitico". Syntypes: Romania. Mures, mont Gurghiensis, ad rivum Gurghium, 46°46'N, 24°51'E, *F. Németh s.n.* (no original material located); Romania. Mures, pagum Lăpuşna, 46°46'N, 25°13'E, *F. Németh s.n.* (no original material located).

Perennial herbs, 30-78 cm tall. *Rootstock* 10-15 mm in diameter, ± horizontal, not tuberculate, not turnip-shaped, with thickened roots along the rootstock. *Stem* erect, leafy, not rooting at nodes, stolons absent, without vegetative stems, with patent to retrorse, eglandular hairs 0.3-1.6 mm long. *Basal leaves* in a persistent rosette, cauline leaves opposite; leaf laminas (4.8)5.7-9.4(10.8) cm long, 5.9-12.8 cm wide, not peltate, palmatifid [ratio main-sinus length/middle segment length = (0.71)0.74-0.81(0.93)], polygonal in outline, base cordate, not coriaceous, with nerves not projected, pilose, with appressed, eglandular hairs on both surfaces; segments 5, in 1 plane, middle segment rhombic, (6.1)9-14.8(17.9) mm wide at the base [ratio segment width at the base/middle segment length = (0.13)0.18-0.23(0.31)], (6)9-14(17)-lobed in distal half [ratio secondary sinus length/middle segment length = (0.20)0.24-0.26(0.29)]; petioles up to 30 cm long, without abscission zone, terete, not swollen, not deflexed in age, with patent to retrorse, eglandular hairs 0.6-1.6 mm long; stipules 4.8-13.4 mm long, 1.3-4.5 mm wide, lanceolate, connate (at least at the base), papery, brown, subglagrous on both surfaces, ciliate on the margin. *Inflorescence* a dichasial cyme with monochasial branches; cymules 2-flowered, solitary [ratio cymule length/leaf length = (1.5)2.7-3.2(3.6)]; peduncles (27)48-89(179) mm long, with patent to retrorse-appressed, eglandular hairs 0.2-1.2 mm long; bracteoles 4.3-14.7 mm long, 0.6-1.8 mm wide, lanceolate, whorled; pedicels 27-40(49) mm long, with retrorse, ± appressed, eglandular hairs 0.2-1.3 mm long. Flowers actinomorphic. *Sepals* (7)7.6-8.6(8.9) mm long, 2.8-3.7 mm wide, lanceolate, with thickened nerves, not accres-

cent, nerves 5, mucro (1.6)1.8-2.2(2.8) mm long [ratio mucro length/sepal length = 0.21-0.37], with antrorse, appressed, eglandular hairs 0.2-0.6 mm long on the abaxial surface (mainly on the nerves), glabrous adaxially. *Petals* (13.8)14.4-16.5(17.6) mm long, (6.3)8.2-8.8(9.7) mm wide, erect-patent, rounded, without claw, purple, hairy on the base of the adaxial surface, glabrous abaxially, ciliate on the basal margin, with hairs 0.5-1.3 mm long. *Stamens* 10, both whorls bearing anthers; filaments (5.2)7-8.2(8.5) mm long, lanceolate, purple, pilose on the abaxial surface, ciliate on the proximal half, with hairs 0.2-0.4 mm long; anthers (1.2)2-2.1 mm long, blue or cream. Nectaries 5, hemispheric, glabrous. *Gynoecium* 5.6-7.9 mm long, purple. *Fruit* (25)26-28(29) mm long, erect, discharge of seed-ejection type; mericarps 3.1-3.6 mm long, 1.4-2.1 mm wide, without a strand of fibers, not compressed at the apex, smooth, without basal beak, with a basal callus, without a basal prong, brown, with erect-patent, eglandular hairs 0.4-0.7 mm long and patent, glandular hairs 0.6-0.8 mm long (mainly at the top of the mericarp); rostrum 16-20 mm long, with a narrowed apex 2.3-3.4 mm long, not twisted, with erect-patent, eglandular hairs 0.1-0.3 mm long; stigmatic remnants 2.7-4.1 mm long, with 5 glabrous lobes. *Seeds* 2.1-2.7 mm long, 1.3-1.8 mm wide, finely reticulate, uniformly colored, brown, glabrous. Cotyledons with entire margin. Figs. 166, 167.

Pollen. *Geranium*-type (Bortenschlager 1967: 431; Park & Kim 1997: 314; Stafford & Blackmore 1991: 72).

Chromosome number. 2*n* = 28, 56.

Phenology. Collected in flower from June to September.

Distribution. This species ranges from northern and central Europe to southern Caucasus (Fig. 168).

Habitat. Roadsides, moist meadows, grassy marshes, streams and shrubby formations; 100-2200 m.

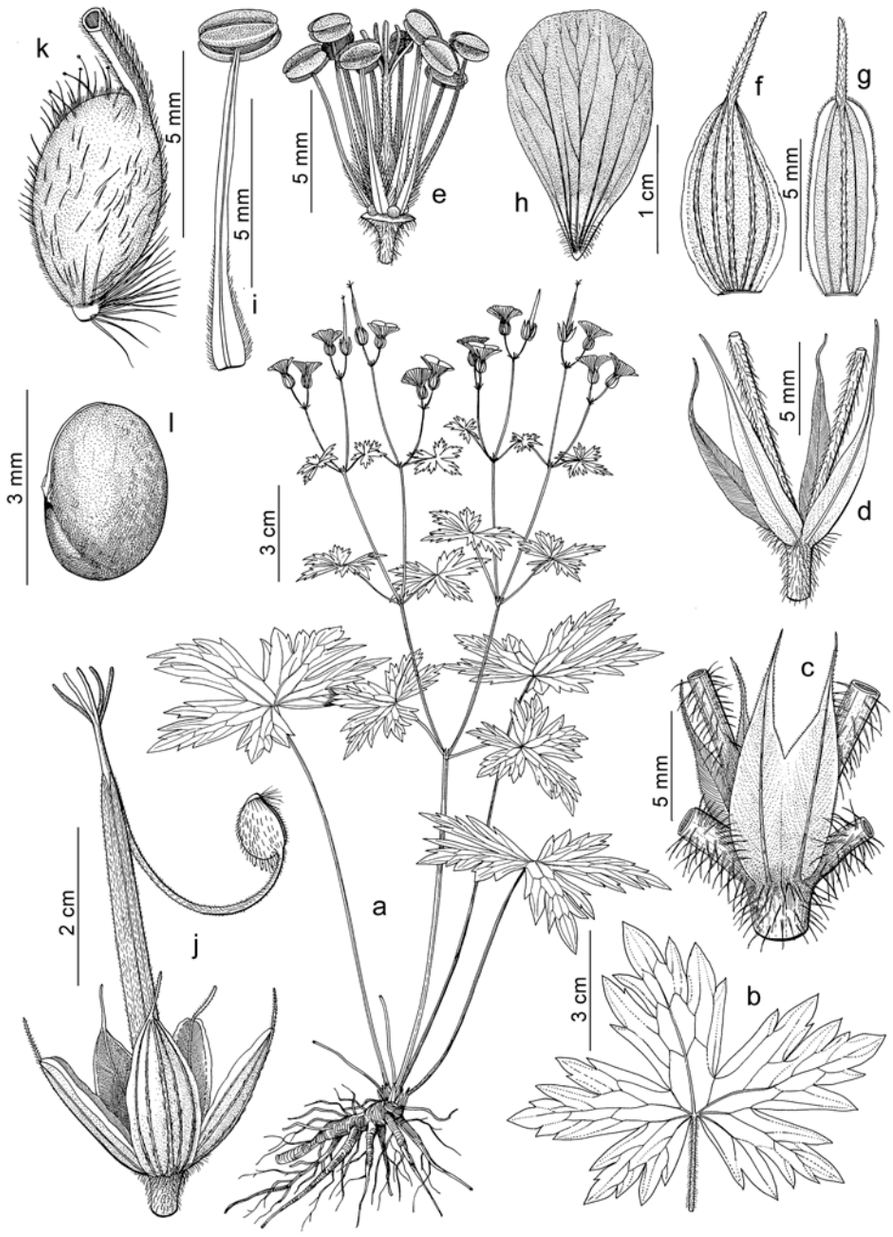


Fig. 166. *Geranium palustre* l. a. Habit. b. Leaf. c. Stipules. d. Bracteoles. e. Flower without petals and sepals. f, g. Sepals. h. Petal. i. Stamen. j. Fruit. k. Mericarp. l. Seed. (Based on: a, e, i, *Alarcón & al. 282,* MA; b-d, *Barta s.n.,* MA-874114; f-h, j, k, *Staudinger 98/45e1,* MA; l, *Castroviejo 15640,* MA).

Representative specimens examined. **Armenia.** Gegharkunik: Nor-Bajazet, in jugo Karni-jarych, 40°21'N, 45°7'E, 15 Aug. 1928, *Zedelmejer & Gejdeman s.n.* (LE). Lori: 8.7 km WNW of Stepanan, between Urasar and Katnaghbjur, 41°1'N, 44°16'E, 30 Aug. 2012, *Vitek & al. 12-0397* (MA). **Austria.** Carinthia: 1 km N Gundersheim, Gaitaler Alpen, Kärnten, 46°39'N, 13°7'E, 15 Sep. 1998, *Staudinger 98/45e1* (MA). Styria: inter Fürstenfeld et Burgau, 47°8'N, 16°6'E, Sep., *Heinrich s.n.* (FI, MA). Upper Austria: Aistersheim, 48°11'N, 13°44'E, 25 Sep. 1879, *Keck s.n.* (MA, FI); valle Hainzenbach pr. Linz, 48°19'N, 13°59'E, *Rauscher s.n.* (P, FI). **Azerbaijan.** Absheron: Baku, Kuba, inter Kuzun et Sudur, 41°21'N, 48°30'E, 2 July 1899, *Alexeenko 7337* (LE). **Bulgaria.** Sofia: montañas de Rila, Markoudjika, Mt. Musala, 42°16'N, 23°36'E, 9 July 2004, *Alarcón & al. 282* (MA); Palakaria, Krac potoceta, S. Siroki, prodanovci, 42°25'N, 23°32'E, 29 June 2002, *Petrova s.n.* (SOM). **Czech Republic.** Central Bohemian: pr. Pruhonice, 50°0'N, 14°33'E, 1 Sep. 1958, *Nitka s.n.* (MA); Jicin, entre Stre Hom y castillo de Kost, 50°28'N, 15°7'E, 7 Sep. 2000, *Cas-*

troviejo 15640 (MA). Plzeň: Bruck, 49º50'N, 12º44'E, 1 Aug. 1926, *Wihan s.n.* (PR). **Denmark.** Sjælland: Bønned, island of Falster, 54º48'N, 11º58'E, 25 Aug. 1967, *Hansen s.n.* (MA); Zealand, E of Humlebjerg, Haraldsted So, Ringsted, 55º29'N, 11º46'E, 19 July 1969, *Svendsen s.n.* (MO). **Finland.** Kanta-Häme: Tavastia, 60º55'N, 24º20'E, 1868, *Lang s.n.* (MA). Southwest Finland: Fennoscandia E, Isthmus karelicus, Uusikirkko, Kaukjärvi, 60º45'N, 21º35'E, 6 July 1937, *Cantell s.n.* (MA); Hattula, Ihalempi, 60º45'N, 21º35'E, 2 July 1983, *Lampinen 4046* (LE). **France.** Auvergne-Rhône-Alpes: Haute Savoie, Champagne, 45º20'N, 6º20'E, 22 Aug. 1902, *Vendrely s.n.* (P); Vichy, 46º7'N, 3º25'E, 1852, *Demenuay s.n.* (P). Grand Est: Vosges, Bussang, 47º53'N, 6º51'E, *Godron 214* (P); Alsace, Elsenheim, 48º9'N, 7º29'E, 20 July 1967, *Gavelle s.n.* (MA); Haut Rhin, entre Illhaeusern et Elsenheim, 48º11'N, 7º26'E, 13 Aug. 1968, *Rastetter s.n.* (MPU). **Georgia.** Mtskheta-Mtianeti: along the Georgian Military road in Krestovi Pass, N of Tibilisi, 42º30'N, 44º27'E, 31 July 1984, *McNeal & al. 283* (MO). Samtskhe-Javakheti: Village Bakuriani, 41º46'N, 43º32'E, 27 June 1916, *Kozlowsky s.n.* (MA). Tbilisi: inter Wladokawkas et Tiflis, 41º41'N, 44º50'E, 21 Aug. 1861, *Ruprecht s.n.* (LE). **Germany.** Bavaria: Bayern, Sumpfige Wiesen am Ostuferdes Maisinger Sees, 47º58'N, 11º16'E, 20 June 1964, *Podlech s.n.* (MA). Brandenburg: pr. Poterdam, 52º24'N, 12º33'E, 29 May 1920, *Gorg s.n.* (BC). Hesse: Fulda, nasse Wiesen in Salzschlirf, 50º37'N, 9º30'E, July, *Freiberg s.n.* (MA). North Rhine-Westphalia: Hilden, regio de Fulda, 51º10'N, 6º55'E, 4 Aug. 1975, *Vigo & Anglada s.n.* (BC). Saxony-Anhalt: Magdeburg, 52º7'N, 11º37'E, July, *Ohl s.n.* (BC). **Greece.** Central Macedonia: Serron, Ep. Sintikis, Mt. Belles (Kerkini), NNE of the village of Ano Poroia, just below the military post of Kalambaka along road to Dimiria, 41º19'N, 22º56'E, 3 Aug. 1979, *Strid & Papanicolaou 16199* (G). **Hungary.** Pest: Budapest, 47º30'N, 19º5'E, *Láng s.n.* (MPU). **Italy.** Piedmont: Piemonte, Folsano, presso la cascina Chammenderio, 44º32'N, 7º43'E, 7 Sep. 1909, *Ferrari s.n.* (FI). Trentino-Alto Adige: Venezia tridentina, Alto Adige, Vipiteno, Pruno, 46º52'N, 11º26'E, 22 July 1950, *Zenari s.n.* (FI). Veneto: San Pietro al Natisone, 46º7'N, 13º29'E, 27 June 1900, *Minio s.n.* (FI); Veneto, tra Trausaequa e Campolongo-Santo Stefano, 46º33'N, 12º34'E, 6 June 2011, *Argenti s.n.* (FI). **Lithuania.** Utena: Zarasai, Laukesa, 55º44'N,

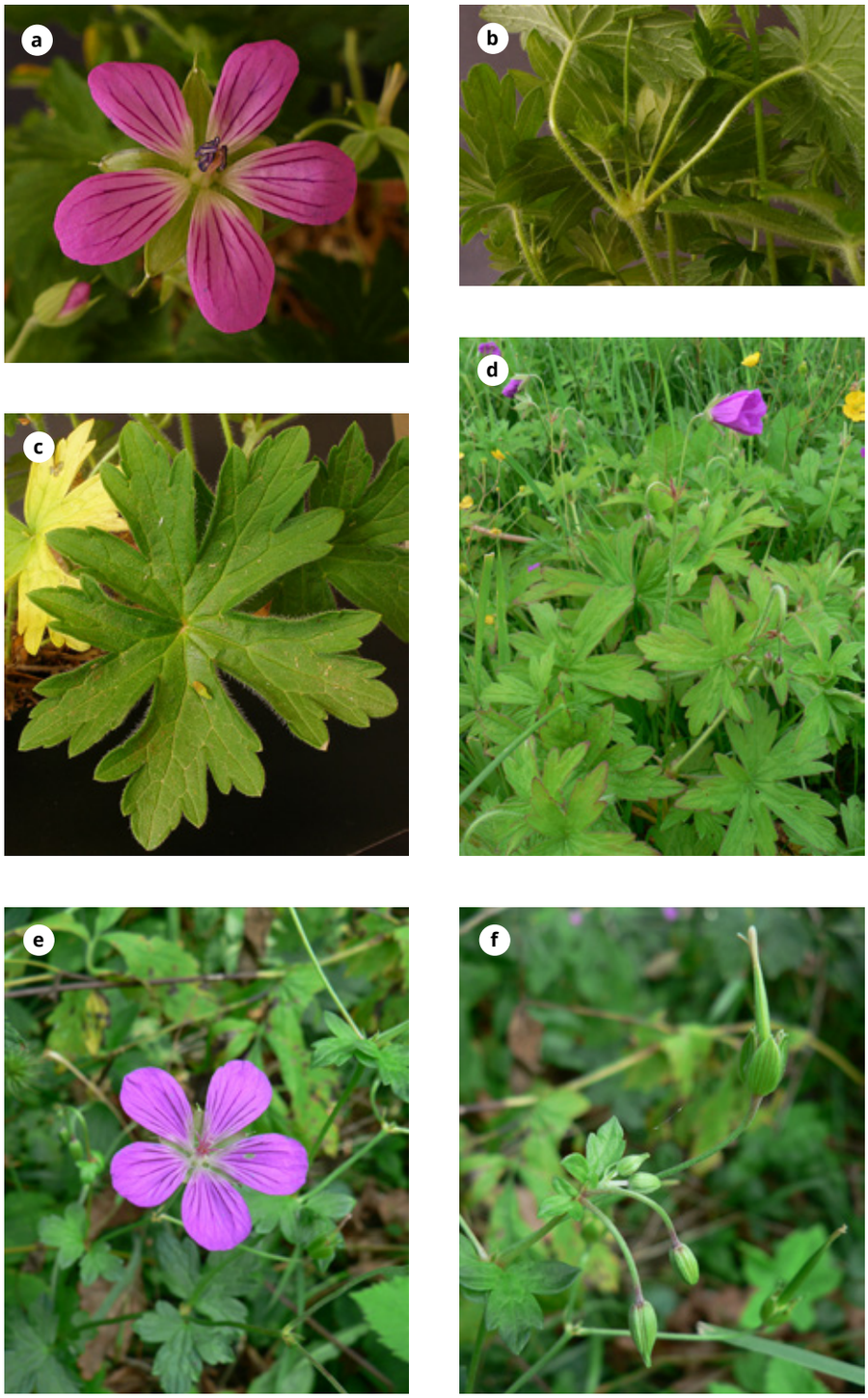


Fig. 167. *Geranium palustre* (Based on: a-c, *Alarcón & al. 282,* MA; d, *Calvo 4905,* MA, photo: J. Calvo; e, f, *Calvo 4937*, MA, photo: J. Calvo).

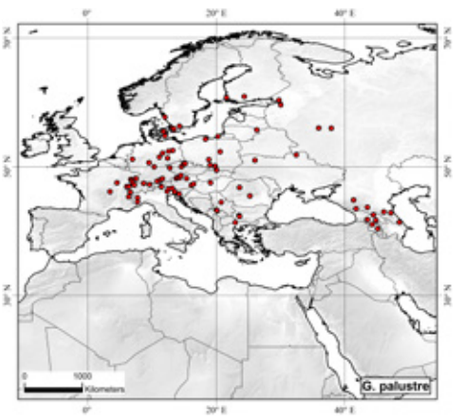


Fig. 168. Distribution of *Geranium palustre*.

26º17'E, 6 Aug. 2010, *Calvo 4937* (MA). **Poland.** Lesser Poland: Orawa, Podszkle-Novy Targ, 49º28'N, 20º1'E, 6 Aug. 1965, *Guzikowie s.n.* (MO); Szczyglice, Cracoiensis districtus, 50º5'N, 19º48'E, 4 Oct. 1973, *Sidzina & Kita s.n.* (MA). Łódź: Slask Dolny, Lisowiec gm. Scinawa, 51º6'N, 18º49'E, 28 July 2006, *Koziol 1611* (FI). Masovian: Puszcza Kampinoska, 52º20'N, 20º35'E, 1952, *Kobenska s.n.* (WA). Pomeranian: Pomorze Zachodnie, Przelom Raduni, Babi Dol, 54º17'N, 18º18'E, 13 July 1971, *Stasiak s.n.* (MA). **Romania.** Nord-Vest: Transilvania, Cluj, 46º46'N, 23º36'E, July, *Prodan 1504* (MO, RO). Sud-Muntenia: Arges, Gorges de Dimbovicioara, 45º27'N, 25º13'E, 9 July 1998, *Güemes & Bacchetta 2425* (MA). **Russia.** Chechenia: Weden, 42º58'N, 46º5'E, 24 June 1861, *Owerin s.n.* (LE). Dagestan: Dagestan, Kasi-Kumuch, Chelusun, 42º50'N, 47º9'E, 13 July 1897, *Alexeenko s.n.* (LE). Kabardino-Balkaria: Terek, Nalczik, Baksan, 43º41'N, 43º31'E, 15 July 1896, *Alexeenko 7340* (LE). Kaliningrad: Kalininskaja oblast, Vyisni Volotsek-Valdai, Kolomno Kostea, 54º42'N, 20º13'E, 29 June 1969, *Rintanen s.n.* (H). Karachayevo-Cherkasskaiya: Teberda, 43º27'N, 41º44'E, 6 July 1905, *Litvinov 340* (LE). Moscow: Mosqua, Volokolamak, pr. Terjaevo, 56º1'N, 35º56'E, 27 July 1973 (MO). St. Petersburg: Leningrad region, pr. Gatchina, 59º37'N, 30º1'E, 23 June 2010, *Calvo 4905* (MA). Stavropol: Stavropolsky kray, Urupskiy r-n, Geplaia, 44º49'N, 41º22'E, 19 Aug. 1990, *Menickiy & al. 31* (LE). **Serbia.** Belgrade: Makovica, 44º29'N, 20º44'E, 1921, *Vandas s.n.* (PR). Šumadija and Western Serbia: ad rivi Zaljevskaja Reka apud vicum Dujka, pr. oppido Sjenica, 43º12'N, 20º3'E, 15 June 1930, *Novak 3257* (PRC); ad rivuli Studenicka, ad montium Javor, N oppido Sjenica, 43º16'N, 20º0'E, 11 July 1930, *Novak 3002* (PRC). **Slovenia.** Inner Carniola–Karst: Carniolia, Adelsburg, 45º46'N, 14º12'E, *Huguenin s.n.* (MPU). **Sweden.** Skåne: Lund, 55º40'N, 13º21'E, 19 Aug. 1849, *Zetterstedt s.n.* (P); Scania, Stehag, 55º54'N, 13º23'E, Aug. 1920, *Kinnader s.n.* (P); Skane, Södra Sandby, Linnebjär, Räften, 56º19'N, 14º15'E, 1927, *Linders s.n.* (P). Västra Götaland: Gothoburgi, 57º43'N, 11º58'E, *Leffler s.n.* (P). **Switzerland.** Bern: Lomboing a Orvin, Jura Bernois, 47º9'N, 7º12'E, 5 July 1888, *Tripet s.n.* (MA). Zürich: Zurich, 47º25'N, 8º40'E, 29 June 1917, *Braun-Chur s.n.* (BC). **Ukraine.** Chernivtsi: Czernogov, pr. Borsna, Evlachovka, 51º50'N, 32º26'E, 28 Aug. 1907, *Lochanjko 3433* (MO).

Discussion. Geranium palustre is well characterized by its sepals with five thickened nerves, that have short, antrorse-appressed, eglandular hairs mainly on nerves. The indumentum of stem, petioles, and peduncles consists of spread, eglandular hairs, while on pedicels these hairs are usually retrorse-appressed ones. Only on the apex of the mericarps have some glandular hairs been found. *Geranium palustre* is an erect herb with a thick and long, horizontal rootstock that has thickened roots along it. It has glabrous nectaries, opposite leaves, and connate stipules for at least a part of their length.

Geranium palustre resembles *G. wlassovianum* in general appearance. The latter has, however, a fascicle of long and thickened roots on a short and vertical rootstock, hairy nectaries, and longer peduncles, sepals, petals, stamens, and fruits, although with some overlap.

---

55. Geranium shikokianum Matsum., Bot. Mag. (Tokyo) 15: 123. 1901. Type locality: "Hab. in Japonia: insula Shikoku, montibus Ishizuchi et Tebako leg. S. Yano anno 1890. Fl. et fr. Augusto". Type: Japan. Shikoku, montibus Ishizuchi et Tebako, 33°46'N, 133°07'E, Aug. 1890, *S. Yano s.n.* (no original material located). Japan. Shikoku, Ehime Prefecture, Kamiukena-gun, Omogo-mura, Mt. Ishizuchi, en route from Tengudake to Omogo-kei, 33°46'N, 133°07'E, 5 Aug. 1985, *M. Takahashi 2070* (neotype, designated by Aedo 2017a: 28, TI!; isoneotypes, GH!, MO-3619891!).

Geranium shikokianum var. *quelpaertense* Nakai, Bot. Mag. (Tokyo) 26: 260. 1912. Type locality: "Hab. Korea: in agris Quelpaeert X. 1907. n. 189., in herbidis Mokan Quelpaert VII. 1907 n. 1758, in herbidis Hallaisan 1500 m. VIII. 1907. n. 1761., in Quelpaert. X. 1906 n. 6. (Faurie). Quelpaert 1911 (T. Mori)". Type: South Korea. Mokan, Quelpaert [Jeju-do], 33°30'N, 126°30'E, July 1907, *U. Faurie 1758* (lectotype, designated by Aedo 2017a: 28, P!; isolectotype, G!).

Geranium yoshiianum Koidz. in Matsum., Ic. Pl. Koisikav. 3, tab. 192. 1917. *Geranium shikokianum* var. *yoshiianum* (Koidz.) H. Hara, J. Jap. Bot. 22: 171. 1948. Type locality: "Kiusiu: insl. Yakushima (Prov. Ohsumi) (leg. Y. Yoshii, Rigakushi.)". Type: Japan. Kyūshū, Ohsumi, Yakushima, 30°20'N, 130°30'E, *Y. Yoshii s.n.* (lectotype, designated by Aedo 2017a: 28, TI!).

Geranium kai-montanum Honda, Bot. Mag. (Tokyo) 44: 317. 1930. *Geranium shikokianum* var. *kai-montanum* (Honda) Honda & H. Hara, J. Jap. Bot. 12: 38. 1936. Type locality: "Hondo: in monte Mitsu-toge, prov. Kai (K. Hisauchi, anno 1928); ibidem (M. Honda, anno 1929)". Type: Japan. Honshū, Hondo, Kai, in monte Mitsu-toge, 35°33'N, 138°49'E, 27 Aug. 1928, *K. Hisauchi s.n.* (lectotype, designated by Aedo 2017a: 28, TI!).

Geranium shikokianum var. *yamatense* H. Hara, J. Jap. Bot. 12: 38 fig. 26C. 1936. Type locality: "Hab. Honshu: prov. Yamato: in monte Ômine (Z. Tashiro-Aug. 24, 1929-type)". Type: Japan. Honshū: Yamato, in monte Omine, 34°15'N, 135°56'E, 24 Aug. 1929, *Z. Tashiro s.n.* (lectotype, designated by Aedo 2017a: 28, KYO!).

Geranium shikokianum f. *plenum* Himaya, J. Jap. Bot. 26: 156. 1951. Type locality: "Hab. Hondo: in monte Mitsutoge, prov. Kai (S. Tanabe, Sept. 27, 1949)". Type: Japan. Honshū, Prov. Kai, in monte Mitsutoge, 35°33'N, 138°48' E, 27 Sep. 1949, *S. Tanabe s.n.* (no original material located).

Perennial herbs, 30-60(80) cm tall. *Rootstock* 6.1-9.3 mm in diameter, ± vertical, not tuberculate, not turnip-shaped, with thickened roots along the rootstock. *Stem* erect, leafy, not rooting at nodes, stolons absent, without vegetative stems, with patent to retrorse, eglandular hairs 0.6-1.2 mm long. *Basal leaves* in a ± deciduous rosette, cauline leaves opposite; leaf laminas (2.6)4.6-7.4 cm long, (3.1)5.8-10.5 cm wide, not peltate, palmatifid [ratio main-sinus length/ middle segment length = (0.74)0.79-0.84(0.87)], polygonal in outline, base cordate, not coriaceous, with nerves not projected, pilose, with appressed, eglandular hairs on both surfaces; segments 5, in 1 plane, middle segment rhombic, (3.6)8.5-10.5(12.1) mm wide at the base [ratio segment width at the base/ middle segment length = (0.15)0.18-0.22(0.30)], (7)9-13(17)-lobed in distal half [ratio secondary sinus length/ middle segment length = (0.17)0.21-0.25(0.31)]; petioles up to 17 cm long, without abscission zone, terete, not swollen, not deflexed in age, with retrorse, appressed or patent, eglandular hairs 0.4-1.3 mm long; stipules 4.1-13 mm long, 3.6-9.4 mm wide,

broadly ovate, connate, papery, brown, glabrous on both surfaces, sometimes with some short ciliae. *Inflorescence* a monochasial cyme; cymules 2-flowered, solitary [ratio cymule length/leaf length = (1.3)1.9-2.5(3.1)]; peduncles (27)42-85(115) mm long, with retrorse, appressed or patent, eglandular hairs 0.2-1 mm long; bracteoles 3.2-9.3 mm long, 1-2.9 mm wide, lanceolate, whorled; pedicels (14)20-33(44) mm long, with retrorse, appressed or patent, eglandular hairs 0.2-1 mm long. Flowers actinomorphic. *Sepals* (6.1)7.4-8.6(9.8) mm long, 2.5-3.8 mm wide, lanceolate, smooth, not accrescent, nerves 3-5, mucro (1.1)1.5-2.4(3.2) mm long [ratio mucro length/sepal length = 0.14-0.37], with patent, eglandular hairs 0.4-1.6 mm long on the abaxial surface, glabrous adaxially. *Petals* (11.9)13-16.6(19.3) mm long, 6.2-11(12.6) mm wide, erect-patent, rounded (rarely retuse or lobed), without claw, purple, glabrous on both surfaces, rarely with some hairs on the base of the adaxial surface, ciliate on the basal margin, with hairs 0.6-1.1 mm long. *Stamens* 10, both whorls bearing anthers; filaments (5.4)6.7-7.9(9) mm long, lanceolate, white, with scattered hairs 0.1-0.4 mm long on abaxial surface and margin; anthers (1.7)1.8-2.3(2.4) mm long, purple. Nectaries 5, hemispheric, with a tuft of hairs at the top, dorsally glabrous. *Gynoecium* 6.1-9.5 mm long, unknown color. *Fruit* 26.2-32(33.6) mm long, erect, discharge of seed-ejection type; mericarps 3.6-4.8 mm long, 2-2.6 mm wide, without a strand of fibers, not compressed at the apex, smooth, without basal beak, with a basal callus, without a basal prong, brown, with ± patent, eglandular hairs 0.3-0.8 mm long and, usually, patent glandular hairs 0.5-1 mm long (mainly at the top of the mericarp); rostrum 17-21.8 mm long, with a narrowed apex 1.4-3.9 mm long, not twisted, with ± patent, eglandular hairs 0.1-0.3 mm long and, rarely, patent glandular hairs 0.5-0.9 mm long; stigmatic remnants (4)4.5-5.1 mm long, with 5 glabrous lobes. *Seeds* 2.8-2.9 mm long, 1.4-2.1 mm wide, finely reticulate, uniformly colored, brown, glabrous. Cotyledons with entire margin. Fig. 169.

Pollen. *Geranium*-type (Park & Kim 1997: 312).

Chromosome number. 2*n* = 28.

Phenology. Collected in flower from June to September.

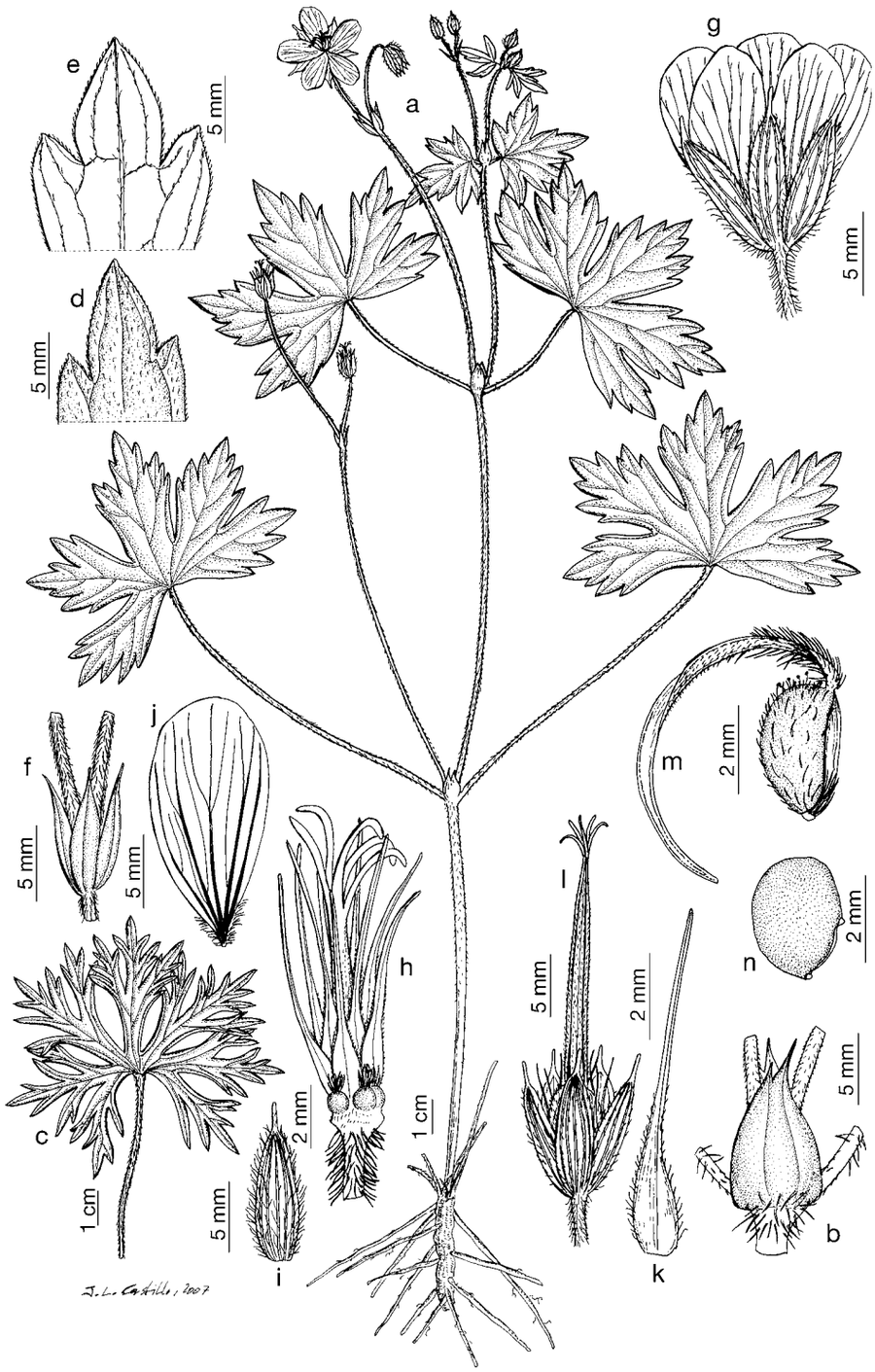


Fig. 169. *Geranium shikokianum*. a. Habit. b. Stipules. c. Leaf. d. Leaf indumentum on adaxial side. e. Leaf indumentum on abaxial side. f. Bracteoles. g. Flower. h. Flower without petals and sepals. i. Sepal. j. Petal. k. Staminal filament. l. Fruit. m. Mericarp. n. Seed. (Based on: a, d-e, *Shiota s.n., 2 Aug. 1935*, GH; b-c, f, *Seiko 1232,* MO; g-j, *Taquet 2306,* MA; k-n, *Taquet 189,* E).

Distribution. This species ranges from South Korea to Japan (central Honshū to Kyūshū and Shikoku) (Fig. 170).

Habitat. Open grassy slopes and deciduous or moist evergreen forests; 200-1950 m.

Representative specimens examined. **Japan.** Honshū: Yamato province, Oomine Mts., Mt. Shaka Ennohana, 34º6'N, 135º54'E, 17 July 1922, *Koidzumi s.n.* (KYO); Nara prefecture, Mt. Omine, 34º6'N, 135º54'E, 1920, *Makino s.n.* (KYO); Yamato province, Mt. Oomine, 34º15'N, 135º56'E, 4 Aug. 1950, *Kitamura s.n.* (KYO); Bingo, Mt. Dougo, 35º3'N, 133º14'E, 27 Aug. 1946, *Tuyama s.n.* (TI); Iwami province, Mt. Sanbei-yama, Sahime-mura, 35º8'N, 132º37'E, 28 July 1958, *Murata 11710* (KYO); Suruga province, Mt. Asitaka, 35º14'N, 138º48'E, 25 Aug. 1933, *Hisauti s.n.* (TI); Shizouka prefecture, Ashitaka Mts., 35º14'N, 138º48'E, 2 May 1954, *Kanai 6014* (TI); Mt. Daisen, 35º22'N, 133º32'E, Aug. 1907 (E); Tottori prefecture, Mt. Daisen, Daisen-cho, Seihaku-gun, 35º22'N, 133º32'E, 17 July 1966, *Furuse 44153* (K); Yamanashi prefecture, Minami-tsuru-gun, Mt. Mitsutoge, 35º31'N, 138º50'E, 4 July 1960, *Asai 8355* (E); Kai province, Mt. Mitsutōge, Nishi-katsura-mura, Minami-tsuru-gun, 35º31'N, 138º50'E, 3 Sep. 1954, *Furuse 28078* (K); Yamanashi prefecture, Minami-tsuru-gun, Mt. Mitsutoge, 35º31'N, 138º50'E, 24 May 1968, *Hasegawa s.n.* (TI); Kai province, Mitsutōge, 35º33'N, 138º49'E, 16 Sep. 1934, *Hisauchi s.n.* (LD, TI); Shinano province, Mt. Nyuugasa, Fujimi-mura, Suwa-gun, 35º54'N, 138º15'E, 24 Sep. 1954, *Furuse s.n.* (S); Chichibu, Ryogami-yama, 36º1'N, 138º51'E, June 1962, *Yamazaki 6497* (GH, H, TI); Nagano-ken, Suwa-gun, Shimosuwa-cho, cercanias de Yashimagahara, 36º4'N, 138º21'E, 28 July 1973, *Seiko 1232* (MO); Ôkubo, 36º34'N, 137º12'E, 1 July 1930, *Kitagawa s.n.* (TI). Kyūshū: Yakushima Is., Mt. Miyanoura-dake from Hananoegoo, 30º20'N, 130º31'E, 7 Aug. 1961, *Furuse s.n.* (GH, S); Kumamoto prefecture, en route from Hinoo Pass to Mt. Nishimine, W of Nekedake, Asogun, 32º50'N, 131º2'E, 23 Aug. 1978, *Yahara 4735* (TI); prefecture Oita, Mt. Kuju, 33º1'N, 131º18'E, 1922, *Makino s.n.* (KYO, L); prefecture Oita, Mt. Oohunayama, Kuju-cho, Kusu-gun, 33º1'N, 131º18'E, 11 Aug. 1922, *Tashiro 1116* (E, GH, L, LD, MO, NY, TI, Z); Oita province, Tsurumidake, 33º17'N, 131º25'E, 2 Oct. 1961, *Togashi 7335* (F, TI). Shikoku: Kochi prefecture, Mt. Nakatsumyojin, Agawa-mura, 33º35'N, 133º3'E, 25 Aug. 1964, *Murata 18829* (KYO, TI); Kochi prefecture, Mt. Kajigamori, Ohtoyo-cho, Nagaoka-gun, 33º45'N, 133º44'E, 14 Aug. 1961, *Oonisi s.n.* (CAS); Iyo, 33º45'N, 132º41'E, 21 Aug. 1935, *Shiota s.n.* (GH); Kochi prefecture, Ishidateyama, 33º46'N, 134º3'E, 10 Aug. 1968, *Inagaki s.n.* (TI); Iyo province, Mt. Ishizuchi, 33º46'N, 133º7'E, 8 Aug. 1934, *Koidzumi s.n.* (KYO, TI); Kochi prefecture, Ishidateyama, 33º46'N, 134º3'E, 25 July 1970, *Simozono s.n.* (TI); Ehime, Kamiukena-gun,Omogo-mura, Mt. Ishizuchi, en route from Tsuchi-goya to Tengu-dake, 33º46'N, 133º7'E, 4 Aug. 1985, *Takahashi 2062* (MO, TI); Ehime prefecture, Ishizuchi-yama, 33º46'N, 133º7'E, 29 Sep. 1965, *Togashi s.n.* (TI); Iyo, Mt. Ishizuchi, 33º46'N, 133º7'E, 21 Aug. 1935, *Yogo 9548* (GH); Kochi prefecture, Tosa Co., Hongawa village, 33º47'N, 133º15'E, 27 July 2003, *Okabayashi 58020* (NY); Tokushima prefecture, en route from Nagoro to the summit of Mt. Sanrei, Higashiiyayama-mura, Miyoshi-gun, 33º50'N, 134º5'E, 5 Aug. 1970, *Fujita s.n.* (KYO); Iyo province, between Mt. Higashiiakaishi and Mt. Hutatsudake, Umagun, 33º50'N, 134º5'E, 8 Sep. 1961, *Murata 14961* (KYO); Tokushima-ken, Mt. Tsurugi-san, Higashiiya-yama-mura, Miyoshi-gun, 33º50'N, 134º5'E, 25 July 1986, *Murata & al. 56031* (GH); Awa province, Mt. Tsurugi, 33º50'N, 134º5'E, 13 Aug. 1954, *Murata 7927* (KYO); Tokushima prefecture, Tsurugisan, 33º50'N, 134º5'E, 28 Aug. 1989, *Yamazaki s.n.* (TI); Ehime prefecture, on the way from Kawamata to Mt. Higashi-akaishi, Uma-gun, 33º52'N, 133º22'E, 13 Sep. 1981, *Yahara 5719* (TI, GH); Awa province, Mt. Kunimi-yama, Nishi-iyayama-mura, Miyoshi-gun, 33º54'N, 133º47'E, 10 Aug. 1954, *Murata 7616* (GH); Kagawa prefecture, Mitoyo-gun, Mt. Unpenji-san, 34º2'N, 133º43'E, 18 Aug. 1962, *Akamatsu s.n.* (GH); Tokushima prefecture, Miyoshi-gun, Tenguzuka, 34º2'N, 133º55'E, 29 July 1957, *Momiyama 141* (TI). **South Korea.** Gangwon: Kangwon, Mt. Taebaek, 37º6'N, 128º55'E, 3 Aug. 1996, *Jinsung Song 159* (KUS); Kangwon-do, Yangyang-gun, Seo-myu, Osek-oncheon, Sulak-san, 38º4'N, 128º36'E, 4 July 1986, *Murata Jin & Sung-chul Ko 21097* (TI); Oung-gu-ni-jil-pul, Mt. Sul-Ack, 38º29'N, 127º29'E, 4 Aug. 1957, *Lee s.n.* (MO). Jeju: Hallaisan, 33º24'N, 126º33'E, 1913, *Taquet 2306* (MA); Quelpaert, 33º30'N, 126º30'E, July 1908, *Taquet 609* (C). South Gyeongsang: Chirisan, S Chulla prov., 35º20'N, 127º43'E, 20 Aug. 1935, *Smith s.n.* (GH).

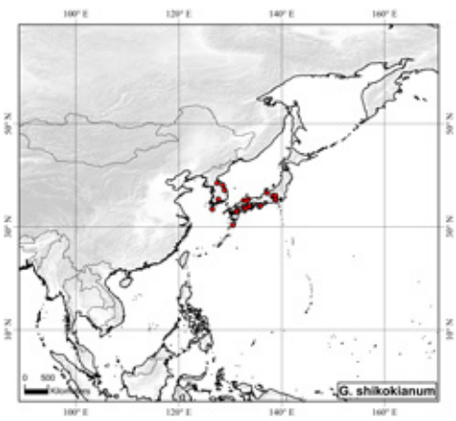


Fig. 170. Distribution of *Geranium shikokianum*.

Discussion. Geranium shikokianum is an erect perennial herb, easily identified by its broadly ovate, connate stipules, and glabrous petals, except for some cilia at the base. The indumentum consists of eglandular hairs, scattered at the stem base and more abundant toward the inflorescence. The hairs are retrorse or spreading. The sepal indumentum is composed of both appressed hairs on the abaxial surface and longer, spreading hairs on the nerves. Finally, there are some glandular hairs at the apex of the mericarp and, sometimes, at the base of the fruit rostrum. The petals are usually glabrous on the adaxial surface, but with cilia on the basal margins. In some rare cases a few hairs occur on the adaxial petal base. The petal apex is usually rounded, although in some cases, it is retuse with a 2- or 3-lobed apex. The inflorescence has monochasial branches, with a cymule and a pair of leaves arising from each node. Each branch usually ends in two cymules, one longer than the other. The connate stipules are broadly ovate and sometimes with a slightly cordate base. Among the specimens examined, this character appears to be constant, i.e., present at all nodes on all individuals.

Geranium shikokianum is quite similar to *G. koreanum.* It can be distinguished from the latter by its more deeply divided leaves with narrower segments and its petals nearly glabrous on the adaxial surface.

I have not been able to find type material of *G. shikokianum* at either TI or K, where types of Matsumura should be kept, and thus a neotype, collected at the original locality, is proposed. *Faurie 1758*, on which *G. shikokianum* var. *quelpaertense* is

based, is heterogeneous. One of the duplicates of this number at E is *G. thunbergii* and is explicitly excluded as lectotype material of this name.

56. Geranium wlassovianum Fisch. ex Link, Enum. Hort. Berol. Alt. 2: 197. 1822. Type locality: "Hab. in Sibiria". Type: Russia. Chita, Ingoda, 51°42'N 115°50'E, *F.E. Fischer s.n.* (lectotype, designated by Knuth 1912: 179, B destroyed). Russia. Chita, Dahuria, 50°58'N, 112°57'E, *O.F. Vlassow s.n.* (neotype, designated by Tsyrenova 1985a: 1640, LE-Fischer D16!).

Geranium vlassovianum DC., Mém. Soc. Phys. Genève 1: 441. 1823. Type locality: "La plante, que je désigne ici, est provenue de graines envoyées des jardins d'Allemagne sous ce nom, que je conserve dans l'idée qu'elle a peut-être été décrite dans quel-qu'ouvrage à moi inconnu: ce nom qui fait allusion à celui de Vlassov, botaniste Russe, paroît indiquer que léspèce est originaire de l'empire Russe". Type: Cultivated from seeds from Germany gardens, probably from Russia, "h. Genev.", 6 June 1821, *unknown collector* (lectotype, here designated, G-DC-215447!).

Geranium berezovcaeanum Prodán, Bul. Grăd. Bot. Univ. Cluj 6: 108, tab. 6 figs. A. 1927. Type locality: "Sibiria occidentalis, ad rivulos. 12. VII. 1918 (leg. Szeewald)". Type: Russia. Buryatiya, Sibiria occidentalis, pr. pagum Berezovca, 51°56'N, 107°30'E, 12 July 1918, *F. Szeewald s.n.* (lectotype, here designated, BUCA-88549 image!).

Geranium selengense Prodán, Bul. Grăd. Bot. Univ. Cluj 6: 108, tab. 5C. 1927. Type locality: "Siberia occidentalis. Prope pagum Berezovea ad marg. rivuli Selenga". Type: Prodán, Bul. Grăd. Bot. Univ. Cluj 6: 108, tab. 5C. 1927 (lectotype, here designated).

Geranium koraiense var. *chejuense* S.J. Park & K.J. Kim, Kor. J. Plant Tax. 32: 3, 2 figs. 1-7. 2002. *Geranium krameri* var. *chejuense* (S.J. Park & K.J. Kim) M. Kim, Korean Endemic Pl.: 239 (2017). Type locality: "Mt. Halla (3 km SW of Kyorae-ri, Pukcheju-Gun, Jeju City, alt., 700m) in Jeju island, Jeju Prov., Korea. Sept. 12, 2001. S.-J. Park & K.-J. Kim 2001015 (Holotype, YNUH; Isotypes, YNUH)". Type: South Korea. Jeju, Mt. Halla, 33°21'N, 126°31'E, 12 Sep. 2001, *S.J. Park & K.J. Kim 2001015* (holotype, YNUH; isotype, YNUH).

Geranium koraiense var. *hallasanense* B.J. Woo & S.J. Park, Integr. Biosci. 9: 123, 124 fig. 1. 2005. Type locality: "Korea. Jeju Prov., Jeju Island, Jeju City, Ara-l-dong (33°25'51.62"N, 126°33'28.65"E), August 26, 2004, B.-J. Woo & S.-J. Park 2040816 (holotype, YNUH)". Type: South Korea. Jeju, Jeju Island, Jeju City, Ara-l-dong, 33°25'N, 126°33'E, 26 Aug. 2004, *B.J. Woo & S.J. Park 2040816* (holotype, YNUH).

Perennial herbs, 25-86 cm tall. *Rootstock* 7-16.8 mm in diameter, ± vertical, not tuberculate, not turnip-shaped, with a fascicle of long and thickened roots. *Stem* erect, leafy, not rooting at nodes, stolons absent, without vegetative stems, with patent (rarely retrorse, appressed), eglandular hairs 0.3-1.1 mm long. *Basal leaves* in a ± deciduous rosette, cauline leaves opposite; leaf laminas (3.7)6-6.8(8.1) cm long, 4.7-9.9 cm wide, not peltate, palmatifid [ratio main-sinus length/middle segment length = (0.70)0.73-0.81(0.84)], polygonal in outline, base cordate, not coriaceous, with nerves not projected, pilose, with appressed, eglandular hairs on both surfaces; segments 5, in 1 plane, middle segment rhombic, (6)8-12.6(19.1) mm wide at the base [ratio segment width at the base/middle segment length = (0.13)0.17-0.25(0.37)], 7-9(10)-lobed in distal half [ratio secondary sinus length/middle segment length = (0.14)0.21-0.26(0.29)]; petioles up to 24 cm long, without abscission zone, terete, not swollen, not deflexed in age, with usually patent, eglandular hairs 0.2-1.1 mm long; stipules 3.1-10 mm long, 1.9-4.7 mm wide, lanceolate, free or connate (at least at the base), papery, brown, with scattered, eglandular hairs on both surfaces and on the margin. *Inflorescence* a monochasial cyme; cymules 2-flowered, solitary [ratio cymule length/leaf length = (0.5)2-3.4(4.6)]; peduncles (43)65-123(164) mm long, with ± patent, eglandular hairs 0.2-1 mm long; bracteoles 3.6-9.5 mm long, 0.5-1.3 mm wide, lanceolate, whorled; pedicels (20)29-39(62) mm long, with patent or retrorse, ± appressed, eglandular hairs 0.2-0.8 mm long. Flowers actinomorphic. *Sepals* (7.9)8.9-10.3(11.2) mm long, 2.9-4.9 mm wide, lanceolate, with thickened nerves, not accrescent, nerves 5, mucro (1.1)1.6-2.5(3.9) mm long [ratio mucro length/sepal length = 0.12-0.38], with antrorse, ± appressed, eglandular hairs 0.1-0.3 mm long and ± patent, eglandular hairs 0.2-1.4 mm long on the abaxial surface, glabrous adaxially. *Petals* (15.5)16.1-19.5(23) mm long, (5.5)8.3-10.1(13.5) mm wide, erect-patent, rounded, without claw, deep magenta-purple, hairy on the base of the adaxial surface, glabrous abaxially, ciliate on the basal margin, with hairs 0.4-1.2 mm long. *Stamens* 10, both whorls bearing anthers; filaments (8.5)9.5-11.2(12.1) mm long, lanceolate, pink, densely pilose on the abaxial surface, ciliate on the proximal half, with hairs 0.6-1.5 mm long; anthers (1.6)2.1-2.5(2.6) mm long, blue. Nectaries 5, hemispheric, with a tuft of hairs at the top, dorsally glabrous. *Gynoecium* 8.9-13.1 mm long, deep red or pink. *Fruit* (30.4)32-35(37.7) mm long, erect, discharge of seed-ejection type; mericarps 2.9-4.3 mm long, 1.3-2 mm wide, without a strand of fibers, not compressed at the apex, smooth, without basal beak, with a basal callus, without a basal prong, brown, with ± patent, eglandular hairs 0.3-1.1 mm long and, usually, patent glandular hairs 0.6-1 mm long (mainly at the top of the mericarp); rostrum 20.7-25.9 mm long, with a narrowed apex (3)3.4-4.8(5.2) mm long, not twisted, with ± patent, eglandular hairs 0.2-0.3 mm long and, usually, patent, glandular hairs 0.5-0.9 mm long; stigmatic remnants 5-6.9 mm long, with 5 glabrous lobes. *Seeds* 2-2.5 mm long, 1.4-1.9 mm wide, finely reticulate, uniformly colored, brown, glabrous. Cotyledons with entire margin. Fig. 171.

Pollen. *Geranium*-type (Bortenschlager 1967: 431; Lu & al. 1996: 320; Park & Kim 1997: 312).

Chromosome number. 2*n* = 28, 56.

Phenology. Collected in flower from June to October.

Distribution. This species ranges through Mongolia, eastern Siberia (Amur, Buryatiya, Chita, Irkutsk and

Primorye) and eastern China (Hebei, Heilongjiang, Henan, Jilin, Nei Mongol, Shandong and Shanxi) (Fig. 172).

Habitat. Roadsides, moist meadows, lake shores, marshes, riverbanks and edge of *Betula* L. and *Salix* L. forests; 500-2300 m.

Representative specimens examined. **China.** Hebei: montaña Dong Ling Shan, Ji Guan Zi Shan, 36º29'N, 115º15'E, 25 July 1951, *Yang Chao Guang 382* (KUN); ciudad Zhangjiakou, distr. Zhulu, montaña Xilingshan, Chang Cheng Ling, 37º12'N, 115º1'E, 1 Aug. 1952, *Yang Chao Guang 10027* (MO); Tschili, Lnog Schi ba pan, Schi ba pan ling, Shen miao ling, 38º24'N, 114º34'E, 31 July 1917, *Limpricht 2953* (WRSL); montaña Xiaowutai shan, Xi Ling Shan, 39º51'N, 114º59'E, 2 July 1935, *Liu Ying 11495* (MO); Pekin, sur le sommet du Sy lin chan, 40º0'N, 116º10'E, Aug. 1888, *Bodinier 261* (E, P). Heilongjiang: Hsiaoling, 45º20'N, 127º18'E, 27 July 1938, *Skvortzov s.n.* (GH); ciudad Shuangyashan, granja forestal Lingxi, montaña Hengtoushan, 46º40'N, 130º34'E, 16 Aug. 1995, *Lin 81627* (MO); ribera del río Yichunwumin, 47º44'N, 128º55'E, 25 July 1951, *Liu Shen'E 3359* (PE). Henan: ciudad San Menxia, distr. Lu Shi, pueblo Shuang Huaishu, 33º49'N, 110º58'E, 20 Sep. 1958, *Fu Jiaqgiu 862* (MO); ciudad San Menxia, distr. Lu Shi, 34º31'N, 110º54'E, 2 Oct. 1958, *Fu Jiaqgiu 1534* (MO). Jilin: Kirin, Kiao ho, 39º8'N, 117º11'E, 17 July 1928, *Licent 8490* (BM, K); provincia Kirinensis, Manshuria Chinensis, 43º0'N, 126º0'E, 29 June 1896, *Komarov 995* (P). Nei Mongol: ciudad Hulunbei Er, población Hai La Er, ribera del río Yimin, 49º21'N, 120º10'E, 15 Aug. 1956, *Exped. Sino-Germ. 8160* (PE); Kinghar montagnes, 49º22'N, 123º9'E, 1 July 1896, *Chaffanjon 1869* (P); ciudad Hulunbei Er, municipio E'Erguna, 49º22'N, 121º43'E, 10 July 1951, *Wang Zhan 1234* (MO); Barga, Dragozennovka, 49º42'N, 121º43'E, 5 Aug. 1937, *Alexandrov s.n.* (GH). Shandong: ciudad Qingdao, montaña Laoshan, Hei Feng Kou, 36º3'N, 120º22'E, 19 Aug. 1998, *Hou Yuan-tong 98225-2* (MO). Shanxi: Schansi austr., Yao-scahn, pr. Hsiatschuan, 37º8'N, 112º55'E, 23 Aug. 1935, *Licent 12662* (W); Schansi, Ko-tong-ze, pr. Ningen, 40º15'N, 113º25'E, 30 July 1933, *Licent 11159* (W). **Mongolia.** Bulgan: vallis 20 km NW ab oppido Bulgan, 48º55›N, 103º22›E, 6 Aug. 1965, *Deyl & Sojak 2549* (PR). Töv: ad ripam dextram rivi Tola apud vicum Songino, 25 km SW ab oppido Ulan-Bator, 47º45'N, 106º30'E, 29 July 1965, *Deyl & Sojak 1365*

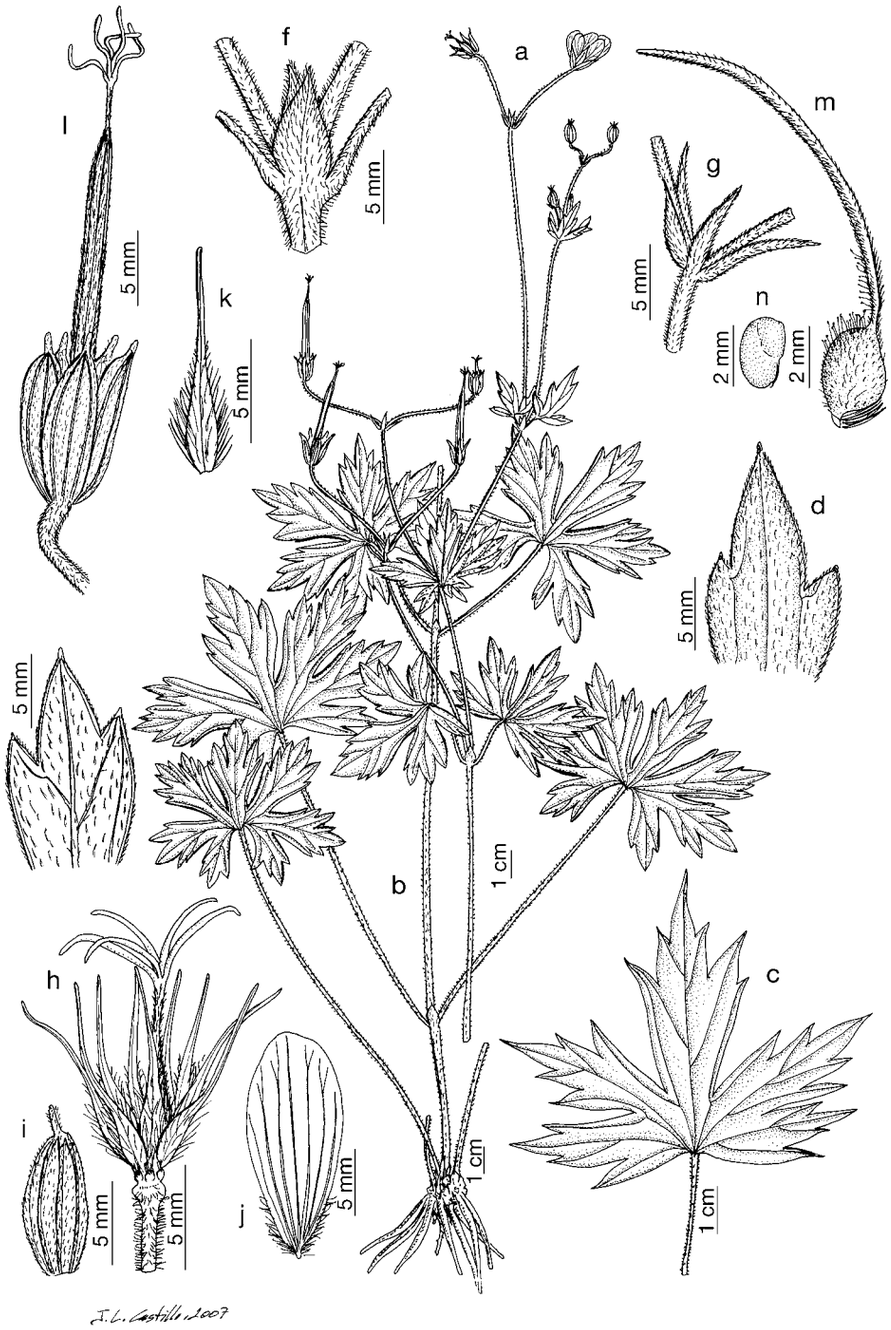


Fig. 171. *Geranium wlassovianum*. a, b. Habit. c. Cauline leaf. d. Leaf indumentum on adaxial side. e. Leaf indumentum on abaxial side. f. Stipules. g. Bracteoles. h. Flower without petals and sepals. i. Sepal. j. Petal. k. Staminal filament. l. Fruit. m. Mericarp. n. Seed. (Based on: a, b, d-n, *Liu Ying 11445,* IBSC; c, *Socava & Lipatova s.n., 31 July 1956*, C).

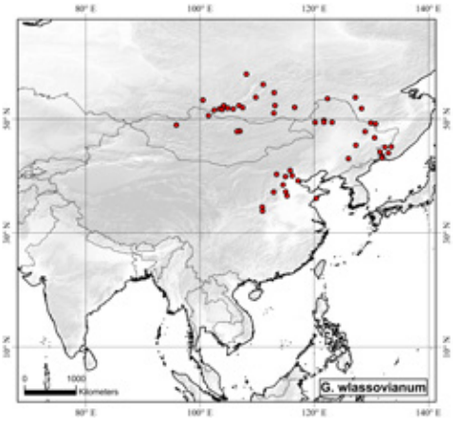


Fig. 172. Distribution of *Geranium wlassovianum*.

(PR); in vallie Nucht ad declivia montium Bogd-úl ca. 15 km SSW ab oppido Ulan-Bator, 47º45'N, 106º30'E, 24 July 1965, *Deyl & Sojak 537* (PR). Ulaanbaatar: vallis silvatica Zajsan ad declivia borealia montium Bogd-úl versus meridionem ab oppido Ulan-Bator, 47º49'N, 107º0'E, 31 July 1965, *Deyl & Sojak 1443* (PR); Ulan-Bator City, NW slope of Mt. Bogd Uul, Dzaysan Canyon, 2-4 km SW Dzaysan Hill Monument, 47º49'N, 107º0'E, 7 July 1972, *Norlindh & Ahti 10137* (S); in vallie Nucht ad declivia montium Bogd-úl ca. 15 km SSW ab oppido Ulan-Bator, 47º50'N, 106º54'E, 13 Sep. 1966, *Vašák 9840* (PR). Zavkhan: Ulan-Bator, Songino, 48º53'N, 95º52'E, 20 July 1974, *Sakiyama s.n.* (TI). **Russia.** Amur: distrito Arjarinskiy, pueblo Leninskoe, 49º15'N, 129º56'E, 25 Aug. 2005, *Ermoshkin s.n.* (VLA); Amur-sejskoe plato, Srednee tecenie r. Sei, 51º47'N, 128º18'E, 25 Aug. 1957, *Nepli s.n.* (C); Zejskaja Pristan, 53º43'N, 127º13'E, July 1899, *Karo 360* (P). Buryatiya: Tunkinskiy amjmak, Okr. pos. Kuiren, 51º30'N, 102º30'E, 20 July 1932, *Kolsheva s.n.* (C); Baikal lake, bay Proval, slope of Baikal shore near village Oimur, 52º19'N, 106º50'E, 11 July 1926, *Konovalov 440* (MA); Zabaikalskaya prov., Upper Angara river basin, near Chencha, 55º59'N, 111º5'E, 14 July 1913, *Sukachev & Poplavskaya 708* (MA). Chita: Nertschinsk, auf Bergabhängen am Nertsch-Flusse, 51º59'N, 116º35'E, 1889, *Karo 178* (C, MA, LD, P); 85 km WNW of Chita, between Tasey and Mukhor-Konduy and next to lake Sirotinka, 52º18'N, 113º8'E, 2 Aug. 1988, *Elias & Murray 11571* (NY). Irkutsk: Sljudianssij rajon, st. Mangutay, r. Bezumianoj, 51º36'N, 103º54'E, 19 July 1970, *Alianskaia & Mazurenko s.n.* (TI); pr. vicum Bystraja, 51º44'N, 103º27'E, 10 Sep. 1967, *Vašák s.n.* (PR); 6 km N a vico Listvenicnoye, 51º51'N, 104º52'E, 15 Sep. 1967, *Vašák s.n.* (PR); Iter Ircutense ad fl Lena et Kirenga, 57º47'N, 108º8'E, 3 Aug. 1910, *Kusnezow 1428* (C). Primorye: Vladivostok and vicinity, 43º7'N, 131º54'E, 1919, *Topping 2409* (US); S Ussuri, 44º0'N, 133º0'E, 21 Sep. 1918, *Jimbo s.n.* (TI); Manshuria, lac Hanka, Turga Rock, 45º0'N, 132º24'E, 10 June 1899, *Bohnhof 44* (K, NY); Kirovsky, 45º5'N, 133º30'E, 5 July 1979, *Ulanova 7541* (P).

Discussion. Geranium wlassovianum is an erect perennial herb, easily identified by its short vertical rootstock with a fascicle of long and thickened roots, its shallowly divided leaves and its long petals with hairs only on the base. The indumentum consists of eglandular hairs, spread or, more rarely, retrorse. At the apex of the mericarp and at the base of the fruit rostrum there are some glandular hairs. The sepals have thickened nerves and an indumentum that consists of short appressed hairs and long and spread hairs. The petals are hairy on the base of the adaxial surface and ciliate on the basal margin. The inflorescence is monochasially arranged, with a cymule and a pair of leaves arising from each node. The peduncle of the cymules is noticeably long toward the base of the inflorescence. The connate stipules of *G. wlassovianum* are more similar to those of *G. koreanum* or *G. shikokianum*, although not as wide. They are usually connate for at least part of their length. In some cases they appear free, at least at some nodes of the plant.

Geranium wlassovianum and *G. maximowiczii* share shallowly divided leaves, paler on the abaxial surface. Both species are difficult to differentiate, and the main characters are referred to in the key. Additionally, in *G. wlassovianum*, the anthers, gynoecium, fruit, and staminal filaments are longer (and with a dense tuft of hairs). Hairs on the stem and inflorescence are also longer and usually patent.

Knuth (1912: 179) typified *G. wlassovianum* on a Fischer's specimen from B herbarium now destroyed. Tsyrenova (1985a) proposed the lectotype from Fischer's herbarium at LE but did not quote Knuth's designation. Thus, I consider that, in fact, she was designated a neotype.

De Candolle (1823: 441) published his *G. vlassovianum* which should be considered heterotypic and perhaps a homonym of *G. wlassovianum*. He indicated that: "La plante, que je désigne ici, est provenue de graines envoyées des jardins d'Allemagne sous ce nom, que je conserve dans l'idée qu'elle a peut-être été décrite dans quel-qu'ouvrage à moi inconnu: ce nom qui fait allusion à celui de Vlassov, botaniste Russe, paroît indiquer que l'espèce est originaire de l'empire Russe". Thus, it seems that Link (1822) and De Candolle (1823) published this species almost simultaneously yet independently.

The Krameri Group—Members of this group are erect perennial herbs with an essentially eglandular indumentum, usually with connate stipules and fasciculate roots, deeply divided and opposite leaves, lanceolate stamens, and large petals that are hairy on the adaxial surface. The cymules are predominantly 2-flowered and usually arranged in a monochasial inflorescence.

57. Geranium dahuricum DC., Prodr. 1: 642. 1824. Type locality: "in turfosis Dahuriae. Patrin... (v. s.)". Type: Russia. Chita, Dahuria, circa pagum Ouroulga, 51°45'N, 114°47'E, 5-16 July 1785, *E.L. Patrin s.n.* (lectotype, designated by Yeo 1992: 132, G-DC-00215795!).

Geranium lasiocaulon Nakai, Bot. Mag. (Tokyo) 49: 350. 1935. Type locality: "Hab. in Korea. Prov. Kanhoku: in herbidis montis Kanbôhô 2100-2500 m. (T. Nakai, no. 7214, typus in Herb. Univ. Imp. Tokyoensis); in herbidis montis Nausetsurei 1800-2000 m. (T. Nakai, no. 7215)". Type: North Korea. Kanhoku, montis Kanbôhô, 41°45' N, 129°20' E, 19 July 1918, *T. Nakai 7214* (holotype, TI!).

Geranium paishanense Y.L. Chang, Fl. Plant. Herb. Chinae Bor.-Or. 6: 291, 17 tab. 6 fig. 2. 1977. *Geranium dahuricum* var. *paishanense* (Y.L. Chang) C.C. Huang & L.R. Xu, Fl. Reipub. Pop. Sin. 43(1): 59. 1998. Type locality: "Jilin Province: Changbaishan Mt., Fusong County, alt.2500m, July 30, 1950, T.N. Liou 1606 (Types, kept in Institute of Forestry and Pedology, Liaoning Province)" [in Chinese]. Type: China. Jilin, Fusong County, Changbaishan Mt., 42°00'N, 128°00'E, 30 July 1950, *T.N. Liou 1606* (holotype, IFP).

Geranium dahuricum var. *baiheense* Z.H. Lu & Y.C. Zhu, Bull. Bot. Res., Harbin 14: 359. 1994. Type locality: "Jilin: Changbai Mts., Edaobaihe Town. alt. 900-1100m, sept. 10, 1989, u Zhaohua 890400 (Typus in HNRH), 890403, 890405, 890407". Type: China. Jilin, Changbai Mts., Edaobaihe Town, 42°00'N, 128°00'E, 10 Sep. 1989, *Lu Zhaohua 890400* (holotype, HNR).

Geranium pissjaukovae Tsyren., Bot. Zhurn. (Moscow & Leningrad) 93(1): 138. 2008. Type locality: "Rossia, Prov. Amuriensis, 10 km ad austro-orientem ab oppido Archara, frutices viarum, 12 VIII 2005, S. Kudrin, D. Tzyrenova (LE, isotypus-VLA)". Type: Russia. Prov. Amuriensis, 10 km

ad austro-orientem ab oppido Archara, 49°12'N, 129°50'E, 12 Aug. 2005, *S. Kudrin & D. Tsyrenova s.n.* (holotype, LE image!; isotype, VLA).

Geranium probatovae Tsyren., Bot. Zhurn. (Moscow & Leningrad) 93(1): 137. 2008. Type locality: "Rossia, Regio autonoma Judaica, districtus Leninsk, oppidum Lazarevo, pratum siccum in declivo expositonis occidentalis, copiosae, 5 IX 2005, D. Tzyrenova (LE, isotypus-VLA)". Type: Russia. Khabarovsk, Regio autonoma Judaica, districtus Leninsk, oppidum Lazarevo, 48°14'N, 132°26'E, 5 Sep. 2005, *D. Tsyrenova s.n.* (holotype, LE-01043874 image!; isoype, VLA).

Perennial herbs, 22-48(72) cm tall. *Rootstock* 4-8 mm in diameter, ± vertical, not tuberculate, not turnip-shaped, with a fascicle of long and thickened roots. *Stem* erect, leafy, not rooting at nodes, stolons absent, without vegetative stems, with retrorse, appressed, eglandular hairs 0.3-1 mm long. *Basal leaves* in a ± deciduous rosette, cauline leaves opposite; leaf laminas (3.4)3.8-5.6(6.2) cm long, 3.9-7.9 cm wide, not peltate, palmatifid [ratio main-sinus length/middle segment length = (0.83)0.86-0.95], polygonal in outline, base cordate, not coriaceous, with nerves not projected, pilose, with ± appressed, eglandular hairs on both surfaces; segments 5, in 1 plane, middle segment rhombic, (1.6)2.9-4.8(5.7) mm wide at the base [ratio segment width at the base/middle segment length = (0.04)0.08-0.13(0.15)], 4-7(10)-lobed in distal half [ratio secondary sinus length/middle segment length = (0.23)0.31-0.36(0.46)]; petioles up to 24 cm long, without abscission zone, terete, not swollen, not deflexed in age, with retrorse, appressed, eglandular hairs 0.2-1 mm long; stipules 3-6.5 mm long, 0.9-3.2 mm wide, lanceolate, connate (at least at the base), papery, brown, with scattered, eglandular hairs on both surfaces and on the margin. *Inflorescence* a dichasial cyme with monochasial branches; cymules 2-flowered, solitary [ratio cymule length/leaf length = (1.8)2-3.1(4.2)]; peduncles (22)40-91(100) mm long, with retrorse, appressed, eglandular hairs 0.3-0.9 mm long; bracteoles 2.6-6.9 mm long, 0.4-1.1 mm wide, lanceolate, whorled; pedicels (13)21-33(44) mm long, with retrorse, appressed, eglandular hairs 0.2-0.6 mm long. Flowers actinomorphic. *Sepals* (5.4)5.8-7.1(9) mm long, 1.6-3.5 mm wide, lanceolate, smooth, not accrescent, nerves 5, mucro (0.9)1-1.5(2) mm long [ratio mucro length/sepal length = 0.13-0.28], with antrorse, ± appressed, eglandular hairs 0.3-1.6 mm long on the abaxial surface, glabrous adaxially. *Petals* (7.9)8.7-13.2(14) mm long, (3.8)4.2-7.9(8.8) mm wide, erect-patent, rounded, without claw, light pink, hairy on the basal 1/3-1/2 of their adaxial surface (rarely up to the apex) and on the base of the abaxial surface, ciliate on the basal margin, with hairs 0.4-1.1 mm long. *Stamens* 10, both whorls bearing anthers; filaments (3.8)5-7.1(7.5) mm long, lanceolate, pink, pilose on the abaxial surface, ciliate on the proximal half, with hairs 0.2-0.8 mm long; anthers (1.4)1.5-1.7(2) mm long, blue. Nectaries 5, hemispheric, usually glabrous. *Gynoecium* 5.1-9.3 mm long, purple. *Fruit* (17.2)19-24(25.5) mm long, erect, discharge of seed-ejection type; mericarps 2.4-3.1 mm long, 1.1-1.7 mm wide, without a strand of fibers, not compressed at the apex, smooth, without basal beak, with a basal callus, without a basal prong, brown, with ± patent, eglandular hairs 0.2-0.7 mm long and patent, glandular hairs 0.9-1.2 mm long (mainly at the top of the mericarp); rostrum 10.5-17.5 mm long, with a narrowed apex 1.5-2.1 mm long, not twisted, with ± patent, eglandular hairs 0.1-0.3 mm long; stigmatic remnants 2.8-4.5 mm long, with 5 glabrous lobes. *Seeds* 1.6-2 mm long, 0.9-1.3 mm wide, finely reticulate, uniformly colored, brown, glabrous. Cotyledons with entire margin. Fig. 173.

Pollen. *Geranium*-type (Bortenschlager 1967: 429; Lu & al. 1996: 320; Park & Kim 1997: 311; Tan & al. 1996: 211).

Chromosome number. 2*n* = 28.

Phenology. Collected in flower from May to November.

Distribution. This species ranges from central and northeastern China (Gansu, Hebei, Heilongjiang, Jilin, Nei Mongol, Qinghai, Shaanxi, Shanxi and Sichuan) to Mongolia, Korea and eastern Siberia (Amur, Chita, Khabarovsk and Primorye) (Fig. 174).

Habitat. Meadows, grassy slopes and edge of *Betula* L., and *Larix* Mill. forests; 450-3300 m.

Representative specimens examined. **China.** Gansu: prefectura Gannan, distrito Zhouqu, pueblo Boyu, urbanización Qumagou, 34°31'N, 102°39'E, 11 July 1993, *Lian Yongshan 93-349* (MO); Qumagou, Boy, Zhougu Xian, 35°29'N, 107°46'E, 11 Aug. 1993, *Lian & al. 93-349* (MO). Hebei: ciudad Xingtai, distrito Neixiu, pueblo Houjiazhuang, urbanización Xiaolingdi Nan Yaoshui, 37°3'N, 114°29'E, 22 Aug. 1950, *Liu Ying 13454* (MO); Pekin, 39°55'N, 116°23'E, *David s.n.* (P). Heilongjiang: Harbin, 45°45'N, 126°36'E, 4 Aug. 1937, *Kitagawa s.n.* (GH); montaña Shuang Yashan, 46°38'N, 131°9'E, 8 Aug. 1995, *Lin 8808* (MO). Jilin: montaña Changbaishan, 42°0'N, 128°0'E, 21 July 1967, *Bosque Zona Templada Exped. 335* (PE); Kirin, 43°51'N, 126°33'E, July 1931, *Chen 133* (GH, NY). Nei Mongol: Pai Loa chan, 13 July 1917, *Licent 3139* (P); W part of Manchuria, Barga, Dragozenovka, 49°42'N, 121°43'E, 15 Aug. 1937, *Alexandrov s.n.* (GH). Qinghai: N Mt. Minhe Xian, 36°4'N, 102°37'E, 16 July 1989, *Ho & al. 793* (CAS); Sining, Kokonor, 36°55'N, 100°9'E, 3 Aug. 1930, *Hopkingson 831* (P, S). Shaanxi: Zhouzhi Xian, Houzhingzi S slope of Taibaishan, 33°48'N, 107°48'E, 10 Nov. 1999, *Zhu & al. 2634* (MO); ciudad Baoji, distrito Long, pueblo Guanshan, urbanización Shajiagou, 34°21'N, 107°21'E, 16 Aug. 1974, *Yu Zhaoying 48* (MO). Shanxi: ciudad Changzhi, distrito Pingshun, 36°11'N, 113°6'E, 8 July 1986, *Wang Jiaqiang 333* (MO); ciudad Datong, distrito Hunyuan, urbanización Baxi, 40°2'N, 113°36'E, 23 July 1959, *Liu Xinyuan 10181* (MO). Sichuan: ciudad Chongqing, distrito Nanchuan, montaña Jinfoshan, templo Feng Huang Si, 29°1'N, 107°10'E, 4 Oct. 1964, *Sichuan Exped. 2218* (MO); prefectura Aba, distrito Jinchuan, 32°54'N, 101°42'E, 1 Aug. 1958, *Li Xin 78263* (MO). **Mongolia.** Dornod: Vostocnaia Mongolia, Sapadnuie B. Jingana, Gora Baian-Jer-uda, 46°40'N, 119°50'E, 9 July 1987, *Ganbold 1344* (LE). **North Korea.** North Hamgyong: Hamgyong-bukto, Furyonggun, Donnae, 41°50'N, 129°25'E, 10 Aug. 1939, *Nakai 6236* (TI). Ryanggang: provincia Pennian, flumen Amnok-gan, fluvium Jalu super districtus Sam-su, circa pagum Sang-su-u, 41°27'N, 128°18'E, 5 Aug.

1897, *Komarov 993b* (GH). South Hamgyong: Chihli, Siao-wutaishan, 39º33'N, 127º20'E, 20 July 1906, *Yabe s.n.* (TI). **Russia.** Amur: prov. Amuriensis, Manshuria Rossica, inter fl. Chingan et Uril, 48º53'N, 130º18'E, 2 July 1895, *Komarov 993* (TI); región Arjarinskiy, pueblo Kundur, a 11 km. al sur por la carretera, 49º6'N, 130º45'E, 12 Aug., *Kudrin s.n.* (VLA); Amurskaia obl., Amur-Zejskoje plateau, Vezcheje (upper part) r. Amur, between Novovoskresenovki and Bibikovo, pr. Kolyschevo, 55º36'N, 125º36'E, 9 July 1958, *Nepli s.n.* (C); Citinsaia obl., Nercinskij rajon, Dol. r. Shilki protiv st. Priiskovoj Sarosli kustarnikov, 55º36'N, 129º27'E, 9 July 1957, *Siplivinskii s.n.* (C). Chita: Dahuria, Nertschinsk, 51º18'N, 119º37'E, 1889, *Karo 189* (C, LD, MA, P, PR, WRSL); distrito Ner-Zavodskiy, pr. pueblo Nerchinskiy Zavod, 51º18'N, 119º36'E, 8 Aug. 2004, *Popova s.n.* (VLA); distrito Nerchinskiy, alred. Pueblo Olekan, 52º22'N, 116º4'E, 14 July 2004, *Popova s.n.* (VLA). Primorye: Vladivostok and vicinity, 43º7'N, 131º55'E, May 1919, *Topping 2412* (US); lac Hanka, Tourga Rock, 45º0'N, 132º24'E, 3 July 1899, *Bohnhof 103b* (NY, P); Kirovsky, 45º5'N, 133º30'E, 23 July 1975, *Ulanova 5976* (C). **South Korea.** Jeju: in herbidis Hallaisan, 33º22'N, 126º30'E, Aug. 1907, *Faurie 1760* (E, G, P). North Gyeongsang: isla Dagelet, 37º30'N, 130º51'E, 18 Sep. 1971, *Yamazaki s.n.* (TI).

Discussion. Geranium dahuricum is an erect perennial herb, easily identified by its short vertical rootstock with a fascicle of long and thickened roots, deeply divided leaves and medium-length petals. The indumentum consists of eglandular hairs, retrorse and appressed. However, it has some glandular hairs at the apex of the mericarp and at the base of the fruit rostrum. The petals are hairy on the base of the adaxial surface and along the nerves, usually reaching between one-third and one-half of its length. The inflorescence appears as a dichasially arranged cyme with monochasial branches. The stipules of *G. dahuricum* are usually connate for at least part of their length. In some cases they appear free, at least at some nodes of the plant. *Geranium dahuricum* usually has glabrous nectaries, although scattered hairs can be found occasionally. There is some variability in the thickness of the roots, in the degree of dissection

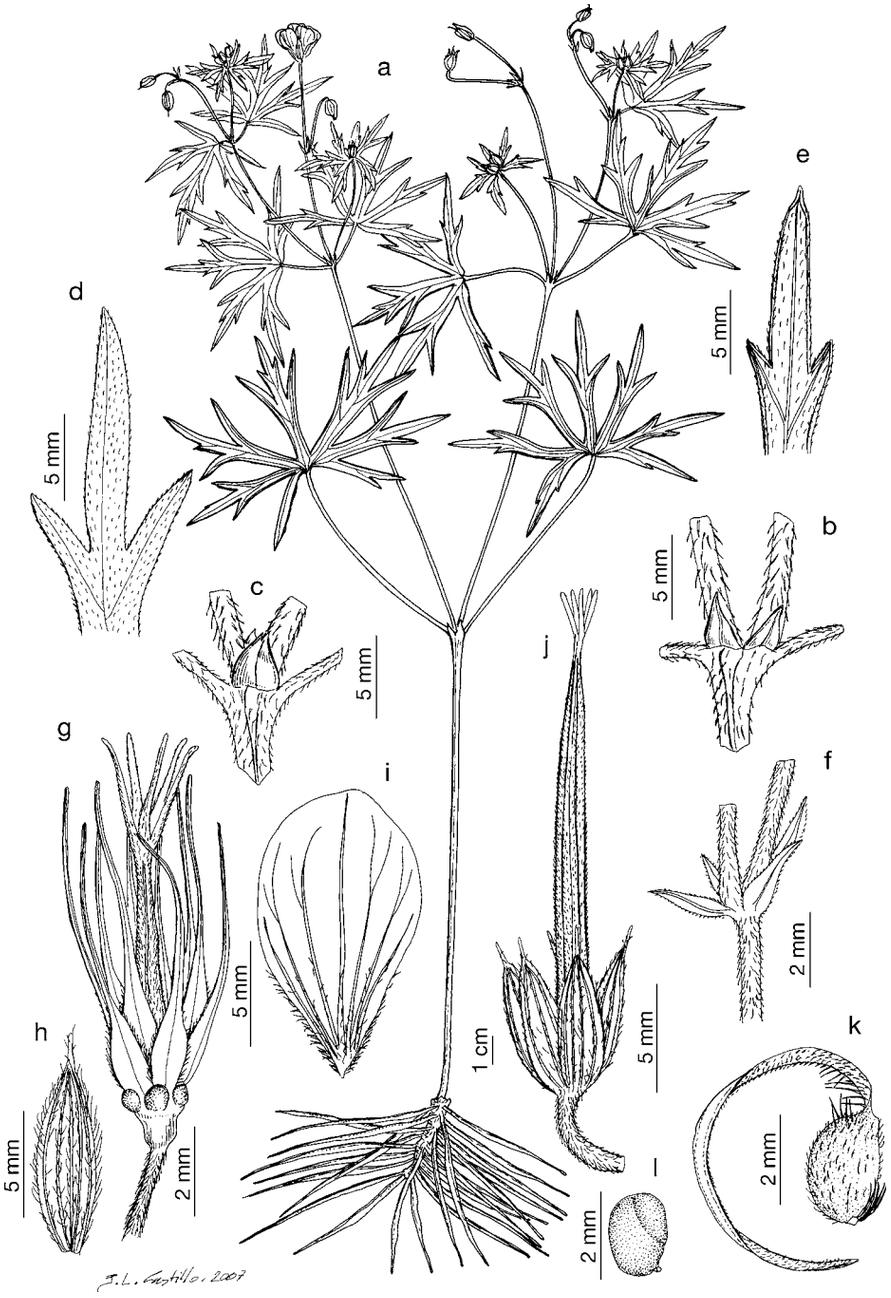


Fig. 173. *Geranium dahuricum*. a. Habit. b, c. Stipules. d. Leaf indumentum on adaxial side. e. Leaf indumentum on abaxial side. f. Bracteoles. g. Flower without petals and sepals. h. Sepal. i. Petal. j. Fruit. k. Mericarp. l. Seed. (Based on: a-e, j-l, *Karo 420,* C; f-i, *Cunningham 197,* E).

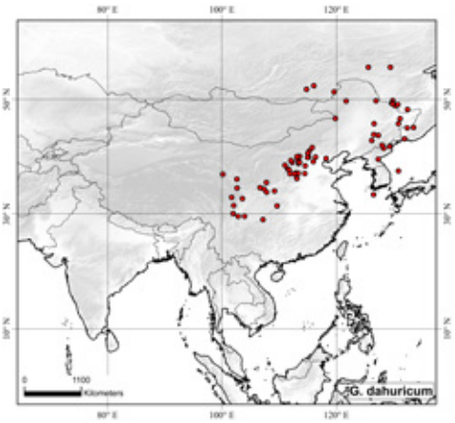


Fig. 174. Distribution of *Geranium dahuricum*.

of the leaves and in the position of the indumentum, but these features seem not to be correlated with each other, or with other characters or any particular geographical area. Thus, I consider that these variability do not deserve taxonomic recognition, but other authors differ from this point of view (Tsyrenova 2008).

Geranium dahuricum is quite similar to *G. soboliferum*. The latter is usually a more robust plant with longer leaf blades, longer sepals, petals, and fruits, and nectaries with hairs. *Geranium krameri* is also close to *G. dahuricum*. In addition to characters mentioned in the key, the former is more robust, with longer fruits, and its leaf blade segments have a tendency to show straight sides.

58. Geranium krameri Franch. & Sav., Enum. Pl. Jap. 2: 306. 1878. Type locality: "Hab. in provinciâ Simosa, insulae Nippon, ubi legit Kramer (Savatier, n. 2006). Fl. Aug.". Type: Japan. Honshū, Simosa, 35°30'N, 140°20'E, *P.A. Savatier 2006* (lectotype, designated by Knuth 1912: 192, P-654992!).

Geranium japonicum Franch. & Sav., Enum. Pl. Jap. 2: 305. 1878. Type locality: "Hab. in montibus Hakone (Savatier, n. 2446bis)". Type: Japan. Honshū, montibus Hakone, 35º14'N, 139º02'E, *P.A. Savatier 2446bis* (lectotype, designated by Knuth 1912: 135, P!).

Geranium sieboldii Maxim., Bull. Acad. Imp. Sci. Saint-Pétersbourg 26: 458. 1880, Type locality: "Japonia (hb. Siebold s. nom. jap. Dai fûro sô): pratis circa Yokohama non rarum, floret a Julio in autumnum, Nagasaki, in horto bot. jap. Motoski (Siebold, Junio fl. incip.). Mandshuria: ad fl. Tumen Koreae finitimum, prope oppidum Hun-tschun, Julio fl. incip. (F. Schmidt), ad fl. Suifun prope Nikolskoje, Aug. Septembri fl. (Goldenstädt), pratis siccioribus ad lacum Hanka, Augusto fl. c. fr. immat. (Przewalski)". Type: Russia. Primorye, Mandshuria, Hun-tschun, 42º39'N, 130º47'E, July 1861, *F. Schmidt s.n.* (lectotype, designated by Bobrov 1949: 22, LE!).

Geranium japonicum var. *adpressipilosum* H. Hara, J. Jap. Bot. 22: 171. 1948. *Geranium japonicum* f. *adpressipilosum* (H. Hara) H. Hara, Enum. Sperm. Jap. 3: 2. 1954. Type locality: "Honshu: Karuizawa, Shinano (H. Hara, Oct. 1, 1945)". Type: Japan. Honshū, Karuizawa, Shinano, 36º20'N, 138º36'E, 1 Oct. 1945, *H. Hara s.n.* (no original material located).

Perennial herbs, (25)50-129 cm tall. *Rootstock* 5-12 mm in diameter, ± vertical, not tuberculate, not turnip-shaped, with a fascicle of long and thickened roots. *Stem* erect, leafy, not rooting at nodes, stolons absent, without vegetative stems, with retrorse, appressed or patent, eglandular hairs 0.4-0.8 mm long. *Basal leaves* in a ± deciduous rosette, cauline leaves opposite; leaf laminas (5.3)5.9-8.2(11.9) cm long, 6.7-14.2 cm wide, not peltate, palmatifid [ratio main-sinus length/middle segment length = (0.82)0.83-0.87(0.88)], polygonal in outline, base cordate, not coriaceous, with nerves not projected, pilose, with appressed, eglandular hairs on both surfaces; segments 5-7, in 1 plane, middle segment rhombic, (4.3)5.4-8.5(8.8) mm wide at the base [ratio segment width at the base/middle segment length = (0.09)0.10-0.15(0.16)], 5-8(14)-lobed in distal half [ratio secondary sinus length/middle segment length = (0.18)0.19-0.25(0.33)]; petioles up to 21 cm long, without abscission zone, terete, not swollen, not deflexed in age, with retrorse, appressed or patent, eglandular hairs 0.3-0.8 mm long; stipules 2.8-5.8 mm long, 1.4-3.8 mm wide, lanceolate, free or connate, papery, brown, with scattered, eglandular hairs on both surfaces and on the margin. *Inflorescence* a monochasial cyme; cymules 2-flowered, solitary [ratio cymule length/leaf length = (1.4)2.7-3.9(7.4)]; peduncles (12)46-70(88) mm long, with retrorse, appressed or patent, eglandular hairs 0.2-0.6 mm long; bracteoles 2.3-4.9 mm long, 0.3-1.4 mm wide, lanceolate, whorled; pedicels (21)27-37(55) mm long, with retrorse, appressed or patent, eglandular hairs 0.1-0.7 mm long. Flowers actinomorphic. *Sepals* (6.2)7.4-9.1(10) mm long, 2.3-4.3 mm wide, lanceolate, smooth, not accrescent, nerves 3-5, mucro (0.6)0.9-1.2(1.3) mm long [ratio mucro length/sepal length = 0.10-0.18], with antrorse, ± appressed, eglandular hairs 0.2-0.7 mm long on the abaxial surface, glabrous adaxially. *Petals* (10)11.1-13.5(14.6) mm long, (4.3)6.2-8(9) mm wide, erect-patent, rounded, without claw, light pink, hairy on the basal 1/4-1/2 of the adaxial surface and on the base of the abaxial surface, ciliate on the basal margin, with hairs 0.5-1.1 mm long. *Stamens* 10, both whorls bearing anthers; filaments (5.8)6.9-8.1(8.7) mm long, lanceolate, pink, pilose on the abaxial surface, ciliate on the proximal half, with hairs 0.3-0.7 mm long; anthers (1.5)1.6-1.9(2.1) mm long, unknown color. Nectaries 5, hemispheric, with a tuft of hairs at the top, dorsally glabrous. *Gynoecium* 6.9-9.6 mm long, unknown color. *Fruit* (25.6)27.1-29.7(30.8) mm long, erect, discharge of seed-ejection type; mericarps 2.4-3.4 mm long, 1.7-2.2 mm wide, without a strand of fibers, not compressed at the apex, smooth, without basal beak, with a basal callus, without a basal prong, brown, with ± patent, eglandular hairs 0.1-0.4 mm long and, usually, patent glandular hairs 0.4-0.7 mm long (mainly at the top of the mericarp); rostrum 16.1-20.5 mm long, with a narrowed apex 1.6-2.6 mm long, not twisted, with ± patent, eglandular hairs 0.1-0.4 mm long and, sometimes, patent glandular hairs 0.5-0.8 mm long; stigmatic remnants (4.5)5.6-6.2(6.6) mm long, with 5 glabrous lobes. *Seeds* 1.6-2.2 mm long, 1.4-2.1 mm wide, finely reticulate, uniformly colored, brown, glabrous. Cotyledons with entire margin. Fig. 175.

Pollen. *Geranium*-type (Lu & al. 1996: 320; Park & Kim 1997: 311).

Chromosome number. 2*n* = 28.

Phenology. Collected in flower from June to September.

Distribution. This species ranges from eastern Siberia (Khabarovsk and Primorye), through northeastern China (Heilongjiang, Jiangsu and Jilin) and Korea to Japan (Fig. 176).

Habitat. Grassy fields, wet places, and humus ground in mixed and deciduous forests; 250-1900 m.

Representative specimens examined. **China.** Heilongjiang: ciudad Haerbin, distrito Yilan, pueblo Jucheng Zi, 45º26'N, 128º1'E, 1959, *[illegible] 1927* (MO); Heilongjiang prov., 48º0'N, 128º0'E, 1959, *Prosp. Gen. Exped. 339* (PE); Haritun, 90 km NNW von Mergen, 49º47'N, 124º27'E, 1928, *Stötzner 44* (S). Jiangsu: Yun tai shan, Lian yun gang, NE of Jiangsu province, 34º38'N, 119º17'E, 19 Sep. 1981, *Yao 8345* (NY). Jilin: ciudad Changchun, Jing Yue Tan, 43º46'N, 125º28'E, 13 Aug. 1963, *Wang Wei & al. 2659* (PE). **Japan.** Honshū: Suruga, 34º58'N, 138º23'E, 1 July 1931, *Shiota s.n.* (GH, KYO, MO); Nagano prefecture, Minamisaku-gun, usudamachi, Furoh-onsen spa, 35º10'N, 138º33'E, 9 Aug. 1992, *Iketani 2811* (MO); Shizuoka, Asagiri-kogen in Mt. Fuji, Fujinomiya-shi, 35º18'N, 138º41'E, 21 Aug. 1977, *Mimoro & al. 1136* (CAS, GH, KYO, MO); Yamanashi prefecture, Kai province, foot of Mt. Fuji, Funatsu-mura, Minami-tsuru-gun, Shizuoka, Fumoto, ESE foot of Mt. Kenashi-yama, Fujinomiya-shi, 35º24'N, 138º33'E, 28 Aug. 1978, *Horino & al. 70* (KYO); Ohmachi, Ichikawa-shi, Shimousa, prefecture Chiba, 35º36'N, 139º44'E, 7 Sep. 1962, *Ohba 626889* (TI); Tokyo, 35º41'N, 139º45'E, Aug. 1878, *Yatabe s.n.* (WU); Katayama, Umashi, 35º46'N, 139º34'E, 29 Sep. 1893 (WU); Shimousa, Ne, Shiroi-machi, In'ba-gun, 35º47'N, 140º43'E, 23 Sep. 1966, *Kurihara & al. 157* (TI); Kai province, Higashi-yamanashi-gun, Mt. Kentoku, 35º49'N, 138º42'E, 14 Sep. 1958, *Kobayashi s.n.* (S); Suruma, 35º51'N, 139º32'E, June 1877, *Bisset s.n.* (K); Kai province, Utsukushi-no-muri, Kiyosato-mura & Ooidzumi-mura, Kita-koma-gun, 35º53'N, 138º27'E, 31 Aug. 1955, *Furuse 29773* (K); Shinano province, Mt. Nyuugasa, Fujimi-mura, Suwa-gun, 35º54'N, 138º15'E, 24 Sep. 1954, *Furuse 28332* (K); Nagano, foot Mt. Yatsu-ga-take, Tachi-zawa, Fujimi-choo Suwa-gun, 35º54'N, 138º15'E, 24 Sep. 1967, *Furuse 45857* (K); Nagano prefecture, Shinano province, foot Mt. Temgu-yama, Ohmiyama, Kawakami-mura, Minami-saku-gun, 35º56'N, 138º37'E, 15 Sep. 1961, *Furuse 39223* (GH, K, S); Nagano prefecture, en route from Azusayama to the Jumonji-Pass, Kawakami-mura, Minamisaku-gun, 35º58'N, 138º40'E, 3 Aug. 1960, *Iwatsuki 5096* (KYO); Nagano prefecture, Azusayama, Minamisaku-saku-gun, 35º58'N, 138º40'E, 7 Aug. 1958, *Kitagawa 1509* (KYO); Nagano prefecture, en route from Minoto-guchi to Gyôja-goya, Mts. Yatsuga-dake, 36º3'N, 138º20'E, 1 Sep. 1967, *Naruhashi & Wakabayashi 20* (KYO); Karuizawa, 36º20'N, 138º35'E, 26 Aug.

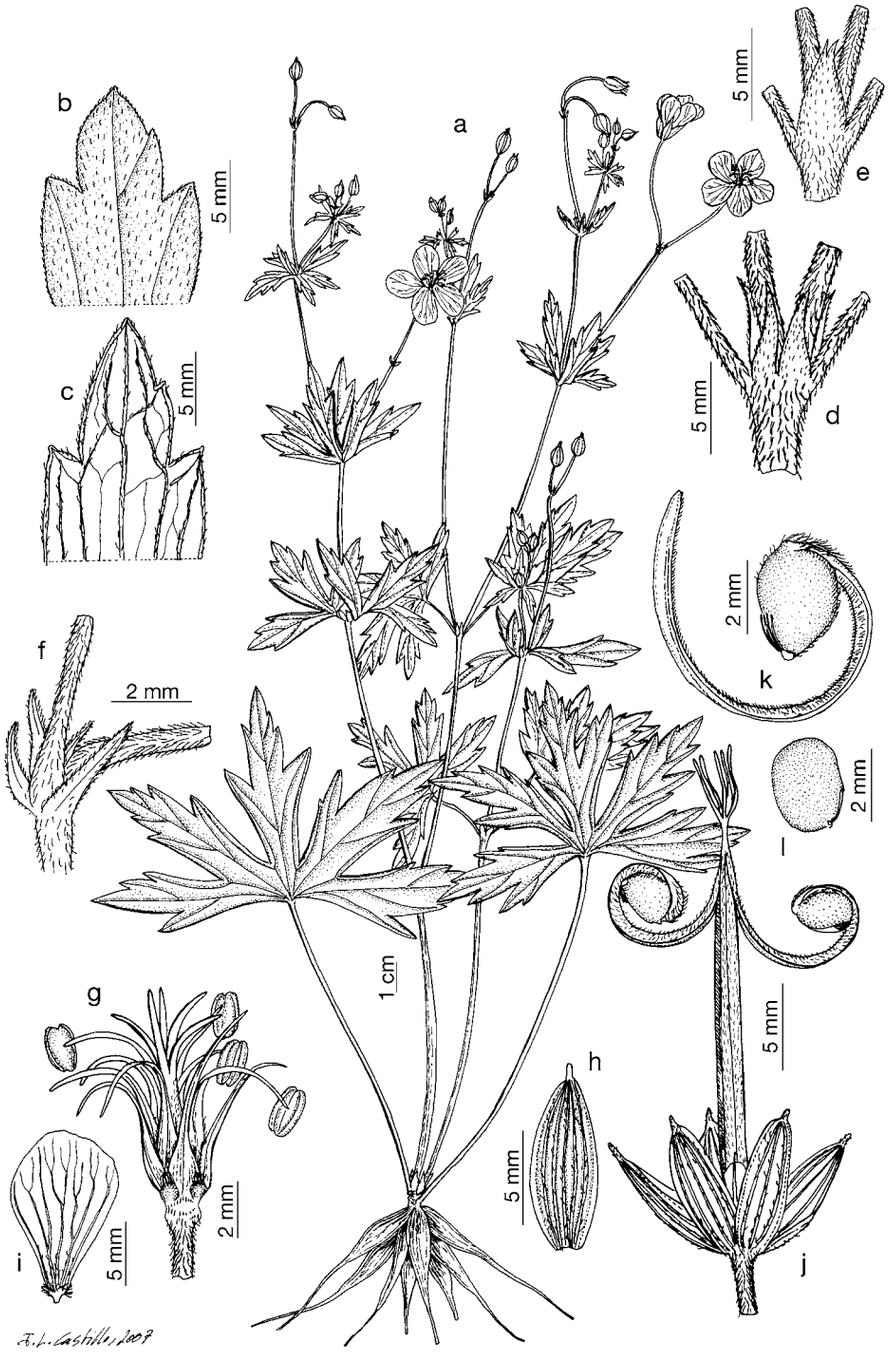


Fig. 175. *Geranium krameri*. a. Habit. b. Leaf indumentum on adaxial side. c. Leaf indumentum on abaxial side. d, e. Stipules. f. Bracteoles. g. Flower without petals and sepals. h. Sepal. i. Petal. j. Fruit. k. Mericarp. l. Seed. (Based on: a-f, *Uchiyama s.n.,13 Aug 1902*, TI; g-i, *Wang Wei & al. 2659,* PE; j-l, *Furuse s.n., 7 Oct. 1961*, GH).

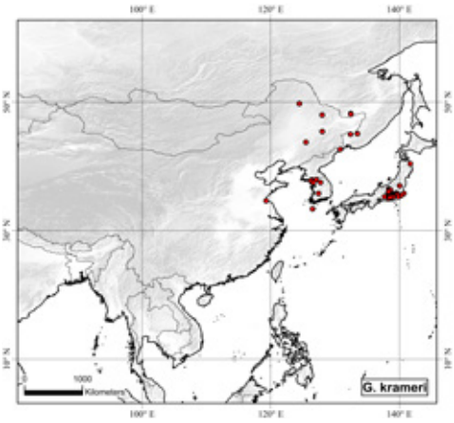


Fig. 176. Distribution of *Geranium krameri*.

1914, *Baker & Baker s.n.* (CAS); Nagano prefecture, Shinano province, Kita-saku-gun, near Karuizawa station, 36º21'N, 138º35'E, 28 Sep. 1957, *Furuse s.n.* (GH); Asamayama, 36º24'N, 138º31'E, 14 July 1898, *Faurie s.n.* (K); Tochigi province, Nasu, Mimotouke, 36º58'N, 140º3'E, 18 Aug. 1909, *Sakurai s.n.* (H); Iwate prefecture, Kunoegun, Taneichicho, Yagi, 40º25'N, 141º43'E, 12 Aug. 1973, *Takahashi 9920* (TI). **North Korea.** South Hwanghae: Myo jang dong, 37º55'N, 126º24'E, 5 Sep. 1967, *Lee & Lee s.n.* (TI). **Russia.** Khabarovsk: provincia autónoma hebrea, región Leninskiy, pueblo Babstovo, 48º7'N, 132º28'E, 5 Sep. 2005, *Tsirenova s.n.* (VLA); provincia autónoma hebrea, región Leninskiy, pueblo Lazarevo, a 3 km. al sur por la carretera, 48º14'N, 132º26'E, 5 Sep. 2005, *Tsirenova s.n.* (VLA); provincia autónoma hebrea, pueblo Lazarevo, a 3 km, 48º14'N, 132º26'E, 5 Sep. 2005, *Tsirenova s.n.* (VLA). Primorye: lac Hanka, Turga Rock, 45º0'N, 132º24'E, 20 June 1899, *Bohnhof 68* (G, NY); Kirovsky, pr. pagum Kirovsky, 45º5'N, 133º29'E, 20 June 1975, *Ulanova & Ponomarchuk 5977* (H, P, W). **South Korea.** Gyeonggi: Sokpat, 37º29'N, 127º44'E, 5 Nov. 1917, *Nakai 6247* (TI); Kyunggi, Mt. Soyo, 37º56'N, 127º5'E, 12 Aug. 1990, *Hee-jang Cha s.n.* (KUS). Incheon: route de Chemulpo a Seoul, 37º28'N, 126º37'E, 13 Sep. 1889, *Bodinier 260* (E, P). Jeju: Quelpaert in herbidis Hallaisan, 33º22'N, 126º30'E, 18 Sep. 1908, *Taquet s.n.* (E). North Jeolla: Chinanpo, 35º46'N, 127º26'E, Aug. 1906, *Faurie 582* (BM).

Discussion. Geranium krameri is an erect herb with a short vertical rootstock that bears a fascicle of fusiform roots. The indumentum of this species is variable, with patent eglandular hairs in some specimens and retrorse and appressed in others. In some specimens there are also some glandular hairs on the mericarp and on the fruit rostrum. The stipules of *G. krameri* are usually connate for at least part of their length. In some cases they appear free, at least at some nodes of the plant. The variability of this feature is difficult to ascertain in herbarium material and, consequently, field studies are needed to clarify the variation among individuals and populations.

Geranium krameri is close to *G. soboliferum* and *G. dahuricum*. The three species have a fascicle of fusiform roots, more or less connate stipules, deeply divided leaves, and large petals that are hairy on the adaxial surface. They also share a similar inflorescence and an essentially eglandular indumentum. *Geranium krameri* has a very short rootstock in which the long, thickened roots are clustered in a fascicle. In contrast, in *G. soboliferum* and *G. dahuricum* the thickened roots are more spread out along the rootstock. *Geranium krameri* is well characterized by its shorter petals, its hairy nectaries, and its long stigmatic remnants. *Geranium soboliferum* has longer petals than *G. krameri*, although the measurements somewhat overlap. In addition, *G. soboliferum* has more deeply divided leaves than *G. krameri*, and glabrous nectaries. *Geranium krameri* has longer sepals and longer stigmatic remnants than *G. dahuricum*, also with some overlap.

---

59. Geranium soboliferum Kom., Trudy Imp. S.-Peterburgsk. Bot. Sada 18(6): 433. 1901. Type locality: "Habitat in paludibus herbosis Manshuriae nec non Koreae septentr. Legi: 1) 16/VII 1896 et 27/VII 1896. Inter Ninguta et Omoso, Manshuriae. 2) 21/VIII 1896. Tiao-cho in districtu urbis Kirin Manshuriae. 3) 3/VIII 1897. Omegan in valle fl. Che-czchen-gan fluvium Jalu-dsian influentis, Koreae septentr. district. Kapsan. 4) 18/VII 1897. In valle fluvii Julu-dsian decursu supremo contra Se-san-po ad ripam dextram (Manshuria)". Type: North Korea. Kapsan distr., above Omegan in Khechkhengan river (Jalu river tributary) valley, 41º04'N, 128º18'E, 3 Aug. 1897, *V.L. Komarov s.n.* (lectotype, designated by Tsyrenova 1985a: 1640, LE!).

Geranium pseudosibiricum var. *striatum* Regel, Tent. Fl.-Ussur. 41. 1861. *Geranium ussuriense* Tsyren., Novosti Sist. Vyssh. Rast. 39: 218. 2007. Type locality: "Meston. Na niznej i srednej Usuri: rastet' vo mnozestve na lugach' bliz' mysa Aua; bliz' ust'ev' rek': Keca, Abderi, Bikina i Imy" [in Russian]. Type: Russia. Ussuri, Bikni Mündung, *R.K. Maack s.n.* (lectotype, designated by Tsyrenova 2007: 219, LE!).

Geranium pseudosibiricum var. *grandiflorum* Regel, Tent. Fl.-Ussur. 41. 1861. Type locality: "Meston. Na verchnej Usuri: na lugach' bliz' kitajskoj derevni Damgu i po r. Sungaci. Cvetet' v' ijule" [in Russian]. Type: Russia. Sungacha river, Damgu, July 1859, *R.K. Maack s.n.* (lectotype, here designated, LE!).

Geranium hakusanense Matsum., Bot. Mag. (Tokyo) 15: 123. 1901. *Geranium yesoense* var. *hakusanense* (Matsum.) Makino, Ill. Fl. Nippon. ed. 2 398. 1954. *Geranium soboliferum* var. *hakusanense* (Matsum.) Kitag., Neo-Lin. Fl. Manshur.: 419. 1979. Type locality: "Hab. in Japonia: prov. Shinano, monte Asama leg. C. Owatari anno 1894. Fl. et fr. Augusto". Type: Japan. Honshū, Shinano, monte Asama, 36º24'N, 138º31'E, Aug. 1894, *C. Owatari s.n.* (no original material located).

Geranium kiusianum Koidz., Bot. Mag. (Tokyo) 39: 7. 1925. *Geranium soboliferum* var. *kiusianum* (Koidz.) H. Hara, J. Jap. Bot. 22: 171. 1948. Type locality: "Hab. Kiushiu: Prov. Bungo, Tano, leg. K. Mayebara VII. 22, 1916". Type: Japan. Kyūshū, Bungo, Tano, 31º49'N, 131º17'E, 22 July 1916, *K. Mayebara s.n.* (no original material located).

Geranium hidaense Makino, J. Jap. Bot. 3: 36. 1926. *Geranium yesoense* var. *hidaense* (Makino) H. Hara, Enum. Sperm. Jap. 3: 6. 1954. Type locality: "Hab. Prov. HIDA: Near Takamaya (T. Makino! 1924, 1925)". Type: Japan. Honshū, Hida, near Takamaya, 36º08'N, 137º15'E, Aug. 1924, *T. Makino s.n.* (lectotype, here designated, CAS!).

Perennial herbs, 49-89 cm tall. *Rootstock* 7-9 mm in diameter, ± vertical, not tuberculate, not turnip-shaped, with a fascicle of long and thickened roots. *Stem* erect, leafy, not rooting at nodes, stolons absent, without vegetative stems, with retrorse, appressed, eglandular hairs 0.2-0.5 mm long. *Basal leaves* in a ± deciduous rosette, cauline leaves opposite; leaf laminas (4.1)5.7-6.5(9.5) cm long, 4.4-11.2 cm wide, not peltate, palmatifid [ratio main-sinus length/middle segment length = (0.90)0.93-0.96], polygonal in outline, base cordate, not coriaceous, with nerves not projected, pilose, with appressed, eglandular hairs on both surfaces; segments 5, in 1 plane, middle segment rhombic, (1.6)1.8-3.3(4.4) mm wide at the base [ratio segment width at the base/middle segment length = 0.03-0.10], 8-10(18)-lobed in distal half [ratio secondary sinus length/middle segment length = (0.31)0.33-0.50(0.60)]; petioles up to 19 cm long, without

abscission zone, terete, not swollen, not deflexed in age, with retrorse, appressed, eglandular hairs 0.2-0.5 mm long; stipules (2.8)8.4-12.3 mm long, 2.3-4.4 mm wide, triangular, connate, papery, green to brown, with scattered, eglandular hairs on both surfaces and on the margin. *Inflorescence* a monochasial cyme; cymules 2-flowered, solitary [ratio cymule length/leaf length = (1.6)2.7-4.9(5.8)]; peduncles 47-104(137) mm long, with retrorse, appressed, eglandular hairs 0.2-0.5 mm long; bracteoles 2.4-6.4 mm long, 0.5-1.7 mm wide, lanceolate, whorled; pedicels (11)29-35(41) mm long, with retrorse, appressed, eglandular hairs 0.2-0.6 mm long. Flowers actinomorphic. *Sepals* (7.3)8.9-10.8 mm long, 3.3-4.7 mm wide, lanceolate, smooth, not accrescent, nerves 3-5, mucro (1.2)1.6-2.1(2.5) mm long [ratio mucro length/sepal length = 0.13-0.26], with antrorse, appressed, eglandular hairs 0.2-0.3 mm long on the abaxial surface, glabrous adaxially. *Petals* (13.4)14.2-18(20) mm long, (7.6)8-10(11.8) mm wide, erect-patent, rounded, without claw, deep reddish purple, hairy on the basal 1/3-1/2 of the adaxial surface and on the base of the abaxial surface, ciliate on the basal margin, with hairs 0.8-1.1 mm long. *Stamens* 10, both whorls bearing anthers; filaments (6.2)8.5-9.9(10.6) mm long, lanceolate, purple, pilose on the abaxial surface, ciliate on the proximal half, with hairs 0.2-0.6 mm long; anthers (1.5)1.7-2.3 mm long, blue. Nectaries 5, hemispheric, with a tuft of hairs at the top, dorsally glabrous. *Gynoecium* 6.7-10.8 mm long, purple. *Fruit* (28.4)30-32(35.1) mm long, erect, discharge of seed-ejection type; mericarps 3.4-3.9 mm long, 1.6-2.1 mm wide, without a strand of fibers, not compressed at the apex, smooth, without basal beak, with a basal callus, without a basal prong, brown, with ± patent, eglandular hairs 0.1-0.7 mm long and, sometimes, patent glandular hairs 0.7-1.1 mm long (mainly at the top of the mericarp); rostrum 18-22.9 mm long, with a narrowed apex 1.9-3.4 mm long, not twisted, with ± patent, eglandular hairs 0.1-0.2 mm long and, sometimes, patent glandular hairs 0.5-0.6 mm long; stigmatic remnants (5)5.6-6.4(6.7) mm long, with 5 glabrous lobes. *Seeds* 2.3-2.6 mm long, 1.6-1.9 mm wide, finely reticulate, uniformly colored, brown, glabrous. Cotyledons with entire margin. Fig. 177.

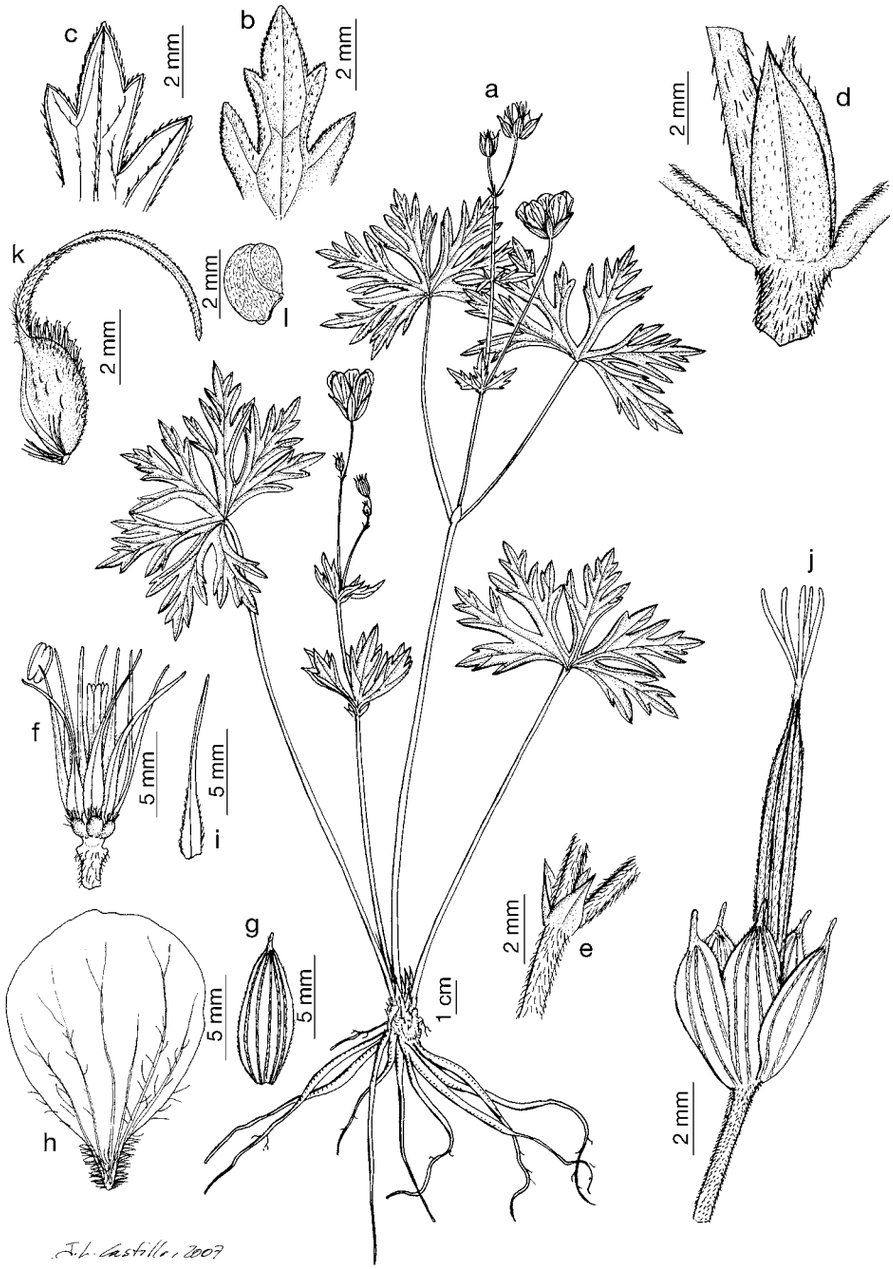


Fig. 177. *Geranium soboliferum*. a. Habit. b. Leaf indumentum on adaxial side. c. Leaf indumentum on abaxial side. d. Stipules. e. Bracteoles. f. Flower without petals and sepals. g. Sepal. h. Petal. i. Staminal filament. j. Fruit. k. Mericarp. l. Seed. (Based on: a-i, *Shimizu 502,* GH; j-l, *Fu Peiyun & al. 1556,* PE).

Pollen. *Geranium*-type (Lu & al. 1996: 320; Park & Kim 1997: 311).

Chromosome number. 2*n* = 28.

Phenology. Collected in flower from July to October.

Distribution. This species ranges from northeastern China (Heilong-

jiang, Jilin and Liaoning), through eastern Siberia (Primorye) and North Korea to Japan (central Honshū and Kyūshū) (Fig. 178).

Habitat. Fields, meadows, marshes, and wet grassy places; 400-1800 m.

Representative specimens examined. **China.** Heilongjiang: Manshuriae, inter Ninguta et Omoso, 44°23'N, 129°26'E, 16 July 1896, *Komarov s.n.* (LE); NE Manshuria near Sta. Shitokheza, 46°8'N, 130°52'E, 30 July 1902, *Litvinov 1950* (NY). Jilin: Manshuria chinensis, provincia Mukdenensis, fluv. Yalu super, ripa dextra, Contra Lesanpo, 41°7'N, 126°9'E, 18 July 1897, *Komarov 997* (NY, P, TI); distrito Yanbian, población Antu, pueblo Er Dao Bai He, 42°34'N, 128°20'E, 9 Sep. 1959, *Fu Peiyun 1556* (PE);-Tiao-cho in districtu urbis Kirin Manshuriae, 43°0'N, 126°0'E, 21 Aug. 1896, *Komarov s.n.* (LE); prefectura Yanbian, ciudad Huichun, pueblo Chunhua, urbanización Lan Jia Tang Ii, 43°11'N, 131°4'E, 6 Aug. 1958, *Wang Chongshu 2009* (MO); prov. Kirinensis, flum. Mu-dan-dsian, 43°18'N, 129°29'E, 27 July 1896, *Komarov s.n.* (W); Jilin Shang, 43°41'N, 126°54'E, 2 Sep. 1936, *Kitagawa s.n.* (TI); ciudad Jilin, municipio Jiaohe, pueblo Lafa, 43°42'N, 127°19'E, 7 Sep. 1950, *Fu Peiyun 2378* (MO); Kirin, O-muhsien, Ch'iaypaho, 43°43'N, 127°20'E, 23 Aug. 1931, *Kung 2176* (PE). Liaoning: Liaoning Shang, 41°0'N, 123°0'E, 16 Aug. 1905, *Kuwabara s.n.* (TI). **Japan.** Honshū: Kai province, Kita-koma-gun, Utsukushi-no-mori, Kiyosato-mura & Ooidzumi-mura, 35°54'N, 138°25'E, 31 Aug. 1955, *Furuse 29772* (K, S); Nagano prefecture, Shinano province, half-way up Amida-dake, Mt. Yatse Hara-mura Suwa-gun, 35°58', 138°12'E, 29 Aug. 1960, *Furuse s.n.* (GH, S); Shinano, Minami-saku-gun, between Mt. Akadate and Mt. Nobe, 36°1'N, 138°31'E, 5 Aug. 1961, *Sato 3048* (TI); Kirigamine, Mt. Kuruma, 36°6'N, 138°12'E, 1 Sep. 1967, *Togashi s.n.* (TI); Iwaki, Nishi-shirakawa-gun, Shirakawa-machi, Takayama, 36°8'N, 137°15'E, 23 Sep. 1940, *Saito 2714* (TI); Gunma prefecture, Kanra-gun, Shimonita-machi, Kouzu farm, 36°12'N, 138°47'E, 25 Sep. 1960, *Satomi s.n.* (TI); Kôdzuke province, Kôdzu bokujô, Kanra-gun, 36°14'N, 138°55'E, 9 Sep. 1956, *Satomi 14471* (S); Tomioka, 36°15'N, 138°53'E, 1876, *Savatier s.n.* (K); Nagano prefecture, Minamigaoka, Karuizawa-cho, Kitasaku-gun, 36°18'N, 138°30'E, 15 Sep. 1968, *Shimizu 502* (BM, GH, KYO, L, P); Shiono, Shinohse, 36°20'N, 138°30'E, 14 Sep. 1895 (WU); Karuizawa, 36°20'N, 138°35'E, 7 Aug. 1914, *Baker & Baker s.n.* (CAS); Nagano prefecture, Shinano province, Karuizawa-station, Karuizawa-machi, Kita-saku-gun, 36°20'N, 138°35'E, 28 Sep. 1957, *Furuse 33192* (GH, K); near Nikko, 36°20'N, 138°35'E, 1899, *Manabe s.n.* (CAS); Shinano, Minami-karuizawa, 36°20'N, 138°35'E, 18 Aug. 1951, *Mizushima 10298* (MO, TI); Nagano prefecture, Shinano province, Kita-saku-gun, near Karuizawa station, 36°21'N, 138°35'E, 28 Sep. 1957, *Furuse s.n.* (GH, S); Asamayama, 36°24'N, 138°31'E, *Haneck 6* (K); Shimotsuke province, Nasu Kofukakori, 37°7'N, 139°58'E, 13 Sep. 1970, *Kitamura s.n.* (KYO); Iwaki, Nishi-shirakawa-gun, Nanko, 37°10'N, 140°10'E, 9 July 1950, *Satomi s.n.* (TI). Kyūshū: Bungo, 31°49'N, 131°17'E, 18 Sep. 1922, *Tashiro s.n.* (KYO). Kyūshū: Higo, Aso-gun, Namino, 32°55'N, 131°13'E, 26 Aug. 1926, *Tashiro s.n.* (KYO); Kumamoto prefecture, Aso-gun, Ichinomiya-machi, Hatabe Spa, 32°56'N, 131°7'E, 8 Sep. 1957, *Shimada 9889* (KYO); Higo, Kumamoto prefecture, Aso-gun, Uchimaki-mura, 32°58'N, 131°2'E, 22 Sep. 1917, *Kouzuma s.n.* (KYO); Kumamoto prefecture, Aso-gun, Uchimaki-mura, 32°58'N, 131°2'E, 10 Oct. 1922, *Yamazaki s.n.* (TI); Oita prefecture, Mt. Kuju, Kokone-cho, Kusu-gun, 33°7'N, 131°14'E, 9 Sep. 1922, *Tashiro 1223* (GH, KYO, L, TI, Z). **North Korea.** Ryanggang: Chang Pek San, 41°59'N, 128°4'E, Aug. 1913, *Mori 135* (TI). **Russia.** Primorye: district Possiet, 42°38'N, 130°48'E, 2 Sep. 1929, *Saverkia 767* (NY); suburb of Nakhodka, Marine biological station Vostok, 42°48'N, 132°53'E, 18 Aug. 1989, *Kharkevich & Buch 583* (H, MO, NY); distrito Jasanskiy, estación Primorskaya, 43°6'N, 131°35'E, 20 July 2003, *Korkyshko s.n.* (VLA); lac Hanka, Turga Rock, 45°0'N, 132°24'E, 15 Aug. 1899, *Bohnhof 245* (MA, NY, P).

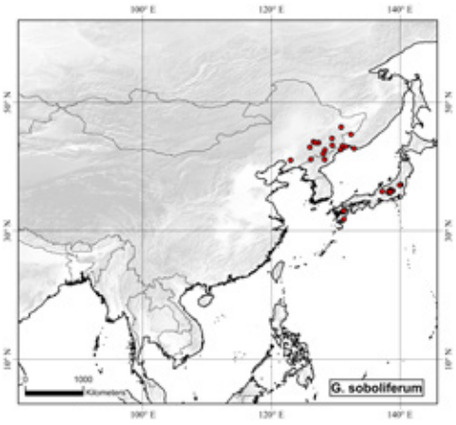


Fig. 178. Distribution of *Geranium soboliferum*.

Discussion. Geranium soboliferum is an erect perennial herb, easily identified by its triangular, connate stipules, deeply divided leaves, and petals that are hairy on the adaxial surface. The indumentum consists of short, retrorse, appressed eglandular hairs scattered on the base of the stem and more abundantly toward the inflorescence. The sepals with minute appressed hairs are also distinctive. Glandular hairs, when present, appear to be restricted to the apex of the mericarp and, sometimes, the base of the fruit rostrum. The petals are long, with hairs on the adaxial surface. The hairs are more abundant toward the base, although they reach half-way up the petal. Connate stipules of *G. soboliferum* were present at all nodes on all individuals examined. They are deciduous, however, and on the basal nodes they are usually wrinkled or lacking. The triangular shape of the stipules is distinctive. They appear to be greenish at first, then become reflexed and brownish when dry. The epithet *soboliferum* refers to the ability to produce soboles, or underground stolons. Yeo (2002a) stated that soboles were not present in the plants he cultivated. I found no soboles among the material studied. *Geranium soboliferum* is similar to *G. dahuricum*. The latter can be differentiated by its shorter petals, usually glabrous nectaries, and more deeply divided leaves with fewer lobes per segment.

Kurata & al. (2019) evaluate the genetic diversity and population structure of the *G. soboliferum* using microsatellite markers, with special emphasis on var. *hakusanense* and var. *kiusianum.*

60. Geranium hayatanum Ohwi, Acta Phytotax. Geobot. 2(3): 152. 1933. *Geranium uniflorum* Hayata, J. Coll. Sci. Imp. Univ. Tokyo 25(19): 65. 1908, nom. illeg., non Pacho, 1827. *Geranium suzukii* var. *hayatanum* (Ohwi) Masam., J. Geobot. 6: [without page or plate number]. 1957. Type locality: "Hab. ad verticem montis Morrison, ad 13094 ped. alt., leg.

S. Nagasawa, Nov. 1905, (No. 684); in eodem monte, ad 13000 ped. alt., leg. T. Kawakami et U. Mori, Oct. 1906, (No. 2254)". Type: China. Taiwan, montis Morrison, 23º28'N, 120º57'E, Oct. 1906, *T. Kawakami & U. Mori 2254* (lectotype, designated by Aedo 2017a: 49, TI image!).

Perennial herbs, 18-60 cm tall. *Rootstock* 3.6-8 mm in diameter, ± horizontal, not tuberculate, not turnip-shaped, with thickened roots along the rootstock. *Stem* trailing and ascending, leafy, not rooting at nodes, stolons absent, without vegetative stems, with patent to retrorse, eglandular hairs 0.2-1 mm long. *Basal leaves* in a ± persistent rosette, cauline leaves opposite; leaf laminas (2.8)3.4-4.9(7.2) cm long, 3.1-8.6 cm wide, not peltate, palmatifid [ratio main-sinus length/middle segment length = 0.75-0.92], polygonal in outline, base cordate, not coriaceous, with nerves not projected, pilose, with appressed, eglandular hairs on both surfaces; segments 5, in 1 plane, middle segment rhombic, 3.4-9.8 mm wide at the base [ratio segment width at the base/middle segment length = 0.14-0.30], 5-11-lobed in distal half [ratio secondary sinus length/middle segment length = 0.21-0.38]; petioles up to 20 cm long, without abscission zone, terete, not swollen, not deflexed in age, with patent to retrorse, eglandular hairs 0.3-1 mm long; stipules 4.8-9.7 mm long, 2.9-6.6 mm wide, broadly ovate, connate, papery, brown, with scattered, eglandular hairs on both surfaces and on the margin. *Inflorescence* a dichasial cyme with monochasial branches; cymules 1-flowered, solitary [ratio cymule length/leaf length = 1.3-3]; peduncles (9.1)24.2-75.8(154) mm long, with patent to retrorse, sometimes uncinate, eglandular hairs 0.2-1.1 mm long; bracteoles 4.3-9.7 mm long, 1-1.9 mm wide, lanceolate, opposite; pedicels 15-30(49.5) mm long, with patent to retrorse, sometimes uncinate, eglandular hairs 0.2-0.8 mm long. Flowers actinomorphic. *Sepals* (6.5)7.6-9.2(10.1) mm long, 2.6-4.9 mm wide, lanceolate, smooth, not accrescent, nerves 3, mucro 1.1-2.5 mm long [ratio mucro length/sepal length = 0.14-0.24], with antrorse to patent, eglandular hairs 0.2-1.4 mm long on the abaxial surface, glabrous adaxially. *Petals* (12.1)14.1-18.4(20.5) mm long, 6.7-11.3 mm wide, erect-patent, rounded or rarely emarginate (notch 0.2-0.4 mm deep), without claw, light purple with a whitish base, hairy on the base of both surfaces, ciliate on the basal margin, with hairs 0.6-1.4 mm long. *Stamens* 10, both whorls bearing anthers; filaments 6.4-9.1 mm long, lanceolate, purple distally, paler at base, pilose on the abaxial surface, ciliate on the proximal half, with hairs 0.2-0.6 mm long; anthers 1.7-2.1 mm long, blue. Nectaries 5, hemispheric, with a tuft of hairs at the top, dorsally glabrous. *Gynoecium* 6.3-9.6 mm long, deep pink. *Fruit* 23.5-31.5 mm long, erect, discharge of seed-ejection type; mericarps 3.1-4.6 mm long, 1.6-2.3 mm wide, without a strand of fibers, not compressed at the apex, smooth, without basal beak, with a basal callus, without a basal prong, brown, with erect to patent, eglandular hairs 0.3-1.2 mm long; rostrum 15.2-22.8 mm long, with a narrowed apex 1.6-3.4 mm long, not twisted, with ± patent, eglandular hairs 0.3-1 mm long; stigmatic remnants 3.5-5.6 mm long, with 5 glabrous lobes. *Seeds* 2.3-3.5 mm long, 1.5-1.7 mm wide, finely reticulate, uniformly colored, brown, glabrous. Cotyledons with entire margin. Fig. 179.

Pollen. *Geranium*-type (Park & Kim 1997: 313 [sub *G. uniflorum*]).

Chromosome number. Unknown.

Phenology. Collected in flower from June to October.

Distribution. This species is endemic to Taiwan (Fig. 180).

Habitat. Roadsides, exposed and rocky slopes with *Juniperus* L. and *Yushania* Keng f., *Abies* Mill. forests, and alpine grassland; 1400-3800 m.

Additional specimens examined. **Taiwan.** Chiayi Co.: Pai-yunn hostel to the top of Mt. Morrison, 23º28'N, 120º57'E, 6 Sep. 1969, *Chien-chang Hsu 6271* (TAI); Mt. Morrison, 23º28'N, 120º57'E, 6 Sep. 1969, *Kao 134* (TAI); Chiayi (Kagi), pr. Haiunsanso, in Mt. Yu-shan (Mt. Niitaka), 23º28'N, 120º57'E, 13 Sep. 1964, *Koyama 23881* (E); Chiayi Co., Yushan, 23º28'N, 120º57'E, 5 July 1998, *Yu-pin Cheng 2363* (PE). Nantou Co.: Hsinyi Hsiang, en route from Kuankao to Chungyangchinkuang, 23º29'N, 120º59'E, 8 July 1993, *Chi-Hsiung Chen 100* (MO); Mayfong, 23º54'N, 120º44'E, 13 June 1980, *Kao 9476* (TAI); Nokozan, 23º59'N, 121º15'E, 1919, *Matuda 252* (TI); Nokogoe in Karenko, 23º59'N, 121º15'E, June, *Ohwi 3128* (P); Nôkô, Central Range, 23º59'N, 121º15'E, 23 Aug. 1929, *Suzuki 2073* (MO); Mt. Neng-kao, between Tien-chih (Noko) and Neng-kao Pass, 23º59'N, 121º15'E, 12 Aug. 1964, *Tamura & Koyama 23313* (TI); Tungyuen Lushan, 24º2'N, 121º11'E, 25 Aug. 1984, *Huang 1209* (TAI); Jenai Hsiang, route from Yunhai to Tienchih, 24º3'N, 121º16'E, 13 Oct. 1992, *Hsiu-Lan Ho & al. 596* (MO); Jenai Hsiang, Tsuifeng, 24º6'N, 121º11'E, 21 July 1998, *Chiu & Yang 4607* (IBSC); Kun-Yang, 24º7'N, 121º16'E, 27 June 1991, *Wei-Hsin Hu 1501* (GH); Tayuling to Hohuanshan, 24º10'N, 121º18'E, 22 Aug. 1967, *Hsu 3814* (TAI). Hsinchu Co.: Ta Pa Chien Sahn, 24º27'N, 121º15'E, 11 Aug. 1972, *Chang 2039* (TAI); Wufen Hsiang, Sheipa National Park, Tapachienshan, 24º27'N, 121º15'E, 7 Sep. 1993, *Chieh-Lin Huang 106* (E, MO); Ta-Pa-Chien-Shan, 24º27'N, 121º15'E, 11 Aug. 1972, *Moo 2062* (TAI); in Mt. Nanko-taisan, 24º45'N, 121º12'E, July 1933, *Ohwi 4193* (TI). Hualien Co.: Hsiulin Hsiang, Taroko National Park, Chilaishan en route from Chengkung nº 1 campsite to the fork of the trails between Chilai, 24º6'N, 121º19'E, 20 July 1994, *Hsiao-Ying Shen 71* (CAS, MO); Tayuling on highway 8 to the summit of Mt. Hohuan-shan, 24º8'N, 121º17'E, 28 June 1977, *Boufford & al. 19304* (MO); Hsiulin Hsiang, Hohuanshan, Loying lodge, 24º8'N, 121º17'E, 1 Oct. 1996, *Chiu & Li 3799* (MO); Hohuanshan, 24º8'N, 121º17'E, 4 Aug. 1977, *Kao 8822* (MO); Mt. Ho-huan, 24º8'N, 121º16'E, 22 Aug. 1967, *Kuo 2642* (TAI). Ilan Co.: Nahutashan, Nanhushanchuang, 24º21'N, 121º27'E, 10 Sep. 1984, *Huang 883* (TAI); Mt. Nanhuta-shan, between Kamibajin and Bunakkei, 24º21'N, 121º27'E, 23 July 1963, *Tamura & Shimizu 20755* (E); Chi-li-ting to nan-hu-shan-chuang, 24º27'N, 121º28'E, 21 Aug. 1969, *Chien-chang Hsu 5984* (TI). Taichung Co.: Yunlingshanchaung, Nanhupeishan, Nanhutashan, 24º21'N, 121º26'E, 5 July 1986, *Wang & al. 3676* (GH); Nanhutashan, 24º21'N, 121º26'E, 21 Aug. 1969, *Yamazaki 86* (TI); Mt. Hsueh-shan,

24º24'N, 121º14'E, 12 July 1963, *Tamura 21100* (E); Shan-cha Shelter to Hsueh-shan-pei-feng, 24º24'N, 121º14'E, 7 July 1987, *Wang & al. 4581* (TAI).

Discussion. Geranium hayatanum shares with *G. suzukii* the trailing habit and 1-flowered cymules. However, *G. hayatanum* is a more robust species very easy to recognize by its long petals, its long and connate stipules similar to those of *G. koreanum* and *G. shikokianum*, and its decumbent but not rooting stems. Both *G. hayatanum* and *G. suzukii* are endemic to Taiwan.

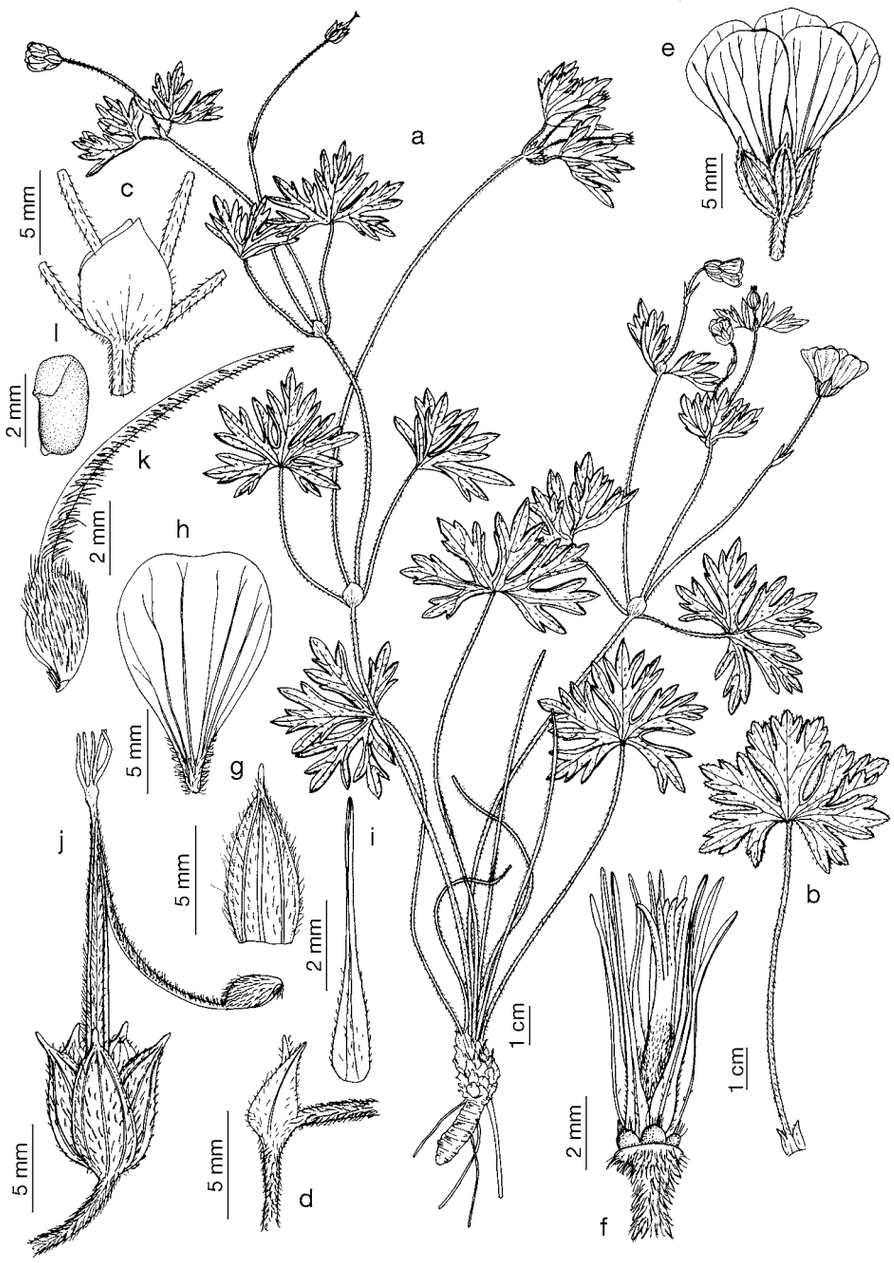


Fig. 179. *Geranium hayatanum*. a. Habit. b. Leaf. c. Stipules. d. Bracteoles. e. Flower. f. Flower without petals and sepals. g. Sepal. h. Petal. i. Staminal filament. j. Fruit. k. Mericarp. l. Seed. (Based on: a, d-h, *Ohwi 4193*, TI; b, *Tamura & Koyama 23313*, TI; c, *Tamura 21100*, TI; i-l, *Huang 883*, TAI).

Fig. 180. Distribution of *Geranium hayatanum*.

61. Geranium yoshinoi Makino ex Nakai, Bot. Mag. (Tokyo) 26: 258. 1912. Type locality: "Hab. Nippon, prov. Bitchū: Hongōmura X. 1910, fructifera, 21. VIII. 1911 floriferum (Zensuke Yoshino) ibidem VII. 1908 floriferum (Yukimatsu Tamura)". Type: Japan. Honshū, Bitchū, Hongōmura, 34º49'N, 133º24'E, Oct. 1910, *Z. Yoshino s.n.* (lectotype, designated by Aedo 2017a: 46: TI!).

Perennial herbs, 34-94 cm tall. *Rootstock* 5.7-8.7 mm in diameter, ± vertical, not tuberculate, not turnip-shaped, with a fascicle of long and thickened roots. *Stem* erect, leafy, not rooting at nodes, stolons absent, without vegetative stems, with retrorse, appressed, eglandular hairs 0.2-0.7 mm long. *Basal leaves* in a ± deciduous rosette, cauline leaves opposite; leaf laminas (4.9)5.4-7.8(9.3) cm long, 5.2-10.7 cm wide, not peltate, palmatifid [ratio main-sinus length/middle segment length = (0.73)0.78-0.88], polygonal in outline, base cordate, not coriaceous, with nerves not projected, pilose, with appressed, eglandular hairs on both surfaces; segments 5, in 1 plane, middle segment rhombic, (7.1)8.1-11.4(15.5) mm wide at the base [ratio segment width at the base/middle segment length = 0.15-0.27], 7-9-lobed in distal half [ratio secondary sinus length/middle segment length = 0.18-0.33];

petioles up to 56 cm long, without abscission zone, terete, not swollen, not deflexed in age, with retrorse, appressed, eglandular hairs 0.2-0.6 mm long; stipules 2.8-6.9 mm long, 0.8-4.1 mm wide, lanceolate, free or connate, papery, brown, with scattered, eglandular hairs on both surfaces and on the margin. *Inflorescence* a monochasial cyme; cymules 2-flowered, solitary [ratio cymule length/leaf length = 2.3-6.6]; peduncles 25-97 mm long, with retrorse, appressed, eglandular hairs 0.2-0.5 mm long; bracteoles 1.9-4.3 mm long, 0.4-0.9 mm wide, lanceolate, whorled; pedicels 17-48 mm long, with retrorse, appressed, eglandular hairs 0.2-0.5 mm long. Flowers actinomorphic. *Sepals* 6.2-7.4(7.8) mm long, 2.5-4.4 mm wide, lanceolate, smooth, not accrescent, nerves 3-5, mucro 0.7-1.6 mm long [ratio mucro length/sepal length = 0.12-0.21], with antrorse, ± appressed, eglandular hairs 0.1-0.4 mm long on the abaxial surface, glabrous adaxially. *Petals* (9.7)11-13.2(14.2) mm long, 3.2-9 mm wide, erect-patent, rounded, without claw, pink, hairy on the basal 1/4-1/2 of the adaxial surface and on the base of the abaxial surface, ciliate on the basal margin, with hairs 0.4-0.7 mm long. *Stamens* 10, both whorls bearing anthers; filaments 5.5-8.5 mm long, lanceolate, slightly dilated at the base, pink, pilose on the abaxial surface, ciliate on the proximal half, with hairs 0.2-0.4 mm long; anthers 1.3-2.1 mm long, unknown color. Nectaries 5, hemispheric, with a tuft of hairs at the top, dorsally glabrous. *Gynoecium* 5.3-8.1 mm long, unknown color. *Fruit* 18.7-26.2 mm long, erect, discharge of seed-ejection type; mericarps 2.7-4 mm long, 1.3-2 mm wide, without a strand of fibers, not compressed at the apex, smooth, without basal beak, with a basal callus, without a basal prong, brown, with ± patent, eglandular hairs 0.2-0.7 mm long; rostrum 10.6-17.3 mm long, with a narrowed apex 1.3-3.3 mm long, not twisted, with ± patent, eglandular hairs 0.1-0.2 mm long; stigmatic remnants (3.6)3.8-4.3(4.6) mm long, with 5 glabrous lobes. *Seeds* 2.1-2.4 mm long, 1.4-1.9 mm wide, finely reticulate, uniformly colored, brown, glabrous. Cotyledons with entire margin. Fig. 181.

Pollen. Ornamentation not studied.

Chromosome number. 2*n* = 28.

Phenology. Collected in flower from July to October.

Distribution. This species ranges from southern Honshū to Kyūshū, in Japan (Fig. 182).

Habitat. Moist, grassy places; 350-950 m.

Additional specimens examined. **Japan.** Honshū: Hiroshima prefecture, Sandakyo,

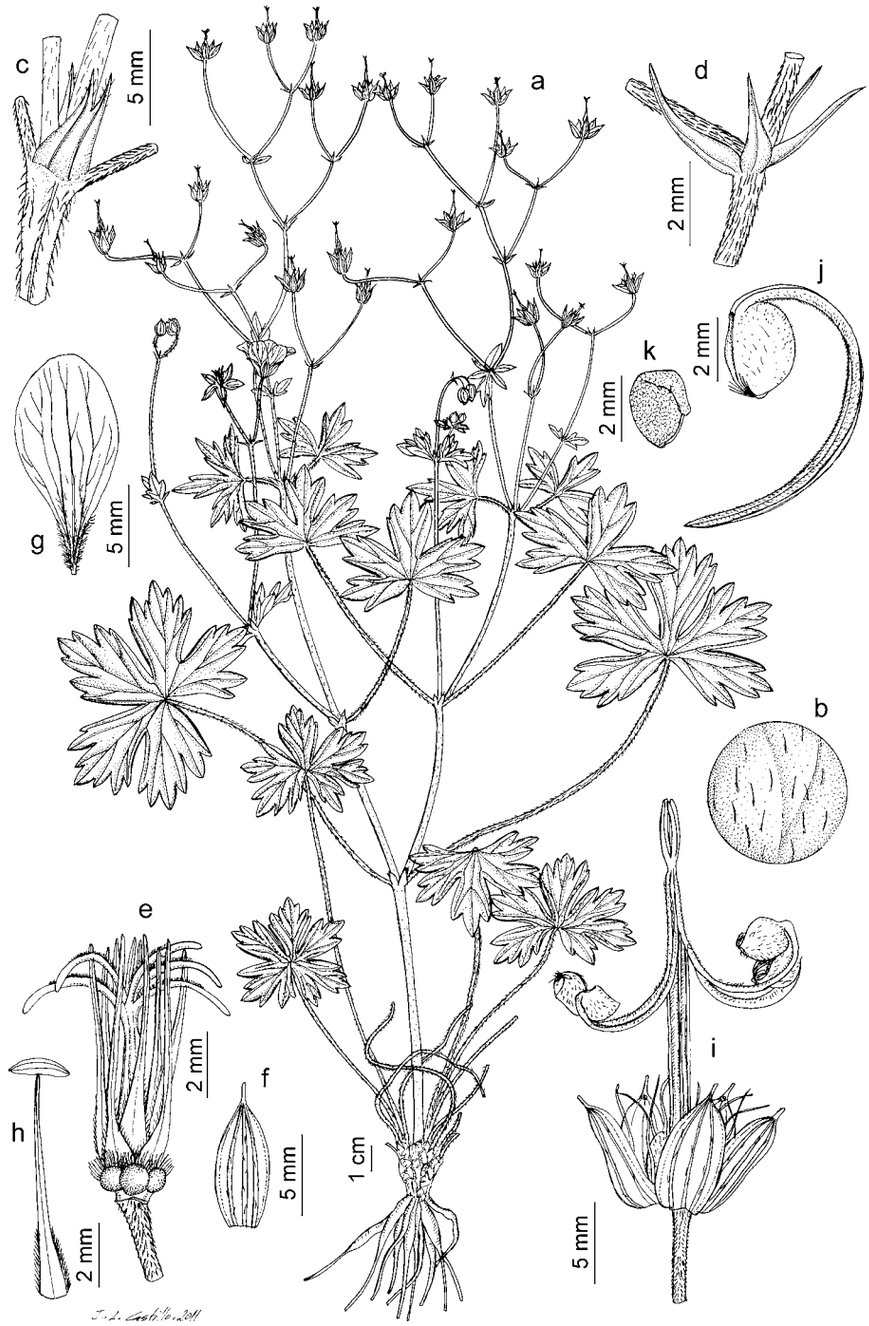


Fig. 181. *Geranium yoshinoi* a. Habit. b. Leaf indument, adaxial surface. c. Stipules. d. Bracteoles. e. Flower without petals and sepals. f. Sepal. g. Petal. h. Stamen. i. Fruit. j. Mericarp. k. Seed. (Based on: a-h, *Murata 18870*, KYO; i-k, *Hashimoto 16054*, KYO).

Togochi-machi, Yamagata-gun, 34º34'N, 132º14'E, Oct. 1934, *Makino s.n.* (TI); Hiroshima prefecture, Yamagata-gun, Mt. Garyu, 34º40'N, 132º20'E, 15 Oct. 1955, *Hara 2985* (TI); Hiroshima prefecture, Yamagata-gun, Yawatamura, 34º40'N, 132º20'E, 15 Oct. 1955, *Kanai s.n.* (TI); Mino province, 34º42'N, 135º31'E, 7 Aug. 1921, *Shiota 1966* (GH); Bitchu, Kawakami-gun, Hirakawa-mura, 34º43'N, 133º28'E, 13 Aug. 1932, *Tashiro s.n.* (KYO); Hiroshima prefecture, en route from Chikada to Senyôbara, Yuki-cho, Jinseki-gun, 34º45'N, 133º15'E, 2 Sep. 1978, *Fukuoka & Kurosaki 2012* (KYO); Bitchu province, 34º51'N, 133º45'E, 1937, *Makino s.n.* (TI); Hiroshima prefecture, Yamagata-gun, Geihoku-cho, Yawata plateau, 34º56'N, 133º13'E, 13 Oct. 1977, *Shimizu s.n.* (KYO); Hiroshima prefecture, Simoichiba, Misaka, Saijou-cho, Hiba-gun, 35º3'N, 133º11'E, 5 Oct. 2002, *Kurosaki 23174* (KYO); Hyogo prefecture, 35º6'N, 134º25'E, 18 Aug. 1988, *Hashimoto 16504* (KYO); Aichi prefecture, Kitashidara-gun, Shidara-machi, 35º6'N, 137º34'E, 13 Aug. 1977, *Murata 4111* (TI); Aichi prefecture, Kitashitara-gun, 35º7'N, 137º38'E, 24 Sep. 1963, *Torii s.n.* (TI); Hokushi, Sansesyo Godaisan, Daikuwaltin-Tetuguwuden, 35º8'N, 136º31'E, 25 July (TI); Shiga prefecture, between Hakodateyama and Tankaiko, Makino-oyo, Takashima-gun, 35º17'N, 135º59'E, 5 Sep. 1964, *Murata 18870* (KYO, TI); Gifu prefecture, en route from Sasamata to the top of Mt. Ibuki, Kasuga-mura, Ibi-gun, 35º25'N, 136º25'E, 27 Oct. 1984, *Takahashi & al. 1042* (KYO); Omi province, Mt. Sanjugatake, 35º29'N, 135º57'E, 3 Oct. 1927, *Tashiro s.n.* (KYO); Gifu prefecture, Ohno-gun, Kiyomi-mura, Natsumaya, Hikotani, 36º7'N, 137º3'E, 7 Sep. 1988, *Nagase s.n.* (KYO); Gifu prefecture, Takayama City, Matsumoto-machi, Ato-do, 36º8'N, 137º15'E, 2 Sep. 1987, *Nagase s.n.* (KYO); Gifu prefecture, in the vicinity of Oosaka-tohge, Kamitakara-mura, Yoshiki-gun, 36º16'N, 137º21'E, 3 Sep. 1987, *Takahashi 10886* (KYO). Kyūshū: Yakushima Is., Mt. Mihara, 30º19'N, 130º30'E, 31 July 1936, *Tuyama s.n.* (TI); Bungo province, 33º34'N, 131º30'E, 29 July 1911, *Tashiro s.n.* (KYO); prefecture Oita, Higashiyama, 33º43'N, 131º39'E, 12 Sep. 1971, *Arakane 154* (TI).

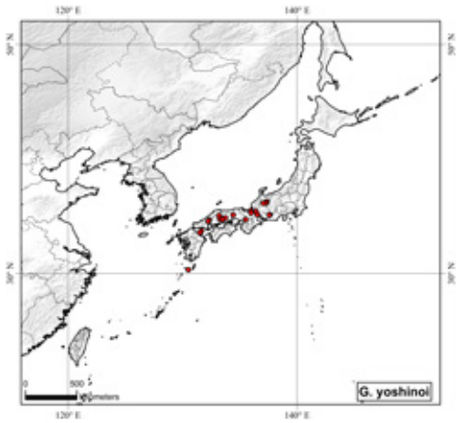


Fig. 182. Distribution of *Geranium yoshinoi*.

Discussion. Geranium yoshinoi is similar to *G. krameri*. Its status as a distinct taxon is supported by a combination of minor features, these, however, usually with some overlap. The most important is the length of the stigmatic remnants, usually longer in *G. krameri* than in *G. yoshinoi*. In addition, G. yoshinoi has less deeply divided leaves, with fewer lobes per segment, the middle segment wider, and shorter sepals, anthers, and fruits. The indument is similar to that of *G. krameri* but with slightly shorter hairs. The geographical distribution of *G. yoshinoi* also supports its taxonomic recognition: it appears to be restricted to southern Honshū and Kyūshū, whereas *G. krameri* occurs northward.

62. Geranium yesoense Franch. & Sav., Enum. Pl. Jap. 2: 305. 1878, ["Yedoense"]. Type locality: "Hab. in insulâ Yeso, Hakodate, unde habuit Dr Savatier (n. 2446)". Type: Japan. Hokkaidō, Hakodate, 41º46'N, 140º44'E, *P.A. Savatier 2446* (lectotype, designated by Knuth 1912: 181, P-00757979!).

Geranium yesoense var. *pseudopratense* Nakai, Bot. Mag. (Tokyo) 23: 103. 1909, ["pseudo-pratense" was mistake according to Nakai 1912: 264, who correteted it to "pseudo-palustre"]. *Geranium yesoense* var. *pseudopalustre* Nakai, Bot. Mag. (Tokyo) 23: 103. 1909. *Geranium miyabei* Nakai, Bot. Mag. (Tokyo) 26: 264. 1912. Type locality: "Hab. Yeso: Zenibako 15. IX. 1889 (Y. Tokubuchi) ibidem 2 VIII. 1899. (J. Matsumura). Hakodate 20. VIII. 1897. n. 551, Yunokawa 25. VIII. 1897. n. 552, in herbidis Mori IX. 1904. n. 6153. (Faurie). Hakodate 15 VIII. 1899 (J. Matsumura). Hakodate VIII. 1906. (Herb. Mus. Imp.)". Type: Japan. Hokkaidō, Hakodate, 41º46'N, 140º44'E, 15 Aug. 1899, *J. Matsumura s.n.* (lectotype, designated by Ikeda & al. 2015: 283, TI!).

Geranium yesoense var. *lobatodentatum* Takeda, Bot. Mag. (Tokyo) 24: 257. 1910, ["*lobato-dentatum*"]. *Geranium yesoense* f. *lobatodentatum* (Takeda) Tatew. in Miyabe & Tatew., Trans. Sapporo Nat. Hist. Soc. 14: 263. 1936. Type locality: "Hab. Yezo: in pratis herbosis promontorii Hanasaki, prope oppid. Nemuro (H. Takeda! 7. VIII. 1909); in herbosis circa oppid. Kushiro (H. Takeda! 18. VII.1909)". SYNTYPES: Japan. Hokkaidō, Yezo, pr. Nemuro, promontorii Hanasaki, 43º17'N, 145º35'E, 7 Aug. 1909, *H. Takeda s.n.* Japan. Hokkaidō, Yezo, pr. Kushiro, 42º58'N, 144º22'E, 18 July 1909, *H. Takeda s.n.* (no original material located).

Geranium dahuricum f. *lobulatum* Nakai, Bot. Mag. (Tokyo) 25: 53. 1911. *Geranium napuligerum* f. *lobulatum* (Nakai) Nakai, Bull. Natl. Sci. Mus. 29: 89. 1950. *Geranium yesoense* f. *lobulatum* (Nakai) H. Hara, Enum. Sperm. Jap. 3: 6. 1954. Type locality: "Primo a ven. J. Iinuma in monte Ibuki provinciae Mino repertum et in Sômokuzusetsu sub nomine G. striati delineatum est. Nuper autem acceptavi specimina in eodem loco lecta ex J. Nikai... Vidi etiam in jugo Misakatoge prov. Kai in silvis socialiter crescentem". Type: Japan. Mino, monte Ibuki, 35°24'N, 136°23'E, *J. Iinuma s.n.* (lectotype, here designated, TNS image!).

Geranium yesoense var. *nipponicum* Nakai, Bot. Mag. (Tokyo) 26: 266. 1912. Type locality: "Hab. Nippon: Gassan 28. IV. 1897. n. 553, Yamagata VII. 1889. n. 4373, Asamayama 20. VII. 1897. n. 549, Ibukiyama 16. VII. 1898. n. 1892, Iidesan 30 VIII. 1898 n. 1896, Komagatake IX. 1905 n. 6995, Norikura 2500 m. 28. VIII. 1905 n. 6995 (Faurie) Ibukiyama 22, VIII. 1909 n. 1953. n. 1954. (J. Nikai) ibidem. 1. VIII. 1881. (R. Yatabe) Chokaisan 28. VII. 1887 (?) ibidem. 6. VIII. 1903. (G. Nakahara) Hakusan 8. VIII. 1881. (?) 14 VIII. 1909 n. 1952 (J. Nikai) Asamayama 22. VIII. 1894. (Owatari) ibidem 20 1880 (R. Yatabe). Nikko 2. VIII. 1878 (?). Yumoto 16 VIII. 1887 (N. Ichikawa). Yatsugatake 21 VIII. 1902 (Y. Yabe) Gassan 23 VII. 1887 (?) ibidem 10 VIII. 1903 (G. Nakahara Shirouma 26 VII. 1903 (Y. Yabe). Komagatake 3 VIII. 1880 (R. Yatabe). Shirouma VIII. 1905 (T. Uchiyama) Akagisan 25. VII. 1903 (B. Hayata) Iidesan 10 VIII. 1904 (G. Nakahara) Akanuma VIII. 1883, Komagatake VII. 1875, Ontake VIII. 1875, Nikko IX. 1874, Wadatoge VII. 1875, Hakusan VIII. 1901. (Herb. Mus. Imp.)". Type: Japan. Honshū, prov. Kaga, mount Hakusan, 36º09'N, 136º44'E, 8 Aug. 1881, *R. Yatabe 36* (lectotype, designated by Aedo 2017a: 36, LE!).

Geranium yesoense f. *albiflorum* Tatew., Trans. Sapporo Nat. Hist. Soc. 14: 264. 1936. Type locality: "Hab. S. Kuriles. Isl. Kunashiri: Tôfutsu (M. Tatewaki, VIII. 20, 1936)". Type: Russia. Kuril Is., Kunashiri Is., Tôfutsu, 43º55'N, 145º35'E, 20 Aug. 1936, *M. Tatewaki s.n.* (lectotype, designated by Aedo 2017a: 36, SAPS image!).

Geranium yesoense f. *leucanthum* Tatew., Trans. Sapporo Nat. Hist. Soc. 14: 264. 1936. Type locality: "Hab. S. Kuriles. Isl. Kunashiri: Tomari (M. Tatewaki, VIII. 21, 1936)". Type: Russia. Kuril Is. Kunashiri Is., Tomari, 44º16'N, 146º10'E, 21 Aug. 1936, *M. Tatewaki s.n.* (lectotype, designated by Aedo 2017a: 37, SAPS image!).

Geranium yesoense f. *intermedium* H. Hara, J. Jap. Bot. 22: 171. 1948. Type locality: "Honshu: Toga in peninsula Oga, Ugo (K. Watanabe, no. 13. Aug. 2, 1938)". Type: Japan. Honshū, Toga, in peninsula Oga, Ugo, 39º54'N, 139º46'E, 2 Aug. 1938, *K. Watanabe 13* (lectotype, designated by Aedo 2017a: 37, TI!).

Geranium yesoense f. *leucanthum* Midzushima, Sci. Res. Ozegahara Moor: 445. 1954, nom. illeg., non Tatew. 1936. *Geranium yesoense* f. *ochroleucum* Okuyama, J. Jap. Bot. 30: 43. 1955. Type locality: "In rocky places of the upper part of Mt. Hiuchi...". Type: Japan. Honshū, Mt. Hiuchi, 36º55'N, 138º04'E, *M. Midzushima s.n.* (no original material located).

Perennial herbs, 15-77 cm tall. *Rootstock* 6.9-11.3 mm in diameter, ± vertical, not tuberculate, not turnip-shaped, with thickened roots along the rootstock. *Stem* erect, leafy, not rooting at nodes, stolons absent, without vegetative stems, with retrorse, ± appressed, eglandular hairs 0.4-0.9 mm long. *Basal leaves* in a ± deciduous rosette, cauline leaves opposite; leaf laminas (3.8)4.1-6.7(9.9) cm long, 4.6-14.3 cm wide, not peltate, palmatifid [ratio main-sinus length/middle segment length = (0.61)0.77-0.83(0.87)], polygonal in outline, base cordate, not coriaceous, with nerves not projected, pilose, with appressed, eglandular hairs on both surfaces; segments 5, in 1 plane, middle segment rhombic, 5-8.8(16) mm wide at the base [ratio segment width at the base/middle segment length = 0.13-0.30], (3)7-13-lobed in distal half [ratio secondary sinus length/middle segment length = 0.25-0.47]; petioles up to 45 cm long, without abscission zone, terete, not swollen, not deflexed in age, with retrorse, appressed, eglandular hairs 0.4-1.1 mm long; stipules (2)5.2-8.7 mm long, 1-5.3 mm wide, ovate, free or connate, papery, brown, with scattered, eglandular hairs on both surfaces and on the margin. *Inflorescence* a monochasial cyme; cymules 2-flowered, solitary [ratio cymule length/leaf length = 1.4-3.2]; peduncles 39-71(132) mm long, with retrorse, ± appressed, eglandular hairs 0.2-0.8 mm long; bracteoles 3.6-8.4 mm long, 0.8-1.4 mm wide, lanceolate, whorled; pedicels 16-52 mm long, with retrorse, ± appressed, eglandular hairs 0.2-0.7 mm long. Flowers actinomorphic. *Sepals* (7)8.6-9.7(11.1) mm long, 3.3-5.8 mm wide, lanceolate, smooth, not accrescent, nerves 3-5, mucro 1.2-2.6 mm long [ratio mucro length/sepal length = 0.14-0.33], with ± erect-patent, eglandular hairs 0.3-1.7 mm long on the abaxial surface, glabrous adaxially. *Petals* (13.2)15-17.2(18.7) mm long, 5.6-10.8 mm wide, erect-patent, rounded, without claw, pink or white, hairy on the basal 1/4-1/3 of the adaxial surface and on the base of the abaxial surface, ciliate on the basal margin, with hairs 0.4-1.2 mm long. *Stamens* 10, both whorls bearing anthers; filaments 5.4-10.5 mm long, lanceolate with an abruptly narrowed apex, pink, pilose on the abaxial surface, ciliate on the proximal half, with hairs 0.2-0.8 mm long; anthers 1.6-2.5 mm long, yellow with bluish lines. Nectaries 5, hemispheric, usually glabrous. *Gynoecium* 6.2-10.3 mm long, red. *Fruit* 26.2-36.4 mm long, erect, discharge of seed-ejection type; mericarps 2.2-4.5 mm long, 1.7-2.6 mm wide, without a strand of fibers, not compressed at the apex, smooth, without basal beak, with a basal callus, without a basal prong, brown, with ± patent, eglandular hairs 0.4-1.1 mm long and, rarely, patent glandular hairs 0.6-1.6 mm long; rostrum 17.7-25.7 mm long, with a narrowed apex 2.5-4.3 mm long, not twisted, with ± patent, eglandular hairs 0.1-0.4 mm long; stigmatic remnants (3.3)3.6-3.9(4.3) mm long, with 5 glabrous lobes. *Seeds* 2.4-3.1 mm long, 1.4-2.3 mm wide, finely reticulate, uniformly colored, brown, glabrous. Cotyledons with entire margin. Fig. 183.

Pollen. *Geranium*-type (Park & Kim 1997: 311).

Chromosome number. 2*n* = 28.

Phenology. Collected in flower from July to October.

Distribution. This species ranges from central Honshū and Hokkaidō, in Japan to Kuril Is., in Russia (Fig. 184).

Habitat. Sandy ground near beaches, meadows on coastal terraces, sunny grassy slopes, and fields; 0-2900 m.

Representative specimens examined. **Japan.** Hokkaidō: Kitami province, Minehama, Shari-cho, Shari-gun, 40º18'N, 140º6'E, 30 July 1969, *Shimizu 121* (NY, PR); Yunokawa, 41º47'N, 140º47'E, 25 Aug. 1897, *Faurie 552* (WU); Hidaka province, Horoidzumi-gun, Erimo-machi, Erimo-misaki, 41º55'N, 143º14'E, 12 July 1974, *Furuse 6281* (G); Oshima, Hakodate port, Tachimachi cape, 41º57'N, 140º27'E, July 1955, *Hatayama s.n.* (TI); Tomakomai-shi, Yufutsu, 42º38'N, 141º43'E, 4 Sep. 1974, *Kurosawa s.n.* (TI); Iburi prefecture, Tomakomai C., Uenae, Utonai Lake, 42º41'N, 141º42'E, 30 July 1986, *Kawahara 845* (TI); Ishikari-shicho, Chitose City, 13.5 km ENE of Tomakomai City on highway 36, 42º45'N, 141º37'E, 17 Aug. 1977, *Boufford & al. 19648* (CAS, GH); Shiribesi, Suttsu, Benkei cape, 42º49'N, 140º11'E, 2 Sep. 1977, *Hara & Kurosawa s.n.* (TI); Shiribeshi division, Iwanai, Raidenmisaki, 42º59'N, 140º35'E, 2 Sep. 1977, *Hara s.n.* (TI); Kushiro province, Hamanaka, Akkeshi-gun, 43º4'N, 145º7'E, 7 July 1959, *Furuse s.n.* (GH); Hamanaka-cho, Kiritapu, Tohfutsu-misaki, Akkeshi-gun, 43º4'N, 145º9'E, 20 Aug. 1984, *Kawahara 397* (TI); Shiribeshi province, Syakotan-gun, Yobetsu-mura, 43º16'N, 140º21'E, 25 July 1955, *Furuse s.n.* (S); Tokoro, 43º42'N, 143º40'E, 13 July 1914, *Baker & Baker s.n.* (CAS); Kitami province, Tokoro, 43º42'N, 143º40'E, 15 July 1956, *Kanai s.n.* (TI); Abashiri division, Koshimizucho, Tomaribetsu, 43º48'N, 144º27'E, 22 July 1937, *Hara s.n.* (TI); Kitami, Syari-machi, 43º54'N, 144º39'E, 7 July 1970, *Togashi s.n.* (TI); Syari, 43º54'N, 144º39'E, 14 Aug. 1937, *Uno 21726* (G); Rishiri Is., 45º10'N, 141º9'E, Aug. 1903, *Makino s.n.* (TI). Honshū: Shizouka prefecture, Suruga province, Haibara-gun, Honkaware-cho, Mt. Tekaridake, 35º20'N, 138º5'E, 19 Aug. 1976, *Kadota 2774* (TI); Shiga prefecture, Mt. Ibuki, 35º24'N, 136º23'E, 23 Aug. 1968, *Hara & Kurosawa s.n.* (TI); Akaishi Mts., Sanpuku Pass, 35º34'N, 138º11'E, 30 July 1953, *Yamazaki s.n.* (TI); Hida, Takayama, 36º8'N, 137º15'E, 10 Aug. 1925, *Honda s.n.* (TI); Nagano prefecture, en route from Mitsumata to Mt. Jonen-dake, to Mt. Choga-dake, 36º16'N, 137º43'E, 11 Aug. 1977, *Boufford & al. 19914* (MO); Senzyogahara, Nikko, 36º24'N, 139º51'E,

1 July 1930, *Komori s.n.* (TI); Mt. Hakusan, 36°26'N, 136°38'E, 29 July 1940, *Hisauti s.n.* (TI); Shinshu, Mt. Yatsugatake, 36°33'N, 137°58'E, 3 Aug. 1931, *Ooi s.n.* (TI); Toyama, National Park Tateyama-Tsurugi, Ikeno-daira-yama, 36°34'N, 137°35'E, 8 Aug. 2004, *Estébanez s.n.* (MA); Hitachi, Toyoshima Is., 36°35'N, 140°38'E, July 1924, *Hayakawa 95* (TI); Toyama-ken, Tateyama-cho, monte Tsurugi-dake, collado entre Ippuku-tsurugi y Mae-tsurugi, 36°36'N, 137°37'E, 7 Aug. 2002, *Estébanez 182* (MA); Hakuba, 36°41'N, 137°51'E, 11 July 1879 (TI); Mt. Shirouma, 36°44'N, 137°45'E, Aug. 1905, *Uchiyama s.n.* (TI); Nikko, 36°46'N, 139°25'E, July 1885 (G); Gumma prefecture, Tone-gun, Katashina-mura, Suganuma, Goshikinuma, 36°50'N, 139°15'E, 7 Sep. 1983, *Murata & Yahara 16161* (TI); Nigata prefecture, Mt. Naeba, 36°50'N, 138°42'E, 30 July 1950, *Takeuchi s.n.* (TI); Iwaki, Mt. Fubou, 37°11'N, 140°37'E, 4 Aug. 1931, *Murai s.n.* (TI); Akanumaga, 37°22'N, 140°26'E, Aug. 1887, *Bisset 4339* (BM); Fukushima prefecture-Yamagata prefecture, Mts. Adzuma, Mt. Nishi-omine, 37°44'N, 140°8'E, 4 Aug. 1981, *Midorikawa s.n.* (TI); Iide mountain range, from Jizodake through Tanemaki, Onishi, Kitamatadake to Iide Onsen, 37°51'N, 139°42'E, 6 Aug. 1973, *Ohba 73110* (H); Miyagi prefecture, Mt. Zaou, Fubousan, Omaedake, 38°7'N, 140°27'E, 14 Aug. 1931, *Saitou s.n.* (TI); Yamagata prefecture, Asahi Mts., Mt. Ooasahi, 38°17'N, 139°54'E, 30 July 1948, *Sato s.n.* (TI); Iwate prefecture, Izawagun, Mt. Yakeishi, 38°58'N, 140°46'E, 3 Aug. 1966, *Takahashi 9919* (TI); border of Iwate prefecture, Waga-gun, Sawauchi-mura & Akita prefecture, Senboku-gun, Senhata-machi, Mt. Mahiru-dake, 39°26'N, 140°40'E, 4 July 1995, *Nemoto & al. 9574027* (MO); Akita prefecture, Toga-mura, 39°56'N, 139°50'E, 28 Sep. 1953, *Furuse s.n.* (TI); Ugo, Oga peninsula, Kitaura, 39°58'N, 139°47'E, 20 Aug. 1952, *Hara & Kurosawa s.n.* (TI); Akita prefecture, Mt. Moriyoshi, 40°2'N, 140°36'E, 1 Aug. 1959, *Hara s.n.* (TI); Aomori prefecture, Tappizaki, 41°15'N, 140°20'E, 27 July 1959, *Hara 185* (TI); Mutsu, Kuwabata-yama, 41°23'N, 141°27'E, 31 July 1964, *Ohashi 4460* (TI). **Russia.** Kuril Is.: Shikotan Is., Shakotan, 43°51'N, 146°49'E, 4 Aug. 1929, *Kondo s.n.* (TI); Kunashiri Is., Nottsuka, 44°44'N, 146°11'E, 24 July 1929, *Kondo s.n.* (TI); Etorofu Is., Porosu, Sokiya, 44°48'N, 147°7'E, 18 July 1927, *Kondo s.n.* (TI); Etorof Is., Rubetsu, 45°5'N, 147°42'E, 24 July 1914, *Baker & Baker s.n.* (CAS); Iturup, E side of Chirip Peninsula, Konservnaya Bay, 45°20'N, 148°0'E, 22 Aug. 1997, *Semsrott 1621* (NY).

Discussion. Geranium yesoense is in many aspects similar to *G. soboliferum*. Both are erect perennial herbs with connate stipules, deeply divided leaves, and large petals that are hairy

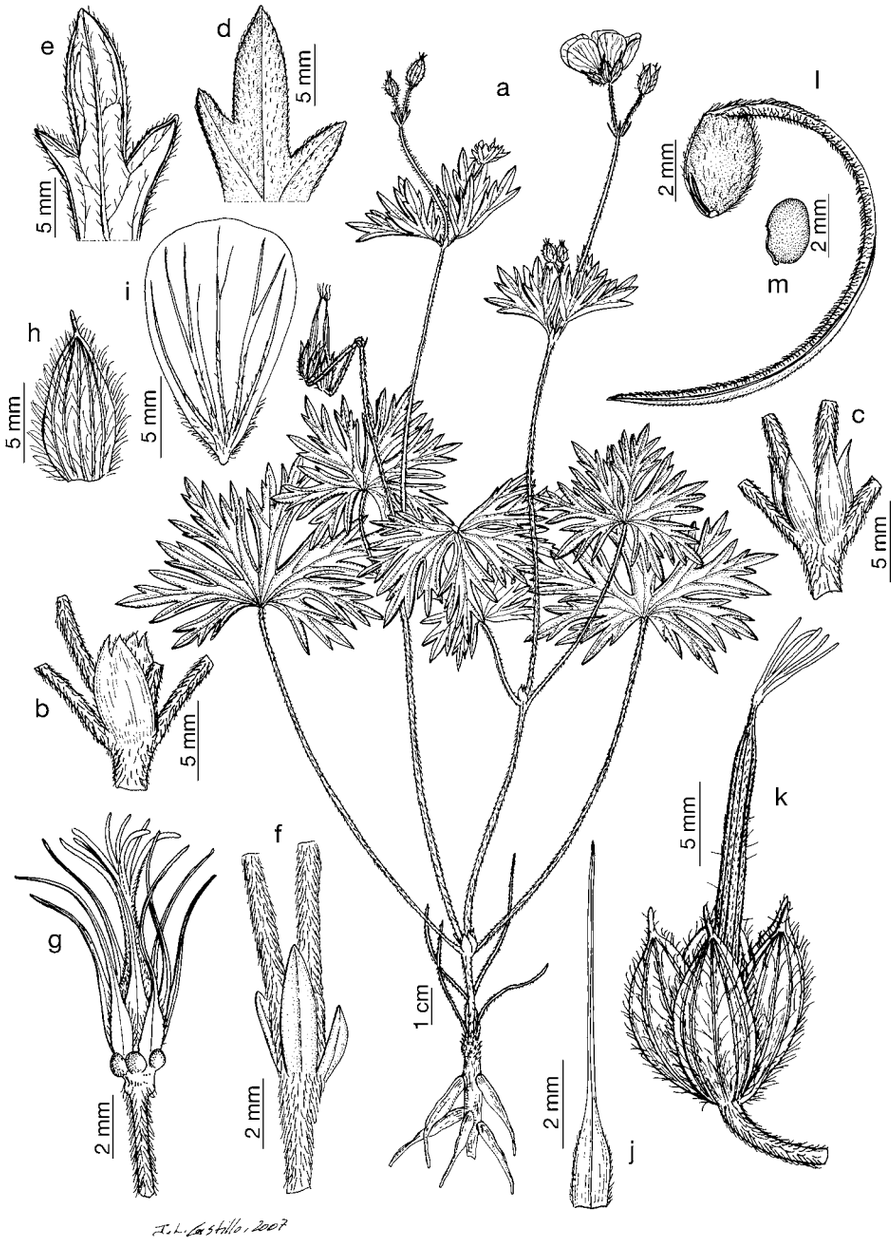


Fig. 183. *Geranium yesoense*. a. Habit. b, c. Stipules. d. Leaf indument, adaxial surface. e. Leaf indument, abaxial surface. f. Bracteoles. g. Flower without petals and sepals. h. Sepal. i. Petal. j. Staminal filament. k. Fruit. l. Mericarp. m. Seed. (Based on: a-f, k-m, *Furuse s.n.*, *7 July 1959*, GH; g-j, *Boufford & al. 19648*, GH).

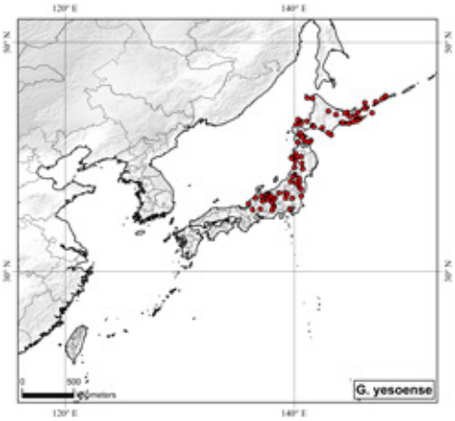


Fig. 184. Distribution of *Geranium yesoense*.

on the adaxial surface. The indument and inflorescence are quite similar in both species, but the eglandular hairs of *G. yesoense* are a bit longer than those of *G. soboliferum*. It is interesting to note that the hairs of the abaxial surface of the sepals are usually a good feature to discriminate *G. yesoense*. The sepals are covered by minute appressed hairs plus erect-patent and longer hairs, present mainly on nerves. As in *G. soboliferum*, glandular hairs of *G. yesoense* are restricted to the apex of the mericarp, although they are found with less frequency than in the former species. The petals of *G. yesoense* are hairy on adaxial surface, at least on the basal 1/4. In some cases the hairs reach the basal 1/3 or more along the petal nerves. The connate stipules of *G. yesoense* are most similar to those of *G. shikokianum*, although not as wide. They are usually connate for at least part of their length. In some cases they appear free, at least at some nodes of the plant. Nevertheless, in a portion of herbarium specimens it was difficult to ascertain, since stipules are early deciduous and many times they are wrinkled or lacking from basal nodes. The rootstock of *G. yesoense* also resembles the rootstock of *G. shikokianum*: short, vertical, and bearing long, thickened non-fasciculate roots. *Geranium soboliferum* and *G. krameri* appear to have the roots that are more fasciculate. The leaves of *G. yesoense* are less deeply divided and with wider segments than those of *G. soboliferum*, although there is some overlap. The nectaries of *G. yesoense* are usually glabrous, in contrast with those of *G. soboliferum*, which have an apical tuft of hairs. In rare cases, however, scattered hairs around the nectaries in *G. yesoense* can be found.

Akiyama (2001) recognized three varieties into *G. yesoense* (var. *yesoense*, var. *nipponicum* and var. *pseudopalustre*) on the basis of the relative degree of leaf incision and on the relative density of the sepal hairs. Wakasugi & al. (2017) carried out a detailed studied both morphological and DNA variability of *G. yesoense* and concluded that "such groups cannot be clearly distinguished on the basis of either morphological or molecular evidence". Therefore, they proposed to synonymize these varieties to *G. yesoense*, as was done in Aedo (2017). In contrast to these studies, Kurata & al. (2021a) suggested that their work based on single nucleotide polymorphism data and chloroplast genome sequences consistently indicated that these varieties "are distinct and independent evolutionary units". However, they found that some high mountain populations are not fully congruent with this pattern. Furthermore, they did not present arguments against the morphological continuity found by Wakasugi & al. (2017).

The species epithet was spelled both *yedoense* and *yesoense* in the original publication. The name of the mountain for which the species was named was given as Mt. Yeso. The spelling *yesoense* has been used subsequently and is accepted here.

Geranium yesoense is an endemic to central and northern Japan reaching eastern Kuril Islands. It has also been recorded in Sakhalin Is. (quoted by Novoselova 1999: 131). Unfortunately, no specimen from this island has been available.

The Columbinum Group—This group comprises two annual species with deeply divided leaves, usually opposite, free stipules, 2-flowered cymules arranged in monochasial inflorescence, short petals, lanceolate staminal filaments, and eglandular indumentum.

63. Geranium columbinum L., Sp. Pl.: 682. 1753. *Geranium pallidum* Salisb., Prodr. Stirp. Chap. Allerton: 310. 1796, nom. illeg. Type locality: "Habitat in Gallia, Helvetia, Germania". Type: "Habitat in Gallia, Helvetia, Germania", *unknown collector* (lectotype, designated by Ghafoor 1978: 47, LINN-858.79 image!).

Geranium columbinum var. *nanum* Gaudin, Fl. Helv. 4: 413. 1829. Type locality: "Hab. ad sepes et in agris". Type: Switzerland, *J. Gaudin s.n.* (no original material located).

Geranium columbinum var. *diffusum* Picard, Mém. Soc. Agric. Boulogne-sur-Mer 1: 121. 1837. Type locality: "se trouve dans les endroits complètement découvertes, sur les rideaux; Manchecourt, etc". Type: France. Manchecourt, 48°14'N, 2°20'E, *C. Picard s.n.* (no original material located).

Geranium columbinum var. *holopetalum* Griseb., Spic. Fl. Rumel. 1: 123. 1843. *Geranium columbinum* [B] *holopetalum* (Griseb.) Graebn. in Asch. & Graebn., Syn. Mitteleur. Fl. 7(1): 47. 1913. Type locality: "In Thracia: in collibus pr. Rusköi alt. 8'-900' frequens in campis rupestribus (substr. sax. aren)!". Type: Turkey. Thracia, in collibus pr. Rusköi, 40°20'N, 26°30'E, *A. Grisebach s.n.* (no original material located) [according to Strid 2000: 294, there is no material at GOET].

Geranium columbinum f. *montanum* Porc. ex Panţu, Mem. Sect. Sti. Acad. Romana 8: 91. 1931. Type locality: "montane dela Rodna". Type: Romania. pr. oppidum Rodno, 47°35'N, 24°40'E, *F. Porcius s.n.* (lectotype, designated by Aedo 2003: 126, CL image!).

Annual herbs, 9-60(70) cm tall. *Stem* erect, leafy, with retrorse, appressed, eglandular hairs 0.3-0.6 mm long. *Basal leaves* in a ± persistent rosette, cauline leaves opposite (rarely alternate near the base); leaf laminas (1.5)2.4-3.8(5.5) cm long, 1.8-4.3(5) cm wide, not peltate, deeply palmatifid [ratio main-sinus length/middle segment length = (0.86)0.88-0.93(0.95)], polygonal in outline, base cordate, not coriaceous, with nerves not projected, pilose, with appressed, eglandular hairs on both surfaces; segments 5(7), in 1 plane, middle segment rhombic, (0.8)0.9-1.4(3.6) mm wide at the base [ratio segment width at the base/middle segment length = 0.03-0.09(0.15)], (3)5-12-lobed in distal half [ratio secondary sinus length/middle segment length = (0.31)0.33-0.45(0.48)]; petioles up to 15 cm long, without abscission zone, terete, not swollen, not deflexed in age, with retrorse, appressed, eglandular hairs 0.3-0.6 mm long; stipules 3-8 mm long, 0.6-1.6 mm wide, lanceolate (sometimes with a short bifid apex), free, papery, brown, with eglandular

hairs on abaxial surface and on the margin, glabrous adaxially. *Inflorescence* a monochasial cyme; cymules 2-flowered, solitary [ratio cymule length/leaf length = (1.1)2-2.8(5.4)]; peduncles (22)27-44(100) mm long, with retrorse, appressed, eglandular hairs 0.2-0.5 mm long; bracteoles 2.5-5.3 mm long, 0.5-1.1 mm wide, lanceolate, whorled; pedicels (20)31-55(63) mm long, with retrorse, appressed, eglandular hairs 0.2-0.8 mm long. Flowers actinomorphic. *Sepals* 5.3-10(11) mm long, 2-4.5(6.3) mm wide, ovate, smooth, accrescent, nerves 3, mucro (1.2)1.7-2.3(3.5) mm long [ratio mucro length/sepal length = 0.20-0.45], with antrorse, appressed, eglandular hairs 0.3-0.5 mm long on the abaxial surface (mainly on the nerves), glabrous adaxially. *Petals* (6.4)7-10.7 mm long, (2.8)3.1-4.2(5) mm wide, erect-patent, rounded or emarginate (notch 0.2-1 mm deep), without claw, purple, glabrous on both surfaces, ciliate on the basal margin, with hairs 0.2-0.4 mm long. *Stamens* 10, both whorls bearing anthers; filaments (2.3)2.6-3.1(5) mm long, lanceolate, white, glabrous except for scattered cilia 0.1-0.2 mm long on the proximal half; anthers 0.6-0.9(1) mm long, blue. Nectaries 5, hemispheric, glabrous. *Gynoecium* 3.2-5 mm long, pink. *Fruit* 20-22(25.9) mm long, erect, discharge of seed-ejection type; mericarps 2.2-4.4 mm long, 1.5-2.6 mm wide, without a strand of fibers, not compressed at the apex, smooth, without basal beak, with a basal callus, without a basal prong, brown, with scattered, ± patent, eglandular hairs 0.1-0.3 mm long; rostrum 15-19 mm long, with a narrowed apex 4-6.8 mm long, not twisted, with erect-patent, eglandular hairs 0.1-0.3 mm long; stigmatic remnants 1.2-2 mm long, with 5 glabrous lobes. *Seeds* 1.6-2.6 mm long, 1.6-2.1 mm wide, finely reticulate, uniformly colored, brown, glabrous. Cotyledons with entire margin. Figs. 185, 186, 188 j-p.

Pollen. *Geranium*-type (Aedo 2003: 129; Bortenschlager 1967: 425; Velasco 1992b: 56).

Chromosome number. 2*n* = 18.

Phenology. Collected in flower from March to October.

Distribution. This species ranges through Europe, northern Africa (from Morocco to Libya) and western Asia (from Turkey to Iran) and it is introduced in northwestern and eastern U.S.A. (Fig. 187).

Habitat. Disturbed areas, roadsides, fields, rock crevices, prairies and deciduous or evergreen forest edges; 0-1730 m.

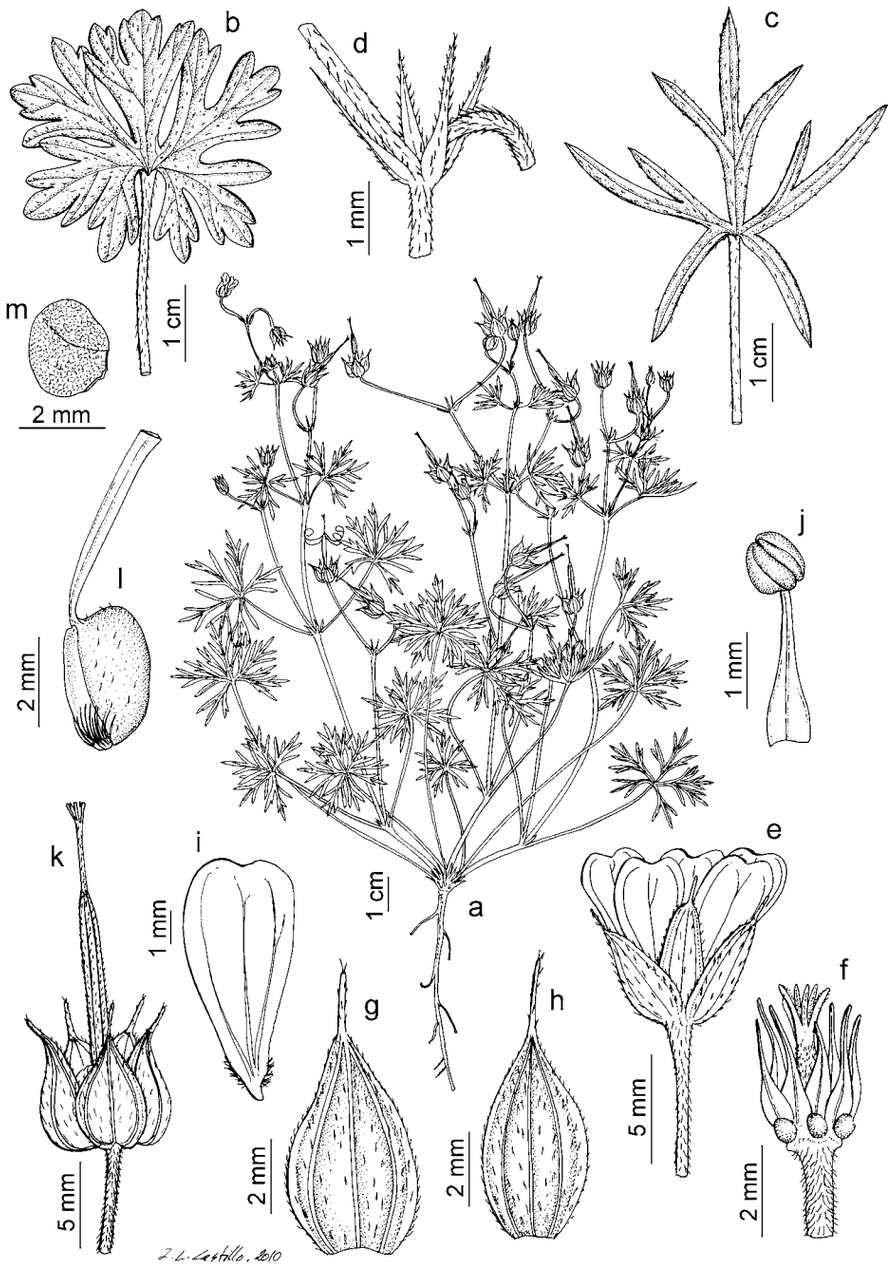


Fig. 185. *Geranium columbinum*. a. Habit. b, c. Leaves. d. Bracteoles. e. Flower. f. Flower without petals and sepals. g. Sepal from a calyx subtending a fruit. h. Sepal of a calyx during anthesis. i. Petal. j. Stamen. k. Fruit. l. Mericarp. m. Seed. (Based on: a, b, d, k-m, *Sáez & al. 5411,* MA; c, *Aedo & al. 2174,* MA; e-j, *Castroviejo & al. 15513,* MA).

Representative specimens examined. **Albania.** Gjirokastër: Pestani, 40º17'N, 20º7'E, 21 June 1898, *Baldacci 322* (LE). **Algeria.** Constantine: Coniet Fedja, 36º21'N, 6º36'E, 24 June 1880, *Cosson s.n.* (P). **Andorra**. San Julià de Lòria: hacia la borda del Ger-

Fig. 186. *Geranium columbinum* (Based on: a, b, *Aedo 15610*, MA; c-e, *Aedo* 15659, MA).

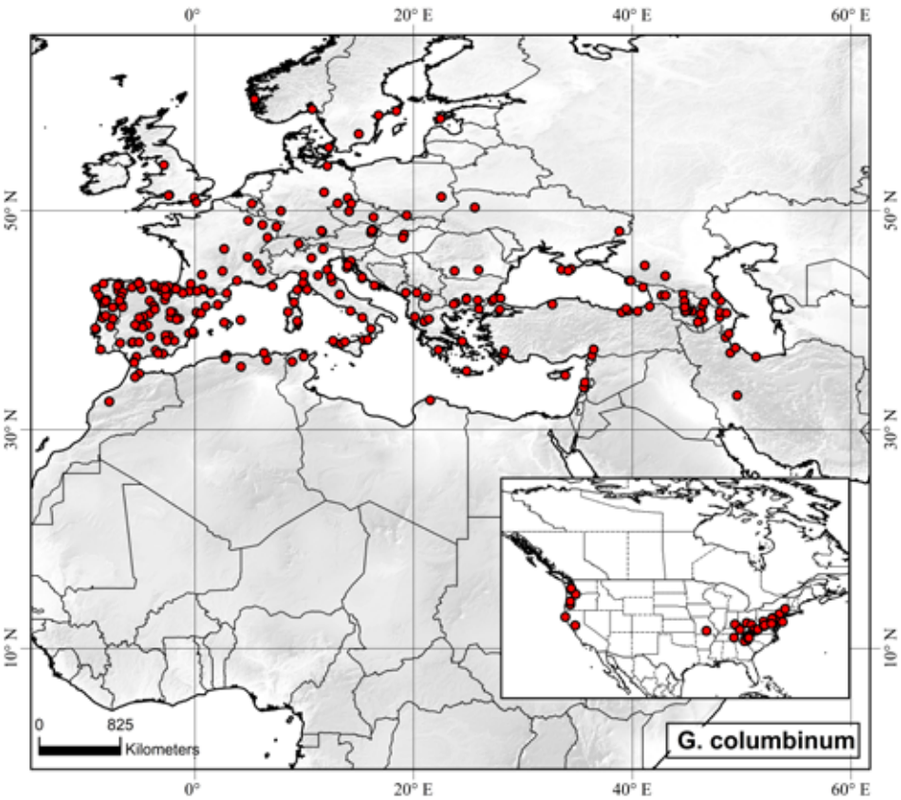


Fig. 187. Distribution of *Geranium columbinum*.

mà, 42°27'N, 1°28'E, 1 June 2007, *Aedo & al. 13874* (MA). **Armenia.** Tavush: Haghartsin monastery, 40°49'N, 44°53'E, 21 June 2005, *Castroviejo & al. 17654* (MA). **Austria.** Lower Austria: Niederösterreich, Ödlitz bei Berndorf, 47°57'N, 16°8'E, 23 May 2016, *Greimler 78* (WU). **Azerbaijan.** Absheron: Baku, Schemacha, ad fl. Sulut-czai infra Chan-kendy, 40°37'N, 48°38'E, 30 July 1900, *Alexeenko 7394* (LE). **Belgium.** Wallonia: Waleffe Saint-Pierre, 50°38'N, 5°14'E, July, *Geerinck-Coutrez 3484* (MA). **Bulgaria.** Blagoevgrad: Rhodopes occidentales, entre Koprivlen y Gotse Delchev, 41°34'N, 23°53'E, 3 July 2004, *Navarro & al. 5043* (MA). **Croatia.** Primorje-Gorski Kotar: inter Rupa et Sapjane, 45°24'N, 14°17'E, 29 May 2010, *Calvo 4705* (MA). **Cyprus.** Larnaca: Xylofagou, 34°57'N, 33°54'E, 18 Apr. 2019, *Medina & al. 10076* (MA). **Czech Republic.** Central Bohemian: Beroun, Srbsko, 49°56'N, 14°7'E, 16 Aug. 2010, *Calvo 4972* (MA). **Denmark.** Hovedstaden: Zealand, Ganlose, NW of Copenhagen, 55°47'N, 12°16'E, 23 June 1971, *Hanse & Svendsen s.n.* (W). **Estonia.** Saare: Oesel, 58°24'N, 22°29'E, 1884, *Fichtencheng s.n.* (LE). **France.** Auvergne-Rhône-Alpes: Isère, Pont-de-Claix, 45°7'N, 5°43'E, 30 May 2011, *Aedo 18400* (MA). Corse: monte Fosco, 42°45'N, 9°23'E, 13 Mar. 1881, *Chabert s.n.* (FI). **Georgia.** Tbili-

si: Tiflis, pr. pagum Bely-Klutsh, 41°43'N, 44°47'E, 11 July 1922, *Zedelmejer s.n.* (LE). **Germany.** Rhineland-Palatinate: Rheinland, SE Bingen, am Gau Algesheimer Kopf, 49°58'N, 7°53'E, 27 May 1987, *Krendl s.n.* (MA, W). **Great Britain.** England: Sussex, E side of Cuckmere Haven, 50°45'N, 0°9'E, 23 July 1898, *Gregor s.n.* (MA). **Greece.** Epirus: Ioánnina, Flabourari, 39°51'N, 20°59'E, 29 July 2007, *Cabezas & al. 751* (MA). Kriti: Aloides, 1 km to Sisses, 35°21'N, 24°52'E, 9 Apr. 1995, *Damanakis s.n.* (NHMC). **Hungary.** Pest: in monte Nagyszal, supra Uacz, 47°50'N, 19°9'E, 22 Aug. 1901, *Filarszky 723* (LE). **Iran.** Mazandaran: Caspian shore at Chalus, 36°38'N, 51°21'E, 17 Mar. 1962, *Furse 1087* (W). **Italy.** Basilicata: Calabria, Monnoli, pr. S. Stephano de Aspromonte, 38°12'N, 15°50'E, 31 May 1998, *Castroviejo & al. 14788SC* (MA). Sardegna: Nouro, Seui-Ussassai, monte Arbu, 39°54'N, 9°23'E, 4 June 2003, *Navarro & al. 4402* (MA). Sicilia: Trápani, monte Cófano, pr. Custonaci, 38°6'N, 12°39'E, 29 May 2000, *Aedo & al. 5545* (MA). **Lebanon.** North: Ras Chakka, 34°18'N, 35°41'E, 22 Apr. 1934, *Gombault 4139* (P). **Libya.** Jabal al Akhdar: Cyrenaica, Kouf, 32°41'N, 21°33'E, 21 Apr. 1938, *Maire & Weiller 341* (MPU). **Montenegro.** Montenegro, 42°30'N, 19°18'E, June, *Ebel s.n.* (W). **Morocco.** Tanger-Tetouan-Al Hoceima: El Aonsar, Andjear, 35°6'N, 5°4'W, 11 June 1930, *Font Quer s.n.* (BC). **North Macedonia.** Skopje: ad secturas Rud. Orasje (etiam Radusa) dictas in vicinitate oppidi general Hanriev, 42°5'N, 21°12'E, May 1938, *Mach s.n.* (PR). **Norway.** Vestland: Hordaland, Os hd, Ranhalmen for Mobergvika, 60°11'N, 5°28'E, 17 July 1952, *Naustdal s.n.* (W). **Poland.** Silesian: Beskid Spdecki, Pasmo Radriejawej, Tylmamowej, 49°34'N, 19°24'E, 12 Aug. 1969, *Pawlowscy s.n.* (LE). **Portugal.** Trás-os-Montes: Alimonde, 41°47'N, 6°53'W, 12 June 2010, *Aedo & al. 17634* (MA). **Romania.** Sud-Vest Oltenia: Oltenia, distr. Dolj, inter Goesti et silvan Vogna, 44°29'N, 23°46'E, 27 May 1971, *Cîrtu s.n.* (MA). **Russia.** Dagestan: Dagestan, Kurinskij, pr. Zizik, 41°46'N, 48°6'E, 2 Apr. 1902, *Alexeenko 7431* (LE). Krasnodar: Sochi, vicinity of Vorontzovka village, 43°36'N, 39°54'E, 25 June 2006, *Naumenko & al. s.n.* (MA). Krym: Tauria, pr. Yalta, 44°30'N, 34°10'E, 24 May 1905, *Golde s.n.* (MO). Stavropol: Terek, Pjatigorsk, 44°2'N, 43°3'E, 19 June 1916, *Gordiagin s.n.* (LE). **Spain.** Albacete: pr. Villapalacios, 38°35'N, 2°40'W, 25 Apr. 2008, *Aedo 15610* (MA). Baleares: Menorca, torrent de Cala Molí, Ses Fontanelles, Es Mercadal, 6 May 2001, *Fraga 49* (MA). **Sweden.** Stockholm: Södermanland, Paroecia Ornö, Svinaker, 59°6'N, 18°27'E, 9 Aug. 1927, *Asplund 1106* (F). **Switzerland.** St. Gallen: Mastrils, 46°58'N, 9°31'E, 7 June 1924, *Coaz s.n.* (W). **Tunisia.** Kef: Dj. Chebon, 36°12'N, 8°55'E, 20 May 1883, *Cosson & al. s.n.* (P). **Turkey.** Karabük: Ovacuma, 41°26'N, 32°43'E, 20 June 2001, *Aedo & al. 6554* (MA). **Ukraine.** Luhansk: Sakarpatskaya obl., Vepikobereshyanskiy r-n, 12 km S Beresnogo, Knyaginya, 48°7'N, 38°51'E, 12 July 1985, *Geltman & al. 780* (LE). **USA.** California: Solano Co., 5,6 milles W of Winters, 38°31'N, 121°59'W, 16 Apr. 1968, *Ishizuka 19* (MA). Delaware: New Castle Co., Townsend, 39°23'N, 75°41'W, June, *Canby s.n.* (NY). District of Columbia: Washington, 38°53'N, 77°1'W, 4 June 1889, *Sudno[?]th s.n.* (MO). Georgia: Rabun Co., at top of Rabun Bald, 34°57'N, 83°18'W, 7 Sep. 1939, *Duncan 1500* (GA). Indiana: Jefferson Co., along Harbarts Creek on the Kellar farm about a mile SW of Wirt, 38°48'N, 85°27'W, 22 May 1935, *Banta 56002* (MO). Kentucky: Madison Co., Grant House, 37°34'N, 84°17'W, 12 July 1960, *Grossman 416* (NY). Maryland: Cecil Co., Port Deposit, 39°36'N, 76°5'W, 2 July 1864, *[illegible]* (MO). Missouri: Texas Co., 2.5 mi N of Slabtowner, 37°19'N, 91°58'W, 22 June 1993, *Summer 5823* (MO). New Jersey: Atlantic Co., Northfield, 39°22'N, 74°33'W, 20 May 1913, *Lighthipe s.n.* (NY). New York: Ulster Co., near foot of Overbook Mt., Woodstock, 42°19'N, 74°0'W, 20 Sep. 1871, *Redfield 975* (MO). North Carolina: Haywood Co., Rd. to Eagles Nest, Wagenesville, 35°7'N, 82°39'W, 20 June 1932, *H.L.B. 4054* (DUKE). Ohio: Jackson Co., Little Salt Creek, 39°6'N, 82°46'W, 24 May 1936, *Bartley & Pontius 245* (NY). Oregon: Multnomah Co., Cascade Locks, 45°40'N, 121°53'W, 24 June 1925, *Peck 9858* (F). Pennsylvania: Lancaster, Safe Harbor, 39°55'N, 76°22'W, 18 May 1889, *Small s.n.* (MO). Tennessee: Unicoi Co., Erwin, 36°8'N, 82°25'W, 13 June 1969, *Sharp & al. 43111* (NY). Virginia: Giles Co., along New River, 0.5 mi NW of Klotz, 37°20'N, 80°40'W, 8 July 1938, *Fogg 14872* (MO). Washington: Lewis Co., Lucas Creek, 46°38'N, 122°46'W, 13 July 1954, *Bechtel 18643* (NY). West Virginia: Mercer Co., Camp Creek State Forest, Lower Wash Fork Creek, off St. Rt. 19, 37°31'N, 81°8'W, 26 May 1987, *Brant & O'Donnell 1084* (MO).

Discussion. Geranium columbinum is an annual herb that may be easily distinguished by its accrescent sepals, its deeply divided leaves, and its eglandular indumentum. *Geranium columbinum* is sometimes mistaken for *G. dissectum* because of its deeply dissected leaves. The latter has, however, glandular indumentum and mericarps without the basal callus (it is replaced by a prong). The differences between *G. columbinum* and *G. carolinianum* (another annual species with accrescent sepals) are addressed under the later species.

---

64. Geranium schrenkianum Trautv., Bull. Soc. Imp. Naturalistes Moscou 57(1): 53. 1882. *G. gracile* Schrenk, Bull. Cl. Phys.-Math. Acad. Imp. Sci. Pétersbourg 3: 308. 1845, nom. illeg., non Ledeb. 1837. Type locality: "Hab. in montibus Chantau". Type: Kazakhstan. Chantau, Songaria, 46°00'N, 80°00'E, 26 June 1843, *A. Schrenk 6179* (lectotype, designated by Bobrov 1949: 14, LE!; isolectotypes, BM!, P-00757899!, TK-001294 image!).

Annual herbs, 6-64 cm tall. *Stem* erect, leafy, with antrorse, appressed, eglandular hairs 0.2-0.4 mm long. *Basal leaves* in a ± persistent rosette, cauline leaves opposite; leaf laminas 1.5-2.9(4.4) cm long, 2.2-2.7(5.3) cm wide, not peltate, palmatisect, polygonal in outline, base cordate, not coriaceous, with nerves not projected, pilose, with appressed, eglandular hairs on both surfaces; segments 5, in 1 plane, middle segment rhombic, 1-1.3(2.1) mm wide at the base [ratio segment width at the base/middle segment length = 0.08-0.13], 3-4(8)-lobed in distal half [ratio secondary sinus length/middle segment length = 0.26-0.41]; petioles up to 7 cm long, without abscission zone, terete, not swollen, not deflexed in age, with antrorse, appressed, eglandular hairs 0.2-0.5 mm long; stipules 2.1-5 mm long, 0.5-1 mm wide, lanceolate, free, papery, brown, with eglandular hairs on abaxial surface and on the margin, glabrous adaxially. *Inflorescence* a monochasial cyme; cymules (1)2-flowered, solitary [ratio cymule length/leaf length = 1.1-2.9]; peduncles 12-48 mm long, with antrorse, appressed, eglandular hairs 0.2-0.3 mm long; bracteoles 1.4-2.8 mm long, 0.3-0.4 mm wide, lanceolate, whorled; pedicels 14-33 mm long, with antrorse, appressed, eglandular hairs 0.2-0.3 mm long. Flowers actinomorphic. *Se-*

pals 4.1-6 mm long, 1.5-3 mm wide, ovate, smooth, not accrescent, nerves 3, mucro 1.6-3 mm long [ratio mucro length/sepal length = 0.34-0.41], with antrorse, appressed, eglandular hairs 0.2-0.4 mm long on the abaxial surface (mainly on the nerves), glabrous adaxially. *Petals* 3-4 mm long, 1.5-2 mm wide, erect-patent, emarginate (notch ca. 0.3 mm deep), without claw, purple, glabrous on both surfaces, ciliate on the basal margin, with hairs 0.1-0.3 mm long. *Stamens* 10, both whorls bearing anthers; filaments 1.5-2.6 mm long, lanceolate, white, glabrous except for a some cilia 0.1-0.2 mm long on the proximal half; anthers 0.3-0.5 mm long, unknown color. Nectaries 5, hemispheric, glabrous. *Gynoecium* 2-4 mm long, pink. *Fruit* 13-17.4 mm long, erect, discharge of seed-ejection type; mericarps 2-3.6 mm long, 1.2-2 mm wide, without a strand of fibers, not compressed at the apex, smooth, without basal beak, with a basal callus, without a basal prong, brown, with scattered antrorse, eglandular hairs 0.1-0.3 mm long; rostrum 9-12 mm long, with a narrowed apex 1-2.1 mm long, not twisted, with erect-patent, eglandular hairs 0.1-0.3 mm long; stigmatic remnants 0.7-1.2 mm long, with 5 hairy lobes. *Seeds* 1.8-2.4 mm long, 1-1.4 mm wide, finely reticulate, uniformly colored, brown, glabrous. Cotyledons with entire margin. Fig. 188 a-i.

Pollen. *Geranium*-type (Aedo 2003: 129).

Chromosome number. Unknown.

Phenology. Collected in flower from April to July.

Distribution. This species ranges from eastern Russia (Orenburg, Rostov, Samara and Volvograd) to Kazakhstan (Fig. 189).

Habitat. Moist places on pebbly or sandy beds of rivers; 0-700 m.

Additional specimens examined. **Kazakhstan.** Akmola: Akmolinskaya obl., vass. r. Tergsakkana, Mt. Kokshetau, SW slope, 52º45'N, 68º59'E, 28 June 1957, *Grubov 28* (LE); Tzelinograd prov., systema fl. Tersakkan, montes Kokschetau, 52º45'N, 68º59'E, 12 July 1957, *Grubov & Popova 4379* (LE).

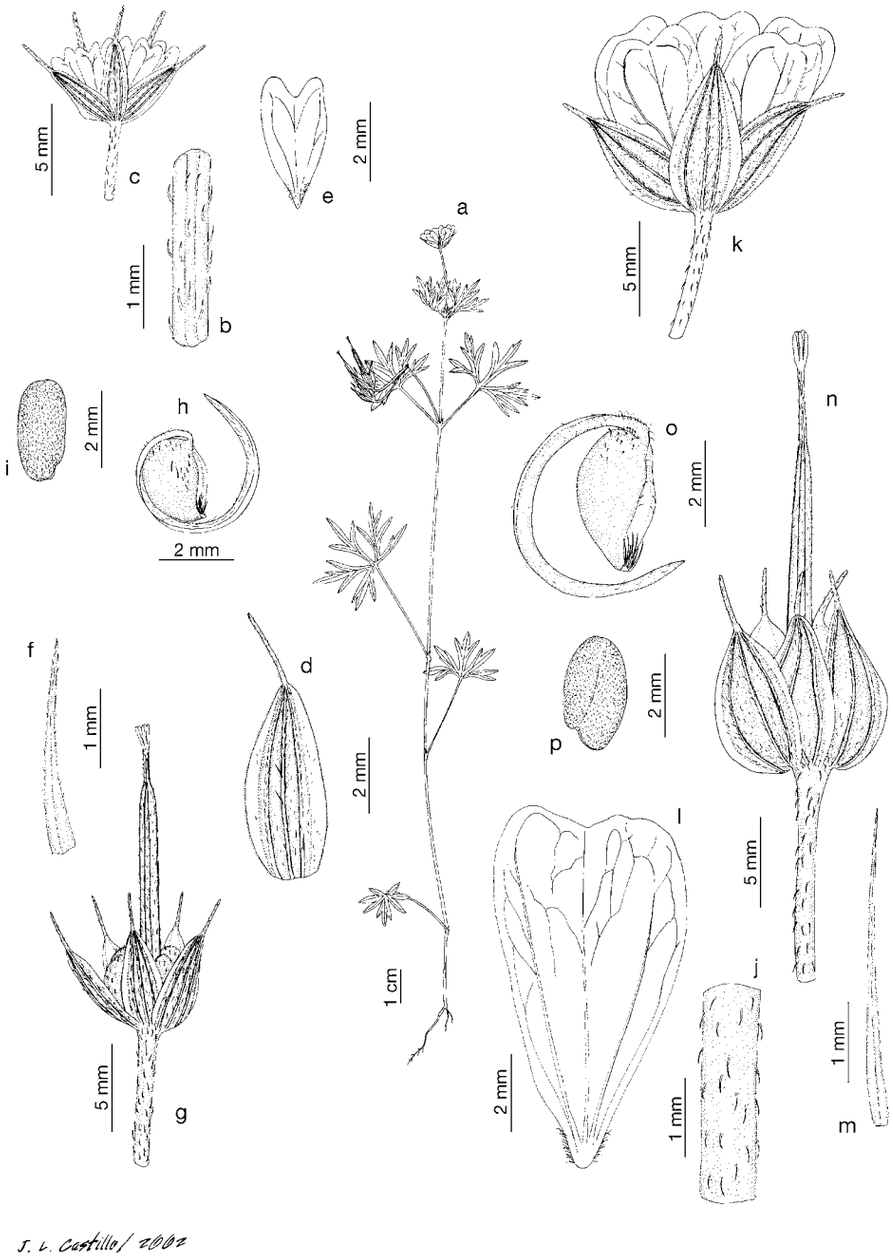


Fig. 188. *Geranium schrenkianum*. a. Habit. b. Peduncle. c. Flower. d. Sepal. e. Petal. f. Stamen. g. Fruit. h. Mericarp. i. Seed. (Based on: a-i, *Korshinsky s.n., 28 June 1890,* LE). *Geranium columbinum*. j. Peduncle. k. Flower. l. Petal. m. Stamen. n. Fruit. o. Mericarp. p. Seed. (Based on: j-m, *González Rebollar & al. s.n.,* MA-480999; n-p, *Borja s.n.,* MA-178916).

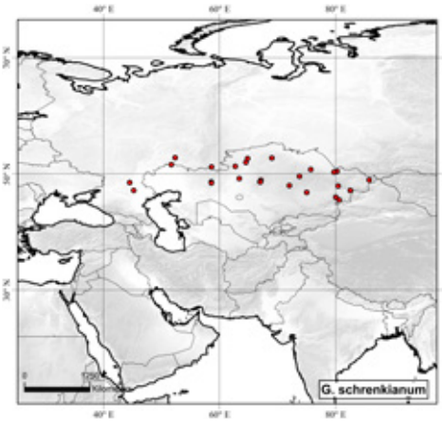


Fig. 189. Distribution of *Geranium schrenkianum*.

Aktobe: Turgai, Irgizskiy distr., between station Berchogur and Karangdy, 48°27'N, 58°33'E, 27 June 1904, *Ianshevkoy s.n.* (LE); Turgai, Turgayskaya obl., Aktiubinskaya gub., Mugodzhary slope Mt. Dodzakci, 48°38'N, 58°32'E, 9 Aug. 1927, *Rusanov 1053* (LE). Almaty: in herbidis ad fl. Lepsa ad radicem montium Alatau, 45°31'N, 80°35'E, 1841, *Karelin & Kiriloff 1328* (LE, P, W). East Kazakhstan: Yli-Balkhash, Siemprbcien obl., Siergiopol u., Bel'tereka, 47°56'N, 80°24'E, 30 July 1890, *Korshinsky s.n.* (LE); S Altai, Saisansky distr., Aleksievka, 48°57'N, 85°45'E, 29 June 1925, *I[?]omn[?]k s.n.* (LE); Semipalatenskaia u., N slope of Mt. Semey-tau, 50°20'N, 79°42'E, 29 June 1928, *Iljin & Heinrichson 343* (LE); Semipalatin obl., Karkaral u., Urocishie Kisul'Tash, Vuysojshie travianoe Soloto, 50°28'N, 80°13'E, 28 June 1890, *Korshinsky s.n.* (LE). Karagandy: Yli-Balkhash, Sientral'no-Kasajstanskiy, Karagandinskaia obl., 35 km NW Akbogay, Mt. Nortay, 46°50'N, 74°59'E, 13 June 1966, *Karamuisheva & al. 4506* (LE); Yli-Balkhash, Karagandinskaia obl., 60 km N Mt. Bolkaj, Bieksau-ata, 46°50'N, 74°59'E, 30 June 1968, *Karamuisheva & al. 509* (LE); Songoria, Ulutau, 48°39'N, 67°0'E (LE); Akmolinskaya obl., Atbasarsk, Ulutaskya Mt., 48°39'N, 66°56'E, 1 July 1914, *Ganeschin 1199* (LE); Karsaky reg., near Ulutau, 48°39'N, 67°1'E, 15 July 1959, *Lipshic 470* (LE); Karsakiaisky reg., near Ulutabsky, 48°39'N, 67°1'E, 18 July 1929, *Pavlov & al. 590* (LE); Akmolinskaya obl., Atbasarsk u., Ulutavskiya Mt., 48°39'N, 66°56'E, 4 July 1914, *Semenov 1199* (LE); Kzyl-ordinsk distr., Mt. Idshe, S of Ulutau, 48°37'N, 67°0'E, 12 July 1929, *Lipshic 386* (LE); Akmolinskaya obl., Atbasarsk u., Gorui Udutau, Ulutaskya, 48°39'N, 66°56'E, 4 July 1914, *Semenov s.n.* (LE); Akmolinskaya obl., Atbasarsk u., Tamdinsky, 48°56'N, 67°5'E, 1 July 1914, *Ganeschin 1187* (LE); Semipalatin obl., Karkaral u., Karaoba, 49°36'N, 73°44'E, 9 July 1890, *Korshinsky s.n.* (LE). Kostanay: Turgai, Turgayskaya obl., river Sasdy, 49°13'N, 63°22'E, 16 July 1904, *Ianshevkoy s.n.* (LE); Turgai, Turgayskaya obl., Aktuvinsky distr., Urkach, 51°19'N, 62°40'E, 8 July 1904, *Ianshevkoy s.n.* (LE); Turgai, Mt. May-Giuba, 52°0'N, 64°30'E, 1913, *Spiridonow s.n.* (LE); Akmolinskaya obl., near lake Ubagan-Denshe (Kus-murunv), 52°40'N, 64°48'E, 18 Aug. 1913, *Korotkij 1254* (LE). North Kazakhstan: Songaria, in declivibus m. Ulutau, 46°0'N, 80°0'E, 15 June 1842, *732* (LE); Central'no-Kasajstanskij, Karagan-dinskaia obl., 40 km WNW station Dzhezdy, Mt. Kastan, 48°0'N, 72°0'E, 14 June 1968, *Karamuisheva & al. 62* (LE). Pavlodar: Pavlodarskaya obl., Mt. Baien-Aul, 50°47'N, 75°41'E, 20 July 1959, *Ra[?]ov[?] 7846* (LE). **Russia.** Orenburg: Orsk, 51°13'N, 58°35'E, 1889, *Antonov s.n.* (LE). Uralskaya obl., Chimirsky distr., Mt. Mugodzhary, 51°37'N, 51°39'E, 29 June 1929, *Yanishevskiy s.n.* (LE). Rostov: Danskaya obl., village Novopablobka, river Miust, 47°10'N, 45°10'E, 16 Apr. 1888, *Pitvinoe s.n.* (LE). Samara: Bushulukskiy ubcl, Bielogorskaya dacha, 52°49'N, 52°19'E, 18 June 1914, *Yanishevskiy 901* (LE). Volvograd: Sarepta, 48°31'N, 44°29'E, 1881 (LE).

Discussion. Geranium schrenkianum is a species quite similar to *G. columbinum* that some authors have included in the synonymy of the latter (Webb & Ferguson 1968: 198). According to Bobrov (1949: 13), *G. schrenkianum* is characterized by its smaller flowers. The species was reevaluated by Aedo (2003), showing that *G. schrenkianum* has antrorse, appressed hairs on the stem, petioles, peduncles, and pedicels, while *G. columbinum* has retrorse hairs in all these parts. Additionally, *G. schrenkianum* has shorter sepals, petals and fruits than *G. columbinum*. These two species have allopatric areas.

The Sibiricum Group—The species of this group are perennials, trailing to ascending, sometimes rooting at the nodes, usually with opposite leaves, free and narrow stipules, 1-2-flowered cymules arranged in monochasial inflorescence and petals of small size, with short hairs at the base.

65. Geranium arnottianum Steud., Nomencl. Bot. ed. 2, 1: 677. 1840. *Geranium affine* Wight & Arn., Prodr. Fl. Ind. Orient.: 133. 1834, nom. illeg., non Ledeb., 1831. Type locality: "Wight! cat. n. 438, 439". Type: India. Peninsula Indiae Orientalis, 1866, *R. Wight 439* (lectotype, here designated, K!; isolectotypes, E-00174284 image!, E-00174285 image!, E-00438231 image! G!, LE!, NY!, P-00712055!).

Perennial herbs, 12-42 cm tall. *Rootstock* 6-7 mm in diameter, ± vertical, not tuberculate, not turnip-shaped, unknown roots. *Stem* prostrate to ascending, leafy, not rooting at nodes, stolons absent, without vegetative stems, with patent, eglandular hairs 0.4-1.4 mm long. *Basal leaves* in a ± persistent rosette, cauline leaves opposite; leaf laminas (2.4)2.7-3.9(4.6) cm long, 2.8-5.6 cm wide, not peltate, palmatifid [ratio main-sinus length/middle segment length = (0.82)0.84-0.87(0.91)], polygonal in outline, base cordate, not coriaceous, with nerves not projected, pilose, with appressed, eglandular hairs on both surfaces; segments 5, in 1 plane, middle segment rhombic, (2.8)3.3-4.4(5.4) mm wide at the base [ratio segment width at the base/middle segment length = 0.14-0.18(0.21)], 8-12(15)-lobed in distal half [ratio secondary sinus length/middle segment length = (0.27)0.29-0.34(0.39)]; petioles up to 7.5 cm long, without abscission zone, terete, not swollen, not deflexed in age, with patent, eglandular hairs 0.6-1.5 mm long; stipules 5.4-7.3(7.6) mm long, 0.7-2 mm wide, lanceolate, free, papery, brown, with eglandular hairs on both surfaces, and on the margin. *Inflorescence* a monochasial cyme; cymules (1)2-flowered, solitary [ratio cymule length/leaf length = (1)1.9-2.2(3.1)]; peduncles (8.1)35-77(85) mm long, with patent, eglandular hairs 0.2-1.3 mm long; bracteoles (3)3.8-5(5.2) mm long, 0.3-0.7 mm wide, lanceolate, usually whorled; pedicels (14.8)18-22.9(26.3) mm long, with patent, eglandular hairs 0.3-1.3 mm long. Flowers actinomorphic. *Sepals* (5.6)5.9-7.2(7.9) mm long, 1.9-3 mm wide, lanceolate, smooth, accrescent, nerves 3, mucro (0.6)0.7-1.1(1.2) mm long [ratio mucro length/sepal length = (0.11)0.12-0.16(0.17)], with ± patent, eglandular hairs 0.6-1.2 mm long on the abaxial surface, glabrous adaxially. *Petals* (8.3)8.4-9.7(12.2) mm long, (4.5)4.7-6.2(7.7) mm wide, erect-patent, emarginate (notch 0.2-1.4 mm deep), without claw, unknown color, glabrous on both surfaces, ciliate on the basal margin, with hairs 0.2-0.3 mm long. *Stamens* 10, both whorls bearing anthers; filaments 4.3-4.7(5.5) mm long, lanceolate, unknown color,

with scattered hairs 0.1-0.3 mm long on abaxial surface and margin; anthers 1.2-1.3 mm long, unknown color. Nectaries 5, hemispheric, glabrous. *Gynoecium* 4.2-6.5 mm long, unknown color. *Fruit* (18.1)19-21(21.9) mm long, erect, discharge of seed-ejection type; mericarps 3.3-4.3 mm long, 1.4-2 mm wide, without a strand of fibers, not compressed at the apex, smooth, without basal beak, with a basal callus, without a basal prong, brown, with ± patent, eglandular hairs 0.7-1.7 mm long; rostrum 11.8-15 mm long, with a narrowed apex 1-2.1 mm long, not twisted, with ± patent, eglandular hairs 0.2-0.5 mm long; stigmatic remnants (1.8)2.1-2.5 mm long, with 5 hairy lobes. *Seeds* 2.6-2.9 mm long, 1.4-1.6 mm wide, finely reticulate, uniformly colored, brown, glabrous. Cotyledons with entire margin. Fig. 190.

Pollen. Ornamentation not studied.

Chromosome number. Unknown.

Phenology. Collected in flower from April to November.

Distribution. This species is endemic to southern India (Kerala and Tamil Nandu) (Fig. 191).

Habitat. Grassland; 1750-2300 m.

Additional specimens examined. **India.** Kerala: Eravikulam, above stream below Eravikulam Hut., 10°13'N, 77°4'E, 3 Nov. 1980, *Rice 187* (NY). Tamil Nandu: plaine de Matepoliam, Nilagiris, Oct. 1838, *Delessert s.n.* (L); Pulney mountains, Kodaikanal Station, 10°10'N, 77°54'E, 2 Apr. 1914, *Saulière 89* (G); Peninsula Indiae Orientalis, Pulney mountains, 10°12'N, 77°30'E, Sep. 1836, *Wight 300* (HBG, MA, NY); Kodaikanal, 10°14'N, 77°29'E, 1 Sep. 1929, *Bembower 124* (MO); Kundahs near Thiashola, 11°22'N, 76°31'E, 16 June 1932, *Bartnes 762* (L); Nilagiri hills, 11°24'N, 76°43'E, *Brandis s.n.* (HBG); Nilagiris, 11°24'N, 76°43'E, Sep. 1886, *Gamble 18102* (HBG); in montibus Nilagiri, 11°24'N, 76°43'E, 1851, *Hohenacker 1141* (L, HBG, RO); Mt. Nilagiri, 11°24'N, 76°43'E, 1851, *Jørgensen s.n.* (WRSL); Nilagiri hills, 11°24'N, 76°43'E, 1839, *Perrottet s.n.* (G); mont Nilghiri, 11°24'N, 76°43'E, *Thomson*

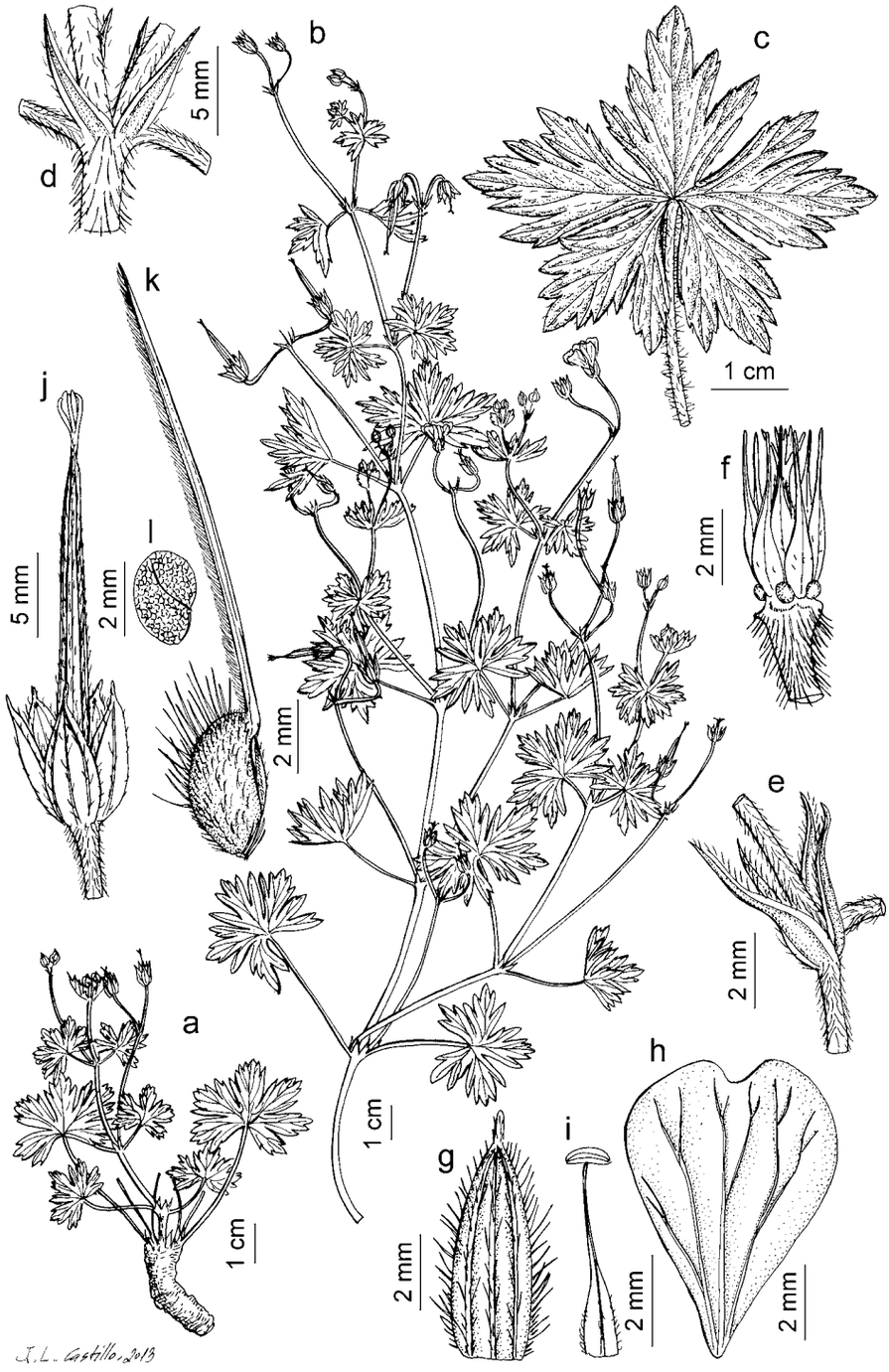


Fig. 190. *Geranium arnottianum*. a, b. Habit. c. Leaf, on the adaxial side. d. Stipules. e. Bracteoles. f. Flower without petals and sepals. g. Sepal. h. Petal. i. Stamen. j. Fruit. k. Mericarp. l. Seed. (Based on: a, *Watt s.n., s.d.,* NY; b, d-l, *Gamble 18102,* HBG; c, *Bartnes 762,* L).

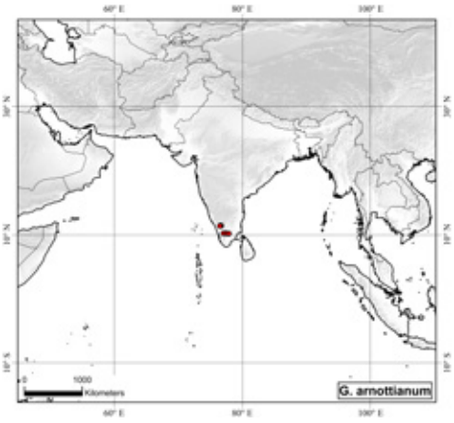


Fig. 191. Distribution of *Geranium arnottianum*.

s.n. (L); Nilagiri hills, 11º24'N, 76º43'E, *Watt s.n.* (NY); Nilghirio, Pykarah, 11º27'N, 76º36'E, Oct. 1910, *Meebold 11522* (WRSL).

Discussion. Geranium arnottianum is a prostrate to ascending herb. Its underground parts are poorly known through the scarce herbarium material available. Nevertheless, it seems to have a narrow, vertical rootstock. Stems, leaves, petioles, and inflorescence are covered by long, eglandular hairs, more densely when young. Among the material studied, cymules are almost always 2-flowered. Sepals are accrescent and fruits have a distinct narrowed apex and long stigmatic remnants. However, its more distinctive features are its relatively long, emarginated petals and its leaves with a rhombic middle segment, which have many lobes. *Geranium arnottianum* is close to *G. nepalense*, a species widespread on the Himalayas that have some isolated localities in Sri Lanka and Sumatra. Some authors have synonymized both species. However, *G. arnottianum* is an endemic from South India, easily to recognize from *G. nepalense* by its long petals, distinctive leaves, and long stigmatic remnants.

66. Geranium nepalense Sweet, Geraniaceae 1, tab. 12. 1820. Type locality: "Several plants of this little species of Geranium were raised last spring by Mr. W. Anderson, at the Botanic Garden, Chelsea, from seeds given him by Sir A. Hume, who received them from Nepal, from one of which our drawing was taken last summer". Type: Sweet, Geraniaceae: 1, tab. 12. 1820 (lectotype, designated by Aedo 2017a: 56). India. Sikkim, 27°30'N, 88°30'E July 1857, *T. Thomson s.n.* (epitype, here designated, L-793234!).

Geranium radicans DC., Prodr. 1: 639. 1824. Type locality: "in Napuliâ. Wallich". Type: Nepal. Napuliâ, 1821, *N. Wallich s.n.* (lectotype, designated by Veldkamp & Moerman 1978: 466, G-DC-00214912!; isolectotypes, K!, MA-617369!, NY!, W!).

Geranium quinquenerve Buch.-Ham. ex D. Don, Prodr. Fl. Nepal.: 208. 1825. Type locality: "Hab. in Nepaliâ, ad ripas umbrosas fluvii Kuli Khana dicti. Hamilton". Type: Nepal. ad ripas umbrosas fluvii Kuli Khana, 27°35'N, 86°08'E, 10 Apr. 1802, *F. Hamilton s.n.* (lectotype, designated by Aedo 2017a: 56, BM- 000521702!).

Geranium lavergneanum H. Lév., Bull. Soc. Agric. Sarthe 39: 319. 1904. Type locality: "Kouy-Tchéou: Hin-y-hien: bord des routes, culyures, fossés. 10 avril 1897; no. 1534, fleurs roses-pourpres et fleurs blanches (Em. Bodinier)". Type: China. Guizhou, Hin-y-hie, 25°05'N, 104°53'E, 10 Apr. 1897, *E. Bodinier 1534* (lectotype, designated by Lauener 1967: 266, E-00216796!; isolectotype, P-00712114!).

Geranium lavergneanum var. *cinerascens* H. Lév., Bull. Soc. Agric. Sarthe 39: 319. 1904. Type locality: "Kouy-Tchéou: environs de Tsin-gay, champ, jardins, bord des routes; environs de Kouy-Yang. Fleurs roses 4 déc. 1897; no. 2018 (J. Laborde et. Em. Bodinier)". Type: China. Guizhou, Kouy-Tchéou, environs de Kouy-Yang, 26°38'N, 106°37'E, 4 Dec. 1897, *J. Laborde & E. Bodinier 2018* (lectotype, designated by Lauener 1967: 266, E-00216795!; isolectotype, P-00712116!).

Geranium fangii R. Knuth, Repert. Spec. Nov. Regni Veg. 40: 218. 1936. Type locality: "Szetschuan: Nanchuan Hsien, 2400-2700 m, an grasigen Stellen (Fang a. 1928 n. 834!, 906!, 1393!). Mow Hsien (Fang a. 1928 n. 5507!)". Type: China. Sichuan, Nanchuan Hsien, 29º06'N, 107º13'E, 1928, *W.P. Fang 834* (lectotype, designated by Aedo 2017a: 56, E-00216777!; isolectotypes, GH-00043668 image!, NY!, P-00712142!).

Geranium oliganthum C.C. Huang, Acta Phytotax. Sin. 1: 161, pl. 9. 1951. *Geranium nepalense* var. *oliganthum* (C.C. Huang) C.C. Huang & L.R. Xu, Fl. Reipub. Pop. Sin. 43(1): 35. 1998. Type locality: "Hopei: Near Eastern Tombs [two symbols in chinisse], alt. 770 m., flowers white, June 17 1931, K. M. Liou 331!-Type". Type: China. Hebei, near Eastern Tombs, 40º15'N, 117º32'E, 17 June 1931, *K.M. Liou 331* (holotype, PE?).

Geranium jinchuanense Z.M. Tan, Bull. Bot. Res., Harbin 14(3): 232, 235 tab. 2. 1994. Type locality: "Sichuan: Jinchuan County, near the town, by the road, 2150 m alt., June 4, 1979, Jinchuan Exped. 322 (Type, ICD)". Type: China. Sichuan, Jinchuan County, near the town, 31º35'N, 101º48'E, 4 June 1979, *Jinchuan Exped. 322* (holotype, SM).

Perennial herbs, 10-72 cm tall. *Rootstock* 2-5.8 mm in diameter, ± vertical, not tuberculate, not turnip-shaped, without thickened roots. *Stem* trailing and ascending, leafy, sometimes rooting at nodes, stolons absent, without vegetative stems, with patent to retrorse, appressed, eglandular hairs 0.2-1.3 mm long. *Basal leaves* in a ± persistent rosette, cauline leaves opposite; leaf laminas (2.3)2.9-3.8(5.3) cm long, 2.7-6.9 cm wide, not peltate, palmatifid [ratio main-sinus length/middle segment length = (0.78)0.80-0.87(0.90)], polygonal in outline, base cordate, not coriaceous, with nerves not projected, pilose, with appressed, eglandular hairs on both surfaces; segments 5, in 1 plane, middle segment broadly rhombic, 3.2-5.6(6.5) mm wide at the base [ratio segment width at the base/middle segment length = (0.13)0.16-0.22(0.23)], 6-10(13)-lobed in distal half [ratio secondary sinus length/middle segment length = (0.11)0.19-0.23(0.28)]; petioles up to 12 cm long, without abscission zone, terete, not swollen, not deflexed in age, with patent to retrorse, eglandular hairs 0.2-1.5 mm long; stipules (3.7)5.4-8.2(11.9) mm long, 0.7-2.4 mm wide, lanceolate, free, papery, brown, with eglandular hairs on abaxial surface and on the margin, ± glabrous adaxially. *Inflorescence* a monochasial cyme; cymules 1-2(3)-flowered, solitary [ratio cymule length/leaf length = (0.7)1.2-2.1]; peduncles (12)40-71(83) mm long, with patent to retrorse, eglandular hairs 0.3-1.3 mm long; bracteoles (2.7)3.4-4.5(5.2) mm long, 0.4-0.9 mm wide, lanceolate, opposite or whorled; pedicels (10.4)15-22(31.9) mm long, with patent to retrorse, eglandular hairs 0.2-1 mm long. Flowers actinomorphic. *Sepals* (4.1)4.4-5.5(5.8) mm long, 1.6-2.5 mm wide, lanceolate, smooth, not accrescent, nerves 3, mucro (0.4)0.7-0.9(1) mm long [ratio mucro length/sepal length = (0.10)0.15-0.20(0.23)], with ± patent, eglandular hairs 0.4-1 mm long on the abaxial surface, glabrous adaxially. *Petals* (4.4)5-5.6(6.3) mm long, (2)2.7-3.3(4) mm wide, erect-patent, rounded or slightly emarginate, without claw, white or pale pink, rarely deep pink, with scattered hairs on the base of both surfaces and on the basal margin, with hairs 0.1-0.4 mm long.

Stamens 10, both whorls bearing anthers; filaments (1.8)2.5-3.1(3.8) mm long, lanceolate, white, pilose on the abaxial surface, ciliate on the proximal half, with hairs 0.1-0.4 mm long; anthers (0.3)0.5-0.7(0.9) mm long, blue. Nectaries 5, hemispheric, glabrous. *Gynoecium* 2.9-4 mm long, purple. *Fruit* (14)15.1-17.8(18.8) mm long, erect, discharge of seed-ejection type; mericarps 2.5-3.2 mm long, 1.3-1.7 mm wide, without a strand of fibers, not compressed at the apex, smooth (with 1 transverse vein at apex), without basal beak, with a basal callus, without a basal prong, brown, with ± patent, eglandular hairs 0.3-1.2 mm long; rostrum 9.3-13.9 mm long, with a narrowed apex 0.9-2 mm long, not twisted, with ± patent, eglandular hairs 0.1-0.6 mm long; stigmatic remnants 0.8-1.2(1.4) mm long, with 5 hairy lobes. *Seeds* 1.9-2.4 mm long, 1.1-1.3 mm wide, finely reticulate, uniformly colored, brown, glabrous. Cotyledons with entire margin. Figs. 192, 193.

Pollen. *Geranium*-type (Bortenschlager 1967: 433; Gagnepain 1903: 87; Park & Kim 1997: 311; Perveen & Gaiser 1999: 266; Tan & al. 1996: 213).

Chromosome number. 2*n* = 26, 28.

Phenology. Collected in flower from January to December.

Distribution. This species ranges from Afghanistan to eastern China through Pakistan, India, Nepal, Burma, Thailand, Laos and Vietnam and it is introduced in Sri Lanka, Sumatra, Australia and Brazil (Fig. 194).

Habitat. Disturbed areas, roadsides, fields, meadows and forest edges; 100-3800 m.

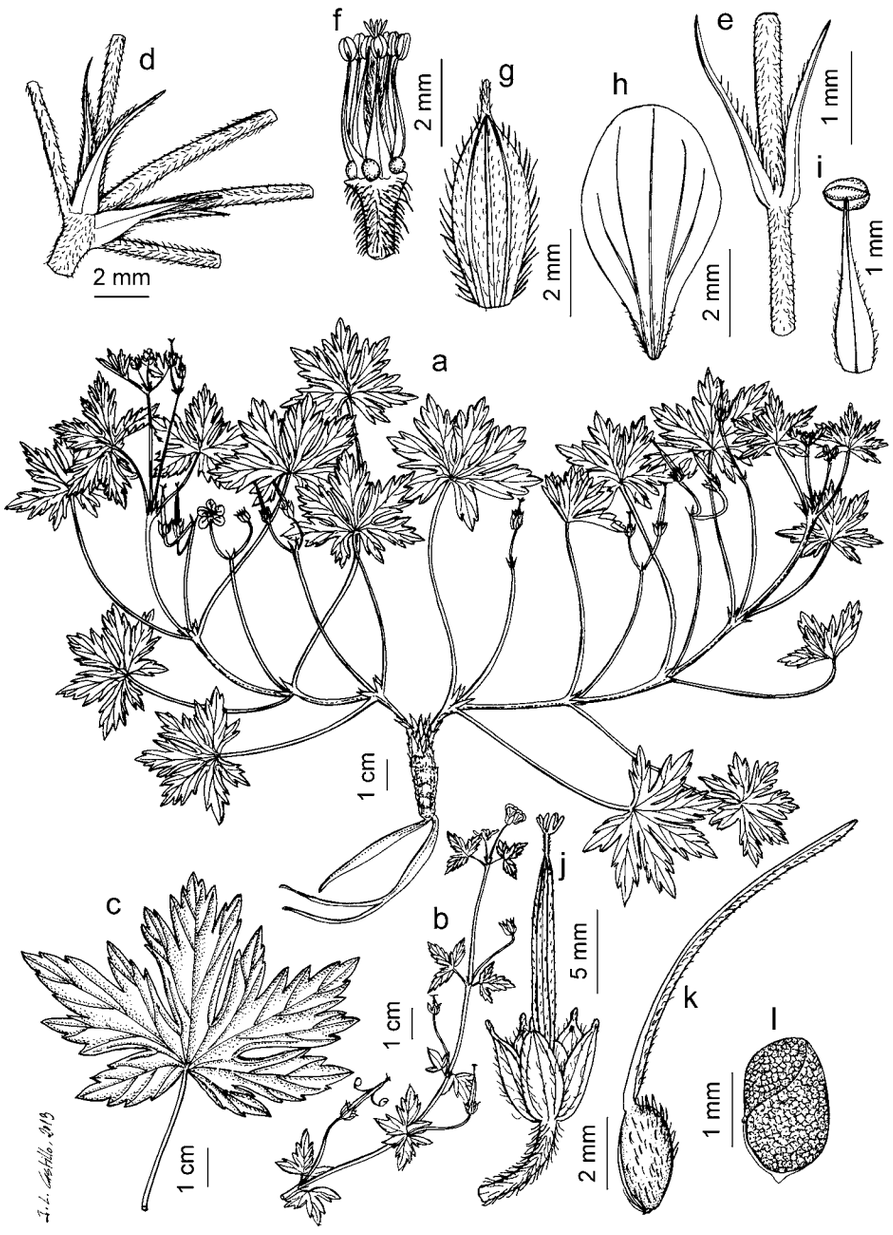


Fig. 192. *Geranium nepalense*. a. Habit. b. Inflorescence. c. Leaf, adaxial surface. d. Stipules. e. Bracteoles. f. Flower without petals and sepals. g. Sepal. h. Petal. i. Stamen. j. Fruit. k. Mericarp. l. Seed. (Based on: a, c-i, *Schmid 170,* G; b, j-l, *Hallier s.n.*, *7 Nov. 1896*, G).

Fig. 193. *Geranium nepalense* (Based on: *Aedo 1176,* MA).

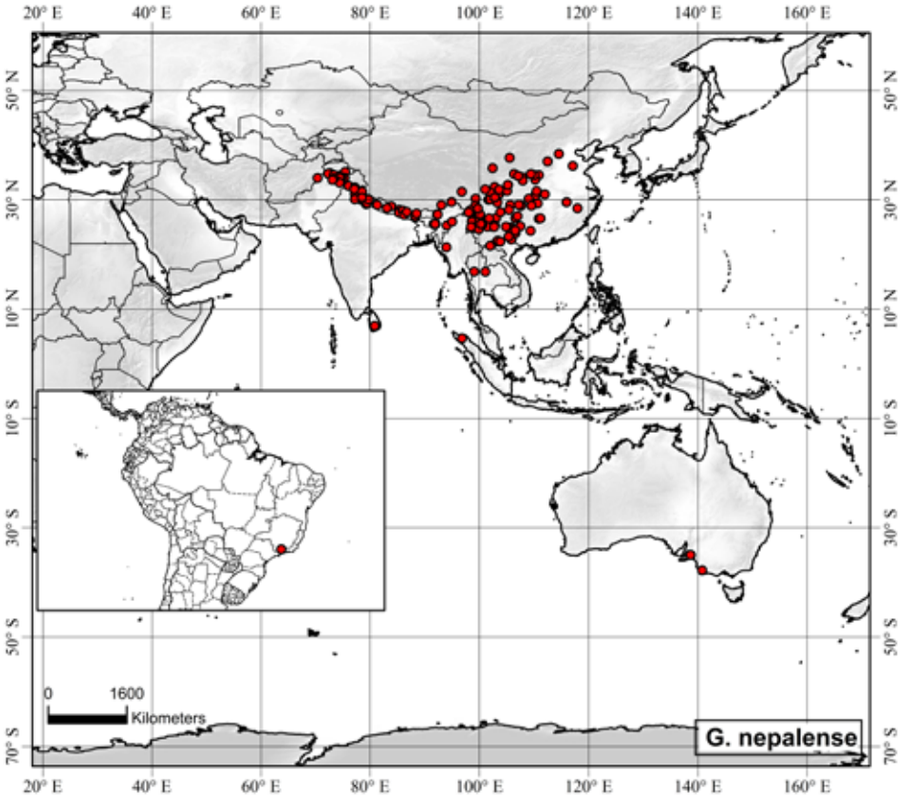


Fig. 194. Distribution of *Geranium nepalense*.

Representative specimens examined. **Afghanistan.** Nangarhar: Kurrum valley, 33°59'N, 70°22'E, 1879, *Aitchison 220.281* (G). **Australia.** South Australia: Southern Lofty, old orchad off Fitzhenry Track, down hill from Cherryville, 34°59'S, 138°42'E, 8 Nov. 1994, *Bates 39722* (AD). **Brazil.** Minas Gerais: Serra de Mantiqueira, garganta do Registro, 22°21'S, 44°46'W, 4 May 2012, *Aedo & al. 1176* (MA). **Burma.** Chin: Southern Chin Hills, Mt. Victoria region, Esakan, 21°19'N, 93°57'E, 31 Mar. 1956, *Alsterlund 157* (GB). **China.** Gansu: Wen Xian, Motianling Shan, Baishui Jiang Nature Reserve, SSW of city of Bikou, Bifeng Gou, 32°42'N, 105°12'E, 7 May 2007, *Boufford & al. 37502* (GH, MA). Guangxi: ciudad Baise, distrito Longlin, 23°54'N, 106°37'E, 7 May 1957, *Liang & Woo 32239* (IBSC). Guizhou: Cehen Co., Long Du, 34 km E of Anlong on road to Cehen, 24°57'N, 105°47'E, 17 Mar. 1996, *Tsi & al. 90* (K). Hebei: province of Chili, Pau an tchan, 38°24'N, 114°34'E, 3 Sep. 1913, *Meyer 1273* (NY). Henan: ciudad Sanmenxia, distrito Lushi, 34°31'N, 110°54'E, 1 Sep. 1958, *Fu Jingqiu 367* (MO). Hubei: prefectura Enshi, distrito Jianshi, pueblo Huaping, 30°12'N, 109°3'E, 1 Oct. 1993, *Wang Congrong 60* (MO). Hunan: Xinning Co., Wanfenglinchang, 26°33'N, 110°55'E, 19 Sep. 1995, *Luo Lin-bo A26* (CAS). Jiangxi: ciudad Shangrao, distrito Wuyan, montaña Zhanggong, 28°27'N, 117°58'E, 10 Apr. 1998, *Lai Shushen 4621* (MO). Ningxia: Shikong, Bao-hsin, Moupin, 37°41'N, 105°33'E, July 1939, *Hu 984* (GH). Qinghai: zona Haidong, distrito Minhe, pueblo Xigou, 35°47'N, 102°26'E, 19 Sep. 1959, *Qinghai-Gansu Exped. 1886* (MO). Shandong: Talanfu, t'ai Shan Mts., 36°11'N, 117°7'E, Sep. 1912, *Clemens 1426* (E). Shanxi: montaña Lingkong, 13 June 1959, *Guan Ke Jian & Chen Yilin 705* (PE). Sichuan: Jinchuan Xian, E of the city Jinchuan on highway 211 to Dusong Xiang, then W along Sesiman Gou toward border with Maerbang Xiang, 31°18'N, 102°0'E, 2 Aug. 2007, *Boufford & al. 38809* (GH, MA). Xizang: Riwoqe Xian, road from Changdu to Nangqen, on road to Riwoqe via Machala coal mine, 31°28'N, 96°46'E, 24 July 2009, *Boufford & al. 40993* (MA). Yunnan: Zhongdian Xian, between Daxue Shan and Xiaoxue Shan, 28°24'N, 99°46'E, 22 Aug. 2004, *Boufford & al. 32593* (MA). **India.** Arunachal Pradesh: Kameng, Rahung to Bondilla, 27°18'N, 92°22'E, 5 June 1957, *Rao 8085* (L). Himachal Pradesh: Solan, Shimla Hills, 30°6'N, 77°10'E, 19 Sep. 1956, *Nanda 112* (G). Jammu-Kashmir: Kotwali, Bazaar, Dharmsala, 33°8'N, 74°24'E, 17 May 1917, *Stewart 1868* (NY). Meghalaya: Mawphlang, Khasi Hills, 25°27'N, 91°45'E, 16 Apr. 1954, *Chand 8010* (L). Nagaland: Mao Karong, 25°18'N, 94°2'E, 19 Feb. 1889, *Watt s.n.* (HBG). Sikkim: Sikkim, Pauree, 27°30'N, 88°30'E, *Prain 277* (HBG). Uttar Pradesh: Kunain, 30°19'N, 78°2'E, 23 July 1968, *Misra 38055* (G). Uttaranchal: Kumaun, district Naini Tal, Gager Pass, 29°13'N, 79°16'E, 25 Sep. 1982, *Rechinger 60650* (G). West Bengal: Darjeeling, 26°45'N, 88°15'E, 17 Dec. 1937 (MO). **Indonesia.** Sumatra: Atjeh, Laut Poependji, 4°39'N, 96°49'E, 3 Sep. 1934, *Steenis 6400* (L, K, P). **Laos.** Phongsaly: Muang Cha, Chang Kwang, 21°35'N, 101°59'E, 17 Apr. 1932, *Kerr 21094* (K, L, P). **Nepal.** Gandaki: C Nepal, Dhaulagiri zone, Mustang distr., Jharkot-Muktinath, 28°48'N, 83°51'E, 22 July 1983, *Kanai 10611* (GH). **Pakistan.** Khyber Pakhtunkhwa: Kagan valley, Shogran, 34°32'N, 73°21'E, 18 July 1970, *Zaffar Ali & Grihmann 6008* (H). **Sri Lanka.** Uva: Hakgala, 6°55'N, 80°49'E, 14 Jan. 1970, *Dassanayake 131* (NY). **Thailand.** Tak: Chiang Mai, mae Sun, 16°51'N, 99°3'E, 25 May 2011, Šida *& al. 102* (PR). **Vietnam.** Lào Cai: Tonkin, Lao-Kay, Chapa, 22°20'N, 103°50'E, 12 June 1913, *Chevalier 29425* (P).

Discussion. Geranium nepalense is a trailing and ascending perennial, sometimes rooting at the nodes, with short petals and eglandular indumentum. This species is sometimes difficult to distinguish from *Geranium sibiricum*. Normally, at least some cymules in each plant of *G. nepalense* are 2-flowered, but 1-flowered cymules are not infrequent. In extreme forms, 2-flowered cymules can be difficult to locate. Information from herbarium specimens is not enough to understand this variability, and further field studies could be necessary. *Geranium nepalense* has leaves with broader segments than in *G. sibiricum* (with the widest point nearest to the apex), shorter narrowed apex of the rostrum, and longer sepal mucro. Additionally, *G. nepalense* is sometimes rooting at the nodes, which has not been observed in *G. sibiricum*. Distribution of *G. nepalense* seems to be more southern than that of *G. sibiricum*.

The lectotype of *G. nepalense* was chosen on an illustration, since no other original material has been located. An epitype is also designated for purposes of the precise application of the name.

67. Geranium sibiricum L., Sp. Pl.: 683. 1753. *Geranium variabile* Moench, Methodus: 283. 1794, nom. illeg. Type locality: "Habitat in Sibiria". Type: "Habitat in Sibiria" (lectotype, designated by Yeo 1992: 189, LINN-858.87 image!).

Geranium acrocarphum Ledeb., Fl. Ross. 1(2): 471. 1842. Type locality: "Hab. in deserto soongore-kirghisico ad ostium fl. Kurtschum! (Fl. alt.)". Type: Russia. Altai, Kurtschum, 51º26'N, 84º02'E, 6 June, *C.A. Meyer s.n.* (herb. Ledebour 1063) (lectotype, designated by Ivleva 2013: 230, LE image!; choice made by M. Novoselova, in sched.).

Geranium ruthenicum R. Uechtr., Oesterr. Bot. Z. 23: 335. 1873. *Geranium sibiricum* subsp. *ruthenicum* (R. Uechtr.) Nyman, Consp. Fl. Eur.: 137. 1878. Type locality: "Vidi e Rossoae europaeae centralis gubernio Jaroslaw (Herb. M. Winkler); e Sibiriae diversis locis (ex gr. ad Fl. Jenissei [Lessing], in ruderatis circa Barnaul [Patrin] et specimina sine loco specialiter indicato ex herb. acad. Petropolitano), denique a regno Tibetano occidentali (reg. temper. alt. 10.000-12.000 ped. ex herb. Ind. orient. Hooker fil. et Thomson); - omnia in herb. regio Berolin. sub nomine G. sibirici MB... Praetera frequenter subspontane in hortis oppidi Tilsit Borussiae orientalis, unde multa specimina sub G. sibirici nomine distribuit etiamque mecum communicavit cl. Heidenreich". Type: Russia. Kaliningrad. Tilsit, 55º02'N, 21º50'E, July 1873, *F.A. Heidenreich s.n.* (lectotype, designated by Aedo 2017a: 52, W!; isolectotypes, F-53330!, K!, MA-71680!, RO!, WU!).

Geranium sibiricum f. *glabrius* H. Hara, J. Jap. Bot. 22: 171. 1948. *Geranium sibiricum* var. *glabrius* (H. Hara) Ohwi, Fl. Japan: 704. Mar. 1953. Type locality: "Hokkaido: Sapporo (J. Matsumura, Aug. 1, 1899)". Type: Japan. Hokkaidō, Sapporo, 42º59'N, 141º14'E, 1 Aug. 1899, *J. Matsumura s.n.* (lectotype, designated by Aedo 2017a: 52, TI!).

Geranium sibiricum subsp. *popovii* Tzvelev, Novosti Sist. Vyssh. Rast. 29: 96. 1993. Type locality: "Ucrainia, quercetum in viridario Alexandria prope opp. Belaja Cerkovj, 15 IX 1956, A. Borissova (LE, cum isotypo)". Type: Ukraine. Alexandria Park near town Belaya Tserkov, 49º48'N, 30º06'E, 15 Nov. 1956, *A.G. Borisova s.n.* (holotype, LE!).

Geranium sibiricum var. *multiflorum* Z.H. Lu, Bull. Bot. Res., Harbin 14: 359. 1994. Type locality: "Heilongjiang: Xunke Countg, Tuanjie Xiang, Lu Zhaohua 8800320, 8800301 (Typus in HNRH), 8800307, 8800309, alt, 450-600m, Jul. 15, 1988". Type: China. Heilongjiang, Xunke Countg, Tuanjie Xiang, 48º05'N, 124º35'E, 15 July 1988, *Lu Zhaohua 8800301* (holotype, HNR).

Geranium amurense Tsyren., Bot. Zhurn. (Moscow & Leningrad) 91(8): 1253. 2006. Type locality: "Rossia, Regio Amuriensis, oppidulum Archara, ubique in locis apertis disturbatis, 12 VIII 2005, D. Tzyrenova (LE, isotypus-VLA)". Type: Russia. Regio Amuriensis, oppidulum Archara, 49º25'N, 130º04'E, 12 Aug. 2005, *D. Tsyrenova s.n.* (holotype, LE image!; isotype, VLA).

Perennial herbs, 15-95 cm tall. *Rootstock* 2-5.3 mm in diameter, ± vertical, not tuberculate, not turnip-shaped, with thickened roots. *Stem* erect or ascending, leafy, not rooting at nodes, stolons absent, without vegetative stems, with patent to retrorse, eglandular hairs 0.3-1 mm long. *Basal leaves* in a deciduous rosette, cauline leaves opposite; leaf laminas (1.7)3.2-5.1(5.8) cm long, 2.2-7.2 cm wide, not peltate, palmatifid [ratio main-sinus length/middle segment length = (0.83)0.88-0.91(0.93)], polygonal in outline, base cordate, not coriaceous, with nerves not projected, pilose, with appressed, eglandular hairs on both surfaces; segments 5, in 1 plane, middle segment narrowly rhombic, (3.2)3.9-4.7(5.5) mm wide at the base [ratio segment width at the base/middle segment length = (0.10)0.11-0.18(0.24)], (7)9-14-lobed in distal half [ratio secondary sinus length/middle segment length = (0.18)0.20-0.25(0.28)]; petioles up to 13 cm long, without abscission zone, terete, not swollen, not deflexed in age, with patent to retrorse, eglandular hairs 0.3-1.5 mm long; stipules 2.6-9.5 mm long, 0.6-1.9 mm wide, lanceolate to subulate, free, papery, brown, with eglandular hairs on abaxial surface and on the margin, ± glabrous adaxially. *Inflorescence* a monochasial cyme; cymules 1(2)-flowered, solitary [ratio cymule length/leaf length = (0.6)0.7-1.5(2.8)]; peduncles (9)17-34(87.6) mm long, with patent to retrorse, eglandular hairs 0.2-0.9 mm long; bracteoles 1.1-5 mm long, 0.3-1 mm wide, linear-lanceolate, opposite; pedicels (18)19-27(35) mm long, with patent to retrorse, eglandular hairs 0.2-0.8 mm long. Flowers actinomorphic. *Sepals* (3.7)4.5-5.8(6.4) mm long, 1.8-3.1 mm wide, lanceolate, smooth, not accrescent, nerves 3, mucro (0.9)1-1.5(1.6) mm long [ratio mucro length/sepal length = (0.18)0.23-0.28(0.35)], with patent to antrorse, ± appressed, eglandular hairs 0.2-1.1 mm long on the abaxial surface, glabrous adaxially. *Petals* 4-5.4(5.8) mm long, (1.8)1.9-2.4(3) mm wide, erect-patent, rounded or slightly emarginate, without claw, white or pale pink with purplish veins, glabrous on both surfaces, ciliate on the basal margin, with hairs 0.1-0.2 mm long. *Stamens* 10, both whorls bearing anthers; filaments (2.4)2.5-2.8(3.1) mm long, lanceolate, yellow, glabrous on the abaxial surface, ciliate on the proximal half, with hairs 0.1-0.3 mm long; anthers (0.3)0.5-0.6(0.7) mm long, blue. Nectaries 5, hemispheric, glabrous. *Gynoecium* 2.4-3.6 mm long, yellow. *Fruit* (13.9)15-18(19.4) mm long, erect, discharge of seed-ejection type; mericarps 2.8-3.6 mm long, 1.1-1.7 mm wide, without a strand of fibers, not compressed at the apex, smooth (with 1 transverse vein at apex), without basal beak, with a basal callus, without a basal prong, brown, with ± patent, eglandular hairs 0.1-1.5 mm long; rostrum 8.5-13.9 mm long, with a narrowed apex 0.3-1 mm long, not twisted, with antrorse, eglandular hairs 0.1-0.5 mm long; stigmatic remnants 0.8-1.3 mm long, with 5 hairy lobes. *Seeds* 2-2.8 mm long, 1.1-1.5 mm wide, finely reticulate, uniformly colored, brown, glabrous. Cotyledons with entire margin. Fig. 195.

Pollen. *Geranium*-type (Bortenschlager 1967: 433; Lu & al. 1996: 320; Park & Kim 1997: 311; Stafford & Blackmore 1991: 74; Tan & al. 1996: 213).

Chromosome number. 2*n* = 28.

Phenology. Collected in flower from February to December.

Distribution. This species ranges from central and eastern Europe and the Caucasus to Japan through Sibe-

ria, Kazakhstan, Tadzhikistan, Uzbekistan, Pakistan, Mongolia, China and Korea, and it is introduced in northeastern U.S.A. (Fig. 196).

Habitat. Waste places, roadsides, fields and forest edges; 0-4300 m.

Representative specimens examined. **Austria.** Carinthia: Kärnten, Klagenfurt am Wörthesee, 46º36'N, 14º17'E, 20 Sep. 2018, *Hohla s.n.* (MA). **Azerbaijan.** Quba-Khachmaz: Kuba, pr. Leze, 41º21'N, 48º30'E, 28 July 1935, *Karjagin s.n.* (LE). **Belorussiya.** Brest: Brest, 52º30'N, 25º30'E, 20 Aug. 1970, *[illegible]* (LE). **China.** Gansu: ciudad Longnan, distrito Wudu, granja Liangshui, 33º23'N, 104º55'E, 28 June 1989, *Ying Junsheng 823* (MO). Guizhou: Kouy Tcheou, Pu Fa, 26º38'N, 106º37'E, June 1913, *Esquirol 4379* (P). Hebei: Montes Occidentales pr. oppidum Peking, mt. Pa da lin (Ba da ling, in angustiis Thii-jun inter pagos Nankou et Huai-lai, ad Murum Magnum, 40º14'N, 116º7'E, 28 July 1961, *Hosticka s.n.* (PR). Heilongjiang: ciudad Haerbin, municipio Shangzhi, pueblo Maoershan, urbanización Xinzhi, 45º43'N, 126º36'E, 13 Sep. 1950, *Wang Guangfei 64* (MO). Henan: ciudad Luoyang, distr. Song, selva Long Chi Man, 34º40'N, 112º26'E, 6 Aug. 1983, *South Team L0080* (MO). Hubei: zona del bosque Shennongjia, Taiyang Ping, 31º45'N, 110º40'E, 21 Sep. 1981, *Taiyang Ping Team 1659* (MO). Jilin: ciudad Baishan, distrito Fusong, pueblo Manjiang, 42º5'N, 128º4'E, 1950, *Liu & al. 1855* (MO). Liaoning: ciudad Shenyang, Beiling, 42º10'N, 123º8'E, 10 Aug. 1955, *Wang Wei 221* (MO). Nei Mongol: Mongolia, Ordos, 39º0'N, 108º0'E, 1884, *Potanin s.n.* (P). Ningxia: ciudad Yinchuan, Xiao Gun Zhong Kou, 38º29'N, 106º9'E, 18 Aug. 1980, *Yu Zhaoying 438* (MO). Qinghai: Yushu Xian, town of Congda, Gala village, 33º3'N, 97º8'E, 30 June 1995, *Boufford & al. 26859* (GH). Shaanxi: Tabai Shan, N side, Haoping-si, 32º56'N, 108º10'E, 16 July 1987, *Tsung-Shen Ying & al. 0259* (GH). Shandong: Pingyi Co., Baotaizhen, 35º26'N, 117º40'E, 22 Feb. 2007, *Guocheng-yong 20062-374* (MA). Shanxi: Chiao-ch'eng distr., Pa-shui-ko, 38º30'N, 111º0'E, 19 Aug. 1924, *Smith 6975* (MO, UPS). Sichuan: Xiangcheng Xian, Reda, 29º6'N, 99º37'E, 15 July 1998, *Boufford & al. 28688* (CAS). Xinjiang: Uygur Zizhiqu, city of Fukang, S margin of Junggar Basin, 44º9'N, 87º59'E, 20 June 1989, *Liston & al. 834-4* (CAS). Xizang: Lhasa, 29º38'N, 91º8'E, June 1939, *Richardson 107* (BM). **Czech Republic.** South Moravian: Moravia centr., Brno, ad viam Hájecká, in Staré Cernovice, 49º11'N, 16º37'E, 10 Sep. 1974, Černoch *25487* (MA). **Georgia.** Tbilisi: inter Wladikawkas et Tiflis, 41º41'N, 44º50'E, 1861, *Ruprecht s.n.* (LE). **Germany.** Bavaria: Bayern, bei Bamberg, 49º54'N, 10º54'E, Aug. 1912, *Harz s.n.* (MA). **Hungary.** Leutenberg, 1899, *Wiefel s.n.* (LE). **Italy.** Piedmont: Piemonte, Torino, S. Sebastiano Po, 44º47'N, 9º4'E, 16 July 1976, *Abbà s.n.* (LE). Trentino-Alto Adige: Borgo Valsugana, Le Valli, 46º3'N, 11º27'E, 17 July 1986, *Prosser & al. s.n.* (FI). **Japan.** Hokkaidō: Kushiro, Tomachise, 42º58'N, 144º22'E, 7 Sep. 1974, *Hara & al. s.n.* (TI). **Kazakhstan.** Pavlodar: Pavlodarskya obl., Mijaylovnao, 53º49'N, 76º32'E, 17 May 1955, *Tzvelev & al. 1104* (LE). **Lithuania.** Vilnius: Vilnae, 54º41'N, 25º17'E, July, *Symonowiczówna s.n.* (LE). **Mongolia.** Ulaanbaatar: 20 km SW Ulan-Bator, 47º43'N, 106º40'E, 13 Aug. 1966, *Soják 5985* (PR). **North Korea.** North Pyongan: Hamgyungbuk Do, Bolsan, 39º57'N, 125º35'E, 31 July 1939, *Nakai s.n.* (TI). **Norway.** Viken: Akershus, Kroer, 59º38'N, 10º50'E, 15 July 1991, *Lye 16628* (O). **Pakistan.** Gilgit-Baltistan: Kara-

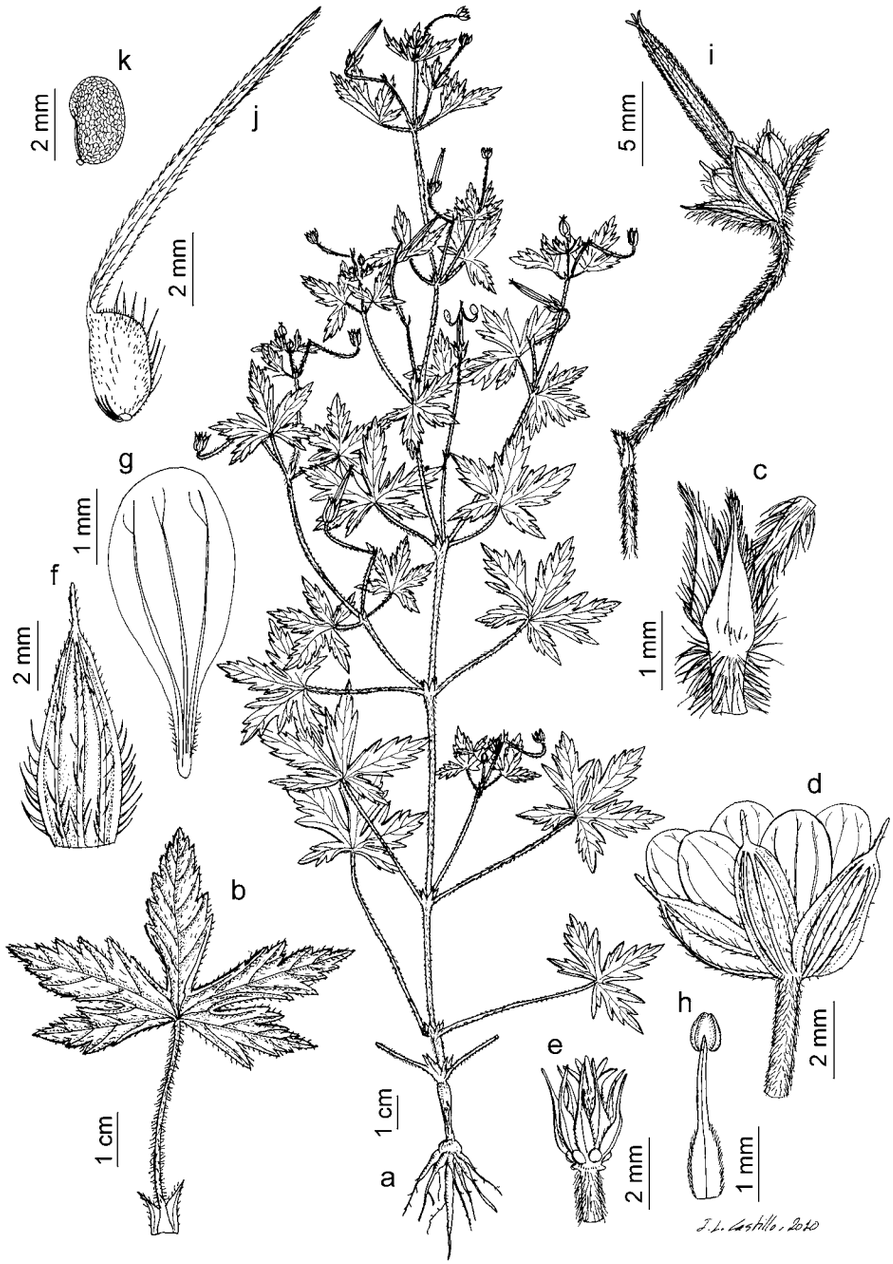


Fig. 195. *Geranium sibiricum*. a. Habit. b. Leaf. c. Bracteoles. d. Flower. e. Flower without petals. f. Sepal. g. Petal. h. Stamen. i. Fruit. j. Mericarp. k. Seed. (Based on: a-c, i-k, *Černoch 42049,* MA; d-h, *Castroviejo & Valdés Bermejo 14246,* MA).

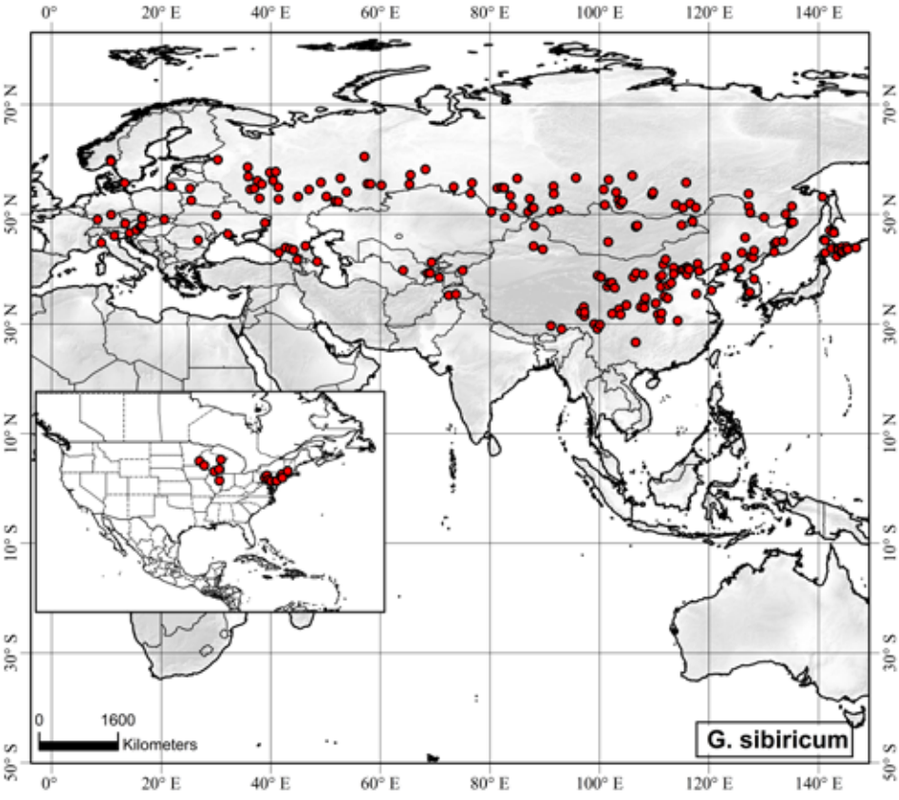


Fig. 196. Distribution of *Geranium sibiricum*.

koran, Nagar village, 35°23'N, 73°48'E, 28 Aug. 1960, *Polunin 6407* (F). **Romania.** Sud-Est: Bucovina, Cernauti, 45°16'N, 26°45'E, 31 Aug. 1931, *Gusuleac s.n.* (MO, P, RO). **Russia.** Altay: curso medio del río Karatsu y Akkurum, 51°8'N, 87°59'E, 16 Aug. 1996, *Castroviejo & Valdés Bermejo 14137SC* (MA). Amur: Blagovbshens, 50°16'N, 127°32'E, 1 July 1891, *Korshinsky s.n.* (LE). Bashkiriya: Mesyagutovo, 55°30'N, 58°13'E, 3 July 1938, *Noscov & al. 438* (LE). Buryatiya: Sabaykalsk oblast, Basseyn rajon, Bargusina, 53°36'N, 109°37'E, 6 Aug. 1911, *Sukoba 435* (LE). Chita: Nertschinsk, 51°59'N, 116°33'E, 1899, *Karo 211* (P). Dagestan: Dargi, pr. Mikihi, 44°13'N, 46°21'E, 6 July 1898, *Alexeenko 7308* (LE). Irkutsk: Irkustk, inter pagos Pribajkalskaja et Listvjanka [cultivated at Brno], 54°30'N, 100°46'E, 13 June 1984, Černoch *42049* (MA). Kabardino-Balkaria: near Baksan on way to mt. Elbrus, 43°40'N, 43°32'E, 14 July 1975, *Degener 33873* (NY). Kaluga: Marussky, 54°31'N, 36°17'E, 8 Aug. 1916, *Minkwitz s.n.* (LE). Khabarovsk: reserva natural Bolshejejtsirskiy, casa en pueblo Bychija, 48°17'N, 134°49'E, 5 July 2004, *Tsirenova s.n.* (VLA). Kostroma: Kostroma, 57°45'N, 40°55'E, 28 Aug. 1979, *Tcevelev 69* (LE). Krasnoyarsk: Malinkovka, Ubey, 55°4'N, 91°36'E, 23 July 1965, *Bukina & al. s.n.* (LE). Kuril Is.: Shikotan Is., Shakotan cape, 43°53'N, 146°50'E, 3 Sep. 1931, *Owi s.n.* (TI). Lipetsk: Semenek, Okrestnosti s. Lebyashe, 52°52'N, 37°57'E, 11 July 1985, *Tijomirov & al. s.n.* (LE). Moscow: Naro-Fominski, 56°5'N, 37°35'E, 28 July 1990, *Skvortsov s.n.* (MO). Nizhny Novgorod: Arasamas, 8 Aug. 1926, *Alejina s.n.* (LE). North Ossetia: Ordshonikidse, Uferregion des Terek, 43°28'N, 44°11'E, 17 July 1966, *Bässler 35* (B). Novgorod: Pestovo, 58°35'N, 35°48'E, 20 Aug. 1983, *Tcevelev 269* (LE). Orenburg: Troiza, pr. Offipowka, 52°19'N, 52°19'E, *Schell 735* (LE). Penza: Penza, 53°11'N, 44°58'E (LE). Perm: Talizui, 60°29'N, 57°6'E, 1876, *Schell 92* (LE). Primorye: Manshuria, lac Hanka, 45°0'N, 132°24'E, 14 Aug. 1899, *Bohnhof 237* (NY, P). Ryazan: Kasimov, 54°55'N, 41°23'E, 28 July 1970, *Tijomirov & al. 4012* (LE). Sakhalin: Otomari, 46°37'N, 142°46'E, 8 Aug. 1923, *Sawasa s.n.* (TI). Samara: Samara, 53°13'N, 50°10'E, 9 Aug. 1928, *Sprygina 2771* (LE). St. Petersburg: Leningrad, 59°56'N, 30°19'E, 9 Aug. 1979, *Tcevelev 46* (LE). Stavropol: Kislovodsk, 43°53'N, 42°43'E, 12 July 1906, *Akinfiev s.n.* (MO). Tambov: Tambov, 52°43'N, 41°26'E, 6 July 1904, *Shiraevskago s.n.* (LE). Tatariya: Kazan, 55°47'N, 49°10'E, 1848, *Klaus s.n.* (LE). Tuva: Tes-Jemskiy, Tannu-Ola, 50°54'N, 92°36'E, 3 Aug. 1908, *Janminzun & al. s.n.* (LE). Tver: Tuvers, 56°51'N, 35°54'E, 27 Aug. 1927, *[illegible] 2* (LE). Udmurtiya: Malo-Purginsky, Urom, Nasuip, 56°33'N, 52°43'E, 7 Aug. 1982, *Baranova s.n.* (LE). Ulyanovsk: Krasnog, 54°28'N, 46°58'E, 23 Aug. 1915, *Shennykob s.n.* (LE). Vladimir: Vladimir, 56°8'N, 40°24'E, 12 July 1912, *Nasarow 1493* (LE). West Siberia: Omsk, 54°58'N, 73°23'E, 14 July 1884, *Golde s.n.* (LE). Yaroslavl: Yaroslavl, 57°36'N, 39°51'E, 17 Aug. 1924, *Garcavi 79* (LE). **Slovakia.** Prešov: pr. Levoca, 49°1'N, 20°35'E, 2 July 2015, Šida *7439* (PR). **South Korea.** Gangwon: Kangwon, Mt. Myon, 38°10'N, 128°14'E, 30 July 1990, *Oh Sang-Hun s.n.* (KUS). **Sweden.** Skania: Lund, 55°40'N, 13°21'E, Oct. 1930, *Wide s.n.* (FI). **Tajikistan.** Gorno-Badakhshan: Badachshan, Pyansk, Kallo, 38°27'N, 70°47'E, 25 July 1964, *Ikonnikov 15844* (LE). **Ukraine.** Kherson: Czernuigow, pr. Lurast, 46°22'N, 32°12'E, 1854, *Borszizow s.n.* (LE). **USA.** Illinois: Champaign Co., Urbana, 40°6'N, 88°12'W, *Gleason 34* (GH). Massachusetts: Hampshire Co., Mount Holyoke College campus, South Hadley, 42°18'N, 72°35'W, 4 Aug. 1979, *Ahles 87219* (MA, VT). Minnesota: Houston Co., Spring Grove, 43°33'N, 91°38'W, Oct., *Ownbey s.n.* (MIN). New York: Dutchess Co., Wappingers Falls, 41°35'N, 73°54'W, 30 July 1977, *Churchill 77715* (MSC). Pennsylvania: Delaware Co., Kirklyn, 39°58'N, 75°17'W, 30 Sep. 1912, *Keeney s.n.* (PH). Wisconsin: Racine Co., W of Burlington, 42°40'N, 88°16'W, 10 Aug. 1968, *Rowlatt s.n.* (MOR). **Uzbekistan.** Bukhara: Darvas, Chirgawas, Kalaichum, 39°44'N, 64°9'E, 29 Sep. 1881, *Regel s.n.* (LE).

Discussion. Geranium sibiricum is an erect to ascending perennial, characterized by 1-flowered cymules, short petals, leaves with narrow segments, and eglandular indumentum. Some specimens occasionally have 2-flowered cymules, although most of the nodes have 1-flowered cymules. Some authors have suggested that European plants are characterized by pink to pinkish violet petals and villous vegetative parts, and Siberian plants by white to pale pink petals and short and appressed hairs. Through the whole area of the species, these characters appear mixed in different combinations, which does not support such a division.

Mirek (1980) indicated that this species is also found in Poland. Unfortunately, it has not been possible to study any herbarium voucher of such record.

68. Geranium thunbergii Siebold & Zucc. ex Lindl. & Paxton, Paxt. Fl. Gard. 1(12): 186 fig. 115. 1851. *Geranium nepalense* var. *thunbergii* (Siebold & Zucc. ex Lindl. & Paxton) Kudô, Medic. Pl. Hokkaido pl. 55. 1922. *Geranium nepalense* subsp. *thunbergii* (Siebold & Zucc. ex Lindl. & Paxton) H. Hara, Fl. East. Himalaya: 638. 1966. Type locality: "Native of Japan". Type: Cultivated at the Garden of the Horticultural Society of London (lectotype, designated by Yeo 1992: 185, CGE-herb. Lindley image!).

Geranium nepalense f. *japonica* Maxim., Bull. Acad. Imp. Sci. Saint-Pétersbourg 26: 454. 1880. Type locality: "Japonia frequens: Yeso, circa Hakodate, Arikawa, Ono, init. Julii fl. incip., Octobri fl. frf. Nippon: Yokkohama, in herbosis secus vias, floret a Julio in Decembrem, Yokoska (Savatier!), Simoda (Yolkin); Kiusu: pratis maritimis ad Nomo-saki, Nagasaki, ad agros, in fruticetis herbosis, a Julio in hiemem fl. et frf. ...". Type: Japan. Kyūshū, Nagasaki, 32°44'N, 129°52'E, 1863, *C.J. Maximowicz s.n.* (lectotype, designated by Aedo 2017a: 62, G-00304516!; isolectotypes, BM-47124!, BR-572630!, L!, MO-1618598!, NY!).

Geranium peregrinum Thell., Repert. Spec. Nov. Regni Veg. 9: 549. 1911. Type locality: "Deutschland: Karlsruhe (Baden), auf Schutt hinter dem Stadtgarten (ob verwildert?), IX. 1907, A. Kneucker". Type: Germany. Baden-Württenberg, Karlsruhe, 49°00'N, 8°23'E, Sep. 1912, *A. Kneucker s.n.* (neotype, designated by Aedo 2017a: 62, KR digital image!).

Geranium iinumai var. *asiaticum* Koidz., Fl. Symb. Or.-Asia: 83. 1930. Type locality: "Japan, auf Yeso (Faurie, Pl. Jap. n. 6151!, n. 6152!)". Type: Japan. Hokkaidō, Yeso, Mori, 42°06'N, 140°34'E, Sep. 1904, *U. Faurie 6152* (lectotype, designated by Aedo 2017a: 62, BM-47060!).

Geranium thunbergii var. *pallidum* Nakai ex H. Hara, Bot. Mag. Tokyo 49: 861. 1935. *Geranium nepalense* f. *pallidum* (Nakai ex H. Hara) H. Hara, J. Jap. Bot. 22: 171. 1948. *Geranium thunbergii* f. *pallidum* (Nakai ex H. Hara) Murata, Acta Phytotax. Geobot. 17: 172. 1958. Type locality: "Hab. at the foot of Mt. Apoi, Shoya, etc. Fl. late Jul.-Sep.". Type: Japan. Hokkaidō, Mt. Apoi, 42°06'N, 143°00'E, *H. Hara s.n.* (no original material located).

Geranium thunbergii var. *glabratum* Nakai ex H. Hara, Bot. Mag. (Tokyo) 49: 862. 1935. *Geranium nepalense* f. *glabratum* (Nakai ex H. Hara) H. Hara, J. Jap. Bot. 22: 171. 1948. *Geranium thunbergii* f. *glabratum* (Nakai ex H. Hara) Murata, Acta Phytotax. Geobot. 17: 172. 1958. Type locality: "Honshu: prov. Tôtômi, Nobe-mura (M. Hisamatsu-Sep. 1893)". Type: Japan. Honshū, Tôtômi, Nobe-mura, 35°57'N, 138°28'E, Sep. 1893, *M. Hisamatsu s.n.* (no original material located).

Geranium chinense Migo, J. Shanghai Sc. Inst. 3: 95. 1935. *Geranium wilfordii* var. *chinense* (Migo) H. Hara, J. Jap. Bot. 22: 172. 1948. Type locality: "Hab. Prov. Kiangsu--Sungkiang (H. Migo, Oct. 17, 1933--typus in Herb. Univ. Imp. Tokyo.)". Type: China. Jiangsu, Sungkiang, 33°55'N, 118°16'E, 17 Oct. 1933, *H. Migo s.n.* (holotype, TI!).

Geranium thunbergii var. *plenum* Iwata, Bot. Mag. (Tokyo) 54: 73, fig. 1. 1940. *Geranium thunbergii* f. *plenum* (Iwata) H. Hara, J. Jap. Bot. 22: 172. 1948. Type locality: "Hab. in monte Amagi, Prov. Idzu (J. Iwata, anno 1936.-Typus in Herb. Univ. Imp. Tokyoensis; Co-typus in Herb. J. Iwata, Yokohamaensis!)". Type: Japan. Honshū, Idzu, monte Amagi, 34°52'N, 139°00'E, 1936, *J. Iwata s.n.* (holotype, TI).

Geranium nepalense f. *roseum* H. Hara, J. Jap. Bot. 22: 172. 1948. *Geranium thunbergii* f. *roseum* (H. Hara) Murata, Acta Phytotax. Geobot. 17: 172. 1958. Type locality: [not stated, probably from Japan]. Type: Japan. Without definite locality, *H. Hara s.n.* (no original material located).

Perennial herbs, 20-70 cm tall. *Rootstock* 2-10 mm in diameter, vertical, not tuberculate, not turnip-shaped, without thickened roots. *Stem* trailing and ascending, leafy, sometimes rooting at nodes, stolons absent, without vegetative stems, with patent to retrorse, appressed, eglandular hairs 0.3-1.4 mm long and, sometimes, patent, glandular hairs 0.8-1.3 mm long. *Basal leaves* in a deciduous rosette, cauline leaves opposite; leaf laminas (2.4)2.7-5.1(6.4) cm long, 3.2-7.7 cm wide, not peltate, palmatifid [ratio main-sinus length/middle segment length = (0.73)0.75-0.86(0.91)], polygonal in outline, base cordate, not coriaceous, with nerves not projected, pilose, with appressed, eglandular hairs on both surfaces; segments 5, in 1 plane, middle segment rhombic, (4)5.4-8.3(12) mm wide at the base [ratio segment width at the base/middle segment length = (0.17)0.22-0.27(0.28)], 5-7(8)-lobed in distal half [ratio secondary sinus length/middle segment length = (0.11)0.15-0.18(0.22)]; petioles up to 23 cm long, without abscission zone, terete, not swollen, not deflexed in age, with patent to retrorse, eglandular hairs 0.3-1.2 mm long and, sometimes, patent, glandular hairs 0.5-1.2 mm long; stipules 4.5-11.9 mm long, 0.8-2.6 mm wide, lanceolate, free, papery, brown, with eglandular hairs on abaxial surface and on the margin, glabrous adaxially. *Inflorescence* a monochasial cyme; cymules 2-flowered, solitary [ratio cymule length/leaf length = (0.6)1.1-2.5]; peduncles (22)31-65(139) mm long, with patent, eglandular hairs 0.2-0.9 mm long and, sometimes, patent, glandular hairs 0.4-1 mm long; bracteoles 2.2-4.8 mm long, 0.4-1.6 mm wide, linear-lanceolate, whorled; pedicels (8.5)13-25(32.9) mm long, with patent, eglandular hairs 0.2-1 mm long and, usually, patent, glandular hairs 0.6-1.1 mm long. Flowers actinomorphic. *Sepals* (5.1)5.4-7.3(8.1) mm long, 1.9-3.1 mm wide, lanceolate, smooth, not accrescent, nerves 3, mucro (0.8)1-1.2(1.9) mm long [ratio mucro length/sepal length = 0.12-0.25], with patent to antrorse, eglandular hairs 0.1-0.9 mm long and patent, glandular hairs 0.2-1.2 mm long on the abaxial surface, glabrous adaxially. *Petals* (6.8)7.3-8.3(9) mm long, (3.2)3.8-5.1(5.7) mm wide, erect-patent, rounded or retuse, without claw, white or purple, hairy on the base of the adaxial surface, glabrous abaxially, ciliate on the basal margin, with hairs 0.1-0.4 mm long. *Stamens* 10, both whorls bearing anthers; filaments (3.2)3.6-4.1(4.7) mm long, lanceolate, white, pilose on the abaxial surface, ciliate on the proximal half, with hairs 0.1-0.7 mm long; anthers 0.8-0.9(1.1) mm long, blue. Nectaries 5, hemispheric, glabrous. *Gynoecium* 3.7-5.3 mm long, pink. *Fruit* (19.1)20-23(26.6) mm long, erect, discharge of seed-ejection type; mericarps 2.5-3.6 mm long, 1.4-1.9 mm wide, without a strand of fibers, not compressed at the apex, smooth, without basal beak, with a basal callus, without a basal prong, black or deep brown, with ±

patent, eglandular hairs 0.2-0.7 mm long and patent, glandular hairs 0.6-1.5 mm long; rostrum 13.2-20.4 mm long, with a narrowed apex 0.5-1.8 mm long, not twisted, with ± patent, eglandular hairs 0.1-0.4 mm long and patent, glandular hairs 0.4-0.8 mm long; stigmatic remnants 1.6-2.3 mm long, with 5 hairy lobes. *Seeds* 1.7-2.2 mm long, 1.3-1.8 mm wide, finely reticulate, uniformly colored, brown, glabrous. Cotyledons with entire margin. Fig. 197.

Pollen. *Geranium*-type (Park & Kim 1997: 313).

Chromosome number. 2*n* = 28.

Phenology. Collected in flower from January to December.

Distribution. This species ranges from central and eastern China, Taiwan, Korea to Japan and it is introduced in Germany, northeastern U.S.A. and southern Brazil (Fig. 198).

Habitat. Seashores, roadsides, fields, waste grounds, weedy areas, rocky hillsides, grassland, along streams and edge of evergreen and deciduous forests; 0-2350 m.

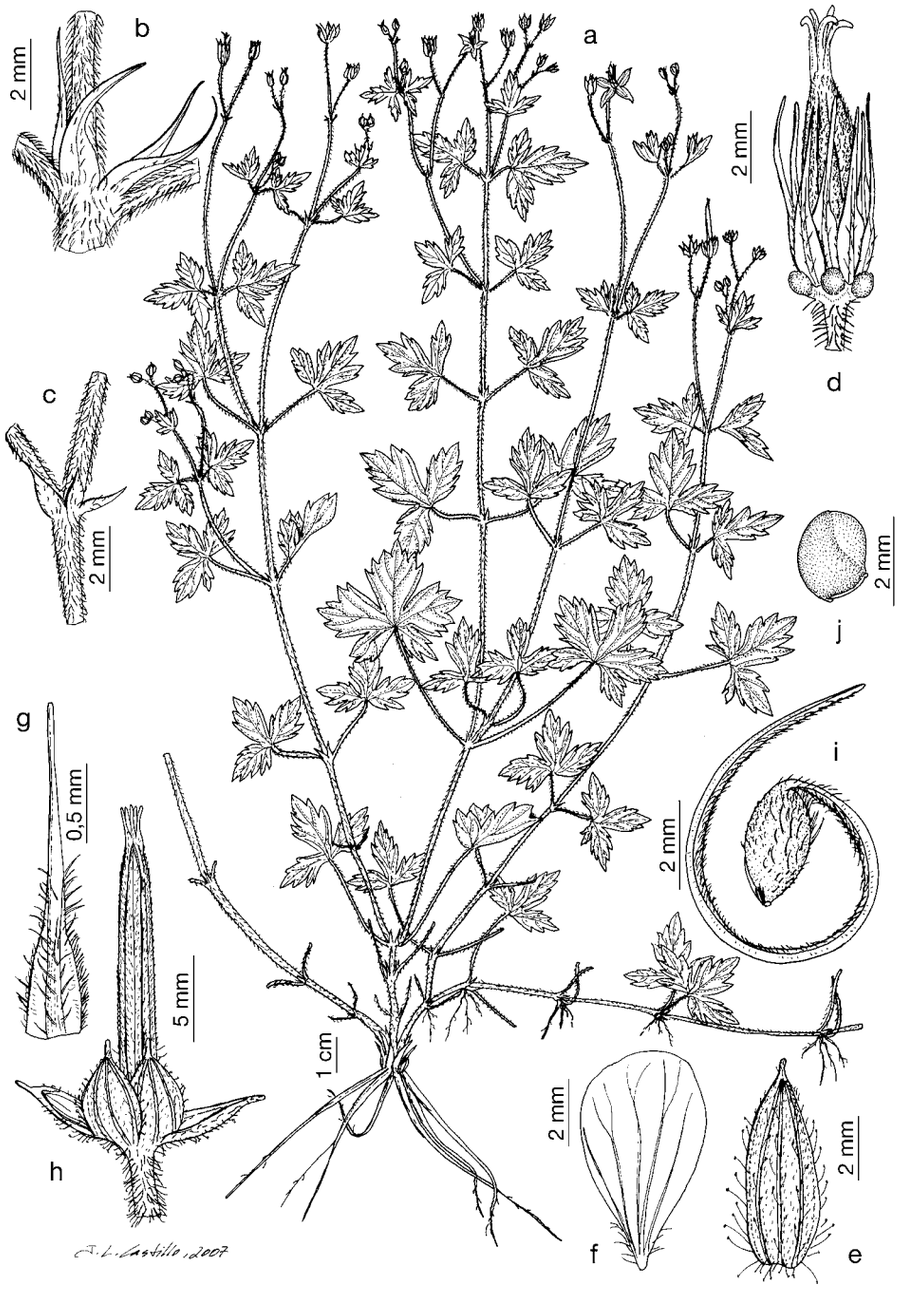


Fig. 197. *Geranium thunbergii*. a. Habit. b. Stipules. c. Bracteoles. d. Flower without petals and sepals. e. Sepal. f. Petal. g. Staminal filament. h. Fruit. i. Mericarp. j. Seed. (Based on: a-c, h-j, *Tsugaru & al. 27069,* MO; d-g, *Yih-Ren Lin & al. 20,* E).

Representative specimens examined. **Brazil.** São Paulo: Campos de Jordao, 22º45'S, 45º31'W, 5 May 2012, *Aedo & al. 1202* (MA). **China.** China, 23 Aug. 1958, *Li Hong Jun 7251* (PE). Anhui: ciudad Huangshan, distrito Xiuning, urbanización Feng, 30º3'N, 118º11'E, 6 Nov. 1996, *Liu Qixin A0575* (MO). Fujian: ciudad Nanping, distrito Songxi, montaña Zhan Lu Shan, 26º38'N, 118º9'E, 11 Oct. 1996, *He Guosheng 7625* (IBSC). Guangdong: ciudad Shaoguan, distrito Ru Yuan, entre Gingxidong y Hay Dai, 24º47'N, 113º35'E, 1 Oct. 1938, *Liu Xinq 28897* (MO). Hebei: ciudad Baoding, pueblo Laiyuan, 38º51'N, 115º28'E, 1958, *Li 7485* (PE). Hubei: prefectura Enshi, distrito Laifeng, pueblo Dahe, 29º30'N, 109º23'E, 25 Aug. 1958, *Li 7261* (MO). Hunan: ciudad Chenzhou, distrito Yizhang, montaña Mangshan, 25º23'N, 112º56'E, 24 Oct. 1942, *Chen Shaoqing 2824* (MO). Jiangsu: Shanghai, 31º15'N, 121º29'E, 18 Sep. 1934, *Migo s.n.* (TI). Jiangxi: montaña Lushan, Huanglong, 25º26'N, 114º25'E, 21 June 1997, *Lai & Shan 1029* (MO). Shaanxi: ciudad Xian, distrito Lantian, población Lanqiao, Xiangzidong, 34º4'N, 109º28'E, 22 Oct. 1958, *Su Guixing 672* (PE). Sichuan: Szechuan, Omei-hsien, Mt. Omei, 29º30'N, 103º18'E, 29 Oct. 1942, *Wang 8102* (E). Zhejiang: ciudad Hangzhou, 30º15'N, 120º9'E, 25 Sep. 1981, *Hangzhou Team 2206* (MO). **Germany.** Baden-Württemberg: Karlsruhe, 49º0'N, 8º23'E, Sep. 1931, *Kneucker s.n.* (MA). **Japan.** Hokkaidō: Saporo City, Maruyama, 43º2'N, 141º20'E, 29 Sep. 1942, *Hara s.n.* (TI). Honshū: Tochigi prefecture, Nikko-shi, Hanaishi-machi, near Jakkonotaki, 6 Sep. 1983, *Murata & Yahara 16121* (TI). Kyūshū: Yakushima, 30º19'N, 130º30'E, 6 Sep. 1926, *Masamune s.n.* (NY). Shikoku: Ehime prefecture, upper region of Mt. Ishizuchi, 33º46'N, 133º7'E, 21 Oct. 1970, *Hara s.n.* (TI). **North Korea.** South Hamgyong: Hamgyungbuk Do, Furyonggun, Donae, 9 Aug. 1939, *Nakai s.n.* (TI). **South Korea.** Jeju: in herbidis Hallaisan, 33º22'N, 126º30'E, Aug. 1907, *Faurie 1761* (E). **Taiwan.** Chiayi Co.: Alishan, 23º28'N, 120º26'E, 21 Mar. 1985, *Huang 2506* (MO, TAI). **USA.** Connecticut: Litchfield Co., New Milford, 41º34'N, 73º24'W, 11 July 1980, *Porges s.n.* (GH). Maryland: Baltimore,

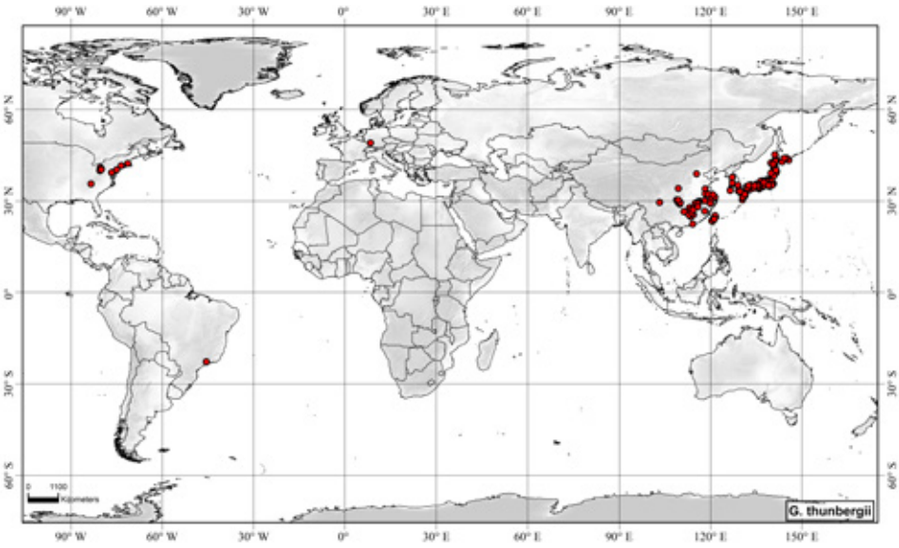


Fig. 198. Distribution of *Geranium thunbergii*.

39°17'N, 76°36'W, 13 Sep. 1952, *Fessenden s.n.* (PH). Massachusetts: Norfolk Co., Wellesley, 42°17'N, 71°17'W, Sep., *Hunnewell 18089* (GH). North Carolina: Swain Co., Great Smoky Mountains National Park, Kanati Fork Trail, 35°34'N, 83°21'W, 7 Oct. 2004, *Busemeyer & al. 2279* (TENN). Pennsylvania: Washington Co., 3.7 km ESE of Majorsville, 39°57'N, 80°28'W, 27 Sep. 1984, *Thompson 2090* (PH).

Discussion. Geranium thunbergii is a trailing and ascending herb sometimes rooting at the nodes. This species has sometimes been submerged in *Geranium nepalense*. However, it is well characterized by the presence of glandular hairs (sometimes restricted to sepals) and by longer petals, sepals, and fruit. Additionally, leaves of *G. thunbergii* have few lobes, and its mericarps are darker. Distribution of *G. thunbergii* seems to be more eastern than those of *G. nepalense*, being alone in Taiwan, Japan, and Korea.

Tsuchimatsu & al. (2014) studied the herbivore pressure associated with the flower color polymorphism of *G. thunbergii*, founding more severe damage in white flowers.

69. Geranium wilfordii Maxim., Bull. Acad. Imp. Sci. Saint-Pétersbourg 26: 453. 1880. Type locality: "Mandshuria orientali littorali: inter 44 et 45° (Wilford) et australi: in fruticetis et ad margines silvarum circa Wladiwostok, sat frequens, fine Augusti fl. frf., nec non ad Amur australem, montibus Bureicis, 3 stadia supra Jekaterino-Nikolskaja, silvis frondosis non rarum, ultimo Julio fl. incip. Japoniae insula Kiusiu, prov. Simabara, fine Septembris fl. c. fr. nond. mat.". Type: Russia. Primorye, Bai Victoria, 43°05'N, 131°55'E, 19 Aug. 1860, *C.J. Maximowicz s.n.* (lectotype, designated by Tsyrenova 1985a: 1642, LE!).

Geranium hastatum Nakai, Bot. Mag. (Tokyo) 23: 100. 1909, nom. illeg., non Andrews, 1805. *Geranium wilfordii* var. *hastatum* H. Hara, J. Jap. Bot. 22: 172. 1948. *Geranium tripartitum* var. *hastatum* (H. Hara) T. Yamaz., J. Jap. Bot. 68: 239. 1993. Type locality: "Habitat in Yeso: prov. Kushiro: Akkeshi. prov. Hitaka: Horoizumi (Y. Tokubuchi). in Hondo: Nikko Sept. 29. 1879 fr. (J. Matsumura). monte Takao in prov. Musashi Sept. 1907 fr. (T. Nakai)". Type: Japan. Honshū, Nikko, 36°44'N, 139°36'E, 29 Sep. 1879, *J. Matsumura s.n.* (lectotype, designated by Aedo 2017a: 72, TI!).

Geranium iinumai Nakai, Bot. Mag. (Tokyo) 23: 100. 1909. *Geranium krameri* var. *iinumai* (Nakai) Nakai, Bot. Mag. (Tokyo) 26: 261. 1912. Type locality: "Habitat in Nippon centrale: monte Ibukiyama (C. Funabashi)". Type: Japan. Honshū, monte Ibukiyama, 35°25'N, 136°24'E, *C. Funabashi s.n.* (lectotype, designated by Aedo 2017a: 72, TI!).

Geranium wilfordii f. *bukoense* Hiyama, J. Jap. Bot. 38: 62. 1963. Type locality: "Hab. Hondo: Mt. Buko, Prov. Musashi (S. Okuyama-type in Herb. Nat. Sci. Mus. Tokyo, #60036)". Type: Japan. Honshū, Hondo, Musashi, Mt. Buko, 35°57'N, 139°05'E, *S. Okuyama s.n.* (holotype, TI-60036).

Geranium wilfordii var. *yezoense* Himaya, J. Jap. Bot. 38: 61. 1963. Type locality: "Hab. Yezo: Asahigawa, Prov. Ishikari (T. Makino, Sept., 1908-type in Makino Herbarium)". Type: Japan. Hokkaidō, Yezo, Ishikari, Asahigawa, 43°45'N, 142°22'E, Sep. 1908, *T. Makino s.n.* (holotype, MAK?).

Geranium wilfordii var. *schizopetalum* F.Z. Li, Acta Phytotax. Sin. 22: 152 fig. 2. 1984. Type locality: "Shandong: zaozhuang Baodugu, 27 VIII 1981, F. Z. Li... 81206 (Type, in Herb. Fores. School, Shandong)". Type: China. Shandong, zaozhuang Baodugu, 35°00'N, 117°42'E, 27 Aug. 1981, *F.Z. Li 81206* (holotype, ZJFI).

Geranium wilfordii var. *glandulosum* Z.M. Tan, Bull. Bot. Res., Harbin 6(2): 56, lam. 8. 1986. Type locality: "Sichuan: Baoxing, Dengchigou, Huangshuijing, alt. 2200 m, September 27, 1936, K. L. Chu 3935 (Type, SZ)". Type: China. Sichuan, Baoxing, Dengchigou, Huangshuijing, 26°32'N, 102°51'E, 27 Sep. 1936, *K.L. Chu 3935* (holotype, SZ).

Geranium wilfordii var. *pilicalyx* T. Yamaz., J. Jap. Bot. 68: 239, fig. 1. 1993. Type locality: "Hab. Prov. Shantung: Taishan (Y. Yabe, Aug. 30, 1925). Prov. Kiangsu: Shanghai, Hongjao road (H. Migo, Jul. 19, 1931, TI). Taiwan: Prov. Taipei, Pianan (J. Ohwi, Jul. 22, 1933, Holotypus TI, Isotypus TNS)". Type: China. Taiwan, Taipei, Pianan-anbu, 24°33'N, 120°51'E, 22 July 1933, *J. Ohwi 4253* (holotype, TI!; isotype, TNS).

Perennial herbs, 24-86 cm tall. *Rootstock* 4.3-8.7 mm in diameter, ± vertical, not tuberculate, not turnip-shaped, with thickened, ± fasciculate roots. *Stem* erect, leafy, not rooting at nodes, stolons absent, without vegetative stems, with retrorse, ± appressed, eglandular hairs 0.3-0.7 mm long. *Basal leaves* in a deciduous rosette, cauline leaves alternate (1-2) and upper opposite; leaf laminas (3.7)3.9-7.3(8.1) cm long, 3.9-10.2 cm wide, not peltate, palmatifid [ratio main-sinus length/middle segment length = (0.73)0.85-0.88(0.92)], triangular in outline, base cordate, not coriaceous, with nerves not projected, pilose, with appressed, eglandular hairs on both surfaces; segments 3(5), in 1 plane, middle segment rhombic, (7)8.7-11.3(14.8)

mm wide at the base [ratio segment width at the base/middle segment length = (0.15)0.18-0.27(0.29)], (7)12-15(19)-lobed in distal half [ratio secondary sinus length/middle segment length = (0.04)0.10-0.18(0.19)]; petioles up to 14 cm long, without abscission zone, terete, not swollen, not deflexed in age, with retrorse, ± appressed, eglandular hairs 0.2-0.9 mm long; stipules 4-7.8 mm long, 0.9-1.4 mm wide, lanceolate, free, papery, brown, with eglandular hairs on both surfaces and on the margin. *Inflorescence* a monochasial cyme; cymules 2-flowered, solitary [ratio cymule length/leaf length = (0.6)0.9-2.4(3)]; peduncles (14)18-30(47) mm long, with retrorse, ± appressed, eglandular hairs 0.2-0.5 mm long and, sometimes, patent, glandular hairs 0.7-1.1 mm long; bracteoles 1.4-4.9 mm long, 0.4-0.7 mm wide, linear-lanceolate, whorled; pedicels (8.5)10-17(19.4) mm long, with retrorse, ± appressed, eglandular hairs 0.1-0.5 mm long and, sometimes, patent, glandular hairs 0.2-1.1 mm long. Flowers actinomorphic. *Sepals* (3.5)5.3-5.9(7.1) mm long, 1.1-2.7 mm wide, lanceolate, smooth, not accrescent, nerves 3, mucro (0.8)0.9-1.4(2.3) mm long [ratio mucro length/sepal length = 0.14-0.33], with antrorse, appressed, eglandular hairs 0.1-0.7 mm long and, sometimes, patent, glandular hairs 0.2-1.1 mm long on the abaxial surface, almost glabrous adaxially. *Petals* 4-6.2(9.2) mm long, 2.1-3.5(6.2) mm wide, erect-patent, rounded or retuse, without claw, pale pink or white, with scattered hairs on the base of both surfaces and on the basal margin, with hairs 0.1-0.4 mm long. *Stamens* 10, both whorls bearing anthers; filaments (3.1)3.2-3.7 mm long, lanceolate, yellow, pilose on the abaxial surface, ciliate on the proximal half, with hairs 0.1-0.4 mm long; anthers (0.7)0.8-0.9(1) mm long, blue. Nectaries 5, hemispheric, glabrous. *Gynoecium* 3.6-4.5 mm long, pale pink to crimson. *Fruit* (19.9)20.3-21(22.2) mm long, erect, discharge of seed-ejection type; mericarps 3-4.1 mm long, 1.5-1.9 mm wide, without a strand of fibers, not compressed at the apex, smooth, without basal beak, with a basal callus, without a basal prong, brown, with ± patent, eglandular hairs 0.7-1.2 mm long and, sometimes, patent glandular hairs 0.6-1.2 mm long; rostrum 12.6-17.3 mm long, with a narrowed apex 0.9-1.7 mm long, not twisted, with ± patent, eglandular hairs 0.1-0.3 mm long and, sometimes, patent glandular hairs 0.5-1 mm long; stigmatic remnants 1.3-2.7 mm long, with 5 hairy lobes. *Seeds* 2.4-2.9 mm long, 1.3-1.7 mm wide, finely reticulate, uniformly colored, brown, glabrous. Cotyledons with entire margin. Fig. 199.

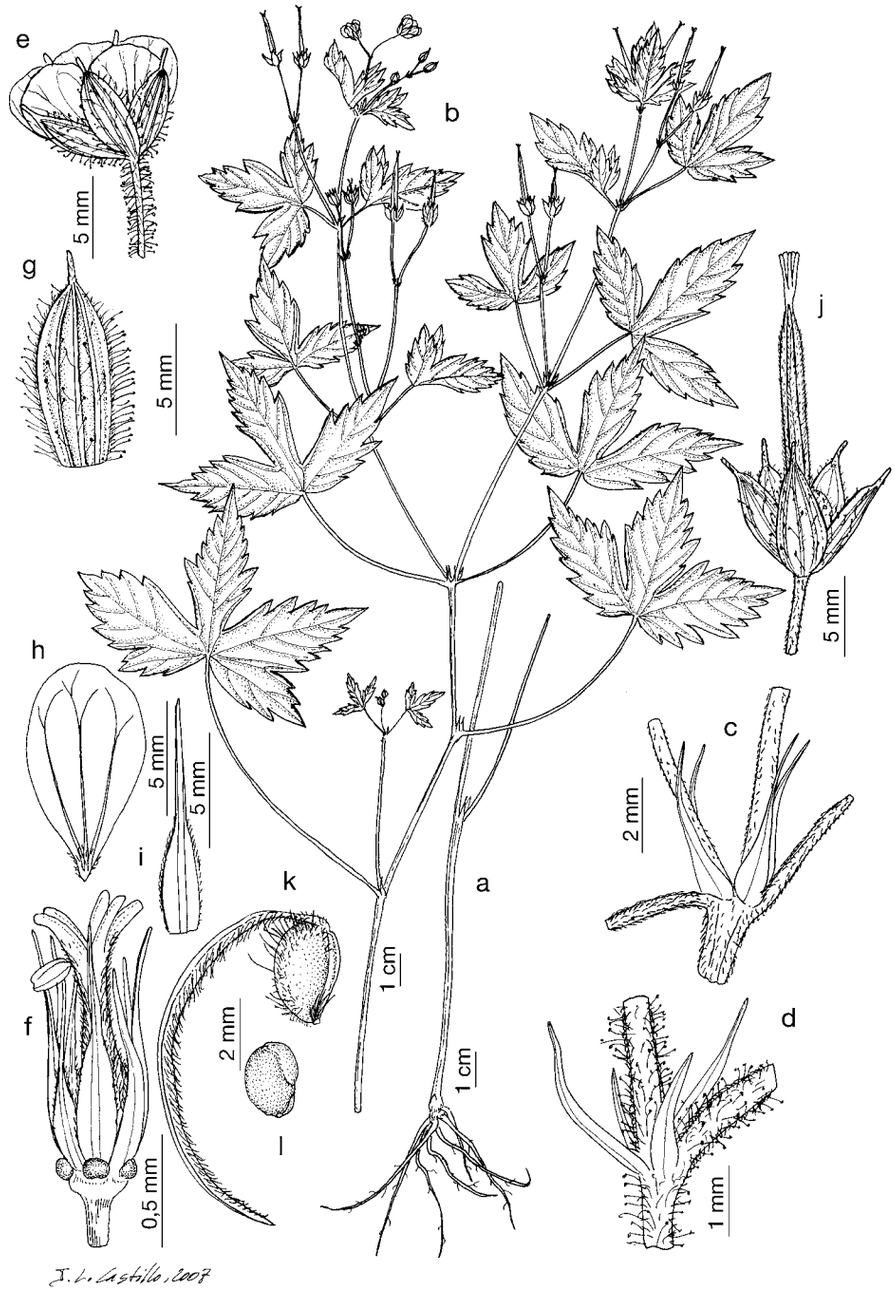


Fig. 199. *Geranium wilfordii*. a, b. Habit. c. Stipules. d. Bracteoles. e. Flower. f. Flower without petals and sepals. g. Sepal. h. Petal. i. Staminal filament. j. Fruit. k. Mericarp. l. Seed. (Based on: a-i, *Ulanova & Ponomarczuk 5978,* C; j, *Farges 110,* MA; k-l, *Zhao Zien 4386,* MO).

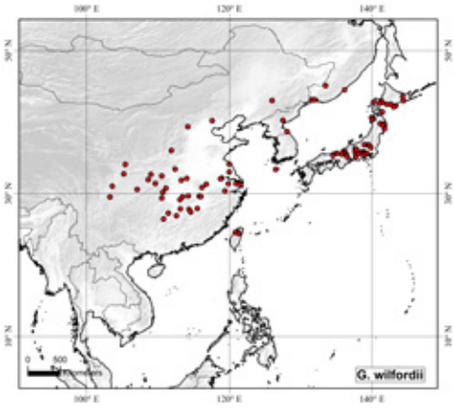


Fig. 200. Distribution of *Geranium wilfordii*.

Pollen. *Geranium*-type (Lu & al. 1996: 320; Park & Kim 1997: 313; Tan & al. 1996: 213).

Chromosome number. 2*n* = 28, 28+2B.

Phenology. Collected in flower from July to November.

Distribution. This species ranges from central and eastern China, through Taiwan, Korea and eastern Siberia (Primorye) to Japan (Hokkaidō and Honshū) (Fig. 200).

Habitat. Roadside slopes, riversides, and edge of deciduous forests; 0-2100 m.

Representative specimens examined. **China.** Anhui: ciudad Anging, distrito Yuexi, 30º50'N, 116º11'E, 15 Aug. 1997, *Xie Zhong Wen 97052* (MO); ciudad Liuan, distrito Shucheng, montaña Wanfoshan, 31º18'N, 116º47'E, 22 Aug. 1997, *Xie Zhong Wen 97165* (GH, MO). Gansu: ciudad Longnan, distrito Wen, pueblo Bi Kou, 32º44'N, 105º14'E, 8 Sep. 1959, *Zhang Zhi Ying 14710* (MO); Su-tchuen oriental, Tchen-Kéou-tin, 34º4'N, 105º26'E, *Farges 110* (MA, P). Hebei: ciudad Tangshan, municipio Zunhua, pueblo Dongling, 40º10'N, 117º37'E, 1935, *Liu Ying 11925* (MO). Henan: ciudad Xinyang, distrito Shang Cheng, Jin Gang Tai, en la montaña Da Bie Shan, 32º7'N, 114º3'E, 21 Sep. 1985, *South Team 1627* (MO). Hubei: ciudad Xianning, distrito Tongshan, montaña Jiugong Shan, 29º39'N, 114º15'E, 17 Oct. 1996, *Tan Ceming 9610074* (MO); ciudad Yicahng, distrito Wufeng, 30º9'N, 110º41'E, 30 Sep. 1990, *Zhao Zien 4386* (MO). Hunan: Sinning Hsien, Ma-Ling-Tung, 26º25'N, 110º48'E, 11 Sep. 1935, *Fan & Li 462* (P); ciudad Hengyang, distrito Nanyue, Cang Jing Dian, 26º53'N, 112º36'E, July 1948, *Liu Ying 516* (MO). Jiangsu: Shanghai, road Hongjao, 31º15'N, 121º29'E, 19 July 1931, *Migo s.n.* (TI); Kunshan, 31º22'N, 120º56'E, 10 June 1934, *Migo s.n.* (TI). Jiangxi: distrito Anfu, montaña Wugong Shan, 27º23'N, 114º36'E, 16 Aug. 1963, *Yue Jun San 3567* (KUN); ciudad Yichun, zona protegida distritto Yifeng, Xikeng, 27º47'N, 114º22'E, 25 Sep. 1997, *Lai Shushen 2174* (MO). Jilin: prov. Kirinensis, Manshuria Chinensis, 43º0'N, 126º0'E, 17 July 1896, *Komarov 991* (TI). Shaanxi: ciudad Ankang, distrito Zhenping, 32º40'N, 109º1'E, 14 Aug. 1997, *Wu Zhen Hai 92-1141* (MO). Shanxi: ciudad Ankang, distrito Pingli, pueblo Baxian, montaña Hualong Shan, 36º1'N, 111º53'E, 23 Aug. 1997, *Wu Zhen Hai 92-1258* (MO); Taibai mt, 39º20'N, 114º12'E, 9 Oct. 1990, *Liu 90-100* (GH). Sichuan: Omei-Hsien, Mt. Omei, 29º30'N, 103º18'E, 19 Nov. 1941, *Chow 4990* (US); ciudad Chongqing, población Wuxi, pueblo Zhong Liang, 30º34'N, 107º6'E, 5 Sep. 1958, *Yang Guang Hui 62253* (P, PE). Zhejiang: Chekiang Tien-mu Shan, 30º20'N, 119º24'E, 1 Sep. 1980, *Yao Kan 79434* (CAS). **Japan.** Hokkaidō: Hidaka, Mt. Apoi, Fuyushima, 42º6'N, 143º2'E, 23 Aug. 1933, *Hara s.n.* (TI); Mombetsu, 42º28'N, 142º4'E, 4 Sep. 1887, *Faurie 1059* (P); Kushiro division, near Kucharo Lake, 43º33'N, 144º17'E, 10 Aug. 1931, *Hara s.n.* (TI). Honshū: Aichi prefecture, Mitaka province, Shitara-gun, Toyone-mura, Kawaure, 35º8'N, 137º42'E, 26 Sep. 1965, *Torii s.n.* (TI); Yamanashi prefecture, Kai, Mt. Houou, Komu River, 35º41'N, 138º18'E, 7 Sep. 1954, *Yamazaki s.n.* (TI); Aomori prefecture, Shimokita-gun, Shiriya, 41º24'N, 141º27'E, 4 Sep. 1988, *Hosoi s.n.* (TI). **North Korea.** Kangwon: Kumgangsan, Naekumgang, 38º39'N, 128º6'E, 25 July 1928, *Kondo s.n.* (TI). South Hamgyong: Hamgyungbuk Do, Furyonggun, Donae, 40º14'N, 127º31'E, 13 Aug. 1939, *Nakai s.n.* (TI). **Russia.** Primorye: distrito Jasanskiy, reserva natural "Kedrovaya pad", 43º6'N, 131º29'E, 15 July 2003, *Tsirenova s.n.* (VLA); ciudad de Vladivostok, ciudad académica, 43º7'N, 131º55'E, 10 July 2003, *Tsirenova s.n.* (VLA); Kirovsky, pr. pag. Kirovsky, in valle fl. Ussuri, 45º5'N, 133º29'E, 22 July 1975, *Ulanova & Ponomarczuk 5978* (C, MO). **South Korea.** Jeju: Quelpaert, Houtien, 33º22'N, 126º30'E, Sep. 1909, *Taquet 2703* (E, G). **Taiwan.** Taichung Co.: Ssuyuanyakou-710, 24º23'N, 121º21'E, 12 Aug. 1986, *Huang s.n.* (TAI); Shantung, Taishan, 24º37'N, 121º9'E, 30 Aug. 1925, *Yabe s.n.* (TI).

Discussion. Geranium wilfordii is a perennial herb, erect and with relatively short petals. It is easily identified by its leaves, which are triangular in outline and with three segments. In some specimens, the blade of basal leaves can have two more very short segments at the base, producing leaves with a ± pentagonal outline. These plants could be confused with *G. thunbergii*, which has longer petals. Basal cauline leaves are usually alternate in *G. wilfordii,* but few herbarium specimens with whole plants are available to ascertain the variability of this feature. Glandular indumentum is variable, sometimes even in the same specimen.

Rostanski & Tokarski (1973) indicated that this species is also found in Poland. Unfortunately, it has not been possible to study any herbarium voucher of such record.

70. Geranium tripartitum R. Knuth in Engl., Pflanzenr. IV.129 (Heft 53): 191. 1912. Type locality: "Korea: Hallaisan, 800-1000 m; am Wegen, in Gebüschen und Wäldern (Faurie a. 1907 n. 1759!, a. 1907 n. 1762!, Taquet a. 1908 n. 603!, a. 1908 n. 682!)". Type: Korea. Quelpaert, Hallaisan, 33º30'N, 126º30'E, 17 Aug. 1908, *T. Taquet 603* (lectotype, designated by Novoselova 2004: 507, LE!; isolectotypes, E-00216737!, G!).

Geranium robertianum var. *glabrum* Franch. & Sav., Enum. Pl. Jap. 2: 307. 1878. Type locality: "Hab. in locis lapidosis tractûs Hakone, unde unicum specimen reportavit Dr Savatier. Provincia Omi (Keiske ex icone)". Type: Japan. Honshū, Omi, Hakone, 35º14'N, 139º02'E, *P.A. Savatier 111* (lectotype, designated by Aedo 2017a: 68, P!).

Geranium tripartitum f. *pilosellum* H. Hara, J. Jap. Bot. 22: 171. 1948. Type locality: "Shikoku: in monte Tsurugisan, Awa (J. Nikai, no. 1791, Aug. 28, 1908)". Type: Japan. Shikoku, Awa, in monte Tsurugisan, 33º51'N, 134º06'E, 28 Aug. 1908, *J. Nikai 1791* (no original material located).

Perennial herbs, 15-60 cm tall. *Rootstock* 3.2-4.8 mm in diameter, ± vertical, not tuberculate, not turnip-shaped, with few thickened, ± fasciculate roots. *Stem* trailing and ascending, leafy, rooting at nodes, stolons absent, without vegetative stems, with scattered, retrorse, ± appressed, eglandular hairs 0.2-0.5 mm long. *Basal leaves* in a deciduous rosette, cauline leaves alternate (usually

1) in middle of shoot and upper opposite; leaf laminas (1.4)2.5-4(4.5) cm long, 1.8-5.8 cm wide, not peltate, palmatisect, triangular in outline, base cordate, not coriaceous, with nerves not projected, pilose, with scattered, appressed, eglandular hairs on both surfaces; segments 3, in 1 plane, middle segment rhombic, 0.4-1.3 mm wide at the base [ratio segment width at the base/middle segment length = 0.02-0.04], 5-11-lobed in distal half [ratio secondary sinus length/middle segment length = 0.11-0.38]; petioles up to 11 cm long, without abscission zone, terete, not swollen, not deflexed in age, with retrorse, ± appressed, eglandular hairs 0.3-0.6 mm long; stipules 1.9-9.6 mm long, 0.6-1.8 mm wide, lanceolate, free, papery, brownish red, glabrous on both surfaces or with scattered, eglandular hairs on abaxial surface and on the margin. *Inflorescence* a monochasial cyme; cymules 2-flowered, solitary [ratio cymule length/leaf length = (0.4)1.1-2.6]; peduncles 12-26 mm long, with retrorse, ± appressed, eglandular hairs 0.2-0.4 mm long; bracteoles 1.3-3.6 mm long, 0.3-0.7 mm wide, lanceolate, whorled; pedicels 12-20.4 mm long, with retrorse, ± appressed, eglandular hairs 0.2-0.4 mm long. Flowers actinomorphic. *Sepals* (4)4.7-5.6(6.4) mm long, 1.4-2.5 mm wide, lanceolate, smooth, not accrescent, nerves 3, mucro 0.5-1.5 mm long [ratio mucro length/sepal length = 0.09-0.32], with abundant, antrorse, appressed, eglandular hairs ca. 0.1 mm long on the surface and scattered, patent, glandular hairs 0.8-1.5 mm long on nerves and margins of the abaxial surface, glabrous adaxially. *Petals* (4.3)4.5-5.8(6.7) mm long, 2.1-3.4 mm wide, erect-patent, rounded, without claw, white, with scattered hairs on the base of both surfaces and on the basal margin, with hairs 0.1-0.4 mm long. *Stamens* 10, both whorls bearing anthers; filaments 2.7-3.5 mm long, lanceolate with an abruptly narrowed apex, white, pilose on the abaxial surface, ciliate on the proximal half, with hairs 0.1-0.3 mm long; anthers 0.5-0.7 mm long, pink. Nectaries 5, hemispheric, glabrous. *Gynoecium* 3-4 mm long, pink. *Fruit* 14-19.2 mm long, erect, discharge of seed-ejection type; mericarps 2.4-3 mm long, 1.2-2 mm wide, without a strand of fibers, not compressed at the apex, smooth, without basal beak, with a basal callus, without a basal prong, brown, with ± patent, eglandular hairs 0.3-0.7 mm long and, usually, patent glandular hairs 0.6-1.1 mm long (restricted to the top of the mericarp); rostrum 10.9-13.7 mm long, with a narrowed apex 0.5-1 mm long, not twisted, with erect-patent, eglandular hairs ca. 0.1 mm long; stigmatic remnants 0.7-1.4 mm long, with 5 hairy lobes. *Seeds* 1.9-2.2 mm long, 1.2-1.6 mm wide, finely reticulate, uniformly colored, brownish red, glabrous. Cotyledons with entire margin. Fig. 201.

Pollen. *Geranium*-type (Park & Kim 1997: 313).

Chromosome number. 2*n* = 28+2B.

Phenology. Collected in flower from July to October.

Distribution. This species ranges from South Korea to Japan (central Honshū to Kyūshū and Shikoku) (Fig. 202).

Habitat. Grassy slopes, and humid, deciduous forests; 250-1550 m.

Additional specimens examined. **Japan.** Honshū: Akaishi Mts., Yashajin-toge, 30 Aug. 1953 (TI); Mt. Toyoguchi, South Alps, 26 July 1964, *Asano s.n.* (TI); Kanagawa prefecture, Togatake, 12 Aug. 1952, *Kanai s.n.* (TI); Yamanashi prefecture, Mt. Honou-zan, Dondoko-zawa, 6 Sep. 1954, *Yamazaki s.n.* (TI); Nagasaki, Simabara, 32º46'N, 130º22'E, 20 Sep. 1863, *Maximowicz 2247* (LE); Shizuoka prefecture, Amagi Pass, Mt. Amagi, Izu, 34º50'N, 139º0'E, 18 Sep. 1961, *Kanai 6255* (TI); Mt. Amagi, 34º50'N, 139º0'E, 27 Oct. 1944, *Yamazaki s.n.* (TI); Shizouka prefecture, 35º0'N, 138º0'E, 19 Sep. 1957, *Momiyama 52* (TI); Atago Yama, Huiga, 35º3'N, 135º37'E, Sep. 1888 (MA, G, P); Nanohawa, Tosa, 35º7'N, 140º13'E, 25 Sep. 1894 (WU); Kanagawa prefecture, Hakone-machi, Ashigarashimo-gun, 35º11'N, 139º2'E, 1926, *Makino s.n.* (TI); Kanagawa prefecture, Hakone, 35º11'N, 139º2'E, 5 Oct. 1930, *Nakai s.n.* (TI); Mt. Kami Hakone, 35º11'N, 139º2'E, 31 Aug. 1926, *Sawada s.n.* (TI); Suruga, Ashitaka Mts., Mt. Kurodake under Ashitaka Hut, 35º14'N, 138º48'E, 17 Sep. 1954, *Kanai s.n.* (TI); Nagano, Karuizawa-machi, 35º18'N, 138º30'E, 14 Aug. 1936, *Ito s.n.* (TI); Kanagawa prefecture, Mt. Ohyama, 35º26'N, 139º13'E, Sep. 1962, *Hisauchi & al. s.n.* (TI); Kanagawa prefecture, Ohyama, 35º26'N, 139º14'E, 3 Sep. 1974, *Kihara s.n.* (TI); Kanagawa, from Ohyama to Afuri-jinja in Mt. Ohyama, Isehara-cho, Naka-gun, 35º26'N, 139º13'E, 21 Sep. 1968, *Shimizu 501* (NY, P); Nishi, Akaishiyama, 35º27'N, 138º8'E, 26 July 1934, *Iyo s.n.* (TI); Sagami province, Mt. Tanzawa, 35º28'N, 139º8'E, 18 Sep. 1949, *Yamazaki 2549* (TI); Sagami province, Sengoku hot well, 35º43'N, 139º44'E, 6 Sep. 1951, *Mizushima s.n.* (TI); Chichibu, Karisaka, 36º1'N, 138º51'E, 24 Sep. 1955, *Hara s.n.* (TI); Chichibu, Bukou-san, 36º1'N, 138º51'E, 30 Sep. 1953, *Kurosawa s.n.* (TI); Mino, Gunjou-gun, Kawai-mura, Kajita, 36º17'N, 137º6'E, 2 Aug. 1934, *Shiota 7724* (GH); Mt. Akagi, 36º25'N, 139º16'E, 17 Sep. 1957, *Hara s.n.* (TI); Ikaho in Kotsuke, 36º29'N, 138º54'E, 4 Sep. 1950, *Ohwi 75* (MO, NY, P); Nikko, 36º45'N, 139º36'E, Aug. 1907 (S); Tochigi prefecture, Nikko-shi, Jakko-no-taki, 36º45'N, 139º36'E, 4 Sep. 1985, *Im & Murata 4577* (TI); Nikko, in der Nahe des Waberfalles Kirifuri-no-taki, 36º45'N, 139º36'E, 18 Aug. 1908, *Onuma s.n.* (Z); Moyagi prefecture, Oshikagun, Kinkazan, 38º17'N, 141º34'E, 25 June 1963, *Takahashi s.n.* (TI); Miyagi-ken, Sendai-shi, Aoshita-Sakunami, 38º20'N, 140º40'E, 3 Oct. 1992, *Tateishi & Kajita 15895* (MO). Kyūshū: Miyazaki prefecture, 32º0'N, 131º0'E, 1 Oct. 1936, *Yosio s.n.* (TI); Hyuga province, Hakidani, Mt. Shiraiwa, 32º19'N, 130º43'E, 21 Aug. 1961, *Hatusima & Sako 26359* (TI); Unzen, 32º45'N, 130º17'E, 19 Aug. 1895, *Carles s.n.* (E); Buzen, Mt. Hiko, 33º28'N, 130º56'E, 10 Aug. 1954, *Toyama 5* (TI); Fukoka prefecture, 33º35'N, 130º25'E, 25 Aug. 1952, *Hashimoto s.n.* (TI); Harima province, Seppikoyama, 35º3'N, 134º39'E, 30 Sep. 1951, *Yamazaki 2952* (TI). Shikoku: Kochi prefecture, Mt. Kajigamori, Otoyo-mura, Nagaoka-gun, 33º45'N, 133º45'E, 22 Aug. 1964, *Murata 18711* (TI); Ehime prefecture, Kamiukena-gun, Mt. Ishizuchi, Jouju, Joujasha, 33º45'N, 133º7'E, 30 Sep. 1965, *Togashi s.n.* (TI); Tokushima prefecture, Ishidateyama, Kito-mura, 33º46'N, 134º3'E, 12 Aug. 1976, *Yamazaki 1058* (TI); Kochi prefecture, Tosa, 33º47'N, 133º15'E, 2 Oct. 1891 (TI). **South Korea.** Jeju: vias Quelpaert, 33º22'N, 126º30'E, Aug. 1907, *Faurie 1759* (E).

Discussion. Geranium tripartitum is easily recognized by its distinctive leaves. They are composed of three rhombic segments divided to the base. Each lateral segment has a deep basal lobe which appears as an additional segment. *Geranium tripartitum* has a short and vertical rootstock,

with few thickened roots, and some prostrate to ascending aerial stems, rooting at nodes. At the rooting nodes, a distinctive bud composed of stipules is found. From each of these buds an aerial flowering stem arises. Leaves of the basal (and medial) part of the stem are alternate, while those of the inflorescence are usually opposite. The indument of *G. tripartitum* is largely composed of eglandular, short, appressed hairs. Glandular hairs are only present on the sepals and on the apex of the mericarp. Particularly characteristic is the indument of the sepals, which have short and appressed eglandular hairs on the surface and long, patent glandular hairs on the nerves and margin. Plants without glandular hairs on the sepals occasionally occur; they were described as *G. tripartitum* f. *pilosellum* H. Hara, but do not merit taxonomic recognition. *Geranium tripartitum* has some important similarities with *G. wilfordii*. Both share a similar rootstock, petal size, staminal filament type, and fruit shape. However, the latter species has palmatifid leaves (usually with three lobes), and an erect stem not rooting at the nodes. *Geranium wilfordii* sometimes presents a sepal indument similar to that previously described for *G. tripartitum*, but it is variable in this feature. *Geranium thunbergii* is also similar to *G. tripartitum*, but *G. thunbergii* has palmatipartite leaves with five segments, longer petals, and usually glandular hairs on peduncles and pedicels.

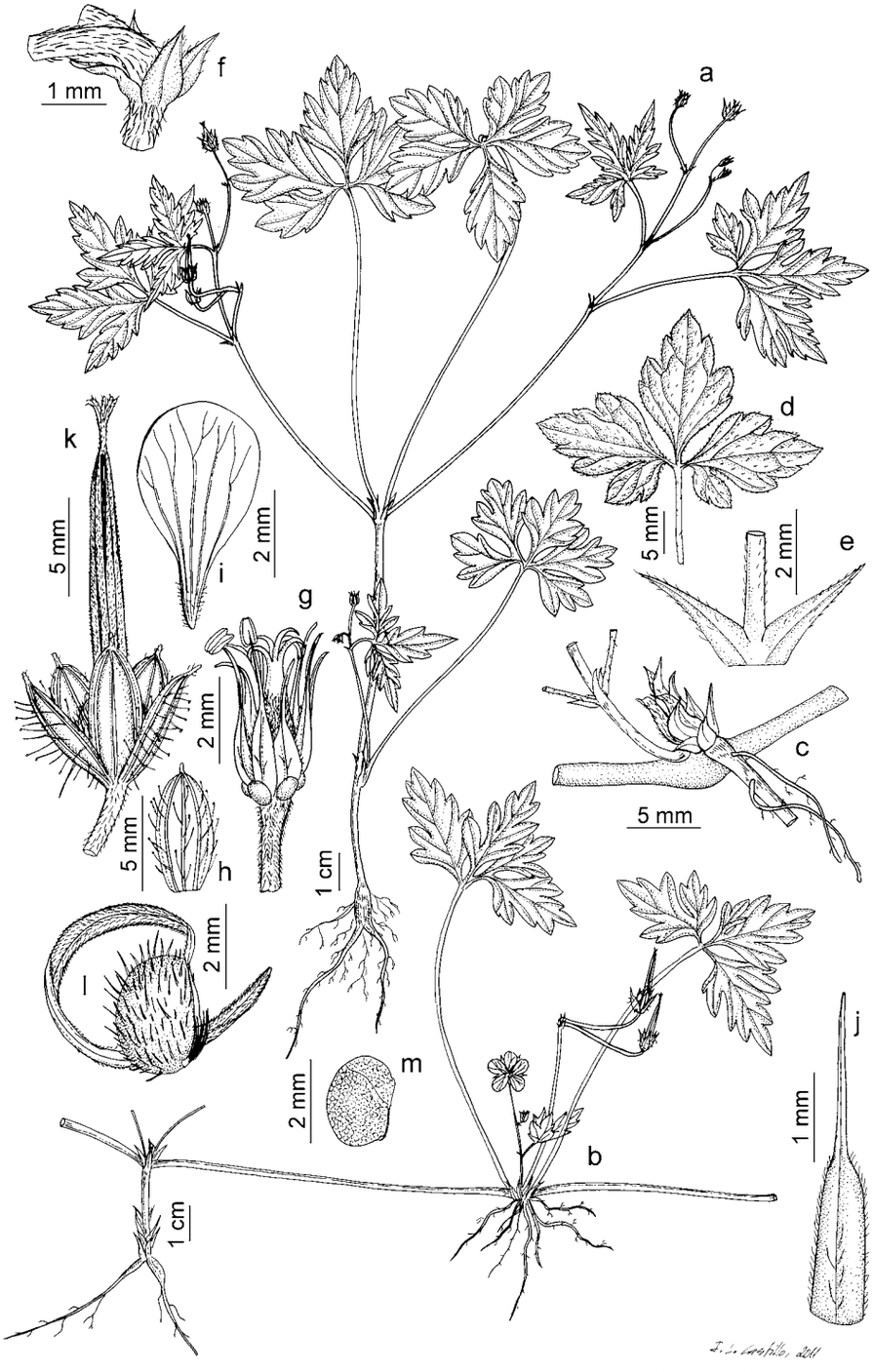


Fig. 201. *Geranium tripartitum*. a, b. Habit. c. Bud. d. Leaf. e. Stipules. f. Bracteoles. g. Flower without petals and sepals. h. Sepal. i. Petal. j. Staminal filament. k. Fruit. l. Mericarp. m. Seed. (Based on: a, *Sawada s.n.*, *31 Aug 1926*, TI; b, c, f, j-m, *Nakai s.n.*, *5 Oct. 1930*, TI; d, e, g-i, *Murata & al. 4577*, TI).

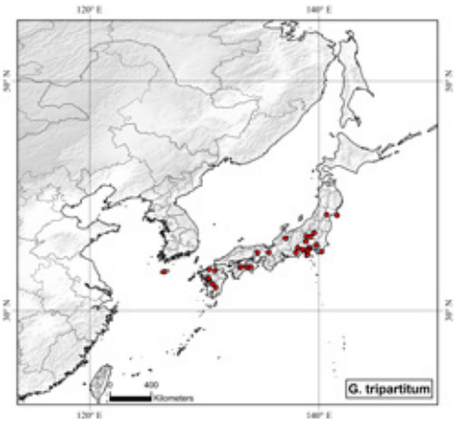


Fig. 202. Distribution of *Geranium tripartitum*.

71. Geranium suzukii Masam., J. Soc. Trop. Agric. 3: 392. 1931. *Geranium nepalense* var. *suzukii* (Masam.) Murata, Acta Phytotax. Geobot. 17: 172. 1958. Type locality: "Hab. Taiheizan. Toganô Jul. 16, 1929, Leg. Suzuki, no. 392 (Typ. in Herb. Taihoku Imp.

Univ.)". Type: China. Taiwan. Taipingshan, 24°29'N, 121°31'E, 16 July 1929, *S. Suzuki 392* (holotype, TAI image!).

Perennial herbs, 18-45 cm tall. *Rootstock* 2-3 mm in diameter, ± horizontal, not tuberculate, not turnip-shaped, without thickened roots. *Stem* trailing, leafy, rooting at nodes, stolons absent, without vegetative stems, with retrorse, ± appressed, eglandular hairs 0.2-0.5 mm long. *Basal leaves* in a deciduous rosette, cauline leaves opposite; leaf laminas (1.1)1.9-2.4(3.3) cm long, 1.5-3.9 cm wide, not peltate, palmatifid [ratio main-sinus length/middle segment length = 0.74-0.84], polygonal in outline, base cordate, not coriaceous, with nerves not projected, pilose, with appressed, eglandular hairs on both surfaces; segments 5, in 1 plane, middle segment obtriangular, 1.4-4.6 mm wide at the base [ratio segment width at the base/middle segment length = 0.12-0.23], 3(5)-lobed in distal half [ratio secondary sinus length/middle segment length = 0.13-0.30]; petioles up to 11 cm long, without abscission zone, terete, not swollen, not deflexed in age, with retrorse, ± appressed, eglandular hairs 0.2-0.4 mm long; stipules 2.6-5.4 mm long, 0.5-1.2 mm wide, linear-lanceolate, free, papery, brownish red, with eglandular hairs on both surfaces and on the margin. *Inflorescence* a monochasial cyme; cymules 1-flowered, solitary [ratio cymule length/leaf length = (0.9)1.1-3]; peduncles (25)37-50(72) mm long, with retrorse, ± appressed, eglandular hairs 0.2-0.6 mm long; bracteoles 2.6-4 mm long, 0.3-0.7 mm wide, linear-lanceolate, opposite; pedicels 11-36 mm long, with retrorse, ± appressed, eglandular hairs 0.1-0.4 mm long. Flowers actinomorphic. *Sepals* (4.1)4.4-5.8(6.4) mm long, 1.3-2.4 mm wide, lanceolate, smooth, not accrescent, nerves 3, mucro 0.9-1.8 mm long [ratio mucro length/sepal length = 0.14-0.43], with antrorse, appressed, eglandular hairs 0.1-0.9 mm long and scattered, patent, glandular hairs 0.5-1.3 mm long on the abaxial surface, ± hairy adaxially. *Petals* (5.2)7.2-8.4(12.7) mm long, 2.6-6.2 mm wide, erect-patent, rounded, without claw, white or pale pink with purplish veins, with scattered hairs on the base of both surfaces and on the basal margin, with hairs 0.1-0.3 mm long. *Stamens* 10, both whorls bearing anthers; filaments 2-4.5 mm long, lanceolate with an abruptly narrowed apex, white, pilose on the abaxial surface, ciliate on the proximal half, with hairs 0.1-0.3 mm long; anthers 0.5-1 mm long, blue. Nectaries 5, hemispheric, glabrous. *Gynoecium* 2.9-5 mm long, green. *Fruit* 17-20 mm long, erect, discharge of seed-ejection type; mericarps 2.5-3.5 mm long, 1.2-1.8 mm wide, without a strand of fibers, not compressed at the apex, smooth,

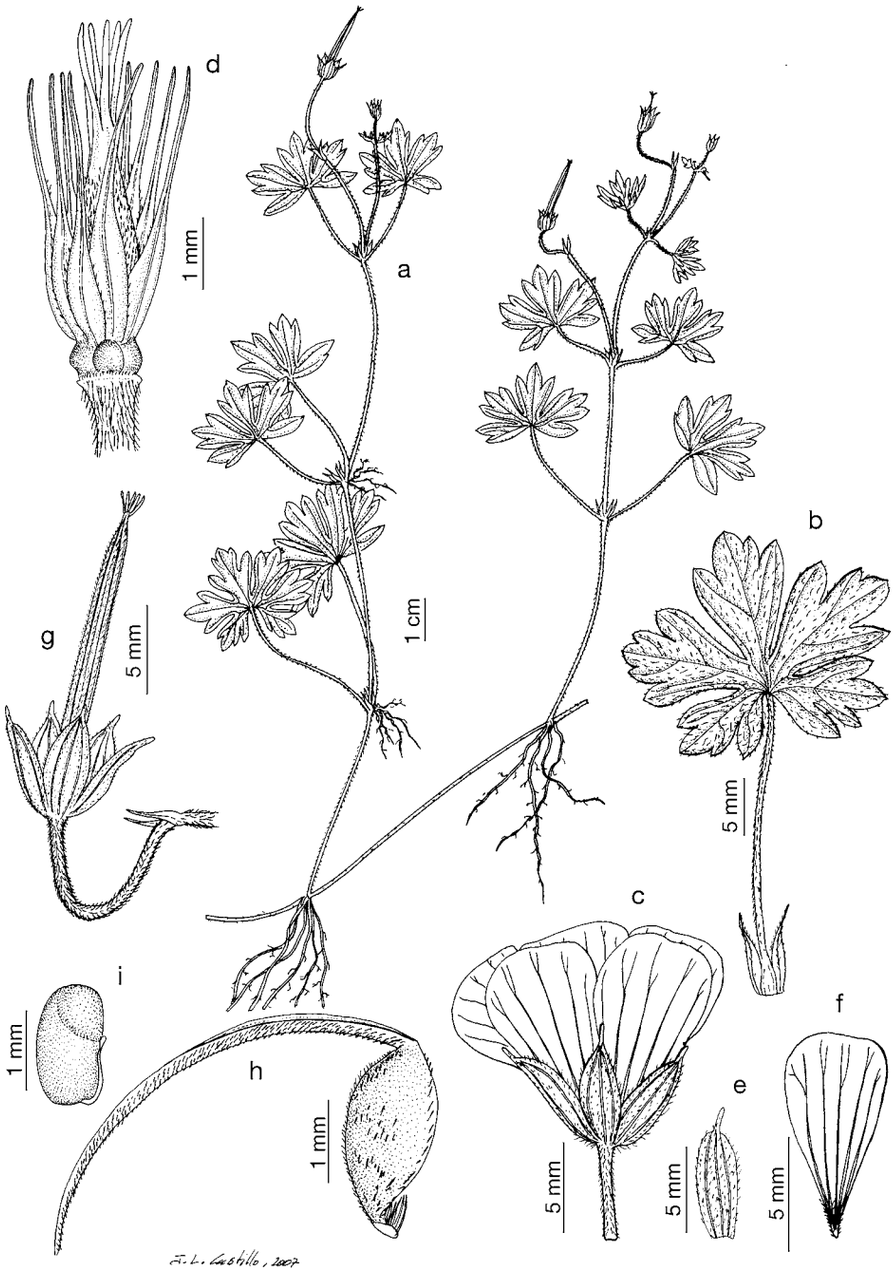


Fig. 203. *Geranium suzukii*. a. Habit. b. Leaf. c. Flower. d. Flower without petals and sepals. e. Sepal. f. Petal. g. Fruit. h. Mericarp. i. Seed. (Based on: a, b, d, e, g-i, *Kelley & al. 138-98*, CAS; c, f, *Shing-Fan Huang & Ming-Jou Wu 5391*, TAI).

Fig. 204. *Geranium suzukii* (Based on: *Aedo 4779,* MA).

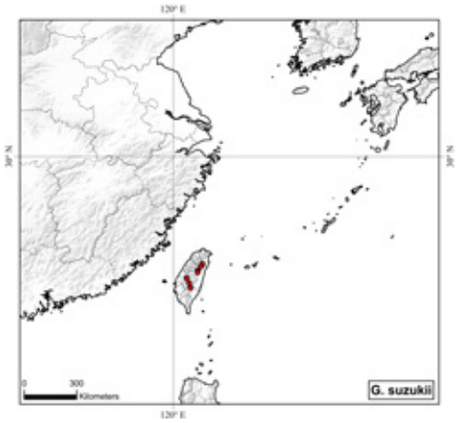


Fig. 205. Distribution of *Geranium suzukii*.

without basal beak, with a basal callus, without a basal prong, brown, with ± patent, eglandular hairs 0.2-0.6 mm long; rostrum 12-16.1 mm long, with a narrowed apex 0.5-1.5 mm long, not twisted, with ± patent, eglandular hairs 0.1-0.2 mm long and, rarely, patent glandular hairs 0.6-0.7 mm long; stigmatic remnants 0.4-1.9 mm long, with 5 almost glabrous lobes. *Seeds* 1.8-2 mm long, 1-1.2 mm wide, finely reticulate, uniformly colored, brown, glabrous. Cotyledons with entire margin. Figs. 203, 204.

Pollen. *Geranium*-type (Park & Kim 1997: 313).

Chromosome number. Unknown.

Phenology. Collected in flower from June to October.

Distribution. This species is endemic to Taiwan (Fig. 205).

Habitat. Edge of coniferous or mixed broadleaf and coniferous forests, on mossy ground; 2300-3250 m.

Additional specimens examined. **Taiwan.** Chiayi Co.: Ali Shan, 23°30'N, 120°50'E, 12 Aug. 1957, *Ram 602* (GH). Hualien Co.: Tayuling on highway 8 to the summit of Mt. Hohuan-shan, 24°8'N, 121°17'E, 28 June 1977, *Boufford & al. 19292* (MO); Hohuanshan, 24°8'N, 121°17'E, 15 Oct. 1992, *Hsieh 938* (TAI). Ilan Co.: Nanhutashan, 24°21'N, 121°26'E, 14 Oct. 1977, *Jeng 1990* (TAI); Nanhutashan, 24°21'N, 121°26'E, 20 Aug. 1969, *Yamazaki & al. 619* (TAI); Nanhutashan, Kiretei-Bunakkei, 24°21'N, 121°26'E, 21 Sep. 1969, *Yamazaki & al. 87* (TAI). Kaohsiung Co.: cottage to Kuhanohsinshan, 23°15'N, 120°54'E, 3 Oct. 1996, *Shing-Fan Huang & Ming-Jou Wu 5391* (MO, TAI). Nantou Co., Yin-hai to Ten-tzu, 23°46'N, 120°43'E, 11 Aug. 1971, *Huang & al. 5753* (TAI); Yinhai-Tentzu, 23°46'N, 120°43'E, 11 Aug. 1964, *Kao 5779* (GH); en route from Tungpu to Patungkuan, 23°46'N, 120°42'E, 18 Aug. 1963, *Tamura & al. 22005* (E); Jenai Hsiang en route from Yunhai to Tienchih, 24°3'N, 121°16'E, 13 Oct. 1992, *Hsiu-Lan Ho 560* (GH, MO); Chilaishan, 24°3'N, 121°16'E, 30 Sep. 1977, *Jeng 1818* (TAI); Ta-yu-ling to Ho-huannshan, 24°8'N, 121°16'E, 22 Aug. 1967, *Chien-chang Hsu 3808* (TAI). Taichung Co.: Jenai Hsiang, just past Tayuling on route 14A, 24°10'N, 121°17'E, 8 Sep. 1998, *Kelley & al. 138-98* (CAS, GH).

Discussion. Geranium suzukii is a trailing herb, consistently rooting at the nodes. It usually has glandular hairs restricted to the sepals and sometimes on the fruit, and 1-flowered cymules. The petals are white or pale pink, which was stated in the protologue and observed in cultivated specimens, not yellow as some authors have mentioned (Huang 1993). *Geranium suzukii* appears to be close to *G. sibiricum* from which it differs by its longer petals, leaves with obtriangular segments (and with few lobes), and glandular indument of the sepals. *Geranium suzukii* is endemic to the central mountains of Taiwan, while the nearest localities of *G. sibiricum* are in central China, about 1200 km to the northwest. The most similar sympatric species is *G. thunbergii*, which is distinguished by its leaves with rhombic and more lobed segments and its 2-flowered cymules with glandular indument.

72. Geranium frigidurbis Moerman, Blumea 24(2): 469. 1978. Type locality: "Bünnemeijer 11906 (L; iso in BO, n.v.), Celebes (Bonthain)". Type: Indonesia. Celebes, Bonthain, 5°21'S, 119°56'E, 8 June 1921, *H.A. Bünnemeyer 11906* (holotype, L-0018342!; isotypes, BO, K!).

Perennial herbs, 20-29 cm tall. *Rootstock* 3-3.5 mm in diameter, ± vertical, not tuberculate, not turnip-shaped, without thickened roots. *Stem* prostrate, leafy, sometimes rooting at nodes, stolons absent, without vegetative stems, with retrorse, appressed, eglandular hairs 0.2-0.4 mm long. *Basal leaves* in a ± persistent rosette, cauline leaves opposite; leaf laminas (1.2)1.4-1.8(3.1) cm long, 1.3-4 cm wide, not peltate, palmatifid [ratio main-sinus length/middle segment length = (0.74)0.76-0.83(0.84)], polygonal in outline, base cordate, not coriaceous, with nerves not projected, pilose, with appressed, eglandular hairs on both surfaces; segments 5, in 1 plane, middle segment obtriangular, 1.7-5.6 mm wide at the base [ratio segment width at the base/middle segment length = 0.19-0.27], 3(4)-lobed in distal half [ratio secondary sinus length/middle segment length = (0.20)0.22-0.26(0.28)]; petioles up to 10 cm long, without abscission zone, terete, not swollen, not deflexed in age, with retrorse, appressed, eglandular hairs 0.2-0.4 mm long, rarely, with scattered, patent, glandular hairs 0.3-0.4 mm; stipules (2.8)3-4(4.2) mm long, 0.8-1.2 mm wide, lanceolate, free, papery, brownish red, with eglandular hairs on abaxial surface and on the margin, ± glabrous adaxially. *Inflorescence* a monochasial cyme; cymules 1(2)-flowered, solitary [ratio cymule length/leaf length = (0.8)1-1.2(1.6)]; peduncles (5.5)6.5-14.9(23) mm long, with retrorse, appressed, eglandular hairs 0.2-0.3 mm long; bracteoles 3-4(4.2) mm long, 0.6-0.9 mm wide, linear-lanceolate, opposite; pedicels (8.5)9.9-14.6 mm long, with retrorse, appressed, eglandular hairs 0.1-0.3

mm long. Flowers actinomorphic. *Sepals* (3.8)4.1-4.5(4.8) mm long, 1.7-2.7 mm wide, lanceolate, smooth, not accrescent, nerves 3, mucro (0.6)1-1.1 mm long [ratio mucro length/sepal length = 0.15-0.28], with ± patent, eglandular hairs 0.6-0.9 mm long on the abaxial surface, glabrous adaxially. *Petals* (3.9)4.3-5.3(5.8) mm long, 1.7-2.6 mm wide, erect-patent, rounded, without claw, pale pink to purple, glabrous on both surfaces, ciliate on the basal margin, with hairs 0.1-0.3 mm long. *Stamens* 10, both whorls bearing anthers; filaments 2-2.9 mm long, lanceolate, unknown color, glabrous on the abaxial surface, ciliate on the proximal half, with hairs 0.1-0.2 mm long; anthers 0.3-0.5 mm long, unknown color. Nectaries 5, hemispheric, glabrous. *Gynoecium* 2.2-3.2 mm long, unknown color. *Fruit* 14-16.2 mm long, erect, discharge of seed-ejection type; mericarps 2.5-2.9 mm long, 1.3-1.6 mm wide, without a strand of fibers, not compressed at the apex, smooth, without basal beak, with a basal callus, without a basal prong, brown, with ± patent, eglandular hairs 0.4-0.9 mm long; rostrum 9.5-10.5 mm long, with a narrowed apex 0.7-0.9(1) mm long, not twisted, with antrorse, eglandular hairs 0.1-0.2 mm long; stigmatic remnants 0.9-1.3 mm long, with 5 glabrous lobes. *Seeds* 2-2.1 mm long, 1.2-1.4 mm wide, finely reticulate, uniformly colored, brown, glabrous. Cotyledons not studied. Fig. 206.

Pollen. Ornamentation not studied.

Chromosome number. Unknown.

Phenology. Collected in flower from February to June.

Distribution. This species is endemic to southern Celebes, in Indonesia (Fig. 207).

Habitat. Open grassy areas on volcanic rocks; 2500-2600 m.

Additional specimens examined. **Indonesia.** Celebes: Gowa district, G. Bawa Karang, subsiduary to G. Lompobatang, 5°19'S, 119°57'E, 14 Feb. 2000, *Argent & al. 58* (E, GH); Lompo Batang, Bonthain, 5°21'S, 119°56'E, 1938, *Monod de Froideville 229* (L).

Discussion. Geranium frigidurbis is a small herb with more or less elongate, prostrate, branched stems some-

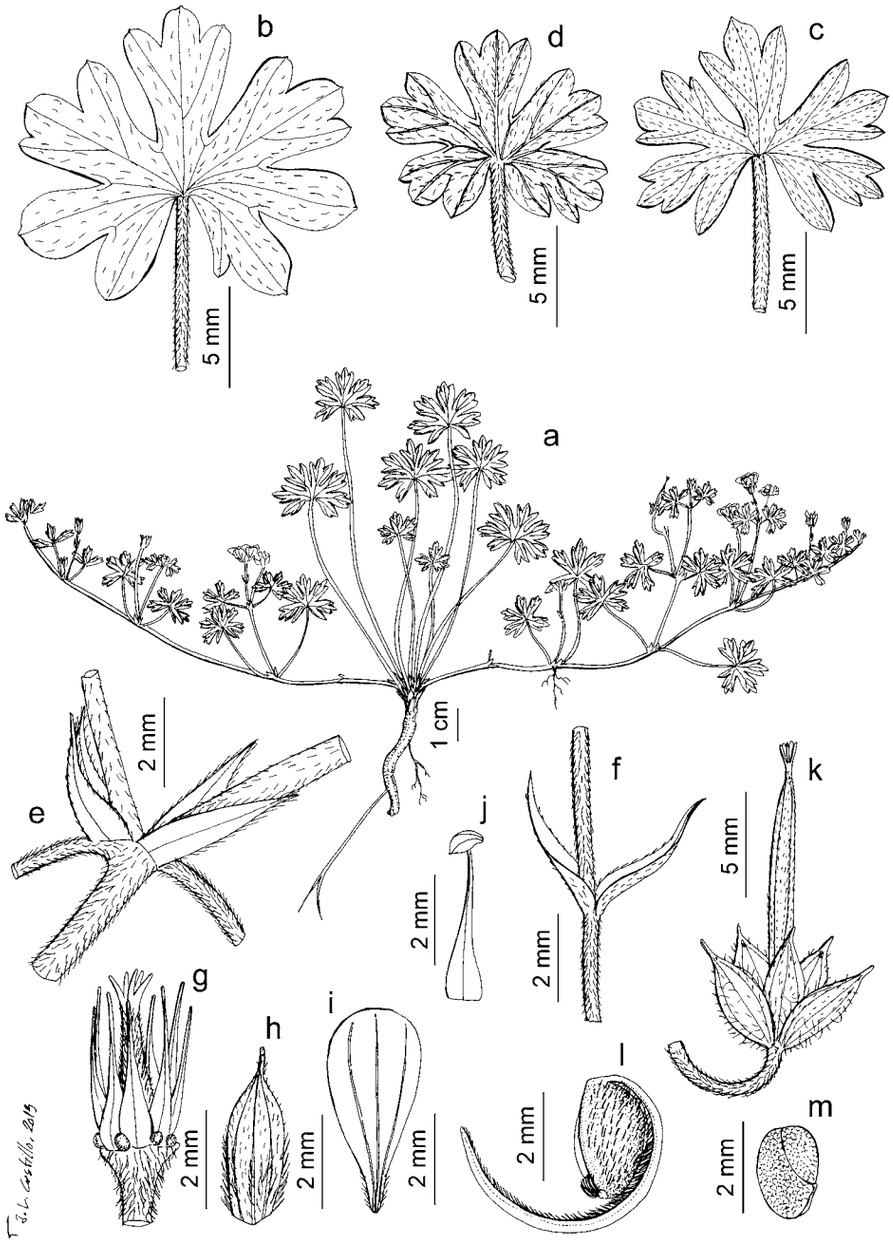


Fig. 206. *Geranium frigidurbis*. a. Habit. b, c. Leaves, adaxial surface. d. Leaf, abaxial surface. e. Stipules. f. Bracteoles. g. Flower without petals and sepals. h. Sepal. i. Petal. j. Stamen. k. Fruit. l. Mericarp. m. Seed. (Based on: a, c, e, f, *Argent & al. 58*, E; b, k-m, *Bünnemeyer 11906*, K; d, g-j, *Monod de Froideville 229*, L).

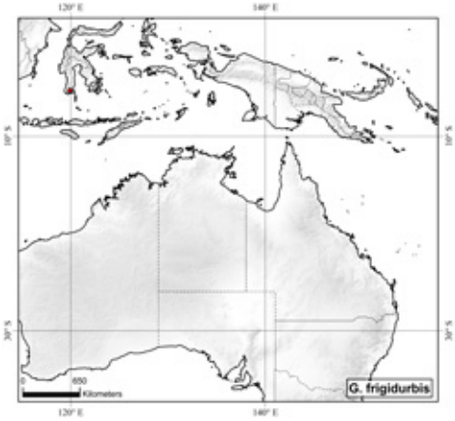


Fig. 207. Distribution of *Geranium frigidurbis*.

times rooting at the nodes. Among the few available collections, the underground parts are poorly represented. Nevertheless, *G. frigidurbis* appears to have a ± vertical rootstock with thin roots. *Geranium frigidurbis* has leaves with five segments, each of which is 3-lobed at the apex. The leaf indument consists of short, appressed eglandular hairs regularly covering both surfaces. The stipules are narrowly lanceolate and free, and quite similar to the bracteoles. The indument of the stems, petioles, peduncles, and pedicels consist of short, retrorsely appressed eglandular hairs. On some petioles, scattered, patent glandular hairs were observed. According to Veldkamp & Moerman (1978: 466, 469) *G. frigidurbis* has 1- or 2-flowered cymules, but 2-flowered cymules appear to be the exception (the same is also true of *G. potentilloides*). In the type collection of *G. frigidurbis*, only one of 15 cymules has two flowers and no 2-flowered cymules were seen in any of the other collections. *Geranium frigidurbis* can be distinguished from *G. niuginiense* by quantitative features. *Geranium frigidurbis* has longer stipules, bracteoles, sepal mucro, hairs of the sepals and mericarps, a narrowed rostrum apex, and shorter peduncles and pedicels. In contrast, *G. frigidurbis* can be differentiated from *G. potentilloides* by its longer sepal mucro, hairs on the sepals and mericarps, and narrowed rostrum apex. The leaves of *G. frigidurbis* have the middle segment 3-lobed at the apex while in *G. potentilloides* the middle segment is variable and in many cases has more than three lobes (up to nine). In addition, the leaves of *G. frigidurbis* are usually, but not always, smaller than those of *G. potentilloides*. These traits all show some degree of overlap, however, making the preparation of a key to separate the species difficult. The concurrence of all of these characters, together with geographical isolation, suggests that Veldkamp & Moerman (1978: 469) were correct in separating *G. frigidurbis* as a distinct species. Carolin (1965: 341) included specimens from Sulawesi, here separated as *G. frigidurbis*, within *G. potentilloides* var. *ardjunense* (here considered to be a species endemic to Java). For more details see the discussion under *G. ardjunense*.

---

73. Geranium potentilloides L'Hér. ex DC., Prodr. 1: 639. 1824. *Geranium dissectum* var. *potentilloides* (L'Hér. ex DC.) Benth., Fl. Austral. 1: 296. 1863. *Geranium pilosum* var. *potentilloides* (L'Hér. ex DC.) Ewart, Fl. Victoria: 682. 1931. Type Sol. ex Willd., Opurage, Motuaro, 1769, *J. Banks s.n.* (lectotype, designated by Carolin 1965: 337, G-DC!; isolectotype, BM!) [precise localities are written only on BM sheet; Tolaga, (38°22'S, 178°18'E), Opurage (Puarangi River, Whitianga, 36°52'S, 175°42'E), and Motuaro (Motuhora Island, 37°51'S, 176°59'E) are separate locations from the North Island].

Geranium philonothum DC., Prodr. 1: 639. 1824. Type locality: "in Novae-Hollandiae orâ merid.". Type: Australia. Novae-Hollandiae, côte merid., unknown collector (lectotype, designated by Carolin 1965: 337, G-DC-00214916!).

Geranium microphyllum Hook. f., Fl. Antarct. 1: 8, tab. 5. 1844. *Geranium potentilloides* var. *microphyllum* (Hook. f.) Hook. f., Fl. Nov.-Zel. 1: 40. 1852. Type locality: "Hab. Lord Auckland's group; in boggy places, alt. 1000 feet". Type: New Zealand. Auckland Is., 50°40'S, 166°10'E, Nov. 1840, *J.D. Hooker s.n.* (lectotype, designated by Carolin 1965: 337, K!).

Geranium potentilloides var. *debile* Hook. f., Fl. Nov.-Zel. 1: 40. 1852. Type locality: "Hab. Northern, Middle, and Southern Islands; chiefly in mountainous situations, Banks and Solander, Colenso, etc... Var. [γ]. East coast, Colenso; Akaroa, Raoul". Type: New Zealand. *W.J. Colenso 1638* (lectotype, designated by Aedo 2017a: 118, K-000729524!; isolectotypes, G!, MEL!, S!).

Geranium microphyllum var. *discolor* G. Simpson & J.S. Thomson, Trans. & Proc. Roy. Soc. New Zealand 73: 156. 1943. Type locality: "Type specimen from the Port Hills near Christchurch, in the Herbarium Plant Reseach Boreau, Wellington". Type: New Zealand. South Is., Port Hills near Christchurch, 43°32'S, 172°38'E, *G. Simpson & J.S. Thomson s.n.* (holotype, CHR-62979 image!).

Geranium microphyllum var. *obtusatum* G. Simpson & J.S. Thomson, Trans. & Proc. Roy. Soc. New Zealand 73: 156. 1943. Type locality: "Type specimen from Flagstaff Hill, near Dunedin, in the Herbarium Plant Reseach Boreau, Wellington". Type: New Zealand. South Is., near Dunedin, Flagstaff Hill, 45°52'S, 170°30'E, *G. Simpson & J.S. Thomson s.n.* (holotype, CHR-75698 image!).

Geranium graniticola Carolin, Proc. Linn. Soc. New South Wales ser. 2, 89: 345, pl. 6 fig. 10, pl. 7 fig. 9. 1965. Type locality: "Oberon, R. Carolin, No. 919, 23.3.1959 (NSW 66128)". Type: Australia. New South Wales, Oberon, 33°43'S, 149°52'E, 23 Mar. 1959, *R.C. Carolin 919* (holotype, NSW-66128).

Geranium potentilloides var. *abditum* Carolin, Proc. Linn. Soc. New South Wales ser. 2, 84: 340, tab. 6 fig. 9. 1965. Type locality: "Munyang near Guthega, R. Carolin, No. 785, 21.1.1959 (NSW 66125)". Type: Australia. New South Wales, Munyang near Guthega, 36°09'S, 148°30'E, 21 Jan. 1959, *R.C. Carolin 785* (holotype, NSW-66125!).

Geranium rubricum Heenan & Courtney, Phytotaxa 314: 90, 91 fig. 1, 2017. Type locality: "New Zealand. Nelson. Red Hills above Motueka River, rocky ridge, ultramafic rocks, 1200 m, December 1990, S. Courtney s.n. (holotype CHR 469918!)". Type: New Zealand. South Is., Nelson. Red Hills above Motueka River, 41°23'S, 172°49'E, *S. Courtney s.n.* (holotype, CHR-469918 image!).

Perennial herbs, 6-76 cm tall. *Rootstock* 1.3-6.9 mm in diameter, ± vertical, not tuberculate, not turnip-shaped, with thickened roots along the rootstock. *Stem* prostrate to ascending, leafy, sometimes rooting at nodes, stolons absent, without vegetative stems, with patent to retrorse, appressed, eglandular hairs 0.1-0.7 mm long and, rarely, with patent, glandular hairs 0.2-0.6 mm long. *Basal leaves* in a deciduous rosette, cauline leaves opposite; leaf laminas (0.8)1.2-3.3(3.8) cm long, 1-4.7 cm wide, not peltate, palmatifid [ratio main-sinus length/middle segment length = (0.65)0.73-0.80(0.83)], polygonal in outline, base cordate, not coriaceous, with nerves not projected, pilose, with appressed, eglandular hairs on both surfaces; segments 5, in 1 plane, middle segment obtriangular, (1.4)2.2-4.5(5.9) mm wide at the base [ratio segment width at the base/middle segment length = 0.13-

0.33], 3-5(9)-lobed at the apex [ratio secondary sinus length/middle segment length = (0.11)0.16-0.23(0.27)]; petioles up to 21 cm long, without abscission zone, terete, not swollen, not deflexed in age, with patent to retrorse, eglandular hairs 0.2-1.4 mm long and, rarely, scattered, patent, glandular hairs 0.3-0.4 mm long; stipules (1.7)2.8-4.5(6.8) mm long, 0.2-0.9(1.9) mm wide, lanceolate, rarely bifid, free, papery, brownish red, with eglandular hairs on both surfaces and on the margin. *Inflorescence* a monochasial cyme; cymules 1(2)-flowered, solitary [ratio cymule length/leaf length = (0.6)1-2.6]; peduncles (1.5)6.6-21(36.6) mm long, with patent to retrorse, appressed, eglandular hairs 0.2-1 mm long and, rarely, with patent, glandular hairs 0.2-0.6 mm long; bracteoles (1.4)2.3-3.5(5.6) mm long, (0.2)0.4-0.5(0.6) mm wide, linear-lanceolate, opposite; pedicels (7.5)13-22(27.2) mm long, with patent to retrorse, appressed, eglandular hairs 0.1-0.8 mm long and, rarely, with patent, glandular hairs 0.2-0.6 mm long. Flowers actinomorphic. *Sepals* (2.9)3.6-5(6.2) mm long, 0.9-2.9 mm wide, lanceolate, smooth, not accrescent, nerves 3, mucro (0.3)0.5-0.7(1.2) mm long [ratio mucro length/sepal length = 0.08-0.34], with antrorse, ± appressed, eglandular hairs 0.1-0.2 mm long on the abaxial surface (sometimes eglandular hairs 0.5-1 mm long on the margin), glabrous adaxially and rarely with patent, glandular hairs 0.2-0.6 mm long. *Petals* (2.2)4.4-5.9(8.1) mm long, 1.1-4.4 mm wide, erect-patent, rounded, without claw, white to pink, glabrous on both surfaces, ciliate on the basal margin, with hairs 0.1-0.4 mm long. *Stamens* 10, both whorls bearing anthers; filaments 1.8-3.8 mm long, lanceolate, yellow, glabrous on the abaxial surface, ciliate on the proximal half, with hairs 0.1-0.2 mm long; anthers 0.4-0.6(0.9) mm long, yellow. Nectaries 5, hemispheric, glabrous. *Gynoecium* 2.3-4.8 mm long, purple. *Fruit* 11-18.7 mm long, erect, discharge of seed-ejection type; mericarps 2.1-3.6 mm long, 0.9-1.8 mm wide, without a strand of fibers, not compressed at the apex, smooth, without basal beak, with a basal callus, without a basal prong, brown, with ± patent, eglandular hairs 0.1-1.8 mm long; rostrum 7.3-12.3 mm long, without a narrowed apex or with a narrowed apex 0.4-0.5(1) mm long, not twisted, with antrorse, eglandular hairs 0.1-0.7 mm long; stigmatic remnants 0.8-1.9 mm long, with 5 usually glabrous lobes. *Seeds* 1.5-2.9 mm long, 0.9-1.8 mm wide, finely reticulate, uniformly colored, brown, glabrous. Cotyledons with entire margin. Figs. 208, 209.

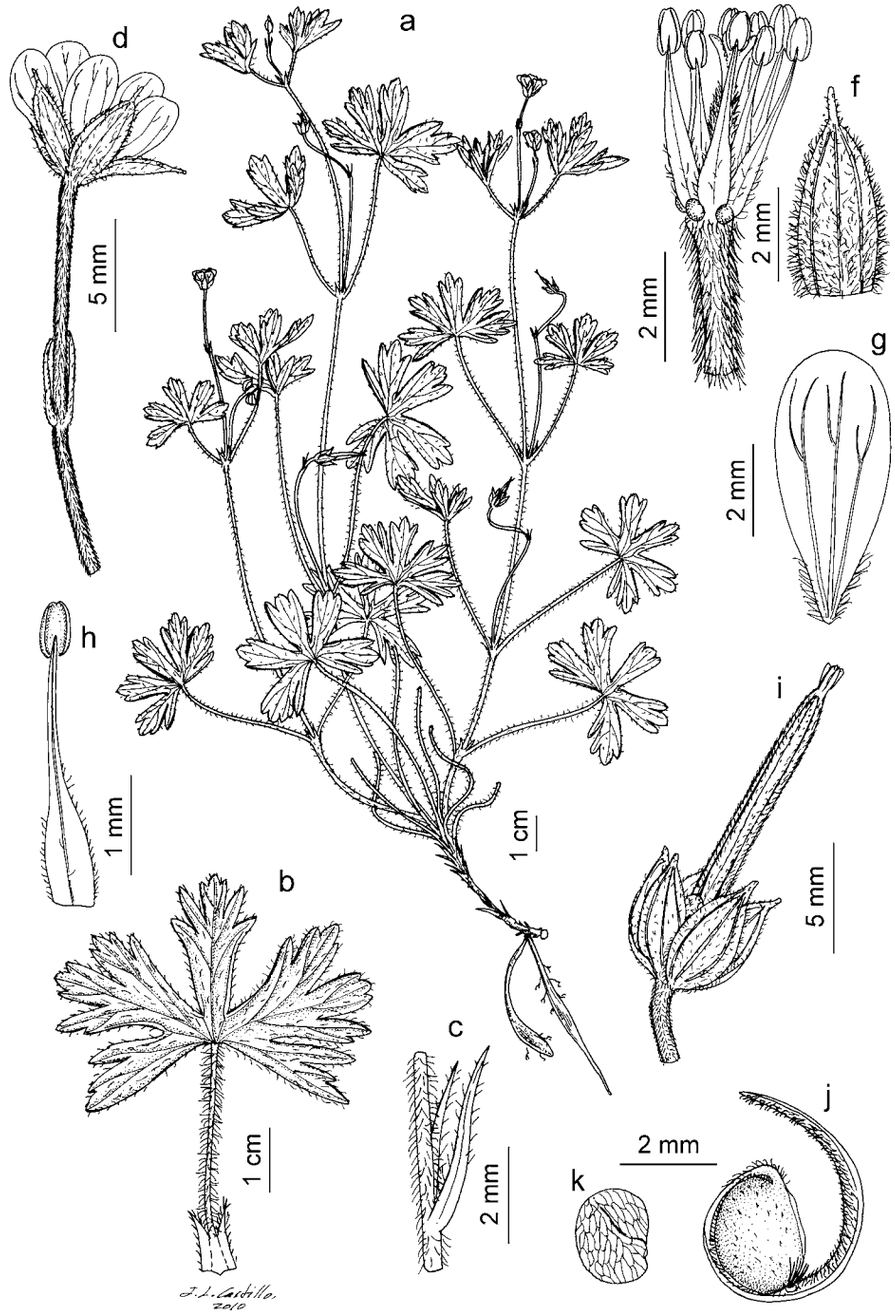


Fig. 208. *Geranium potentilloides*. a. Habit. b. Leaf. c. Bracteoles. d. Flower and pedicel. e. Flower without petals and sepals. f. Sepal. g. Petal. h. Stamen. i. Fruit. j. Mericarp. k. Seed. (Based on: a, c-h, *Curtis s.n.*, AK-150226; b, *Carolin 752*, K; i-k, *Brown 5224*, BM).

Fig. 209. *Geranium potentilloides* (Based on: *Aedo 4473,* MA).

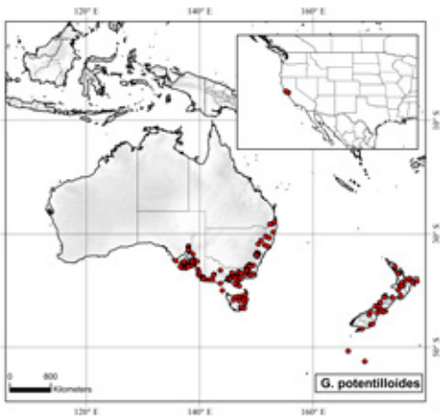


Fig. 210. Distribution of *Geranium potentilloides*.

Pollen. *Geranium*-type (Bortenschlager 1967: 431 [sub *G. microphyllum*]).

Chromosome number. 2*n* = 52-54, 112.

Phenology. Collected in flower from January to December.

Distribution. This species ranges through southeastern Australia and New Zealand and it is introduced in California (Fig. 210).

Habitat. Roadsides, weedy areas, marshy creeks, dunes, boggy areas, open grassland, among rocks, and edge of *Eucalyptus* L'Hér. and *Nothofagus* Blume forests; 0-2050 m.

Representative specimens examined. **Australia.** New South Wales: North East, Grafton, 29°41'S, 152°56'E, 25 Apr. 1912, *Cleland s.n.* (AD); Wimmera, 31°10'S, 150°48'E, *Mueller s.n.* (MO); Snowy Mts., W slope above Trapyard Creek, 32°14'S, 152°0'E, 25 Jan. 1957, *Eichler 13500* (AD); Mt. Bindo summit, 33°43'S, 150°0'E, 10 May 1984, *Benson & Keith 1864* (NSW); White Rock Mts., near Rockton, in Nulbaugh Forest, 37°3'S, 149°22'E, 1 June 1959, *Willis s.n.* (MEL). Queensland: Moreton district, Mt. Tamborine, 27°55'S, 153°10'E, Mar. 1947, *Clemens s.n.* (F); Mt. Tamborine, about 45 mi S of Brisbane, 27°55'S, 153°10'E, 5 June 1930, *Hubbard 2516* (K); above Pale Creek, 5 mi from SW border, 28°17'S, 152°48'E, 1 June 1959, *Carolin 1024* (G, L); Spring Creek road, between Queen Mary falls and The Head, 28°18'S, 152°23'E, 4 Jan. 2002, *Forster 28080* (MEL). South Australia: Flinders Range, Warren Gorge, 32°9'S, 138°1'E, 5 Sep. 1989, *Hyde 433* (AD); Southern Flinders Range, Mambray Creek, 32°50'S, 138°4'E, 7 July 1974, *Whibley 4377* (AD); near Devils Hole in Caroline Forest Reserve, ca. 20 km SE of Mt. Gambier, 33°35'S, 138°48'E, 17 Nov. 1959, *Jackson 242* (AD, G); Adelaide, Adelaide Plains, Bethany, 34°32'S, 138°58'E, 11 Oct. 1959, *Eichler 16275* (AD); South Eastern, Brown Beach, 38°3'S, 140°58'E, 11 Oct. 1984, *Donner 10142* (MA). Tasmania: Furneaux group, Hogan Is., 39°13'S, 146°59'E, 20 Nov. 1990, *Whinray 9318* (MEL); Kings Is., 40°0'S, 144°0'E, *Neate s.n.* (MEL); Lowhead, Launceston, 41°4'S, 146°48'E, Dec. 1934, *Jones & Doore 147* (ILL, NY); N of Cradle Mountain, near road to Waldheim, at Pencil Pine Creek, 41°40'S, 145°56'E, 10 Jan. 1960, *Eichler 16554* (AD); Mt. Wellington, 42°53'S, 147°14'E, 1 Feb. 1973, *Ratkowsky & Ratkowsky 101* (MO). Victoria: Delegate River bridge at Bidwell near Bendoc, 35°34'S, 149°28'E, 18 Jan. 1948, *Willis s.n.* (MEL); ridge of Major Mitchell Plateau, Gramians, 23 km SSE of Halls Gap, 36°26'S, 143°39'E, 16 Dec. 1975, *Streimann 3132* (L); Hall's Gap, 37°8'S, 142°31'E, 16 Apr. 1979, *Lebreton s.n.* (S); Bentley's Plain, 20.6 km from Ensay toward Tongio, 37°14'S, 147°55'E, 5 Jan. 1969, *Canning 1486* (L); Wilson's Promontory, Norman Bay, 38°58'S, 146°22'E, 16 Oct. 1971, *Melville & Webb 71787* (K). **New Zealand.** Campbell Is.: Campbell Is., 52°30'S, 169°5'E, 29 Mar. 1949, *Walker 5086* (US). Chatham Is.: Kaia Hill, 44°0'S, 176°30'W, Dec. 1994, *Shrubsole & Bates 40562* (AD, AK). New Zealand North Is.: N of Clevedon, 30 km SE of Auckland, 37°0'S,

175°3'E, 10 Nov. 1978, *Gardner 2118* (G, L, K); Murchison Co., Lake Rotoiti, Nelson, 38°4'S, 176°43'E, 18 Jan. 1962, *Melville 6079* (K, L); Te Porere Redoubt, pr. Ruapehu, 39°3'S, 175°16'E, 10 May 1975, *Gardner 1034* (L, MO); Wairarapa Co., Mt. Holdsworth, Tararua Range, ca. 13 mi NW of Masterton, 40°52'S, 175°25'E, 6 Dec. 1961, *Melville 5510* (K, L); Golden Bay Co., Nelson, pr. Lake Sylvester, W of Cobb Reservoir, 41°7'S, 172°39'E, 12 Jan. 1961, *Melville 5911* (K). New Zealand South Is.: Mt. Peel, 41°9'S, 172°35'E, Jan. 1933, *Anderson s.n.* (NY); Waitahu River, Westland County, 42°4'S, 171°49'E, 21 Jan. 1973, *Thompson 600* (L); mount Torlesse, 43°16'S, 171°49'E, Jan. 1909, *Travers s.n.* (G, L); Mt. Cook National Park, just N of park headquarters, 43°44'S, 170°5'E, 7 Feb. 1983, *Strid 22299* (MO); Humbolt Mts., Otago Lake, 46°1'S, 170°5'E, Feb. 1897, *Cockayne s.n.* (NY). **USA.** California: Alameda, 37°45'N, 122°14'W, 11 May 1891, *Greene s.n.* (F); Marin Co., Bear Valley, 37°59'N, 122°48'W, 29 May 1898, *Eastwood s.n.* (F); Marin Co., Bolema Club, between Bolinas and Olema, 37°59'N, 122°45'W, 3 May 1965, *McHoul s.n.* (UC).

Discussion. Geranium potentilloides is a small herb with more or less elongated, prostrate to ascending stems rarely rooting at the nodes. The rootstock is vertical and with ± fusiform roots. *Geranium potentilloides* has leaves with five segments, which are 3-5(9)-lobed at the apex. The leaf indument consists of short, appressed eglandular hairs uniformly covering both surfaces. The cymules are usually 1-flowered, although exceptionally some 2-flowered cymules occur in predominantly 1-flowered individuals. The indument of the stems, peduncles, pedicels, and sepals is usually composed of short appressed hairs. Some specimens both from Australia and New Zealand show longer, patent hairs. Two collections from New Zealand [*Travers s.n.* (G, L), *van Zanten 1602* (L)] and one from Australia [*Tate s.n.* (AD)] show patent glandular hairs on the stem and inflorescence. Leaf size varies widely in both Australia and New Zealand, but small-leaved plants are more frequent in New Zealand. Indeed, some authors (e.g., Allan 1961: 235) have recognized the New Zealand plants as a distinct species, *G. microphyllum*. However, as Carolin (1965: 338) pointed out, there is no correlation of leaf size with other features. Webb & al. (1988) accepted both *G. microphyllum* and *G. potentilloides* in their New Zealand flora. According to Webb & al. (1988), *G. potentilloides* is distinguished from *G. microphyllum* by the distinctly alveolate seeds, the pink petals, and the sepals with spreading hairs. I have found, however, that all these features vary in a continuum and independently, which makes difficult the recognition of discrete taxa. Dawson & Beuzenberg (2000: 5) counted the chromosomes of *G. microphyllum* (2*n* = 52-54) and de Lange & al. (2004: 880) those of *G. potentilloides* (2*n* = 112). These studies are based on two and one samples, respectively. It appears interesting to confirm these numbers with more samples and to explore their relation to the morphological variation. Nevertheless, elsewhere in *Geranium* there are species with two or more chromosome numbers. For instance, Van Loon (1984c: 289) found 2*n* = 28 and 42 for *G. macrostylum* and 2*n* = 20 and 40-44 for *G. lucidum*. Two counts of *G. potentilloides* from New Guinea by Borgmann (1964: 149) should be attributed to *G. niuginiense* (2*n* = 36) and *G. hyperacrion* (2*n* = 56). Mitchell & al. (2009) analyzed two samples of *G. microphyllum* and one of *G. potentilloides* using ETS and ITS sequences. They appear in an unresolved clade, with *G. sessiliflorum*-*G. traversii* as sister group, which suggests that they are closely related.

Carolin (1965: 336) recognized *G. potentilloides* as a broadly defined species that included three varieties. One of them, var. *ardjunense*, is here considered to be an independent species (for more details see the discussion under *G. ardjunense*). The second one, *G. potentilloides* var. *abditum*, was distinguished by Carolin (1965: 340) by its seeds, which are blackish with deep elongated alveolae somewhat larger than those of the other two varieties. However, a broad range of variation in the form of the cells of seed-coat has suggested that this feature has little taxonomic value.

De Candolle (1824: 639) stated in the protologue that the original material was collected "in Novâ-Hollandiâ", which appears to be a misprint, as Carolin (1965: 337) pointed out. On the lectotype in the Candolle herbarium "Nova Zelandia" is clearly indicated.

Geranium graniticola was described by Carolin (1965: 345) as showing affinities with var. *abditum* because of its similar seed coat. Carolin (1965: 345) emphasized that *G. graniticola* has pedicels and peduncles more or less equal in length, while *G. potentilloides* had short peduncles and relatively long pedicels. This feature is very variable, however, even within the same gathering, which suggests that it is not taxonomically useful.

Geranium potentilloides is similar to *G. niuginiense* from New Guinea and *G. frigidurbis* from Sulawesi. For more details see the discussion under those species.

74. Geranium ardjunense Zoll. & Moritzi, Natuur-Geneesk. Arch. Ned.-Indië 2: 585. 1845. *Geranium potentilloides* var. *ardjunense* (Zoll. & Moritzi) Carolin in Steenis, Fl. Malesiana 6: 447. 1964. Type locality: "Geranium Ardjunense Z. et M. Herb. N. 2246... In rupibus montis Ardjoeno 8-1000' IX. 1844; in summitatibus montium Tengger XI. 1844". Type: Indonesia. Java, montis Ardjuno, pr. Kamelamdingan, 7°45'S, 112°35'E, Sep. 1844, *H. Zollinger 2246* (lectotype, designated by Carolin 1965: 341, G-00302625!; isolectotypes, B destroyed, BO, FI!, P-00758030!, Z!).

Perennial herbs, (9)22-80 cm tall. *Rootstock* 2-4.2 mm in diameter, vertical, not tuberculate, not turnip-shaped, without thickened roots. *Stem* prostrate to ascending, leafy, sometimes rooting at nodes, stolons absent, without vegetative stems, with retrorse, appressed, eg-

landular hairs 0.2-0.5 mm long. *Basal leaves* in a ± persistent rosette, cauline leaves opposite; leaf laminas (0.9)1.6-2.7(3.4) cm long, 1.3-4.6 cm wide, not peltate, palmatifid [ratio main-sinus length/middle segment length = (0.82)0.84-0.88(0.93)], polygonal in outline, base cordate, not coriaceous, with nerves not projected, pilose, with appressed, eglandular hairs on both surfaces; segments 5, in 1 plane, middle segment obtriangular, 1-2.5(3.8) mm wide at the base [ratio segment width at the base/middle segment length = 0.08-0.19], 3-5(6)-lobed at the apex [ratio secondary sinus length/middle segment length = (0.19)0.24-0.31(0.37)]; petioles up to 30 cm long, without abscission zone, terete, not swollen, not deflexed in age, with retrorse, appressed, eglandular hairs 0.2-0.7 mm long; stipules (2.5)4.4-5.8(6.8) mm long, 0.7-2.6 mm wide, lanceolate, free, papery, brownish red, with eglandular hairs on both surfaces and on the margin. *Inflorescence* a monochasial cyme; cymules 1-flowered, solitary [ratio cymule length/leaf length = (0.6)0.9-1.4(1.7)]; peduncles (10.4)15.1-37.1(55.8) mm long, with retrorse, appressed, eglandular hairs 0.2-0.5 mm long; bracteoles (2.5)3.5-4.4(5.5) mm long, 0.9-1.9 mm wide, lanceolate, opposite; pedicels (8.4)14.5-28.9(43) mm long, with retrorse, appressed, eglandular hairs 0.2-0.6 mm long. Flowers actinomorphic. *Sepals* (5.4)6.6-7.4(7.9) mm long, 1.9-3.8 mm wide, lanceolate, smooth, accrescent, nerves 3, mucro (0.5)0.7-1(1.2) mm long [ratio mucro length/sepal length = 0.07-0.18], with antrorse, ± appressed, eglandular hairs 0.4-0.7 mm long on the abaxial surface, glabrous adaxially. *Petals* (2.6)4.3-6.3(7.9) mm long, 1.7-3.3 mm wide, erect-patent, rounded, without claw, pink, glabrous on both surfaces, ciliate on the basal margin, with hairs

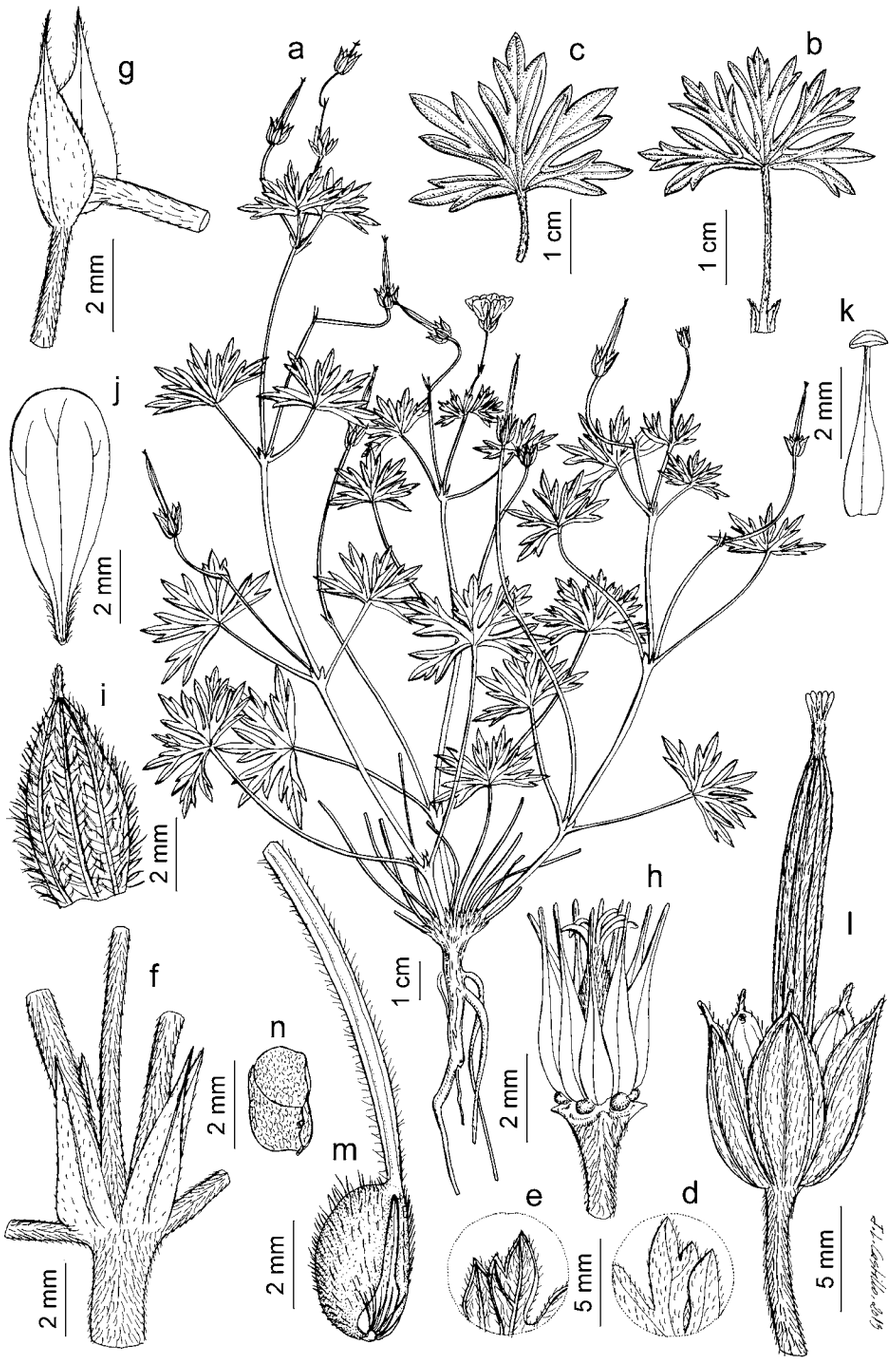


Fig. 211. *Geranium ardjunense*. a. Habit. b, c. Leaves, adaxial surface. d. Detail of indument on the adaxial leaf surface. e. Detail of indument on the abaxial leaf surface. f. Stipules. g. Bracteoles. h. Flower without petals and sepals. i. Sepal. j. Petal. k. Stamen. l. Fruit. m. Mericarp. n. Seed. (Based on: a-f, k-m, *Backer 37198*, L; g-j, *Neubauer s.n.*, *4 June 1956*, WU).

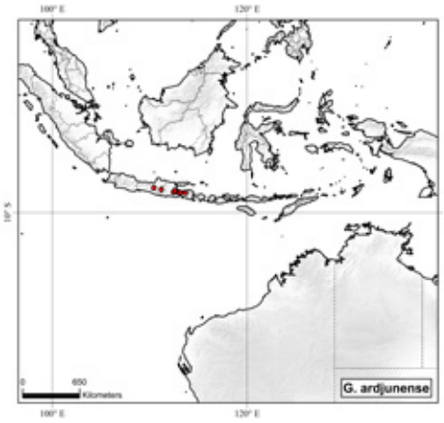


Fig. 212. Distribution of *Geranium ardjunense*.

0.1-0.4 mm long. *Stamens* 10, both whorls bearing anthers; filaments 2.6-4 mm long, lanceolate, unknown color, glabrous on the abaxial surface, ciliate on the proximal half, with hairs 0.1-0.3 mm long; anthers 0.5-0.8 mm long, unknown color. Nectaries 5, hemispheric, glabrous. *Gynoecium* 3.7-6.1 mm long, unknown color. *Fruit* 18-24.5 mm long, erect, discharge of seed-ejection type; mericarps 3.3-4 mm long, 1.5-2.1 mm wide, without a strand of fibers, not compressed at the apex, smooth, without basal beak, with a basal callus, without a basal prong, brown, with ± patent, eglandular hairs 0.2-0.9 mm long; rostrum 12.8-18.3 mm long, with a narrowed apex 0.5-1.4 mm long, not twisted, with antrorse, eglandular hairs 0.1-0.4 mm long; stigmatic remnants 0.9-1.5 mm long, with 5 hairy lobes. *Seeds* 2.4-2.8 mm long, 1.2-1.7 mm wide, finely reticulate, uniformly colored, brown, glabrous. Cotyledons with entire margin. Fig. 211.

Pollen. *Geranium*-type (Bortenschlager 1967: 431).

Chromosome number. Unknown.

Phenology. Collected in flower from January to December.

Distribution. This species ranges through central and eastern Java (Fig. 212).

Habitat. Grassy slopes, rocky areas, and *Casuarina* L. forests; 2000-3200 m.

Additional specimens examined. **Indonesia.** Java: Java, *Junghuhn s.n.* (L); Merbabu, 7°27'S, 110°26'E, 22 Apr. 1920, *Coert 119* (L); Merbabu, 7°27'S, 110°26'E, *Leeuwen 1167* (BO); Merbabu, 7°27'S, 110°26'E, 30 Dec. 1913, *Leeuwen s.n.* (BO); Merbabu, 7°27'S, 110°26'E, Sep. 1923, *Roorda van Eysinga s.n.* (MO); Mt. Lawu, 7°37'S, 111°11'E, 21 May 1981, *Afriastini 277* (L); Lawu, 7°37'S, 111°11'E, 6 Mar. 1925, *Coert 363* (L); Lawu, 7°37'S, 111°11'E, 5 Nov. 1932, *Coert 994* (L); Lawu, 7°37'S, 111°11'E, *Dorgelo 442* (L); Lawu, 7°37'S, 111°11'E, Nov. 1924, *Dorgelo 464* (L); Lawu, near the refuge house, below the summit, 7°37'S, 111°11'E, 4 June 1956, *Neubauer s.n.* (WU); Mt. Welirang (Ardjoeno), 7°43'S, 112°34'E, 4 June 1935, *Steenis 7055* (K, L); Ardjuno, bors Lalidjivo, 7°45'S, 112°35'E, 7 June 1929, *Backer 37198* (L); Lalidjiwo, 7°45'S, 112°35'E, 24 Aug. 1916, *Koorder 43861* (BO); Kenbac, Ardjuno complex, 7°45'S, 112°35'E, 9 June 1929, *Skottsberg & Baker 37199* (L); Kawi, 7°55'S, 112°27'E, 17 Apr. 1929, *Leeuwen 12330* (L); Mungil Pass, 7°56'S, 112°57'E, 20 Jan. 1915, *Ridley s.n.* (K); Tengger, Tosari, 7°57'S, 113°8'E, 31 July 1932, *Kleinhoonte 383* (L); Besceki, Jang Plateau, Djentor naar Selonjeng, 7°59'S, 113°40'E, 15 July 1932, *Steenis 10921* (GH, L).

Discussion. Geranium ardjunense is a prostrate to ascending perennial herb, sometimes rooting at the nodes. The rootstock is vertical, slim, and with thin roots. The indument of *G. ardjunense* consists of short, appressed eglandular hairs. The leaves are deeply divided, have five segments, and the lobes are usually 3- or 5-lobed at the apex. *Geranium ardjunense* has 1-flowered cymules, relatively wide bracteoles, and long sepals. The sepals are ca. 5.4-6.5 mm long in flower and enlarge considerably in fruit, reaching 7.9 mm in length. *Geranium ardjunense* is probably the most distinct among the group of species close to *G. potentilloides* (which includes also *G. frigidurbis* and *G. niuginiense*). *Geranium ardjunense* is easily recognized at first sight by its long sepals. Its deeply divided leaves and its wide bracteoles also unequivocally characterize it. Geographically, the nearest species of this group is *G. frigidurbis*, endemic to Sulawesi (around 800 km to the northeast). The latter has less divided leaves, usually with the segments 3-lobed at the apex, shorter stipules, peduncles, pedicels and fruits, narrower bracteoles, and sepals (3.8)4.1-4.5(4.8) mm long. *Geranium homeanum* is more or less sympatric with *G. ardjunense* in central Java. The former, however, is restricted to lower altitudes and is probably adventive. *Geranium homeanum* is easily distinguished by its longer leaves with more lobed segments, its cymules usually 2-flowered, its narrow bracteoles, its shorter sepals and its fruit without a narrowed apex. Reports of *Geranium ardjunense* outside Java refer to other species. Lam (1945: 579) recorded *G. ardjunense* in Sulawesi on the base of two collections: *Froideville 229* and *Bünnemeyer 11906*. Carolin (1965: 341) treated *G. ardjunense* as a variety of *G. potentilloides* and included there both collections. Finally, Veldkamp & Moerman (1978: 469) considered those plants to be a distinct species endemic to Sulawesi, which they named *G. frigidurbis*. Carolin (1965: 336) also recorded var. *ardjunense* from Sumatra and Timor. Veldkamp & Moerman (1978: 466-469), however, re-identified the plants from Sumatra and Timor as *G. nepalense* and *G. homeanum*, respectively.

75. Geranium homeanum Turcz., Bull. Soc. Imp. Naturalistes Moscou 36(1): 591. 1863. Type locality: "Nova Zeelandia, loco dicto Perakiteri, Everard Home N° 86". Type: New Zealand. North Island, 1845, *E. Home 86* (lectotype, designated by Carolin 1965: 346 and Mosyakin & de Lange 2019: 173 in second step, KW-001001016 image!) [see Gardner 1999: 16 and Mosyakin & de Lange 2019: 170-173 for the locality of this collection].

Geranium parviflorum Willd., Enum. Pl.: 716. 1809, nom. illeg., non Curtis, 1782. *Geranium potentilloides* var. *parviflorum* Hook. f., Fl. Tasman. 1: 57. 1855. Type locality: "Habitat... ". Type: Unknown locality and collector (lectotype, designated by Aedo 2017a: 128, B-W-12572-01-0 image!).

Geranium dissectum var. *glabratum* Hook. f., Fl. Nov.-Zel. 1: 39. 1852. *Geranium glabratum* (Hook. f.) Small in Underw. & Britton (eds.), N. Amer. Fl. 25(1): 10. 1907. Type locality: [not indicated, N. Zealand?]. Type: New Zealand. *J. Edgerley s.n.* (lectotype, designated by Carolin 1965, 346: K-000729525!).

Geranium nepalense f. *javanicum* Backer, Schoolfl. Java: 168. 1911. Type locality: "Alleen bij Ngadiwono (Tengger) gevonden". Type: Indonesia. Java. Ngadiwono (Tengger), 7°53'S, 112°53'E, 1913, *C.A. Backer 8403* (lectotype, designated by Veldkamp & Moerman 1978: 467, BO; isolectotypes, L-0018344!, U-0002237!).

Perennial herbs, 20-90 cm tall. *Rootstock* 3-7.4 mm in diameter, ± vertical, not tuberculate, not turnip-shaped, with ± thickened roots.

Stem prostrate to ascending, leafy, not rooting at nodes, stolons absent, without vegetative stems, with ± retrorse, usually appressed, eglandular hairs 0.3-0.9 mm long. *Basal leaves* in a ± persistent rosette, cauline leaves opposite; leaf laminas (1.5)2.6-4.1(6.1) cm long, 2.2-8.2 cm wide, not peltate, palmatifid [ratio main-sinus length/middle segment length = (0.74)0.77-0.82(0.87)], polygonal in outline, base cordate, not coriaceous, with nerves not projected, pilose, with appressed, eglandular hairs on both surfaces; segments 5, in 1 plane, middle segment rhombic, (1.6)3.7-6.9(8.3) mm wide at the base [ratio segment width at the base/middle segment length = 0.11-0.29], (3)5-7(9)-lobed in distal half [ratio secondary sinus length/middle segment length = (0.13)0.20-0.28(0.35)]; petioles up to 18 cm long, without abscission zone, terete, not swollen, not deflexed in age, with ± retrorse, usually appressed, eglandular hairs 0.1-0.8 mm long; stipules 3.2-7.3 mm long, 0.6-1.8 mm wide, lanceolate, free, papery, brownish red, with eglandular hairs on abaxial surface and on the margin, glabrous adaxially. *Inflorescence* a monochasial cyme; cymules (1)2-flowered, solitary [ratio cymule length/leaf length = (0.5)0.6-1.5(1.9)]; peduncles (8)21.3-47.3(105) mm long, with ± retrorse, usually appressed, eglandular hairs 0.2-0.8 mm long; bracteoles 2.6-4.2 mm long, 0.3-0.8 mm wide, lanceolate, whorled; pedicels (8.3)10-19(22.4) mm long, with ± retrorse, usually appressed, eglandular hairs 0.2-0.6 mm long. Flowers actinomorphic. *Sepals* (2.8)3.5-4.2(5.7) mm long, 1.5-2.6 mm wide, lanceolate, smooth, not accrescent, nerves 3, mucro (0.7)0.8-1(1.4) mm long [ratio mucro length/sepal length = 0.17-0.37], with ± patent, scattered, appressed, eglandular hairs 0.3-0.6 mm long on the abaxial surface, glabrous adaxially. *Petals* (2.8)3.3-4.7(7.8) mm long, 1.1-3.9 mm wide, erect-patent, rounded, without claw, white or pale pink, glabrous on both surfaces, with scattered hairs on the basal margin, with hairs 0.1-0.3 mm long. *Stamens* 10, both whorls bearing anthers; filaments 1.7-3.6 mm long, lanceolate, yellow, glabrous or with scattered hairs 0.1-0.3 mm long on the abaxial surface and margin; anthers 0.3-0.7 mm long, yellow. Nectaries 5, hemispheric, glabrous. *Gynoecium* 2.3-4.7 mm long, yellow. *Fruit* 12.4-18.4 mm long, erect, discharge of seed-ejection type; mericarps 1.8-3.1 mm long, 1.1-1.7 mm wide, without a strand of fibers, not compressed at the apex, smooth, without basal beak, with a basal callus, without a basal prong, brown, with erect-patent, eglandular hairs 0.3-0.9 mm long; rostrum 7.5-13 mm long, without a narrowed apex, not twisted, with erect-patent, eglandular hairs 0.1-0.5 mm long; stigmatic remnants 0.7-1.3 mm long, with 5 hairy lobes. *Seeds* 1.6-2.3 mm long, 0.9-1.3 mm wide, finely reticulate, uniformly colored, brown, glabrous. Cotyledons with entire margin. Fig. 213.

Pollen. Ornamentation not studied.

Chromosome number. 2*n* = 52.

Phenology. Collected in flower from January to December.

Distribution. This species ranges through southeastern Australia (Queensland, New South Wales, South Australia and Victoria) and Tasmania and it is probably introduced in New Zealand, Timor, Java and Hawaii (Fig. 214).

Habitat. Disturbed open areas, dunes, grassy slopes, base of cliffs, rock outcrops, temperate rain forests, and *Eucalyptus* L'Hér., *Casuarina* L., and *Acacia* Mill. forests; 0-2700 m.

Representative specimens examined. **Australia.** New South Wales: Mt. Lindsay, 28°23'S, 152°52'E, 31 May 1959, *Carolin 944* (B); North Coast, the Summit, Gibraltar Range, 87 km W of Grafton on Gwydir highway, 29°32'S, 152°18'E, 28 Dec. 1989, *Jobson 1053* (MEL); Deep Creek, Pokolbin State Forest, NW of Cessnock, 32°54'S, 151°25'E, 17 Sep. 1954, *Constable 30960* (K); Hurstville, 33°57'S, 151°6'E, May 1901, *Ganfield s.n.* (US); S Coast Nadgee Nature Reserve, Newtons Beach Camping Area, 37°21'S, 149°57'E, 22 Jan. 1985, *Albrecht 1513* (MEL). Queensland: Condamine, 26°54'S, 150°6'E, *Hartmann 410* (MEL); Nineteen Loggin Area, Timber Reserve 209, Mt. Brisbane, 27°6'S, 152°32'E, 21 June 1990, *Forster 6879* (MEL); Moreton district, Mt. Glorious, 27°20'S, 152°46'E, Jan. 1945, *Clemens s.n.* (G); Mt. Mitchell, Cunninghams Gap, 28°3'S, 152°23'E, 18 Aug. 1992, *Forster 11104* (MEL); Lamington National Park, 28°15'S, 153°8'E, 6 Feb. 1959, *Carolin 1046* (G). South Australia: Southern Flinders Range, Mt. Remarkable National Park, Melrose, 32°48'S, 138°10'E, 10 Oct. 1973, *Czornij 622* (AD, MA); Northern Lofty, 0.2 km due S of Mt. Bryan summit, 33°25'S, 138°58'E, 29 Oct. 1993, *Lang 2285* (AD); Southern Lofty, Creek near Mt. Pleasant, 34°45'S, 139°1'E, 14 Jan. 2000, *Bates 55698* (AD, MA); Southern Lofty, along Hindmarsh Creek, 35°23'S, 139°3'E, 3 Apr. 1994, *Bates 36872* (AD); Southern Lofty, Hindmarsh River at Top Falls, 35°30'S, 138°40'E, 20 May 2005, *Bates s.n.* (AD). Tasmania: Maydena, 42°42'S, 146°36'E, 17 Apr. 2000, *de Lange 114* (MEL). Victoria: Mt. Buffalo National Park, 36°42'S, 146°47'E, 6 Dec. 1971, *Carrick 3015* (AD); East Gippsland, 4.5 km NE of Buldah Trail, 37°16'S, 149°7'E, 9 Jan. 1986, *Yugovic 298* (MEL); Catchment of New Guinea Bend, Snowy River gorge, 20.5 km NE Buchan, 37°22'S, 148°18'E, 18 Dec. 1976, *Cameron 7767B* (MEL); Murrindal River Natural Feature Reserve, 37°24'S, 148°12'E, 28 Oct. 1984, *Beauglehole & al. 78991* (MEL); Wilsons Promontory National Park, 38°58'S, 146°18'E, 13 Dec. 1983, *Beauglehole 75922* (MEL). **Indonesia.** Java: Nongkodjajar, 7°53'S, 112°49'E, 1928, *[illegible] s.n.* (BO); Ngadiwono, 7°54'S, 112°53'E, 4 July 1919, *Arens 84* (L); Tengger, 7°54'S, 112°53'E, 8 Nov. 1908, *Buijsman s.n.* (L); Tosari, 7°57'S, 113°8'E, 14 June 1976, *Everaants 239* (L); Gegend von Malang, Pigen und Lilidjiwo, 7°58'S, 112°37'E, *Schroter s.n.* (Z). Nusa Tenggara Timur: Timor, Noepesu-Mutis, 9°32'S, 124°16'E, 4 July 1968, *Schmutz 2338a* (L); Timor, Mt. Moetis, 9°37'S, 124°13'E, 14 Nov. 1935, *Voogd 2272* (NY, BO, L). **New Zealand.** New Zealand North Is.: Mangonui Co., Te Huka Bay, 34°25'S, 172°55'E, 30 Dec. 1979, *Gardner 2634* (AK); Cavalli Is., Motukawanui Is., Papatara Bay, 35°0'S, 173°57'E, 2 Jan. 1979, *Court s.n.* (AK); Whangarei Falls, 35°43'S, 174°19'E, 5 Feb. 1978, *Gardner 2087* (G); Coromandel, 8.1 km N of Whitianga, 36°45'S, 174°44'E, 10 Mar. 1973, *Orchard 3956* (AD, MEL); Otorohanga Co., Upper Awaroa Valley above Te Koraha, 38°13'S, 174°56'E, 19 Jan. 1986, *de Lange s.n.* (AK). New Zealand South Is.: Onehunga, 41°8'S, 174°20'E, *Kirk s.n.* (AK, F); Awarua Bay, 44°19'S, 168°6'E, Dec. 1974, *Powell s.n.* (AD). **Timor.** Ainaro: Port, 8°50'S, 125°35'E, 1962, *Cinatti 275* (L); Port, above Maubisse,

near Flecha Pass, 8º50'S, 125º35'E, 3 Jan. 1954, *Steenis 18362* (L); Port, Huato-Builico, NW of Mt. Tatamailau, 8º59'S, 125º30'E, 4 Jan. 1954, *Steenis 18378* (L). Ermera: Port, Mt. Tatamailau, 8º54'S, 125º29'E, 5 Jan. 1954, *Steenis 18444* (L). Manufahi: Samoro, Mt. Sobale, 8º57'S, 125º40'E, 1883, *Forbes 3818* (GH, L, WU). **USA.** Hawaii: Hawaii Is., Volcanoes National Park, Kipuka Nene, 19º15'N, 155º39'W, 9 Aug. 1975, *Darwin s.n.* (GH); near Kau Desert about 8 mi W Volcano House, 19º25'N, 155º15'W, 26 June 1926, *Degener 18416* (B, CAS, F, GH, MO, NY); Kealakekua, 19º31'N, 155º55'W, 10 Feb. 1948, *Greenwell 19202* (B); 17 mi along main road from Kohala toward Waimea, 19º59'N, 155º40'W, 14 Aug. 1936, *Degener 18415* (CAS, F, GH, MO, NY); Maui Is., Upper East end of Auwahi, 20º38'N, 156º19'W, 7 Oct. 1984, *Wagner & al. 1984.450* (GH).

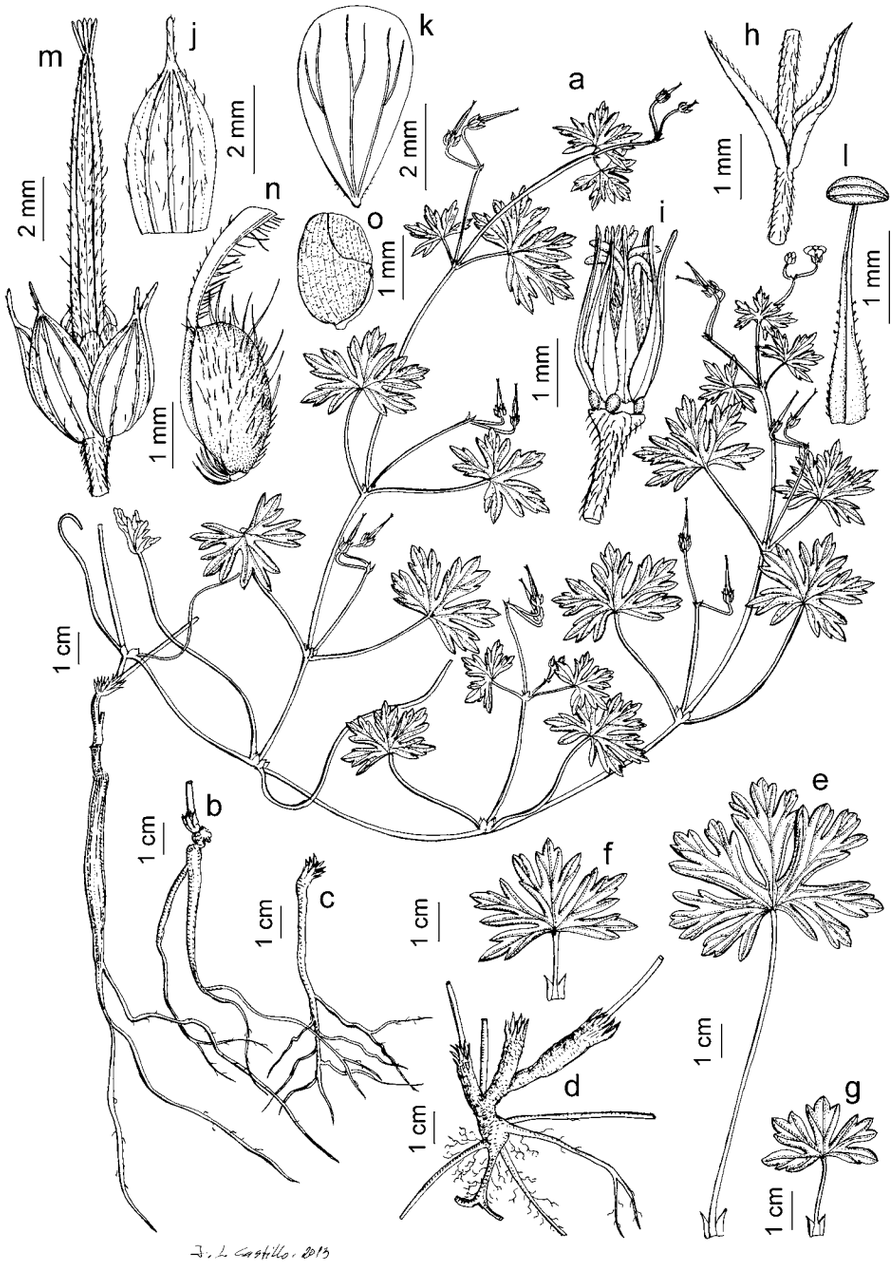


Fig. 213. *Geranium homeanum*. a. Habit. b-d. Rootstock details. e-g. Leaves, adaxial surface. h. Bracteoles. i. Flower without petals and sepals. j. Sepal. k. Petal. l. Stamen. m. Fruit. n. Mericarp. o. Seed. (Based on: a, g, m-o, *Cameron 7767B*, MEL; b, *Cameron 4331*, MEL; c, *Cameron 3054*, MEL; d: *Chesterfield & Bush 2325*, MEL; e, *Cameron 4730*, MEL; f, *Hosking 2152*, MEL; h-l, *Jobson & Heron 179*, MEL).

Discussion. Geranium homeanum is a prostrate to ascending perennial herb. The stem is usually branched from the base, and there is no evidence that it roots at the nodes. In well-developed plants the rootstock is short, usually vertical, ± branched, not turnip-shaped, and has ± fusiform roots. However, young plants sometimes have a single, ± thickened, tapering rootstock or taproot which is never napiform as in *G. solanderi* or *G. retrorsum*. Carolin (1965: 346) suggested that *G. homeanum* can be annual, probably on the basis of very young plants with a tapering rootstock not yet thickened. *Geranium homeanum* has scattered, short, usually retrorse, ± appressed eglandular hairs. The leaves have five segments, which are usually 5- or 7-lobed at the apex. Leaves with a 3-lobed or 9-lobed middle segment are occasional on sheets in which most leaves on the plants have 5- or 7-lobed middle segments. The cymules are usually 2-flowered, although exceptionally some individuals may have a few 1-flowered cymules mixed with the 2-flowered cymules. The sepals are useful for distinguishing *G. homeanum* from other species because they are short, with a proportionally long mucro and with scattered hairs.

A collection from Awarua Bay [*Powell s.n.* (AD)], New Zealand, has sepals like those of *G. homeanum* (short and with long mucro), but no rootstock. More collections should be made in this area to confirm the

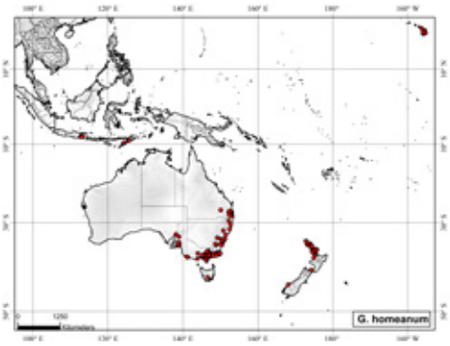


Fig. 214. Distribution of *Geranium homeanum*.

presence of *G. homeanum* on New Zealand's South Island. Specimens from Timor have slightly longer sepals, and are more densely hairy. The specimen *De Voogd 2272* (L) has some glandular hairs on the petioles and pedicels, but duplicates of this collection at BO and NY lack this feature. Otherwise, the plants of this collection fall well within the range of variability of *G. homeanum*. Timor plants were recorded as *Geranium affine* (a synonym for *G. arnottianum*) by J. Britten (Forbes 1885: 501) and as *G. potentilloides* var. *ardjunense* by Carolin (1965: 336). Veldkamp & Moerman (1978: 466-469) rightly re-identified these specimens as *G. homeanum*. Some specimens of *G. nepalense* with predominantly 2-flowered cymules may be difficult to separate from *G. homeanum*. The latter has shorter sepals with a relatively longer sepal mucro, shorter petals, shorter staminal filaments, and a fruit without the rostrum narrowed at the apex. Similarly, in some cases *G. homeanum* can be difficult to distinguish from *G. potentilloides*. Normally, the first species has 2-flowered cymules while the second has predominantly 1-flowered cymules. Exceptions can been found, however. Thus, on some fragmentary herbarium specimens this feature alone may not be sufficient for reliable identification. These cases may be resolved because *G. homeanum* has a longer sepal mucro than *G. potentilloides*. *Geranium retrorsum* and *G. solanderi* are easily distinguished from *G. homeanum* by their turnip-shaped rootstocks. Both *G. retrorsum* and *G. solanderi* have a shorter sepal mucro and more deeply divided leaves than does *G. homeanum* (and *G. solanderi* differs further in having patent hairs on the peduncles and pedicels).

Hanks & Small (1907: 10) reported *G. glabratum* (a synonym for *G. homeanum*) from California (U.S.A.). According to Aedo (2001b: 32) it was considered to be based on confusion with *G. retrorsum*. Later, Aedo (2012: 391) corrected the identification of the Californian plants to *G. core-core*. The status of *G. homeanum* in New Zealand is controversial. According to Gardner (1984: 127) *G. homeanum* is adventive in New Zealand, as evidenced by its preference for modified habitats and the absence of old collections from the North Island. In contrast, Webb & al. (1988: 732) considered this species to be native to New Zealand. Wagner & al. (1990: 732) considered *G. homeanum* not to be native in Hawaii, probably for similar reasons. Carolin (1965: 347) indicated that *G. homeanum* is not native in Java. On the contrary, in southeastern Australia *G. homeanum* occurs in more natural habitats, suggesting that this is the only area to which it is native. Such a hypothesis appears to be more reasonable than the supposition that the species is scattered throughout all the islands and is native to them all. According to de Lange (*in litt.*) *G. homeanum* was introduced by tourists in the Cook Islands, New Zealand. Unfortunately, I was unable to examine a voucher for this report.

---

76. Geranium traversii Hook. f., Handb. N. Zeal. Fl. 726. 1867. Type locality: "Chatham Island: waste ground, W. Travers". Type: Nez Zealand. Chatham Island, 44º00'S, 176º30'E, *W. Travers 25* (lectotype, designated by Carolin 1965: 343, K-000729530!; isolectotypes, MO!, W!).

Geranium traversii var. *elegans* Cockayne, Trans. & Proc. New Zealand Inst. 34: 320. 1902. Type locality: "[Chatham Is]". Type: New Zealand. Chatham Island, near summit of Maunganui hill, 43º45'S, 176º35' E, 19 Jan. 1901, *L. Cockayne 4342* (lectotype, designated by Aedo 2017a: 135, WELT-30964 image!; isolectotype, NY-02317715!).

Perennial herbs, 20-38 cm tall. *Rootstock* 9-10 mm in diameter, vertical, not tuberculate, not turnip-shaped, without thickened roots. *Stem* erect, leafy, not rooting at nodes, stolons absent, without vegetative stems, sericeous, with usually retrorse, ± appressed, eglandular hairs 0.3-0.8 mm long. *Basal leaves* in a ± persistent rosette, cauline leaves opposite; leaf laminas (1.6)2-6.1(6.7) cm long, 2.1-7.6 cm wide, not peltate, palmatifid [ratio main-sinus length/middle segment length = 0.56-0.68], polygonal in outline, base cordate, not coriaceous, with nerves not projected, silky-hairy on both surfaces; segments 5-7, in 1 plane, middle segment obtriangular, 4.2-20.9 mm wide at the base [ratio segment width at the base/middle segment length = 0.27-0.53], 3-5(6)-lobed in distal half [ratio secondary sinus length/middle segment length = 0.56-0.68]; petioles up to 15 cm long, without abscission zone, terete, not swollen, not deflexed in age, with retrorse, ± appressed, eglandular hairs 0.2-0.6 mm long; stipules 3.9-11.4 mm long, 1.4-3.1(4.3) mm wide, lanceolate, free, papery, brownish red, sericeous on abaxial surface, glabrous adaxially. *Inflorescence* a monochasial cyme; cymules 1-flowered, solitary [ratio cymule length/leaf length = (0.5)1-3.2]; peduncles (5)9-21(33) mm long, with retrorse, ± appressed, eglandular hairs 0.2-0.6 mm long; bracteoles 2.3-6.8 mm long, 0.4-1.2 mm wide, linear-lanceolate, opposite; pedicels 7-39.5 mm long, with retrorse, ± appressed, eglandular hairs 0.3-0.6 mm long. Flowers actinomorphic. *Sepals* (5)5.7-7.8(8.4) mm long, 2.3-3.9 mm wide, lanceolate, smooth, not accrescent, nerves 3, mucro (0.6)0.7-1.1(1.3) mm long [ratio mucro length/sepal length = 0.10-0.22], sericeous, with antrorse, appressed, eglandular hairs 0.3-0.6 mm long on the abaxial surface, glabrous adaxially. *Petals* (6.4)9.4-12.7(15.9) mm long, 4.3-12 mm wide, erect-patent, rounded, with claw 1-2.6 mm long, white or pale pink, with scattered hairs on the base of the adaxial surface, glabrous abaxially surface, ciliate on the basal margin, with hairs 0.1-0.3 mm long. *Stamens* 10, both whorls bearing anthers; filaments 3-4.9 mm long, lanceolate, white, pilose on the abaxial surface, ciliate on the proximal half,

with hairs 0.1-0.4 mm long; anthers 0.9-1.4 mm long, yellow. Nectaries 5, hemispheric, glabrous. *Gynoecium* 4.1-5.6 mm long, yellow. *Fruit* 16.1-19.8 mm long, erect, discharge of seed-ejection type; mericarps 3-3.6 mm long, 1.5-1.9 mm wide, without a strand of fibers, not compressed at the apex, smooth, without basal beak, with a basal callus, without a basal prong, brown, with ± patent, eglandular hairs 0.4-0.7 mm long; rostrum 10.2-13.3 mm long, without a narrowed apex, not twisted, with erect-patent, eglandular hairs 0.1-0.4 mm long; stigmatic remnants 1.9-2.6 mm long, with 5 usually hairy lobes. *Seeds* 2.2-2.7 mm long, 1.3-1.6 mm wide, finely reticulate, uniformly colored, brown, glabrous. Cotyledons with entire margin. Fig. 215.

Pollen. Ornamentation not studied.

Chromosome number. 2*n* = 28, 52, 54.

Phenology. Collected in flower from November to February.

Distribution. This species is endemic to Chatham Is., in New Zealand (Fig. 216).

Habitat. Steep, north-facing slopes of soil and clay overlying lava and tuff on rocks near the sea; 0-100 m.

Additional specimens examined. **New Zealand.** Chatham Is.: Chatham Is., cultivated at Dunedin, *Matthews s.n.* (K); cultivated plant from Christchurch, originally from Chatham Is., Nov. 1920, *Petrie s.n.* (MO, NY); N coast of Chatham Is., 43º45'S, 176º37'W, Jan. 1901, *Cockayne 4343* (NY); Chatham Is., bay E of blowhole, S of Cape Young, 43º45'S, 176º30'W, 7 Feb. 1982, *Given & Williams 12799* (AD, MO, MEL, NSW); Chatham Is., 43º45'S, 176º35'W, *Haorbiy s.n.* (W); Chatham Is., 43º45'S, 176º30'W, *Kirk s.n.* (F, GH, MO); Chatham Is., 43º45'S, 176º35'W, 1952, *Lothian s.n.* (AD); Chatham Is., 43º45'S, 176º30'W, 1850, *Sinclair s.n.* (NSW); Chatham Is., 43º56'S, 176º31'W, 1903, *Cox 1694* (K).

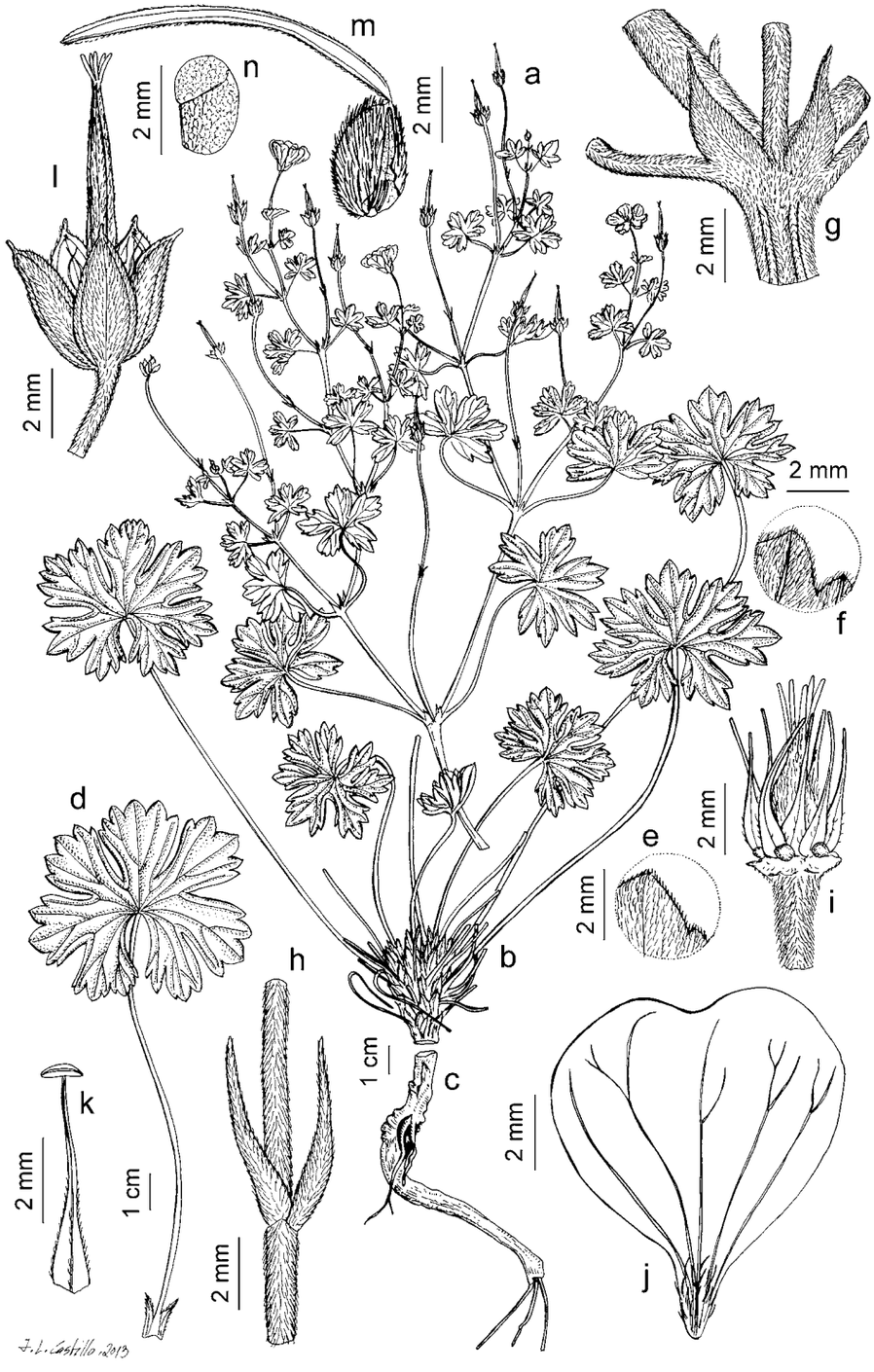


Fig. 215. *Geranium traversii*. a-c. Habit. d. Leaf, adaxial surface. e. Detail of indument, adaxial leaf surface. f. Detail of indument, abaxial leaf surface. g. Stipules. h. Bracteoles. i. Flower without petals and sepals. j. Petal, abaxial surface. k. Stamen. l. Fruit. m. Mericarp. n. Seed. (Based on: a, b, h-n, *Matthews s.n.*, s.d., K; c, *Lothian s.n.*, *1952*, AD; d-g, *Kirk s.n.*, *s.d.*, GH).

Fig. 216. Distribution of *Geranium traversii*.

Discussion. Geranium traversii is an erect, robust herb well characterized by its shallowly divided leaves with a dense silky indument. The very wide (in some cases almost as wide as long) petals with an evident claw are also distinctive. The petals are usually longer than 9 mm, but shorter petals occur in some, probably re-flowering, individuals. The habit and underground parts of *G. traversii* are not well known because most available sheets have only fragments. The rootstock is ± thickened and tapering. Allan (1961: 236) indicated that the stems are ". . . branching, often producing arched runners that root and produce off-set plants." However, I have not observed this feature among the specimens I have seen. Mitchell & al. (2009) and Heenan & al. (2010) suggested that *G. traversii* is related to *G. brevicaule* on the basis of ETS and ITS sequence data of the native species from New Zealand.

77. Geranium neglectum Carolin, Proc. Linn. Soc. New South Wales ser. 2, 89: 343, pl. 6 fig. 12, pl. 7 fig. 8. 1965. Type locality: "Banks of the Boyd River, jenolan-Kanangra. R. C. Carolin No. 916, 23.3.1959 (NSW 66124)". Type: Australia. New South Wales, Boyd River, Jenolan-Kanangra, 33º49'S, 150º 02'E, 23 Mar. 1959, *R.C. Carolin 916* (holotype, NSW-66124).

Perennial herbs, 34-102(120) cm tall. *Rootstock* 1.5-5.8 mm in diameter, ± vertical, not tuberculate, not turnip-shaped, with ± thickened roots. *Stem* prostrate to ascending, leafy, usually rooting at nodes, stolons absent, without vegetative stems, with retrorse, appressed, eglandular hairs 0.2-0.4 mm long. *Basal leaves* in a ± persistent rosette, cauline leaves opposite; leaf laminas (1.5)2.2-3.7(5.2) cm long, 2.2-5.8 cm wide, not peltate, palmatifid [ratio main-sinus length/middle segment length = (0.71)0.78-0.85(0.90)], polygonal in outline, base cordate, not coriaceous, with nerves not projected, ± strigose on adaxial surface and with appressed, eglandular hairs restricted to the nerves abaxially; segments 5, in 1 plane, middle segment obtriangular, 2.4-4.4(5.4) mm wide at the base [ratio segment width at the base/middle segment length = 0.14-0.24], (1)3(5)-lobed in distal half [ratio secondary sinus length/middle segment length = (0.06)0.08-0.29(0.33)]; petioles up to 44 cm long, without abscission zone, terete, not swollen, not deflexed in age, with retrorse, appressed, eglandular hairs 0.2-0.4 mm long; stipules 2-4.8 mm long, 0.3-0.9 mm wide, lanceolate to subulate, free, papery, brownish red, with eglandular hairs on abaxial surface and on the margin, ± glabrous adaxially. *Inflorescence* a monochasial cyme; cymules 1(2)-flowered, solitary [ratio cymule length/leaf length = (1.8)2.3-4.5(6.1)]; peduncles (27)57-93(205) mm long, with retrorse, appressed, eglandular hairs 0.1-0.4 mm long; bracteoles 2.3-3.8 mm long, 0.4-0.7 mm wide, linear-lanceolate, opposite; pedicels (20)34-49(57) mm long, with retrorse, appressed, eglandular hairs 0.1-0.4 mm long. Flowers actinomorphic. *Sepals* (5.7)6.2-7.8(8.3) mm long, 2.1-2.9 mm wide, lanceolate, smooth, not accrescent, nerves 3, mucro (0.5)0.6-0.9(1) mm long [ratio mucro length/sepal length = 0.08-0.15], with antrorse, appressed, eglandular hairs 0.1-0.3 mm long on the abaxial surface, glabrous adaxially. *Petals* (9)10.8-13.6(15.6) mm long, 4.8-9.1 mm wide, erect-patent, rounded, without claw, pink with white base, glabrous on both surfaces, ciliate on the basal margin, with hairs 0.2-0.4 mm long. *Stamens* 10, both whorls bearing anthers; filaments 4.4-7.9 mm long, lanceolate, yellow, pilose on the abaxial surface, ciliate on the proximal half, with hairs 0.1-0.2 mm long; anthers (1.3)1.4-1.6 mm long, yellow. Nectaries 5, hemispheric, glabrous. *Gynoecium* 4.9-9.8 mm long, yellow. *Fruit* 21.2-26.5 mm long, erect, discharge of seed-ejection type; mericarps 2.7-3.6 mm long, 1.4-1.8 mm wide, without a strand of fibers, not compressed at the apex, smooth, without basal beak, with a basal callus, without a basal prong, black, with ± patent, eglandular hairs 0.3-0.7 mm long; rostrum 14-18.5 mm long, with a narrowed apex 2-3.8 mm long, not twisted, with erect-patent, eglandular hairs 0.1-0.3 mm long; stigmatic remnants (1.9)2.4-2.7(3.6) mm long, with 5 glabrous lobes. *Seeds* 1.9-2.4 mm long, 1.1-1.4 mm wide, finely reticulate, uniformly colored, dark brown, glabrous. Cotyledons with entire margin. Fig. 217.

Pollen. Ornamentation not studied.

Chromosome number. Unknown.

Phenology. Collected in flower from November to May.

Distribution. This species ranges from Queensland to Victoria, in southeastern Australia (Fig. 218).

Habitat. Bogs, swampy grounds, creeks, stream banks, and open forests of *Eucalyptus* L'Hér.; 550-1500 m.

Additional specimens examined. **Australia.** Australian Capital Territory: Paddy's River district, Tidbinbilla Valley, 0.25 mi NE of Mountdomain Homestead, 35º24'S, 148º57'E, 17 Mar. 1963, *Adams 576* (K, L, MEL, NSW); Billy Billy Creek above Gibraltar Falls, 35º30'S, 148º54'E, 19 Jan. 1966, *Burbidge 7539A* (AD, MEL, NSW). New South Wales: Thunderbolts Hiding Place on Mt. Lindesay Highway, 11.1 km SSW of the Boono Boono Falls towards Tenterfield, 28º52'S, 152º8'E, 14 Dec. 1986, *Coveny & al. 12398* (L, MEL, MO); Timbarra road 24 mi E field, 29º0'S, 152º10'E, 14 Apr. 1963, *Macdonald 281* (K); Timbarra, 29º1'S, 152º10'E, *Stuart 162* (MEL); Torrington, near Deepwater, 29º19'S, 151º42'E, Mar. 1907, *Deane s.n.* (NSW); Gibraltar Range National Park, 3 km from Gwydir Hway along Mulligans Hot Road, 29º31'S, 152º19'E, 23 Nov. 1973, *Rodd 2483* (NSW); Clarence River, River Anne [=Oban River], 30º1'S, 152º0'E, *Beckler s.n.* (MEL); N Tablelands, down track to Rileys caves, 30º1'S, 151º53'E, 22 Jan. 1998, *McColl & Plaza 21/98* (NSW); Guyra, 30º15'S, 151º45'E, Nov. 1987, *Bates 12363* (AD); Northern Tablelands, New England Tableland, Ebor Falls, E of Armdale, 30º24'S, 152º21'E, 27 Nov. 1970, *Telford 2391* (CANB); 1 km E of Serpentine River, 65 km E of Armidale, 30º30'S, 152º25'E, 12 Mar. 1970, *Briggs 3443* (K, NSW); creek at closure gate for track leading to Little Murray Works De-

pot, Barrington Tops National Park, 31°58'S, 151°27'E, 19 Feb. 2007, *Hosking 2899* (MEL); Cudgegong River, ca. 32 km ESE of Rylstone, 32°52'S, 150°17'E, 11 Mar. 1969, *Pickard & Coveny 964* (NSW); 3 km from Newnes road N along Long Swamp road, 33°18'S, 150°5'E, 1 Feb. 1988, *Hind & D'Aubert 5502* (MEL); Long Swamp Coxs River Lidsale, 33°20'S, 150°6'E, 14 Nov. 1987, *Bishop & al. 769* (NSW); Sylvandale, Wills Lane 0.5 mi E of Blackheath, Blue Mts., 33°37'S, 150°16'E, 13 Mar. 1967, *Constable 7341* (G, K, L, NSW); Edith, Oberon - Jenolan road, 33°46'S, 149°55'E, 9 Mar. 1950, *Constable s.n.* (NSW); head of Little River, Jenolan, 33°46'S, 150°7'E, 28 Jan. 1968, *Rodd 584* (NSW); S Tablelands region, near Oallen Crossing, 12 km SSW of Nerriga, 35°9'S, 149°57'E, 3 Jan. 1972, *Adams 2628* (NSW); ca. 5 km SE of Captain's Flat on road to Braidwood, 35°34'S, 149°28'E, 25 Dec. 1969, *Briggs 3201* (K, MEL, NSW); Southern Tablelands, Tinderry Mts., ca. 2.5 km SE of Tinderry Peak, 35°43'S, 149°17'E, 7 May 1992, *Lyne & Donaldson 756* (MEL); 0.5 mi NW of Big Badja Mill, 36°8'S, 149°29'E, 27 Apr. 1968, *Rodd 659* (NSW); Badja State Forest, Tuross road, ca. 50 m N of Wadbilliga National Park sign, 36°11'S, 149°30'E, 12 Feb. 2004, *Walsh 6007* (MEL); Mt. Dromedary, 36°18'S, 150°1'E, 1880, *Reader 7* (MEL); East Gippsland, grid Z-11, Bidwell, 37°10'S, 148°48'E, 18 Jan. 1948, *Wakefield 2325* (MEL); within the Victorian grid Z-15, Yambulla Flat, 37°15'S, 149°26'E, 21 Dec. 1948, *Wakefield 2825* (MEL); Sidlings Swamp, Timbillica, 40 km S of Eden, 37°16'S, 149°40'E, 24 Nov. 1981, *Binns 285* (NSW). Queensland: Watson's Swamp, 6 km N of Amiens, 28°32'S, 151°48'E, 27 Mar. 1993, *Bean 5855* (MEL). South Australia: Armidale, 30°31'S, 151°40'E, Mar. 1914, *Boorman s.n.* (G). Victoria: Delegate River bridge at Bidwell near Bendoc, 35°34'S, 149°28'E, 18 Jan. 1948, *Willis s.n.* (MEL); East Gippsland, Bonang Highway, E side, N of Mt. Tingaringy Turn-off, 37°0'S, 148°40'E, 31 Dec. 1970, *Beauglehole 35619* (AD, MEL); East Gippsland, Pretty Gully, 2.5-4.5 mi by road E of Bonang Highway, 37°4'S, 148°46'E, 1 Jan. 1971, *Beauglehole 35687* (MEL); East Gippsland, Bonang River near Bendoc, 37°9'S, 148°52'E, Jan. 1889, *French s.n.* (MEL); Bendoc, far E Gippsland, near geodetic border with NSW, 2 mi S of the township, 37°9'S, 148°51'E, Feb. 1963, *Rogers s.n.* (MEL); Delegate River bridge at Bidwell, 37°10'S, 148°48'E, 31 Jan. 1941, *Hunter 31* (MEL); NW side of Delegate River Bridge, Bonang-Bendoc Road, 10km E of Bonang PO, 37°12'S, 148°48'E, 3 Feb. 1980, *Beauglehole 68055* (MEL); Bonang Highway, near Bonang Saw Mill, 37°12'S, 148°42'E, 16 Jan. 1970, *Willis s.n.* (MEL); East Gippsland, upper Rodger River, Rodger River-Deddick Trail, 37°14'S, 148°34'E, 25 Jan. 1983, *Chesterfield s.n.* (MEL); Delegate River, 37°15'S, 148°51'E, 1887, *Merrall s.n.* (MEL); East Gippsland, upper Rodger River, 37°16'S, 148°32'E, 15 Feb. 1983, *Chesterfield s.n.* (MEL); Coombimbah

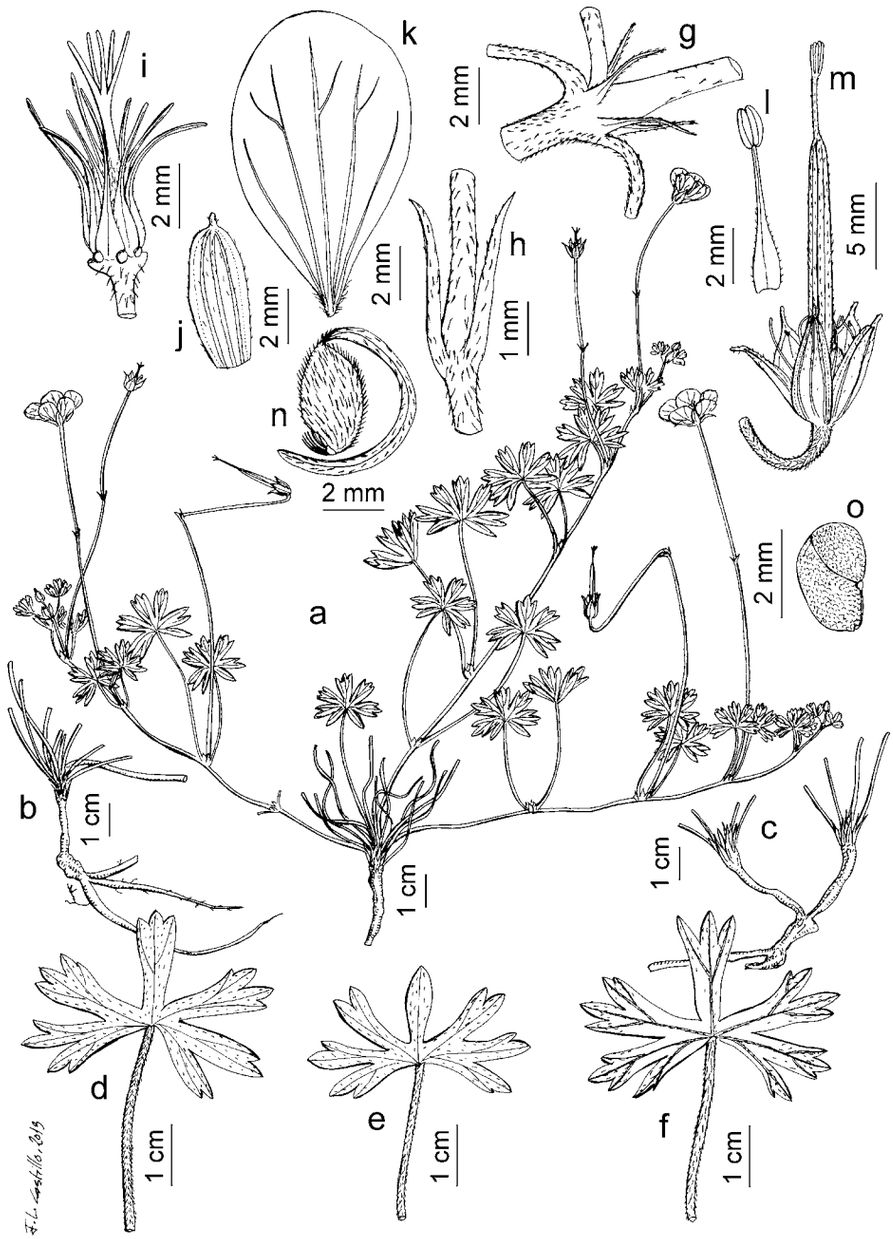


Fig. 217. *Geranium neglectum*. a. Habit. b, c. Rootstock. d, e. Leaves, adaxial surface. f. Leaf, abaxial surface. g. Stipules. h. Bracteoles. i. Flower without petals and sepals. j. Sepal. k. Petal. l. Stamen. m. Fruit. n. Mericarp. o. Seed. (Based on: a, i-o, *Walsh 6007*, MEL; b, d, f-h, *Chesterfield s.n.*, MEL-626344; c, *Hosking 2899*, MEL; e, *Chesterfield s.n.*, MEL-626341).

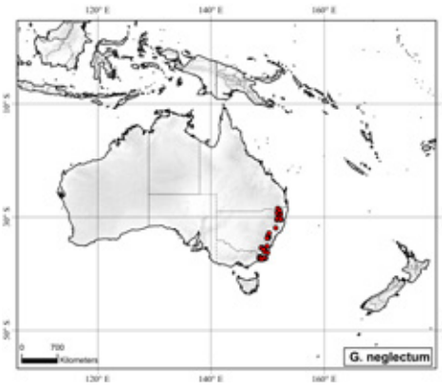


Fig. 218. Distribution of *Geranium neglectum*.

[=Combienbar] Valley (Eastern head of Bemm River), 37º27'S, 148º57'E, 1887, *Merrall s.n.* (MEL); between Bemm and Coombinbah [= Combienbar] Rivers, 37º30'S, 148º55'E, 1887, *Sayer s.n.* (MEL).

Discussion. Geranium neglectum is a prostrate perennial herb, but with the stems ascending when supported by other plants. It has a long, branched stem usually rooting at the nodes. The rootstock is short, branched, not turnip-shaped, and has ± fusiform roots. The indument of *G. neglectum* is composed of scattered, short, usually retrorsely appressed hairs. The leaves have five segments, which are usually 3-lobed at the apex. Leaves with an unlobed middle segment are occasional on sheets in which most leaves have 3-lobed middle segments. The stipules are free, narrow, lanceolate, and usually have a subulate apex. The cymules are usually 1-flowered although exceptionally some 2-flowered cymules occur on predominantly 1-flowered individuals. The pedicels and peduncles, as well as the petals, are all noticeably longer than those of other *Geranium* species. The fruit rostrum has a long narrowed apex. *Geranium neglectum* is similar to *G. potentilloides*, but is easily distinguished from the latter species by its longer peduncles, longer petals, and the apex of the rostrum, which is always narrowed and usually longer (2-3.8 mm).

The Nodosum Group—This group gathered perennial species with opposite leaves with broad and rhombic to ovate segments, distinct stipules, 2-flowered cymules arranged in dichasial inflorescence, long, narrow and emarginate petals, lanceolate staminal filaments, and glabrous nectaries. Yeo (2002a) recognized an "Endressii Group" that is renamed here as the *Nodosum Group*, because *G. endressii* is relocated into the *Sylvaticum Group*. *Geranium endressii* has alternate leaves on the base of the stem which suggests that it is more related to the *Sylvaticum Group*.

78. Geranium nodosum L., Sp. Pl.: 681. 1753. Type locality: "Habitat in Delphinatu". Type: "Habitat in Delphinatu" (lectotype, designated by Aedo in Jarvis 2007: 538, LINN-858.61 image!).

Geranium freyeri Griseb., Spic. Fl. Rumel. 1: 126. 1843. *Geranium nodosum* var. *freyeri* (Griseb.) Nyman, Consp. Fl. Eur.: 137. 1878. *Geranium collinum* [B] *freyeri* (Griseb.) Graebn. in Asch. & Graebn., Syn. Mitteleur. Fl. 7(1): 25. 1913. Type locality: "ex specimin in m. Krimberg Carnioliae lectis". Type: Slovenia. m. Krimberg, 45º55'N, 14º28'E, Aug. 1839, *A.H. Grisebach s.n.* (lectotype, here designated, GOET-022866!).

Geranium nodosum subsp. *eugeniae* Sennen, Diagn. Nouv. Pl. Espagne Maroc 1928: 11. 1928. *Geranium eugeniae* (Sennen) Sennen, Pl. Espagne 1928 n.° 6545. 1929, in sched. Type locality: "Hab.- Pyrénées de l'Ariège: Massif du Llaurenti, Artigues, à Pla del Bosc, belle forêt de sapins, vers 1600 m". Type: France. Pyrénées Orientales, Artigues, massif du Llaurenti, 42º43'N, 2º04'E, 25 July 1928, *fr. Sennen s.n., Pl. d'Espagne 6545* (lectotype, here designated, BC!; isolectotypes, FI!, MA-71670!, MA-425014!, MAF-25280!, P!, W!).

Perennial herbs, 19-50 cm tall. *Rootstock* 3-6.1 mm in diameter, ± horizontal, not tuberculate, not turnip-shaped, without thickened roots. *Stem* erect, leafy, not rooting at nodes, stolons absent, without vegetative stems, with retrorse, appressed, eglandular hairs 0.2-0.5 mm long. *Basal leaves* in a persistent rosette, cauline leaves opposite; leaf laminas (4.3)7.1-9(13.7) cm long, 5.7-17.5 cm wide, not peltate, palmatifid [ratio main-sinus length/middle segment length = (0.74)0.79-0.84(0.87)], polygonal in outline, base cordate, not coriaceous, with nerves not projected, pilose, with ± appressed, eglandular hairs on both surfaces; segments (3)5, in 1 plane, middle segment ovate, (8)15-20.3(24.8) mm wide at the base [ratio segment width at the base/middle segment length = 0.22-0.29(0.31)], (9)11-17(21)-lobed in distal half [ratio secondary sinus length/middle segment length = (0.05)0.06-0.09(0.12)]; petioles up to 19 cm long, without abscission zone, terete, not swollen, not deflexed in age, with retrorse, appressed, eglandular hairs 0.2-0.7 mm long; stipules 3.9-15.9 mm long, 0.8-3.6 mm wide, lanceolate, free, papery, brown, with eglandular hairs on abaxial surface and on the margin, glabrous adaxially. *Inflorescence* a dichasial cyme with monochasial branches; cymules 2-flowered, solitary [ratio cymule length/leaf length = (1)1.6-2.1]; peduncles (24)29-61(86) mm long, with eglandular, retrorse, appressed hairs 0.2-0.4 mm long; bracteoles 1.9-12 mm long, 0.5-1.3 mm wide, linear-lanceolate, whorled; pedicels (4.2)12-19(21) mm long, with retrorse, appressed or hook-shaped, eglandular hairs 0.1-0.3 mm long. Flowers actinomorphic. *Sepals* (6.4)6.8-7.7(7.8) mm long, 2.4-3.9 mm wide, lanceolate, smooth, not accrescent, nerves 3, mucro (1.5)1.8-2.3(3.7) mm long [ratio mucro length/sepal length = 0.23-0.47], with antrorse, appressed, eglandular hairs 0.2-0.4 mm long on the abaxial surface, glabrous adaxially. *Petals* (11.1)13.2-16.7(18.6) mm long, (4.8)5.2-6.5(8.4) mm wide, erect-patent, emarginate (notch 1.2-2.4 mm deep), without claw, light pink to deep magenta, hairy on the base of both surfaces, ciliate on the basal margin, with hairs 0.3-0.5 mm long. *Stamens* 10, both whorls bearing anthers; filaments (6.8)8.3-9.3(10.2) mm long, lanceolate, pink, pilose on the abaxial surface, ciliate on the proximal half, with hairs 0.2-0.5 mm long; anthers (1.5)1.6-1.9(2.1) mm long, blue. Nectaries 5, hemispheric, glabrous. *Gynoecium* 5.3-9.7 mm long, purple. *Fruit* (24)27-30(32) mm long, erect, discharge of seed-ejection type; mericarps 3.1-4.3 mm long, 1.4-2.1 mm wide, without a strand of fibers, not compressed at the apex, smooth (with 1 transverse vein at the apex), without basal beak, with a basal callus, without a basal prong, brown, with ± appressed, eglandular hairs 0.2-0.6 mm long; rostrum 16-23 mm long, with a narrowed apex 2.9-5.9 mm long, not twisted, with ± patent, eglandular hairs 0.1-0.2 mm long; stigmatic remnants 3.3-4.7 mm long, with 5 hairy lobes. *Seeds* 2.7-2.8 mm long, 1.7-2 mm wide, reticulate, uniformly

colored, brown, glabrous. Cotyledons with entire margin. Figs. 219, 220.

Pollen. *Geranium*-type (Gagnepain 1903: 86; Velasco 1992b: 55).

Chromosome number. 2*n* = 28.

Phenology. Collected in flower from April to September.

Distribution. This species ranges from northeastern Spain, through southern France, Italy and Switzerland to Slovenia and Croatia and it is introduced in Belgium, Germany and Great Britain (Fig. 221).

Habitat. Meadows, streams, edge of *Abies* Mill., and *Fagus* L. forests; 250-1600 m.

Representative specimens examined. **Belgium.** Wallonia: Namur, Roly, au lieu dit la Grotte, 50º8'N, 4º32'E, 28 June 1867, *Cogniaux 208* (LE, P). **Croatia.** Zadar: montes Velebit N. inter Krasno & Kuterevo, 44º17'N, 15º12'E, 19 June 1981, Černoch *s.n.* (MA). **France.** Auvergne-Rhône-Alpes: Isère, Pont-de-Claix, 45º7'N, 5º43'E, 30 May 2011, *Aedo 18398* (MA). Corse: Bastélica, 42º0'N, 9º3'E, 26 June 1878, *Reverchon s.n.* (MPU, P). Nouvelle-Aquitaine: Var, Bougon, 46º22'N, 0º3'W, 11 June 1861, *Bourgeau s.n.* (P). Occitanie: Ariège, Ax-les-Thermes, fontaine du Drazet, 42º43'N, 1º50'E, Aug. 1913, *Hibon 764* (P); Midi-Pyrénées, Ariége, castillo de Montsegur, 42º52'N, 1º49'E, 15 Aug. 2002, *Aedo 8405* (MA); Aude, Quillan, foret des Fanges, 42º52'N, 2º11'E, 16 June 1888, *Neyraut s.n.* (MPU). Provence-Alpes-Côte d'Azur: Alpes Maritimes, gorge du Loup, 43º43'N, 6º59'E, 10 May 1990, *Larsen & Larsen 40677* (MA); Basses Alpes, gorges de Verdon, 43º48'N, 6º24'E, 9 June 1948, *Weber s.n.* (G). **Germany.** Hesse: Wetzlar, 50º33'N, 8º30'E (NY). **Great Britain.** England: South Somerset, Luccombe, 51º11'N, 3º33'W, June 1894, *Thompson s.n.* (BIRM); Herefordshire, Sellack, 51º57'N, 2º38'W, 17 Sep. 1902, *Ley s.n.* (BIRM). **Italy.** Abruzzo: Majella, Palena, 41º58'N, 14º7'E, 18 June 1972, *Chiapella s.n.* (FI). Liguria: Cinquenterre, S Baracca, Mt. Agata und Mt. Grumo, 44º31'N, 8º45'E, 1 June 1980, *Polatschek s.n.* (W). Lombardy: Bérgamo, Roncola, monte Linzone, 45º46'N, 9º31'E, 15 Aug. 2019, *Aedo 26752* (MA). Marche: monte Petrano, Cagli, 43º31'N, 12º37'E, 26 June 1938, *Bettini s.n.* (FI). Piedmont: Meana bei Susa, 45º06'N, 7º04'E, 8 June 1924, *Ronniger s.n.* (W). Tuscany: Toscana-Reggello, sopra Marcereto, Torrente Resco, 43º41'N, 11º32'E, 7 July 1991, *Elisi s.n.* (MA). Umbria, monte Catria, 43º28'N, 12º42'E, Aug. 1877, *Ricci s.n.* (FI). Veneto: Bellunese, 46º8'N, 12º13'E, 29 May 1911, *Minio s.n.* (FI). **Slovenia.** Central Slovenia: Krain, im walde am Crimberg bei Laibach, 45º58'N, 14º17'E, *Freyer 1784* (W). Coastal–Karst: Istrien, St. Canzian, 45º40'N, 14º1'E, 17 June 1909, *Korb s.n.* (W). Inner Carniola–Karst: in sylvaticis montis Schnecberg, Carniolia, 45º34'N, 14º27'E, July (W); pr. Unec, Rakov Skocjan, 45º47'N, 14º17'E, 13 Aug. 2017, *Aedo 25255* (MA). **Spain.** Gerona: Osona, Vidrà, Ciuret, 42º8'N, 2º20'E, 9 July 2014, *Calvo & Ross 6606* (MA); Ripoll, 42º12'N, 2º12'E, Sep., *Sennen (frère) s.n.* (MA); San Juan de las Abadesas, Olot, 42º14'N, 2º16'E, Aug., *Vayreda s.n.* (MA); La Baga inter Coll de Sentigosa et la Cantina, 42º15'N, 1º52'E, 15 Sep. 1949, *Bolòs s.n.* (BC); Creixenturri, 42º18'N, 2º21'E, Aug., *Isern s.n.* (MA); Pirineos, Set Casas, 42º22'N, 2º18'E, Aug., *Isern s.n.* (MA). Lérida: Artiga de Lin, valle de Aran, 42º33'N, 1º36'E, 4 Aug. 1879, *Compañó s.n.* (BC); valle de Arán, 42º45'N, 0º48'E, *Villiers s.n.* (MA). **Switzerland.** Bern: Lamboing a Otonis, Jura bernois, 47º7'N, 7º9'E, 5 July 1845, *Tormaz[?] s.n.* (MA). Tessin: ufergebusch des Laveggio bei Mendrisio, 45º52'N, 8º58'E, 12 Sep. 1932, *Koch s.n.* (MA); Tessin, monte San Giorgio sur Tre Fontane, 45º54'N, 8º57'E, 8

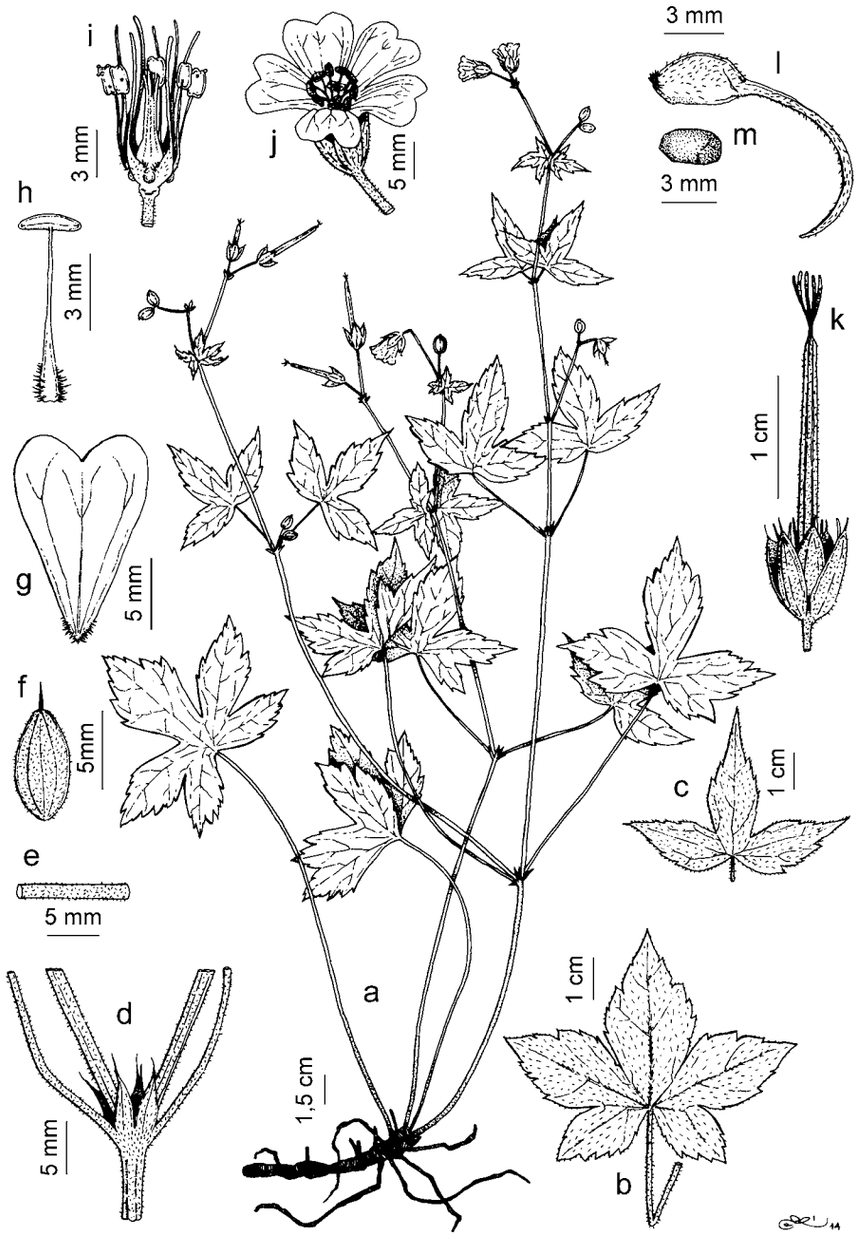


Fig. 219. *Geranium nodosum*. a. Habit. b. Basal leaf, on abaxial side. c. Cauline leaf, on adaxial side. d. Stipules. e. Pedicel. f. Sepal. g. Petal. h. Stamen. i. Flower without petals and sepals. j. Flower. k. Fruit. l. Mericarp. m. Seed. (Based on: *Monasterio & al. 1158,* MA).

Fig. 220. *Geranium nodosum* (Based on: *Monasterio & al. 1158,* MA).

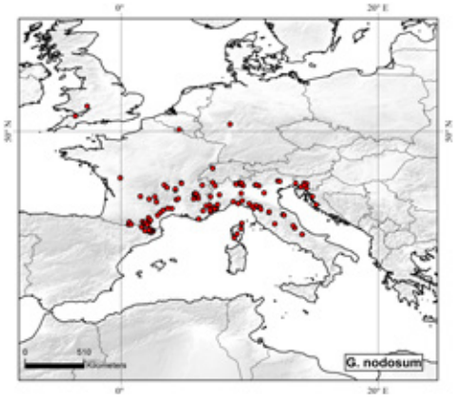


Fig. 221. Distribution of *Geranium nodosum*.

June 1930, *Bar s.n.* (MA, P). Valais: Valesia, chez les Reuses supra Orsières, 46º1'N, 7º9'E, 12 Aug. 1896, *Bernouilli s.n.* (W).

Discussion. Geranium nodosum is an erect perennial herb with a thin horizontal rootstock, opposite and shallowly divided leaves, free and narrow lanceolate stipules and long and emarginate petals. Stem-leaves gradually diminish in size and usually reduce the length of the pair of basal segments giving an appearance of 3-segment leaves. In well-developed plants the inflorescence is arranged in a primary dichasial cyme with two main branches where cymules are disposed monochasially. The indumentum varies in density and consists of short, retrorse, appressed, eglandular hairs distributed on the stem, petioles, peduncles, and pedicels. Sometimes the hairs of pedicels are retrorse and hook-shaped.

Geranium nodosum is quite similar to *G. versicolor* in general appearance, shape of leaves, and petals; however, *G. nodosum* never has glandular indumentum, and the eglandular hairs are shorter and retrorse-appressed or hook-shaped (in *G. versicolor* eglandular hairs are longer and patent). Stipules, peduncles, pedicels, and rostrum narrowed apex of the fruit are shorter in *G. nodosum* than in *G. versicolor*, although with some overlap. Additionally, in *G. nodosum* the sepal mucro is longer, petals are light pink to deep magenta, and stigmatic remnants are hairy.

Geranium nodosum and *G. versicolor* have an allopatric distribution. The first grows from eastern Pyrenean to northern Balkans, while the second is found in southern Italy and southern Balkans. They appear to overlap in Central Apennines. *Geranium nodosum* is widely used in gardens and naturalized in Great Britain, Belgium, and Germany. Some French lowland localities shown in the map (e.g., Var, Bougon, *Bourgeau s.n.,* P) probably also represent naturalizations.

79. Geranium rectum Trautv., Bull. Soc. Imp. Naturalistes Moscou 33(1): 459. 1860. *Geranium rectum* var. *glabratum* Trautv., Bull. Soc. Imp. Naturalistes Moscou 33(1): 459. 1860, nom. illeg. Type locality: "In promontorio montium Alatau, ad fl. Baskan, 29 Jun. (flor. et fruct. inmat.) in conspectum venit". Type: Kazakhstan. Alatau, Baskan, 46º14'N, 78º56'E, 29 June 1840, *A. Schrenk s.n.* (lectotype, designated by Novoselova 1996: 87, LE!; isolectotype, K!).

Geranium rectum var. *villosulum* Trautv., Bull. Soc. Imp. Naturalistes Moscou 33(1): 459. 1860, ["villosula"]. Type locality: "Habitat cum praecedente" [in promontorio montium Alatau, ad fl. Baskan]. Type: Kazakhstan. Alatau, Baskan, 46º14'N, 78º56'E, 29 June 1840, *A. Schrenk s.n.* (lectotype, here designated, LE!).

Geranium rectum var. *villosum* Regel, Trudy Imp. S.-Peterburgsk. Bot. Sada 5: 254. 1877. Type locality: "Dschasyl-kul, Alatu, leg. Kuschakewicz". Type: Kazakhstan. Dschungar. Alatau, [Dschasyl-kul], May 1873, *A. Kuschakewicz s.n.* (lectotype, here designated, LE!; isolectotype, G-00421004!).

Perennial herbs, 21-84 cm tall. *Rootstock* 3-11 mm in diameter, ± horizontal, not tuberculate, not turnip-shaped, without thickened roots. *Stem* erect, leafy, not rooting at nodes, stolons absent, without vegetative stems, with retrorse, appressed, eglandular hairs 0.3-1.1 mm long and, sometimes, patent, glandular hairs 1.3-2.7 mm long. *Basal leaves* in a ± persistent rosette, cauline leaves opposite; leaf laminas (4.4)5.1-7.7(10.1) cm long, 5.4-12.1 cm wide, not peltate, palmatifid [ratio main-sinus length/middle segment length = (0.70)0.77-0.82(0.87)], polygonal in outline, base cordate, not coriaceous, with nerves not projected, pilose, with ± appressed, eglandular hairs on both surfaces; segments 5, in 1 plane, middle segment rhombic, (6.6)8.2-11.7(13.8) mm wide at the base [ratio segment width at the base/middle segment length = (0.14)0.18-0.22(0.30)], (10)13-19(23)-lobed in distal half [ratio secondary sinus length/middle segment length = (0.14)0.17-0.20(0.25)]; petioles up to 43 cm long, without abscission zone, terete, not swollen, not deflexed in age, with retrorse, appressed, eglandular hairs 0.3-0.7 mm long and, sometimes, patent, glandular hairs 1.4-2 mm long; stipules 6.1-22.7 mm long, 1.3-5 mm wide, lanceolate, free, papery, brown, with minute, eglandular hairs on abaxial surface and on the margin, glabrous adaxially. *Inflorescence* a dichasial cyme with monochasial branches; cymules 2-flowered, solitary [ratio cymule length/leaf length = (1.4)2-2.2(3.1)]; peduncles (35)64-135(159) mm long, with retrorse, appressed or uncinate, eglandular hairs 0.2-0.4 mm long and, sometimes, patent, glandular hairs 1.4-2.5 mm long; bracteoles 2.7-9.5 mm long, 0.4-0.9 mm wide, lanceolate, whorled; pedicels (13)21-38(53) mm long, with retrorse, appressed or uncinate, eglandular hairs 0.2-0.5 mm long and, sometimes, patent, glandular hairs 0.9-1.7 mm long. Flowers actinomorphic. *Sepals* (5.7)6.6-7.6(8.5) mm long, 2.2-3.2 mm wide, lanceolate, smooth, not accrescent, nerves 3, mucro (0.9)1.6-2(2.8) mm long [ratio mucro length/sepal length = 0.13-0.37], with antrorse, ± appressed, eglandular hairs 0.1-0.5 mm long and, usually, patent, glandular hairs 1.5-3.1 mm long on the abaxial surface, glabrous adaxially. *Petals* (13.4)13.8-15.7(17.5) mm long, (5.4)6-7.5(7.8) mm wide, erect-patent, emarginate (notch 0.3-0.7 mm deep), without claw, bright rose-pink, hairy on the basal 1/3 of thei adaxial surface, glabrous abaxially, ciliate on the basal margin, with hairs 0.3-0.6 mm long. *Stamens* 10, both whorls bearing anthers; filaments (4.9)6-6.6(7.4) mm long, lanceolate, white, pilose on the abaxial surface, ciliate on the proximal half, with hairs 0.2-0.6 mm long; anthers (1.3)1.4-1.8(2.1) mm long, white with blue margin. Nectaries 5, hemispheric, glabrous. *Gynoecium* 3.7-8.7 mm long, pink. *Fruit* 27-30(31) mm long, erect, discharge of seed-ejection type; mericarps 3-3.4 mm long, 1.5-1.9 mm wide, without a strand of fibers, not compressed at the apex, smooth, without basal beak, with a basal callus, without a basal prong, brown, with ± appressed, eglandular hairs 0.1-0.7 mm long and, sometimes, patent, glandular hairs 0.4-1.3 mm long; rostrum 19-22 mm long, with a narrowed apex 3.7-4.4 mm long, not twisted, with patent, eglandular hairs 0.1-0.2 mm long and, rarely, patent, glandular hairs 0.7-1.1 mm long; stigmatic remnants 2.3-3.2 mm long, with 5 glabrous lobes. *Seeds* 2.2-2.6 mm long, 1-1.5 mm wide, smooth, uniformly colored, brown, glabrous. Cotyledons with entire margin. Fig. 222.

Pollen. Ornamentation not studied.

Chromosome number. Unknown.

Phenology. Collected in flower from May to August.

Distribution. This species ranges from the Tien Shan Mountains, in northwestern China to Kazakhstan and Uzbekistan (Fig. 223).

Habitat. Meadows and forest edges; 900-2550 m.

Additional specimens examined. **China.** Xinjiang: región Uygur, distrito Yili, población Zhaosu, 43º7'N, 81º4'E, 12 July 1957, *Lin Yebu 225* (PE); región Uygur, distrito Yili, población Gong Liu, pueblo Mohe, 43º18'N, 82º30'E, 10 July 1965, *Wang Qingrui 2554* (PE); región Uygur, distrito Yili, población Xinyuan, 43º27'N, 83º8'E, 22 July 1989, *Xu Langran 1529* (PE); in montibus Bogdo Ola, Ozun-ava, 43º35'N, 89º40'E, 7 June 1928, *Hummel 182* (S); in montibus Bogdo Ola, Utch Bozan, 43º35'N, 89º40'E, 8 June 1928, *Hummel 219* (S); in montibus Bogdo Ola, Fu Shu Shi, 43º35'N, 89º40'E, 23 June 1928, *Hummel 393* (S); in montibus Bogdo Ola, Hai na hi, 43º35'N, 89º40'E, 10 July 1928, *Hummel 474* (S); in montibus Bogdo Ola, Fu Shu Shi, 43º35'N, 89º40'E, 9 Aug. 1928, *Hummel 757* (S); distrito Yili, ciudad Wu Lu Mu Qi, 43º48'N, 87º37'E, 1 July 1974, *Lin You Run 74016* (IBSC); distrito Yili, cuenca inferior del río Guxitai, 43º54'N, 81º21'E, 1 June 1965, *Zhou Tai Yan 650568* (KUN). **Kazakhstan.** Songarei, *Schrenk s.n.* (G). Almaty: Tien Shien mountains, S of Almaty, not far from Big Almaty Lake, 43º3'N, 76º59'E, 3 June 2008, *Stenberg 186* (S); Tien-Shan, Malaja Almaatink-Tal, Sailijski Alatau, Met. Stat. Worota, 43º5'N, 77º4'E, July 1976, *Krügel s.n.* (JE); Tian-Shan, montes Zailijski Alatau, distr. Alama-Ata, in valle fluminis Malaja Almaatinka, loco Medeo dicto, 43º9'N, 77º3'E, 30 May 1974, *Vašák s.n.* (G); in declivitas septentrionalis jugi Ketmenj, in faucibus fl. Kul-Saj, 43º27'N, 80º26'E, 29 June 1964, *Roldugin 4826* (B, C, G, H, JE, MO, PRC, W). **Uzbekistan.** Fergana: Fergana-Alai Gebirge, lado

izquierdo del valle de Kon-su al oeste del lago Kok-kul, a unos 9 km al sureste de Schachimardan (Chamsaabad), 39º59′N, 71º48′E, 5 July 1989, *Günther & al. 712* (JE).

Discussion. Geranium rectum is an erect perennial herb with a short horizontal rootstock, opposite and shallowly divided leaves, free and narrow lanceolate stipules and long petals. The indumentum consists of appressed, eglandular hairs distributed from the stem base to inflorescence. *Geranium rectum* also shows a distinctive indumentum of long, patent glandular hairs ending in a narrow cell (this apical cell is of similar width to that of the basal cell). These hairs are always present in a variable density, on sepals, and sometimes on stems, petioles, peduncles, and pedicels. As in other species of the genus, such as *G. collinum, G. nodosum,* or *G. psilostemon,* the peduncle of the cymules may be noticeably long, especially toward the base of the inflorescence. The petals are narrow, slightly emarginate, and hairy on the basal third of the adaxial surface.

Geranium rectum is easily differentiated from *G. nodosum* and *G. versicolor* for its short staminal filaments, its long and distinctive glandular hairs on sepals and pedicels, and its leaves with a rhombic middle segment.

Since Edgeworth & Hooker (1874: 429) recorded *G. rectum* in the Himalayas ("Kashmir, *Falconer*; in Baltal, *T Thomson*"), some authors have identified Himalayan specimens as *G. rectum* or have accepted this name in the regional literature (i.e., Nasir 1983; Malhotra 1997). The origin of the mistake may be from some specimens identified as *G. rectum* [*Falconer 324* (P-05124324, other duplicates examined are *G. wallichianum*); *Duthie s.n.* (18 July 1892, WU)] that really belong to *G. rubifolium*. The latter is a species that resembles *G. rectum* by its shallowly divided leaves. Differences between *G. rectum* and *G. rubifolium* are addressed in the discussion of the latter species. All these data strongly suggest that *G. rectum* should be excluded from the Himalayas.

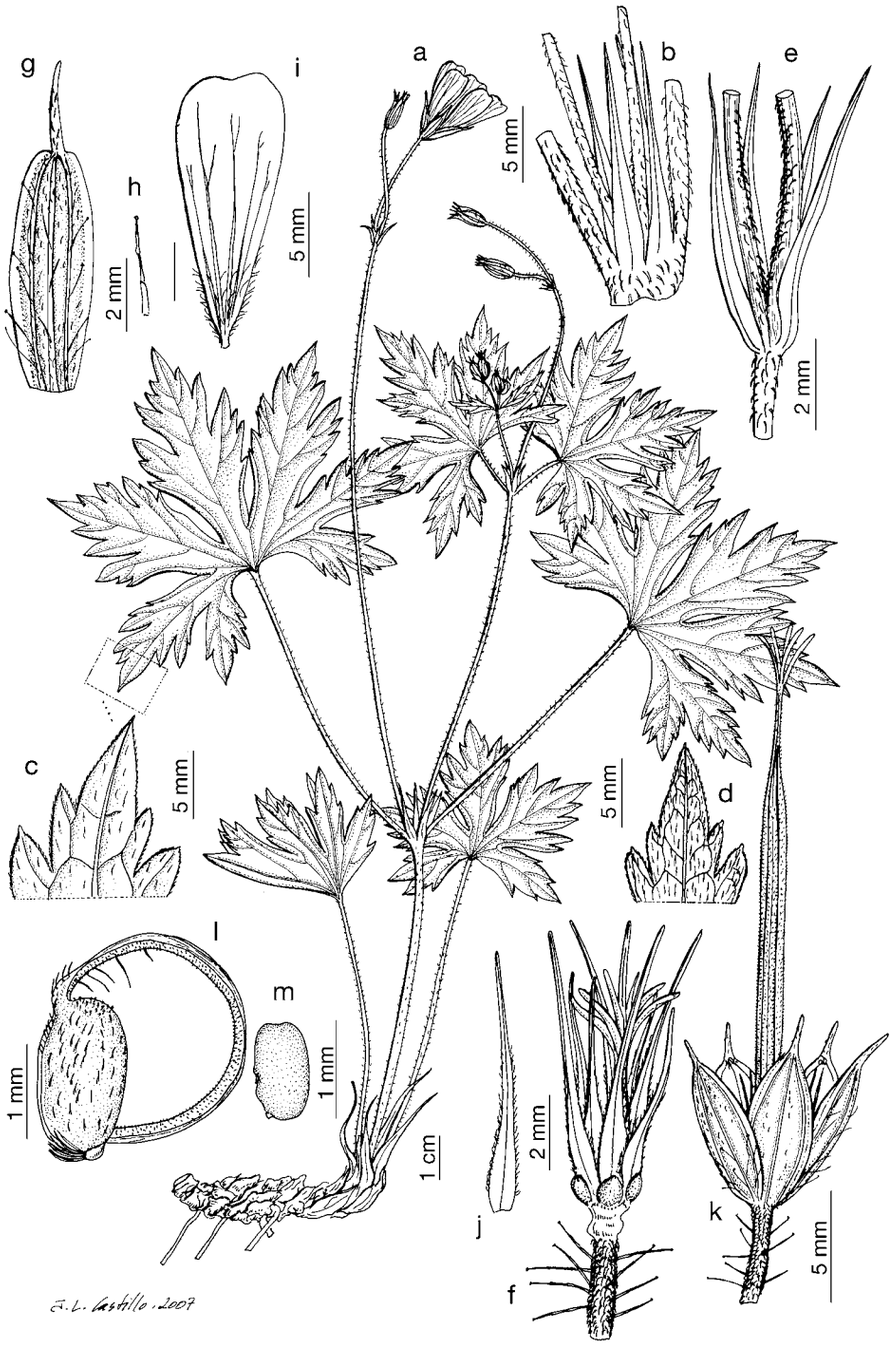


Fig. 222. *Geranium rectum*. a. Habit. b. Stipules. c. Leaf indumentum on adaxial side. d. Leaf indumentum on abaxial side. e. Bracteoles. f. Flower without petals and sepals. g. Sepal. h. Glandular hair of sepal. i. Petal. j. Staminal filament. k. Fruit. l. Mericarp. m. Seed. (Based on: a-k, *Roldugin s.n., 29 June 1964*, C; k-m, *Lin You Run 74016,* IBSC).

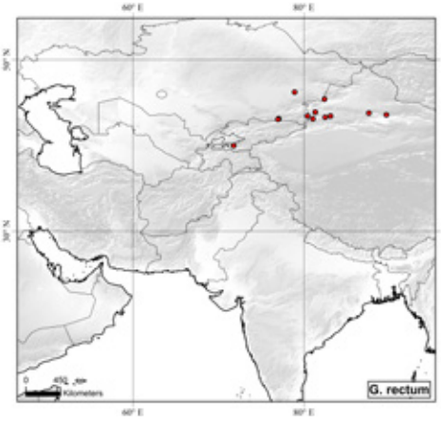


Fig. 223. Distribution of *Geranium rectum*.

80. Geranium versicolor L., Cent. Pl. I: 21. 1755. *Geranium striatum* L., Syst. Nat. ed. 10 1143. 1759, nom. illeg. Type locality: "Habitat in Italia". Type: Morison, Pl. Hist. Univ. 2 sect. 5, tab. 16 fig. 24. 1680 (lectotype, designated by Aedo in Jarvis, 2007: 540). Italy. Sicily Nebrodi, arroyo Torti, 8 June 2000, *M.Á. García & al. 1481* (epitype, designated by Aedo in Jarvis 2007: 540, MA-645561!).

Geranium striatum var. *parvulum* N. Terracc., Annuario Reale Ist. Bot. Roma 4: 81. 1891. Type locality: "presso la Casina Toscano". Type: Italy. Monte Pollino, 39º54'N, 16º11'E, July 1886, *N. Terracciano s.n.* (lectotype, here designated, RO!).

Geranium striatum var. *glabratum* Formánek, Verh. Naturf. Vereins Brünn 37: 208. 1898. Type locality: "Habitat ad Nevěska, Prekopan et in reg. media et superiore Galičica pl. M.". Type: Greece. Nevěska, Prekopan et in reg. media et superiore Galičica pl. M., 40º38'N, 21º29'E, 12 June? 1885, *E. Formánek s.n.* (lectotype, here designated, BRNM-10172 image!).

Perennial herbs, 26-62 cm tall. *Rootstock* 6-8 mm in diameter, ± horizontal, not tuberculate, not turnip-shaped, without thickened roots. *Stem* erect, leafy, not rooting at nodes, stolons absent, without vegetative stems, with patent, eglandular hairs 0.7-1.4 mm long and patent, glandular hairs 0.1 mm long. *Basal leaves* in a persistent rosette, cauline leaves opposite; leaf laminas (4.7)6.3-9(11.5) cm long, 5.7-13.5 cm wide, not peltate, palmatifid [ratio main-sinus length/middle segment length = (0.76)0.81-0.85(0.89)], polygonal in outline, base cordate, not coriaceous, with nerves not projected, pilose, with ± appressed, eglandular hairs on both surfaces; segments (3)5, in 1 plane, middle segment ovate, (8.1)11.3-14.1(21.4) mm wide at the base [ratio segment width at the base/middle segment length = (0.20)0.21-0.27(0.30)], (9)13-19(23)-lobed in distal half [ratio secondary sinus length/middle segment length = (0.06)0.07-0.11(0.17)]; petioles up to 27 cm long, without abscission zone, terete, not swollen, not deflexed in age, with patent, eglandular hairs 0.3-1.2 mm long and patent, glandular hairs 0.1 mm long; stipules 6.8-15 mm long, 0.5-4.3 mm wide, subulate, free, papery, brown, with eglandular hairs on abaxial surface and on the margin, glabrous adaxially. *Inflorescence* a dichasial cyme with monochasial branches; cymules 2-flowered, solitary [ratio cymule length/leaf length = (1.7)2-2.7(4)]; peduncles (28)51-103(155) mm long, with patent, eglandular hairs 0.7-1.3 mm long and patent, glandular hairs 0.1 mm long; bracteoles 4.5-9.8 mm long, 0.4-0.9 mm wide, linear-lanceolate, whorled; pedicels (12)15-35(43) mm long, with patent, eglandular hairs 0.4-1 mm long and patent, glandular hairs 0.1 mm long. Flowers actinomorphic. *Sepals* (6.4)7.4-8.6(9.9) mm long, 2-3.8 mm wide, lanceolate, smooth, not accrescent, nerves 3, mucro (1)1.3-1.9(2.1) mm long [ratio mucro length/sepal length = 0.14-0.27], with erect-patent, eglandular hairs 0.3-1 mm long (along the nerves) and patent, glandular hairs 0.1 mm long on the abaxial surface, glabrous adaxially. *Petals* (13)14.9-17(18.5) mm long, (5.2)5.8-8.1(8.6) mm wide, erect-patent, emarginate (notch 1-4.6 mm deep), without claw, white, with violet veins, hairy on the base of both surfaces, ciliate on the basal margin, with hairs 0.3-0.4 mm long. *Stamens* 10, both whorls bearing anthers; filaments (7)8.6-10.3(12.5) mm long, narrowly lanceolate, white, pilose on the abaxial surface, ciliate on the proximal half, with hairs 0.1-0.5 mm long; anthers (1.7)2-2.2 mm long, blue. Nectaries 5, hemispheric, glabrous. *Gynoecium* 5.5-9.4 mm long, purple. *Fruit* (26)27-34 mm long, erect, discharge of seed-ejection type; mericarps 3.3-4 mm long, 1.5-1.9 mm wide, without a strand of fibers, not compressed at the apex, smooth (sometimes with 1 transverse vein at the apex), without basal beak, with a basal callus, without a basal prong, brown, with ± appressed, eglandular hairs 0.2-0.9 mm long and patent, glandular hairs 0.1 mm long; rostrum 19-26 mm long, with a narrowed apex 4.9-8.1 mm long, not twisted, with patent, eglandular hairs 0.1-0.3 mm long and patent, glandular hairs 0.1 mm long; stigmatic remnants 2.5-4.4 mm long, with 5 glabrous lobes. *Seeds* 2.2-3 mm long, 1.2-1.9 mm wide, reticulate, uniformly colored, brown, glabrous. Cotyledons with entire margin. Figs. 224, 225.

Pollen. *Geranium*-type (Bortenschlager 1967: 433 [sub *G. striatum*]; Stafford & Blackmore 1991: 64).

Chromosome number. 2*n* = 28.

Phenology. Collected in flower from May to August.

Distribution. This species ranges from southern Italy to Balkans (Albania, North Macedonia and Greece) and it is introduced in France and Great Britain (Fig. 226).

Habitat. Meadows, ravines, stream banks and edge of *Abies* Mill., *Castanea* Mill., *Fagus* L. and *Pinus* L. forests; 250-1600 m.

Representative specimens examined. **Albania.** Vlorë: in reg. subalpina m. Corab, 40º7'N, 19º51'E, July, *Dimone s.n.* (W). **France.** Bretagne: Finistère, talus boisé près Morlaix, 48º34'N, 3º49'W, 12 July 1881, *Miciol s.n.* (W). Normandie: Cherbourg, 49º39'N, 1º39'W, 28 May 1891, *Corbière s.n.* (MPU). **Great Britain.** Channel Island: Jersey, 49º13'N, 2º7'W, 8 Aug. 1832, *Lagasca s.n.* (MA). England: North Somerset, Flay Bourton, 51º25'N, 2º42'W, 9 June 1929, *White s.n.* (W). **Greece.** Epirus: Metsovo, puerto de Katara, estación Snowplow, 39º47'N, 21º13'E, 27 July 2007, *Calvo & al. 865* (MA); Metsovo, pr. embalse Aoos Springs, 39º48'N, 21º5'E, 27 July 2007, *Calvo & al. 1055* (MA); Ioánnina, 3 km al N de Ghreveniti, 39º49'N, 21º0'E, 29 July 2007, *Cabezas & al. 595* (MA). Mount Athos: peninsula Hagion Oros, Karyaes, 40º15'N, 24º15'E, 15 July 1891, *Sintenis & Bornmüller 800* (LE, P). Peloponnese: 3 km S Kalamata und Spasti, 37º2'N, 22º7'E, 4 Aug. 1986, *Röthlisberger s.n.* (G); Peloponeso, Lakonia, Taigetos Mts., Ladagha gorge, 37º4'N, 22º17'E, 24 June 2007, *Aedo & al. 14260* (MA). Thessaly: Agrapha, in oropedio Neurópolis reg. infer. Pindi, 39º18'N, 21º34'E, 28 June 1885, *Heldreich s.n.* (W). West Macedonia: Macedonia occidentalis in jugo supra Pisoderion pr. Florina, 40º46'N, 21º23'E, 11 June 1955, *Rechinger 15765* (W). **Italy.** Abruzzo: Aquila, Pettorano sul Gizio S Sulmona, 41º58'N, 13º58'E, 16 May 1972, *Leute 1504* (W). Basilicata: Lucania, Abriola, in silva Buffata vocata, 40º31'N, 15º47'E, June 1939, *Gavioli 27547* (FI); Laconia, Pignola m. Serranetta, 40º33'N, 15º46'E, 10 Aug. 1925, *Gavioli s.n.* (MA). Calabria: Aspromonte, von Gamba-

rie gegen die Santuaria di Possi, 38º10'N, 16º0'E, 10 June 1976, *Burri & Krendl s.n.* (W); Calabria, Nicastro supra Platania, 38º58'N, 16º18'E, 14 June 1899, *Fiori s.n.* (FI). Campania: Salerno, Cilento septentrionale lungo la starda sale a Cicerale, 40º17'N, 15º21'E, 26 Apr. 2016, *Biaggini & al. s.n.* (FI); Hirpinia, Avellino, in nemoribus montis Montevergine, 40º56'N, 14º44'E, 25 July 1910, *Pellanda 2726* (P). Lazio: Caprarola, Barchettodi Palazzo Farnese, 42º18'N, 12º14'E, 8 July 2001, *Scarici s.n.* (FI). Marche: dintorni di Sarnano, nella valle da Ponte Carfagna, 43º1'N, 13º16'E, 2 June 1981, *Brilli & al. s.n.* (FI). Molise: San Massimo, San Egidio Matese, 41º27'N, 14º26'E, 20 Aug. 1979, *Bianchini s.n.* (FI). Sicilia: Palermo, Geraci Siculo, Piano Grande, 37º51'N, 14º8'E, 3 June 2000, *García & al. 1351* (MA); Nebrodi, entre la Portella de Femina Morta y Monte Soro, 37º56'N, 14º42'E, 4 June 2000, *García & al. 1447* (MA). **North Macedonia.** Pelagonia: Galicica planina, pass on the road Trpejka-Lescovec, 40º58'N, 20º51'E, 21 July 1981, *Frost-Olsen 4092* (MA). Southwestern: between Ohrid and Resen, E of Openica, 41º7'N, 20º48'E, 19 June 1965, *Ooststroom 23963* (L).

Discussion. Geranium versicolor is an erect perennial herb, with a medium-length horizontal rootstock, thin roots, opposite and shallowly divided leaves, free and narrow lanceolate stipules, and long petals. The inflorescence is arranged in a primary dichasial cyme with two main branches where cymules are disposed monochasially. Stem-leaves gradually diminish in size and usually reduce the length of the pair of basal segments, giving an appearance of 3-segment leaves. The indumentum consists of spread, eglandular hairs distributed in a variable density from the stem base to inflorescence. Additionally, *G. versicolor* has very short, patent glandular hairs throughout the plant, but more conspicuous and in higher density on peduncles and pedicels. The petals are usually deeply notched, white, and with a close network of fine magenta-colored veins that fade with age (Yeo 2002a: 65). The indumentum of petals is restricted to the base and occurs on both surfaces.

Differences between *Geranium versicolor* and *G. nodosum* are addressed in the discussion of the latter species. *Geranium versicolor* is widely used in gardens and naturalized in Great Britain and France.

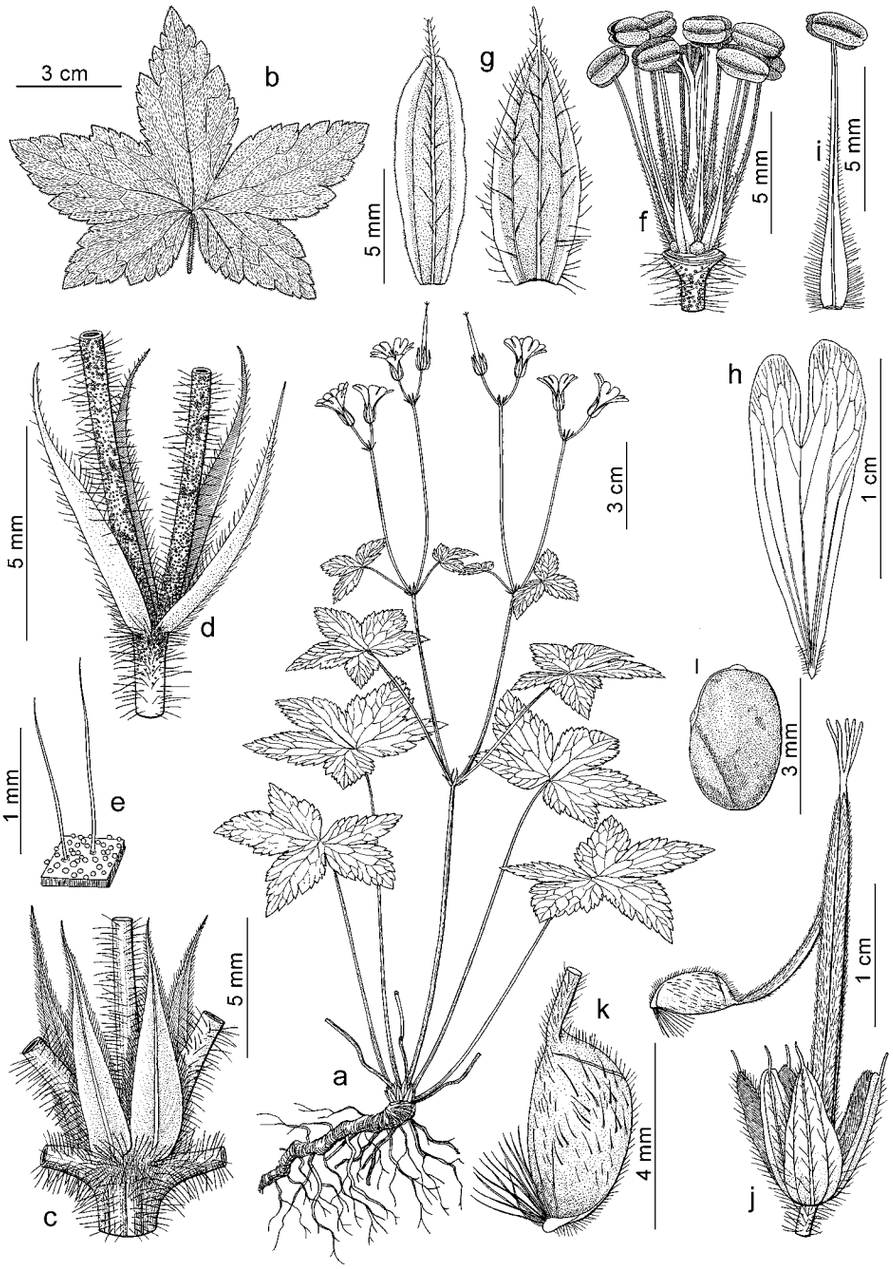


Fig. 224. *Geranium versicolor*. a. Habit. b. Leaf. c. Stipules. d. Bracteoles. e. Detail of pedicel indumentum. f. Flower without petals and sepals. g. Sepals. h. Petal. i. Stamen. j. Fruit. k. Mericarp. l. Seed. (Based on: a, c-e, *Frost-Olsen 3864,* MA; b, f, g, i, *Frost-Olsen 3864,* MA; h, *Cabezas & al. 654,* MA; j-l, *Cabezas & al. 595,* MA).

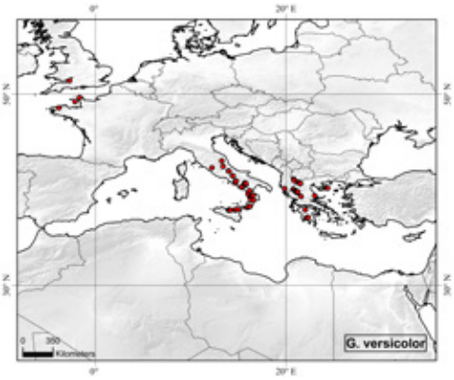


Fig. 226. Distribution of *Geranium versicolor*.

Fig. 225. *Geranium versicolor* (Based on: *Aedo 14260,* MA).

The Arabicum Group—This group is characterized by the trailing habit, opposite cauline leaves, the broadly ovate and connate stipules, the monochasially branched inflorescence, the petals glabrous or hairy only on the base, and the staminal narrow filaments, without an expanded base. Some relation can be suggested with "The Wallichianum group" on the basis of the trailing habit, opposite leaves, monochasial inflorescence, and connate stipules. The species of "Arabicum group" have, however, shorter flowers that are not dark pigmented.

81. Geranium andringitrense H. Perrier, Bull. Soc. Linn. Normandie ser. 7, 7: 188. 1925. Type locality: "Le Geranium andringitrense est commun sur les rocailles et parmi les Philippia de la brousse éricoïde au dessus de 2.000 m., mais je ne l'ai observé que sur ces massif (nos 5.696, 5.698, 13.608, 14.482 de mon Herbier)... L'aire restreinte de l'espèce, sa spécialisation évidente aux rocailles de la cime de l'Andringita...". Type: Madagascar. Andringitra, 22°11'S, 46°58'E, 22 Feb. 1932, *H. Perrier de la Bathie 14482* (lectotype, here designated, P-0048228!).

Perennial herbs, 33-110 cm tall. *Rootstock* 2.8-18.2 mm in diameter, ± vertical, not tuberculate, not turnip-shaped, without thickened roots. *Stem* trailing and ascending, leafy, not rooting at nodes, stolons absent, without vegetative stems, with retrorse, appressed, eglandular hairs 0.3-0.5 mm long. *Basal leaves* in a deciduous rosette, cauline leaves opposite; leaf laminas (2.5)3.4-4.6(5) cm long, 3.1-5.6 cm wide, not peltate, palmatifid [ratio main-sinus length/middle segment length = (0.73)0.76-0.83(0.87)], polygonal in outline, base cordate, not coriaceous, with nerves not projected, pilose, with ± appressed, eglandular hairs on both surfaces; segments 5, in 1 plane, middle segment rhombic, (3.4)4.5-6.9(7.8) mm wide at the base [ratio segment width at the base/middle segment length = (0.19)0.21-0.25(0.27)], 5-7(10)-lobed in distal half [ratio secondary sinus length/middle segment length = (0.18)0.27-0.33(0.35)]; petioles up to 20 cm long, without abscission zone, terete, not swollen, not deflexed in age, with retrorse, appressed, eglandular hairs 0.2-0.5 mm long; stipules 6.4-11 mm long, 3-5.5 mm wide, broadly ovate, connate, papery, brown, with scattered, eglandular hairs on abaxial surface and on the margin, usually glabrous adaxially. *Inflorescence* a monochasial cyme; cymules 1(2)-flowered, solitary [ratio cymule length/leaf length = (1.1)1.7-2.6(2.9)]; peduncles (30)44-59(100) mm long, with retrorse, appressed, eglandular hairs 0.2-0.4 mm long; bracteoles 1.9-5.2 mm long, 0.6-1.4 mm wide, lanceolate, opposite or whorled; pedicels (19)21-28(35) mm long, with retrorse, appressed, eglandular hairs 0.2-0.5 mm long. Flowers actinomorphic. *Sepals* (6.6)6.9-7.7(9.9) mm long, 2-3.2 mm wide, lanceolate, smooth, not accrescent, nerves 3, mucro (0.9)1.3-1.8(2.2) mm long [ratio mucro length/sepal length = 0.13-0.32], with ± patent, eglandular hairs 0.5-1 mm long on the abaxial surface, glabrous adaxially. *Petals* (12.3)13.2-15.5(17.1) mm long, (3.9)5.6-7.1(8.3) mm wide, erect-patent, rounded, without claw, white, glabrous or sparsely ciliate on the basal margin, with hairs 0.1-0.2 mm long. *Stamens* 10, both whorls bearing anthers; filaments (4.7)5-6(6.6) mm long, lanceolate, white, pilose on the abaxial surface, ciliate on the proximal half, with hairs 0.1-0.3 mm long; anthers 1-1.2(1.3) mm long, pink. Nectaries 5, hemispheric,

glabrous. *Gynoecium* 4.5-5.3 mm long, pale pink. *Fruit* (15)17-21(21.6) mm long, erect, discharge of seed-ejection type; mericarps 3.5-4.3 mm long, 1.2-1.8 mm wide, without a strand of fibers, not compressed at the apex, smooth (with 1 transverse vein at the apex), without basal beak, with a basal callus, without a basal prong, brown, with ± patent, eglandular hairs 0.5-0.8 mm long; rostrum 9.1-13.2 mm long, with a narrowed apex 1.1-2.4 mm long, not twisted, with erect-patent, eglandular hairs 0.3-0.6 mm long; stigmatic remnants 2.1-3 mm long, with 5 hairy lobes. *Seeds* 2.6-2.8 mm long, 1.2-1.3 mm wide, finely reticulate, uniformly colored, brown, glabrous. Cotyledons with entire margin. Fig. 227.

Pollen. Ornamentation not studied.

Chromosome number. Unknown.

Phenology. Collected in flower from February to December.

Distribution. This species is endemic to Madagascar (Fig. 228).

Habitat. Meadows, streams, open bushland, among steep cliffs and in shade in light forests; 1600-2500 m.

Additional specimens examined. **Madagascar.** Fianarantsoa: Andrianony, Manjarivolo, 29 Oct. 1970, *Guillaumet 3339* (P); massif de l'Andringitra, Ivangomena, pic Humbert, 15 Oct. 1934, *Heim s.n.* (P); massif de Andringitra, Iratsy, vallées de la Riambava et de l'Antsifotra, 27 Nov. 1924, *Humbert 3830* (P); Ambalavao district, Mahazony canton, Onidranomiadilaka, Vohimarina, 21°53'S, 46°55'E, 14 Nov. 1955, *Rakotovao 7492* (P); Fianarantsoa, Andringitra National Park, trail from Camp 2 to Camp Catta on the Andohariana Plateau, 22°8'S, 46°51'E, 16 Sep. 2006, *Almeda 9373* (CAS); Fianarantsoa, Andringitra Mts., along path from field station, 22°8'S, 46°56'E, 3 Apr. 2010, *Thulin & Razafindraibe 11770* (UPS); Fianarantsoa, on plateau, 22°9'S, 45°53'E, 6 Nov. 2003, *Phillipson & al. 5685* (P); Andringitra Forest reserve, 6-8 km of Antanifotsy, along paht to Pic Boby, 22°11'S, 46°53'E, 23 Mar. 1989, *Goldblatt & Schatz 8982* (P); Andringitra RN, Mt. Boby, 22°11'S, 46°53'E, 20 Mar. 2003, *Homolle 1190* (P); Fianarantsoa, Andringitra, Camp IV, 38 km S Ambalavo, Andringitra Reserve on ridge above headwatwaters of Sahavatoy River, 22°11'S, 46°58'E, 9 Dec. 1993, *Lewis & al. 1069* (MO); Andringitra, 22°11'S, 46°58'E, June 1965, *Morat 1294* (P); Andringitra, 22°11'S, 46°58'E, Apr. 1921, *Perrier de la Bathie 13608* (P); Andringitra, 22°11'S, 46°58'E, Sep. 1911, *Perrier de la Bathie 5696*

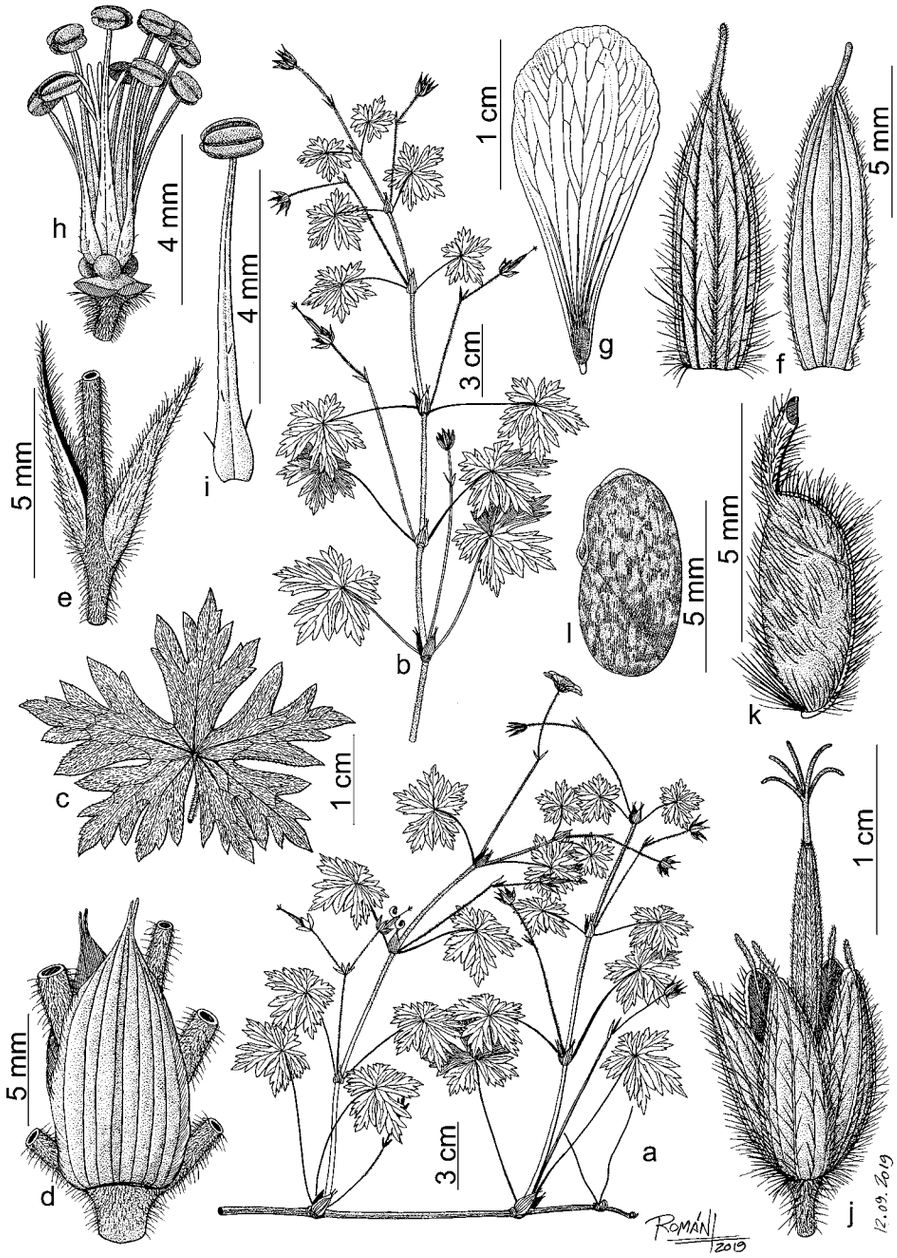


Fig. 227. *Geranium andritringense*. a, b. Habit. c. Leaf. d. Stipules. e. Bracteoles. f. Sepals. g. Petal. h. Flower without petals and sepals. i. Stamen. j. Fruit. k. Mericarp. l. Seed. (Based on: a, h, i, *Thulin & Razafindraibe 11770,* UPS; b, c, g, *Ranarivelo & al. 495,* P; d-f, j-l, *Lewis & al. 1069,* P).

Fig. 228. Distribution of *Geranium andritringense*.

(P); Andringitra, 22º11'S, 46º58'E, 21 Nov. 1928, *Perrier de la Bathie 9698* (P); Ambalavao, Sendrisoa, 22º11'S, 46º57'E, 4 May 1961, *Rakotoson 11572* (P); Ambalava, Sendrisoa, 22º11'S, 46º57'E, 18 Oct., *Rakotovao 8447* (P); Fianarantsoa, Andringitra, allée por Pic Boby, 22º11'S, 46º54'E, 13 Feb. 2007, *Ranarivelo & al. 495* (P); Ambalavao district, Sendrisoa, 22º11'S, 46º57'E, 16 May 1952, *Surveillant 4049* (P); Ambalavao, Sendrisoa, 22º11'S, 46º57'E, 15 June 1953, *Surveillant 5592* (P); P.N. Andringitra, camino al Pic Boby o Imarivolanitra, 22º12'S, 46º52'E, 18 Nov. 2004, *Aizpuru s.n.* (MA); P.N. Andringitra, camino al Pic Boby o Imarivolanitra, 22º12'S, 46º52'E, 18 Nov. 2004, *Aizpuru s.n.* (MA); P.N. Andringitra, circuito Diavolana, bajando al río Zomandao, 22º12'S, 46º52'E, 17 Nov. 2004, *Aizpuru s.n.* (MA).

Discussion. Geranium andringitrense shares with *G. arabicum* the general appearance, the broadly ovate and connate stipules, and the eglandular indumentum. *Geranium andringitrense* is, consequently, a prostrate herb with a slender vertical rootstock, slim roots, and ascending aerial stems. The aerial stems, however, do not root in the nodes as in *G. arabicum*. The hairs of *G. andringitrense* on the stem, petioles and peduncles and pedicels are always very short and retrorse-appressed. Its stipules are strongly acute, unlike *G. arabicum* that varies from obtuse to acute. The cymules of *G. andringitrense* are predominantly 1-flowered. Some specimens occasionally have 2-flowered cymules, although most of the nodes have 1-flowered cymules. *G. andringitrense* is an endemic from Madagascar, easily recognized from *G. arabicum* by its long sepals and petals. Additionally, *G. andringitrense* further differs from *G. arabicum* in its longer sepal mucro and its longer narrowed apex of the fruit. Although both species coincide in Madagascar the former is found in higher areas.

---

82. Geranium arabicum Forssk., Fl. Aegypt.-Arab.: 124. 1775. Type locality: "In Yemen frequens, Arab. Talab vel Chåda. Aliis Ghasl" [Talab, Chåda, and Ghasl are vernacular names]. Type: Yemen. Kurma, 14°34'N, 43°38'E, 1763, *P. Forsskål 735* (lectotype, designated by Kokwaro 1971a: 647, C-10002309 image!).

Perennial herbs, 16-119 cm tall. *Rootstock* 1.6-7.3 mm in diameter, ± vertical, not tuberculate, not turnip-shaped, without thickened roots. *Stem* trailing and ascending, leafy, rooting at nodes, stolons absent, without vegetative stems, with patent to retrorse, eglandular hairs 0.3-1.2 mm long. *Basal leaves* in a deciduous rosette, cauline leaves opposite; leaf laminas (1.3)2.6-3.7(6.6) cm long, 1.5-7.5 cm wide, not peltate, palmatifid [ratio main-sinus length/middle segment length = (0.72)0.81-0.89(0.98)], polygonal in outline, base cordate, not coriaceous, with nerves not projected, pilose, with ± appressed, eglandular hairs on both surfaces; segments 5, in 1 plane, middle segment rhombic, (1.7)2.6-5.9(11.6) mm wide at the base [ratio segment width at the base/middle segment length = (0.10)0.15-0.25(0.35)], (7)11-15(19)-lobed in distal half [ratio secondary sinus length/middle segment length = (0.16)0.23-0.42(0.58)]; petioles up to 18 cm long, without abscission zone, terete, not swollen, not deflexed in age, with patent to retrorse, eglandular hairs 0.3-1.3 mm long; stipules 3.4-12.3 mm long, 2-5.6 mm wide, broadly ovate (sometimes with a short bifid apex), connate, papery, brown, with eglandular hairs on abaxial surface and on the margin, glabrous adaxially. *Inflorescence* a monochasial cyme; cymules 1-2-flowered, solitary [ratio cymule length/leaf length = (0.7)0.9-1.6(2.8)]; peduncles (15)31-58(93) mm long, with retrorse to patent, eglandular hairs 0.2-1 mm long; bracteoles 1.4-4.7 mm long, 0.3-1.4 mm wide, lanceolate, opposite or whorled; pedicels (6.7)15-25(44.3) mm long, with patent to retrorse, eglandular hairs 0.2-1 mm long. Flowers actinomorphic. *Sepals* (3.6)4.8-6.1(7.2) mm long, 1.5-3.7 mm wide, lanceolate, smooth, not accrescent, nerves 3, mucro (0.2)0.5-0.8(1.4) mm long [ratio mucro length/sepal length = 0.05-0.27], with ± patent, eglandular hairs 0.3-1.1 mm long, on the abaxial surface, glabrous adaxially. *Petals* (3.9)4.9-8.2(12.4) mm long, (2)2.7-3.9(7.6) mm wide, erect-patent, rounded or slightly emarginate (notch 0.2-0.7 mm deep), without claw, white to purple, glabrous on both surfaces, with scattered hairs on the basal margin, with hairs 0.1-0.7 mm long. *Stamens* 10, both whorls bearing anthers; filaments (2.1)2.9-3.7(4.5) mm long, lanceolate, white, pilose on the abaxial surface, ciliate on the proximal half, with hairs 0.1-0.4 mm long; anthers (0.4)0.6-0.8(1.2) mm long, pink. Nectaries 5, hemispheric, glabrous. *Gynoecium* 2.8-6.9 mm long, pale pink. *Fruit* (12)16-18(24) mm long, erect, discharge of seed-ejection type; mericarps 2.9-4 mm long, 1.2-2 mm wide, without a strand of fibers, not compressed at the apex, smooth (with 1 transverse vein at the apex), without basal beak, with a basal callus, without a basal prong, brown, with ± patent, eglandular hairs 0.2-0.8 mm long; rostrum 8.4-16.8 mm long, with a narrowed apex 0.2-1 mm long, not twisted, with erect-patent, eglandular hairs 0.1-0.6 mm long; stigmatic remnants 1.1-1.8 mm long, with 5 hairy lobes. *Seeds* 1.9-2.9 mm long, 1.1-1.5 mm wide, finely reticulate, uniformly colored, brown, glabrous. Cotyledons with entire margin.

Pollen. *Geranium*-type.

Chromosome number. Unknown.

Phenology. Collected in flower from January to December.

Distribution. This species ranges from western Asia (Saudi Arabia and Yemen) to western Africa (Cameroon, Equatorial Guinea and Nigeria) and eastern Africa (Burundi, Eritrea, Ethiopia, Kenya, Madagascar, Malawi, Rwanda, Tanzania, Uganda, Zaire and Zimbabwe).

Habitat. Roadsides, disturbed areas, rocky outcrops, grassy slopes, meadows, bamboo formations, bushlands, shady ravines, and forest edges; 700-4000 m.

1. Leaves shalowy divided [ratio main-sinus length/main segment length = (0.72)0.76-0.81(0.88); ratio secondary sinus length/main segment length = (0.16)0.20-0.25(0.33)].

82a. subsp. **arabicum**

1. Leaves deeply divided [ratio main-sinus length/main segment length = (0.80)0.87-0.91(0.98); ratio secondary sinus length/main segment length = (0.22)0.30-0.44(0.58)].

82b. subsp. **latistipulatum**

82a. Geranium arabicum subsp. **arabicum**

Geranium simense Hochst. in A. Rich., Tent. Fl. Abyss. 1: 116. 1847. Type locality: "Crescit inter Memessah et Adona, mense Sempember florens, et in convalle fluvii Mareb, ubi lethale morbi germen hausit indefessus et flebilis dotor et amicus Quartin Dillon; in regione media montis Silke, in provincia Semiène (Schimper), et in latere boreali montis Koubi, in locis frigidis prope Adoua (Schimper). Pl. Schimp. Abyss., sect. II, n° 670". Type: Ethiopia. Amhara, in regione media montis Silke, 13°22'N, 38°17'E, 14 Feb. 1840, *W. Schimper 670* (lectotype, designated by Kokwaro 1971a: 648, P-00390243!; isolectotypes, BM-00796993!, BR-008368256!, K-000417212!, MA-617368!, MO-1891050!, RO!, S-G-2853!, W!).

Geranium simense var. *glabrior* Oliv., Fl. Trop. Afr. 1: 291. 1868. Type locality: "Camaroons mountain, 7000 ft., Mann!". Type: Cameroon. Camaroons mountain, 4°09'N, 9°14'E, *G. Mann s.n.* (lectotype, designated by Kokwaro 1971a: 648, K; isolectotype, NY-03777431!).

Geranium simense var. *repens* Oliv., Fl. Trop. Afr. 1: 291. 1868. Type locality: "Upper Guinea. Fernando Po, 8-9000 ft., Mann!". Type: Equatorial Guinea. Fernando Po, 1°29'N, 5°37'E, *G. Mann s.n.* (lectotype, designated by Kokwaro 1971a: 648, K!).

Geranium simense f. *umbrosa* Engl., Abh. Königl. Akad. Wiss. Berlin 1891(2): 274. 1892. Type locality: "Abyssinien, in Gebüschen um 1900-2800m; Mariam-Schoïdo (Schi. 1862 n. 736); Abo-Wadela (St. 974); Debra-Tabor bei Gafat (St. 982); Magdala (St. 983); Nori (St. 973); mittlere Region des Silke (Schi. II 670); Nordseite des Kubbi (Schi. II 1061); Lotho (Schi. 1854 n. 346). Kilimandscharo, im unteren Wald um 2000 m (Dr. Hans Meyer n. 18). Kamerungebirge, um 2300 m (G. Mann n. 1966)". Type: Ethiopia. Tigray, Kubbi, 14°08'N, 38°43'E, 20 Nov. 1838, *W. Schimper 1061* (lectotype, here designated, W!; isolectotypes, K-00417213!, LE!, P-0039025!).

Geranium simense f. *aprica* Engl., Abh. Königl. Akad. Wiss. Berlin 1891(2): 274. 1892. Type locality: "Abyssinien, auf Bergwiesen um 2700 m; am Hedscha (Schi. 1862 n. 734); Intschatkab (Schi. II 1378); am Guna (St. 980). Kilimandscharo, um 2900 m (v. Höhnel 134 (149). Fernando-Po, um 2600-2900 m (G. Mann)". Type: Ethiopia. Abyssinien, Tigray, Hedscha, 13°30'N, 39°30'E, 5 May 1862, *W. Schimper 734* (lectotype, designated by Kokwaro 1971a: 648, BM; isolectotypes, K, PRE-00775695 image!, Z-000172336!).

Geranium simense var. *meyeri* Engl., Abh. Königl. Akad. Wiss. Berlin 1891(2): 274. 1892. Type locality: "Kilimandscharo, an der Schneequelle um 4500 m (Dr. Hans Meyer n. 15)". Type: Tanzania. Kilimandscharo, 3°08'S, 37°26'E, *H. Meyer 15* (lectotype, designated by Kokwaro 1971a: 648, B destroyed).

Geranium keniense Standl., Smithsonian Misc. Collect. 68(5): 7. 1917. Type locality: "Type in the U.S. National Herbarium, no. 631573, collected on the western slopes of Mount Kenia, along the trail from West Kenia Forest Station to summit, in the giant heath zone, British East Africa, altitude about 3,630 meters, September 21 to 27, 1909, by E.A. Mearns (no. 1513)". Type: Kenya. Mount Kenya, along the trail from West Kenya Forest Station to summit, 0°15'S, 37°15'E, 21-27 Sep. 1909, *E.A. Mearns 1513* (holotype, US-631573!; isotype, BM-000796991!).

Geranium simense var. *keniense* R. Knuth, Repert. Spec. Nov. Regni Veg. 34: 144. 1933. Type locality: "Kenya-Kolonie: Mount Elgon, 2600 m (Granvik a. 1926 n. 44 - Typus der Varietät!)". Type: Kenya. Mount Elgon, 1°08'N, 34°33'E, 1926, *H. Granvik 44* (holotype, B destroyed).

Leaf laminas (1.3)2.9-4.1(6.6) cm long, 1.5-7.5 cm wide, palmatifid [ratio main-sinus length/middle segment length = (0.72)0.76-0.81(0.88), ratio secondary sinus length/middle segment length = (0.16)0.20-0.25(0.33)]; segments 5, middle segment rhombic, (2.6)3.7-7(11.6) mm wide at the base, 7-15(18)-lobed in distal half. Figs. 229 a-l, 230.

Pollen. *Geranium*-type (Bortenschlager 1967: 433 [sub *G. simense* and *G. frigidum*]).

Chromosome number. 2*n* = 28.

Phenology. Collected in flower from January to December.

Distribution. This subspecies ranges from western Asia (Saudi Arabia and Yemen) to western Africa (Cameroon, Equatorial Guinea and Nigeria) and eastern Africa (Burundi, Eritrea, Ethiopia, Kenya, Madagascar, Malawi, Rwanda, Tanzania, Uganda, Zaire and Zimbabwe) (Fig. 231).

Habitat. Roadsides, disturbed areas, rocky outcrops, grassy slopes, meadows, bamboo formations, bushlands, shady ravines, and forest edges; 700-4000 m.

Representative specimens examined. **Burundi.** Muramvya: Bugarama, 2°41'S, 29°0'E, 25 June 1966, *Lewalle 1016* (BR, S); Teza, 3°12'S, 29°33'E, 29 Oct. 1972, *Reekmans 1978* (BR). Ruyigi: Rusengo, 3°23'S, 30°21'E, July 1932, *Becquet 140* (BR). **Cameroon.** Adamawa: Tchabal Mbabo, de Ardo Niakol a Hama Aoudi, 7°16'N, 12°9'E, 2 Nov. 1967, *Félix 8982* (P). Northwest: station on the road going to the Forestry plantation, 6°30'N, 10°40'E, 2 July 1959, *Daranola 40576* (P); près Nsom vers Kakar (25 km SSE Nkambé), 6°38'N, 10°40'E, 9 July 1967, *Letouzey 8819* (P). Southwest: Cameroon Mt., Hut 1, 4°8'N, 9°14'E, 23 Mar. 1981, *Morton 1271* (MO); NE side of Cameroun mountain, along road to radio Station, 4°13'N, 9°10'E, 30 Oct. 1963, *Tryon & al. 6508* (GH). West: Bambuttos, au dessus de Djuttitsa, 16 km NNE de Dschang, 5°26'N, 10°3'E, 5 Apr. 1976, *Villiers 1131* (P). **Equatorial Guinea.** Bioko Norte: pico Basilé, 3°35'N, 8°45'E, 1 Dec. 2010, *Aedo & al. 18093* (MA). Bioko Sur: camino de Moca Malabo hacia el lago Biaó, mirador del lago Biaó, 3°21'N, 8°37'E, 18 Dec. 2007, *Cabezas & al. 1096* (MA). **Eritrea.** Gash-Barka: Mochi, 14°25'N, 37°33'E, 5 Oct. 1916, *Baldrati 655* (FT). Southern: Halai, 15°1'N, 39°20'E, 28 Apr. 1894, *Schweinfurth 333* (JE, Z); Acchelé Guzai, Saganeiti, 15°3'N, 39°11'E, 11 Sep. 1902, *Pappi 263* (G); Saganeiti, gorge de Degerra, 15°3'N, 39°11'E, 1 May 1892, *Schweinfurth & Riva 1781* (G, P, Z). **Ethiopia.** Amhara: 50 km N of Debre Markos, trail across Choke mts towards Mota, 10°38'N, 37°50'E, 9 Sep. 2004, *Friis & al. 11516* (C, UPS); Amara, Gonder, mt. Guna, 11°43'N, 38°14'E, 4 Apr. 1986, *Hedberg 86018* (UPS); Mareb, 12°20'N, 39°16'E, Nov., *Quartin-Dillon 597* (P); Cabberé, 13°0'N, 38°0'E, 1853, *Schimper 334* (G, P). Oromia: Mega, 4°5'N, 38°20'E, 18 Feb. 1952, *Gillett 14346* (B, FT); 43 km S Agere Selam, on road to Kebre Mengist, 6°12'N, 38°42'E, 11 Jan. 1972, *Friis 737* (C). Southern Nations, Nationalities, and Peoples: Oromia, Agere Selam near NLM station, 6°29'N, 38°31'E, 1 Sep. 1971, *Hovda s.n.* (UPS). Tigray: de Memsa a Adua, 14°9'N, 38°53'E, *Quartin-Dillon 10* (P). **Kenya.** Bomet: Nyansa province, Kericho district, South Western Mau forest reserve, camp 8, 0°36'S, 35°18'E, 15 Aug. 1949, *Maas 5809* (Z). Embu: 4 mi above Irangi, 0°31'S, 37°27'E, 26 Sep. 1949, *White 1377* (COI, GB). Nandi: Nyansa province, Londiani district, Tinderet forest reserve, camp 5, 0°1'S, 35°23'E, 8 July 1949, *Maas 5418* (COI, G, GB, S, Z). Nakuru: Rift Valley province, Bahati Escarpment, 20 km

NE of Nakuru, 0°10′S, 36°11′E, 11 Sep. 1966, *Strid 3117* (GB). Nyeri: Central province, Nanyuki district, mt. Kenya W slope, 0°10′S, 37°13′E, 20 Jan. 1971, *Vänskä 55* (H); Nyeri district, Aberdare mts., 1 km NW Kiandongoro gates, 0°27′S, 36°50′E, 18 Sep. 1986, *Hagemann 3058* (B). Taita-Taveta: Wundanyi, Vuria Hill, 3°25′S, 38°18′E, 21 Feb. 2012, *Chase & al. 6654* (UPS). Trans-Nzoia: Mt. Elgon, versant E, mission SW de l'Omo, 1°8′N, 34°36′E, 28 July 1933, *Aramboug s.n.* (P). **Madagascar.** Antananariyo: Ankaizinana, 17°59′S, 47°21′E, 19 Apr. 1923, *Decary 1925* (P); Tananarive, district de Manjakandriana, autour du Ambatolaona, 18°55′S, 47°53′E, 11 Nov. 1912, *Humbert 1201* (B). Mahajanga: Fiv. Bealanana, commune Mangindrano, lac Matsabor y Maika, 14°9′S, 48°57′E, 16 Apr. 2003, *Razafitsalama & al. 354* (P). Toliara: versant N du Pic d'Ivohibe, 24°42′S, 46°58′E, 28 Sep. 1926, *Decary 5643* (P). **Malawi.** Central: Viphyya playeau, 11°47′S, 33°48′E, 18 Apr. 2013, *Buira 1850* (MA); Dedza mt., 14°21′S, 34°21′E, 6 Apr. 1989, *Hedberg 89095* (UPS). Northern: Nkhata Bay district, 2 mi SW Chikangawa, 11°50′S, 33°48′E, 3 Aug. 1978, *Phillips 3674* (MO, Z). Southern: Mt. Milanji, 15°53′S, 35°41′E, 1891, *Whyte s.n.* (G, WU). **Nigeria.** Cross river: Obudu, Cattle Ranch, 6°22′N, 9°22′E, 17 Aug. 1973, *Linnavuori s.n.* (H). **Rwanda.** Kigali: Gisozi, 1°55′S, 30°3′E, 23 Apr. 1993, *Breyne 5996* (BR). Southern: forêt de Nyungwe, environs du Uwinka, 2°32′S, 29°27′E, 10 Aug. 1969, *Bouxin & Radoux 584* (BR). Western: Ruhengeri, Kidaho, Rutovu, 1°23′S, 29°45′E, 27 Mar. 1962, *Nshonere A46* (BR). **Saudi Arabia.** Asir: Raida escarpment, 18°12′N, 42°24′E, 9 May 1992, *Hedberg & Hedberg 92108* (UPS). **South Sudan.** Eastern Equatoria: Imatong Mts., Kipia, 3°57′N, 32°57′E, 6 July 1947, *MacLeay 195* (BM). **Tanzania.** Arusha: Arusha National Park, mt Meru, 3°13′S, 36°40′E, 23 June 1946, *Greenway 7806* (US). Kagera: W Lake province, Ngara, Bushubi, Keza, 2°45′S, 30°41′E, 15 May 1960, *Tanner 4985* (B, S). Kilimanjaro: Kilimanscharo, 3°4′S, 37°22′E, 21 Feb. 1934, *Schlieben 4816* (B, G, MA, P, S, Z); Moshi district, 3°20′S, 37°20′E, 16 Oct. 1943, *Wallace 111* (S); South Pare Mts., Chome Forest Reserve, Bwambo Gujini-Heigande, 4°21′S, 37°54′E, 8 Sep. 1999, *Mlangwa & Masanyika 475* (MA, MO). Mbeya: Poroto mts., 9°0′S, 33°45′E, 17 May 1957, *Richards 9780* (B, S). Njombe: Songea district, Matengo hills, Luwiri Kitega, 9°18′S, 35°8′E, 24 May 1956, *Milne-Redhead & Taylor 10428* (B). Tanga: W Usambara, Manolo, Msai, 4°37′S, 38°14′E, 28 May 1914, *Peter 4141* (B). **Uganda.** Western: Ruwenzori, Mobuku valley, Bikoni, 0°11′N, 30°14′E, 30 Dec. 1934, *Taylor 2732* (G, S); Bushenyi, Buhweju Bushenyi, Ankole, Nyankalokwe, Rugongo, 0°22′S, 30°29′E, 11 Sep. 2000, *Rwaburindore 4985* (C, UPS); Western province, Kigezi district, Virunga Kette, Muhavura und Mgahing, 1°22′S, 29°40′E, 14 Nov. 1954, *Stauffer 766* (P, UPS, Z). **Yemen.** Janad: Djennati, 13°32′N, 44°1′E, Nov. 1837, *Botta s.n.* (P); Ibb governate, 4 mi. SE of Ibb on Ibb Research Farm, in Wadi Mahchtul, 13°56′N, 44°10′E, 1 Aug. 1983, *Spellenberg & al. 7537* (NY). Tahama: Shibam, c. 40 km NE Sanaa, 15°30′N, 43°54′E, 17 Oct. 1975, *Hepper 5767* (C). **Zaire.** North Kivu: Virunga-Kette, Nyamuragira Nordhang, beim Laboratorie, 1°24′S, 29°12′E, 20 Aug. 1954, *Stauffer 103* (UPS, Z); Camp Rueru, SW slope of mt. Mikeno, 1°27′S, 29°25′E, 14 Mar. 1927, *Linder 2322* (GH); volcan Mikeno, 1°27′S, 29°25′E, 1934, *Witte 1774* (P); Shaheru, 1°28′S, 29°25′E, Jan., *Lebrun 9345* (P). **Zimbabwe.** Manicaland: Inyanga district, ad pagum Inyanga, 18°20′S, 32°40′E, 22 Jan. 1931, *Norlindh & Weimarck 4550* (UPS); Inyanga, above left bank of Nyamingura river, 18°23′S, 32°57′E, 26 Apr. 1958, *Phipps 1255* (P); Eastern division, Umtali district, Engwa, 19°22′S, 32°46′E, 2 Feb. 1955, *Exell & al. 91* (BM).

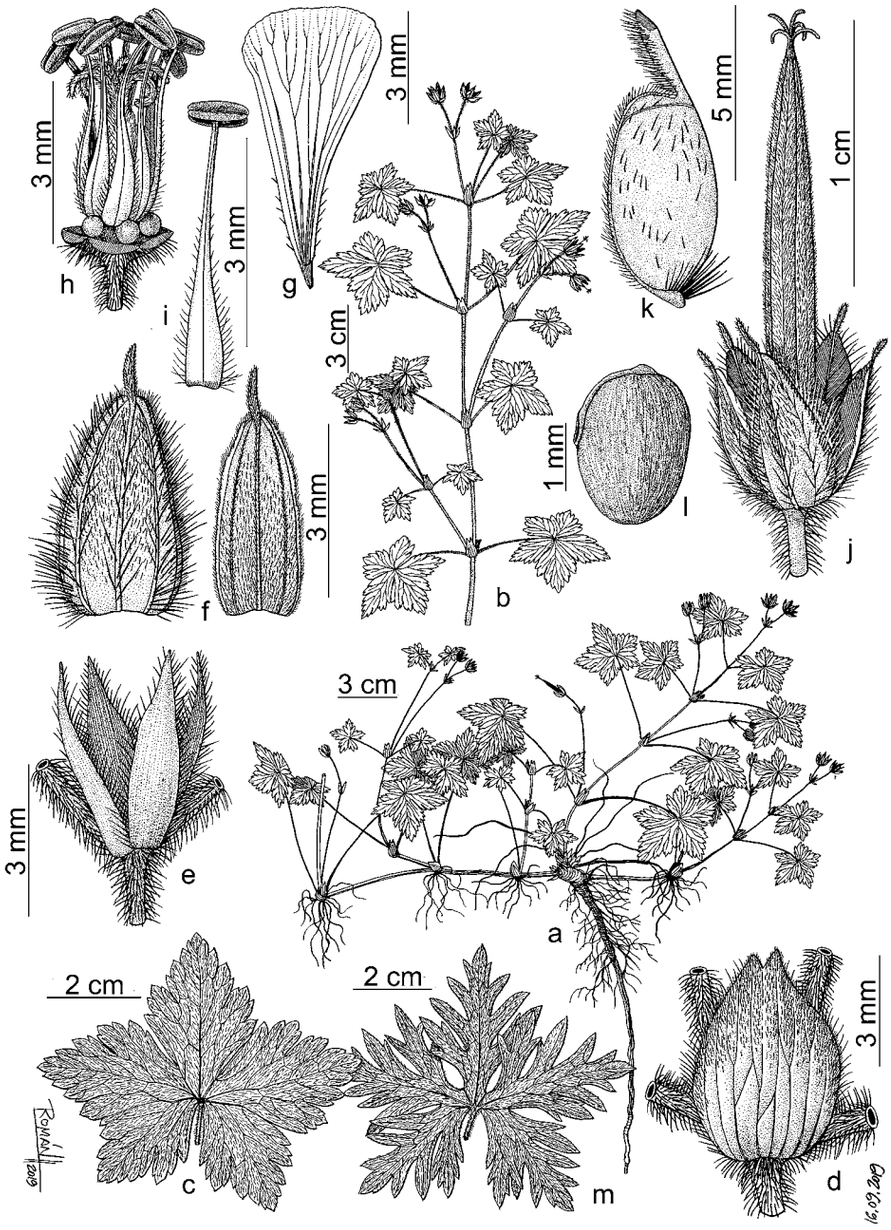


Fig. 229. *Geranium arabicum* subsp. *arabicum.* a, b. Habit. c. Leaf. d. Stipules. e. Bracteoles. f. Sepals. g. Petal. h. Flower without petals and sepals. i. Stamen. j. Fruit. k. Mericarp. l. Seed. (Based on: a, b, g-i, *Baldrati 664,* FT; c, *Ambjörn 314,* S; d-f, *Hildebrandt 199,* WU; j-l, *Schimper 736,* C. *Geranium arabicum* subsp. *latistipulatum.* m. Leaf. (Based on: *Fries 1537,* UPS).

Fig. 230. *Geranium arabicum* subsp. *arabicum* (Based on: *Aedo 18093,* MA).

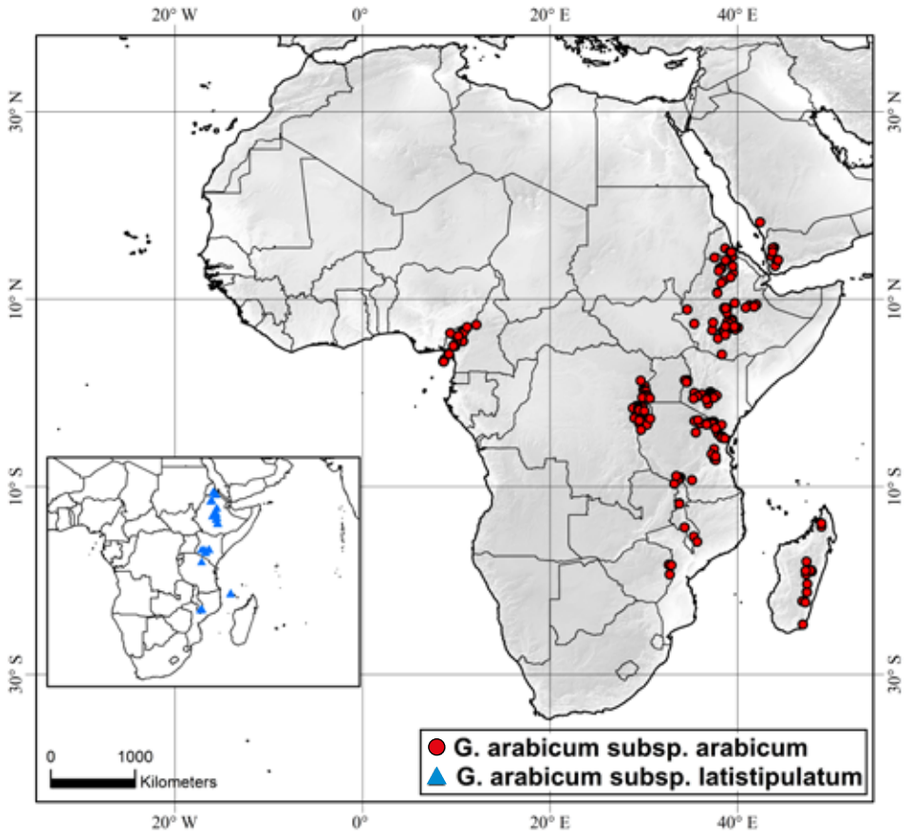


Fig. 231. Distribution of *Geranium arabicum*.

82b. Geranium arabicum subsp. **latistipulatum** (Hochst. ex A. Rich.) Kokwaro, Kew Bull. 23: 530. 1969. *Geranium latistipulatum* Hochst. ex A. Rich., Tent. Fl. Abyss. 1: 117. 1847. Type locality: "Geranium latistipulatum. Hochst., in pl. Schimp. Abyss., sect. II, n° 1378... Crescit in pratis montanis prope Entchetkab, et in monte Bouahit, provincia Semiène, mense Julio flores (Schimper)". Type: Ethiopia. Entchetkab, 13º07'N, 38º07'E, 31 July 1838, *W. Schimper 1378* (lectotype, designated by Kokwaro 1971a: 649, P-00390246!; isolectotypes, BM, BR-008368287!, FI-W-30037!, K-000417214!, MA-617381!, MO-1891079!, W!).

Geranium mlanjensis J.R. Laundon, Bol. Soc. Brot. ser. 2, 35: 70, [foto 4]. 1961. Type locality: "NYASALAND: Mt. Mlanje: Luchenya Plateau, 2100 m., fl. & fr. 11.VII.1946, Brass 16789 (K!; NY; SRGH!), fl. & fr. 1891, Buchanan 1018 (K!); Path from Little Ruo down to Naiwani, fl. & fr. 29.VII.1957, Chapman 467 (BM!, LISC!; SRGH!); Tuchila Plateau 1950 m., fl. & fr. 21.VII.1956, Newman & Whitmore 132 (BM!, holotype; SRGH!, isotype); Little Ruo Plateau, 1890 m., fl. 4.VIII.1956, Newman & Whitmore 332 (BM!; SRGH!); Plateau, fl. 10.XI.1913, Shinn 7 (BM!); 1830 m., fl. X.1891, Whyte 72 (BM!)". Type: Malawi. Tuchila Plateau, 15°58'S, 35°17'E, 21 July 1956, *E.I. Newman & T.C. Whitmore 132* (holotype, BM-000797019 image!; isotype, SRGH).

Leaf laminas (1.8)2.3-3.4(6.1) cm long, 2.2-6.8 cm wide, palmatifid [ratio main-sinus length/middle segment length = (0.80)0.87-0.91(0.98), ratio secondary sinus length/middle segment length = (0.22)0.30-0.44(0.58)]; segments 5, middle segment rhombic, (1.7)2.4-3.5(5.9) mm wide at the base, (7)11-15(19)-lobed in distal half. Fig. 229 m.

Pollen. Ornamentation not studied.

Chromosome number. Unknown.

Phenology. Collected in flower from January to December.

Distribution. This subspecies ranges from Eritrea, through Ethiopia, Kenya, Tanzania and Malawi to Comoros (Fig. 231).

Habitat. Roadsides, rocky slopes, meadows and forest edges; 1840-3300 m.

Additional specimens examined. **Comoros.** plateau de la Grand Comore, 11°34'S, 43°19'E, May 1847, *Boivin s.n.* (P); Grand Comore, pente W du Karthala, 11°44'S, 43°21'E, 8 Dec. 983, *Villiers 2270* (P). **Eritrea.** Central: Hamasen, Asmara, 15°20'N, 38°55'E, 10 Sep. 1915, *Baldrati 662* (FT); Asmara, Adi Sono, 15°20'N, 38°55'E, 23 Apr. 1909, *Chiovenda 69* (FT); Hamasen, lungo il Mai Belà presso Asmara, 15°20'N, 38°55'E, 5 May 1902, *Pappi 5081* (FT, G, Z); Asmara, 15°20'N, 38°55'E, 14 Feb. 1893, *Terracciano & Pappi 450* (FT). Gash-Barka: Amasen, At-Zien, 15°25'N, 38°40'E, 19 May 1902, *Pappi 5283* (FT, G). Northern Red Sea: Assaorta, monte Dijot, 15 Aug. 1902, *Pappi 2972* (FT). Southern: Amarta, grupo del monti Soyra, monte Mamahot verso il torrente Arigot, 14°44'N, 39°30'E, 23 Aug. 1902, *Pappi 1252* (FT). **Ethiopia.** Addis Ababa: c. 13 km E of Addis Abbaba, 9°1'N, 38°44'E, 19 Oct. 1947, *Ambjörn 448* (S); Addis Ababa, 9°1'N, 38°44'E, 24 Apr. 1966, *De Wilde 10830* (B, C, MO, P). Amhara: Debrebarham, 9°40'N, 39°31'E, 1972, *Hildebrandt 300* (WU); Wollo province, Dessie, 11°8'N, 39°38'E, 6 Aug. 1946, *Hall 9* (BM); Cabberé, 13°0'N, 38°0'E, 1853, *Schimper 338* (G, P, S, WU); Begemder province, Semian mountains, Sankaber, 1 km from wardens house on road to Addis Gey, 13°18'N, 38°15'E, 24 Sep. 1969, *De Wilde & Gilbert 226* (UPS). Oromia: Oromiya, bale, Goba, in the town, pr. police station, 7°0'N, 39°58'E, 11 Nov. 1982, *Hedberg 9102* (UPS); Bale province, 25 km W of Dinchu or Curie, 7°6'N, 39°47'E, 28 May 1972, *Ash 1711* (MO); Oromia, 40 km NW of Arsi-Robe towards Iteya, 8°8'N, 39°25'E, 22 Oct. 2006, *Friis & al. 12533* (C, UPS); Amara, Shewa, Gorebela escarpment between town and church, 8°35'N, 39°42'E, 5 June 1982, *Edwards & al. 502/82: 64* (UPS); Addis Abeba, Olettà, 9°4'N, 38°30'E, 25 Oct. 1937, *Bartolozzi s.n.* (FT); Oromiya, Shoa province, 7 km S of Mulu farm on cement factory road, turning off left c. 45 km N of Addis Ababa on main Gondar road, 9°18'N, 38°45'E, 14 Sep. 1973, *Ash 2084* (UPS); Addis Abeba, Bolè, 9°32'N, 38°45'E, 20 June 1939, *Pichi Sermoli s.n.* (FT). **Kenya.** Meru: Mt. Aberdare, rivuli Marania, 0°3'N, 37°27'E, 14 Feb. 1922, *Fries & Fries 1537* (UPS); Meru, plateau du Kenya, 0°02'N, 37°38'E, 16 Sep. 1937, *Babault s.n.* (P, S). Nyandarua: Thompson's Falls, 0°2'N, 36°21'E, 23 Mar. 1936, *Meinertzhagen s.n.* (BM, S); Mt. Aberdare, Kinangop plateau, 0°44'S, 36°34'E, 4 Apr. 1922, *Fries & Fries 2736* (UPS). Nyeri: Mt. Aberdare, Coles Mill, 0°30'S, 36°42'E, 20 Jan. 1922, *Fries & Fries 1060* (UPS); Mt. Aberdare, forest station, 0°30'S, 36°42'E, 28 Dec. 1921, *Fries & Fries 460* (UPS). Uasin Gishu: Mau Range, c. 10 km N of Timboroa, 0°3'N, 35°32'E, 2 June 1948, *Hedberg 1082* (UPS, S). **Malawi.** Southern: Mlanje Mt., near Sombani Hut, 15°53'S, 35°41'E, 4 Jan. 1971, *Hilliard & Burtt 6154* (MO, S); Southern province, Mt. Mulanjeon the approach to Chinzama Hut from Sombani directionateau, 15°53'S, 35°39'E, 7 Sep. 1998, *Strungell & al. 85* (MO); Mt. Milanji, 15°53'S, 35°41'E, 1891, *Whyte s.n.* (Z); Southern region, Mulanje, Lichenya Plateau, 15°58'S, 35°32'E, 16 Apr. 2013, *Buira 1830* (MA); Mlanje Mt., path from Little Ruo down to Naiwani, 15°58'S, 35°17'E, 29 July 1957, *Chapman 467* (BM); Mlanje mountain, pentes de la partie superieure du versant occidental, 15°58'S, 35°34'E, Sep. 1937, *Humbert 17173* (P); Mlanje Mt., Luchenya Plateau, 16°0'S, 35°18'E, 11 July 1946, *Brass 16789* (MO, NY, US). **Tanzania.** Arusha: Ngorongoro crater, 3°10'S, 35°35'E, 24 Dec. 1967, *Jaasund 2352* (GB).

Discussion. Geranium arabicum is a trailing herb with a slender vertical rootstock that has slim roots. The aerial stems are profusely branched and scrambling and rooting in the nodes. This species is easily distinguished by its broadly ovate, connate stipules, present in all nodes of the stem. These stipules may be obtuse or acute, and then sometimes with the tip remaining free. The indumentum varies in density and always consists of short, eglandular hairs. Normally, at least some cymules in each plant of *G. arabicum* are 2-flowered, but 1-flowered cymules are not infrequent. In extreme forms, 2-flowered cymules can be difficult to locate. The petals are usually a little longer than the sepals but widespread throughout the area of *G. arabicum* specimens appear with petals twice as long (up to ca. 10 mm long). One collection from the Aberdare Mountains in Kenya [*Strid 2187* (GB, UPS)] has unusual petals of 12.4 mm long, but otherwise it falls into the variability of *G. arabicum*. The petals also vary in color from white to purple, but independent of other features.

The leaves are opposite and very variable in size and degree of division. Scattered throughout the distribution area of the typical *G. arabi-*

cum, some forms with deeply divided leaves have been found. These forms lack a particular habitat or area of distribution and are connected by intermediate individuals that, at first, do not advise its taxonomic recognition. I finally have accepted them as subsp. *latistipulatum* because they seem to remain constant in the populations, considering the series of duplicates examined. In these plants, the primary and secondary segments are narrower and more deeply divided than in those of *G. arabicum* s.str. There is some overlap in all measurements that difficult identifications and no other feature has been found to support this subspecies.

Gilbert & Vorster (2000: 366) proposed a "G. sp. = *Miehe* 3002" and a "subsp. = *Ash* 1711", both without Latin description nor holotype. I have seen one herbarium sheet from "Bale Mountains National Park, Sanetti Plateau, E of Mt Batu, between Tulu Dimtu and Garba Guracha" collected by *Friis & al. 5750* (C) that could correspond to the former and that I have classified as *G. kilimandscharicum* and a dupla of *Ash 1711* (MO) that I have classified as *G. arabicum* subsp. *latistipulatum*. This provisional way of describing species that is seen in some floras is somewhat disappointing as it makes it difficult to analyze the variability of the species concerned.

Wondimu & al. (2017) studied the complex of *G. arabicum* and allied species of mainland Africa using AFLP markers. They focused the work on alpine populations and they identify only two genetic groups corresponding to *G. arabicum* and *G. kilimandscharicum*. These authors considered that some taxa not validly described by Gilbert & Vorster (2000), as well as subsp. *latistipulatum* do not deserve taxonomic recognition.

According to Hilliard & Burtt (1985: 222), *G. arabicum* is also present in South Africa (Eastern Cape, Port St. Johns, 31°37'S, 29°32'E, *Wager s.n.* (PRE)). Unfortunately, it has not been possible to examine any voucher of that record.

83. Geranium kilimandscharicum Engl., Abh. Königl. Akad. Wiss. Berlin 1891(2): 274. 1892. Type locality: "Kilimandscharo, auf den oberen Grasflächen von 4000-4500 m (blühend im November -- Dr. Hans Meyer n. 16, 255)". Type: Tanzania. Kilimandscharo, Nov., *H. Meyer 16, 255* (B destroyed). Tanzania. Kilimanjaro, near Peters Hut, 3°08'S, 37°26'E, 16 June 1948, *O. Hedberg 1221* (neotype, designated by Kokwaro 1971b: 8, UPS-139989!; isotypes, EA, K!, S!).

Perennial herbs, 4-19 cm tall. *Rootstock* 1.4-3.6 mm in diameter, ± vertical, not tuberculate, not turnip-shaped, without thickened roots. *Stem* prostrate, leafy, not rooting at nodes, stolons absent, without vegetative stems, with patent to retrorse, eglandular hairs 0.1-0.7 mm long. *Basal leaves* in a deciduous rosette, cauline leaves opposite; leaf laminas (0.9)1.1-1.7(2.4) cm long, 1.1-2.9 cm wide, not peltate, palmatifid [ratio main-sinus length/middle segment length = (0.69)0.70-0.74(0.81)], orbicular in outline, base cordate, not coriaceous, with nerves not projected, pilose, with ± appressed, eglandular hairs on both surfaces; segments 5, in 1 plane, middle segment obtriangular, (1.7)1.8-2.7(5.1) mm wide at the base [ratio segment width at the base/middle segment length = (0.24)0.27-0.33(0.44)], 3-5(7)-lobed in distal half [ratio secondary sinus length/middle segment length = (0.22)0.28-0.36(0.49)]; petioles up to 7 cm long, without abscission zone, terete, not swollen, not deflexed in age, with patent to retrorse, eglandular hairs 0.2-0.5 mm long; stipules 1.9-4.2 mm long, 1.9-3.8 mm wide, broadly ovate, connate, papery, brown, with eglandular hairs on abaxial surface and on the margin, glabrous adaxially. *Inflorescence* a monochasial cyme; cymules 1-flowered, solitary [ratio cymule length/leaf length = (0.5)0.6-1.2(1.9)]; peduncles (2.2)7-22(30) mm long, with retrorse to patent, eglandular hairs 0.1-0.4 mm long; bracteoles 2.1-4.6 mm long, 0.6-2.5 mm wide, lanceolate, opposite; pedicels (1.8)7.9-14.9(17.3) mm long, with patent to retrorse, eglandular hairs 0.1-0.5 mm long. Flowers actinomorphic. *Sepals* (3.9)4.8-5.9(7.6) mm long, 1.8-3.8 mm wide, lanceolate, smooth, not accrescent, nerves 3, mucro (0.2)0.2-0.5(0.6) mm long [ratio mucro length/sepal length = 0.04-0.12], with ± patent, eglandular hairs 0.2-1 mm long on the abaxial surface, glabrous adaxially. *Petals* (4.2)5.5-8.3(9.9) mm long, (2.1)2.9-4(4.6) mm wide, erect-patent, rounded, without claw, pale pink or white, glabrous. *Stamens* 10, both whorls bearing anthers; filaments (2.4)2.6-3.3(3.5) mm long, lanceolate, white, glabrous or pilose on the abaxial surface, ciliate on the proximal half, with hairs 0.1-0.2 mm long; anthers (0.7)0.7-0.8(0.9) mm long, pink. Nectaries 5, hemispheric, glabrous. *Gynoecium* 1.9-4.1 mm long, white. *Fruit* (13)14.9-16.9(18) mm long, erect, discharge of seed-ejection type; mericarps 2.5-3.3 mm long, 1.5-1.8 mm wide, without a strand of fibers, not compressed at the apex, smooth (with 1-2 transverse veins at the apex), without basal beak, with a basal callus, without a basal prong, brown, with ± patent, eglandular hairs 0.2-0.4 mm long; rostrum 9.5-12.8 mm long, without a narrowed apex, not twisted, with erect-patent, eglandular hairs 0.1-0.4 mm long; stigmatic remnants 0.9-1.9 mm long, with 5 glabrous lobes. *Seeds* 2-2.2 mm long, 1.4-1.6 mm wide, finely reticulate, uniformly colored, brown, glabrous. Cotyledons with entire margin. Fig. 232, 233.

Pollen. *Geranium*-type (Bortenschlager 1967: 431).

Chromosome number. Unknown.

Phenology. Collected in flower from January to December.

Distribution. This species ranges from Ethiopia through Uganda and Kenya to northern Tanzania (Fig. 234).

Habitat. Disturbed areas, grassy slopes, rocky outcroops, bogs and ericaceous scrubs; 2900-4250 m.

Additional specimens examined. **Ethiopia.** Oromia: Bale Region, Bale Mountains

National Park, Sanetti Plateau, between Tulu Dimtu and Garba Guracha, 6º51′N, 39º51′E, 6 Nov. 1988, *Friis & al. 5750* (C); Bale province, c. 20 mi S of Goba, on route to Maslo, 7º0′N, 39º40′E, 6 Apr. 1975, *Ash 2868* (US); Bale province, c 20 mi S of Goba, foot of mount Tolu Deemtu, 7º0′N, 39º58′E, 22 June 1976, *Ash 3533* (C, FT, P, UPS, US); Bale province, Bale Mountains National Park, Garba Goracha camp, Giant Mole Rat, 7º10′N, 39º48′E, 30 Oct. 1973, *Hedberg 5555* (UPS). **Kenya.** Bungoma: Mt. Elgon, in the crater, at Maji ya Moto, 1º8′N, 34º36′E, 21 May 1948, *Hedberg 1023* (UPS); Western Province, Mt. Elgon, on the ridge W of Suam River, 1º9′N, 34º38′E, 25 Sep. 1966, *Bie 66311* (UPS); Mt. Elgon, E slope above Japata estate, 1º9′N, 34º38′E, 23 Feb. 1948, *Hedberg 141* (UPS); Mt. Elgon, 1º9′N, 34º38′E, 13 June 1920, *Lindblom s.n.* (S). Meru: mt. Kenya, Surinam Track, 17 Apr. 1962, *Bernardi 9174* (US); Meru, Mt Kenia National Park, Sirimon Track, 0º3′S, 37º17′E, 21 Sep. 1986, *Hagemann & Classen 3136* (B); Central Province, Mt Kenia National Park, Sirimon Track, at Camp Site, 0º3′S, 37º17′E, 12 Feb. 1979, *Jonsell & Moberg 4680* (UPS); Meru, mount Kenia, near Shipton's cave, 0º8′S, 37º18′E, 4 Oct. 2011, *Buira 1643* (MA); Mt Kenia, Gorges valley, along edges of Nithi River, 0º8′S, 37º22′E, 11 Jan. 1958, *Coe & Karika 363* (UPS); Mt Kenia National Park, vicinity Metior Station, 0º8′S, 37º24′E, 11 Jan. 1975, *Croat 28201* (MO); Mt Kenia, W alpine region, in the upper part of the Hausburg Valley, 0º8′S, 37º15′E, 9 Aug. 1948, *Hedberg 1863* (UPS, S). Nyandarua: Mt Aberdare, pr. Sattima, 0º19′S, 36º36′E, 13 Mar. 1922, *Fries & Fries 2373* (UPS). Nyeri: Nanyuki district, Mt Kenia, 0º7′S, 37º14′E, 16 July 1971, *Hedberg 5029* (UPS); Mt Aberdare, 0º23′S, 36º38′E, 4 Feb. 1922, *Fries & Fries 1364a* (UPS); Mt Aberdare, Naivasha district., Naivasha-Nyeri track, 0º27′S, 36º42′E, 28 Oct. 1934, *Taylor 1402* (BM, S). **Tanzania.** Arusha: Mt. Meru, 3º15′S, 36º44′E, 17 Jan. 1970, *Hedberg 4653* (UPS). Kilimanjaro: Kilimandscharo, Shira Plateau, 3º2′S, 37º14′E, 4 July 1970, *Friis 244* (C); Kilimandscharo, Shira Plateau, W of Kibo, 3º2′S, 37º14′E, 19 July 1970, *Zogg & Gassner 21/22* (Z); Kilimandscharo, 3º4′S, 37º22′E, 29 Dec. 1933, *Schlieben 4427* (B, BM, MA P, S, Z); Kilimandscharo, S slope above Mweka Wildlife College, 3º8′S, 37º22′E, 18 Nov. 1967, *Hedberg 4374* (UPS); Kilimandscharo, 3º8′S, 37º26′E, Dec. 1929, *Wettstein s.n.* (WU); Kilimandscharo, Marangu route SE of Kibo, 3º8′S, 37º26′E, 15 July 1967, *Zogg & Gassner 2/20* (Z); Kilimandscharo, uber Peter's Hut, 3º8′S, 37º26′E, 17 July 1967, *Zogg s.n.* (Z). **Uganda.** Eastern: Bugishu province, Mt. Elgon, Mudange, 1º7′N, 34º29′E, May 1935, *Synge 1895* (BM).

Discussion. Geranium kilimandscharicum is an herb with a slender vertical rootstock and prostrate aerial stems that do not root in the nodes as in *G. arabicum*. The former shares with *G. arabicum* the general appearance, the broadly ovate and connate stipules, and the eglandular indumentum. The stipules of *G. kilimandscharicum* are shorter than in *G. arabicum* and always with a rounded apex. The inflorescence is monochasially branched with cymules shorter than those of *G. arabicum* and constantly 1-flowered. The fruit of *G. kilimandscharicum* is a bit shorter than that of the *G. arabicum* and has a rostrum without a narrowed apex and glabrous stigmatic remnants. The leaves of *G. kilimandscharicum* are small and

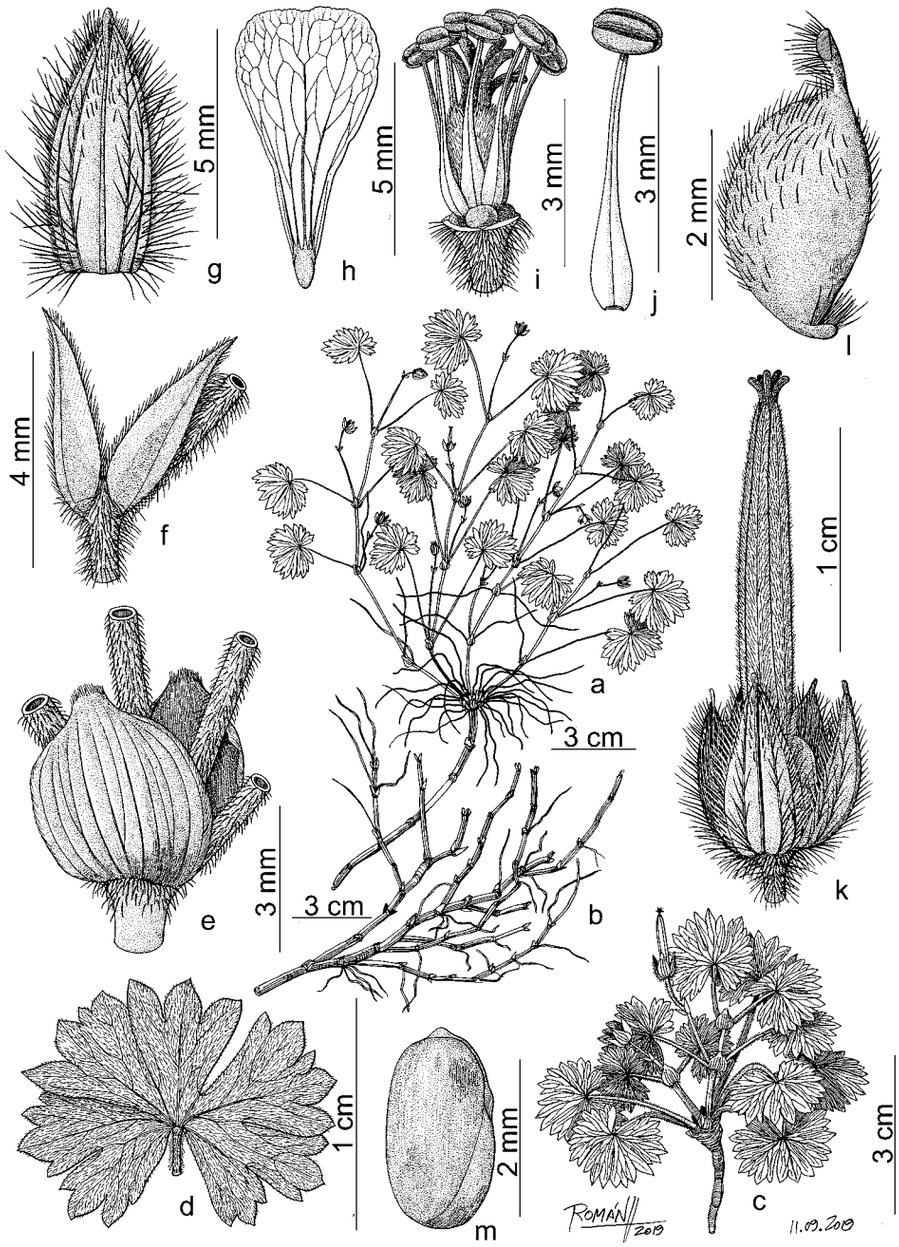


Fig. 232. *Geranium kilimanscharicum*. a, b. Habit. c. Fruiting branch. d. Leaf. e. Stipules. f. Bracteoles. g. Sepal. h. Petal. i. Flower without petals and sepals. j. Stamen. k. Fruit. l. Mericarp. m. Seed. (Based on: a, e-j, *Coe & Karika 363,* UPS; b, *Hedberg 4374,* UPS; c, k-m, *Zogg s.n.*, Z-000172319; d, *Wettstein s.n., Dec. 1929*, WU).

Fig. 233. *Geranium kilimandscharicum* (Based on: *Buira 1643,* MA, photo: A. Buira).

Fig. 234. Distribution of *Geranium kilimanscharicum*.

frequently red on the abaxial surface. They are orbicular in outline and with the middle segment obtriangular, in contrast with *G. arabicum* that has leaves pentagonal in outline and with the middle segment rhombic. The number of lobes of the middle segment is also a good difference among both species, being 3-5(7) in *G. kilimandscharicum* and (7)11-15(19) in *G. arabicum*.

Geranium kilimandscharicum occurs at higher altitudes than *G. arabicum*. As Kokwaro (1971b) indicated some specimens of the contact area between both species are sometimes difficult to identify.

Other species from Eurasia

84. Geranium franchetii R. Knuth in Engl., Pflanzenr. IV.129 (Heft 53): 177. 1912. Type locality: "Central-China: Szetschuan, Nanchuan (Rosthorn a. 1891 n. 124!).-- Hupeh (Henry a. 1885-1888 n. 6154!),-- Yunnan (Maire a. 1904!)". Type: China. Hubei, Hupeh, S Patang, 30º59'N, 114º53'E, *A. Henry 6154* (lectotype, designated by Yeo 1992: 146-147, K-000729450!; isolectotypes, E-00216871!, GH-00263537!, LE!, NY!, US-01108046 image!).

Geranium strigellum R. Knuth, Repert. Spec. Nov. Regni Veg. 19: 230. 1923. Type locality: "China, Provinz West-Hupeh: Chang-yang (Wilson no. 666 [5700] sub G. Vlassoviano - Typus in herb. Berol.!)". Type: China. Sichuan, Changyang, 30º30'N, 111º14'E, *E.H. Wilson 666* (holotype, B destroyed; lectotype, designated by Yeo 1992: 146, W!; isolectotypes, E-00216840!, K-000729449!, LE!, NY!, US-00100939 image!).

Geranium siamense Craib, Bull. Misc. Inform. 1926(4): 158. 1926. *Geranium lambertii* subsp. *siamense* (Craib) T. Shimizu, Tonan Ajia Kenkyu 8(2): 180. 1970. Type locality: "Doi Chiengdao, 2100 m., abundant on open rocky ground, Kerr 6601". Type: Thailand. Chiang Mai, Doi Chiengdao, 19°22'N, 98°54'E, 6 Nov. 1922, *A.F. Kerr 6601* (lectotype, here designated, BM-

000796463!; isolectotypes, BK-257916, K-000729535!).

Geranium franchetii var. *glandulosum* Z.M. Tan, Bull. Bot. Res., Harbin 6(2): 53, lam. 5. 1986. Type locality: "Sichuan: Pengshui, Tiaotuo, Shizidong, alt. 1350 m, June 15, 1979, Pengshui Exped. 572 (Type, fl. ICD)". Type: China. Sichuan, Pengshui, Tiaotuo, Shizidong, 29°21'N, 108°15'E, 15 June 1979, *Pengshui Exped. 572* (holotype, SM).

Perennial herbs, 20-76 cm tall. *Rootstock* 4.5-8.7 mm in diameter, ± horizontal, not tuberculate, not turnip-shaped, with thickened roots along the rootstock. *Stem* erect, leafy, not rooting at nodes, stolons absent, without vegetative stems, with scattered retrorse, appressed, eglandular hairs 0.2-0.5 mm long and, sometimes, scattered, patent, glandular hairs 1-1.2 mm long. *Basal leaves* in a ± deciduous rosette, cauline leaves alternate (usually 1) and upper opposite; leaf laminas (2.1)3.6-6.8(7.2) cm long, 3.3-8.8 cm wide, not peltate, palmatifid [ratio main-sinus length/middle segment length = (0.72)0.77-0.81(0.83)], polygonal in outline, base cordate, not coriaceous, with nerves not projected, pilose, with appressed, eglandular hairs and, rarely, ± patent, glandular hairs on both surfaces; segments 5, in 1 plane, middle segment rhombic, (6.1)7-9.3(10.8) mm wide at the base [ratio segment width at the base/middle segment length = (0.19)0.22-0.29(0.36)], 7-11(13)-lobed in distal half [ratio secondary sinus length/middle segment length = (0.18)0.19-0.27(0.28)]; petioles up to 19 cm long, without abscission zone, terete, not swollen, not deflexed in age, with retrorse, ± appressed, eglandular hairs 0.3-0.7 mm long; stipules 4.9-11.9 mm long, 1.2-2.8 mm wide, lanceolate, free or connate, papery, brown, with scattered, eglandular hairs on both surfaces and on the margin. *Inflorescence* a monochasial cyme; cymules 2-flowered, solitary [ratio cymule length/leaf length = (2.4)2.8-4.7(6.2)]; peduncles (52)64-115(132) mm long, with retrorse, ± appressed, eglandular hairs 0.1-0.8 mm long; bracteoles 3.7-8.8 mm long, 0.2-0.8 mm wide, lanceolate, whorled; pedicels (17)23-36(39) mm long, with retrorse, ± appressed, eglandular hairs 0.1-0.6 mm long. Flowers actinomorphic. *Sepals* (6.6)6.9-8.2(9.6) mm long, 2.1-3.8 mm wide, lanceolate, smooth, not accrescent, nerves 3, mucro (1.3)1.5-2(2.5) mm long [ratio mucro length/sepal length = 0.14-0.38], with antrorse to patent, eglandular hairs 0.1-1.6 mm long on the abaxial surface, glabrous adaxially. *Petals* (10.6)13.8-15.1(15.6) mm long, (6.6)7-9.2(9.9) mm wide, erect-patent, rounded, without claw, pink to purple, hairy on the basal 1/4-1/2 of their adaxial and abaxial surfaces, ciliate on the basal margin, with hairs 0.8-1.3 mm long. *Stamens* 10, both whorls bearing anthers; filaments (5.5)6.4-

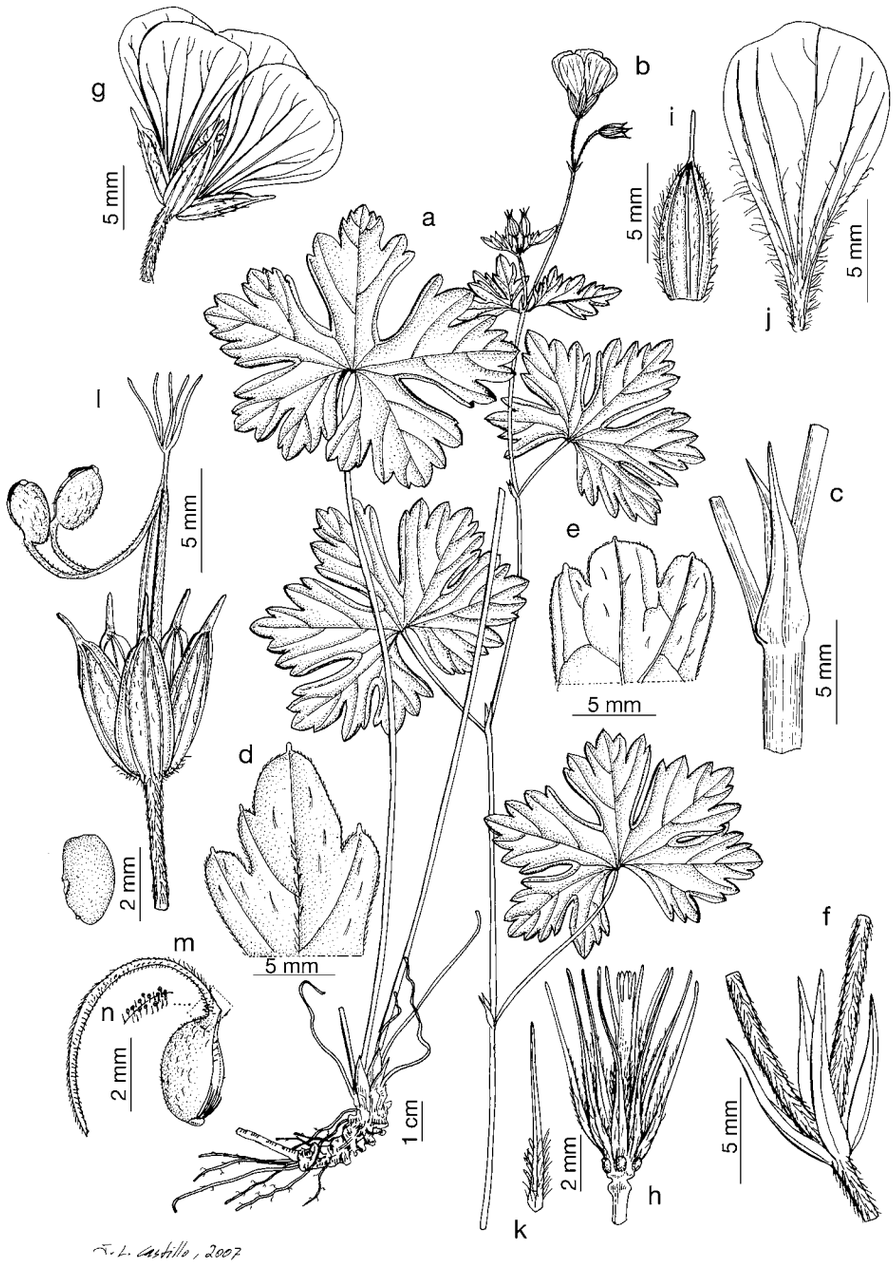


Fig. 235. *Geranium franchetii*. a, b. Habit. c. Stipules. d. Leaf indumentum on adaxial side. e. Leaf indumentum on abaxial side. f. Bracteoles. g. Flower. h. Flower without petals and sepals. i. Sepal. j. Petal. k. Staminal filament. l. Fruit. M, n. Mericarp. O. Seed. (Based on: a-j, *Henry 6154,* GH; k-o, *Wilson 666,* E).

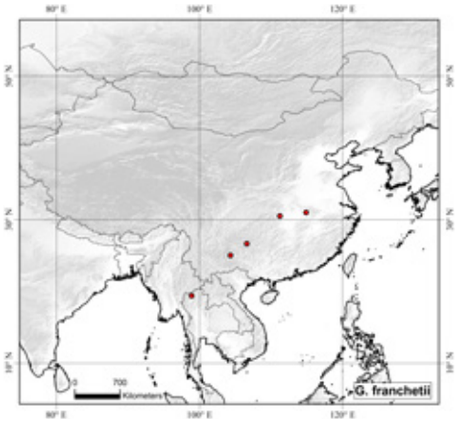


Fig. 236. Distribution of *Geranium franchetii*.

8.1(8.5) mm long, lanceolate, pink, covered densely with hairs 0.4-1 mm long on the abaxial surface and margin, hairless towards the tip; anthers (1.4)1.5-2(2.2) mm long, unknown color. Nectaries 5, hemispheric, usually with a tuft of hairs at the top, dorsally glabrous. *Gynoecium* 5.8-8.4 mm long, purple. *Fruit* 18.9-25(27.6) mm long, erect, discharge of seed-ejection type; mericarps 3-3.6 mm long, 1.3-2.3 mm wide, without a strand of fibers, not compressed at the apex, smooth, without basal beak, with a basal callus, without a basal prong, brown, with ± patent, eglandular hairs 0.2-0.5 mm long and, sometimes, with ± patent, glandular hairs 0.1-0.2 mm long; rostrum 11.1-17.9 mm long, with a narrowed apex 1.2-3.6 mm long, not twisted, with ± patent, eglandular hairs 0.1-0.7 mm long and, occasionally, scattered ± patent, glandular hairs 0.5-1 mm long; stigmatic remnants 3-4.5 mm long, with 5 glabrous lobes. *Seeds* 2.4-3.2 mm long, 1.2-2.2 mm wide, finely reticulate, uniformly colored, brown, glabrous. Cotyledons with entire margin. Fig. 235.

Pollen. *Geranium*-type (Tan & al. 1996: 212).

Chromosome number. Unknown.

Phenology. Collected in flower from February to December.

Distribution. This species ranges from southeastern China (Guizhou, Hubei, Sichuan, Yunnan) to northern Thailand (Fig. 236).

Habitat. Limestone ridges and forest edges; ca. 2100 m.

Additional specimens examined. **China.** Guizhou: Kouy-Tchéou, 26º38'N, 106º37'E, *Cavalerie 2952* (MA, P). Yunnan: E Yunnan, Lo Shiueh mt, 31 May 1937, *McLaren s.n.* (E); Yunnan orient., oppidi Loping, montis Beling-schan, 25º0'N, 104º20'E, 10 Feb. 1917, *Handel-Mazzetti 10143* (W). **Thailand.** Chiang Mai: Northern, Chiengmai, Doi Chiengdao, 19º22'N, 98º54'E, 3 Dec. 1961, *Smitinand & Anderson 7292* (K).

Discussion. Geranium franchetii is an erect herb, well characterized by its cauline alternate leaves and short rootstock, along which are thickened roots. It has erect-patent petals hairy on 1/4-1/2 of their adaxial surface and on the base of the abaxial one and staminal filaments with long hairs. The nectary indumentum is variable but usually has a tuft of hairs at the top. The stipules may be free or connate, at least at some nodes of the plant; this feature varies even within the same specimen. Among the studied specimens, no material with glandular hairs was observed, except by some scattered hairs on the fruit.

Geranium siamense is only known from the type. It lacks the rootstock, and has sepals and fruit a bit longer than *G. franchetii*, occasionally with scattered glandular hairs, but otherwise it falls into the variability of *G. franchetii*.

Although *G. franchetii* has alternate leaves on the stem and staminal filaments with a narrow base, similar to the species of the *Sylvaticum Group*, it cannot be ascribed to this group due to its hairy petals and the presence of connate stipules. This seems to be an isolated species with no obvious resemblance to other *Geranium*.

85. Geranium psilostemon Ledeb., Fl. Ross. 1(2): 465. 1842. Type locality: "Hab. in provinciis caucasicis occidentalibus! (Nordmann)". Type: Georgia. Caucasus, Adshara, 41°40'N, 42°00'E, *A. Nordmann s.n.* (lectotype, designated by Novoselova 1998: 149, LE!).

Geranium armenum Boiss., Fl. Orient. 1: 878. 1867. Type locality: "Hab. in subalpinis Armeniae Turcicae ad Gumuchkhané (Bourg!), in Transcaucasiâ occidentali ad fines Turcicas (Nordm!), Armeniâ Rossicâ (Szow!). Fl. aest.". Type: Turkey. Foret de Macka, 40°48'N, 39°36'E, 4 Aug. 1862, *E. Bourgeau 194* (lectotype, here designated, G-BOIS!; isolectotype, P!).

Geranium armenium André, Rev. Hort. ser. 4, 63: 350. 1891. Type locality: "Depuis deux ans je cultive, à Lacroix, un Geranium que j'ai reçu d'un horticulteur suisse, sous le nom de G. Gerardi". Type: France. Cultivated at Lacroix, É. *André s.n.* (no original material located).

Perennial herbs, 35-85(120) cm tall. *Rootstock* 10-11 mm in diameter, ± horizontal, not tuberculate, not turnip-shaped, with thickened roots along the rootstock. *Stem* erect, leafy, not rooting at nodes, stolons absent, without vegetative stems, with retrorse, ± appressed, eglandular hairs 0.3-0.7 mm long. *Basal leaves* in a ± persistent rosette, cauline leaves opposite; leaf laminas (7.2)8.2-10.5(12) cm long, 9-17 cm wide, not peltate, palmatifid [ratio main-sinus length/middle segment length = (0.78)0.79-0.84(0.89)], polygonal in outline, base cordate, not coriaceous, with nerves not projected, pilose, with ± appressed, eglandular hairs on both surfaces; segments 5(7), in 1 plane, middle segment rhombic, (10.3)12.9-15.9(20.7) mm wide at the base [ratio segment width at the base/middle segment length = (0.16)0.17-0.24(0.27)], 13-27-lobed in distal half [ratio secondary sinus length/middle segment length = (0.14)0.22-0.31(0.35)]; petioles up to 33 cm long, without abscission zone, terete, not swollen, not deflexed in age, with retrorse, appressed, eglandular hairs 0.3-0.6 mm long; stipules 2.2-16.4 mm long, 1-3.5 mm wide, lanceolate, free, papery, brown, with eglandular hairs on abaxial surface and on the margin, usually glabrous adaxially. *Inflorescence* a dichasial cyme; cymules 2-flowered, solitary [ratio cymule length/leaf length = (1.1)1.5-2.7(3.4)]; peduncles (48)87-150(170) mm long, with retrorse, ± appressed, eglandular hairs 0.3-0.5 mm long and, sometimes, patent, glandu-

lar hairs 0.3-0.5 mm long; bracteoles 2.9-7 mm long, 0.8-1.6 mm wide, lanceolate, whorled; pedicels (21)27-44(59) mm long, with retrorse, ± appressed, eglandular hairs 0.2-0.4 mm long and patent, glandular hairs 0.5-1.1 mm long. Flowers actinomorphic. *Sepals* (8.2)8.9-9.4(10.6) mm long, 3.7-5.3 mm wide, lanceolate, smooth, not accrescent, nerves 5, mucro (2.1)3-3.6(5.1) mm long [ratio mucro length/sepal length = 0.26-0.53], with antrorse, ± appressed, eglandular hairs 0.2-0.7 mm long and patent, glandular hairs 0.6-1.2 mm long on the abaxial surface, glabrous adaxially. *Petals* (14.9)17-20.1(20.7) mm long, (9.7)13.2-14.5(15.6) mm wide, erect-patent, rounded, without claw, purple with a dark basal spot, glabrous on both surfaces, ciliate on the basal margin, with hairs 0.3-0.8 mm long. *Stamens* 10, both whorls bearing anthers; filaments (5.8)6.2-7.5(9.7) mm long, lanceolate, yellow with dark purple apex, glabrous on the abaxial surface, ciliate on the proximal half, with hairs 0.2-0.4 mm long; anthers (2)2.5-2.8(2.9) mm long, black. Nectaries 5, hemispheric, glabrous. *Gynoecium* 4.5-9.1 mm long, black. *Fruit* (32)33-35(35.7) mm long, erect, discharge of seed-ejection type; mericarps 4.4-5.4 mm long, 2.3-2.9 mm wide, without a strand of fibers, not compressed at the apex, smooth, without basal beak, with a basal callus, without a basal prong, brown, with ± patent, eglandular hairs 0.2-0.7 mm long and patent, glandular hairs 0.5-0.9 mm long; rostrum 24-28 mm long, with a narrowed apex 2.8-4.9 mm long, not twisted, with ± patent, eglandular hairs 0.2-0.5 mm long and patent, glandular hairs 0.6-0.8 mm long; stigmatic remnants 2.5-4.1 mm long, with 5 glabrous lobes. *Seeds* 3.7-4 mm long, 2-2.1 mm wide, smooth, uniformly colored, brown, glabrous. Cotyledons with entire margin. Figs. 237, 238.

Pollen. Ornamentation not studied.

Chromosome number. 2*n* = 26?, 28, 56.

Phenology. Collected in flower from June to September.

Distribution. This species ranges from northeastern Turkey to Georgia (Fig. 239).

Habitat. Alpine meadows, grassy slopes and edge of *Abies* Mill., and *Picea* A. Dietr. forests; 500-2200 m.

Additional specimens examined. **Georgia.** Transcaucasia, 1885, *Massalsky s.n.* (MA). Adjara: Caucasus occidentalis, pagi Shuakhevi, 41°37'N, 42°11'E, 20 July 1979, *Esvandzhia s.n.* (BR); Batum, Artvin, supra Salalet, 41°38'N, 41°38'E, 1 July 1911, *Woronow 33* (LD); Adjaria in Anticaucaso, inter Batum et Akhalzikh, in pago Danais ?araul, 41°40'N, 42°41'E, 22 June 1890, *Sommier & Levier 258* (FI); Akhalzikhe, Adygeni, 41°40'N, 42°41'E, 9 Aug. 1936, *Sosnowsky & al. s.n.* (MA). Guria: distr. Chokhatauri, ad australem versus pagi Bakhmaro montes Meskhtski khrebet, in declivibus montis Grdzeli-vake, 41°51'N, 42°20'E, 22 July 1979, *Vašák & Esvandzhia s.n.* (G);

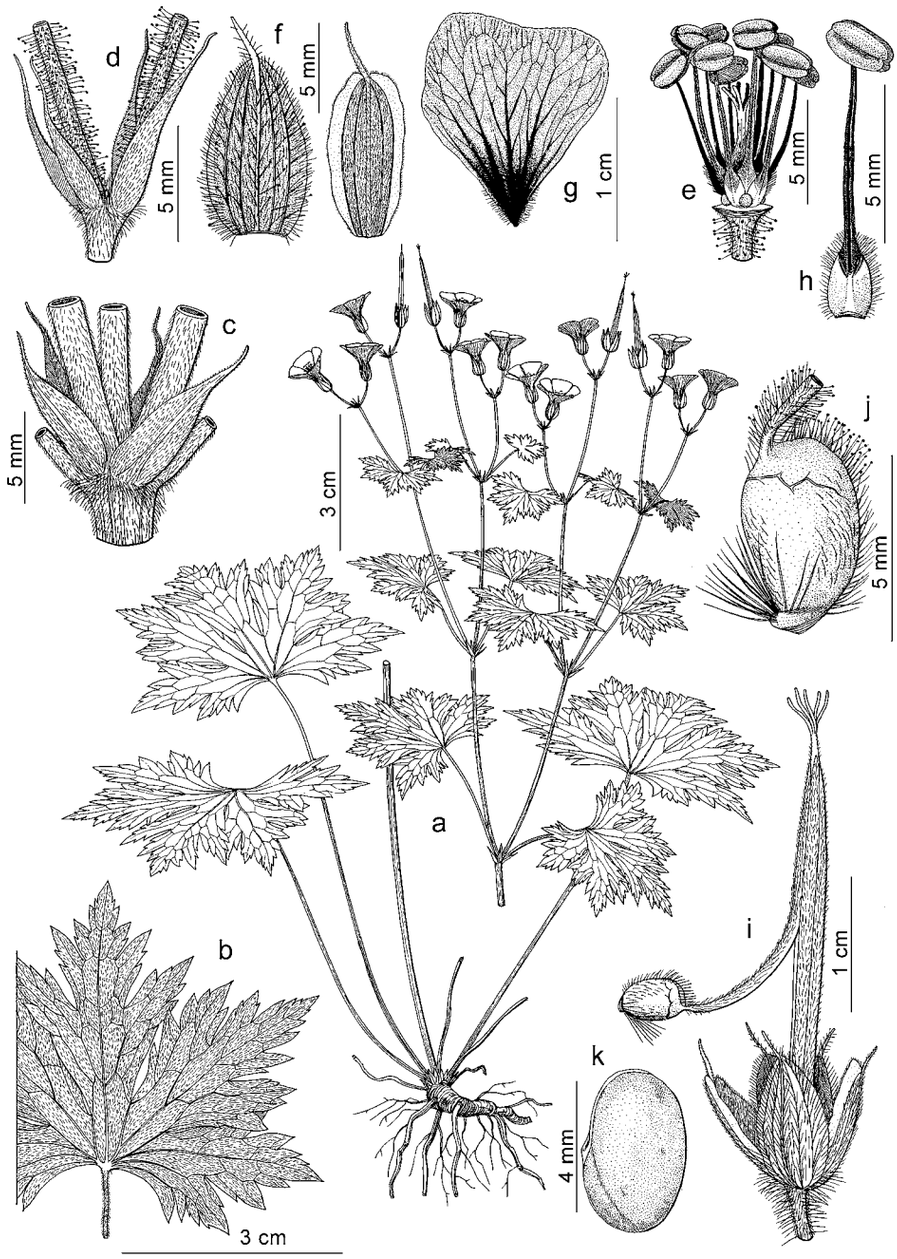


Fig. 237. *Geranium psilostemon*. a. Habit. b. Leaf. c. Stipules. d. Bracteoles. e. Flower without petals and sepals. f. Sepals. g. Petal. h. Stamen. i. Fruit. j. Mericarp. k. Seed. (Based on: a-h, *Nisa 765,* MA; i-k, *Walther 10686,* HBG).

Kuyais, distr. Ozurgety (Guria), in jugo Adzharico, pr. pagum Bachmaro, 41°55'N, 42°0'E, 15 July 1925, *Grossheim 312* (G, LD). Racha-Lechkhumi and Kvemo Svaneti: Svanetia in monte Tetenar supra pagum Ciolur ad flumen Hippum, Tzkhenis-Tzkhali, 42°45'N, 42°53'E, 1 Aug. 1890, *Sommier & Levier s.n.* (FI). Samegrelo-Zemo Svaneti: Mingrelie, Mt. Askhi, 42°35'N, 42°30'E, 22 Aug. 1893, *Alboff 440* (G). Samtskhe-Javakheti: Kartli, Borjomi, Bakuriani, Bakuriani Botanical garden, 41°45'N, 43°31'E, 8 Aug. 1998, *Merello & al. 2042* (MA). South Ossetia: mont Syrkh-Laberta, source d'eau minerale, 42°27'N, 43°37'E, 18 Aug. 1928, *Busch & Busch s.n.* (G); Kvaisa distr., iugum montium Radchinskij khrebet, vicinitas pagi Lesora, montis Tagverulla, 42°31'N, 43°41'E, 21 July 1989, *Cuba s.n.* (M). **Turkey.** Artvin: Batum, Jaila Nakerov, 1 July 1912, *Holmberg 2024* (LD); Hatila valley, Nakare locality, 41°13'N, 41°47'E, 14 June 1984, *Kasapligil 6617* (GH). Bayburt: Rize, Soganli Daglari, 55 km from Of in the direction of Bayburt, 40°31'N, 40°27'E, 20 Aug. 1987, *Eggli 952* (Z). Gümüşhane: Pontus, Ciganadagh supra Hanskver, 40°37'N, 39°30'E, 20 July 1889, *Sintenis 1373* (LD); Lazistan, pr. Djimil, 40°40'N, 39°40'E, July 1866, *Balansa 1370* (G, P, RO). Rize: 4,5 km de Çamlik, 40°42'N, 40°37'E, 28 June 2001, *Nisa & al. 765* (MA); 4 km SE Ikizdere, 40°45'N, 40°35'E, 24 June 1998, *Svensson 6205* (LD). Trabzon: Hamsikoy, 40°41'N, 39°28'E, 28 July 1956, *Lesse s.n.* (P); Trabzon, oberhalb Hamsikoy an der Strasse Trabzon-Zigana Pass, 40°41'N, 39°28'E, 10 July 1958, *Simon s.n.* (LD); Sumila, 40°41'N, 39°39'E, 31 July 1889, *Sintenis 1978* (LD); Trabzon, am Soganli-Pass, 40°45'N, 40°14'E, 11 Sep. 1971, *Walther 10686* (HBG).

Discussion. Geranium psilostemon is an erect perennial herb with thickened roots along a short horizontal rootstock, opposite and shallowly divided leaves, free stipules, and long petals. The indumentum consists of appressed, eglandular hairs. At the pedicels, sepals, and fruits there are also patent glandular hairs that occasionally appear on peduncles. The inflorescence is dichasially arranged. The peduncle of the cymules is noticeably long toward the base of the inflorescence. The sepals have five nerves and a long mucro. The petals are ciliate on the basal margin and have a distinctive dark spot at the base that reaches about a fourth of their length. The staminal filament apex, the anthers and the stigmas are blackish, as is the petal base.

The affinities of *G. psilostemon* appear obscure. Yeo (2002a: 67) included *G. psilostemon* in the *Sylvaticum Group*. It, however, lacks some important features of this group, such as the alternate leaves on the middle part of the stem and the aggregates of cymules at the top of each branch. The structure of the inflorescence of *G. psilostemon* and the leaf arrangement suggest that it is more similar to the *Pratense Group*

Fig. 238. *Geranium psilostemon* (Based on: *Aedo 10452,* MA).

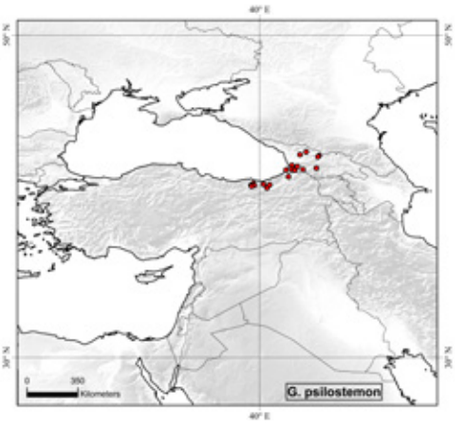


Fig. 239. Distribution of *Geranium psilostemon*.

(including *G. collinum*). However, *G. psilostemon* has glabrous nectaries and lacks the typical staminal filaments of the *Pratense Group*, with a broad triangular base abruptly narrowed toward the apex.

The chromosome number 2*n* = 26 attributed to this species (Martin & al. 2022) should be confirmed. According to Bobrov (1949: 18), this species is also present in North Caucasus (Dagestan, near Durushtal in former Kyurin district, 41°45'N, 47°44'E). Unfortunately, it has not been possible to examine any voucher of that record.

86. Geranium rosthornii R. Knuth in Engl., Pflanzenr. IV.129 (Heft 53): 180. 1912. Type locality: "Central-China, Szetschuan: Nanchuan (Rosthorn a. 1891, n. 1014!)". Type: China. Sichuan, Nanchuan, 29°05'N, 107°10'E, 25 Sep. 1891, *A. Rosthorn 1014* (holotype, B destroyed; lectotype, designated by Yeo 1992: 15, O!).

Geranium bockii R. Knuth in Engl., Pflanzenr. IV.129 (Heft 53): 180. 1912. Type locality: "Central-China, Szetschuan: Nanchuan (Rosthorn a. 1891, n. 902!)". Type: China. Sichuan, Nanchuan, 29°05'N, 107°10'E, 21 Sep. 1891, *C. Bock & A. Rosthorn 992* (neotype, designated by Yeo 1992: 143, O!).

Geranium henryi R. Knuth, Repert. Spec. Nov. Regni Veg. 19: 228. 1923. Type locality: "China, Provinz Hupeh (Henry a. 1885-88 no. 6752 sub G. erisotemon - Typus in herb. Berol.!)". Type: China. Hubei, Ichang, 30°47'N, 111°08'E, 1885-88, *A. Henry 6752* (holotype, B destroyed; isotypes, E-00216044!, K!, MO-1888949!, P-712090!, US image!).

Geranium hupehanum R. Knuth, Repert. Spec. Nov. Regni Veg. 19: 229. 1923. Type locality: "China, Provinz Hupeh (Wilson no. 2287 sub G. Vlassovianum - Typus in herb. Berol.!)". Type: China. Hupeh, *E.H. Wilson 2287* (holotype, B destroyed; isotypes, K-000729352!, NY!, W!).

Geranium wilsonii R. Knuth, Repert. Spec. Nov. Regni Veg. 19: 231. 1923. *Geranium henryi* var. *wilsonii* (R. Knuth) Yeo, Edinburgh J. Bot. 49(2): 142. 1992. Type locality: "China: Provinz West-Hupeh (Wilson no. 2405 -Typus in herb. Berol.!)". Type: China, Hubei, West-Hupeh, Fang, 32°06'N, 110°50'E, *E.H. Wilson 2405* (holotype, B destroyed; isotypes, E-00216839!, ILT, K-000729347!, P-712091!, W!).

Geranium pseudofarreri Z.M. Tan, Bull. Bot. Res., Harbin 6(2): 50, 60 tab. 3. 1986, ["pseudo-farreri"]. Type locality: "Sichuau: Lixian, Miyaluo, alt. 3100 m, July 14, 1982, Z. M. Tan 25 (Type, SZ)". Type: China. Sichuan, Lixian, Miyaluo, 31°39'N, 102°48'E, 14 July 1982, *Z.M. Tan 25* (holotype, SZ).

Geranium yuexiense Z.M. Tan, Bull. Bot. Res., Harbin 6(2): 55, 64 tab. 7. 1986. Type locality: "Sichuan: Yuexi, Laji Commune, alt. 3600 m, July 11, 1979, Yuexi Exped. 704 (Type, fl. ICD)". Type: China. Sichuan, Yuexi, Laji Commune, 28°36'N, 102°47'E, 11 July 1979, *Yuexi Exped. 704* (holotype, SM).

Geranium butuoense Z.M. Tan, Bull. Bot. Res., Harbin 10(1): 26, tab. 2. 1990. Type locality: "Sichuan: Butuo County, Zeluo Commune, alt. 2400 m, August 9, 1979, Butuo Exped. 716 (Type, ICD)". Type: China. Sichuan, Butuo County, Zeluo Commune, 27°42'N, 102°47'E, 9 Aug. 1979, *Butuo Exped. 716* (holotype, SM).

Geranium duclouxii Yeo, Edinburgh J. Bot. 49(2): 148, 149 fig. 5. 1992. Type locality: "Yunnan, Lou pou près Tong tchouan, x 1909, S. Tén (Ducloux 1440) (holo. E)". Type: China. Yunnan, Lou pou près Tong tchouan, 26°05'N, 103°10'E, Oct. 1909, *F. Ducloux 1440* (holotype, E-00216825 image!; isotype, P!).

Geranium fargesii Yeo, Edinburgh J. Bot. 49(2): 150, 151 fig. 6. 1992. Type locality: "Su-tchuen [Sichuan] oriental, district de Tchen-kéou-tin, Farges (holo. P, iso. P, three sheets)". Type: China. Sichuan, district de Tchen-kéou-tin, 34°04'N, 105°26'E, *P.G. Farges s.n.* (holotype, P-712078!; isotype, MA-699078!).

Perennial herbs, 21-80 cm tall. *Rootstock* 5.2-14 mm in diameter, ± horizontal, not tuberculate, not turnip-shaped, with napiform roots along the rootstock. *Stem* erect, leafy, not rooting at nodes, stolons absent, without vegetative stems, with patent to retrorse, eglandular hairs 0.1-1.6 mm long. *Basal leaves* in a ± deciduous rosette, cauline leaves opposite; leaf laminas (2.5)3.3-7.1(9.6) cm long, 3.4-13.6 cm wide, not peltate, palmatifid [ratio main-sinus length/middle segment length = (0.71)0.78-0.81(0.87)], polygonal in outline, base cordate, not coriaceous, with nerves not projected, pilose, with appressed, eglandular hairs on both surfaces; segments 5, in 1 plane, middle segment rhombic, (3.1)5.5-11.8(17.4) mm wide at the base [ratio segment width at the base/middle segment length = (0.14)0.21-0.25(0.29)], (7)9-11(16)-lobed in distal half [ratio secondary sinus length/middle segment length = (0.16)0.19-0.31(0.43)]; petioles up to 33 cm long, without abscission zone, terete, not swollen, not deflexed in age, with patent to retrorse, eglandular hairs 0.3-1.4 mm long; stipules 3.5-10.1 mm long, 2.2-5.6 mm wide, broadly lanceolate, connate (at least at the base), papery, brown, with scattered, eglandular hairs on both surfaces and on the margin. *Inflorescence* a monochasial cyme; cymules 2-flowered, solitary [ratio cymule length/leaf length = (1.5)2.4-3(4.3)]; peduncles (16)35-72(158) mm long, with patent to retrorse, eglandular hairs 0.2-1.2 mm long; bracteoles 2.3-10.6 mm long, 0.5-3.5 mm wide, lanceolate, rarely ovate, whorled; pedicels (6.6)14-23(44) mm long, with patent to retrorse, eglandular hairs 0.1-1.1 mm long. Flowers actinomorphic. *Sepals* (6.3)6.5-8.1(9) mm long, 2.2-3.8 mm wide, lanceolate, smooth, not accrescent, nerves (3)5, mucro (0.7)1-1.4(3.2) mm long [ratio mucro length/sepal length = 0.12-0.49], with antrorse to patent, eglandular hairs 0.1-1.7 mm long on the abaxial surface, glabrous adaxially. *Petals* (10.1)11.7-13.4(15.7) mm long, (3.5)5.4-7.1(10.7) mm wide, erect-patent, rounded, without claw, pink to purple, hairy on the basal 1/3-1/2 of their adaxial surface and on the base of the abaxial surface, ciliate on the basal margin, with hairs 0.6-1.8 mm long. *Stamens* 10, both whorls bearing anthers; filaments (5.2)6.6-8.3(9.9) mm long, lanceolate, pink, covered densely with hairs 0.3-2 mm long on the abaxial surface and margin, hairless towards the tip; anthers (1.6)1.7-2.3(2.4) mm long, purple. Nectaries 5, hemispheric, with a tuft of hairs at the top, dorsally glabrous. *Gynoecium* 6-9.1 mm long, purple. *Fruit* (18.7)20.1-23.4(23.8) mm long, erect, discharge of seed-ejection type; mericarps 2.6-3.8 mm long, 1.5-1.9 mm wide, without a strand of fibers, not compressed at the apex, smooth, without basal beak, with a basal callus, without a basal prong, brown,

with ± patent, eglandular hairs 0.2-1 mm long; rostrum 11.3-15 mm long, with a narrowed apex 2-3.2 mm long, not twisted, with ± patent, eglandular hairs 0.1-0.6 mm long; stigmatic remnants (2.3)2.8-4.6(5) mm long, with 5 usually glabrous lobes. *Seeds* 1.8-2.8 mm long, 0.9-1.6 mm wide, finely reticulate, uniformly colored, brown, glabrous. Cotyledons with entire margin. Fig. 240.

Pollen. *Geranium*-type (Park & Kim 1997: 313 [sub *G. henryi*]; Tan & al. 1996: 212 [sub *G. butoense*]).

Chromosome number. Unknown.

Phenology. Collected in flower from March to October.

Distribution. This species ranges from western Burma to central China (Guizhou, Henan, Hubei, Shaanxi, Shanxi, Sichuan and Yunnan) (Fig. 241).

Habitat. Meadows, grassy slopes and forest edges; 600-4100 m.

Additional specimens examined. **Burma.** Chin: Chin hills, Haka, 22º58'N, 94º0'E, Aug. 1910, *Venning 92* (NY, C). **China.** Guizhou: montaña Fanjing, Flama grande, 27º55'N, 108º41'E, 21 Aug., *[illegible] 3654* (PE); zona Tongren, montaña Fan Jin Shan, 27º55'N, 108º41'E, 16 July 1931, *Sin 51226* (IBSC); ciudad Zunyi, distrito Daozhen, pueblo Dagan, urbanización Shiren, 28º53'N, 107º35'E, 13 Oct. 1995, *Liu Zhengyu 15739* (MO); ciudad Zunyi, distrito Daozhen, pueblo Dagan, urbanización Shiren, 28º53'N, 107º35'E, 12 Oct. 1995, *Liu Zhengyu 15740* (MO). Henan: ciudad Luoyang, población Song, Long Chiman, 34º40'N, 112º26'E, 15 Aug. 1959, *[illegible] 34907* (PE); ciudad Luoyang, población Song Long Chiman, 34º40'N, 112º26'E, 22 Sep. 1956, *Dep. Silvicultura Prov. Henan 1138* (PE). Hubei: W Hupeh, *Wilson 2348* (NY, W); W Hupeh, July 1907, *Wilson 2440* (GH, US); ciudad Yichang, distr. Chang Yang, 30º47'N, 111º8'E, 20 Oct. 1973, *Huang 2537* (MO); distrito Enshi, población Badong, 31º1'N, 110º19'E, 1958, *Qian Min Zhi 1440* (PE); Hsing Shan, 31º12'N, 110º50'E, *Wilson 2201* (E, NY); Hubei: Shennongjia Forest District, E side of Jizigou Canyon, 31º30'N, 110º30'E, 25 Aug. 1980, *Sino-Amer. Bot. Exped. 65* (E, GH); Hubei: bosque Shen Nongjia, 31º45'N, 110º40'E, 21 Sep. 1958, *Huang 106* (MO); Hubei: bosque Shen Nongjia, Da Qian Jia Ping, 31º45'N, 110º40'E, 9 Aug. 1986, *Wang Cheng Zhong 853* (PE); Hubei: C China, Paokang, 31º52'N, 111º15'E, July 1901, *Wilson 2281* (NY). Shaanxi:, 20 July 1958, *Dai Tainlun 101327* (MO); provincia Schen-si septentr., Hian-San, 4 Aug. 1897, *Giraldi s.n.* (K); ciudad Ankang, distrito Pingli, pueblo Baxian, montaña Hualong Shan, 32º25'N, 108º31'E, 23 Aug. 1992, *Wu Zhen Hai 92-1298* (MO); ciudad Ank-

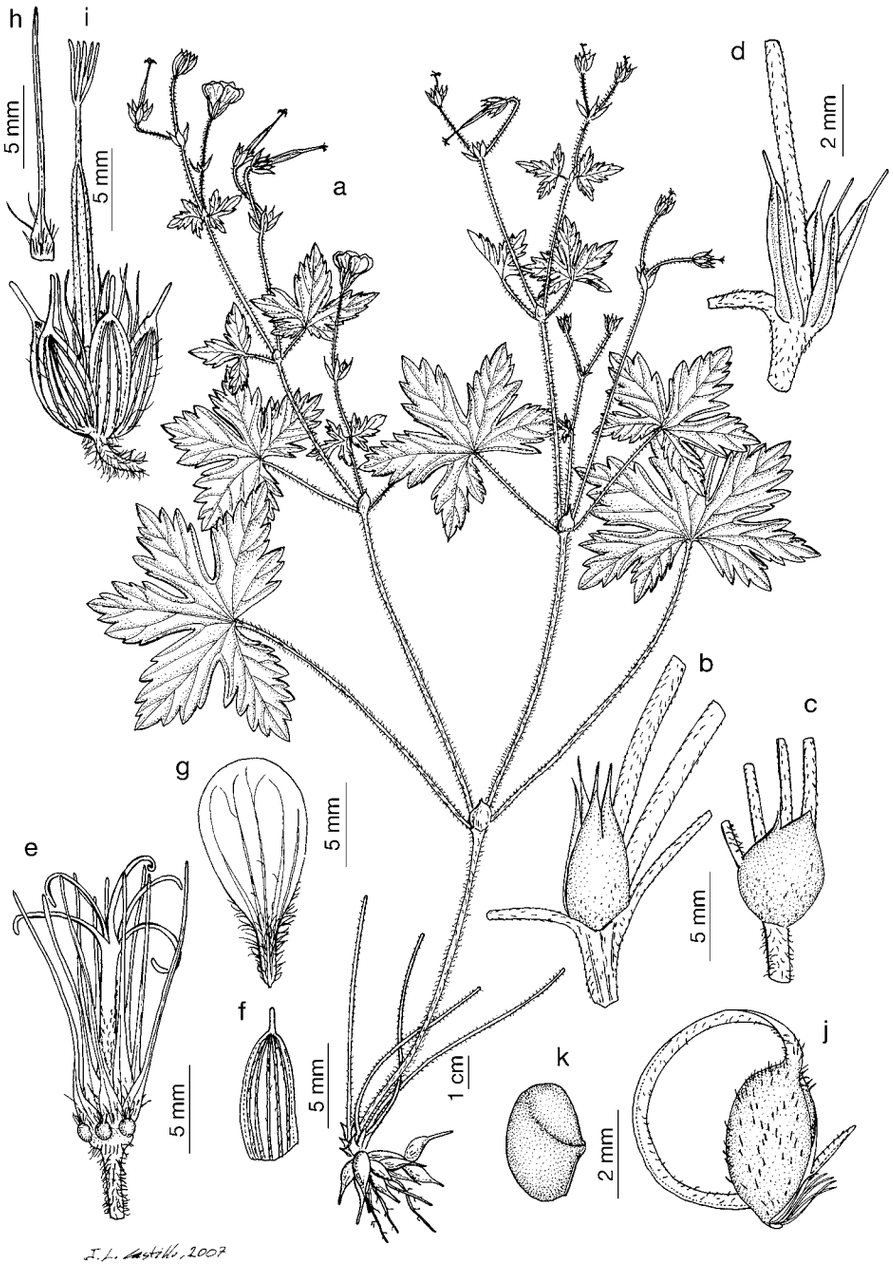


Fig. 240. *Geranium rosthornii*. a. Habit. b, c. Stipules. d. Bracteoles. e. Flower without petals and sepals. f. Sepal. g. Petal. h. Staminal filament. i. Fruit. j. Mericarp. k. Seed. (Based on: a, d, h-k, *illegible 34907,* PE; b, *Dai Tianlun 101297,* MO; c, *Jinfoshan Exped. 1682,* PE; e-g, *Wilson 2405,* E).

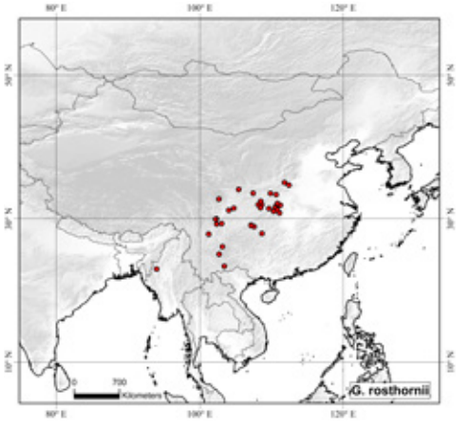


Fig. 241. Distribution of *Geranium rosthornii*.

ang, distrito Pingli, Qian Jiaping, Da Ya Zi, 33º20'N, 110º40'E, 7 Aug. 1988, *Xu Guan Yuan 4065* (MO); ciudad Ankang, distrito Pingli, Qianjiaping, 33º20'N, 110º40'E, 17 Aug. 1988, *Xu Guangsui 4055* (MO); ciudad Shangluo, población Shan Yang, montaña Tian Zhu Shan, Tie Zhong Ping, 33º31'N, 109º52'E, 3 Sep. 1952, *Wang Zuobin 16430* (KUN); ciudad Hanzhong, distrito Foping, en el camino del templo Sanguanmiao a la montaña Guang Tou Shan, 33º32'N, 107º27'E, 16 Aug. 1989, *Ying Junsheng 717* (MO). Shanxi: Yüan-ch'ü distr., Shui-wang-ping, 35º0'N, 111º50'E, 21 July 1924, *Smith 6680* (MO, S, UPS). Sichuan: W flank of Balan Shan, 8 Sep. 1991, *Chamberlain & al. 63* (E); Muli, Kulu, Tungyehtze, 27º50'N, 101º15'E, 21 Sep. 1937, *Yü 14318* (BM, E); ciudad Chongqing, población Nanchuan, montaña Jinfoshan, 29º1'N, 107º10'E, 11 July 1986, *Jinfoshan Exped. 1682* (PE); distr. Shi Mian, 29º14'N, 102º22'E, 1955, *Xie Chaojun s.n.* (PE); ciudad Leshan, distrito Jinkouhe, montaña Shouping, 29º18'N, 103º4'E, 21 July 1995, *Xu Honggui 5557* (MO); Luting, 29º55'N, 102º13'E, 1963, *Kuan & Wang 1786* (K); ciudad Ya'an, distr. Tianquan, montaña Erlang shan, 29º58'N, 102º20'E, 18 Aug. 1987, *Peng Dingyi 46206* (IBSC); Shigu Town, Shang Village, Xiaoshuigou, Maoxian County, 31º9'N, 104º3'E, 18 July 2002, *Xin-Fen & Yu-Lan 2317* (GH); ciudad Chongqing, distrito Wuxi, pueblo Hongchiba, 31º24'N, 109º38'E, 25 Sep. 1988, *Chen Yao Dong 2030* (PE); ciudad Chongqing, distrito Wuxi, 31º24'N, 109º38'E, 20 June 1958, *Yang Guang Hui 58540* (MO); ciudad Mian Yang, población Ping Wu, 31º27'N, 104º45'E, *Jiang Xinglin 10773* (PE); ciudad Chongqing, distrito Kai, urbanización Chechangda, 31º30'N, 108º29'E, 10 Aug. 1958, *Dai Tianlun 101752* (MO); ciudad Chongqing, distrito Chengkou, 31º56'N, 108º39'E, 19 Aug. 1958, *Dai Tianlun 101297* (MO); ciudad Chongqing, distrito Chengkou, pueblo Beiping, Dajiaoban Wan, 31º56'N, 108º10'E, 29 July 1958, *Dai Tianlun 101602* (MO); ciudad Chongqing, distrito Chengkou, 31º56'N, 108º39'E, 9 Aug. 1958, *Dai Tianlun 101693* (MO); Tsipula, 32º43'N, 102º41'E, 2 Aug. 1922, *Smith 4167* (UPS); Su-tchuen oriental, Tchen-Kéoutin, 34º4'N, 105º26'E, *Farges 112* (MA, P). Yunnan: paturages du Lo-chan, *Maire s.n.* (E); Ta-hai-tse, 1913, *Maire s.n.* (E); Mengzi, 23º21'N, 103º26'E, *Henry 10558* (MO, NY); Miao-kao-szu, Ta-p'u-chi, Kun-ming, 25º2'N, 102º43'E, Mar. 1939, *Tsiang & Wang 16477b* (GH); Yunnan, Tong tchouan, 26º5'N, 103º10'E, 1909, *Ducloux 4625* (P).

Discussion. Geranium rosthornii is an erect herb with connate stipules and opposite leaves. It has erect-patent petals hairy on one-third to one-half of their adaxial surface and on the base of the abaxial one and staminal filaments with long hairs. Some specimens have noticeably broad bracteoles, but otherwise they agree with *G. rosthornii*. This species resembles some specimens of *Geranium dahuricum*, although it can be distinguished by its usually short napiform roots along the rootstock (not long and fasciculate), its leaves with a broad middle segment, its longer stipules, and its denser indumentum on petals and staminal filaments.

The type of *G. bockii* has leaf blades with segments more rhombic than those of *G. rosthornii*; otherwise they are undistinguishable. It is mentioned in the original protologue that *G. pseudofarreri* may have glandular hairs, which has not been observed in any specimen of *G. rosthornii*. Unfortunately, the original material of the former is not available and, consequently, its synonymization remains provisional.

87. Geranium rotundifolium L., Sp. Pl.: 683. 1753. *Geranium malvaceum* Burm. f., Spec. Bot. Geran.: 24. 1759, nom. illeg. *Geranium malvifolium* Scop., Fl. Carniol. ed. 2, 2: 37. 1771, ["malvaefolium"], nom. illeg. *Geranium propinquum* Salisb., Prodr. Stirp. Chap. Allerton: 310. 1796, nom. illeg. *Geranium rotundifolium* var. *malvifolium* Scop. ex Mutel, Fl. Franç. 1: 205. 1834. Type locality: "Habitat in Europae cultis". Type: "Habitat in Europae cultis" (lectotype, designated by Carolin 1965: 335, LINN-858.83 image!).

Geranium rotundifolium var. *album* Weston, Bot. Univ. 2: 352. 1771. Type locality: [not indicated]. Type: Without definite locality, *R. Weston s.n.* (no original material located).

Geranium rotundifolium var. *minus* Weston, Bot. Univ. 2: 352. 1771. Type locality: [not indicated]. Type: Without definite locality, *R. Weston s.n.* (no original material located).

Geranium subrotundum Ehrh. ex Hoffm., Deutschl. Fl. ed. 4 1(2): 65. 1804. *Geranium rotundifolium* [2] *subrotundum* (Ehrh. ex Hoffm.) Graebn. in Asch. & Graebn., Syn. Mitteleur. Fl. 7(1): 49. 1913. Type locality: "In ruderatis, agris (Hannover. Ehrh. l.c.)". Type: Germany. Hannover, 52º22'N, 9º44'E, *G.F. Hoffmann s.n.* (no original material located).

Geranium viscidulum Fr., Novit. Fl. Suec. Alt.: 216. 1828. Type locality: "in cultis Scaniae ad Raby, inter Trolleberg & Kjellby &c. aliquoties visa". Type: Sweden. Scåne, inter Trolleberg & Kjellby, 55º42'N, 13º08'E, *E. Fries s.n.* (lectotype, here designated, UPS-151220 image!).

Geranium rotundifolium var. *pinnatifidum* Picard, Mém. Soc. Agric. Boulogne-sur-Mer 1: 125. 1837. Type locality: "J'ai ramassé moi-même cette curieuse variété autour de Saint-Denis, près des haies". Type: France. Saint-Denis, 49º24'N, 2º41'E, *C. Picard s.n.* (no original material located).

Geranium rotundifolium var. *strictum* Picard, Mém. Soc. Agric. Boulogne-sur-Mer 1: 124. 1837. Type locality: "Cette variété, remarquable par son port, se trouve aux environs de Paris, d'oú je l'ai reçue... ". Type: France. Paris, 48º50'N, 2º20'E, *C. Picard s.n.* (no original material located).

Geranium potentilloides Klotzsch in Klotzsch & Garcke, Bot. Ergebn. Reise Waldemar: 123, tab. 17. 1862, nom. illeg., non DC. 1824. Type locality: "Von Dr. Hoffmeister im Himalaya entdeckt". Type: Himalaya, *W. Hoffmeister s.n.* (no original material located).

Geranium rotundifolium var. *trichospermum* Sanio & Borbás, Term. Közl. 8(77): 36. 1876. *Geranium rotundifolium* [?] *trichospermum* (Sanio & Borbás) Graebn. in Asch. & Graebn., Syn. Mitteleur. Fl. 7(1): 49. 1913. Type locality: "G. macropetalum Borb. var. in lit. ad Sanio... Mehadia a Strazuc hegyen". Type: Romania. Mehadia, 44°54'N, 22°22'E, *C.G. Sanio s.n.* (no original material located).

Geranium rotundifolium var. *hungaricum* Simonk., Aradvm. Term. Leir.: 65. 1893. Type locality: "Napos, sziklás hegyoldalakon. Paulis szorosának hegyoldalain, Gyorok felett a Kecskésen; Dézna várhegyén és Halmágy mellett". Syntypes: Hungary. Napos, 47°27'N, 21°23'E, *L. Simonkai s.n.* Hungary. Halmágy, 46°57'N, 20°55'E, *L. Simonkai s.n.* Romania. Paulis, 45°56'N, 22°52'E, *L. Simonkai s.n.* Romania. Dézna, 46°24'N, 22°15'E, *L. Simonkai s.n.* (no original material located).

Geranium rotundifolium subvar. *albifora* Rouy in Rouy & Foucaud, Fl. France 4: 91. 1897. *Geranium rotundifolium* [1] *albiflorum* (Rouy) Graebn. in Asch. & Graebn., Syn. Mitteleur. Fl. 7(1): 49. 1913. *Geranium rotundifolium* f. *albiflora* (Rouy) Briq., Prodr. Fl. Corse 2(2): 7. 1936. Type locality: [not indicated]. Type: France. Without definite locality, *G. Rouy s.n.* (no original material located).

Geranium rotundifolium f. *albiflora* Rouy in Rouy & Foucaud, Fl. France 4: 91. 1897, nom. illeg. Type locality: [not indicated]. Type: France. Without definite locality, *G. Rouy s.n.* (no original material located).

Geranium rotundifolium var. *angustifolium* Rouy in Rouy & Foucaud, Fl. France 4: 91. 1897. *Geranium rotundifolium* [b] *angustifolium* (Rouy) Graebn. in Asch. & Graebn., Syn. Mitteleur. Fl. 7(1): 49. 1913. Type locality: "la var. ß çà et là, pas très rare". Type: France. Without definite locality, *G. Rouy s.n.* (no original material located).

Geranium rotundifolium var. *glabrescens* Murr, Deutsche Bot. Monatsschr. 15: 15. 1897. Type locality: [Croatia. Lesina, not explicitly stated]. Type: Croatia. Lesina, 43°08'N, 16°43'E, *J. Murr s.n.* (no original material located).

Geranium rotundifolium var. *caespitulosum* Lojac., Malpighia 20: 195. 1906. *Geranium rotundifolium* [3] *caespitulosum* (Lojac.) Graebn. in Asch. & Graebn., Syn. Mitteleur. Fl. 7(1): 49. 1913. Type locality: "In nemoribus elatis. Piano dei Zucchi Tin.! in Herb. Pan.!". Type: Italy. Sicily, Piano dei Zucchi, 37º54'N, 13º59'E, 10 Apr. 1830, *V. Tineo s.n.* (lectotype, here designated, PAL-74659 image!).

Geranium rotundifolium var. *barcinonense* Sennen, Pl. Espagne n.° 3337. 1918, in sched. Type locality: "Barcelone: S. Gervasio, bord des chemins". Type: Spain. Barcelona, San Gervasio, 41º23'N, 2º07'E, 15 May 1918, *fr. Sennen s.n.* (lectotype, here designated, MA-71156!; isolectotypes, BC-12586!, BM!, W!).

Geranium rotundifolium f. *thurstonii* Druce, Bot. Soc. Exch. Club Brit. Isles 5: 551. 1920. Type locality: "The specimens by our member, Mr Edgar Thurston, on Looe Cliffs, Cornwall, in May 1919, the earlier being sent on March 21 of that year. Mr Thurston's large collection of Cornish plants has been presented to Kew". Type: Great Britain. England, Cornwall, Looe Cliffs, 50º21'N, 4º27'W, May 1919, *E. Thurston s.n.* (lectotype, here designated, OXF-DR image!; choice made by P. D. Sell, in sched.).

Annual herbs, 10-45 cm tall. *Stem* erect, leafy, with patent, eglandular hairs 0.2-1.2 mm long and, sometimes, patent, glandular hairs 0.2-0.6 mm long. *Basal leaves* in a persistent rosette, cauline leaves opposite; leaf laminas (1.2)1.5-3.3(5.2) cm long, 1.8-4.4(6.8) cm wide, not peltate, palmatifid [ratio main-sinus length/middle segment length = (0.51)0.52-0.61(0.65)], orbicular in outline, base cordate, not coriaceous, with nerves not projected, pilose, with appressed, eglandular (and sometimes glandular) hairs on both surfaces; segments 5, in 1 plane, middle segment obtriangular, (4.8)5.3-10(16.7) mm wide at the base [ratio segment width at the base/middle segment length = (0.34)0.36-0.48(0.54)], (3)6-8-lobed at the apex [ratio secondary sinus length/middle segment length = (0.15)0.16-0.20(0.22)]; petioles up to 17 cm long, without abscission zone, terete, not swollen, not deflexed in age, with patent, eglandular hairs 0.2-1.4 mm long and, usually, patent, glandular hairs 0.2-0.6 mm long; stipules 1.6-5.8 mm long, 0.4-2.3 mm wide, lanceolate, free, papery, brown, with eglandular hairs on abaxial surface and on the margin, usually glabrous adaxially. *Inflorescence* a monochasial cyme; cymules 2-flowered, solitary [ratio cymule length/leaf length = 0.5-0.9(1.9)]; peduncles (10)18-41(47) mm long, with patent, eglandular hairs 0.1-1.3 mm long and, usually, patent, glandular hairs 0.2-0.5 mm long; bracteoles 1.8-3.2 mm long, 0.4-0.8 mm wide, linear-lanceolate, whorled; pedicels 7-13(20) mm long, with patent, eglandular hairs 0.2-1 mm long and patent, glandular hairs 0.2-0.6 mm long. Flowers actinomorphic. *Sepals* (3.8)4.5-5.4(6) mm long, 1.1-2.8 mm wide, lanceolate, smooth, not accrescent, nerves 3, mucro 0.2-0.4(0.6) mm long [ratio mucro length/sepal length = 0.05-0.14], with patent, eglandular hairs 0.4-1.3 mm long and patent, glandular hairs 0.4-0.9 mm long on the abaxial surface, glabrous adaxially. *Petals* (3.8)6-8.7 mm long, (1.5)1.6-2.6(2.9) mm wide, erect-patent, rounded, with claw 1-3.2 mm long (weakly bicarinated), purple, glabrous. *Stamens* 10, both whorls bearing anthers; filaments (2.3)3-4.3(4.8) mm long, lanceolate, white, glabrous except for a some cilia 0.1-0.2 mm long on the proximal half; anthers 0.4-0.5(0.7) mm long, yellow. Nectaries 5, hemispheric, glabrous. *Gynoecium* 2.8-4.8 mm long, purple. *Fruit* 15-18(19.3) mm long, erect, discharge of seed-ejection type; mericarps 2.1-3 mm long, 1.3-1.7 mm wide, without a strand of fibers, not compressed at the apex, smooth, without basal beak, with a basal callus, without a basal prong, brown, with ± patent, eglandular hairs 0.2-0.7 mm long; rostrum 11-14 mm long, with a narrowed apex 1.9-4.2 mm long, not twisted, with patent, eglandular hairs 0.1-0.5 mm long and, sometimes, patent glandular hairs 0.3-0.5 mm long; stigmatic remnants 1-1.4 mm long, with 5 hairy lobes. *Seeds* 1.5-2 mm long, 1.2-1.4 mm wide, reticulate, uniformly colored, brown, glabrous. Cotyledons with entire margin. Figs. 242, 243.

Pollen. *Geranium*-type (Perveen & Gaiser 1999: 267; Velasco 1992b: 56).

Chromosome number. 2*n* = 26.

Phenology. Collected in flower from January to December.

Distribution. This species ranges through Europe, northern Africa (from Morocco to Libya) and western and central Asia (to northwestern India and eastern Kazakhstan) and it is introduced in the U.S.A., Dominican Republic, South Africa and Australia (Fig. 244).

Habitat. Cultivated and disturbed areas, open habitats, roadsides, rocky slopes and dry grassland; 0-2850 m.

Representative specimens examined. **Afghanistan.** Bamyan: Bamian, in valle 16 km S Doab, 35º0'N, 68º0'E, 13 June 1962, *Rechinger 16661* (W). **Albania.** Vlorë: Valona, Saranda, isolotto di kepi Stillos, 39º41'N, 19º59'E, 10 May 2017, *Cecchi s.n.* (FI). **Algeria.** El Bayadh: Oran, Djebel Ksel, près Geryville, 33º43'N, 1º10'E, 30 May 1856, *Cosson s.n.* (P). **Andorra**. Andorra la Vella: Santa Colona, riu d'Enclar, 42º29'N, 1º29'E, 4 July 1992, *Aedo & al. CN-832* (MA). **Armenia.** Syunik: pr. Vaidanadzor, 38º57'N, 46º12'E, 27 June 2005, *Quintanar & al. 1457* (MA). **Australia.** Tasmania: Launceston, 41º27'S, 147º9'E, 28 Oct. 1943, *Curtis s.n.* (HO). **Azerbaijan.** Kalbajar-Lachin: Zangelan, pr. Kegnja, 39º3'N, 46º41'E, 30 May 1937, *Grossheim s.n.* (LE). **Belgium.** Wallonia: Namur, 50º28'N, 4º52'E, 1867, *Thielens & Devos 211* (LE). **Bosnia-Herzegovina.** Mostar, 43º25'N, 17º49'E, 1895, *Raap 41* (P). **Bulgaria.** Plovdiv: Central Rhodope Mts., pr. Assenovgrad, 41º59'N, 24º52'E, 29 June 2004, *Aedo & al. 10181* (MA). **Croatia.** Primorje-Gorski Kotar: bei Buccari, 45º18'N, 14º32'E, 18 May 1923, *Zerny s.n.* (W). **Cy-**

prus. Limassol: Pissouri, 34º40'N, 32º43'E, 17 Apr. 2019, *Aedo & al. 26429* (MA). **Dominican Republic.** Pedernales: Parque Nacional Sierra de Bahoruco, loma La Manigua, 18º15'N, 71º44'W, 8 Dec. 1983, *Peláez & al. 2065* (NY). **Estonia.** Tartu: an Wegen, Rathshof bei Dorpat, 58º21'N, 26º44'E, *Kapp & Bienet 171* (LE). **France.** Auvergne-Rhône-Alpes: Auvergne, Allier, Hérisson, 46º30'N, 2º42'E, 11 Aug. 2002, *Aedo 8397* (MA). Corse: Bastia, 42º42'N, 9º27'E, 2 June 1877, *Neyraut s.n.* (MPU). **Georgia.** Tbilisi: Kartli, Narikala Citadel, 41º42'N, 44º48'E, 8 June 1999, *Merello & al. 2222* (MA). **Germany.** Rhineland-Palatinate: Palatinat, Deidesheim, 49º24'N, 8º11'E, 10 May 1847, *Schultz s.n.* (MPU). **Great Britain.** England: Kew, Surrey, 51º28'N, 0º16'W, 11 June 1958, *Dunk & Halliday s.n.* (MA). **Greece.** Kriti: Chania, penins. Akrotiri ad monasterium Hag. Triada, 35º31'N, 24º2'E, 25 May 1942, *Rechinger 13330* (W). Peloponnese: Ahaia, Akrata, Zarochla, ladera NE del monte Helmos, 37º58'N, 22º17'E, 24 June 2007, *Navarro & al. 7072* (MA). **Hungary.** Pest: in monte Nagyszál supra Vacz, 47º47'N, 19º8'E, 22 Aug. 1901, *Filarszky 728* (LE). **India.** Himachal Pradesh: Punjab, Bashahr, Shimla, Chini, 31º32'N, 78º15'E, 4 June 1928, *Parker 2952* (W, LE). Jammu-Kashmir: Khasmir, Rampur, Ghelum Valley, 34º7'N, 74º9'E, 3 July 1931, *Stewart 12130* (MO). **Iran.** Isfahan: Esfahan, Shahreza, Kuh-e Dombalan, 32º2'N, 51º52'E, 23 May 1975, *Foroughi 17252* (LE). **Iraq.** Dohuk: Mosul, ad confines Turciae prov. Hakari in ditione oppidi Zakho, 37º9'N, 42º41'E, 2 Apr. 1957, *Rechinger 12161* (W). **Ireland.** Leinster: Dublín Co., Ringsend, 53º20'N, 6º18'W, Apr., *Parnell s.n.* (MA). **Israel.** Haifa: Monte Carmelo, sopra Haifa, 32º44'N, 35º2'E, 26 Apr. 1969, *Steinberg 3109* (FT). **Italy.** Campania: pr. Castellbate, monte Licosa, 40º15'N, 14º56'E, 13 Apr. 2015, *Aedo 22577* (MA). Sardegna: Nouro, Seui-Ussassai, foresta de monte Arbu, 39º53'N, 9º20'E, 4 June 2003, *Navarro & al. 4486* (MA). Sicilia: Trápani, monte Acci, pr. Mácari, 38º0'N, 12º44'E, 29 May 2000, *Aedo & al. 5574* (MA). **Kazakhstan.** South Kazakhstan: Predioria okp., Dszilia, pr. Taschent, 1926, *Fedtschenko 38* (LE). **Kyrgyzstan.** Naryn: Tian-Schan occidentalis, convallis Ak-Tasch in montibus Karshan-tau, 41º0'N, 74º35'E, 14 May 1928, *Popov & Vvedensky 429a* (MA, MO, W). **Lebanon.** South: Saida, 33º33'N, 35º22'E, 15 Mar. 1931, *Gombault 645* (P). **Libya.** Derna: Cyrenaica, Derna, 32º45'N, 22º39'E, 22 Apr. 1887, *Taubert 430* (P). **Malta.** Gozo Is.: Miggiar Scini, 36º2'N, 14º15'E, 27 Apr. 1907, *Sommier s.n.* (FI). **Morocco.** Tanger-Tetouan-Al Hoceima: Xauen, Jbel Lakra, Hauta-el-Kasdir, 35º6'N, 5º7'W, 22 June 1997, *Aedo & al. 4110* (MA). **North Macedonia.** Pelagonia: 2 km N of Murgasevo, 41º15'N, 21º15'E, 7 July 1976, *Frost-Olsen 330* (MA). **Pakistan.** Punjab: Rawalpindi, Ayub National Park, 33º35'N, 73º2'E, 22 Mar. 1971, *Kazmi 3017* (M). **Poland.** Subcarpathian: Galicia, in collibus Miodobory pr. Kolodziejówkam, 50º27'N, 22º0'E, 1892, *Woloszczak s.n.* (W). **Portugal.** Algarve: Vila do Bispo, praia Furnas, 37º3'N, 8º51'W, 29 May 2008, *Medina 4410* (MA). Madeira: Porto Santo, camino hacia el pico Branco, 33º5'N, 16º18'W, 18 Mar. 2007, *Aedo & al. 13782* (MA). **Romania.** Vest: Transsilvania, Turda, in abruptis fissurae Cheia Turzii loco Vrf. labirintului, 45º51'N, 23º7'E, 14 July 1933, *Nyárády s.n.* (MO). **Russia.** Dagestan: Dagestan, pr. Derbent, 42º3'N, 48º17'E, 31 Mar. 1902, *Alexeenko 7441* (LE). Krasnodar: Maikop, 44º36'N, 40º6'E, 1921, *Pastuchov s.n.* (MA). Krym: Yalta, supra Livadiam, 44º30'N, 34º10'E, 11 Apr. 1900, *Puring s.n.* (LE). Rostov: Scherkask, 47º14'N, 39º42'E, 1825 (LE). St. Pe-

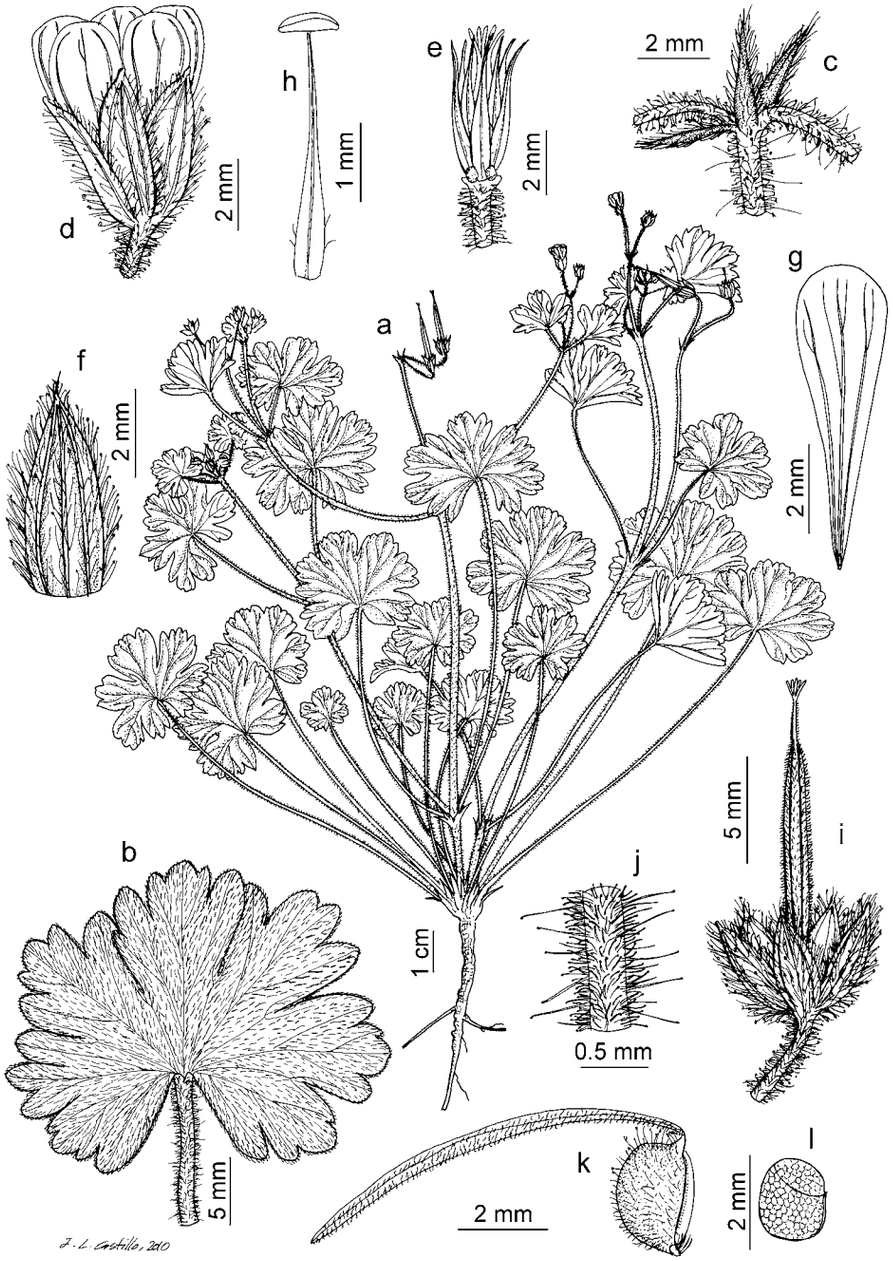


Fig. 242. *Geranium rotundifolium*. a. Habit. b. Leaf. c. Bracteoles. d. Flower. e. Flower without petals and sepals. f. Sepal. g. Petal. h. Stamen. i. Fruit. j. Peduncle indument. k. Mericarp. l. Seed. (Based on: a, c-l, *Sanchiz & al. s.n.,* MA-586626; b, *Rico & al. 6824,* MA).

Fig. 243. *Geranium rotundifolium* (Based on: *Aedo 26938,* MA).

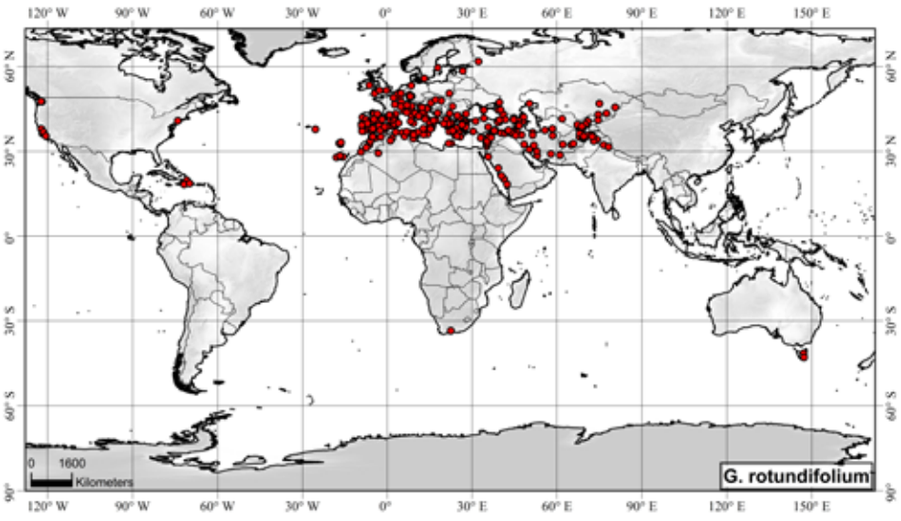


Fig. 244. Distribution of *Geranium rotundifolium*.

TERSBURG: ex agro Petropolitano, 61°41'N, 32°16'E, *Marshal von Bieberstain s.n.* (LE). **Saudi Arabia.** TABUK: Jabal Dabbagh, 100 km SW of Tabuk, 27°51'N, 35°44'E, 11 Apr. 1985, *Collenette 5263* (E). **Serbia.** SOUTHERN AND EASTERN SERBIA: Nis, pr. pagum Sicevo, 43°20'N, 22°5'E, 1968, *Weber s.n.* (PR). **Slovakia.** BRATISLAVA: Presburg, Thebnersteig, 48°9'N, 17°7'E, 25 May 1877, *Eschfaeller s.n.* (F). **South Africa.** WESTERN CAPE: Cape Peninsula, near Old Brewery, below Newlands Reservoir, 33°28'S, 18°20'E, 27 Sep. 1937, *Salter 6981* (BOL). **Spain.** ALMERÍA: Sierra Nevada, Abrucena, barranco de la Mina, 19 June 1992, *Aedo & al. CN-416* (MA). BALEARES: Menorca, Trabaluger, barranco Son Fideu, 39°57'N, 4°0'E, 22 Apr. 1957, *Montserrat s.n.* (JACA). CANARIAS: El Hierro, Mocanal, 27°49'N, 17°56'W, 2 Jan. 2013, *Aedo 19651b* (MA). **Sweden.** SKÅNE: Lund, 55°42'N, 13°11'E, Sep. 1889, *Moller s.n.* (P). **Switzerland.** VAUD: Bex, 46°15'N, 7°1'E, 1898 (MO). **Syria.** HOMS: Ain Ajouz, 34°46'N, 36°18'E, 5 May 2007, *Rico 2239* (MA). **Tajikistan.** SUGHD: Samarkand obl., Kimun, 38°35'N, 68°53'E, 26 May 1908, *Fedorov s.n.* (LE). **Tunisia.** GAFSA: pr. Sened, 34°27'N, 9°15'E, 26 Mar. 2009, *Calvo & al. 3100* (MA). **Turkey.** ÇANAKKALE: Evciler, Kaz Dagi, Mt. Ido, 39°44'N, 26°48'E, 13 May 2000, *Castroviejo 15237* (MA). **Turkmenistan.** AHAL: Ashabad, 37°57'N, 58°23'E, 23 Apr. 1897, *Litvinov 1142* (LE). **USA.** CALIFORNIA: San Luis Obispo Co., 1.3 mi NW of Cuesta Pass, 0.4 mi S of Tassajara Creek road, 35°20'N, 120°37'W, 27 May 1999, *Keil 28354* (OBI, MA). NEW YORK: Queens Co., Ballast, Northern Terminus of 8th Ave., 40°42'N, 74°0'W, 16 May 1880, *Brown s.n.* (NY). WASHINGTON: King Co., S of West Seattle Bridge, 47°30'N, 122°0'W, 31 July 2016, *Zika & Jacobson 28196* (MA). **Uzbekistan.** SURKHANDARYA: Margelan distr., 38°14'N, 67°54'E, 5 May 1913, *Dessiatoff 457* (LE).

Discussion. Geranium rotundifolium is an annual species readily identified by the entire petals, the fruit with smooth mericarps and the reticulate seeds. It is native throughout Europe, northern Africa, and central and western Asia and has been introduced in many parts of America (Aedo 2012), South Africa and Australia (Aedo 2017a). Täckholm & Chrtek (1968: 141) indicated this species in Egypt. Unfortunately, it has not been possible to study any herbarium voucher of such record. *Geranium rotundifolium* has been frequently confused with *G. pusillum* and *G. molle*, both of which have carpel-projection fruit discharge (subg. *Robertium*). *Geranium molle* has petals emarginate at the apex and mericarps transversely wrinkled and glabrous, while in *G. rotundifolium* the petals are rounded at the apex and the mericarps are smooth and covered with patent hairs. *Geranium pusillum* has slightly emarginate petal apices, smooth mericarps with appressed hairs, and a rostrum without a narrowed apex. The chromosome number 2*n* = 28 attributed to this species (Martin & al. 2022) should be confirmed.

Yeo (2002a: 66) included *G. rotundifolium* in the monotypic "Rotundifo-

lium Group", showing the difficulties to establish affinities with other species of the genus. *Geranium rotundifolium* seems to be a very isolated species that is difficult to relate to other living species of *Geranium*.

88. Geranium rubifolium Lindl., Edward's Bot. Reg. 26, tab. 67. 1840. Type locality: "It was raised in the garden of the Horticultural Society, from Himalayan seeds presented by Dr. Royle in May 1839". Type: Lindley, Edward's Bot. Reg. 26, tab. 67. 1840 (lectotype, here designated). India. Jammu-Kashmir, Rajparyan sanctuary, upper Bringhi river, 33º36'N, 75º26'E, 23 Aug. 1943, *F. Ludlow & G. Sherriff 9346* (epitype, here designated, BM-13725353!).

Geranium costatum Graham, Edinburgh New Philos. J. 31: 390. 1841. Type locality: "This very distinct and handsome species was raised at the Botanic Garden, Edinburgh, from seeds sent by my friend Dr. Falconar from Cashmeer in 1839". Type: India. Cashmeer, 28 July 1841, *R. Graham s.n.* (lectotype, here designated, G-00421010!).

Geranium kishtvariense R. Knuth, Repert. Spec. Nov. Regni Veg. 19: 229. 1923. Type locality: "West-Himalaya, Provinz Kishtvár: Von Kishtvár zu dem Pir Pâtšáski- oder Kishtvár-Paß (Herb. Schlaginweit no. 3777 sub G. rectum Trautv.-Typus in Herb. Berol.)". Type: India. Jammu-Kashmir, West-Himalaya, Kishtvár, Von Kishtvár zu dem Pir Pâtšáski- oder Kishtvár-Paß, 33º19›N, 75º46›E, *A. Schlagintweit 3777* (holotype, B destroyed). India. Jammu-Kashmir. Baramulla, Khilanmarg, 34°01'S, 74°21'W, 7 June 2018, *I.A. Hurrah 303942* (neotype, designated by Hurrah & Wagh 2021: 170, 171 fig.1, LWG image!).

Perennial herbs, 18-81 cm tall. *Rootstock* 1.6-9.5 mm in diameter, ± horizontal, not tuberculate, not turnip-shaped, without thickened roots. *Stem* erect, leafy, not rooting at nodes, stolons absent, without vegetative stems, with retrorse, appressed, eglandular hairs 0.3-0.8 mm long. *Basal leaves* in a ± deciduous rosette, cauline leaves alternate (1-2) and upper opposite; leaf laminas (2.6)5.6-9.1(13) cm long, 3.2-15.5 cm wide, not peltate, palmatifid [ratio main-sinus length/middle segment length = (0.62)0.76-0.82(0.84)], polygonal in outline, base cordate, not coriaceous, with nerves not projected, pilose, with ± appressed, eglandular hairs on both surfaces; segments 5, in 1 plane, middle segment rhombic, (5.2)11.4-16.1(22.7) mm wide at the base [ratio segment width at the base/middle segment length = (0.16)0.20-0.27(0.44)], (9)12-28(33)-lobed in distal half [ratio secondary sinus length/middle segment length = (0.08)0.10-0.16(0.22)]; petioles up to 26 cm long, without abscission zone, terete, not swollen, not deflexed in age, with retrorse, ± appressed, eglandular hairs 0.3-0.9 mm long; stipules 1.8-11.6 mm long, 0.9-5.7 mm wide, lanceolate, free or partially connate, papery, brown, with eglandular hairs on abaxial surface and on the margin, glabrous adaxially. *Inflorescence* a monochasial cyme; cymules 2-flowered, solitary [ratio cymule length/leaf length = (1.5)1.7-8.5(9.5)]; peduncles (36)48-105(155) mm long, with retrorse to patent, eglandular hairs 0.2-0.5 mm long and, usually, patent, glandular hairs 0.7-1.3 mm long; bracteoles 2.1-8.7 mm long, 0.4-1.2 mm wide, lanceolate, whorled; pedicels (12)23-35(39) mm long, with patent, eglandular hairs 0.2-0.5 mm long and, usually, patent, glandular hairs 0.5-2.1 mm long. Flowers actinomorphic. *Sepals* (6)7.2-8.5(9.5) mm long, 2.2-3.4 mm wide, lanceolate, smooth, not accrescent, nerves 3, mucro (1.2)1.8-3.4(3.5) mm long [ratio mucro length/sepal length = 0.19-0.48], with ± patent, eglandular hairs 0.2-0.8 mm long and patent, glandular hairs 0.9-2 mm long on the abaxial surface, glabrous adaxially.

Petals (14.1)16.6-18.2(27) mm long, (7.7)9.5-13.8(18.4) mm wide, erect-patent, emarginate (notch 0.5-1.4 mm deep), without claw, purple, hairy on the base of the adaxial surface, glabrous abaxially, ciliate on the basal margin, with hairs 0.4-0.9 mm long. *Stamens* 10, both whorls bearing anthers; filaments (4.7)5.1-6.6(8.9) mm long, lanceolate, purple, pilose on the abaxial surface, ciliate on the proximal half, with hairs 0.3-0.6 mm long; anthers (1.3)1.7-2.1(2.3) mm long, purple. Nectaries 5, hemispheric, with a tuft of hairs at the top, dorsally glabrous. *Gynoecium* 6-11.9 mm long, dark purple. *Fruit* (28)30-32(35) mm long, reflexed when immature, discharge of seed-ejection type; mericarps 3.3-4.8 mm long, 1.8-2.6 mm wide, without a strand of fibers, not compressed at the apex, smooth (with 1 transverse vein at the apex), without basal beak, with a basal callus, without a basal prong, brown, with ± patent, eglandular hairs 0.4-0.8 mm long and, patent, glandular hairs 0.5-1.6 mm long; rostrum 20-27 mm long, with a narrowed apex 1.1-2.4 mm long, not twisted, with ± patent, eglandular hairs 0.2-0.5 mm long and patent, glandular, hairs 0.7-1 mm long; stigmatic remnants 3-4.2 mm long, with 5 glabrous lobes. *Seeds* 2.9-3.5 mm long, 1.7-1.8 mm wide, finely reticulate, uniformly colored, brown, glabrous. Cotyledons with entire margin. Fig. 245.

Pollen. Ornamentation not studied.

Chromosome number. Unknown.

Phenology. Collected in flower from June to August.

Distribution. This species ranges from northern Pakistan to northwestern India (Himachal Pradesh and Jammu-Kashmir) (Fig. 246).

Habitat. Conifer forest edges; 2300-3600 m.

Additional specimens examined. **India.** Himachal Pradesh: Dalhousie, Punjab, 32º31'N, 75º58'E, 12 July 1936, *Koelz 8883* (GH). Jammu-Kashmir: Kashmir, 1864, *Falconer 324* (P); Banihal Pass, 33º26'N, 75º11'E, 1 July 1931, *Stewart 13339* (K); Kashmir, Sinthan Pass, 33º34'N, 75º30'E, 8 July 1939, *Ludlow 198* (BM); Kashmir, Sinthan Pass, 33º34'N, 75º30'E, 28 June 1917, *Stewart 3138* (K); Pahlgam, 34º0'N, 75º19'E, Aug. 1925, *Stewart 13336* (K); Pahlgam, 34º0'N, 75º19'E, 30 July 1927, *Stewart 13338* (K); Kashmir, Pahlgam, 34º0'N, 75º19'E, 13 July 1925, *Stewart 7863* (K); Kashmir, Pahlgam, 34º0'N, 75º19'E, 18 July 1925, *Stewart 7907* (G, K, MO, S); Kashmir, Pahlgam, Tulion, 34º0'N, 75º19'E, July 1925, *Stewart 7907a* (G); Kashmir, Pahlgam, 34º0'N, 75º19'E, 7 Aug. 1925, *Stewart 8120* (MO, G, S); Kh-

illanmarg, 34º2'N, 74º21'E, 14 Aug. 1929, *Stewart 10427* (K); between Gulmarg & Khillanmarg, [cultivado en Wakehurst], 34º3'N, 74º22'E, 8 July 1978, *Lancaster 177* (MA); Kashmir, Gulmarg, 34º3'N, 74º22'E, 9 Aug. 1956, *Polunin 56/113* (BM, B); Kashmir, Gulmarg, 34º3'N, 74º22'E, 3 Aug. 1919, *Rich 1212* (K, B); Khasmir, near Aru, 34º3'N, 75º25'E, July 1977, *Ryding 254* (UPS, B); Kashmir, Gulmarg, 34º3'N, 74º22'E, July 1929, *Stewart 10359* (S); Kashmir, above Gulmarg, 34º3'N, 74º22'E, Aug. 1929, *Stewart 10539a* (NY); Kashmir, Gulmarg, 34º3'N, 74º22'E, 19 Aug. 1929, *Stewart 13321* (NY); Kashmir, Gulmarg, 34º3'N, 74º22'E, 3 Aug. 1926, *Stewart 13337* (MO); Sonamarg, 34º18'N, 75º17'E, 20 July 1921, *Stewart 6378* (NY); Sonamarg, 34º18'N, 75º17'E, 24 July 1922, *Stewart 7179* (NY); Sonamarg, 34º18'N, 75º17'E, 16 July 1928, *Stewart 9712* (S, NY); Kashmir, Kun Patthar, Masjid Nar, 34º31'N, 75º6'E, 14 Aug. 1939, *Stewart & Stewart 18511* (NY); Kashmir, Tilel valley to Chorwan, 34º39'N, 74º53'E, 16 Aug. 1939, *Stewart 18597* (US). **Pakistan.** Azad Jammu and Kashmir: Kashmir, Pir Panjal Range, Fras Nag, 34º1'N, 73º51'E, 16 July 1947, *Stewart 23095* (K). Gilgit-Baltistan: Kashmir, Minimarg, Gilgit rd., 34º46'N, 75º4'E, 30 Aug. 1939, *Stewart 19154* (NY). Khyber Pakhtunkhwa: Kankoli Bhonja, Khagan, 34º46'N, 73º32'E, 21 July 1896, *Duthie s.n.* (K).

Discussion. Geranium rubifolium is an erect herb with a long and slim, horizontal rootstock that has slender roots. The basal internodes of the stem are short and usually with 1-2 alternate leaves. The inflorescence is monochasially arranged, with 2-flowered cymules on the upper nodes of the stem, which bear opposite leaves. The indumentum consists of eglandular and glandular hairs, the latter show some variation in density and are usually copious on pedicels and sepals. The stipules may be free or connate but with the tip remaining free. Both types can be found on the same individual. The stigmas remain dark purple in herbarium specimens.

The affinities of *G. rubifolium* appear obscure. Yeo (2002a: 95) included this species in the *Wallichianum Group*, probably because of the stigma color. *Geranium rubifolium*, however, differs from this group in its alternate leaves on the basal nodes, and its clear staminal filaments and anthers. *Geranium rubifolium* resembles *G. schmidii*, a Himalayan species of the *Sylvaticum Group* because both

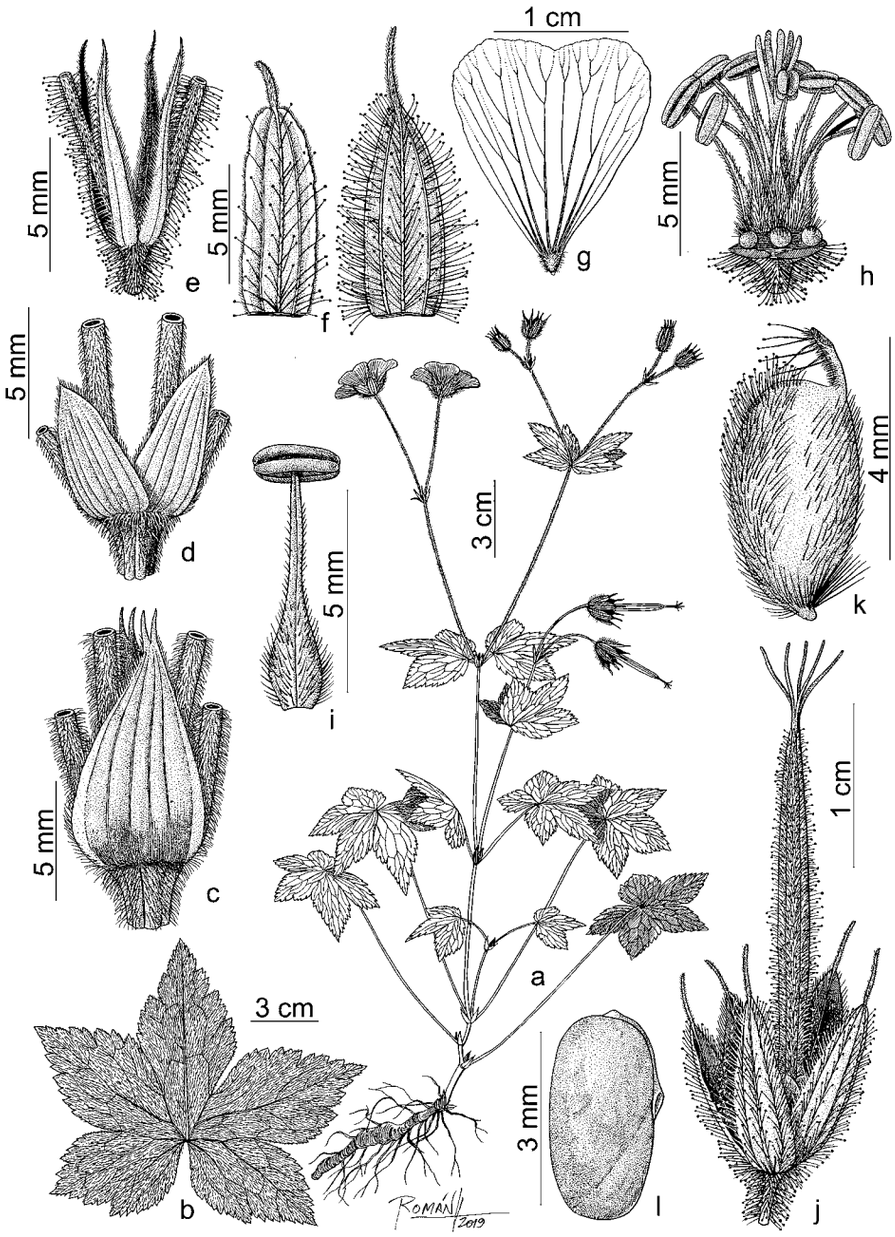


Fig. 245. *Geranium rubifolium*. a. Habit. b. Leaf. c, d. Stipules. e. Bracteoles. f. Sepals. g. Petal. h. Flower without petals and sepals. i. Stamen. j. Fruit. k. Mericarp. l. Seed. (Based on: a, d, *Polunin 56/113,* BM; b, c, e, *Ludlow & Sherriff 9346*, BM; f-h, *Ludlow 198*, BM; j-l, *Stewart 8120*, G).

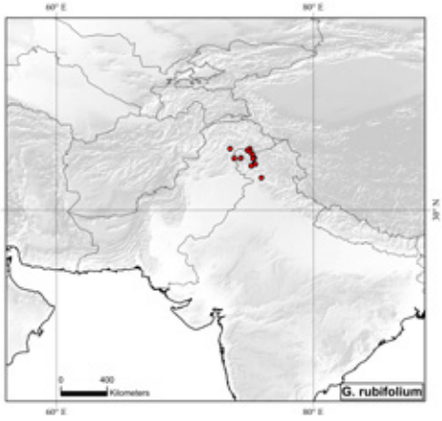


Fig. 246. Distribution of *Geranium rubifolium*.

have long and emarginate petals. Nevertheless, the species of the latter group has a dichasially arranged inflorescence with aggregates of cymules toward the apex of each branch, free stipules, and glabrous nectaries. Additionally, *G. rubifolium* further differs from *G. schmidii* in its less deeply divided leaves, its reflexed fruits, and its shorter narrowed apex of the fruit.

Geranium rubifolium has sometimes been confused with *G. rectum*, a species of the *Nodosum Group* that grows on the Tien Shan Mountains, with shallowly divided leaves. The latter species has shorter sepals and petals, glabrous nectaries, erect fruits, dichasial inflorescences, and opposite leaves with free stipules.

According to art. 9.12 of the Shenzhen Code the lectotype of *G. rubifolium* has been chosen on the illustration cited by Lindley (1840), since no other original material has been located. An epitype is also designated for purposes of the precise application of the name.

89. Geranium sanguineum L., Sp. Pl.: 683. 1753, ["sangvineum"]. Type locality: "Habitat in Europae pratis siccis umbrosis". Type: "Habitat in Europae pratis siccis umbrosis" (lectotype, designated by Aedo 2001b: 23, Herb. Clifford 343 Geranium 1 Sheet A, BM image!; choice made by B. Jonsell and C. Jarvis).

Geranium lancastriense Mill., Gard. Dict. ed. 8 n.° 4. 1768, ["lancastrense"]. *Geranium sanguineum* var. *lancastriense* (Mill.) Dum. Cours., Bot. Cult. ed. 2, 5: 37. 1811. *Geranium sanguineum* [II] *lancastriense* (Mill.) Graebn. in Asch. & Graebn., Syn. Mitteleur. Fl. 7(1): 28. 1913. Type locality: "... it grows naturally in Lancashire and Westmoreland, where I saw it in plenty". Type: Great Britain. *Geranium haematodes, Lancastrense flore eleganter striato*, Ray Hist. 1061, from the Chelsea Physick Garden, 1724, *Ph. Miller "112"* (lectotype, here designated, BM image!).

Geranium sanguineum var. *erectum* Weston, Bot. Univ. 2: 353. 1771. Type locality: [not indicated]. Type: Without definite locality, *R. Weston s.n.* (no original material located).

Geranium sanguineum var. *incisum* Weston, Bot. Univ. 2: 353. 1771. Type locality: [not indicated]. Type: Without definite locality, *R. Weston s.n.* (no original material located).

Geranium sanguineum var. *striatum* Weston, Bot. Univ. 2: 353. 1771. Type locality: [not indicated]. Type: Without definite locality, *R. Weston s.n.* (no original material located).

Geranium prostratum Cav., Diss. 4: 196, tab. 76 fig. 3. 1787. *Geranium sanguineum* var. *prostratum* (Cav.) Willd., Sp. Pl. 3(1): 697. 1800. Type locality: "Habitat in Anglia, Suecia... V.V. in R.H.P.". Type: Without definite locality, *A.J. Cavanilles s.n.* (lectotype, here designated, P!).

Geranium sanguineum var. *villosissimum* DC., Prodr. 1: 639. 1824. *Geranium sanguineum* [C] *villosissimum* (DC.) Graebn. in Asch. & Graebn., Syn. Mitteleur. Fl. 7(1): 28. 1913. Type locality: "DC. fl. fr. n. 4541" ["Fontainebleau", sec DC. in Lam., Fl. France 4: 845. 1805]. Type: France. Fontainebleau, 48º24'N, 2º42'E, *A.P. Candolle s.n.* (no original material located).

Geranium sanguineum var. *nitens* Chevall., Fl. Gén. Env. Paris 2(2): 801. 1828. Type locality: "Commune en été au bois de Boulogne, à Fontainebleau". Type: France. au bois de Boulogne, à Fontainebleau, 48º51'N, 2º14'E, and 48º24'N, 2º42'E, *F.F. Chevallier s.n.* (no original material located).

Geranium sanguineum var. *biflorum* G. Don, Gen. Hist. 1: 716. 1831. Type locality: "Native of Switzerland". Type: Switzerland. Without definite locality, *G. Don s.n.* (no original material located).

Geranium sanguineum var. *latifolium* Parl., Fl. Ital. 5: 142. 1873. Type locality: "La varietà ß nasce insieme alla specie, ma è meno comune". Type: Italy. Lombardia, monte Barro a Sala, 45°49'N, 9°22'E, Sep 1866, *F. Parlatore s.n.* (lectotype, here designated, FI!).

Geranium sanguineum var. *latifolium* Čelak., Prodr. F. Böhmen 3: 530. 1875, nom. illeg., non Parl. 1873. Type locality: "... Pardibic (Čeněk mit ß.)!... Fuss der Sovice bei Roudnic! Jungbunzlau (Hipp. ß.)!... ". Type: Czech Republic. Pardibic, 50°01'N, 15°46'E, *J.N. Čeněk s.n.* (lectotype, here designated, PR-925198 image!).

Geranium sanguineum var. *caerulea* Evers, Verh. K.K. Zool.-Bot. Ges. Wien 46: 69. 1896, ["parviflora caerulea"]. *Geranium sanguineum* [1] *coeruleum* (Evers) Graebn. in Asch. & Graebn., Syn. Mitteleur. Fl. 7(1): 28. 1913. Type locality: "Trient, Goccia d'Oro". Type: Italy. Trient, Goccia d'Oro, 46°03'N, 11°08'E, 29 May 1894, *G. Evers s.n.* (lectotype, here designated, GZU-000343634 image!).

Geranium sanguineum f. *latisectum* Evers, Verh. K.K. Zool.-Bot. Ges. Wien 46: 69. 1896, ["latisecta"]. *Geranium sanguineum* [D] *latisectum* (Evers) Graebn. in Asch. & Graebn., Syn. Mitteleur. Fl. 7(1): 28. 1913. Type locality: [Trentino]. Type: Italy. Trient, Goccia d'Oro, 46°03'N, 11°08'E, 29 Sep. 1894, *G. Evers s.n.* (lectotype, here designated, GZU-000343633 image!).

Geranium sanguineum var. *parviflora* Evers, Verh. K.K. Zool.-Bot. Ges. Wien 46: 69. 1896. *Geranium sanguineum* [B] *parviflorum* (Evers) Graebn. in Asch. & Graebn., Syn. Mitteleur. Fl. 7(1): 27. 1913. Type locality: "bei Rom, Insuggherata". Type: Italy. Rom, in collibus Farnesina, 42°09'N, 11°51'E, 26 May 1888, *G. Evers s.n.* (lectotype, here designated, GZU-000343631 image!).

Geranium sanguineum subsp. *sanguineiforme* Rouy in Rouy & Foucaud, Fl. France 4: 86. 1897. *Geranium sanguineiforme* (Rouy) A.W. Hill, Index Kew. Suppl. 6: 91. 1926. Type locality: "Hab.-Oise: taillis de la forêt de Compiègne (Kralik in herb. Rouy, sub. nom. G. nodosi)". Type: France. Oise, forêt de Compiègne, 49°24'N, 2°53'E, *J.L. Kralik s.n.* (lectotype, here designated, LY-0680684 image!).

Geranium sanguineum var. *latipartitum* Petunn. in Syr. & Petunn. in Syr., Ill. Fl. Mosk. Gub. 2: 327, fig. [without number]. 1907. Type locality: "U. Luzkov', Srp. u., v' polovine avgusta 1887 g. i Belye Kolodezi, Klm. u., v' sentjabre (II)". Type: Russia. Moscow, Belye Kolodezi, 54°55'N, 38°41'E, 15 Aug. 1887, *A.N. Petunnikov s.n.* (lectotype, here designated, MW-0424855 image!).

Geranium sanguineum var. *podperae* A. Wildt, Allg. Bot. Z. Syst. 16: 19. 1910, ["podpěrae"]. *Geranium sanguineum* [III] *podperae* (A. Wildt) Graebn. in Asch. & Graebn., Syn. Mitteleur. Fl. 7(1): 28. 1913. Type locality: "Habitat in collibus stepposis, quae Veternik dicuntur, prope Wischau, urbem Moraviae australis, supra mare 390 m, substratu argillaceo cum copiosis Stipis. (Et Stipa Tirsa Stev., pro Moravia species nova, ibi crescit.)". Type: Czech Republic. Moravia australis, [collis] Veternik prope Wischau [= Vyškov], 49°11'N, 16°59'E, June 1909, *A. Wildt s.n.* (lectotype, here designated, BRNM-26852 image!).

Geranium sanguineum f. *macranthum* C.E. Lundstr., Acta Horti Berg. 5: 76, Taf. 4 Fig. 4. 1914. Type locality: [not indicated]. Type: cultivated at Bergius Botanic Garden, *C.E. Lundström s.n.* (no original material located).

Geranium sanguineum var. *villosum* Murr, Allg. Bot. Z. Syst. 21: 67. 1915. Type locality: "Mulde des Fläscherberges unter dem Typus". Type: Liechtenstein. Fläscherberg, 47°03'N, 9°33'E, 21 June 1914, *J. Murr s.n.* (lectotype, here designated, IBF-100593 image!).

Geranium sanguineum f. *grandiflorum* Font Quer, Treb. Mus. Ci. Nat. Barcelona,

Sèr. Bot. 5: 20. 1924, ["grandiflora"]. Type locality: "Monte de la Abadesa, c. de Burgos... ". Type: Spain. Burgos, Monte de la Abadesa, 42°18'N, 3°42'W, 22 May 1914, *P. Font Quer s.n.* (lectotype, here designated, BC-12381 image!).

Geranium sanguineum f. *biflorum* Nyár., Kolozsvár Fl. 5: 337. 1943, nom. illeg., non G. Don (1831). Type locality: "Kocs. kétvirágú, vir. kisebbek, 10-12 mm sz. Területünk közelében Köesbércen a Tordahasadék felett (HNy 1917)". Type: Romania. pr. Köesbércen sobre el Tordahasadék, 46°33'N, 23°41'E, 8 June 1917, *E.J. Nyárády s.n.* (lectotype, here designated, SIB image!)

Geranium sanguineum var. *biflorum* Rozeira, Anais Fac. Sci. Porto 31(1): 55. 1946, nom. illeg., non G. Don (1831). Type locality: "No entanto, no Instituto de Botânica Dr. Júlio Henriques, encontramos um exemplar distribuido pelo Institut Botanique de Montpellier, colhido em Milhau au Puy de France (Aveyron) por Ivolas, que tonha todos os pedúnculos bifloros, e outro, colhido emn Vimioso: Regadas, por Mariz, em que um dos pedúnculos era bifloro. Os exemplares de Aveyron, embora menos robustos, eram em tudo iguais aos nossos e por isso parece-nos poder admitir, que esta nova variedade se encontra também en França". Syntypes: Portugal. Tras-os-Montes, Vimioso, Regadas, 41°18'N, 7°46'W, *J. Mariz s.n.* France. Aveyron, Milhau au Puy de France, 44°05'N, 3°04'E, *P.L. Ivolas s.n.* (no original material located).

Perennial herbs, 21-60 cm tall. *Rootstock* 5.9-14 mm in diameter, ± horizontal, not tuberculate, not turnip-shaped, with thickened roots along the rootstock. *Stem* erect or ascending, leafy, not rooting at nodes, stolons absent, without vegetative stems, with patent, eglandular hairs 0.7-3.1 mm long. *Basal leaves* in a ± deciduous rosette, cauline leaves opposite; leaf laminas (2.3)3.1-4(5.1) cm long, 3-5.7 cm wide, not peltate, palmatifid [ratio main-sinus length/middle segment length = (0.79)0.83-0.87(0.90)], polygonal in outline, base cordate, not coriaceous, with nerves not projected, pilose, with appressed, eglandular hairs on both surfaces; segments 5, in 1 plane, middle segment rhombic (with lanceolate lobes), (1.2)2.5-3.1(5.5) mm wide at the base [ratio segment width at the base/middle segment length = (0.06)0.11-0.14(0.17)], 3-5(7)-lobed in distal half [ratio secondary sinus length/middle segment length = (0.27)0.31-0.39(0.48)]; petioles up to 8 cm long, without abscission zone, terete, not swollen, not deflexed in age, with patent, eglandular hairs 0.6-2.3 mm long; stipules 2.5-5.8 mm long, 1.6-4.4 mm wide, lanceolate, free or connate at the base, papery, brown, with eglandular hairs on abaxial surface and on the margin, glabrous adaxially. *Inflorescence* a monochasial cyme; cymules 1-flowered, solitary [ratio cymule length/leaf length = (1.9)2.4-3.2(3.3)]; peduncles (25)44-80(96) mm long, with patent, eglandular hairs 0.5-2.3 mm long; bracteoles 1.8-3.8 mm long, 0.7-1.6 mm wide, lanceolate, opposite; pedicels (15)21-37(53) mm long, with patent, eglandular hairs 0.8-2.3 mm long. Flowers actinomorphic. *Sepals* (7.1)8-8.7(11.7) mm long, 3.3-5.2 mm wide, lanceolate, smooth, not accrescent, nerves (3)5, mucro (1.1)1.7-2.3(2.4) mm long [ratio mucro length/sepal length = 0.14-0.34], with patent, eglandular hairs 1-3.1 mm long on the abaxial surface, glabrous adaxially. *Petals* (13.6)15-17.7(21.8) mm long, (8)11.2-14.5(16) mm wide, erect-patent, emarginate (notch 0.6-3 mm deep), without claw, purple, hairy on the base of the adaxial surface, glabrous abaxially, ciliate on the basal margin, with hairs 0.5-1.3 mm long. *Stamens* 10, both whorls bearing anthers; filaments (5.4)5.6-8.4(9.1) mm long, lanceolate, pink, pilose on the abaxial surface, ciliate on the proximal half, with hairs 0.3-0.9 mm long; anthers (1.3)1.7-2.7(2.8) mm long, blue. Nectaries 5, hemispheric, glabrous. *Gynoecium* 6.5-8.8 mm long, purple. *Fruit* (27.9)32-40(41.9) mm long, erect, discharge of seed-ejection type; mericarps 3.7-5.5 mm long, 1.4-2.7 mm wide, without a strand of fibers, not compressed at the apex, smooth (with 2-3 transverse veins at apex), without basal beak, with a basal callus, without a basal prong, brown, with ± patent, eglandular hairs 0.2-2.1 mm long (mainly at the top of the mericarp); rostrum 19-32 mm long, with a narrowed apex 1.7-3.3 mm long, not twisted, with ± patent, eglandular hairs 0.4-1 mm long; stigmatic remnants 3.3-4.4 mm long, with 5 sometimes hairy lobes. *Seeds* 3.3-4.1 mm long, 2-2.7 mm wide, finely reticulate, uniformly colored, brown, glabrous. Cotyledons with entire margin. Figs. 247, 248.

Pollen. *Geranium*-type (Bortenschlager 1967: 429; Gagnepain 1903: 86; Velasco 1992b: 55).

Chromosome number. 2*n* = 52?, 56?, 82?, 84.

Phenology. Collected in flower from April to September.

Distribution. This species ranges through Europe to Turkey and the Caucasus and it is introduced in northeastern U.S.A. (Fig. 249).

Habitat. Roadsides, meadows, waste grounds, rocky outcroops, shrubby slopes and edge of *Fagus* L., *Picea* A. Dietr., *Pinus* L. and *Quercus* L. forests; 0-2100 m.

Representative specimens examined. **Albania.** Tirana: Dajti, 41°23'N, 19°55'E, 27 May 1937, *Pennington 100* (K). **Andorra**. San Julià de Lòria: hacia la borda del Germà, 42°27'N, 1°28'E, 1 June 2007, *Aedo & al. 13922* (MA). **Armenia.** Syunik: pr. vil. Tandzatap and Ahavni, 39°21'N, 46°17'E, 25 June 2005, *Gonzalo & al. 98* (MA). **Austria.** Tyrol: Achensee, 47°27'N, 11°42'E, July 1978, *Albert s.n.* (MA). **Azerbaijan.** Absheron: Great Caucasus, upper part Kaban, Ylla-Xam, 40°40'N, 49°18'E, 9 June 1949, *Kemularia & al. s.n.* (MA). **Belgium.** Wallonia: Namur, Wépion, 50°25'N, 4°53'E, 23 May 1867, *Thielens s.n.* (F). **Belorussiya.** environs de Gilomir, May 1834, *Steven s.n.* (LE). **Bosnia-Herzegovina.** Hrvatska, N of Senj, c. 4 km W of Rusevo Krmpotsko, 45°5'N, 14°55'E, 21 June 1983, *Frost-Olsen 5017* (MA). **Bulgaria.** Smolyan: Central Rhodope Mts., Smolyan, pr. Gela, 41°39'N, 24°33'E, 28 June 2004, *Aedo & al. 10172* (MA). **Croatia.** Primorje-Gorski Kotar: inter Rupa et Sapjane, 45°24'N, 14°17'E, 29 May 2010, *Calvo 4708* (MA). **Czech Republic.** South Moravian: Moravia centralis, Hustopece, in declivibus stepposis Pouzdranske kopce prope p. Pouzdrany, 48°56'N, 16°37'E, June, *Suza s.n.* (MO). **Denmark.** Nordjylland: Lendrup Strand S of Lögstör, 56°58'N, 9°15'E, 19 June 1970, *Jeppesen & Holm-Nielsen s.n.* (MA). **Estonia.** ca. 30 km NW of Pärnu: nera Koonga, 58°35'N, 24°9'E,

9 Aug. 1986, *Skvortsov & al. s.n.* (MO). **Finland.** Åland: Sottunga, Centre, Eriksson's manor, road to Skage, 60°8'N, 20°40'E, 1 July 1981, *Nordström 894* (MA). **France.** Auvergne-Rhône-Alpes: Savoie, pr. Aussois, 45°13'N, 6°44'E, 31 May 2011, *Aedo 18414* (MA). **Georgia.** Racha-Lechkhumi and Kvemo Svaneti: Rocha, Shkmeri, 42°29'N, 43°25'E, 17 July 1967, *Gognidi & al. s.n.* (MA). **Germany.** Bavaria: Bayern, Oberbayern, Echinger Lohe b. Eching nördlich Munchen, 48°31'N, 12°4'E, 26 June 1905, *Dihm s.n.* (MA). **Great Britain.** Scotland: Wigtownshire, Mull of Galloway, 55°1'N, 4°0'W, 12 July 1939, *Whithing s.n.* (K). **Greece.** Ionian Islands: Korfu, W Vistonas, Ortsrand, 39°41'N, 19°43'E, 28 May 1982, *Krendl s.n.* (MA). **Hungary.** Borsod-Abaúj-Zemplén: Jósvafö, a Aggtelek et Domica, in mt. Nagyoldal, 48°29'N, 20°33'E, 13 June 1961, *Zertova s.n.* (PR). **Ireland.** Munster: Clare Co., W of Lough Fingall, Burren, 52°43'N, 9°6'W, 4 July 1987, *Scannell s.n.* (MA). **Italy.** Calabria: Cosenza, Sila Grande, lago Cecita, 39°23'N, 16°33'E, 13 June 1997, *Iter Medit. VIII 1251* (CLU). Liguria: Genova, monte del Gazzo, Madona del Gazzo, 44°27'N, 8°50'E, 27 May 1998, *Sequeira 3464* (MA). Sicilia: Messina, Valdemone, 37°56'N, 15°0'E, *Todaro 332* (MPU, RO). **Latvia.** Jēkabpils: Lettland, Bulduri, bei Riga, 56°25'N, 25°42'E, 30 May 1920, *Zamels s.n.* (K). **Moldova.** Leova: Karpinensky, 46°41'N, 28°28'E, 16 May 1961, *Geydeman s.n.* (LE). **Montenegro.** Rožaje: S of Decici, c. Rozaj along the road to Pec, 42°50'N, 20°15'E, 8 July 1983, *Frost-Olsen 5607* (MA). **North Macedonia.** Southwestern: between Ohrid and resen, E of Openica, 41°7'N, 20°48'E, 19 June 1965, *Ooststroom & Hennipman 23954* (LE). **Norway.** Viken: Akershus county, Baerum, Snaroya, 59°52'N, 10°36'E, 28 June 2003, *Sunding s.n.* (MA). **Poland.** Podlaskie: Bielowbieza, Kosy Most, 52°47'N, 23°48'E, 11 June 2010, *Calvo 4832* (MA). **Portugal.** Estremadura: Alcobaça, Batalha, 39°39'N, 8°50'W, 9 June 1944, *Rozeira & Castro s.n.* (MA). **Romania.** Centru: Cluj-Napoca, Buru, gorges de Cheile Turzii, Munti Trascau, 46°23'N, 23°33'E, 14 July 1998, *Güemes & Bacchetta 2558* (MA). **Russia.** Bashkiriya: Mesyagutovo, 55°31'N, 58°16'E, 24 June 1929, *Noskov 21* (LE). Dagestan: Dagestan, Buynaksky, 42°49'N, 47°7'E, 7 June 1961, *Cvieliev & al. 309* (LE). Kabardino-Balkaria: Kabardino-Balkaria, Baksan, Gisgit, 43°40'N, 43°32'E, 22 July 1990, *Menicky s.n.* (LE). Kaliningrad: Kaliningrad, 54°43'N, 20°30'E, 21 June 1949, *Pobedimova 559* (LE). Kaluga: ad fluv. Oka supra Kaluga, inter pagos Rozhdestveno et Vyrka, 55°55'N, 36°23'E, 14 July 1981, *Skvortsov s.n.* (MO). Krasnodar: Krasnodarsky kray, Gelendsik, Markotj, Vinogradnuy, 44°33'N, 38°4'E, 1 Aug. 1990, *Menicky s.n.* (LE). Krym: Tauria merid., supra Nikitum, 44°32'N, 34°14'E, 20 Apr. 1928, *Chalew s.n.* (W). Kursk: Timskiy, 51°40'N, 37°10'E, 1897, *Gruorbez s.n.* (LE). Orenburg: Vodorasdel rek Bol'shoy Maluy Churan, 51°38'N, 57°32'E, 14 June 1930, *Sujova s.n.* (LE). Orlov: Orel, 52°58'N, 36°4'E, 14 Aug. 1868, *Regel s.n.* (LE). Penza: Penza, 53°12'N, 45°0'E, 16 June 1915, *Spruigin 154* (LE). Perm: Krasnonfim?, 58°1'N, 56°17'E, *Krylov 158* (LE). Pskov: Pusgomkunsk, 56°25'N, 29°25'E, 26 June 1968, *[illegible] 482* (LE). Rostov: Royska Donsogo, 48°49'N, 40°5'E, 1911, *Stepuni 58* (LE). Ryazan: Rjasan, Ranenburgskiy, 53°14'N, 39°58'E, 27 June 1926, *Savicz 585* (LE). Samara: Bubupukskiy bor, Bushuluksky ubl., 27 July 1914 (LE). Saratov: Jvaluinska, 5 July 1919, *Gross 117* (LE). St. Petersburg: Leningradskaya obl., ad fl. Narovam, 61°41'N, 32°16'E, 1872 (F). Stavropol: Kislovodsk, 43°55'N, 42°43'E, June 1954, *Bouska s.n.* (PR). Tambov: Tambov, 52°43'N, 41°26'E, 1 June 1920 (LE). Tatariya: Kasan, Tschistopol, 55°22'N, 50°38'E, 2 June 1885, *Korshinsky s.n.* (LE). Tula: Belew, 53°49'N, 36°9'E, *Kiroff*

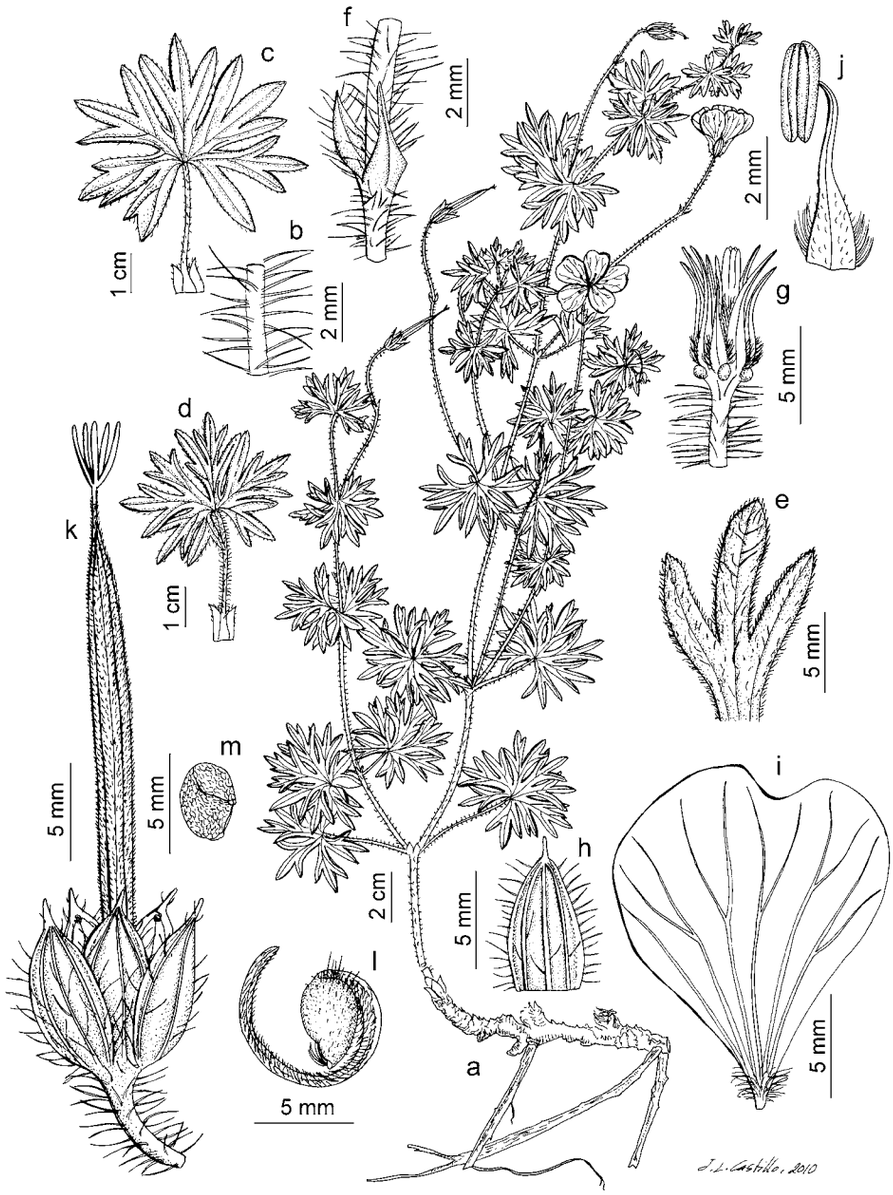


Fig. 247. *Geranium sanguineum*. a. Habit. b. Detail showing peduncle indumentum. c, d. Leaves. e. Detail of the middle segment of a leaf. f. Bracteoles. g. Flower without petals and sepals. h. Sepal. i. Petal. j. Stamen. k. Fruit. l. Mericarp. m. Seed. (Based on: a, *Cebolla & al. s.n.,* MA-385670; b, f-j, *Nogués & Calvo 3640,* MA; c, e, *Ferrero & al. s.n.,* MA-595222; d, *Jiménez & al. 57,* MA; k-m, *López 2063,* MA).

Fig. 248. *Geranium sanguineum* (Based on: *Calvo 4708,* MA, photo: J. Calvo).

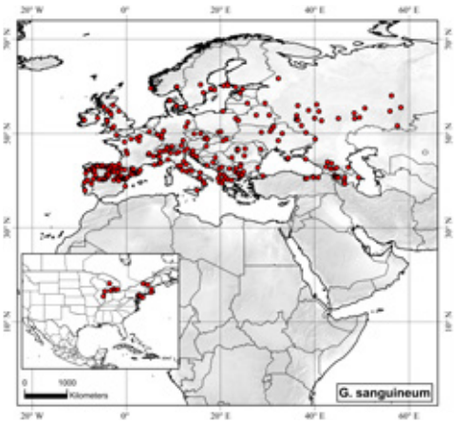


Fig. 249. Distribution of *Geranium sanguineum.*

s.n. (LE). Ulyanovsk: Simbirsk, Sysran, Okolo, 53°10'N, 48°28'E, 22 June 1885, *Korshinsky s.n.* (LE). Vladimir: Vladimir, 56°8'N, 40°24'E, 26 June 1912, *Kaparov 14901* (LE). Voronezh: Valuysky, Vedelevka, 50°11'N, 38°7'E, 7 July 1911, *Dubyanskiy s.n.* (LE). **Serbia.** Southern and Eastern Serbia: Vranja, 42°33'N, 21°54'E, June 1895, *Adamovic s.n.* (P). **Slovakia.** Košice: Kosice, settlement Kavencany, 48°46'N, 21°13'E, 25 June 1995, *Mikolas 7322* (MA). **Slovenia.** Gorizia: Illyrische Buschwald, Trnovski gozd, Osthänge des Cavn, 45°57'N, 13°53'E, 29 May 1966, *Peterman s.n.* (MA). **Spain.** Cantabria: San Cristóbal del Monte, 42°50'N, 4°7'W, 8 June 1997, *Aedo 4101* (MA). **Sweden.** Östergötland: Krokak Marmorbrottet, 58°40'N, 16°22'E, 16 July 1952, *Ridell s.n.* (RO). **Switzerland.** Valais: Fully, Grand Chavalard, 46°10'N, 7°6'E, 13 July 1990, *Valdés Bermejo 12083* (MA). **Turkey.** Rize: 8 km antes del Ovit dagi Gecidi, 40°39'N, 40°43'E, 29 June 2001, *Nisa & al. 921* (MA). **Ukraine.** Chernihiv: Czernigow, Oster, pr. Nowosselki, 50°57'N, 30°52'E, July, *Racoczi 913* (W, K). **USA.** Illinois: Chicago, 41°51'N, 87°39'W, 1882, *Ohlendorf s.n.* (F). Massachusetts: Essex Co., Andover, 42°39'N, 71°8'W, 19 June 1901, *Moore 50* (GH). Michigan: Schoolcraft Co., county road 437, 42°6'N, 85°38'W, 28 July 1986, *Henson 2172* (MICH). New Jersey: Ocean Co., Manahawkin, 39°42'N, 74°16'W, 21 July 1923, *Long 27981* (GH, PH). New York: Franklin Co., Loon Lake, 44°33'N, 74°4'W, July 1922, *Small s.n.* (NY). Pennsylvania: Delaware Co., Swarthmore, 39°54'N, 75°21'W, June, *Natkins s.n.* (PH). Rhode Island: Newport Co., Middletown, 41°32'N, 71°17'W, 5 July 1909, *Williams s.n.* (GH). Vermont: Washington Co., Barre City, 44°12'N, 72°29'W, 14 June 1976, *Ladd 1364* (VT).

Discussion. Geranium sanguineum is easily differentiated from other species of *Geranium* present in Eurasia by its 1-flowered cymules, long petals, and its distinctive leaf shape. The leaves are opposite and deeply divided, with leaf segments that usually have three narrow and long lobes. The rootstock of *G. sanguineum* is horizontal, long and robust and has thickened roots along it. The stipules can be free or partially connate at their base. The indumentum consists of long, patent, eglandular hairs that are widespread in varying density throughout the whole plant. Lewis (1969) analyzed the variation in both leaf dissection and size of *G. sanguineum* and associated more dissected or narrower leaves with dry habitats.

As stated in Aedo (2012: 414) *G. sanguineum* has some superficial resemblance with several Mexican spe-

cies. Yeo (2002a: 114) indicated that it has much in common with the *Krameri Group* except for the lack of hairs over the adaxial surface of the petals. Thus Yeo (2002a: 114) suggested the possibility of an affinity to the *Palustre Group*, but without further support. In fact, *G. sanguineum* seems to be a very isolated species that is difficult to relate to other living species of *Geranium*.

According to Van Loon (1984b: 271) the chromosome numbers different to 2*n* = 84 attributed to this species should be confirmed.

Geranium sanguineum is a species native to Eurasia, widely used in gardens and naturalized in North America. The specimen collected by *Gandoger s.n.* (MO-1891051) in an imprecise locality of Morocco or Algeria is suspected to be a labeling mistake. Thus, its presence in North Africa should be confirmed. Its presence in Australia, probably as garden-escape, is based on a specimen at AD that could not be studied.

90. Geranium swatense Schönb.-Tem. in Rech. f. (ed.), Fl. Iran. 69: 22, tab. 1. 1970. Type locality: "Rechinger 19566, W!... Pakistan:... Swat:... Utror, 2500 m, 23. 8. 1962, Rech. 19566!". Type: Pakistan. Khyber Pakhtunkhwa, Swat, Utror, 35°35'N, 72°25'E, 23 Aug 1962, *K.H. Rechinger 19566* (holotype, W!; isotypes, B-100715980!, G-00365994!, M-0243894!).

Perennial herbs, 16-60 cm tall. *Rootstock* 7.2-12.1 mm in diameter, ± vertical, not tuberculate, not turnip-shaped, without thickened roots. *Stem* trailing and ascending, leafy, not rooting at nodes, stolons absent, without vegetative stems, with patent to retrorse, eglandular hairs 0.2-1.4 mm long and patent, glandular hairs 0.6-2.3 mm long. *Basal leaves* in a ± persistent rosette, cauline leaves opposite; leaf laminas (2)2.7-4.5(4.8) cm long, 2.4-6 cm wide, not peltate, palmatifid [ratio main-sinus length/middle segment length = (0.72)0.77-0.79(0.86)], polygonal in outline, base cordate, not coriaceous, with nerves not projected, pilose, with appressed, eglandular hairs on both surfaces and, sometimes, with scattered glandular hairs abaxially; segments 5, in 1 plane, middle segment rhombic, (3.5)3.8-9.1(10.3) mm wide at the base [ratio segment width at the base/middle segment length = (0.17)0.21-0.29(0.36)], 6-9-lobed in distal half [ratio secondary sinus length/middle segment length = (0.18)0.21-0.25(0.30)]; petioles up to 14 cm long, without abscission zone, terete, not swollen, not deflexed in age, with patent to retrorse, eglandular hairs 0.3-1 mm long and patent, glandular hairs 0.4-2.2 mm long; stipules 2.8-5.6 mm long, 0.8-1.7 mm wide, lanceolate, free, papery, brown, with eglandular hairs on abaxial surface and on the margin, ± glabrous adaxially. *Inflorescence* a monochasial cyme; cymules 2-flowered, solitary [ratio cymule length/leaf length = (1.5)2.5-4.1(4.7)]; peduncles (42)56-93(109) mm long, with retrorse to uncinate, eglandular hairs 0.2-0.3 mm long and patent, glandular hairs 0.6-2.8 mm long; bracteoles 2.9-5.3 mm long, 0.3-1.1 mm wide, lanceolate, whorled; pedicels (17)21-42(55) mm long, with patent to retrorse, eglandular hairs 0.2-0.4 mm long and patent, glandular hairs 1.3-3 mm long. Flowers actinomorphic. *Sepals* (7.2)7.7-9.2(9.8) mm long, 2.3-3.4 mm wide, lanceolate, smooth (with a small dark purple zone at the base), not accrescent, nerves 3, mucro (1)1.4-1.8(2.6) mm long [ratio mucro length/sepal length = 0.11-0.28], with ± patent, eglandular hairs 0.1-0.4 mm long and patent, glandular hairs 1.2-2.8 mm long on the abaxial surface, glabrous adaxially. *Petals* (14.4)15.1-19(20.8) mm long, (7.7)9.2-12.3(12.8) mm wide, erect-patent, rounded, without claw, purple, hairy on the base of the adaxial surface, ciliate on the basal margin, with hairs 0.5-1.1 mm long. *Stamens* 10, both whorls bearing anthers; filaments (5.9)7-7.9(8.8) mm long, lanceolate, white to pink, pilose on the abaxial surface, ciliate on the proximal half, with hairs 0.3-1 mm long; anthers 2-2.1 mm long, yellow. Nectaries 5, hemispheric, glabrous. *Gynoecium* 6-9.4 mm long, pink to purple. *Fruit* (28.8)30-33(34.2) mm long, erect, discharge of seed-ejection type; mericarps 3.3-4.2 mm long, 1.7-2.4 mm wide, without a strand of fibers, not compressed at the apex, smooth (usually with 1-2 transverse veins at the apex), without basal beak, with a basal callus, without a basal prong, brown, with ± patent, eglandular hairs 0.3-0.6 mm long and patent, glandular hairs 0.7-1.3 mm long; rostrum 20.3-23.9 mm long, with a narrowed apex 3.3-5.6 mm long, not twisted, with ± patent, eglandular hairs 0.2-0.4 mm long and patent, glandular hairs 0.6-1.5 mm long; stigmatic remnants 3.8-5.1 mm long, with 5 glabrous lobes. *Seeds* 2.4-3.3 mm long, 1.5-2.1 mm wide, finely reticulate, uniformly colored, brown, glabrous. Cotyledons with entire margin. Fig. 250.

Pollen. *Geranium*-type (Perveen & Gaiser 1999: 267).

Chromosome number. Unknown.

Phenology. Collected in flower from March to September.

Distribution. This species ranges through northern Pakistan (Fig. 251).

Habitat. Meadows and edge of coniferous forests; 2300-4100 m.

Additional specimens examined. **Pakistan.** Gilgit-Baltistan: Rama, Aston distr., 34°58'N, 75°57'E, 27 July 1946, *Stewart 22897a* (NY, US); Nanga Parbat, NE slopes near Rama, 34°58'N, 75°57'E, 13 Aug. 1955, *Webster 6465* (M); Gilgit, Babusar valley, N of Babusar village, 35°12'N, 74°2'E, 11 Sep. 1983, *Aldén & al. 6119* (GB); near track from Astor to Ramma lake, 35°20'N, 74°50'E, 30 Aug. 1995, *Sinnot 76* (K); Northern Areas, Astor, Nanga Parbat, Mushkin forest, below Mushkin Rest House, 35°29'N, 74°43'E, 5 Sep. 1995, *Dickoré 12718* (M); Northern Areas, Nanga Parbat, Mushkin Rest House, 35°30'N, 74°44'E, 12 Mar. 1996, *Nüsser 243* (B); Northern Areas, Nanga Parbat, Mushkin Rest House, 35°30'N, 74°44'E, 12 Mar. 1996, *Nüsser 254* (B); Northern Areas, Chilas, Diamir, NW above Gor, 35°32'N, 74°29'E, 4 Sep. 1995, *Dickoré 12637* (M); Mushkin forest, Astor valley, 35°42'N, 74°47'E, 27 July 1892, *Duthie 12261* (FI, W); Rama valley, SW of Astor, Gula Aquey, 36°20'N, 75°50'E, 28 July 1967, *Lankester & Pearson 1246* (BM). Khyber Pakhtunkhwa: Gilgit, Babusar village, 35°8'N, 74°2'E, 4 Sep. 1988, *Omar & Qaiser 2626* (MO); Babusar

valley, 35°8′N, 74°2′E, 4 Aug. 1993, *Schickhoff 1692* (M); Swat state, 35°14′N, 72°27′E, July 1953, *Stewart 25207a* (BM); North-West Frontier, Swat, Utror-Tal bei Utror, 35°29′N, 72°27′E, 13 Sep. 1983, *Ern & Prelaz 7525* (B).

Discussion. Geranium swatense is a trailing and ascending small herb with a ± vertical rootstock that bears thin roots. It has opposite leaves, not deeply divided, short and free stipules, long petals that are glabrous except on the base, glabrous nectaries and narrow staminal filaments. This species is easily distinguished by its long and sometimes entangled glandular hairs on petioles, peduncles, pedicels and sepals.

The affinities of *G. swatense* are difficult to ascertain. At first sight, it resembles *G. collinum* or *G. rosthornii*. *Geranium collinum*, however, has more deeply divided leaves, with more lobes per segment, longer peduncles, shorter petals, hairy nectaries, and staminal filaments with a broad triangular base and an abruptly narrowed apex. *Geranium rosthornii* has broad and connate stipules and an erect habit. Neither of the two has the characteristic glandular hairs of *G. swatense.*

Geranium swatense is a rare species from northern Pakistan of which few collections are known. Field study focused on obtaining additional specimens can help elucidate the variability of this species.

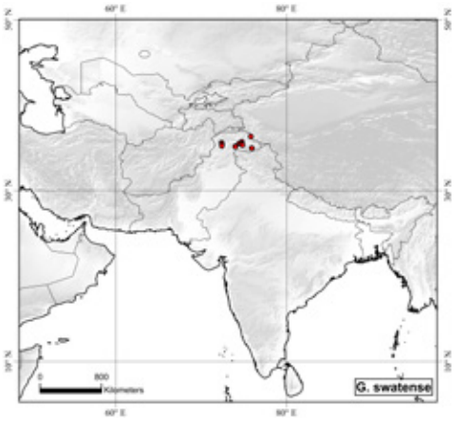


Fig. 251. Distribution of *Geranium swatense*.

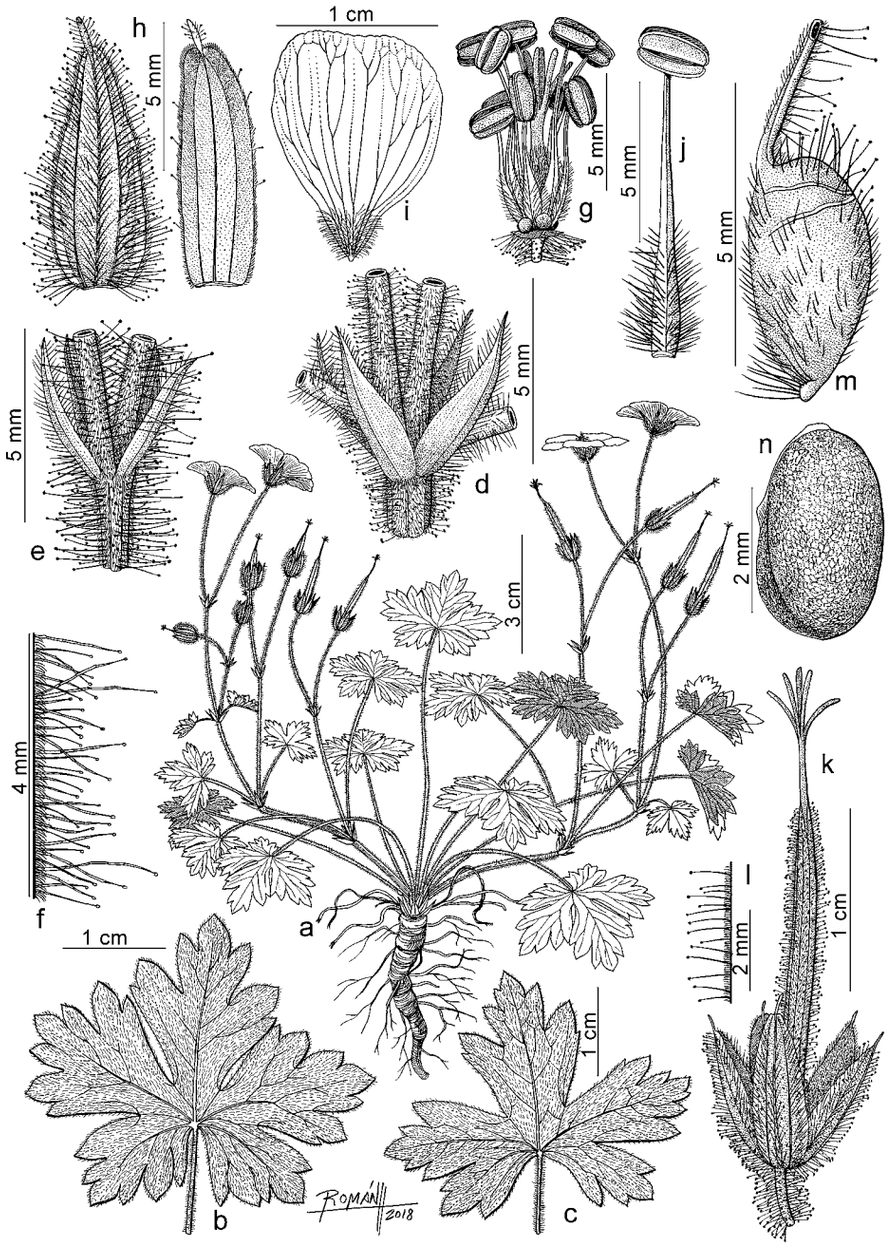


Fig. 250. *Geranium swatense*. a. Habit. b, c. Leaves. d. Stipules. e. Bracteoles. f. Detail of peduncle indumentum. g. Flower without petals and sepals. h. Sepals. i. Petal. j. Stamen. k. Fruit. l. Detail of the rostrum indumentum. m. Mericarp. n. Seed. (Based on: a-l, *Webster & Nasir 6465,* S; m-n, *Rechinger 19566,* G).

The Papuanum Group—This group is characterized by its prostrate habit, its opposite, palmatifid or palmatisect leaves and its 1-flowered cymules arranged in monochasial inflorescence. The stems may rooting at nodes and the stipules are ovate, connate or free (although sometimes overlapping). The bracteoles are opposite, usually overlapping its bases one on another giving a sheathed appearance. The petals are of small size, without claw, and usually glabrous. The indumentum is predominantly eglandular.

91. Geranium leptodactylon Veldkamp, Blumea 24(2): 471. 1978. Type locality: "Veldkamp & Stevens 5783

(L; iso in LAE), Nova Guinea (Mt. Suckling)". Type: Papua New Guinea. Goropu mountains, Mt. Suckling, 9º40'S, 148º56'E, 27 June 1972, *J.F. Veldkamp & P.F. Stevens 5783* (holotype, L-0018347!; isotypes, BISH-1001862 image!, LAE).

Perennial herbs, 2.5-8.2 cm tall. *Rootstock* 1.2-2.7 mm in diameter, ± vertical, not tuberculate, not turnip-shaped, with ± thickened roots. *Stem* prostrate, leafy, rooting at nodes, stolons present, without vegetative stems, with retrorse, ± appressed, eglandular hairs 0.1-0.2 mm long. *Basal leaves* in a persistent rosette, cauline leaves opposite; leaf laminas (0.5)0.6-0.9(1.4) cm long, 0.7-1.5 cm wide, not peltate, palmatisect, polygonal in outline, base cordate, not coriaceous, with nerves not projected, pilose, with appressed, eglandular hairs on both surfaces; segments 7(9), in more than 1 plane (with the pair of basal segments ± perpendicular to the plane formed by the remaining segments), middle segment rhombic (with linear lobes), 0.2-0.3 mm wide at the base [ratio segment width at the base/middle segment length = 0.05-0.07], 9-12-lobed in distal half [ratio secondary sinus length/middle segment length = 0.52-0.69]; petioles up to 7.5 cm long, without abscission zone, terete, not swollen, not deflexed in age, with retrorse, ± appressed, eglandular hairs 0.1-0.2 mm long; stipules 1.3-3.4 mm long, 0.8-1.8 mm wide, ovate, free, papery, brownish red, with eglandular hairs on abaxial surface and on the margin, glabrous adaxially. *Inflorescence* a monochasial cyme; cymules 1-flowered, solitary [ratio cymule length/leaf length = 0.7-2.5]; peduncles 6.6-16.2 mm long, with retrorse, ± appressed, eglandular hairs 0.1-0.2 mm long; bracteoles 1.1-1.7 mm long, 0.5-0.9 mm wide, lanceolate, opposite, overlapping at base to appear sheathing; pedicels 5.8-12.9 mm long, with retrorse, ± appressed, eglandular hairs 0.1-0.2 mm long. Flowers actinomorphic. *Sepals* 4.1-4.7 mm long, 1.4-1.7 mm wide, lanceolate, smooth, not accrescent, nerves 3, mucro 0.3-0.6 mm long [ratio mucro length/sepal length = 0.09-0.13], with erect-patent, eglandular hairs 0.3-0.5 mm long on the abaxial surface, ± glabrous adaxially. *Petals* 3.3-4.4 mm long, 1.3-1.8 mm wide, erect-patent, rounded, without claw, white to pink, hairy on the base of the adaxial surface, ciliate on the basal margin, with hairs ca. 0.1 mm long. *Stamens* 10, both whorls bearing anthers; filaments ca. 1.7 mm long, lanceolate with an abruptly narrowed apex, unknown color, pilose

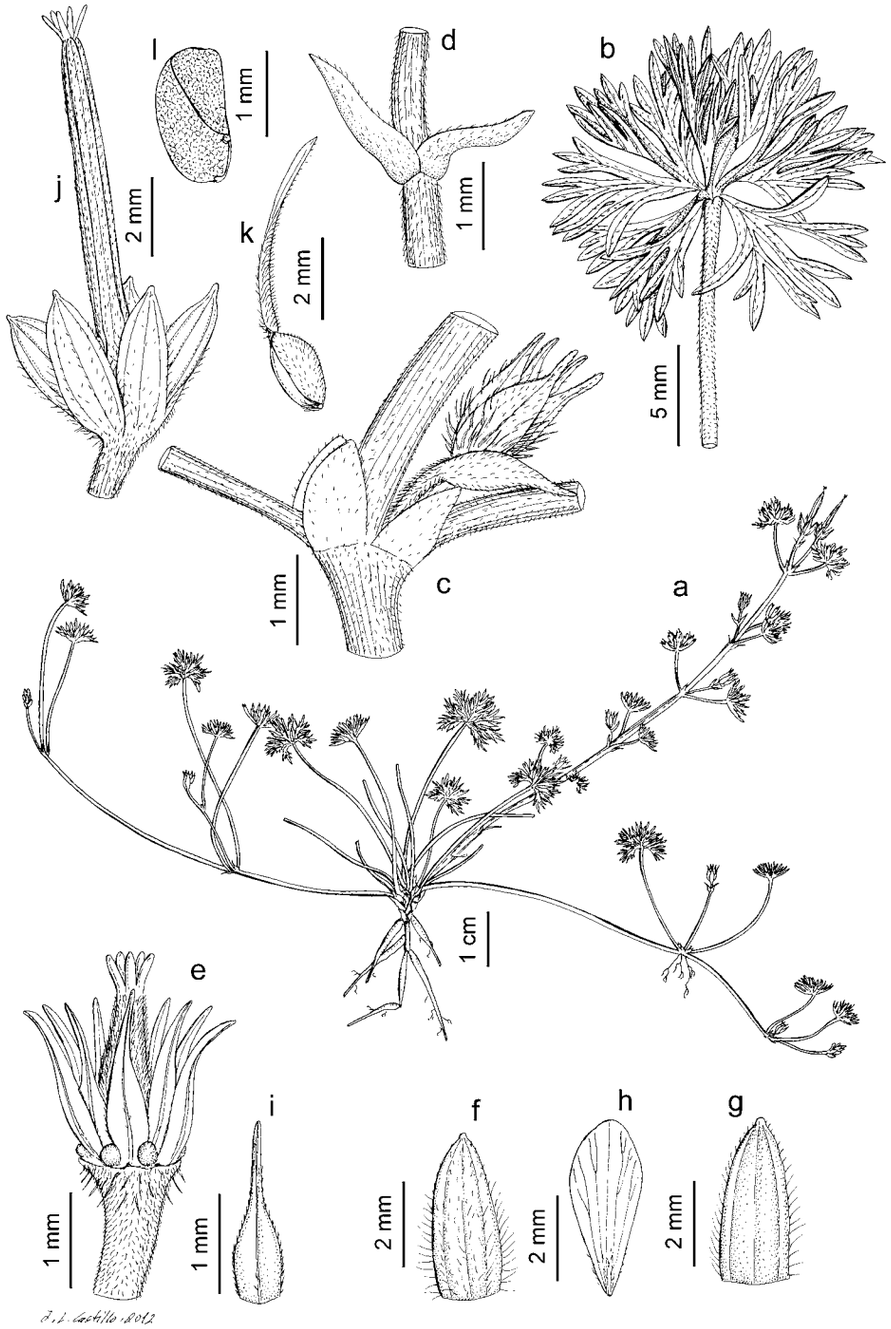


Fig. 252. *Geranium leptodactylon*. a. Habit. b. Leaf. c. Stipules. d. Bracteoles. e. Flower without petals and sepals. f. Sepal, abaxial surface. g. Sepal, adaxial surface. h. Petal. i. Staminal filament. j. Fruit. k. Mericarp. l. Seed. (Based on: a, c-l, *Stevens & Veldkamp s.n.*, *25 June 1972*, L; b, *Veldkamp & Stevens 5754*, L).

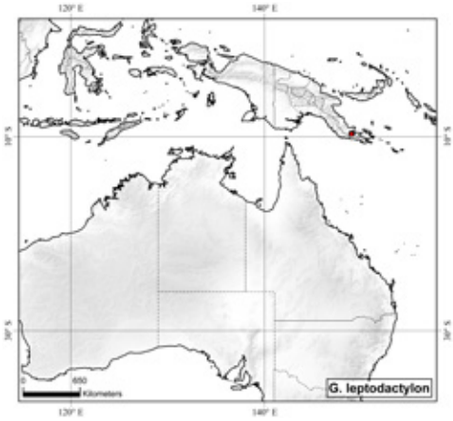


Fig. 253. Distribution of *Geranium leptodactylon*.

on the abaxial surface, ciliate on the proximal half, with hairs ca. 0.1 mm long; anthers unknown. Nectaries 5, hemispheric, glabrous. *Gynoecium* 1.9-2 mm long, unknown color. *Fruit* 8.9-10.9 mm long, erect, discharge of seed-ejection type; mericarps 1.9-2 mm long, 0.9-1 mm wide, without a strand of fibers, not compressed at the apex, smooth, without basal beak, with a basal callus, without a basal prong, brown, with erect-patent, eglandular hairs ca. 0.1 mm long; rostrum 5.3-7.5 mm long, without a narrowed apex, not twisted, with erect-patent, eglandular hairs 0.1-0.2 mm long; stigmatic remnants 0.7-1.1 mm long, with 5 glabrous lobes. *Seeds* 1.5-1.6 mm long, 0.9-1 mm wide, finely reticulate, uniformly colored, brown, glabrous. Cotyledons not studied. Fig. 252.

Pollen. Ornamentation not studied.

Chromosome number. Unknown.

Phenology. Collected in flower in June.

Distribution. This species is endemic to eastern New Guinea (Fig. 253).

Habitat. Margins of tussocks of *Styphelia* Sm. and grasses, and on open sandy flats; 3250-3500 m.

Additional specimens examined. **Papua New Guinea.** Northern: Goropu Mts., Mt. Suckling, S ridge Goë Dendeniwa, 9º40'S, 148º56'E, 24 June 1972, *Veldkamp & Stevens 5754* (L). Milne Bay: Milne bay district, Raba Raba subdistrict, Goe, 9º42'S, 149º2'E, 5 July 1972, *Stevens & Veldkamp s.n.* (L). Raba Raba subdistrict, Milne bay district, southern end of Goe Dendeniwa, 9º45'S, 148º58'E, 25 June 1972, *Stevens & Veldkamp s.n.* (GH, L).

Discussion. Geranium leptodactylon is well characterized by its distinctive palmatisect leaves with segments deeply divided into linear lobes. In general aspect *G. leptodactylon* is similar to *G. multipartitum*, an acaulescent species endemic to the Andes. They share deeply divided leaves with linear segments. In both species the pair of basal segments is more or less perpendicular to the plane formed by the remaining segments of the leaf. *Geranium leptodactylon* has a short vertical rootstock with some fusiform roots. Arising from the rosette it has one to several prostrate aerial stems, which root at the nodes. The indument of short eglandular hairs on all parts of the plant is not dense. The stipules are ovate, short, and with an obtuse, rounded apex. This species appears to be restricted to the higher mountains of southeastern New Guinea. According to Veldkamp & Moerman (1978), plants of *G. leptodactylon* are usually sterile. Herbarium material is scarce, and only three sheets have flowers or fruits. Thus, the variation of some descriptive details has not been properly described.

92. Geranium clemensiae R. Knuth, Repert. Spec. Nov. Regni Veg. 45: 61. 1938. Type locality: "Neu-Guinea: Morobe Distr., Mt. Sarawaket, auf dem Gipfel (Clemens a. 1937 n. 5872 -- Typus in herb. Berol.!).-- Blühend April". Type: Papua New Guinea. Morobe Distr., Mt. Sarawaket, 6°15'S, 147°00'E, 8 Apr. 1937, *J. Clemens 5872* (holotype, B destroyed; lectotype, designated by Aedo 2017a: 83, A-00351565!; isolectotype, L-0018352!).

Geranium sarawaketense R. Knuth, Repert. Spec. Nov. Regni Veg. 45: 61. 1938. Type locality: "Neu-Guinea: Morobe Distr., Mt. Sarawaket (Clemens a. 1937 n. 5871 -- Typus in herb. Berol.!).-- Blühend und fruchtend März". Type: Papua New Guinea. Morobe Distr., Mt. Sarawaket, 6°15'S, 147°00'E, 1937, *J. Clemens 5871* (holotype, B destroyed; lectotype, designated by Aedo 2017a: 83, A-00351564!).

Geranium subcompositum Veldkamp, Blumea 24(2): 474. 1978. Type locality: "LAE 61481 Croft & Lelean (L; iso in LAE; BRI, CANB, n.v.), Nova Guinea (Mt. Albert Edward) (Distributed as Veronica archboldii!)". Type: Papua New Guinea. Goilala subdistrict, Mt. Albert Edward, between E & W domes on NE, 8º25'S, 147º20'E, 27 June 1974, *J.R. Croft & Y. Lelean s.n.* (holotype, L-0018353!; isotypes, BRI-AQ0374905 image!, CANB, LAE).

Perennial herbs, 5-41 cm tall. *Rootstock* 3-4.4 mm in diameter, ± vertical, not tuberculate, not turnip-shaped, with ± thickened roots. *Stem* prostrate, leafy, sometimes rooting at nodes, stolons absent, without vegetative stems, with retrorse, appressed, eglandular hairs 0.1-0.2 mm long. *Basal leaves* in a ± persistent rosette, cauline leaves opposite; leaf laminas (0.5)1.2-2.1(2.2) cm long, 0.8-2.7 cm wide, not peltate, palmatisect, polygonal in outline, base cordate, not coriaceous, with nerves not projected, pilose, with appressed, eglandular hairs on both surfaces; segments (3)5, in 1 plane, middle segment obtriangular (with lanceolate lobes), (0.3)0.6-1.3 mm wide at the base [ratio segment width at the base/middle segment length = 0.06-0.13], 3-4(6)-lobed in distal half [ratio secondary sinus length/middle segment length = (0.24)0.36-0.47(0.56)]; petioles up to 19 cm long, without abscission zone, terete, not swollen, not deflexed in age, with retrorse, appressed, eglandular hairs 0.1-0.2 mm long; stipules 1.3-2.9 mm long, 0.3-1.4 mm wide, usually ovate, free (although overlapping), papery, brownish red, with eglandular hairs on abaxial surface and on the margin, glabrous adaxially. *Inflorescence* a monochasial cyme; cymules 1-flowered, solitary [ratio cymule length/leaf length = (0.6)0.8-3.1]; peduncles 7.7-47(133) mm long, with retrorse, appressed, eglandular hairs 0.1-0.2 mm long; bracteoles 0.9-3 mm long, 0.4-1.1 mm wide, lanceolate to broad-

ly lanceolate, subopposite, overlapping at base on one side of the pedicel, exposing the opposite part; pedicels 6.2-33(91) mm long, with retrorse, appressed, eglandular hairs 0.1-0.2 mm long. Flowers actinomorphic. *Sepals* (4.1)4.6-5.4(6.9) mm long, 1.3-1.9 mm wide, lanceolate, smooth, not accrescent, nerves 3, mucro 0.3-1 mm long [ratio mucro length/sepal length = 0.08-0.17], with antrorse, ± appressed, eglandular hairs 0.1-0.6 mm long on the abaxial surface, glabrous adaxially. *Petals* 3.9-7.8 mm long, 2.1-3.1 mm wide, erect-patent, rounded, without claw, white to pink, glabrous or sparsely ciliate on the basal margin, with hairs ca. 0.1 mm long. *Stamens* 10, both whorls bearing anthers; filaments 1.7-4 mm long, usually lanceolate with an abruptly narrowed apex, unknown color, glabrous, sometimes with scattered hairs ca. 0.1 mm long on the margin; anthers 0.3-0.8 mm long, unknown color. Nectaries 5, hemispheric, glabrous. *Gynoecium* 1.8-3.2 mm long, unknown color. *Fruit* 8.7-15.9 mm long, erect, discharge of seed-ejection type; mericarps 2-2.8 mm long, 1-1.4 mm wide, without a strand of fibers, not compressed at the apex, smooth, without basal beak, with a basal callus, without a basal prong, brown, with erect-patent, eglandular hairs 0.1-0.4 mm long; rostrum 4.9-10.2 mm long, with a narrowed apex 0.1-0.4 mm long, not twisted, with erect-patent, eglandular hairs 0.1-0.5 mm long; stigmatic remnants 0.8-1.9 mm long, with 5 glabrous lobes. *Seeds* 1.4-2.1 mm long, 1-1.4 mm wide, finely reticulate, uniformly colored, brown, glabrous. Cotyledons with entire margin. Fig. 254.

Pollen. Ornamentation not studied.

Chromosome number. Unknown.

Phenology. Collected in flower from April to July.

Distribution. This species ranges through eastern New Guinea (Fig. 255).

Habitat. Grassy banks along rivers, tussock grassland, cushion bogs, and edge of forests; 1750-3800 m.

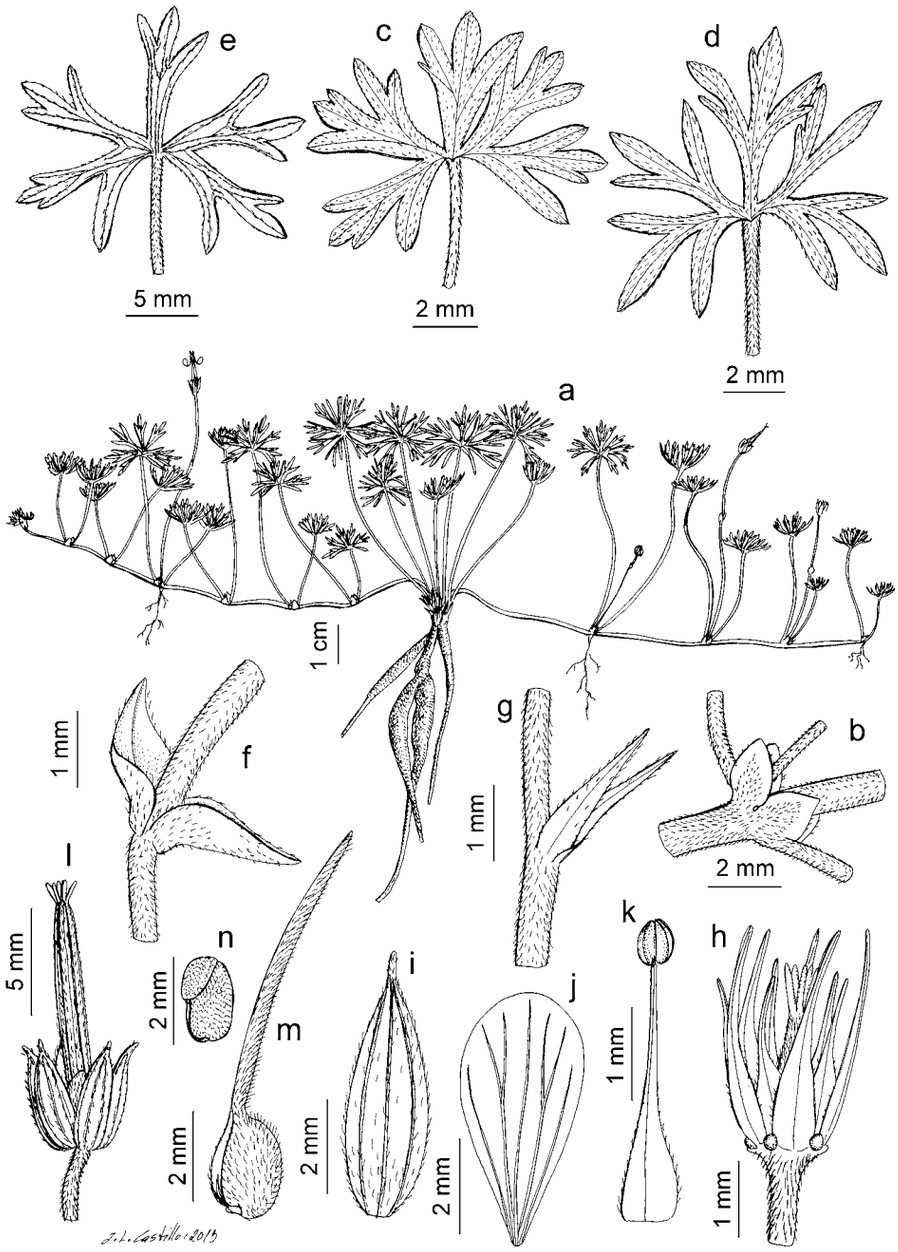


Fig. 254. *Geranium clemensiae*. a. Habit. b. Stipules. c, d. Leaves, adaxial surface. e. Leaf, abaxial surface. f, g. Bracteoles. h. Flower without petals and sepals. i. Sepal. j. Petal. k. Stamen. l. Fruit. m. Mericarp. n. Seed. (Based on: a, e, *Craven 2793*, L; b, d, f, *Croft & Lelean s.n.*, *27 June 1974*, L; c, *Clemens 5871*, A; g-k, *Veldkamp & Stevens 5581*, L; l-n, *Coode & Stevens s.n.*, *1 May 1971*, L).

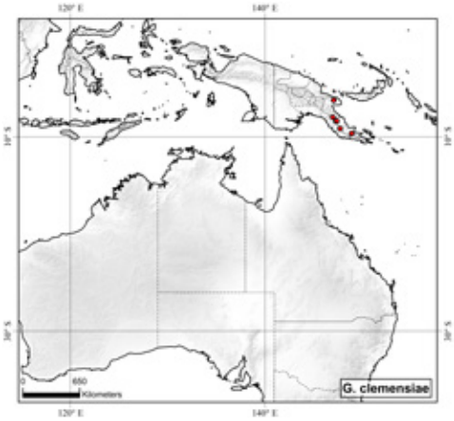


Fig. 255. Distribution of *Geranium clemensiae*.

Additional specimens examined. **Papua New Guinea.** Central: Tapini subdistrict, summit ridges of Mt. Strong, 8º0'S, 147º0'E, 1 May 1971, *Coode & Stevens s.n.* (L); Central district, NW part of Mt. Albert Edward, 8º23'S, 147º24'E, 27 June 1974, *Craven 2793* (L). Northern: district, Kokoda subdistrict, Mt. Kenive (Nisbet), 9º10'S, 147º45'E, 31 July 1974, *Croft & al. s.n.* (L); Goropu Mts., Mt. Suckling, Mayu II, 9º40'S, 148º56'E, 14 June 1972, *Veldkamp & Stevens 5581* (L); Goropu Mts., Mt. Suckling, Mayu II, 9º40'S, 148º56'E, 22 July 1972, *Veldkamp & Stevens 5991* (HBG, L).

Discussion. Geranium clemensiae is a variable species and difficult to interpret from the small amount of material available. An additional difficulty is the absence of flowers or rootstocks on most of the sheets. *Geranium clemensiae* shares with *G. leptodactylon* a prostrate aerial stem arising from a short vertical rootstock with some fusiform roots. Both species have palmatisect leaves and an indument of short appressed eglandular hairs. Some leaves of *G. clemensiae* should be considered subpalmatisect since the segments are not completely separated. However, the leaves of *G. leptodactylon* are very distinct because they have more segments, which are dissected into more numerous, very narrow, and deep lobes. The leaves of *G. clemensiae* typically have a middle segment divided into three apical lobes, and in some cases several additional lobelets. In a fragment of *Craven 2793* (L), it has been verified that the prostrate stem roots at the nodes. This feature should be checked in more individuals of *G. clemensiae* to establish whether it is only occasional or consistent. Each pedicel has two bracteoles that vary from lanceolate to broadly lanceolate. They are not sheathing, but overlap at the base on one side of the pedicel, exposing the opposite part. Ovate stipules are free, but their bases overlap and appear as if they were connate.

Specimens from Mt. Suckling, in the southernmost area of the distribution of *G. clemensiae*, are a bit deviant as Veldkamp & Moerman (1978) indicated. They have longer and narrower stipules, not ovate, and more or less obtuse as in the remaining specimens. Additionally, they have longer peduncles, bracteoles, pedicels, and sepals. In general appearance, however, they are like those from Sarawaket Mountains at the opposite side of the area of distribution for *G. clemensiae*. In both cases they have longer stems, not rooting at the nodes, and larger leaves. Unfortunately, these specimens lack a rootstock.

I have considered *G. clemensiae* to have a similar circumscription to that provided by Veldkamp & Moerman (1978) for *G. subcompositum*. There are, however, two significant differences: (1) I have separated, as a new species, the collections from Star Mountains (*Veldkamp 6368*) (see under *G. castroviejoi*), and (2) I have considered that the plants from Mt. Sarawaket should be included under *G. clemensiae*. The types of *G. clemensiae* and *G. sarawaketense*, both collected on Mt. Sarawaket by Clemens, formerly in B, have been lost. Veldkamp & Moerman (1978) located a duplicate of each at A, indicating that the majority of specimens of these sheets belong to *G. subcompositum*. These authors considered that these duplicate should be rejected as original material because they disagree markedly with the descriptions given by Knuth (1938). I have examined Clemens's collections carefully, however, and I have found only minor discrepancies between the descriptions and the specimens. It should be noted that Knuth's descriptions are not as detailed as could be desired (see also art. 9.19, note 7). Consequently, I have considered that there is no reason to reject *G. clemensiae* and *G. sarawaketense* as "dubious names" and to exclude them in favor of *G. subcompositum* as Veldkamp & Moerman (1978) did. More collections are needed to clarify the circumscription and taxonomy of this species and would help to determine if *G. clemensiae* is simply a variable species or if it should be divided into several taxa.

93. Geranium castroviejoi Aedo, Syst. Bot. Monogr. 102: 86. 2017. Type locality: "Papua New Guinea. Star Mountains, W Sepik, camp 2, Tel Basin, 5°00'S, 141°05'E, 8 Apr 1975, J. F. Veldkamp 6368 (holotype, L!; isotype: K!)". Type: Papua New Guinea. Star mountains, W Sepik, camp 2, Tel Basin, 5°00'S, 141°05'E, 8 Apr. 1975, *J.F. Veldkamp 6368* (holotype, L!; isotype, K-001089664!).

Perennial herbs, 9-22 cm tall. *Rootstock* 1-3 mm in diameter, vertical, not tuberculate, not turnip-shaped, without thickened roots. *Stem* prostrate, leafy, rooting at nodes, stolons present, with short vegetative stems, with retrorse, appressed, eglandular hairs 0.1-0.3 mm long. *Basal leaves* in a ± persistent rosette, cauline leaves opposite (on buds alternate); leaf laminas (0.7)0.9-1.2(1.3) cm long, 0.8-1.4 cm wide, not peltate, palmatisect, polygonal in outline, base cordate, not coriaceous, with nerves not projected, ± strigose on adaxial surface and with appressed, eglandular hairs restricted to the nerves abaxially; segments 5, in 1 plane, middle segment obtriangular, 0.4-1 mm wide at the base [ratio segment width at the base/middle segment length = 0.10-0.14], 3(5)-lobed in distal half [ratio secondary sinus length/middle segment length = 0.26-0.40]; petioles up to 6.6 cm long, without abscission zone, terete, not swollen, not deflexed in age, with retrorse, appressed, eglandular hairs 0.1-0.3 mm long; stipules 1.6-2.2 mm long, 0.9-1.7 mm wide, ovate, connate (except on buds), papery, brownish red, with eglandular hairs on abaxial surface and on the margin, glabrous adaxially. *Inflorescence* a monochasial cyme; cymules 1-flowered, solitary [ratio cymule length/leaf length = 0.7-0.8]; peduncles 8.9-34.6 mm long, with retrorse, appressed, eglandular hairs 0.1-0.2 mm long; bracteoles 1.7-2.3 mm long, 0.8-1.2 mm wide, broadly lanceolate, opposite, overlapping at base to appear sheathing; pedicels 5.6-18.4 mm

long, with retrorse, appressed, eglandular hairs 0.1-0.3 mm long. Flowers actinomorphic. *Sepals* 3.1-4.7 mm long, 0.9-1.2 mm wide, lanceolate, smooth, not accrescent, nerves 3, mucro 0.7-0.8 mm long [ratio mucro length/sepal length = 0.16-0.24], with antrorse, ± appressed, eglandular hairs 0.1-0.2 mm long and ± patent, glandular hairs 0.4-0.9 mm long on the abaxial surface, glabrous adaxially. *Petals* 5-5.6 mm long, 1.5-1.9 mm wide, erect-patent, rounded, without claw, pink, with scattered hairs on the base of the adaxial surface, ciliate on the basal margin, with hairs ca. 0.1 mm long. *Stamens* 10, both whorls bearing anthers; filaments 1.6-2.5 mm long, lanceolate with an abruptly narrowed apex, unknown color, with scattered hairs ca. 0.1 mm long on the abaxial surface and margin; anthers 0.5-0.6 mm long, unknown color. Nectaries 5, hemispheric, glabrous. *Gynoecium* 2.4-2.6 mm long, unknown color. *Fruit* 11.4-12.8 mm long, erect, discharge of seed-ejection type; mericarps 2.2-3 mm long, 1-1.3 mm wide, without a strand of fibers, not compressed at the apex, smooth, without basal beak, with a basal callus, without a basal prong, brown, with erect-patent, eglandular hairs 0.1-0.3 mm long; rostrum 7.8-9 mm long, without a narrowed apex, not twisted, with erect-patent, eglandular hairs 0.1-0.2 mm long; stigmatic remnants 1-1.2 mm long, with 5 glabrous lobes. *Seeds* 1.9-2 mm long, 0.9-1 mm wide, finely reticulate, uniformly colored, brown, glabrous. Cotyledons not studied. Fig. 256.

Pollen. Ornamentation not studied.

Chromosome number. Unknown.

Phenology. Collected in flower in April.

Distribution. This species is endemic to central New Guinea (Fig. 257).

Habitat. Bank of rivulets among tall grasses, and edge of conifer forests; 2900-3100 m.

Additional specimens examined. **Papua New Guinea.** West Sepik: Star Mts., Telefomin subdistrict, W Sepik, ca. 2 km SE of Mt. Capella summit ridge, 4º58'S, 141º6'E, 10 Apr. 1975, *Barker & Umba s.n.* (L).

Discussion. Veldkamp & Moerman (1978) examined the collection *Veldkamp 6368* and noted the great dis-

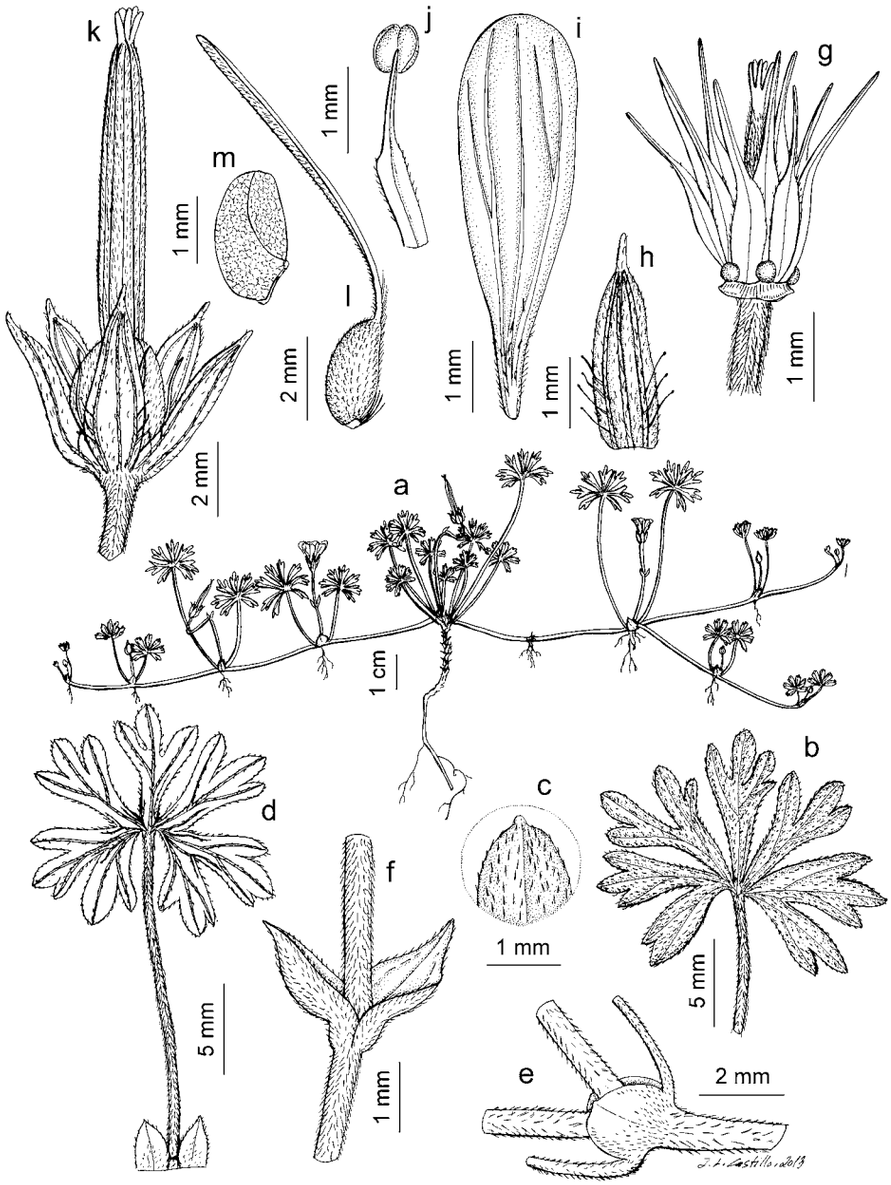


Fig. 256. *Geranium castroviejoi*. a. Habit. b. Leaf, adaxial surface. c. Detail of leaf indument. d. Leaf, abaxial surface. e. Stipules of prostrate stems. f. Bracteoles. g. Flower without petals and sepals. h. Sepal. i. Petal. j. Stamen. k. Fruit. l. Mericarp. m. Seed. (Based on: a, *Barker & Umba s.n., 10 Apr. 1975*, L; b-m, *Veldkamp 6368*, L).

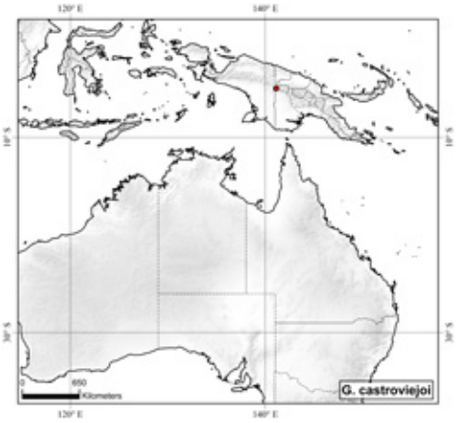


Fig. 257. Distribution of *Geranium castroviejoi*.

tance (over 700 km) between the locality of their *G. subcompositum* (here *G. clemensiae*) and the specimens collected from the Star Mountains. They overlooked, however, some important morphological differences that permit recognition of the plants from the Star Mountains as a distinct species. The most relevant difference is presence of patent glandular hairs on the sepals, especially towards the base, in *G. castroviejoi*. The leaves of *G. castroviejoi* and *G. clemensiae* are quite similar in shape, but not in the indument of the abaxial surface: leaves of the former have distinctive lines of appressed eglandular hairs on the nerves, while the surface between the nerves has a more or less dense indument in *G. clemensiae*, so the nerves do not stand out as in *G. castroviejoi*. The staminal filaments of *G. castroviejoi* are abruptly narrowed at the apex. In some flowers there are a pair of auricles (one on each side) just at the point where the filament narrows. However, the scarce available material does not permit us to establish whether it is a consistent feature of the species or not. For the same reason, the underground parts of *G. castroviejoi* are not well known. It is interesting to note that the leaves are alternate toward the apex and have free stipules whereas those of the middle of shoot are opposite and have connate stipules.

94. Geranium monticola Ridl., Trans. Linn. Soc. London, Bot. 9(1): 23. 1916. Type locality: "Camp XIII, 10,500 ft.". Type: Indonesia. Papua, Mt. Carstensz, Camp XIII, 4º06'S, 137º10'E, 1912, *C.B. Kloss s.n.* (lectotype, designated by Veldkamp & Moerman 1978: 472, BM-000075364!).

Perennial herbs, 3-30 cm tall. *Rootstock* 2.4-6.2 mm in diameter, ± vertical, not tuberculate, not turnip-shaped, without thickened roots. *Stem* prostrate, leafy, not rooting at nodes, stolons absent, with short vegetative stems, with retrorse, usually appressed, eglandular hairs 0.1-0.3 mm long. *Basal leaves* in a persistent rosette, cauline leaves opposite (on buds alternate); leaf laminas (0.5)0.7-1.1(1.5) cm long, 0.5-1.6 cm wide, not peltate, palmatifid [ratio main-sinus length/middle segment length = 0.68-0.80(0.88)], polygonal in outline, base cordate, not coriaceous, with nerves not projected, pilose, with scattered long hairs or strigose on adaxial surface and sericeous, with antrorse, appressed, eglandular hairs abaxially; segments 5(7), in 1 plane, middle segment obtriangular, 0.9-2 mm wide at the base [ratio segment width at the base/middle segment length = 0.22-0.33], (1)3(4)-lobed at apex [ratio secondary sinus length/middle segment length = 0.13-0.31]; petioles up to 10 cm long, without abscission zone, terete, not swollen, not deflexed in age, with retrorse, appressed, eglandular hairs 0.1-0.6 mm long; stipules 2.1-4.9 mm long, 1.5-3.3 mm wide, ovate, connate (except on buds), papery, brownish red, with eglandular hairs on abaxial surface and on the margin, glabrous adaxially. *Inflorescence* a monochasial cyme; cymules 1-flowered, solitary [ratio cymule length/leaf length = 0.4-0.9(1.1)]; peduncles 3.5-21.7 mm long, with retrorse, appressed, eglandular hairs 0.1-0.3 mm long; bracteoles 1.9-4.9 mm long, 1.2-2.7 mm wide, broadly lanceolate, opposite, overlapping at base to appear sheathing; pedicels 2.9-28.3 mm long, with retrorse, appressed, eglandular hairs 0.1-0.4 mm long. Flowers actinomorphic. *Sepals* (3)3.5-4.7(5.7) mm long, 1.1-2.1 mm wide, lanceolate, smooth, not accrescent, nerves 3, mucro 0.3-0.8 mm long [ratio mucro length/sepal length = 0.12-0.20], sericeous, with antrorse, appressed, eglandular hairs 0.2-0.4 mm long and scattered, patent, eglandular and glandular hairs 0.7-1.4 mm long on the abaxial surface, glabrous adaxially. *Petals* (4.7)5.2-6.5(7.1) mm long, 1.7-3.1 mm wide, erect-patent, rounded, without claw, purple, rarely white, glabrous. *Stamens* 10, both whorls bearing anthers; filaments 1.8-2.3 mm long, lanceolate with an abruptly narrowed apex, yellow, glabrous on the abaxial surface, ciliate on the proximal half, with hairs 0.1-0.2 mm long; anthers 0.4-0.7 mm long, yellow. Nectaries 5, hemispheric, glabrous. *Gynoecium* 2.1-3.3 mm long, yellow. *Fruit* 7.9-12.5 mm long, erect, discharge of seed-ejection type; mericarps 1.6-2.8 mm long, 1-1.3 mm wide, without a strand of fibers, not compressed at the apex, smooth, without basal beak, with a basal callus, without a basal prong, brown, sericeous, with antrorse, ± appressed, eglandular hairs 0.1-0.4 mm long; rostrum 3.7-8.1 mm long, without a narrowed apex, not twisted, sericeous, with erect-patent, eglandular hairs 0.1-0.3 mm long; stigmatic remnants 0.7-1.2 mm long, with 5 hairy lobes. *Seeds* 1.4-1.8 mm long, 0.7-1 mm wide, finely reticulate, uniformly colored, brown, glabrous. Cotyledons with entire margin. Fig. 258.

Pollen. Ornamentation not studied.

Chromosome number. Unknown.

Phenology. Collected in flower from January to November.

Distribution. This species ranges through central New Guinea (Fig. 259).

Habitat. Sandy banks of streams in subalpine grassland, and open rocky soil with outcrops of limestone; 3100-4700 m.

Representative specimens examined. **Indonesia.** Papua: Mt. Jaya, PT-Freeport Indonesia Concession Area, Gure East-Water monitoring site accessible by helicopter, 7 Feb. 1998, *Johns 8962* (BO); Trikora, N side Kec. Wamena, Kab. Jayawijawa, 3º55'S, 138º44'E, 17 Oct. 1992, *Argent 92470* (E, GH); Mt. Jaya, Mimika Regency, PT-Freeport Indonesia Concession Area, equidistant beween the two Fairy Lakes, 3º58'S, 136º59'E, 20 Mar. 1999, *Edwards 4237* (K); Mt. Jaya, PT-Freeport Indonesia Concession Area, Fairy Lakes, 3º58'S, 136º59'E, 15 Oct. 1998, *Johns 9136* (K); Western Sudirman Range, Carstensz Mts., Bacopa Valley, 4º1'S, 137º5'E, 25 Jan. 1991, *Miller 21498* (MU); Mt. Jaya, Mimika Regency, PT-Freeport Indonesia Concession Area, Batubersih, top of the path to Fairy Lakes, road to access from Sura-

baya shop, 4º2'S, 137º5'E, 23 Mar. 1999, *Edwards 4280* (A, BO); Mt. Jaya, Mimika Regency, PT-Freeport Indonesia Concession Area, Batubersih, top of path to Fairly Lakes, road access from Surabaya workshop, 4º2'S, 137º5'E, 23 Mar. 1999, *Willis 200* (K); Mt. Jaya, Mimika Regency, PT-Freeport Indonesia Concession Area, N of Carstensz Meadow, 4º3'S, 137º7'E, 30 Mar. 1999, *Johns 10112B* (GH, K); Mt. Jaya, PT-Freeport Indonesia Concession Area, Meren Valley, between Lakes, along trail to glaciers on summit area pf Mt. Jaya, 4º3'S, 137º4'E, 15 Feb. 1998, *Johns 9126* (BO); Mt. Jaya, head of Carstensz Meadow, 4º3'S, 137º6'E, 22 Aug. 1992, *Miller s.n.* (MU); Mt. Jaya, Mimika Regency, PT-Freeport Indonesia Concession Area, E of Carstensz Meadow, 4º3'S, 137º6'E, 4 Aug. 1998, *Sands 7085* (K); Mt. Jaya, Mimika Regency, PT-Freeport Indonesia Concession Area, D.O.M. valley, near Mine, 4º3'S, 137º8'E, 19 Mar. 1999, *Utteridge 147* (K); Mt. Jaya, Mimika Regency, PT-Freeport Indonesia Concession Area, Mt. Jaya, Meren Valley, along path from Grasberg Mine to 1st glacial Lake on way to New Zealand Pass, 4º4'S, 137º8'E, 9 Mar. 1998, *Baker 946* (K); Mt. Jaya, Lembah Fairytale Valley, western rift valley S of main ridge, 4º4'S, 137º11'E, 26 Jan. 1991, *Miller 21632b* (MU); Western Sudirman Range, Carstensz Mts., Lembah Fairytale Valley, 4º4'S, 137º11'E, 26 Jan. 1991, *Miller 21667* (MU); Mt. Jaya, upper Wanagon Valley, 4º4'S, 137º4'E, 14 Aug. 1992, *Miller 22911* (MU); Mt. Jaya, Mimika Regency, PT-Freeport Indonesia Concession Area, D.O.M. valley, 4º4'S, 137º7'E, 16 Feb. 1998, *Puradyatmika 10299* (K); Carstensz Meadow, extrémité S, environs de la station géodésique WO North, 4º4'S, 137º5'E, 28 Apr. 1973, *Raynal 17332* (K, P); Mt. Jaya, Mimika Regency, PT-Freeport Indonesia Concession Area, S of Carstensz Meadow just past Ertsberg pit, W of limestone crusher, 4º4'S, 137º7'E, 3 Aug. 1998, *Sands 7059* (GH); Mt. Carstensz, Yellow Valley, 4º5'S, 137º11'E, 28 Jan. 1972, *Hope 16048* (L); Western Sudirman Range, Carstensz Mts., Carstensz Valley, 4º5'S, 137º11'E, 24 Jan. 1991, *Miller 21466* (MU); Mt. Jaya, West Agawagon Valley, slopes of Grasberg, 4º5'S, 137º7'E, 20 Aug. 1992, *Miller 23428* (MU); Carstens groep, Nassau Mts., 4º5'S, 137º11'E, 1936, *Steenis s.n.* (L); Mt. Carstensz, 4º5'S, 137º11'E, Nov. 1936, *Wissel 103* (L); 2 km E of Wilhelmina top, 4º15'S, 138º53'E, Sep. 1938, *Brass & Meijer Drees 10185* (GH, L); 7 km NE of Wilhelmina top, 4º15'S, 138º53'E, Sep. 1938, *Brass & Meijer Drees 9868* (L); Mt. Trikora, 4º15'S, 138º45'E, 19 Aug. 1982, *Mangen 399* (L, LUX); Mt. Trikora, Somalak valley, 4º15'S, 138º45'E, 20 Aug. 1983, *Mangen 713* (L); Mt. Trikora, scree at the base of the N wall, 4º15'S, 138º45'E, 21 Aug. 1983, *Mangen 738* (LUX); Mt. Trikora, crest to the W of the summit, 4º15'S, 138º45'E, 6 Aug. 1984, *Mangen 910* (L). **Papua New Guinea.** HELA:

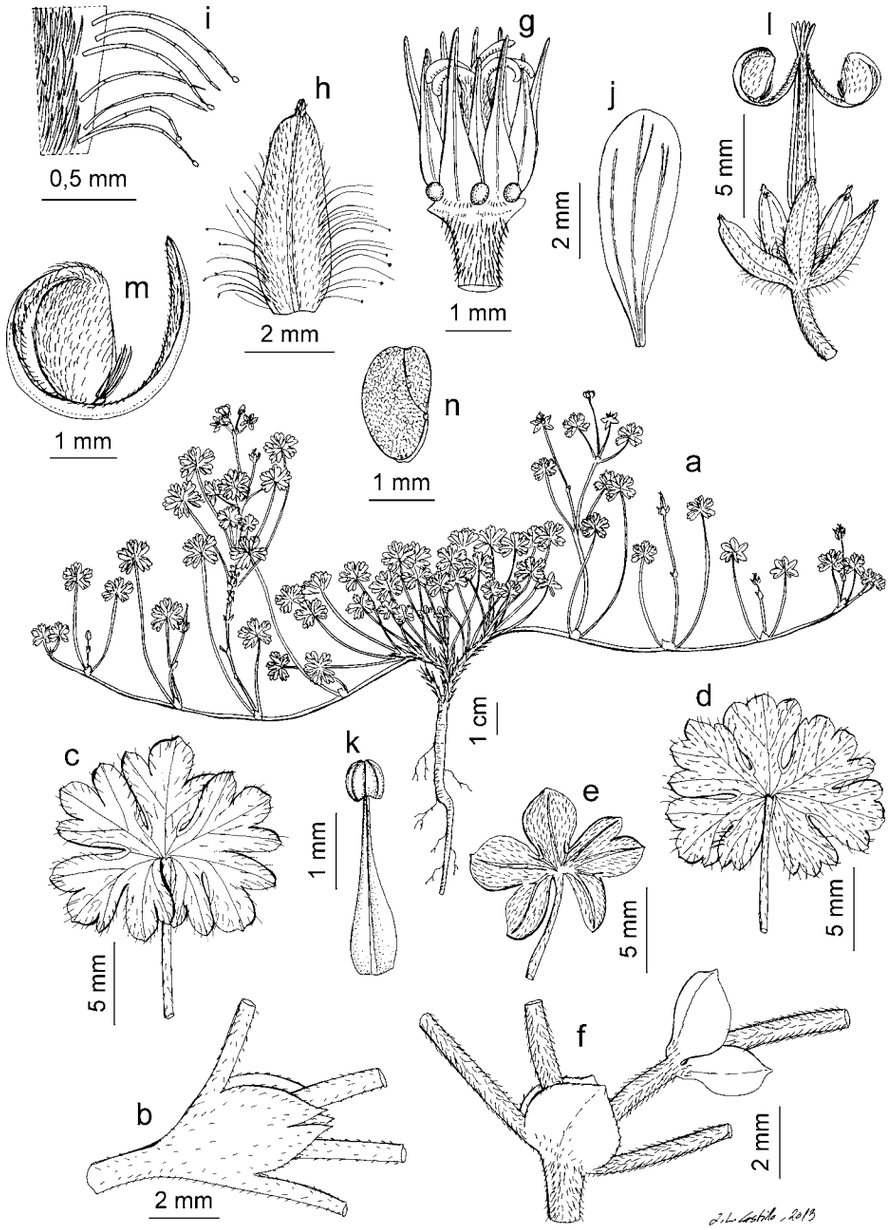


Fig. 258. *Geranium monticola*. a. Habit. b. Stipules. c, d. Leaves, adaxial surface. e. Leaf, abaxial surface. f. node with stipules (left) and bracteoles (right). g. Flower without petals and sepals. h. Sepal. i. Detail of sepal indument. j. Petal. k. Stamen. l. Fruit. m. Mericarp. n. Seed. (Based on: a, c, *Puradyatmika 10299*, K; b, f-n, *Edwards 4280*, BO; d, *Johns 10112B*, K; e, *Miller s.n.*, *22 July 1992*, MU).

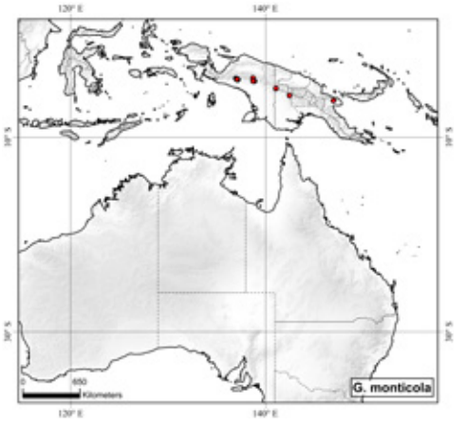


Fig. 259. Distribution of *Geranium monticola*.

Western province, Mt. Karoma, radio station, 5º43'S, 142º29'E, 10 Sep. 1981, *Veldkamp & Wiakabu 7713* (L). Morobe: summit Mt. Bangeta, 6º15'S, 147º0'E, 1 Nov. 1963, *Royen s.n.* (L). West Sepik: Star Mts., Telefomin subdistrict, district Tarn in valley immediatelly N of Mt. Capella E summit, 4º58'S, 141º6'E, 17 Apr. 1975, *Barker & Umba s.n.* (AD, E, GH, K, L, M, NSW); Star Mts., Telefomin subdistrict, West Sepik district Mt. Capella, 4º58'S, 141º6'E, 29 May 1975, *Croft & Hope s.n.* (GH, K, L, M); Star Mts., West Sepik, Dagabulon, Camp 10, 5º0'S, 141º5'E, 17 Apr. 1975, *Veldkamp 6472* (L); Star Mts., West Sepik, NE Peak Capella, summit, 5º0'S, 141º5'E, 19 Apr. 1975, *Veldkamp 6499* (L).

Discussion. Geranium monticola is usually a cushion-like herb, with more or less elongated prostrate stems not rooting at the nodes. The rootstock is vertical and with thin roots. In well-developed plants the prostrate stems are more or less branched. Buds covered by stipules and petiole remnants are produced toward the apex of the branches of the rootstock and on the nodes of the prostrate stems. It should be noted that the leaves of the buds are alternate and with free stipules whereas those of the prostrate stems are opposite with connate stipules such as are present in *G. castroviejoi*. The bracteoles of *G. monticola* are strictly opposite and imbricate (Carolin 1964: 446), but not sheathing. Another important feature of *G. monticola* is the calyx indument. The abaxial surface of the sepals is densely covered by short (0.2-0.4 mm), appressed eglandular hairs. In addition, on the basal half there are more or less abundant long (0.7-1.4 mm) spreading hairs. These hairs are both glandular and eglandular, but the proportions of the two types vary. Furthermore, glandular hairs have an apical cell slightly wider than the peduncle, but this cell is sometimes lost in dried specimens and the hairs then appear eglandular. The most distinctive feature of *G. monticola*, however, is the sericeous indument of the abaxial surface of the leaves. Veldkamp & Moerman (1978: 472) pointed out that the indument of the adaxial surface of the leaves of *G. monticola* is variable. In the area of Mt. Carstensz some plants have the adaxial surface of the leaves glabrous, while others have scattered, erect-patent, long hairs, and finally some have a dense, strigose indument of appressed hairs. On some herbarium sheets mixed collections can be found [*Wissel & Colijn 103* (L), *Sands 7085* (K), *Kloss s.n.* (BM)], which suggests that this feature does not have taxonomic importance. Eastern populations, except one from Mt. Wilhemina, which is glabrous, have the abaxial surface of the leaves strigose (*Brass & Meijer Drees 10185*, A, L). The shape of the middle leaf segment is also variable because of the variation in lobing: plants with three-lobed segments may be mixed with those with entire middle segments in the same gathering. Two localities (Mt. Karoma and Mt. Bangeta) are far from the main area of distribution for *G. monticola*. Unfortunately, the collections from those areas are insufficient to ascertain if they can be differentiated. The specimens from Mt. Karoma (*Veldkamp & Wiakabu 7713*, L) form compact cushions with smaller leaves. The middle leaf segment is usually entire, although there are some leaves with 3-lobed middle segments. It is also interesting to note that their leaves have 7 segments, not 5, as in the remaining collections of *G. monticola*. The cymules have a very short peduncle and apparently no pedicel. These features should be checked in more specimens to establish if they are occasional or not. The specimen from Mt. Bangeta (*Royen 20046*, L) is quite similar to other collections of *G. monticola* except for its short cymules, which also lack pedicels. Plants from both localities should be carefully re-collected to fill in the gaps in the descriptions and to clarify their status.

95. Geranium wilhelminae Veldkamp, Blumea 24(2): 476. 1978. Type locality: "Brass 9207 (L; iso in LAE; A, BO, n.v.) Nova Guinea (Wilhelmina)". Type: Indonesia. Papua, Wilhelmina, lake Habbema, 4°15'S, 138°53'E, Aug. 1938, *L.J. Brass 9207* (holotype, L-0018357!; isotypes, A-00043676!, BO, BRI-AQ0221062 image!, LAE).

Geranium lacustre Veldkamp, Blumea 24(2): 471. 1978. Type locality: "Versteeg 2494 (L; iso in BO, n.v.), Nova Guinea (Mt Wilhelmina)". Type: Indonesia. Papua. Mt. Wilhelmina, near the lake, 4°15'S, 138°53'E, 17 Feb. 1913, *G.M. Versteeg 2494* (holotype, L-0018346!; isotype, BO).

Perennial herbs, 3-41 cm tall. *Rootstock* 1.6-3.5 mm in diameter, vertical, not tuberculate, not turnip-shaped, without thickened roots. *Stem* prostrate, leafy, rooting at nodes, stolons present, with short vegetative stems, with retrorse, appressed, eglandular hairs 0.1-0.3 mm long. *Basal leaves* in a ± persistent rosette, cauline leaves opposite (on buds alternate); leaf laminas (0.5)0.6-0.8(1.1) cm long, 0.6-1.2 cm wide, not peltate, palmatifid [ratio main-sinus length/middle segment length = 0.63-0.83], polygonal in outline, base cordate, not coriaceous, with nerves not projected, glabrous or strigose on adaxial surface, and with appressed, eglandular hairs restricted to the nerves on the abaxial surface; segments 5, in 1 plane, middle segment obtriangular or broadly lanceolate, 0.7-1.4 mm wide at the base [ratio segment width at the base/middle segment length = 0.15-0.33], 1-3-lobed in distal half [ratio secondary sinus length/middle segment length = 0.26-0.40]; petioles up to 5.5 cm long, without abscission zone, terete, not swollen, not deflexed in age, with retrorse, appressed, eglandular hairs 0.1-0.4 mm long; stipules 1.3-2.2 mm long, 0.8-1.5 mm wide, ovate, free (sometimes connate at the apex of stem), papery, brownish red, with eglandular hairs on abaxial surface and on the margin, glabrous adaxially. *Inflorescence* a monochasial cyme; cymules 1-flowered, solitary [ratio cymule length/leaf length = 0.4-0.9]; peduncles 1.8-8.8 mm long, with retrorse, appressed, eglandular hairs 0.1-0.3 mm long; bracteoles 1.8-3 mm long, 0.8-1.6 mm wide, broadly

lanceolate, opposite, overlapping at base to appear sheathing; pedicels 2.2-10.7 mm long, with retrorse, appressed, eglandular hairs 0.1-0.3 mm long. Flowers actinomorphic. *Sepals* (2.7)3-4.3(4.6) mm long, 1.3-1.9 mm wide, lanceolate to broadly lanceolate, smooth, not accrescent, nerves 3, mucro 0.3-0.8 mm long [ratio mucro length/sepal length = 0.13-0.25], with antrorse, ± appressed, eglandular hairs 0.1-0.3 mm long and ± patent, glandular hairs 0.4-1.1 mm long on the abaxial surface, glabrous adaxially. *Petals* (4.1)4.6-5.4 mm long, 1.4-2.1 mm wide, erect-patent, rounded, without claw, pink, glabrous. *Stamens* 10, both whorls bearing anthers; filaments 1.7-2.3 mm long, lanceolate with an abruptly narrowed apex, yellow, with scattered hairs ca. 0.1 mm long on the margin; anthers 0.4-0.6 mm long, unknown color. Nectaries 5, hemispheric, glabrous. *Gynoecium* 1.6-2.7 mm long, unknown color. *Fruit* 8.2-11.6 mm long, erect, discharge of seed-ejection type; mericarps 1.8-2.6 mm long, 0.7-1.4 mm wide, without a strand of fibers, not compressed at the apex, smooth, without basal beak, with a basal callus, without a basal prong, brown, with antrorse, ± appressed, eglandular hairs 0.1-0.2 mm long; rostrum 5.5-8.1 mm long, without a narrowed apex, not twisted, with erect-patent, eglandular hairs 0.1-0.3 mm long; stigmatic remnants 0.7-1.2 mm long, with 5 hairy lobes. *Seeds* 1.5-1.7 mm long, 0.9-1 mm wide, finely reticulate, uniformly colored, brown, glabrous. Cotyledons not studied. Fig. 260.

Pollen. Ornamentation not studied.

Chromosome number. Unknown.

Phenology. Collected in flower from February to September.

Distribution. This species is endemic to central New Guinea (Fig. 261).

Habitat. Open boggy grounds, grassland, banks of streams and treefern savannas; 2300-4000 m.

Additional specimens examined. **Indonesia.** Papua: 2 km E of Wilhelmina top, 4º15'S, 138º53'E, Sep. 1938, *Brass & Meijer Drees 10186* (L); 11 km NE of Wilhelmina top, 4º15'S, 138º53'E, Sep. 1938, *Brass & Meijer Drees 9813* (A, L); Mt. Trikora, base of False Peak, to the N, 4º15'S, 138º45'E,

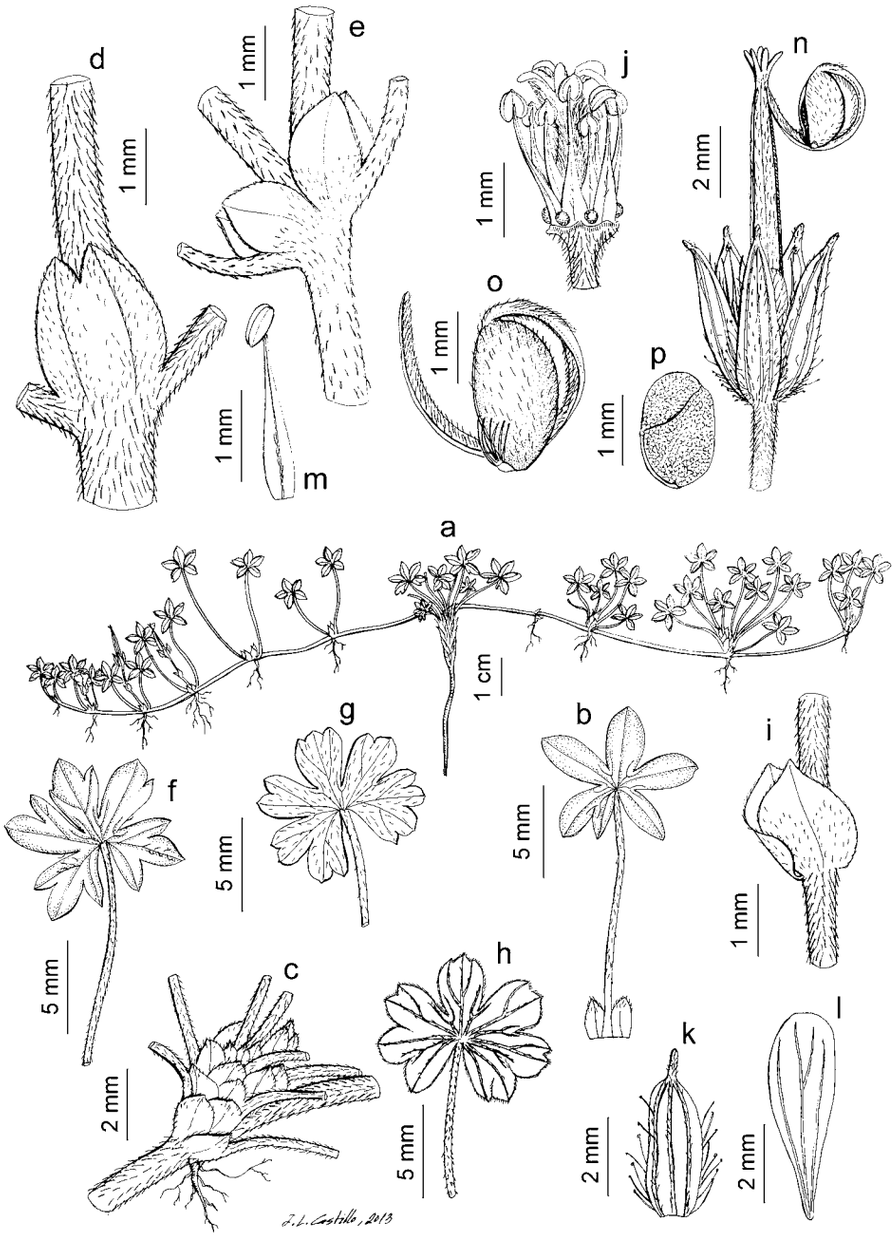


Fig. 260. *Geranium wilhelminae*. a. Habit. b, f, g. Leaves, adaxial surface. c. Rooting node. d, e. Stipules of the cauline leaves. h. Leaf, abaxial surface. i. Bracteoles. j. Flower without petals and sepals. k. Sepal. l. Petal. m. Stamen. n. Fruit. o. Mericarp. p. Seed. (Based on: a, b, f, i, *Brass 9207*, L; c, *Mangen 990*, L; d, j-p, *Brass & Meijer Drees 9813*, L; e, h, *Mangen 1027*, L; g, *Mangen 1243*, L).

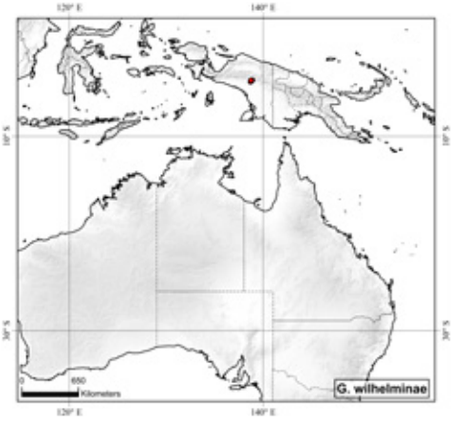


Fig. 261. Distribution of *Geranium wilhelminae*.

11 Aug. 1984, *Mangen 1027* (L); Mt. Trikora, huge valley NE of the summit, lateral moraine deposits, 4º15'S, 138º45'E, 17 Aug. 1984, *Mangen 1112* (L); Mt. Trikora, Somalak valley, 4º15'S, 138º45'E, 4 Aug. 1984, *Mangen 1212* (L); Mt. Trikora, base of False Peak, to the N, 4º15'S, 138º45'E, 11 Aug. 1984, *Mangen 1243* (L); Mt. Trikora, Somalak valley, slightly undulate lateral moraine deposits, 4º15'S, 138º45'E, 17 Aug. 1983, *Mangen 553* (L, LUX); Mt. Trikora, 4º15'S, 138º45'E, 25 Aug. 1983, *Mangen 687* (LUX); Mt. Trikora, Somalak valley, 4º15'S, 138º45'E, 18 Aug. 1983, *Mangen 688* (L); Mt. Trikora, Hanging valley, N of the summit, 4º15'S, 138º45'E, 10 Aug. 1984, *Mangen 990* (L); Valentijn Mts., NE of Koruppun valley, S slopes of main range, Valentijn base camp, 4º25'S, 138º42'E, 10 Aug. 1988, *Mangen 2311* (LUX).

Discussion. Geranium wilhelminae is a small herb with a weak, vertical rootstock, slender roots, and some prostrate, aerial stems rooting at the nodes. It should be noted that the leaves of prostrate stems are opposite nearer to the base of the rosette but become alternate toward the stem apex. The stipules are ovate and usually free, but at the apical nodes of the prostrate stems there are occasional, partially connate stipules. The bracteoles of *G. wilhelminae* are broad and strictly opposite and imbricate, but not sheathing. The calyx indument comprises both short appressed eglandular hairs, usually along the nerves and long, spreading glandular hairs on the basal half of the sepals. The leaves of *G. wilhelminae* are palmatifid, with five segments. The appressed eglandular hairs are mostly restricted to the nerves on the abaxial surface. The indument of the adaxial surface and shape of the leaf segments are variable. Collections from Mt. Wilhelmina are predominantly glabrous on the adaxial surface with unlobed, broadly lanceolate segments. Even in the same gathering from this area, however, there are specimens with 2- or 3-lobed obtriangular segments and/or with a hairy adaxial surface. The density of the indument varies from a few scattered hairs to more or less patchily strigose. The only collection from the Valentijn Mountains is sterile, but the leaves are quite similar to those on plants from Mt. Wilhelmina. Plants collected from Mt. Trikora are more variable: the leaves frequently have three-lobed segments, but again within the same gathering there are usually unlobed segments as well. *Geranium lacustre* was described from the same locality as *G. wilhelminae*, although it was compared with *G. papuanum* instead of with *G. wilhelminae*. The two fragments of the type of *G. lacustre* have some leaves with unlobed segments and others with two or three lobes. The density of the hairs on the adaxial surface is also variable. Both specimens fall easily within the range of variability of *G. wilhelminae*. *Geranium wilhelminae* bears some resemblance to *G. castroviejoi* because of the glandular hairs on the sepals and hairs on the nerves of the abaxial surface of the leaves. The latter, however, has palmatisect leaves with narrow segments (never unlobed) and longer peduncles and pedicels. The two species occupy allopatric distributions.

96. Geranium hyperacrion Veldkamp, Blumea 24(2): 470. 1978. Type locality: "NGF 16010 v. Royen (L; iso in LAE), Nova Guinea (Mt. Wilhelm)". Type: Papua New Guinea. Monolithic Rock to summit Mt. Wilhelm, 5°45'S, 145°05'E, 26 Sep. 1962, *P. van Royen NGF 16010* (holotype, L-0018345!; isotype, LAE).

Perennial herbs, 4-12 cm tall. *Rootstock* 1-2.1 mm in diameter, vertical, not tuberculate, not turnip-shaped, without thickened roots. *Stem* prostrate, leafy, rooting at nodes, stolons present, with short vegetative stems, with ± patent, eglandular hairs 0.1-0.2 mm long and, very rare, patent, glandular hairs 0.2-0.3 mm long. *Basal leaves* in a ± persistent rosette, cauline leaves opposite (on buds alternate); leaf laminas (0.3)0.5-0.8(1) cm long, 0.5-1.1 cm wide, not peltate, palmatifid [ratio main-sinus length/middle segment length = 0.52-0.63(0.68)], polygonal in outline, base cordate, not coriaceous, with nerves not projected, glabrous on the adaxial surface, and with scattered, antrorse, appressed, eglandular hairs, on the abaxial surface and margin; segments (5)7, in 1 plane, middle segment broadly lanceolate, 0.8-2.3 mm wide at the base [ratio segment width at the base/middle segment length = 0.30-0.45], entire; petioles up to 3.7 cm long, without abscission zone, terete, not swollen, not deflexed in age, with ± patent, eglandular hairs 0.1-0.2 mm long and, exceptionally, patent, glandular hairs 0.2-0.3 mm long; stipules 0.8-1.9 mm long, 0.7-1.3 mm wide, ovate, free (although sometimes overlapping), papery, brownish red, with eglandular hairs on abaxial surface and on the margin, glabrous adaxially. *Inflorescence* a monochasial cyme; cymules 1-flowered, solitary [ratio cymule length/leaf length = 0.6-1.6]; peduncles 1.7-5.1 mm long, with ± patent, eglandular hairs 0.1-0.2 mm long; bracteoles 1-1.9 mm long, 0.8-1.3 mm wide, broadly lanceolate, opposite, overlapping at base to appear sheathing; pedicels 2.6-8 mm long, with ± patent, eglandular hairs 0.1-0.2 mm long. Flowers actinomorphic. *Sepals* (3.1)3.3-4.2(4.6) mm long, 1.4-2 mm wide, lanceolate, smooth, not accrescent, nerves 3, mucro 0.2-0.4 mm long [ratio mucro length/sepal length = 0.05-0.10], with antrorse, ± appressed, eglandular hairs 0.2-0.4 mm long on the abaxial surface, glabrous adaxially. *Petals* 4.8-6.8 mm long, 1.9-3 mm wide, erect-patent, rounded, without claw, pink, glabrous or sparsely ciliate on the basal margin, with hairs ca. 0.1 mm long. *Stamens* 10, both whorls bearing anthers; filaments 2.4-2.9 mm long, lanceolate with an abruptly narrowed apex, unknown color, pilose on the abaxial surface, ciliate on the proximal half, with hairs 0.1-0.2 mm long; anthers 0.4-0.5 mm long, unknown color. Nectaries 5, hemispheric, glabrous. *Gynoecium* 2.9-4.1 mm long,

unknown color. *Fruit* 10.4-11.4 mm long, erect, discharge of seed-ejection type; mericarps 1.6-2 mm long, 0.9-1.1 mm wide, without a strand of fibers, not compressed at the apex, smooth, without basal beak, with a basal callus, without a basal prong, brown, with erect-patent, eglandular hairs 0.1-0.2 mm long; rostrum 6.8-7.4 mm long, without a narrowed apex, not twisted, with erect-patent, eglandular hairs 0.1-0.2 mm long; stigmatic remnants 0.7-1.2 mm long, with 5 glabrous lobes. *Seeds* 1.3-1.5 mm long, 0.9-1 mm wide, finely reticulate, uniformly colored, brown, glabrous. Cotyledons with entire margin. Fig. 262.

Pollen. Ornamentation not studied.

Chromosome number. 2*n* = 56.

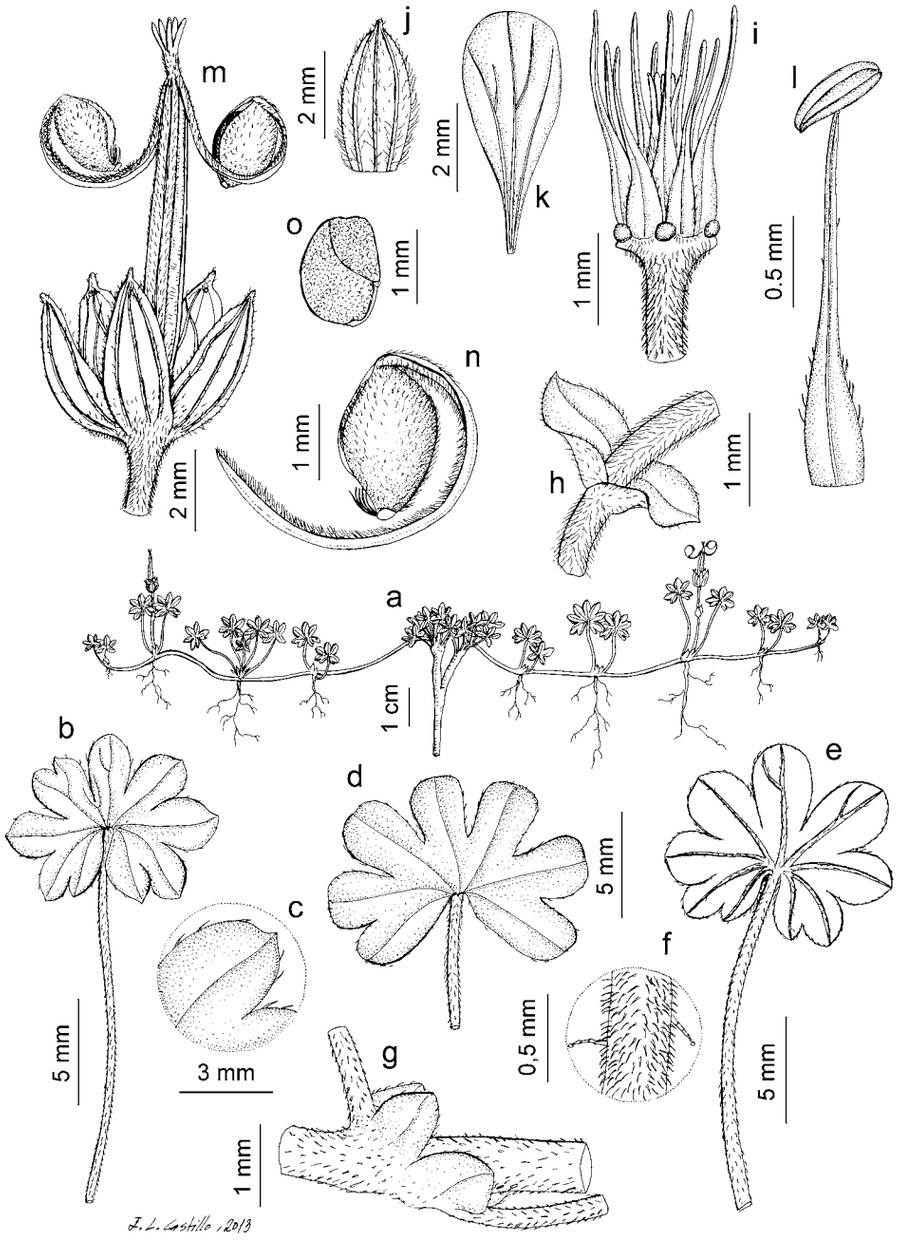


Fig. 262. *Geranium hyperacrion*. a. Habit. b, d. Leaf, adaxial surface. c, Detail of leaf indument. e. Leaf, abaxial surface. f, Detail of petiole indument. g. Stipules of prostrate stems. h. Bracteoles. i. Flower without petals and sepals. j. Sepal. k. Petal. l. Stamen. m. Fruit. n. Mericarp. o. Seed. (Based on: a, *Borgmann 92*, L; b, c, *Balgooy 235*, L; d-g, *Balgooy 187*, L; h-o, *Royen 16010*, L).

Phenology. Collected in flower from June to September.

Distribution. This species is endemic to central New Guinea (Fig. 263).

Habitat. Open patches of poor, well-drained soil, among low grasses and other herbs; 3650-4350 m.

Additional specimens examined. **Papua New Guinea.** Eastern Highlands: Mt. Wilhelm, W Pinde valley, 5º45'S, 145º5'E, 1965, *Balgooy 187* (L); Mt. Wilhelm, Brass'Tarn, small ridge E of Lake, 5º45'S, 145º5'E, 6 May 1965, *Balgooy 235* (A, L, NSW); Mt. Wilhelm, 5º45'S, 145º5'E, 13 June 1960, *Borgmann 92* (L). Southern Highlands: western summit of Mt. Giluwe, 6º5'S, 143º50'E, 21 Aug. 1961, *Schodde 1946* (K, L).

Discussion. Geranium hyperacrion is similar to *G. wilhelminae* in general appearance. Both are small herbs with a weak, vertical rootstock with slim roots and some prostrate stems rooting at the nodes. They also share opposite leaves on prostrate stems and alternate ones on the buds. A more careful examination, however, reveals several differences. The stems and petioles of *G. hyperacrion* have short and spreading eglandular hairs and scattered glandular hairs (especially toward the bases of the petioles). In contrast, the indument on the stems and petioles of *G. wilhelminae* consists of only short, appressed eglandular hairs. The leaves of *G. hyperacrion* are consistently glabrous on the adaxial surface and almost always have seven broadly lan-

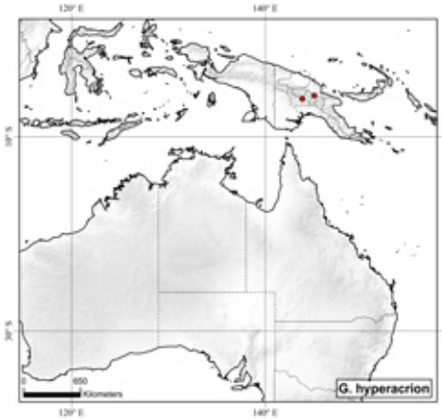


Fig. 263. Distribution of *Geranium hyperacrion*.

ceolate, entire segments; the leaves of *G. wilhelminae* have five segments and can be entire or three-lobed at the apex. The sepals of *G. hyperacrion* have only short, eglandular hairs, while those of *G. wilhelminae* also have spreading glandular hairs. Veldkamp & Moerman (1978: 471) reported *G. hyperacrion* from Mt. Bangeta on the basis of the specimen *van Royen NGF 20002* (no herbarium is stated). Unfortunately, I was not able to examine the voucher. This locality is 200 km toward the east, on the Sarawaket Range, where *G. editum*, a similar species, is found.

97. Geranium editum Veldkamp, Blumea 24(2): 470. 1978. Type locality: "Hartley 11102, p.p. (L, mixtum cum G. niuginiensi, in LAE non est), Nova Guinea (Saruwaket)". Type: Papua New Guinea. Morobe, Base of Mt. Sarawaket, 6°20'S, 147°10'E, 19 Jan. 1963, *T.G. Hartley 11102 p.p.* (holotype, L-0018340!; isotype, K-001089663!).

Perennial herbs, 5-11 cm tall. *Rootstock* 1.3-1.4 mm in diameter, vertical, not tuberculate, not turnip-shaped, without thickened roots. *Stem* prostrate, leafy, rooting at nodes, stolons present, with short vegetative stems, with ± patent, eglandular hairs 0.1-0.2 mm long. *Basal leaves* in a ± persistent rosette, cauline leaves opposite (on buds alternate); leaf laminas (0.4)0.5-0.6(0.7) cm long, 0.6-1 cm wide, not peltate, palmatifid [ratio main-sinus length/middle segment length = 0.65-0.77], polygonal in outline, base cordate, not coriaceous, with nerves not projected, ± strigose on adaxial surface, and with appressed, eglandular hairs restricted to the nerves abaxially; segments (5)7, in 1 plane, middle segment broadly lanceolate, 0.7-1.3 mm wide at the base [ratio segment width at the base/middle segment length = 0.25-0.32], entire; petioles up to 0.5 cm long, without abscission zone, terete, not swollen, not deflexed in age, with ± patent, eglandular hairs 0.1-0.2 mm long; stipules 1.1-1.4 mm long, 1.2-1.5 mm wide, ovate, connate (except on buds), papery, brownish red, with eglandular hairs on abaxial surface and on the margin, glabrous adaxially. *Inflorescence* a monochasial cyme; cymules 1-flowered, solitary [ratio cymule length/leaf length = 0.6-2.9]; peduncles 12.1-17.7 mm long, with ± patent, eglandular hairs 0.1-0.2 mm long; bracteoles 1.7-1.9 mm long, 0.8-1.2 mm wide, broadly lanceolate, opposite, overlapping at base to appear sheathing; pedicels 4.8-22.1 mm long, with ± patent, eglandular hairs 0.1-0.2 mm long. Flowers actinomorphic. *Sepals* 2.6-3 mm long, 1.1-1.6 mm wide, lanceolate, smooth, not accrescent, nerves 3, mucro 0.3-0.5 mm long [ratio mucro length/sepal

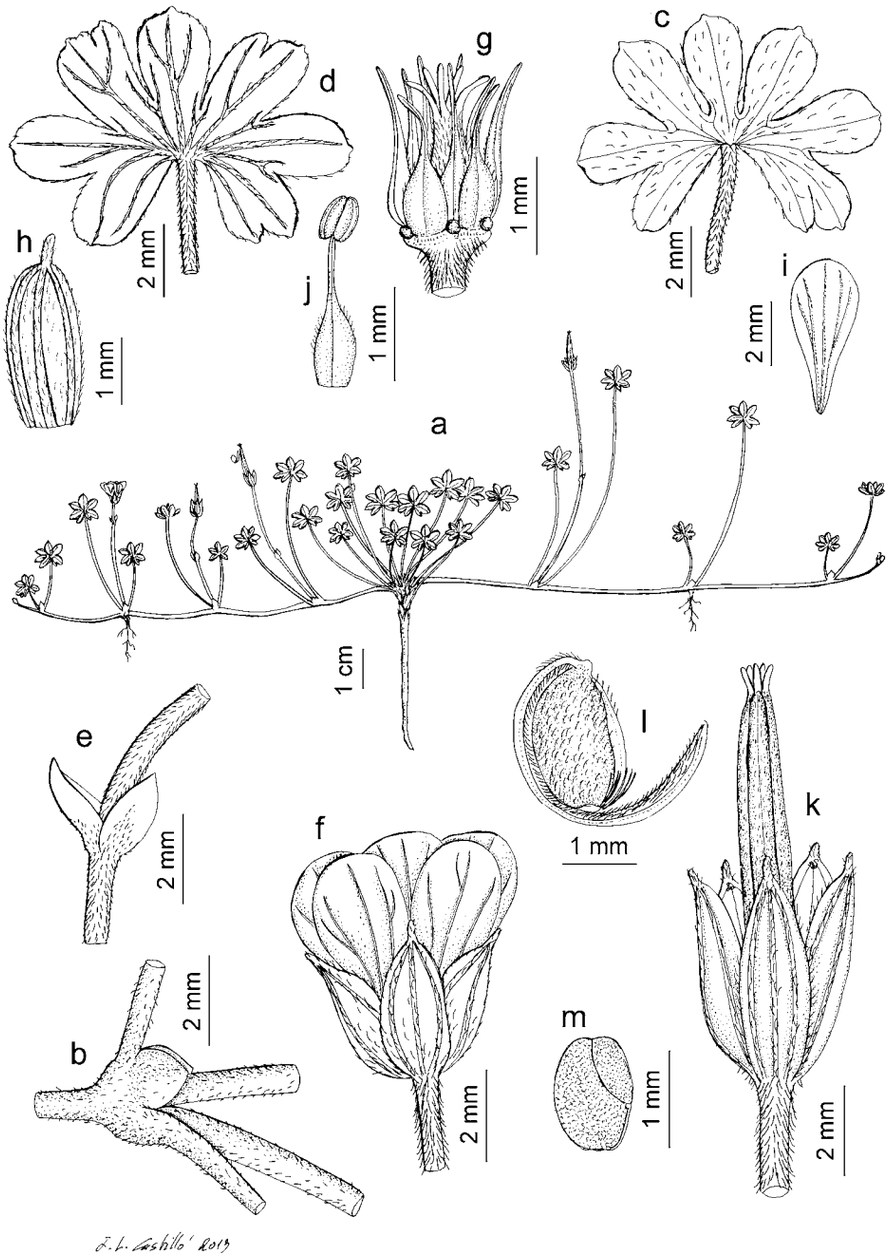


Fig. 264. *Geranium editum*. a. Habit. b. Stipules. c. Leaf, adaxial surface. d. Leaf, abaxial surface. e. Bracteoles. f. Flower. g. Flower without petals and sepals. h. Sepal. i. Petal. j. Stamen. k. Fruit. l. Mericarp. m. Seed. (Based on: *Hartley 11102*, K).

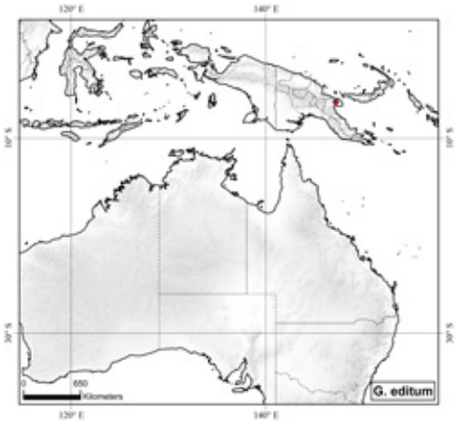


Fig. 265. Distribution of *Geranium editum*.

length = 0.11-0.22], with antrorse, ± appressed, eglandular hairs 0.1-0.3 mm long on the abaxial surface, glabrous adaxially. *Petals* 4.6-5.3 mm long, 1.4-2.5 mm wide, erect-patent, rounded, without claw, white, glabrous. *Stamens* 10, both whorls bearing anthers; filaments 1.8-2 mm long, lanceolate with an abruptly narrowed apex, unknown color, glabrous or with scattered hairs 0.1-0.2 mm long on the abaxial surface and margin; anthers 0.4-0.5 mm long, unknown color. Nectaries 5, hemispheric, glabrous. *Gynoecium* 1.9-2.2 mm long, unknown color. *Fruit* 9.2-9.9 mm long, erect, discharge of seed-ejection type; mericarps 1.8-1.9 mm long, 1-1.4 mm wide, without a strand of fibers, not compressed at the apex, smooth, without basal beak, with a basal callus, without a basal prong, brown, with erect-patent, eglandular hairs 0.1-0.2 mm long; rostrum 5.1-5.8 mm long, without a narrowed apex, not twisted, with erect-patent, eglandular hairs 0.1-0.2 mm long; stigmatic remnants 0.4-0.8 mm long, with 5 glabrous lobes. *Seeds* 1.3-1.4 mm long, 0.9-1 mm wide, finely reticulate, uniformly colored, brown, glabrous. Cotyledons not studied. Fig. 264.

Pollen. Ornamentation not studied.

Chromosome number. Unknown.

Phenology. Collected in flower in January.

Distribution. This species is endemic to eastern New Guinea (Fig. 265).

Habitat. Fire-induced alpine meadows; ca. 3050 m.

Discussion. Geranium editum is a rare species known only from the type specimen. The scarce available material is probably insufficient to ascertain its variability. Although similar to *G. hyperacrion* in general appearance and leaf shape, *G. editum* has only eglandular hairs on the stems and petioles. Leaves of *G. editum* have scattered eglandular hairs on the adaxial surface, sometimes in patches, while the leaves are glabrous adaxially in *G. hyperacrion*. In addition, the peduncles of *G. editum* are significantly longer than in *G. hyperacrion*.

98. Geranium papuanum Ridl., Trans. Linn. Soc. London, Bot. 9(1): 22. 1916. Type locality: "Camps X to XI, 6700 to 8300 ft.". Type: Indonesia. Papua, Mt. Carstensz, Camp X to XI, 4º07'S, 137º12'E, 1912, *C.B. Kloss s.n*. (lectotype, designated by Veldkamp & Moerman 1978: 473, BM-000075366!).

Geranium papuanum var. *alpestre* Ridl., Trans. Linn. Soc. London, Bot. 9: 23. 1916. Type locality: "Camps XIII to XI, 8300 to 10,500 ft. Closely allied to this is a smaller-flowered plant, with broader papery stipules, from Wharton Range, New Guinea, collected by Giulianetti (Herb. Kew.)". Type: Indonesia. Papua, Mt. Carstensz, Camps XIII to XI, 4º06'S, 137º11'E, 1912, *C.B. Kloss s.n.* (lectotype, designated by Veldkamp & Moerman 1978: 473, BM-000075365!; isolectotype, K-000729531!).

Perennial herbs, 16-50 cm tall. *Rootstock* 2-4 mm in diameter, vertical, not tuberculate, not turnip-shaped, without thickened roots. *Stem* prostrate, leafy, rooting at nodes, stolons present, without vegetative stems, with ± patent to retrorse, appressed, eglandular hairs 0.2-0.5 mm long. *Basal leaves* in a ± persistent rosette, cauline leaves opposite; leaf laminas (0.6)0.7-0.9(1.3) cm long, 0.8-1.6 cm wide, not peltate, palmatifid [ratio main-sinus length/middle segment length = 0.57-0.77], polygonal in outline, base cordate, not coriaceous, with nerves not projected, with scattered, long hairs on the adaxial surface and appressed, eglandular hairs restricted to the nerves abaxially; segments 5, in 1 plane, middle segment obtriangular, 1.2-3.3 mm wide at the base [ratio segment width at the base/middle segment length = 0.28-0.52], 3-lobed in distal half [ratio secondary sinus length/middle segment length = 0.10-0.21]; petioles up to 6.5 cm long, without abscission zone, terete, not swollen, not deflexed in age, with patent to retrorse, appressed, eglandular hairs 0.1-0.3 mm long; stipules 1.6-4.3 mm long, 0.4-0.7 mm wide, lanceolate, free, papery, brownish red, with eglandular hairs on abaxial surface and on the margin, glabrous adaxially. *Inflorescence* a monochasial cyme; cymules 1-flowered, solitary [ratio cymule length/leaf length = 1.2-2.9(6)]; peduncles (8.5)16.1-22.7(48.5) mm long, with patent to retrorse, appressed, eglandular hairs 0.1-0.4 mm long; bracteoles 1.9-2.8 mm long, 0.4-0.9 mm wide, lanceolate, opposite; pedicels (4.5)12-25(67.7) mm long, with patent to retrorse, appressed, eglandular hairs 0.1-0.5 mm long. Flowers actinomorphic. *Sepals* (5.2)5.8-6.8(8.1) mm long, 1.4-2.8 mm wide, lanceolate, smooth, not accrescent, nerves 3, mucro 0.4-0.9 mm long [ratio mucro length/sepal length = 0.07-0.15], with erect-patent, eglandular hairs 0.2-0.8 mm long on the abaxial surface, ± glabrous adaxially. *Petals* (9.2)10-12.7(14.3) mm long, 3.4-6.4 mm wide, erect-patent, rounded, without claw, purple, glabrous or with scattered hairs on the base of the abaxial surface and the basal margin, with hairs 0.2-0.3 mm long. *Stamens* 10, both whorls bearing anthers; filaments 3.4-5.7 mm long, lanceolate, yellow, glabrous or with scattered hairs 0.1-0.4 mm long on the abaxial surface and margin; anthers 0.7-1 mm long, yellow. Nectaries 5, hemispheric, glabrous. *Gynoecium* 4.1-6.4 mm long, yellow. *Fruit* 15.6-22.9 mm long, erect, discharge of seed-ejection type; mericarps 2.2-3.2 mm long, 1-1.6 mm wide, without a strand of

fibers, not compressed at the apex, smooth, without basal beak, with a basal callus, without a basal prong, brown, with erect-patent, eglandular hairs 0.3-0.6 mm long; rostrum 10.9-18.5 mm long, with a narrowed apex 1.5-2.8 mm long, not twisted, with erect-patent, eglandular hairs 0.3-0.6 mm long; stigmatic remnants 1.2-2.2 mm long, with 5 glabrous lobes. *Seeds* 1.8-1.9 mm long, 1.2-1.3 mm wide, finely reticulate, uniformly colored, brown, glabrous. Cotyledons with entire margin. Fig. 266.

Pollen. Ornamentation not studied.

Chromosome number. Unknown.

Phenology. Collected in flower from March to September.

Distribution. This species ranges through New Guinea (Fig. 267).

Habitat. Grassland, steep slopes, sides of open limestone sinkholes, mossy forests, and among stumps of *Cyathea* Sm.; 2500-3500 m.

Additional specimens examined. **Indonesia.** Papua: Wamena, Snow Mts., Mt. Soqosa, 3°55'S, 138°44'E, 30 Aug. 2003, *Emanuelsson 3123a* (S); Mt. Carstensz, Camp X to XI, 4°7'S, 137°12'E, 1912, *Kloss s.n.* (BM); Valentijn Mts., NE of Koruppun valley, S slopes of main range, Valentijn base camp, 4°25'S, 139°42'E, 10 Aug. 1988, *Mangen 2299* (A, LUX); Valentijn Mts., NE of Koruppun valley, S slopes of main range, Valentijn base camp, 4°25'S, 139°42'E, 10 Aug. 1988, *Mangen 2356* (LUX). **Papua New Guinea.** Eastern Highlands: Kainantu subdistrict, Mt. Piora, NE slopes, 6°43'S, 145°58'E, 5 Sep. 1975, *Croft & Akakavara s.n.* (K, L, M); Kainantu subprovince, Mt. Piora, upper slopes, 6°43'S, 145°58'E, 5 Sep. 1975, *Sands & al. 1695* (A, K, L). Enga: Iparon Rock, Tupa lumbi grasslands via Laiagam, 5°17'S, 143°46'E, 10 Aug. 1981, *Reeve 24* (K); Paiela, 5°17'S, 142°54'E, 1981, *Reeve 303* (K); Laiagam, Mt. Pimbilyo, 5°29'S, 143°29'E, 25 Mar. 1982, *Reeve 4524* (NSW); Porgera area, Paiela road near end of limestone escarpments, 5°29'S, 143°4'E, 5 Sep. 2005, *Takeuchi & al. 20179* (A). West Sepik: Star Mts., Telefomin subdistrict, W Sepik, Tel Basin, on ridge leading towards Mt. Capella, summit ridge, 4°57'S, 141°9'E, 3 Apr. 1975, *Barker s.n.* (A, AD, K, L); Star Mts., Telefomin subdistrict, W Sepik, Camp I, Tel Basin, 4°57'S, 141°9'E, 1 Apr. 1975, *Veldkamp 6236* (L); Star Mts., Telefomin subdistrict, W Sepik, 2 km SE of Mt. Capella, summit ridge, 4°58'S, 141°6'E, 10 Apr. 1975, *Barker & Umba s.n.* (L); Star Mts., Telefomin subdistrict, W Sepik, slopes of Mt. Scorpion, 4°58'S, 141°3'E, 29 May 1975, *Croft & Hope s.n.* (A, L).

Discussion. Geranium papuanum is unique among *Geranium* species

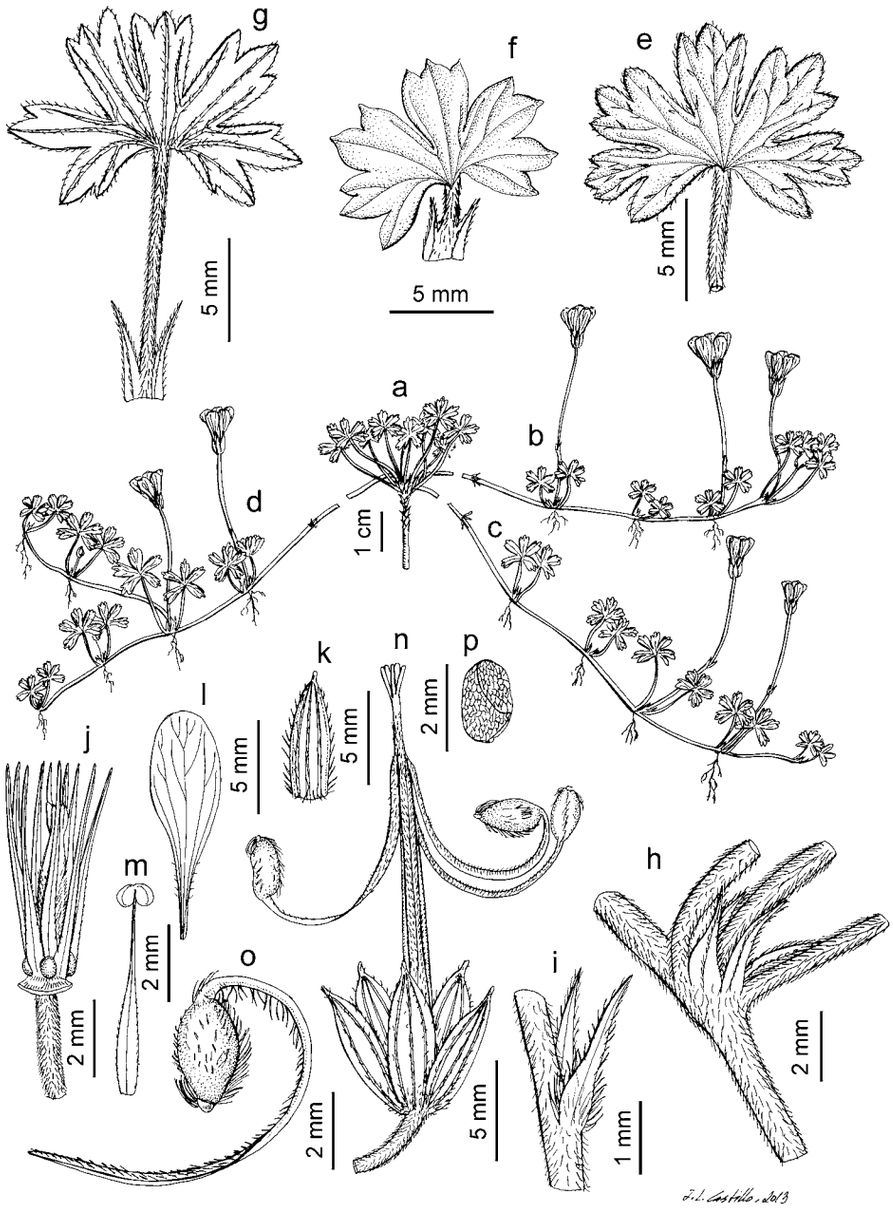


Fig. 266. *Geranium papuanum*. a-d. Habit. e, f. Leaves, adaxial surface. g. Leaf, abaxial surface. h. Stipules of prostrate stems. i. Bracteoles. j. Flower without petals and sepals. k. Sepal. l. Petal. m. Stamen. n. Fruit. o. Mericarp. p. Seed. (Based on: a, e, g, i, n-p, *Croft & Akakavara s.n.*, *5 Sep. 1975*, L; b-d, j-m, *Veldkamp 6236*, L; f, *Sands & al. 1695*, A; h, *Takeuchi & al. 20179*, A).

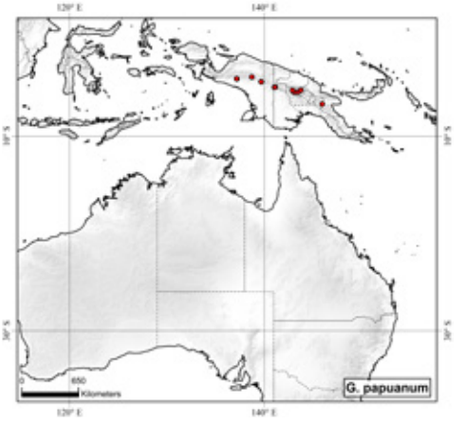


Fig. 267. Distribution of *Geranium papuanum*.

from New Guinea because of its long petals. It is also easy to identify by its fruits, which have a rostrum with a significantly narrowed apex. The general aspect of *G. papuanum* is similar to that of other species from New Guinea, with prostrate stems rooting at the nodes. As noted also in *G. monticola*, the stems can be branched. The underground parts of *G. papuanum* are not well known, however, because most herbarium specimens are fragments. The rootstock appears to be vertical and the roots slender, although this needs to be confirmed with more comprehensive collections. The leaves have five segments, which are 3-lobed at the apex. The indument of the adaxial surface of the leaves shows some variation. The surface can be almost glabrous or have scattered long hairs (0.5-1 mm long), which may sometimes occur in patches. Veldkamp & Moerman (1978: 474) tentatively included within *G. papuanum* a specimen collected from the Star Mountains having short sepals with glandular hairs and palmatisect leaves (*Barker & Umba s.n.*, L-380874). I included that collection in the new species, *G. castroviejoi* (Aedo 2017a).

99. Geranium whartonianum Veldkamp, Blumea 24(2): 476. 1978. Type locality: "LAE 61390 Croft et al. (L; iso in LAE; BRI, n.v.), Nova Guinea (Mt. Albert Edward)". Type: Papua New Guinea. Mt. Albert Edward, 8º25'S, 147º20'E, 21 June 1974, *J.R. Croft & al. s.n.* (holotype, LAE-61390; isotypes, BRI-AQ0353164 image!, L-0018358!).

Perennial herbs, 10-34 cm tall. *Rootstock* 1.6-5.1 mm in diameter, vertical, not tuberculate, not turnip-shaped, with ± thickened roots. *Stem* prostrate, leafy, not rooting at nodes, stolons absent, without vegetative stems, with retrorse, appressed, eglandular hairs 0.1-0.4 mm long. *Basal leaves* in a ± persistent rosette, cauline leaves opposite; leaf laminas (0.6)1-1.3(1.8) cm long, 1-2.9 cm wide, not peltate, palmatifid [ratio main-sinus length/middle segment length = 0.62-0.70(0.76)], polygonal in outline, base cordate, not coriaceous, with nerves not projected, glabrous or with scattered long hairs on adaxial surface, ± strigose abaxially; segments 5, in 1 plane, middle segment obtriangular, 1.7-3.6 mm wide at the base [ratio segment width at the base/middle segment length = 0.24-0.40], 3-lobed in distal half [ratio secondary sinus length/middle segment length = (0.09)0.12-0.17(0.25)]; petioles up to 23 cm long, without abscission zone, terete, not swollen, not deflexed in age, with retrorse, appressed, eglandular hairs 0.1-0.4 mm long; stipules 1.4-2.6 mm long, 0.6-1.2 mm wide, ovate, free, papery, brownish red,

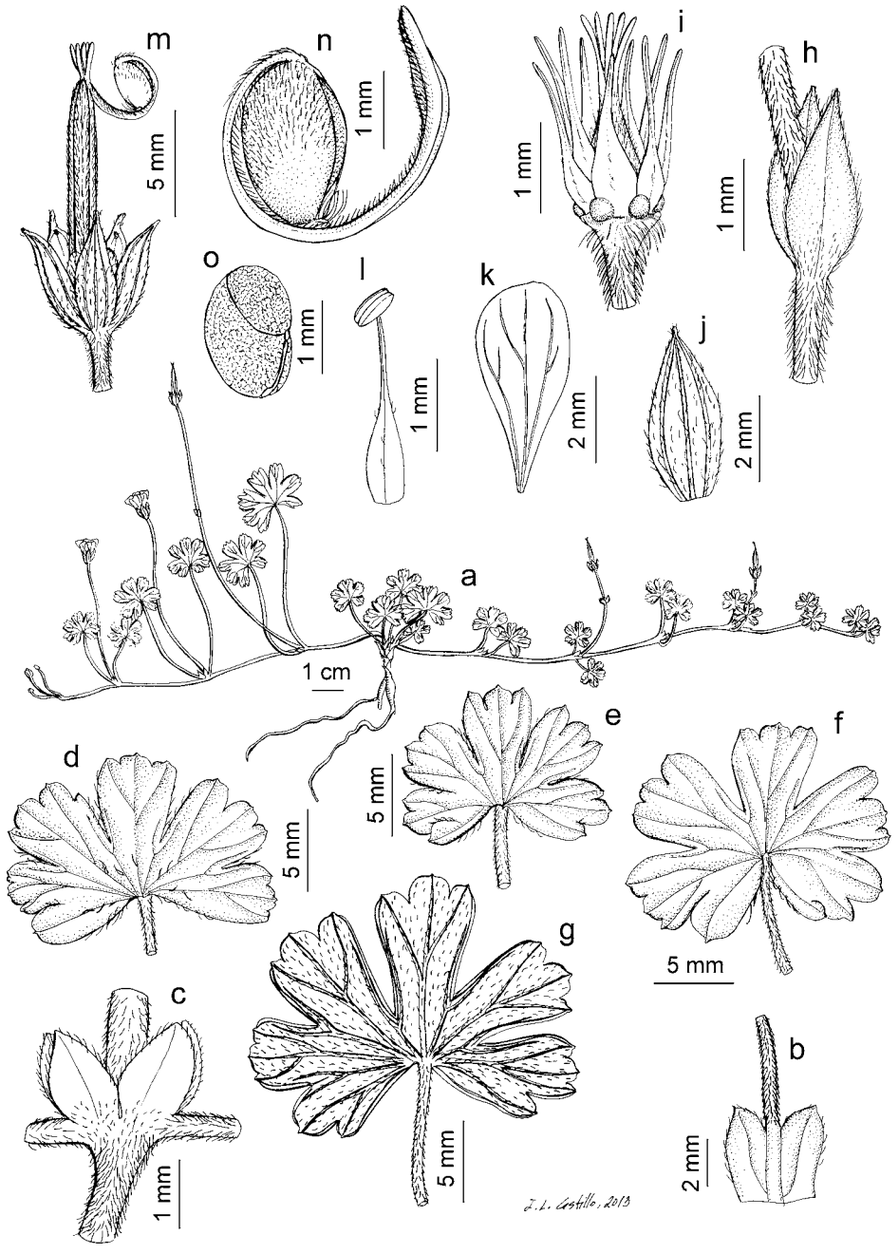


Fig. 268. *Geranium whartonianum*. a. Habit. b. Stipules of the basal leaves. c. Stipules of the cauline leaves. d-f. Leaves, adaxial surface. g. Leaf, abaxial surface. h. Bracteoles. i. Flower without petals and sepals. j. Sepal. k. Petal. l. Stamen. m. Fruit. n. Mericarp. o. Seed. (Based on: a-d, g, *Woods 3004*, E; e, f, *Woods 3004*, L; h-o, *Craven 2798*, A).

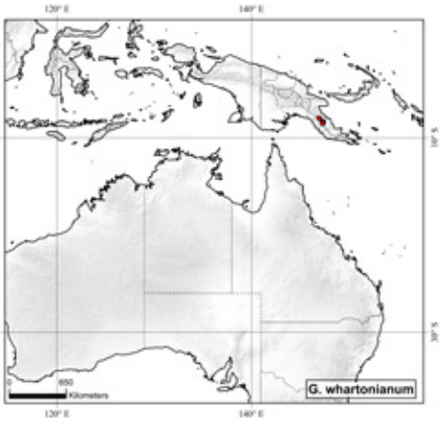


Fig. 269. Distribution of *Geranium whartonianum*.

with eglandular hairs on abaxial surface and on the margin, glabrous adaxially. *Inflorescence* a monochasial cyme; cymules 1-flowered, solitary [ratio cymule length/leaf length = (0.7)1.2-3.6]; peduncles (8.4)10.7-14.9(59.8) mm long, with retrorse, appressed, eglandular hairs 0.1-0.3 mm long; bracteoles 1.3-2.1 mm long, 0.4-1.1 mm wide, lanceolate, opposite, usually overlapping at base to appear sheathing; pedicels 7.1-15.9 mm long, with retrorse, appressed, eglandular hairs 0.1-0.4 mm long. Flowers actinomorphic. *Sepals* (3.1)3.9-4.5(4.6) mm long, 1.2-2.3 mm wide, lanceolate, smooth, not accrescent, nerves 3, mucro 0.2-0.6 mm long [ratio mucro length/sepal length = 0.07-0.22], with erect-patent, eglandular hairs 0.2-0.9 mm long on the abaxial surface, ± glabrous adaxially. *Petals* (4.2)4.5-6(6.9) mm long, 2.1-3.5 mm wide, erect-patent, rounded, without claw, white or pale pink, glabrous. *Stamens* 10, both whorls bearing anthers; filaments 2.2-3.3 mm long, lanceolate, unknown color, pilose on the abaxial surface, ciliate on the proximal half, with hairs ca. 0.1 mm long; anthers 0.4-0.6 mm long, unknown color. Nectaries 5, hemispheric, glabrous. *Gynoecium* 2.4-3.2 mm long, unknown color. *Fruit* 10.6-15.2 mm long, erect, discharge of seed-ejection type; mericarps 1.7-2.7 mm long, 0.9-1.3 mm wide, without a strand of fibers, not compressed at the apex, smooth, without basal beak, with a basal callus, without a basal prong, brown, with erect-patent, eglandular hairs 0.1-0.4 mm long; rostrum 6.9-9.7 mm long, without a narrowed apex, not twisted, with erect-patent, eglandular hairs 0.1-0.2 mm long; stigmatic remnants 1.1-1.6 mm long, with 5 hairy lobes. *Seeds* 1.6-1.8 mm long, 0.8-1.1 mm wide, finely reticulate, uniformly colored, brown, glabrous. Cotyledons with entire margin. Fig. 268.

Pollen. Ornamentation not studied.

Chromosome number. Unknown.

Phenology. Collected in flower from January to August.

Distribution. This species is endemic to eastern New Guinea (Fig. 269).

Habitat. Among grasses on stream banks, on tops of standing stems of dead *Cyathea* Sm., and in remnant of alpine forests; 2800-3800 m.

Additional specimens examined. **Papua New Guinea.** Central: Tapini, summit ridge of Mt. Strong, 8º0'S, 147º0'E, 1 May 1971, *Coode & Stevens s.n.* (L); Central district, Mt. Albert Edward, NE part, 8º23'S, 147º24'E, 27 June 1974, *Craven 2798* (A, L); Central district, Mt. Albert Edward, 8º25'S, 147º20'E, May 1933, *Brass 4227* (NY); Central district, Mt. Albert Edward, 8º25'S, 147º20'E, May 1933, *Brass 4476* (NY); Central district, W slope of Wharton Range, track from Avios to Murray Pass, 8º30'S, 147º21'E, 19 Jan. 1965, *Royen s.n.* (A); Central district, Wharton Range, Murray Pass, 8º32'S, 147º21'E, June 1933, *Brass 4637* (A, NY); Central district, Goilala subdistrict, Murray Pass, Mt. Albert Edward region, abobe Sidibamu, 8º32'S, 147º21'E, 7 Aug. 1968, *Woods 3004* (E, GH, L).

Discussion. Geranium whartonianum is a small herb, with more or less elongated, prostrate stems not rooting at the nodes. The rootstock is vertical and with ± fusiform roots. *Geranium whartonianum* has leaves with five segments, which are 3-lobed at the apex. The stipules are ovate and free. As in *G. papuanum*, the indument of the leaf adaxial surface can vary from glabrous to having scattered, spreading hairs 0.6-0.9 mm long, which may sometimes occur in patches. The range of variation can be found within the same gathering. This species also has many similarities with *G. niuginiense*: for further discussion, see under that species.

100. Geranium balgooyi Veldkamp, Blumea 24(2): 469. 1978. Type locality: "v. Balgooy 924 (L; iso in LAE), Nova Guinea (Mt. Wilhelm)". Type: Papua New Guinea. Mt. Wilhelm, 5°45'S, 145°5'E, 29 June 1965, *M.M. Balgooy 924* (holotype, L-0018338!; isotypes, C-10018763!, K-000729533!, LAE).

Perennial herbs, 3-25 cm tall. *Rootstock* 2.1-4.7 mm in diameter, vertical, not tuberculate, not turnip-shaped, without thickened roots. *Stem* prostrate, leafy, not rooting at nodes, stolons absent, without vegetative stems, with retrorse, appressed, eglandular hairs 0.1-0.3 mm long. *Basal leaves* in a ± persistent rosette, cauline leaves opposite; leaf laminas (0.7)1-1.4(1.8) cm long, 0.8-1.1(2) cm wide, not peltate, palmatifid [ratio main-sinus length/middle segment length = 0.64-0.75], polygonal in outline, base cordate, not coriaceous, with nerves not projected, pilose, with appressed, eglandular hairs on both surfaces; segments 5, in 1 plane, middle segment obtriangular, 1.8-2(3.6) mm wide at the base [ratio segment width at the base/middle segment length = 0.24-0.38], 3-5(7)-lobed in distal half [ratio secondary sinus length/middle segment length = 0.17-0.31]; petioles up to 10 cm long, without abscission zone, terete, not swollen, not deflexed in age, with retrorse, appressed, eglandular hairs 0.1-0.3 mm long; stipules 2-3.7 mm long, 1.1-2.4 mm wide, ovate, free (although overlapping), papery, brownish red, glabrous or with scattered, eglandular hairs on abaxial surface and on the margin, glabrous adaxially. *Inflorescence* a monochasial cyme; cymules 1-flowered, solitary [ratio cymule length/leaf length = 0.5-1]; peduncles 1.5-5(9) mm long, with retrorse, appressed, eglandular hairs 0.1-0.2 mm long; bracteoles 2.1-5.1 mm long,

0.9-2.1 mm wide, broadly lanceolate, subopposite, overlapping at base on one side of the pedicel, exposing the opposite part; pedicels absent or (2.4)4.1-25.4(41.8) mm long, with retrorse, appressed, eglandular hairs 0.1-0.3 mm long. Flowers actinomorphic. *Sepals* (2.6)3.3-4.6(5.5) mm long, 1.3-2.4 mm wide, lanceolate, smooth, not accrescent, nerves 3, mucro 0.4-0.8 mm long [ratio mucro length/sepal length = 0.09-0.22], with antrorse, ± appressed, eglandular hairs 0.1-0.2 mm long and ± patent, eglandular hairs 0.4-1 mm long on the abaxial surface, glabrous adaxially. *Petals* (4.2)5-5.4(5.6) mm long, 1.8-3.2 mm wide, erect-patent, rounded, without claw, white to pink, glabrous. *Stamens* 10, both whorls bearing anthers; filaments 1.3-2.2 mm long, lanceolate with an abruptly narrowed apex, unknown color, glabrous; anthers 0.3-0.4 mm long, unknown color. Nectaries 5, hemispheric, glabrous. *Gynoecium* 1.7-2.9 mm long, unknown color. *Fruit* 8.9-10.4 mm long, erect, discharge of seed-ejection type; mericarps 2-2.8 mm long, 0.8-1.4 mm wide, without a strand of fibers, not compressed at the apex, smooth, without basal beak, with a basal callus, without a basal prong, brown, with erect-patent, eglandular hairs 0.1-0.3 mm long; rostrum 5.2-6.5 mm long, without a narrowed apex, not twisted, with erect-patent, eglandular hairs 0.1-0.3 mm long; stigmatic remnants 0.6-1.3 mm long, with 5 glabrous lobes. *Seeds* 1.7-1.9 mm long, 1-1.2 mm wide, finely reticulate, uniformly colored, brown, glabrous. Cotyledons with entire margin. Fig. 270.

Pollen. Ornamentation not studied.

Chromosome number. Unknown.

Phenology. Collected in flower from April to July.

Distribution. This species is endemic to central and eastern New Guinea (Fig. 271).

Habitat. Wet peaty soil among grass tussocks together mosses and *Pilea* Lindl. or epiphytic on *Cyathea* Sm.; 3100-4000 m.

Additional specimens examined. **Papua New Guinea.** Eastern Highlands: Mt. Wilhelm, W Pinde valley, near mouth of inflow stream, 5°45'S, 145°5'E, 1 May 1965, *Balgooy 187* (L); Mt. Wilhelm, Lake Tekeh Pangwa, 5°45'S, 145°5'E, 23 June 1965,

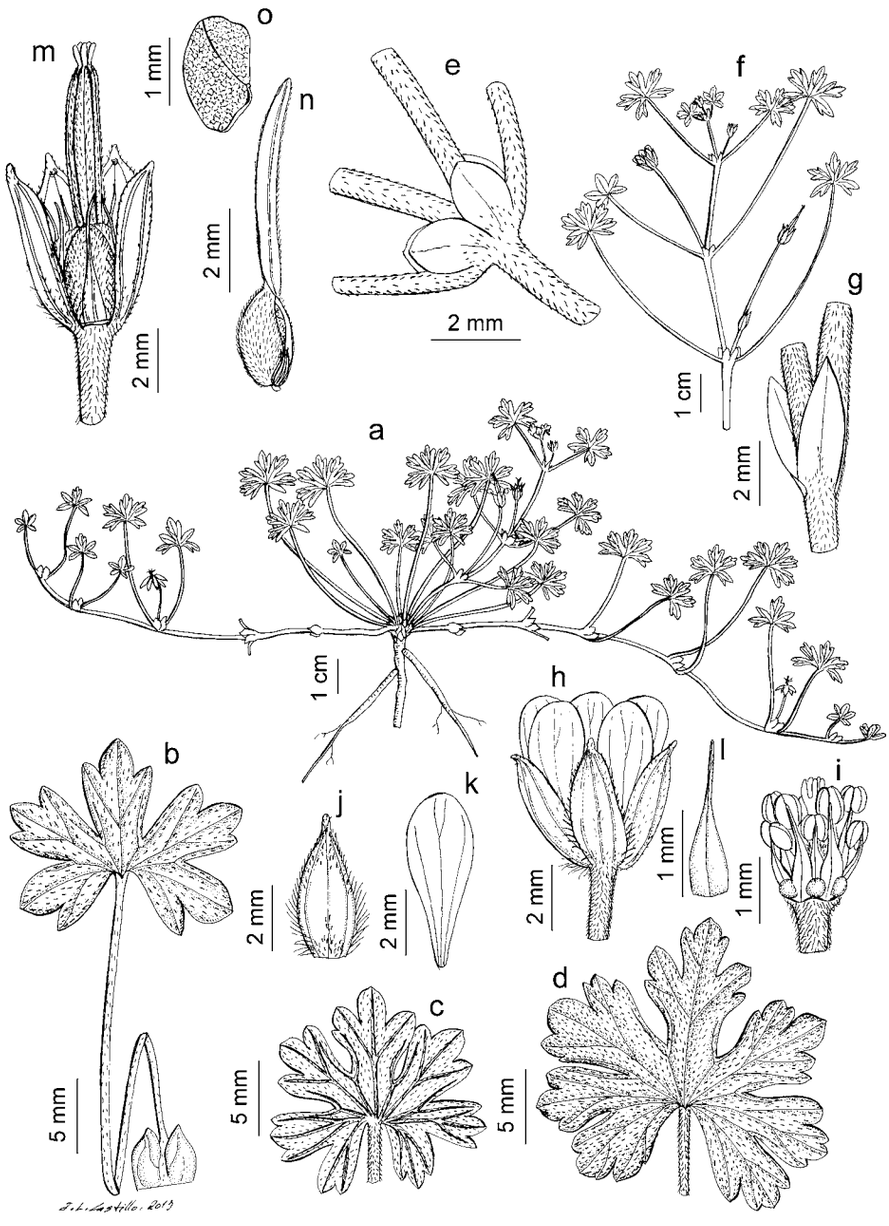


Fig. 270. *Geranium balgooyi*. a. Habit. b, d. Leaves, adaxial surface. c. Leaf, abaxial surface. e. Stipules of prostrate stems. f. Detail of inflorescence. g. Bracteoles. h. Flower. i. Flower without petals and sepals. j. Sepal. k. Petal. l. Staminal filament. m. Fruit. n. Mericarp. o. Seed. (Based on: a, b, e-o, *Vink 16235*, P; c, *Balgooy 924*, L; d, *Barker & Umba s.n.*, *17 Apr. 1975*, L).

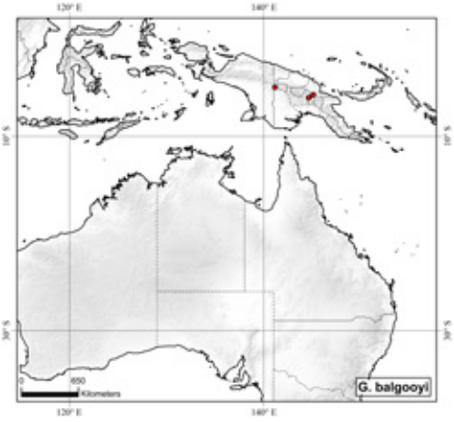


Fig. 271. Distribution of *Geranium balgooyi*.

Balgooy 818 (A, L, NSW). Western Highlands: Kubor Range, Mt. Kinkain, 6º3'S, 144º38'E, 24 July 1963, *Vink 16168* (L); Kubor Range, Mt. Kinkain, 6º3'S, 144º38'E, 31 July 1963, *Vink 16235* (K, L, MO, P). West Sepik: Star Mts., Telefomin subdistrict, Tarn in valley immediately N of Mt. Capella E summit, 4º58'S, 141º9'E, 17 Apr. 1975, *Barker & Umba s.n.* (A, AD, L).

Discussion. Geranium balgooyi is a small herb with more or less elongate, prostrate stems not rooting at the nodes. The rootstock is vertical and bears ± fusiform roots. *Geranium balgooyi* has leaves with five segments. The leaf segments are mostly 3-lobed at the apex but in the same gathering some 5-lobed segments (very rarely 7-lobed) are usually to be found. The stipules are broadly ovate and free. The leaf indument consists of short, appressed eglandular hairs uniformly covering both surfaces. However, the most distinctive feature of this species is its short or absent pedicels, which are usually 1.5-5 mm long, and only rarely reaching even 9 mm in length. Within the same gathering are others with shorter or absent pedicels. The bracteoles are significantly longer, although they are indistinguishable from stipules in cymules lacking a pedicel. The sepals of *G. balgooyi* is covered with short, appressed eglandular hairs mainly toward the abaxial base and margins. On the margins are some spreading, eglandular hairs are found, which are appreciably longer than those found in other species, such as *G. whartonianum*. One collection of *G. balgooyi* has been made from from Star Mountains about 400 km west of the main area of distribution of the species. The specimen has sepals with marginal hairs a bit longer than those from Mt. Wilhelm, but otherwise it falls into the established variability of the species. *Geranium balgooyi* is sympatric with *G. hyperacrion*, which also has short pedicels. The latter, however, is easily distinguished by its prostrate stems rooting at the nodes, leaves with seven segments, broadly lanceolate and unlobed at the apex, glabrous on the adaxial surface, and by its connate stipules.

101. Geranium niuginiense Veldkamp, Blumea 24(2): 473. 1978. Type locality: "v. Balgooy 296 (L; iso in LAE), Nova Guinea (Mt. Wilhelm)". Type: Papua New Guinea. Mt. Wilhelm, S of lake Pinde, 5°45'S, 145°5'E, 11 May 1965, *M.M. Balgooy 296* (holotype, L-0018350!; isotype, LAE).

Perennial herbs, 5-85 cm tall. *Rootstock* 1.8-3 mm in diameter, vertical, not tuberculate, not turnip-shaped, with ± thickened roots. *Stem* prostrate, leafy, sometimes rooting at nodes, stolons absent, without vegetative stems, with patent to retrorse, appressed, eglandular hairs 0.1-0.4 mm long. *Basal leaves* in a ± persistent rosette, cauline leaves opposite; leaf laminas (0.7)1.2-1.6(2.9) cm long, 0.9-2.1(4) cm wide, not peltate, palmatifid [ratio main-sinus length/middle segment length = (0.66)0.74-0.81(0.84)], polygonal in outline, base cordate, not coriaceous, with nerves not projected, strigose on both surfaces; segments 5, in 1 plane, middle segment obtriangular, 0.9-2.4(4.7) mm wide at the base [ratio segment width at the base/middle segment length = 0.10-0.34], 3-lobed in distal half [ratio secondary sinus length/middle segment length = (0.10)0.18-0.26(0.30)]; petioles up to 13 cm long, without abscission zone, terete, not swollen, not deflexed in age, with patent to retrorse, appressed, eglandular hairs 0.1-0.5 mm long; stipules (1.2)1.8-2.9(3.5) mm long, 0.5-1.3(1.7) mm wide, ovate, rarely lanceolate, usually free, rarely ± connate, papery, brownish red, with eglandular hairs on abaxial surface and on the margin, glabrous adaxially. *Inflorescence* a monochasial cyme; cymules 1-flowered, solitary [ratio cymule length/leaf length = (0.5)0.7-3.1]; peduncles (7.2)16.5-33.6(55.7) mm long, with patent to retrorse, appressed, eglandular hairs 0.1-0.6 mm long; bracteoles (1.4)2-3(3.3) mm long, (0.5)0.7-1(1.5) mm wide, lanceolate to broadly lanceolate, opposite, usually overlapping at base to appear sheathing; pedicels (4.2)10-23(40.8) mm long, with patent to retrorse, appressed, eglandular hairs 0.1-0.7 mm long. Flowers actinomorphic. *Sepals* (3.5)4.1-4.9(5.3) mm long, 1.1-2.6 mm wide, lanceolate, smooth, not accrescent, nerves 3, mucro (0.3)0.5-0.7(0.8) mm long [ratio mucro length/sepal length = 0.09-0.22], with antrorse, ± appressed, eglandular hairs 0.1-0.7 mm long on the abaxial surface, glabrous adaxially. *Petals* 4.2-6.3(7.1) mm long, 1.4-4.3 mm wide, erect-patent, rounded, without claw, white or pale pink, glabrous. *Stamens* 10, both whorls bearing anthers; filaments 1.7-3.2 mm long, lanceolate, unknown color, glabrous or with scattered hairs 0.1-0.2 mm long on the abaxial surface and margin; anthers 0.4-0.6 mm long, unknown color. Nectaries 5, hemispheric, glabrous. *Gynoecium* 2.1-3.6 mm long, unknown color. *Fruit* (9.9)11.6-16.1 mm long, erect, discharge of seed-ejection type; mericarps 2-2.8 mm long, 0.9-1.4 mm wide, without a strand of fibers, not compressed at the apex, smooth, without basal beak, with a basal callus, without a basal prong, brown, with erect-patent, eglandular hairs 0.2-0.4 mm long; rostrum 6.3-11.3 mm long, without a narrowed apex, not twisted, with erect-patent, eglandular hairs 0.1-0.4 mm long; stigmatic remnants 0.6-1.5 mm long, with 5 hairy lobes. *Seeds* 1.6-2.3 mm long, 1.1-1.3 mm wide, finely reticulate, uniformly colored, brown, glabrous. Cotyledons with entire margin. Fig. 272.

Pollen. Ornamentation not studied.

Chromosome number. 2*n* = 36.

Phenology. Collected in flower from January to December.

Distribution. This species ranges from central to eastern New Guinea (Fig. 273).

Habitat. Open grassy places, damp grounds near rivers, shade of shrubs, on dead tree and *Cyathea* Sm. trunks, and mossy rocks on river banks; 2050-3950 m.

Additional specimens examined. **Indonesia.** Papua: Wamena River camp, 3º55'S, 138º44'E, 20 Oct. 1992, *Mendum 92780* (E). **Papua New Guinea.** Central: Iswan Swamp, SSW of Mt. Service in Mt. Victoria

massif, 8°55'S, 147°32'E, 17 May 1976, *Royen 10801* (L). Chimbu: at foot of Mt. Aniata, head of Yogom plateau, 6°8'S, 145°4'E, 9 July 1959, *Cruttwell 1030* (K, L); Mt. Aniata, [cultivated froms seed at Adelaide Botanic garden], 6°8'S, 145°4'E, 9 Apr. 1959, *Cruttwell 1070* (AD). Eastern Highlands: Mt. Wilhelm, Lake Tekeh Pangwa, 5°45'S, 145°5'E, 23 June 1965, *Balgooy 828* (L); Mt. Wilhelm, 5°45'S, 145°5'E, 4 June 1960, *Borgmann 66* (L); Mt. Wilhelm, E slopes, 5°45'S, 145°5'E, 27 June 1959, *Brass 30183* (A, L); Mt. Wilhelm, S of Lake Aunde, 5°47'S, 145°3'E, 13 May 1965, *Balgooy 320* (L); Chimbu subdistrict, E slope of Mt. Wilhelm, near Lake Aunde, 5°47'S, 145°3'E, 21 July 1956, *Hoogland & Pullen 5708* (L); Chimbu subdistrict, Lake Aunde, 5°47'S, 145°3'E, 24 Sep. 1962, *Royen 15187* (L); Chimbu subdistrict, Lake Aunde, 5°47'S, 145°3'E, 25 Sep. 1962, *Royen 15196* (L). Morobe: Finisterre Mts., Naitmambi Range, crest, 6°0'S, 146°33'E, 7 Aug. 1976, *Royen 11653* (L); Finschhafen subdistrict, Mt. Sarawaket, summit region, 6°17'S, 147°5'E, 15 Dec. 1975, *Croft & Lelean s.n.* (L); base of Mt. Sarawaket, 6°20'S, 147°10'E, 19 Jan. 1963, *Hartley 11102* (L). Milne Bay: Mokorua, 9°40'S, 149°30'E, 11 Aug. 1962, *Cruttwell 1324* (K); Milne district, Raba Rba subdistrict, Goe, 9°42'S, 149°2'E, 5 July 1972, *Stevens & Veldkamp s.n.* (A, K, L); Milne Bay district, N slope of Mt. Dayman, gorge of Upper Gwariu River, 9°50'S, 149°17'E, 30 May 1953, *Brass 22643* (A, L). Northern: Goropu Mts., Mt. Suckling, S ridge Goë Dendeniwa, 9°34'S, 148°56'E, 21 June 1972, *Veldkamp & Stevens 5724* (L); Goropu Mts., Mt. Suckling, S ridge Goë Dendeniwa, 9°34'S, 148°56'E, 21 June 1972, *Veldkamp & Stevens 5753* (L). Southern Highlands: western summit of Mt. Giluwe, 6°5'S, 143°50'E, 23 Aug. 1961, *Schodde 1961* (A, K, L). Western Highlands: Wabag subdistrict, N slopes of Sugarloaf coplex, along Wapu River, 5°45'S, 143°41'E, 21 July 1960, *Hoogland & Schodde 7215* (L).

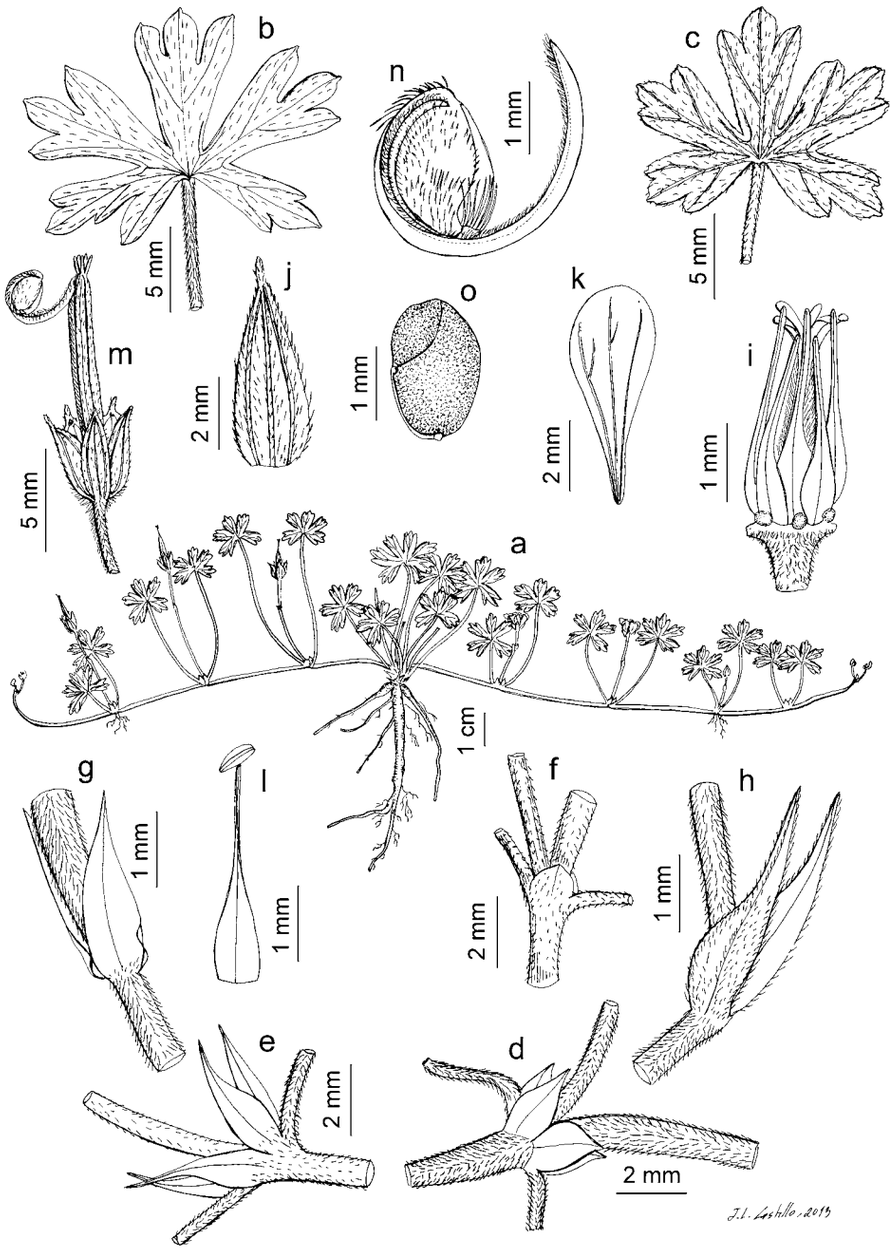


Fig. 272. *Geranium niuginiense*. a. Habit. b. Leaf, adaxial surface. c. Leaf, abaxial surface. d-f. Stipules. g, h. Bracteoles. i. Flower without petals and sepals. j. Sepal. k. Petal. l. Stamen. m. Fruit. n. Mericarp. o. Seed. (Based on: a, d, g, *Brass 30183*, L; b, e, *Hoogland & Schodde 7215*, L; c, i-l, *Balgooy 320*, L; f, *Mendum 92780*, E; h, *Cruttwell 1030*, L; m-o, *Royen 15187*, L).

Discussion. Geranium niuginiense is a small herb with more or less elongated, prostrate stems sometimes rooting at the nodes. The rootstock is vertical with ± fusiform roots. *Geranium niuginiense* has leaves with five segments that are 3-lobed at the apices. The leaf indument consists of short, appressed eglandular hairs uniformly covering both surfaces. Veldkamp & Moerman (1978: 473) indicated that *G. niuginiense* is a variable species and that specimens from the Owen Stanley Range (the southeastern subarea, between 7° and 9° S) have more deeply divided

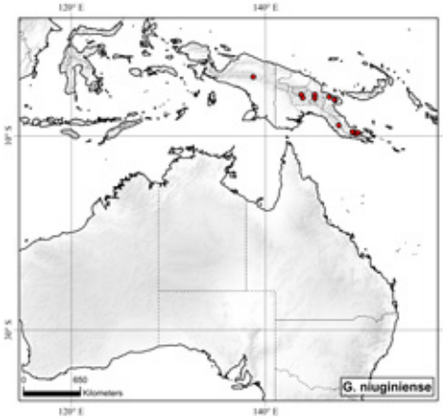


Fig. 273. Distribution of *Geranium niuginiense*.

leaves and larger flowers than those from Mt. Wilhelm (the northwestern subarea, south to 7° S). I compared specimens from the two subareas and found them to be similar in petal length, sepal length, and main-sinus length/middle segment length ratio. However, I noted some differences in indument and shape of the stipules and bracteoles. Specimens from the Owen Stanley Range display patent indument on the stems, petioles, and pedicels while plants from the northwestern subarea usually have retrorsely appressed hairs. The stipules and bracteoles from the first subarea are constantly lanceolate, while in the second subarea the stipules are predominantly ovate and the bracteoles are mainly broadly lanceolate. Different combinations of these features advise against a taxonomic recognition of these variants. *Geranium whartonianum* is quite similar to *G. niuginiense* and occupies a geographic distribution between the two subareas where *G. niuginiense* occurs. The most striking difference between the two is the indument of the adaxial surface of the leaves. The leaves of *G. whartonianum* are glabrous or with scattered long hairs mainly near the margins of the adaxial surface while the leaves of *G. niuginiense* are uniformly covered by short hairs. In addition, the leaves of *G. niuginiense* are usually more deeply divided both in the main sinus and in the secondary sinus, the bracteoles and sepal mucro are usually longer, and the staminal filaments are usually shorter, but there is some overlap in all of these characters. *Geranium balgooyi* is partially sympatric with *G. niuginiense* in the surroundings of Mt. Wilhelm. It can be distinguished from *G. niuginiense* by its shorter pedicels and fruits, longer bracteoles, and staminal filaments with an abruptly narrowed apex. *Geranium niuginiense* is quite similar to *G. potentilloides*, an endemic from Australia and New Zealand. Carolin (1965: 339) placed *G. niuginiense* in synonymy under *G. potentilloides*. However several differences between the two species may be underscored. The leaves of *G. niuginiense* have the middle segment 3-lobed at the apex while the middle segment of *G. potentilloides* is variable and often has more than three lobes (up to nine). In addition, leaves of *G. niuginiense* are always small, (0.7)1.2-1.6(2.9) cm long, while in *G. potentilloides* the leaves show some size variation, (0.8)1.2-3.3(3.8) cm long, which overlaps with that of *G. niuginiense*. *Geranium niuginiense* has bracteoles relatively wider and fruits without a narrowed rostrum apex. All these traits show some degree of overlap, which increases the difficulty of preparing keys to the species. The concurrence of all these minor differences together with the geographical isolation, however, suggests that *G. niuginiense* should be separated as an independent species, as Veldkamp & Moerman (1978: 473) proposed. *Geranium niuginiense* is also difficult to separate from *G. frigidurbis*, an endemic from Sulawesi. For more details see the discussion under *G. frigidurbis*.

The Solanderi Group—This group is characterized by its erect to ascending habit, its turnip-shaped rootstock, its opposite, usually palmatifid leaves and its usually 2-flowered cymules arranged in monochasial inflorescence. The stipules are lanceolate and free. The bracteoles are whorled, not overlapping. The petals are of medium size, usually without claw and glabrous, except on the base.

102. Geranium solanderi Carolin, Proc. Linn. Soc. New South Wales ser. 2, 89: 350. 1965. *Geranium pilosum* Sol. ex Willd., Sp. Pl. 3(1): 706. 1800, nom. illeg., non Cav. 1788. *Geranium dissectum* var. *pilosum* Hook. f., Fl. Tasman. 1: 56. 1855. *Geranium dissectum* var. *australe* Benth., Fl. Austral. 1: 296. 1863. *Geranium carolinianum* var. *australe* (Benth.) Fosberg, Occas. Pap. Univ. Hawaii 32: 6. 1937. Type locality: "Geranium pilosum. Forst. prod. n. 531... Habitat in Nova Zeelandia. (v. s.)". Type: New Zealand. New Zealand, *J.R. Forster s.n.* (lectotype, designated by Carolin 1965: 351, K!; isolectotype, C).

Geranium dissectum f. *tasmanica* Gand., Bull. Soc. Bot. France 47: 306. 1901. Type locality: "Hab. Southport (Woods): Stone Pit Chapel (Spicer); Georges Bay (Simson, n° 187); sed specimina Simsoniana, nos 138, 188 et 509 sub nomine G. dissecti inscripta ad aliam speciem (forte novam) certissime pertinent, sicut et illa circa New Town et Jutland a Spicero lecta". Type: Australia. Tasmania, Stone Pit Chapel, 42º50'S, 147º20'E, 23 Nov. 1876, *W.W. Spicer 44* (lectotype, designated by Aedo & al. 2005a: 35, LY image!).

Geranium drummondii Carolin, Proc. Linn. Soc. New South Wales ser. 2, 89: 353, pl. 6 fig. 4. 1965. Type locality: "Drummond, Swan River No. 4". Type: Australia. Western Australia, Swan River, 32º03'S, 115º44'E, *J. Drummond 4bis* (holotype, K!; isotype, E-00135018!).

Ge*ranium gardneri* de Lange, New Zealand J. Bot. 43(2): 564, 565 fig. 1. 2005. Type locality: "(Fig. 1): AK 151759, R. O. Gardner 2712, 18 Apr 1980, New Zealand, Great Barrier Island, Tryphena Scenic Reserve". Type: New Zealand. North Is., Great Barrier Island, Tryphena Scenic Reserve, 36º10'S, 175º25'E, 18 Apr. 1980, *R.O. Gardner 2712* (holotype, AK-151759!).

Perennial herbs, 12-100 cm tall. *Rootstock* (2.4)8.9-21.8 mm in diameter, vertical, not tuberculate, turnip-shaped, without thickened roots. *Stem* erect to ascending, leafy, not rooting at nodes, stolons absent, without vegetative stems, with patent to retrorse, not appressed, eglandular hairs 0.4-1.8 mm long and, exceptionally, patent, glandular hairs 0.2-0.4 mm long. *Basal leaves* in a ± deciduous rosette, cauline leaves opposite; leaf laminas (1.2)2.2-3.3(5.1) cm long, 1.4-6.3 cm wide, not peltate, palmatifid to palmatisect [ratio main-sinus length/middle segment length = 0.70-0.87(0.92)], polygonal in outline, base cordate, not coriaceous, with nerves not projected, pilose, with ± appressed, eglandular hairs on both surfaces; segments 5, in 1 plane, middle segment obtriangular,

(1.9)2.7-5(6.8) mm wide at the base [ratio segment width at the base/ middle segment length = (0.06)0.15-0.23(0.33)], 3-6(10)-lobed in distal half [ratio secondary sinus length/ middle segment length = (0.14)0.21-0.36(0.47)]; petioles up to 24 cm long, without abscission zone, terete, not swollen, not deflexed in age, with patent, eglandular hairs 0.4-1.7 mm long and, exceptionally, patent, glandular hairs 0.2-0.4 mm long; stipules (2)3.3-5.4(8) mm long, 0.3-2.1 mm wide, lanceolate, free, papery, brownish red, with eglandular hairs on abaxial surface and on the margin, glabrous adaxially. *Inflorescence* a monochasial cyme; cymules (1)2-flowered, solitary [ratio cymule length/leaf length = (0.4)0.8-1.2(3.3)]; peduncles (4)18-40(61) mm long, with patent to retrorse, not appressed, eglandular hairs 0.3-2 mm long and, exceptionally, patent, glandular hairs 0.2-0.3 mm long; bracteoles 1.5-4.7 mm long, 0.3-0.8 mm wide, lanceolate, whorled; pedicels (8)11-19(34) mm long, with patent to retrorse, not appressed, eglandular hairs 0.2-2 mm long and, exceptionally, patent, glandular hairs 0.2-0.5 mm long. Flowers actinomorphic. *Sepals* (3.2)4.2-5.5(6.6) mm long, 1.6-3.4 mm wide, lanceolate to broadly lanceolate, smooth, not accrescent, nerves 3, mucro (0.2)0.4-0.6(1) mm long [ratio mucro length/sepal length = (0.04)0.08-0.14(0.25)], with ± patent, eglandular hairs 0.5-1.8 mm long on the abaxial surface (exceptionally with patent, glandular hairs 0.2-0.5 mm long), glabrous adaxially. *Petals* (3)4.5-6(8.5) mm long, 1.4-6.2 mm wide, erect-patent, rounded, without claw, purple, glabrous on both surfaces, ciliate on the basal margin, with hairs 0.1-0.3 mm long. *Stamens* 10, both whorls bearing anthers; filaments 2.7-4.5 mm long, lanceolate, yellow, glabrous on the abaxial surface, ciliate on the basal margin, with hairs 0.1-0.2 mm long; anthers 0.3-0.9 mm long, yellow. Nectaries 5, hemispheric, glabrous. *Gynoecium* 2.5-4.8 mm long, yellow. *Fruit* 11.1-18.3(21.4) mm long, erect, discharge of seed-ejection type; mericarps 2-3.3 mm long, 1.1-1.8 mm wide, without a strand of fibers, not compressed at the apex, smooth, without basal beak, with a basal callus, without a basal prong, usually black, with erect-patent, eglandular hairs 0.1-1.5 mm long and, exceptionally, glandular hairs 0.2-0.3 mm long; rostrum 8.8-15.3 mm long, without a narrowed apex or with a narrowed apex 0.4-1.5 mm long, not twisted, with erect-patent, eglandular hairs 0.1-1.1 mm long and, exceptionally, glandular hairs 0.2-0.5 mm long; stigmatic remnants (0.6)0.9-1.4(1.8) mm long, with 5 hairy lobes. *Seeds* 1.4-2.2 mm long, 0.9-1.6 mm wide, reticulate, uniformly colored, brown, glabrous. Cotyledons with entire margin. Figs. 274, 275.

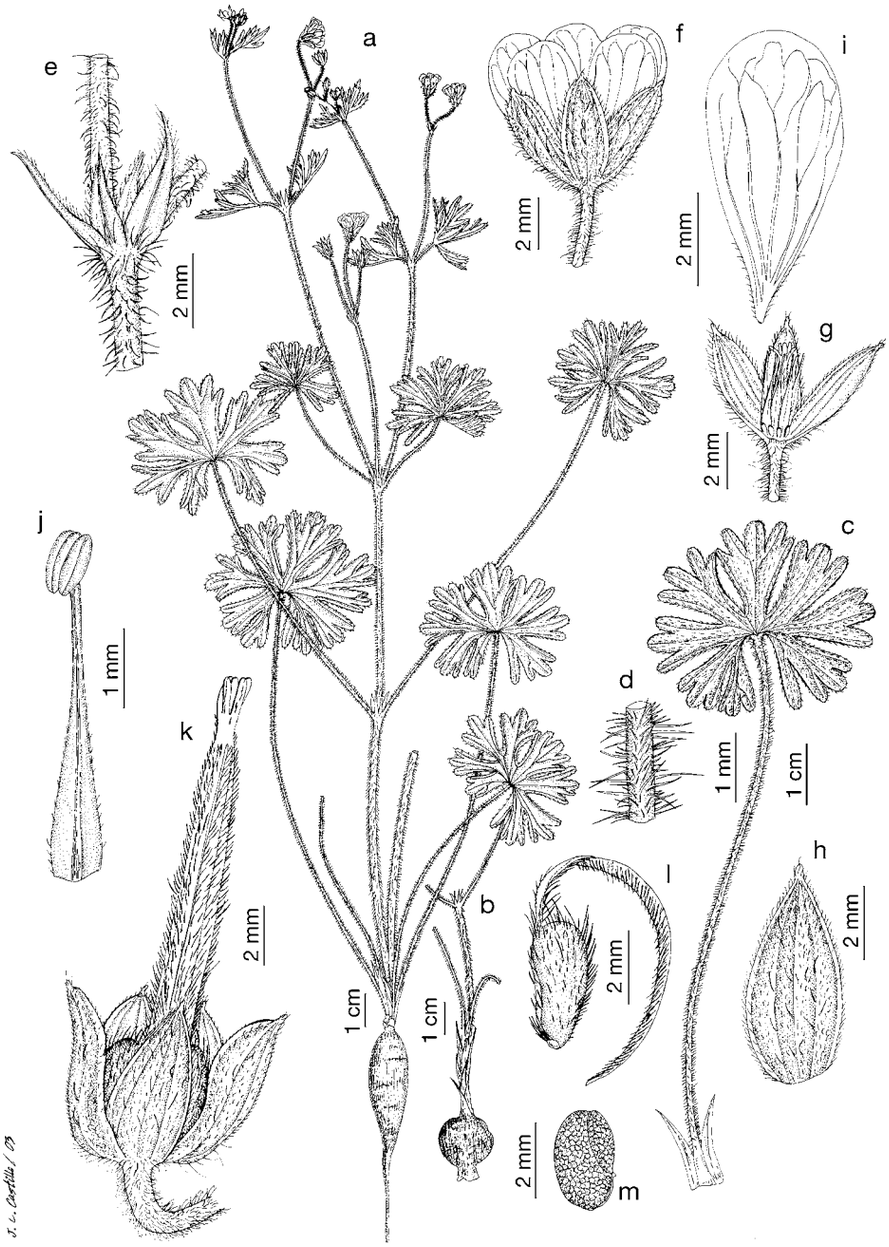


Fig. 274. *Geranium solanderi*. a. Habit. b. Rootstock. c. Leaf. d. Peduncle. e. Bracteoles. f. Flower. g. Flower without petals. h. Sepal. i. Petal. j. Stamen. k. Fruit. l. Mericarp. m. Seed. (Based on: *Keighery & Gibson 436*, PERTH).

Fig. 275. *Geranium solanderi* (Based on: *de Lange 225,* AK, from seeds raised at MA).

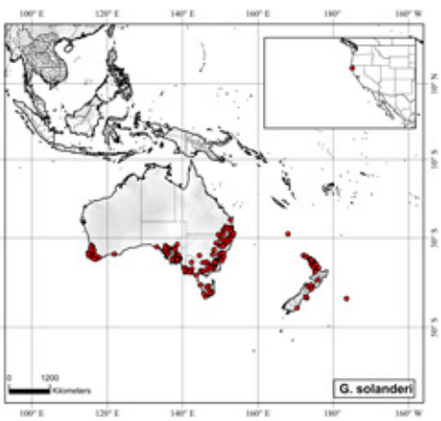


Fig. 276. Distribution of *Geranium solanderi*.

Pollen. *Geranium*-type (Aedo & al. 2005a: 6).

Chromosome number. 2*n* = c. 24, 26.

Phenology. Collected in flower from January to December.

Distribution. This species ranges from southern and western Australia and Tasmania to New Zealand and it is introduced in California (Fig. 276).

Habitat. Roadsides, weedy areas, sandy loam, base of cliffs, damp grounds, grassland, river gorges, and open forests of *Eucalyptus* L'Hér.; 0-1950 m.

Representative specimens examined. **Australia.** Australian Capital Territory: Cotter River district, by Two Sticks Road, S side of Mt. Coree, Brindabella Range, 35°19'S, 148°48'E, 10 Jan. 1961, *Schodde 1232* (AD). New South Wales: North Coast, Nanegai trig, North Head, Iluka, 28°52'S, 153°36'E, 27 Mar. 1982, *Hind 3067* (MO); Coocalla, 24 km SW of Garah, 29°10'S, 149°29'E, 30 Sep. 1978, *Wilson 1926* (K, L); Lett River, 33°31'S, 150°12'E, 21 Mar. 1959, *Carolin 861* (L); Shellharbour, N of Kiama, 34°34'S, 150°52'E, 6 Dec. 1950, *Constable 19190* (L, MO); Kosciusko State Park, near Jindabyne, 36°25'S, 148°37'E, 20 Jan. 1963, *Fagg s.n.* (AD). Queensland: Wide Bay district, Maryborough, 25°32'S, 152°42'E, 20 Oct. 1948, *Clemens s.n.* (F, G, US); Darling Downs district, 3 mi SE of Blaxland, 27°12'S, 151°24'E, 13 Oct. 1940, *Smith & Everist 799* (GH, NY); Lockyer valley, 27°25'S, 152°36'E, 11 May 1943, *Clemens 42/65* (GH); Toowoomba, 27°33'S, 151°57'E, Sep. 1931, *Longman s.n.* (K); Millmerran, 27°52'S, 151°16'E, 15 Mar. 1931, *Hubbard 5848* (K, L); Pale Creek, 28°17'S, 152°48'E, 1 June 1959, *Carolin 1023* (G). South Australia: Flinders Ranges, 5.3 km SSE of St Mary Peak, Flinders Ranges National Park, 31°32'S, 138°35'E, 19 Nov. 1999, *Canty BS104-2751* (AD); Gairrdner-Torrens, near Belt Hill, N side of Lake Acraman, 31°51'S, 135°29'E, 8 Nov. 1997, *Bates 48935* (AD); Eyre Peninsula, Gawler Range, E of Miccollo Hill, 32°32'S, 136°37'E, 15 Oct. 1983, *Weber 8040* (AD); Southern Lofty, Blackfellow Creek Road, opposite Mt. Magnificient, 35°19'S, 138°40'E, 12 Nov. 2003, *Taplin 976* (AD); South East, Comaum, 37°15'S, 140°58'E, 1966, *Alcock 155* (AD); Lower South East, Ewens Ponds, E of Port Macdonnell, 38°3'S, 140°42'E, 5 Oct. 1963, *Kraehenbuehl 943* (AD). Tasmania: Marrawak, Green Point, 40°54'S, 144°39'E, 26 Jan. 1969, *Canning 1850* (L); Westmoreland Falls Reserve, 41°27'S, 146°23'E, 20 May 1983, *Moscal 2430* (HO); Table Mt., 42°50'S, 145°39'E, 29 Dec. 1973, *Ratkowsky & Ratkowsky 1072* (MO); Mt. Wellington, 42°54'S, 147°14'E, 1971, *Allan s.n.* (HO); Hedgerow, Launceston, 43°30'S, 146°2'E, 27 Oct. 1943, *Curtis s.n.* (K). Victoria: 71 km from Corrong toward Omeo, 35°46'S, 142°22'E, 4 Jan. 1969, *Canning 1458* (L); Nug Nug near Myrtleford, 36°39'S, 146°42'E, 18 Dec. 1965, *Gray 5824* (PERTH); Port Phillip, 37°51'S, 144°58'E, 1802, *Brown s.n.* (LE); Gippsland Plain, 38 Paxton St East Malvern, c. 10 km SE from Melbourne, 37°52'S, 145°3'E, 1 Jan. 2010, *Walsh 7178* (MA, MEL); Southern Uplands, Otway Ranges, 9 km NE of Apollo Bay, 38°46'S, 143°40'E, 11 Nov. 1957, *Botrill s.n.* (AD). Western Australia: Lake Joondalup, 31°45'S, 115°47'E, 29 Aug. 1973, *Congdon s.n.* (PERTH); Pagononi Regional

Park, Baldivis, 32º16'S, 115º47'E, 21 Oct. 1997, *Keighery 15099* (PERTH); Tonebridge, 34º13'S, 116º54'E, 28 Aug. 1997, *May 756* (PERTH); Mt. Chudalup, 35 km S of Pemberton, 34º45'S, 116º5'E, 15 Dec. 1965, *Wilson 4003* (MA, PERTH); Walpole National Park, Peaceful Bay, 35º0'S, 116º38'E, 30 Oct. 1992, *Wheeler 3493* (PERTH). **New Zealand.** Chatham Is.: Lake Huro, Mangape Stream Outlet, 43º56'S, 176º31'W, 29 Mar. 1996, *de Lange 225* (MA, AK). New Zealand North Is.: Three Kings Is., Great Is., Tasman Valley, 34º9'S, 172º9'E, 15 Dec. 1982, *Wright 5221* (AK); Mangonvi, Unuwhao, 34º26'S, 172º54'E, 31 Dec. 1979, *Gardner 2647* (AK); Tamaki, Mt. Mangere, 36º57'S, 174º47'E, 6 Jan. 1990, *Gardner 6066* (AK); Whale Is., bay of Plenty, 37º5'S, 176º5'E, 29 May 1984, *Ogle 3* (AK); Pukawa fore-shore, Lake Taupo, 39º49'S, 175º55'E, 28 Feb. 1983, *Gardner 4000* (AK, G, K, L). New Zealand South Is.: Te Kakaho Is., 40º54'S, 174º6'E, 26 Mar. 1984, *Wright 6371* (AK); Mackay's Bluff, 41º11'S, 173º22'E, 16 Nov. 1980, *Gardner 2775* (AK); Nelson, Botanical Hill, 41º16'S, 173º18'E, 17 Nov. 1980, *Gardner 2777* (AK); Christchurch City, Saint Albans, 43º30'S, 172º39'E, 1 Dec. 2001, *Sykes s.n.* (AK); Akaroa, 43º48'S, 172º58'E, 1837 (G); Green Is., Dunedin, 45º57'S, 170º23'E, 30 Oct. 1891, *Lindsay s.n.* (E). **USA.** California: Humboldt Co., Trinidad, 41º3'N, 124º8'W, 11 June 1911, *Tracy 3238* (UC).

Discussion. Geranium solanderi is characterized by a turnip-shaped rootstock, 2-flowered cymules with patent eglandular hairs on the peduncles and pedicels, short petals only 3-8.5 mm long, and fruits with a short narrowed apex or lacking a narrowed apex, and relatively short persistent stigma lobes. Gardner (1984) studied the variability of *G. solanderi* in New Zealand and distinguished two variants from the common form, one called "large petals" and the other called "coarse hairs". The name *G. gardneri* was proposed by de Lange & al. (2005a) to recognize the "coarse hairs" form, and these authors identified additional morphological features to differentiate *G. gardneri* from *G. solanderi*: a more cylindrical tap-root [here rootstock], less divided leaves, and seeds with shorter alveolae. I confirmed in this study, however, that intermediate character states or a combination of the features diagnostic of each form are common in Australian material. All of these features, as well as petal length and coarseness and direction of the hairs, vary in a continuum and independently, which makes more difficult the recognition of discrete taxa. De Lange & al. (2005a: 566) quoted Smith (1999), who claimed that Australian intermediate forms between *G. gardneri* and *G. solanderi* should be recognized at the species rank. De Lange (2005a: 566) indicated that *G. gardneri* ". . . showed no close affinity, with *G. solanderi* sens. str. being nested within a clade involving *G. retrorsum* L'Hér. ex DC., and *G. gardneri* with *G. potentilloides*, a result which has independent support . . ." on the basis of an unpublished study of DNA sequences. However, Mitchell & al. (2009: 26) analyzed DNA sequences of New Zealand species of *Geranium* and found that *G. gardneri* is included in a clade (with 100% posterior probability) together with *G. retrorsum*, "*G. aff. retrorsum*", and *G. solanderi*. This clade had three separate branches: (1) *G. solanderi* alone, (2) two samples of "*G. aff. retrorsum*", grouped with 95 % posterior probability, and (3) a subclade (without posterior probability shown) comprising the two samples of *G. retrorsum* (grouped with 100% posterior probability) and the two samples identified as *G. gardneri* (grouped with 100% posterior probability). The clade was thus unresolved at the species level (at least not with a sufficient probability) and included only one sample of *G. solanderi* and no plants from Australia.

Another remarkable form was that described by Carolin (1965: 353) as *G. drummondii* from SW Australia. It is characterized by a dense, entangled indument especially on the pedicels, sepals, and mericarps. However intermediate forms are common in this area and in other Australian localities.

Geranium solanderi has predominantly 2-flowered cymules, but herbarium specimens with some 1-flowered cymules, especially toward the apex of inflorescence, are frequent. Three specimens of *G. solanderi* [*Hosking 2167* (CANB), *Jackson 87* (L, US), *Moore 8733* (CANB)] have widely spreading glandular hairs on stem and inflorescence, which seems to be an exceptional feature in this species. *Geranium solanderi* strongly resembles *G. berteroanum*, which is an endemic from the Andes. In *G. berteroanum* glandular forms are frequent, and the bracteoles (2.5-6.7 mm), sepals [(4.4)5.4-6.1(7)] mm), and persistent stigma lobes [(1.1)1.3-1.7(2.1) mm) are all longer than in *G. solanderi*. In summary, *G. solanderi* appears to be a very variable species with some remarkable forms not yet fully resolved. Thus, any attempt to split it might be premature and unfeasible. *Geranium retrorsum* and *G. solanderi* are similar species, many times difficult to differentiate, especially on herbarium specimens. It is particularly problematic in the case of forms of *G. solanderi* with "coarse hairs" where the indument of the pedicel and peduncle consists of more or less retrorse but not appressed, hairs. However, in favor of the independence of both species, Carolin (1965: 349) stated that "It [*G. retrorsum*] grows in association with this latter species [*G. solanderi*] but does not appear to hybridize". Except for the short sepals, with a proportionally long mucro and scattered hairs, fragments of *G. homeanum*, collected without rootstock, are also difficult to separate with certainty from *G. solanderi*. According to Carolin (1965), the seed coat of *G. homeanum* is a bit different from the seed coat of *G. retrorsum* and *G. solanderi*. In *G. homeanum* the dorsal alveolae are shallow and mostly elongate, while in *G. retrorsum* and especially in *G. solanderi* they are isolateral and deeper.

103. Geranium obtusisepalum Carolin, Proc. Linn. Soc. New South Wales ser. 2, 89: 344, pl. 6 fig. 11, pl. 7 fig. 7. 1965. Type locality: "Munyang near Guthega, R. Carolin No. 783, 25.1.1959 (NSW 66126)". Type: Australia. New

South Wales, Munyang near Guthega, 36º21'S, 148º25'E, 25 Jan. 1959, *R.C. Carolin 783* (holotype, NSW-66126!; isotypes, G!, L!).

Perennial herbs, 10-68 cm tall. *Rootstock* 8-21 mm in diameter, vertical, not tuberculate, turnip-shaped, without thickened roots. *Stem* prostrate to ascending, leafy, not rooting at nodes, stolons absent, without vegetative stems, with patent to retrorse, eglandular hairs 0.2-1.1 mm long and usually patent, glandular hairs 0.5-1.1 mm long. *Basal leaves* in a ± persistent rosette, cauline leaves opposite; leaf laminas (1.3)1.4-2.9(3.5) cm long, 1.7-4.4 cm wide, not peltate, palmatifid [ratio main-sinus length/middle segment length = 0.74-0.77(0.80)], polygonal in outline, base cordate, not coriaceous, with nerves not projected, pilose, with ± appressed, eglandular hairs on both surfaces; segments 5, in 1 plane, middle segment obtriangular, 2.1-5.9 mm wide at the base [ratio segment width at the base/middle segment length = 0.23-0.31], 3-lobed in distal half [ratio secondary sinus length/middle segment length = (0.19)0.25-0.34(0.36)]; petioles up to 19 cm long, without abscission zone, terete, not swollen, not deflexed in age, with patent to retrorse, eglandular hairs 0.2-0.9 mm long and, usually, scattered, patent, glandular hairs 0.6-1.5 mm long; stipules 1.3-2.5 mm long, 0.5-1.2 mm wide, lanceolate, free, papery, brownish red, with eglandular hairs on both surfaces and on the margin. *Inflorescence* a monochasial cyme; cymules 1-flowered, solitary [ratio cymule length/leaf length = (0.5)1-1.7(3.8)]; peduncles (5.2)11.6-23.2(32.5) mm long, with patent to retrorse, appressed, eglandular hairs 0.1-0.5 mm long; bracteoles 1-2.6 mm long, 0.4-0.8 mm wide, lanceolate, opposite; pedicels (7.3)12.6-19.6(20.9) mm long, with patent to retrorse, ap-

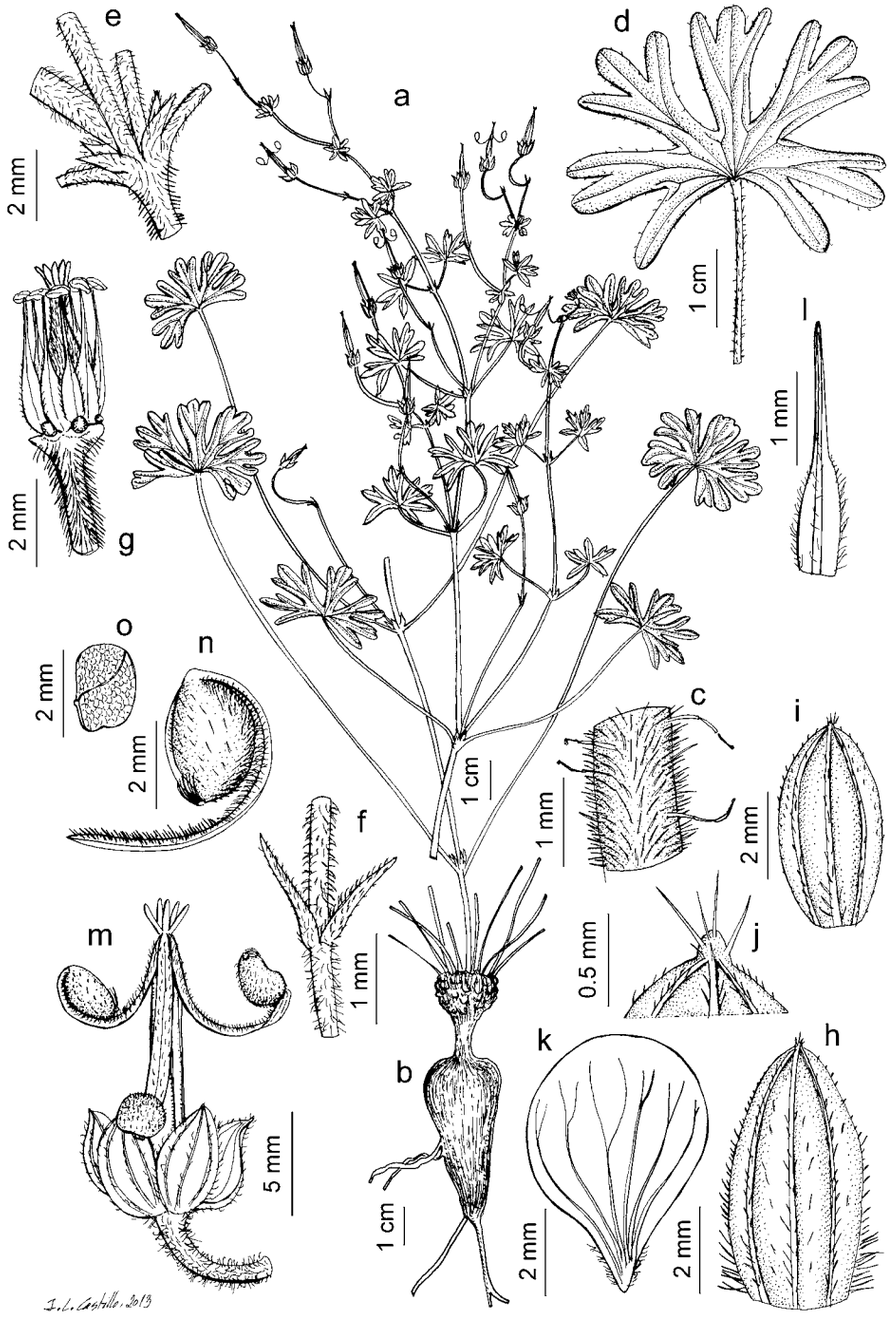


Fig. 277. *Geranium obtusisepalum*. a, b. Habit. c. Detail of stem indument. d. Leaf, adaxial surface. e. Stipules. f. Bracteoles. g. Flower without petals and sepals. h-i. Sepals. j. Sepal apex. k. Petal. l. Staminal filament. m. Fruit. n. Mericarp. o. Seed. (Based on: a-e, m-o, *Zich 223*, NSW; f-l, *Briggs & Zich 2684*, NSW).

Fig. 278. Distribution of *Geranium obtusisepalum*.

pressed, eglandular hairs 0.1-0.6 mm long. Flowers actinomorphic. *Sepals* (3.7)4.1-5.8(6.3) mm long, 2.2-3.4 mm wide, lanceolate, smooth, not accrescent, nerves 3, mucro 0.1-0.2(0.3) mm long [ratio mucro length/sepal length = 0.02-0.07], with erect-patent, eglandular hairs 0.2-0.8 mm long on the abaxial surface, ± glabrous adaxially. *Petals* (4)4.2-6.2 mm long, 2.3-4.4 mm wide, erect-patent, rounded, without claw, pink with white base, glabrous on both surfaces, ciliate on the basal margin, with hairs 0.1-0.3 mm long. *Stamens* 10, both whorls bearing anthers; filaments 2.4-3.1 mm long, lanceolate, unknown color, pilose on the abaxial surface, ciliate on the proximal half, with hairs 0.1-0.3 mm long; anthers 0.5-0.6 mm long, white to yellow. Nectaries 5, hemispheric, glabrous. *Gynoecium* 3-3.8 mm long, green to pale pink. *Fruit* (14.4)15.5-17.6(18.6) mm long, erect, discharge of seed-ejection type; mericarps 2.8-3.6 mm long, 1.5-1.9 mm wide, without a strand of fibers, not compressed at the apex, smooth, without basal beak, with a basal callus, without a basal prong, brown, with erect-patent, eglandular hairs 0.3-0.7 mm long; rostrum 9.2-12.5 mm long, without a narrowed apex, not twisted, with erect-patent, eglandular hairs 0.3-0.7 mm long; stigmatic remnants 1.3-2.1 mm long, with 5 hairy lobes. *Seeds* 1.7-2.3 mm long, 1.3-1.7 mm wide, finely reticulate, uniformly colored, brown, glabrous. Cotyledons with entire margin. Fig. 277.

Pollen. Ornamentation not studied.

Chromosome number. Unknown.

Phenology. Collected in flower from October to March.

Distribution. This species ranges through New South Wales and Victoria, in southeastern Australia (Fig. 278).

Habitat. Grassy areas, gentle slopes, and edge of *Eucalyptus* L'Hér. forests; 1350-1550 m.

Additional specimens examined. **Australia.** Australian Capital Territory: Mt. Franklin, 35°28'S, 148°46'E, 3 Feb. 1961, *Kaspiew 1093* (L); Blackfellows Gap, Namadgi National Park, 2 km directly S of Mt. Gingera, 35°35'S, 148°46'E, 19 Jan. 1993, *Briggs & Zich 2684* (NSW); Smokers' Flat Trail, S edge of Smokers' Flat, 3.5 km from carpak towards Orroral Valley turn-off, 36°1'S, 148°25'E, 6 Mar. 1993, *Zich 223* (NSW). New South Wales: upper Tumur River near Junction Shaft, 36°1'S, 148°25'E, 16 Feb. 1957, *Filmer s.n.* (NSW); Kosciusko Hotel Dam, 36°24'S, 148°25'E, 24 Jan. 1959, *Carolin 779* (K). Victoria: Point Lonsdale, 38°17'S, 144°37'E, Oct. 1912, *Tilden 687* (F, G, GH, K).

Discussion. Geranium obtusisepalum is close to *G. retrorsum* and *G. solanderi*. The three species are erect, prostrate, or ascending perennial herbs with free stipules and short petals. They share a distinctive vertical, turnip-shaped rootstock, also found in some species from South America such as *G. core-core* and *G. limae* (Aedo & al. 2005a). *Geranium obtusisepalum* is well characterized by 1-flowered cymules and sepals with a very short mucro. Both *G. retrorsum* and *G. solanderi* have 2-flowered cymules and a conspicuous sepal mucro. The number of lobes of the middle leaf segment is always three in *G. obtusisepalum*, but varies from three to 10 in *G. retrorsum* and *G. solanderi*. *Geranium obtusisepalum* is more or less thickly covered with short, eglandular, usually spreading, hairs. Glandular hairs are also usually present and scattered among the eglandular hairs, but they are restricted to the stem and petiole base. *Geranium obtusisepalum* occurs in a small area in the mountains of southeastern Australia. A specimen collected by J.E. Tilden on Point Lonsdale on the coast of Victoria fits very well with *G. obtusisepalum*, although the locality far from the main range is rather surprising. Another outlier appears to be *Wehl s.n.*, 1892 (MEL) from southern Queensland (see Australia's Virtual Herbarium; http://avh.chah.org.au, 22 Nov, 2013). Unfortunately, I was unable to examine a voucher of the latter and have therefore not included it in the list of specimens examined or in the map.

104. Geranium grande (Carolin) Aedo, Syst. Bot. Monogr. 102: 151. 2017. *Geranium solanderi* var. *grande* Carolin, Proc. Linn. Soc. New South Wales ser. 2, 89: 353. 1965, ["grandis"]. Type locality: "Ebor Gorge, New England, R. Carolin No. 0766, 2.1.1959 (NSW)". Type: Australia. New South Wales, Ebor Gorge, New England, 30°23'S, 152°20'E, 2 Jan. 1959, *R.C. Carolin 766* (holotype, NSW-66129!; isotype, K-000073843!).

Perennial herbs, 40-95 cm tall. *Rootstock* ca. 15 mm in diameter, vertical, not tuberculate, turnip-shaped, without thickened roots. *Stem* erect to ascending, leafy, not rooting at nodes, stolons absent, without vegetative stems, with patent, eglandular hairs 0.6-1.4 mm long. *Basal leaves* in a ± persistent rosette, cauline leaves opposite; leaf laminas (2.5)2.6-4.6(5.5) cm long, 3.1-6.3 cm wide, not peltate, palmatifid [ratio main-sinus length/middle segment length = (0.57)0.62-0.80(0.90)], polygonal in outline, base cordate, not coriaceous, with nerves not projected, pilose, with ± appressed, eglandular hairs on both surfaces; segments 5, in 1 plane, middle segment obtriangular, (2.5)4.6-10.5(12) mm wide at the base [ratio segment width at the base/middle segment length = (0.14)0.20-0.30(0.40)], 3-4(6)-lobed in distal half [ratio secondary sinus length/middle segment length = (0.17)0.24-0.30(0.40)]; petioles up to 13 cm long, without abscission zone, terete, not swollen, not deflexed in age, with patent, eglandular hairs 0.4-2 mm long; stipules (3.2)3.7-5.7(7.5) mm long, 0.8-1.8 mm wide, lanceolate, free, papery, brownish red, with eglandular hairs on both surfaces and on the margin. *Inflorescence* a monochasial cyme; cymules 2-flowered, solitary [ratio cymule length/leaf length = 2.5-3.8]; peduncles (32)64-91(116) mm long, with patent, eglandular hairs 0.4-1.7 mm long; bracteoles 3.6-4.4(6) mm long, 0.7-1.2 mm wide, lanceolate, whorled; pedicels 24-44(52) mm

long, with patent, eglandular hairs 0.2-1.1 mm long. Flowers actinomorphic. *Sepals* (6.4)6.9-7.7(9.2) mm long, 2.3-4 mm wide, lanceolate, smooth, not accrescent, nerves 3, mucro 0.7-1.1(1.5) mm long [ratio mucro length/ sepal length = (0.09)0.11-0.20], with ± patent, eglandular hairs 0.6-1.1 mm long on the abaxial surface, glabrous adaxially. *Petals* 11.3-13.2(14.6) mm long, 5-9.3 mm wide, erect-patent, rounded, without claw, pale pink, glabrous on both surfaces, ciliate on the basal margin, with hairs 0.2-0.6 mm long. *Stamens* 10, both whorls bearing anthers; filaments 5.4-8.7 mm long, lanceolate, yellow, glabrous on the abaxial surface, ciliate on the basal margin, with hairs 0.2-0.5 mm long; anthers 1.2-1.6 mm long, yellow. Nectaries 5, hemispheric, glabrous. *Gynoecium* 6.7-9.1 mm long, pale pink. *Fruit* 24.9-28 mm long, erect, discharge of seed-ejection type; mericarps 3.3-3.8 mm long, 1.4-2.2 mm wide, without a strand of fibers, not compressed at the apex, smooth, without basal beak, with a basal callus, without a basal prong, usually black, with erect-patent, eglandular hairs 0.5-1 mm long; rostrum 17.8-20.3 mm long, with a narrowed apex 1.8-2.7 mm long, not twisted, with erect-patent, eglandular hairs 0.5-0.7 mm long; stigmatic remnants 2-3.2(3.6) mm long, with 5 hairy lobes. *Seeds* 2.5-2.8 mm long, 1.3-1.9 mm wide, reticulate, uniformly colored, brown, glabrous. Cotyledons not studied. Fig. 279.

Pollen. Ornamentation not studied.

Chromosome number. Unknown.

Phenology. Collected in flower from October to May.

Distribution. This species ranges through eastern New South Wales, in southeastern Australia (Fig. 280).

Habitat. Open grassland, damp places with *Sphagnum* L., and *Eucalyptus* L'Hér. remnants; 450-500 m.

Additional specimens examined. **Australia.** New South Wales: N.S. Wales, 1824, *Cunningham 30* (MEL); Wallangarra, 28°55'S, 151°55'E, May 1914, *Boorman s.n.* (NSW); Glen Innes, 29°43'S, 151°43'E, Dec. 1913, *Boorman s.n.* (NSW); Mt. Lind-

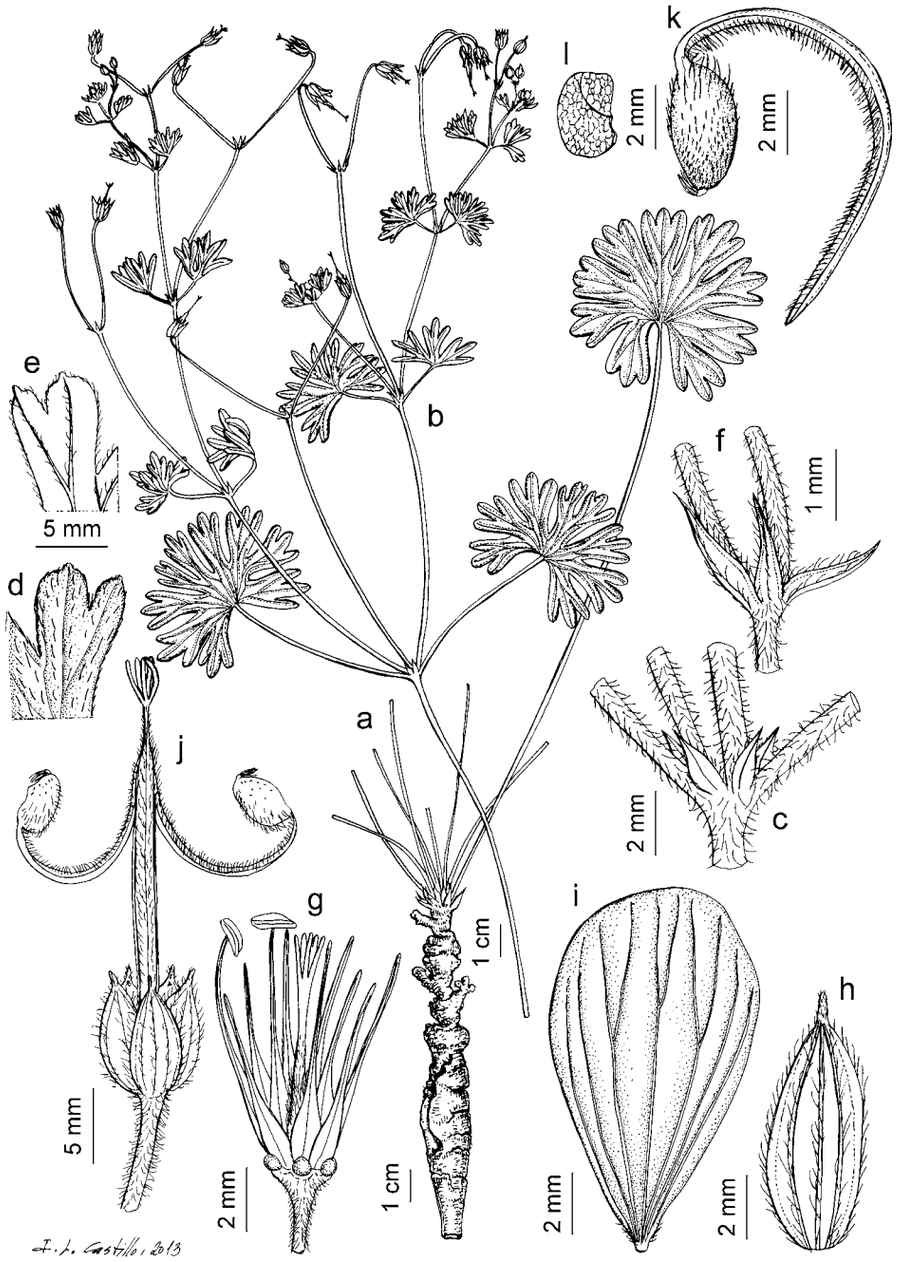


Fig. 279. *Geranium grande*. a, b. Habit. c. Bracts. d. Detail of indument, adaxial leaf surface. e. Detail of indument, abaxial leaf surface. f. Stipules. g. Flower without petals and sepals. h. Sepal. i. Petal. j. Fruit. k. Mericarp. l. Seed. (Based on: a, j-l, *Carolin 766*, NSW; b-f, *Crawford 5653*, NSW; g-i, *Prober s.n.*, *29 Oct. 1991*, CANB).

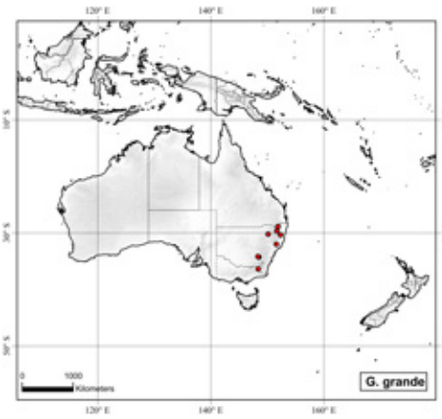


Fig. 280. Distribution of *Geranium grande*.

say, 30º16'S, 150º10'E, 4 Nov. 1909, *Cambage 2370* (NSW); Gloucester Tops, 32º3'S, 151º37'E, Jan. 1967, *Coveny s.n.* (NSW); Central Western Slopes, Hardem-Blayney railways easement 540 m N Monteagle Stock Route Crossing, 34º13'S, 148º22'E, 1 Dec. 1999, *Crawford 5653* (NSW); ca 2.6 km N from Murringo centre, on top road to Davey's Creek, 1.6 km from Murringo-Bendick Murrel road, 34º18'S, 148º32'E, 29 Oct. 1991, *Prober s.n.* (CANB); Kosciusko Hotel, 36º24'S, 148º25'E, 23 Jan. 1959, *Carolin 766* (K).

Discussion. Geranium grande is a species easily recognizable by its turnip-shaped rootstock, robust stem, 2-flowered cymules, long peduncles, petals, and sepals, and fruit with a long narrowed apex and long persistent stigma lobes. It is interesting to note the significant gap in petal size between *G. solanderi*, which has petals that only reach a length of 8.5 mm long in extreme cases, and *G. grande*, which has petals that vary in length from 11.3 mm to 14.6 mm. The same pattern is found in the length of both the fruit narrowed rostrum apex and persistent stigma lobes of the fruit. It is curious that the distinctness of *G. grande* from *G. solanderi* has been overlooked by previous workers while other variability within *G. solanderi* has received considerable attention from a taxonomic point of view. Carolin (1965: 353), in describing this variety, indicated that the rootstock is "swollen but not napiform." The holotype shows, however, a turnip-shaped rootstock indistinguishable from that of *G. solanderi*. *Geranium neglectum* resembles *G. grande* in its long peduncles, petals, and sepals, and fruit with a long narrowed rostrum apex and long persistent stigma lobes. *Geranium neglectum* is easily differentiated from *G. grande* by its 1-flowered cymules and cylindrical rootstock. A specimen at K collected by R.C. Carolin from the Kosciusko Hotel has the same number (766) as the holotype. It appears that a labeling mistake has occurred, because the date (23 Jan. 1959) and the details of the locality are not those of the holotype.

105. Geranium retrorsum L'Hér. ex DC., Prodr. 1: 644. 1824. *Geranium dissectum* var. *retrorsum* (L'Hér. ex DC.) Hook. f., Fl. Nov.-Zel. 1: 39. 1852. *Geranium pilosum* var. *retrorsum* (L'Hér. ex DC.) Jeps., Man. Fl. Pl. Calif.: 589. 1925. Type locality: "in Novâ-Zelandiâ. Banks. (v. s. cum semill. immat.)". Type: New Zealand. Novâ-Zelandiâ, 1769-1770, *J. Banks s.n.* (lectotype, designated by Carolin 1965: 349, G-DC-00212045!; isolectotype, BM!).

Geranium dissectum var. *patulum* Sol. ex Hook. f., Handb. N. Zeal. Fl.: 36. 1864. *Geranium pilosum* var. *grandiflorum* R. Knuth in Engl., Pflanzenr. IV.129 (Heft 53): 75. 1912, nom. illeg. Type locality: [not indicated, New Zealand]. Type: New Zealand. [without locality], *J. Banks & D.C. Solander s.n.* (lectotype, designated by Aedo & al. 2005a: 52, BM-000075361!).

Geranium australe Nees in Lehm., Pl. Preiss. 1: 162. 1845, nom. illeg., non Dum. Cours. 1805. *Geranium pilosum* var. *australe* Nees ex Ostenf., Biol. Meddel. Kongel. Danske Vidensk. Selsk. 3: 721. 1921. Type locality: "In Australia occidentali. Herb. Preiss. No. 1907". Type: Australia. Australia occidentali, *L. Preiss 1907* (lectotype, designated by Carolin 1965: 349, LE!; isolectotype, LD-1083133 image!).

Perennial herbs, 9-39(70) cm tall. *Rootstock* 4.9-16.3 mm in diameter, vertical, not tuberculate, turnip-shaped, without thickened roots. *Stem* erect to ascending, leafy, not rooting at nodes, stolons absent, without vegetative stems, with retrorse, appressed, eglandular hairs 0.2-0.9 mm long. *Basal leaves* in a ± deciduous rosette, cauline leaves opposite; leaf laminas (1)1.8-3(4.2) cm long, 1.6-5.3 cm wide, not peltate, palmatifid to palmatisect [ratio main-sinus length/middle segment length = (0.66)0.75-0.85(0.96)], polygonal in outline, base cordate, not coriaceous, with nerves not projected, pilose, with appressed, eglandular hairs on both surfaces; segments 5, in 1 plane, middle segment obtriangular, (1.2)2.4-4.1(9.8) mm wide at the base [ratio segment width at the base/middle segment length = (0.07)0.15-0.23(0.37)], 3-6(9)-lobed in distal half [ratio secondary sinus length/middle segment length = (0.21)0.30-0.38(0.46)]; petioles up to 23 cm long, without abscission zone, terete, not swollen, not deflexed in age, with retrorse, appressed, eglandular hairs 0.2-0.9 mm long; stipules (1.9)2.9-4.5(6.5) mm long, 0.5-1.5 mm wide, lanceolate, free, papery, brownish red, with eglandular hairs on abaxial surface and on the margin, glabrous adaxially. *Inflorescence* a monochasial cyme; cymules (1)2-flowered, solitary [ratio cymule length/leaf length = (0.4)0.7-1.5(5.8)]; peduncles (6.6)13-28(84.1) mm long, with retrorse, appressed, eglandular hairs 0.1-0.5 mm long; bracteoles 1.4-4.2 mm long, 0.3-0.9 mm wide, lanceolate, whorled; pedicels 6.6-39.6 mm long, with retrorse, appressed, eglandular hairs 0.2-0.6 mm long. Flowers actinomorphic. *Sepals* (3.2)4.9-5.7(6.6) mm long, 1.5-3.5 mm wide, lanceolate, smooth, not accrescent, nerves 3, mucro (0.2)0.4-0.6(0.9) mm long [ratio mucro length/sepal length = (0.05)0.08-0.11(0.18)], with antrorse, ± appressed, eglandular hairs 0.2-1.3 mm long on the abaxial surface, glabrous adaxially. *Petals* (2.9)3.7-5.7(9.2) mm long, 1.4-4.5 mm wide, erect-patent, rounded or slightly emarginate, without claw, purple, glabrous on both surfaces, ciliate on the basal margin, with hairs 0.1-0.3 mm long. *Stamens* 10, both whorls bearing anthers; filaments 2.2-4.7 mm long, lanceolate, white, glabrous on the abaxial surface, ciliate on the basal margin, with hairs 0.1-0.2 mm long; anthers 0.4-1 mm long, yellow. Nectaries 5, hemispheric, glabrous. *Gynoecium* 2-4.5 mm long, yellow. *Fruit* 11-20.6 mm long, erect, discharge of seed-ejection type; mericarps 2.3-3.9 mm long, 1.1-2.1 mm wide, without a strand of fibers, not compressed at the apex, smooth, without basal beak, with a basal callus, without a basal prong, usually black, with erect-patent, eglandular hairs 0.2-1.2 mm long; rostrum 7.8-14.4 mm long, without a narrowed apex or with a narrowed apex 0.4-1.2 mm long, not twisted, with erect-patent, eglandular hairs 0.1-0.8 mm long; stigmatic remnants (0.6)0.9-1.2(1.7) mm long, with 5 hairy lobes. *Seeds* 1.5-2.8 mm long, 0.9-1.7 mm wide, finely

reticulate, uniformly colored, brown, glabrous. Cotyledons with entire margin. Figs. 281, 282.

Pollen. *Geranium*-type (Aedo & al. 2005a: 6).

Chromosome number. 2*n* = 52.

Phenology. Collected in flower from January to December.

Distribution. This species ranges from southern and western Australia to Tasmania and New Zealand and it is introduced in Hawaii (Fig. 283).

Habitat. Roadsides, weedy areas, rocky outcrops, grassland, dunes, creeks, and open *Eucalyptus* L'Hér. forests; 0-1300 m.

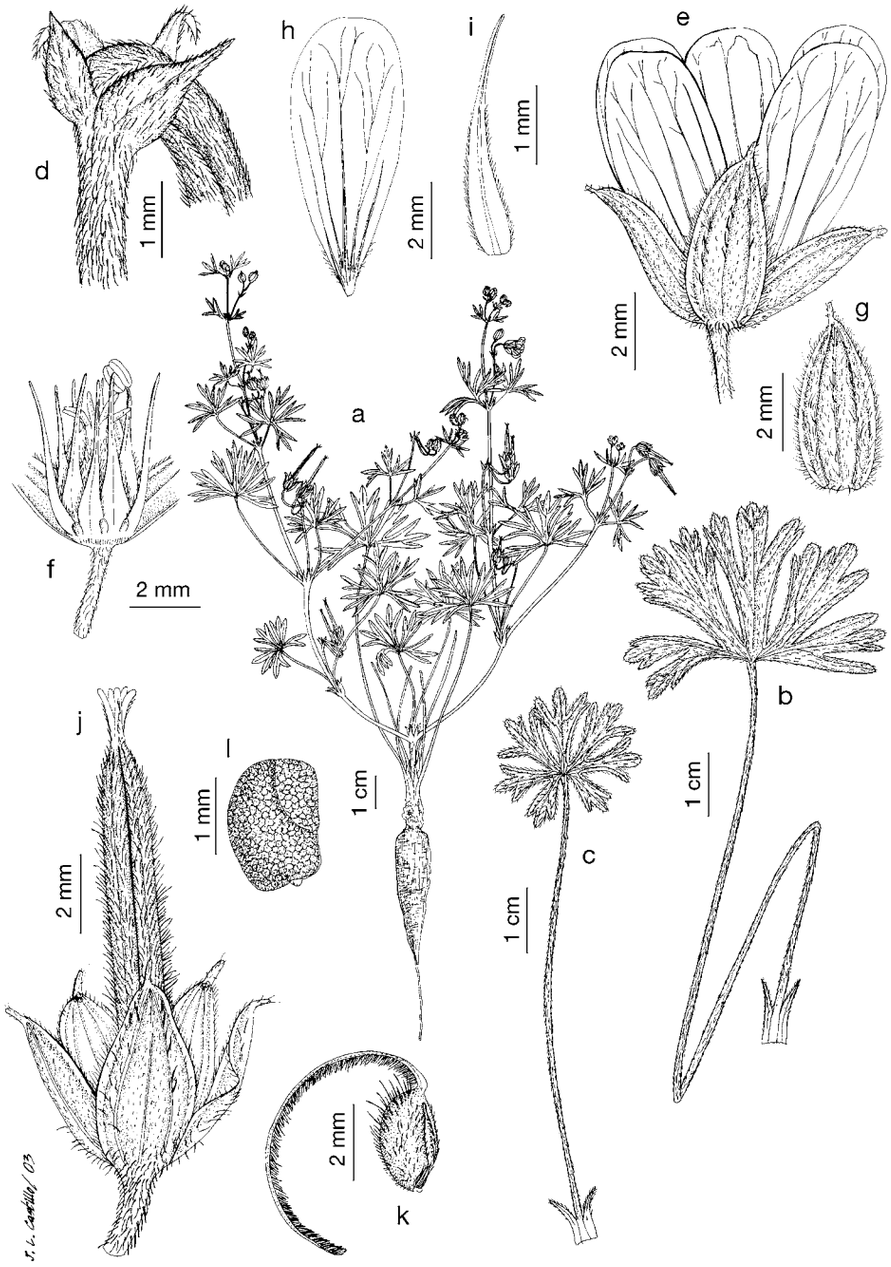


Fig. 281. *Geranium retrorsum*. a. Habit. b, c. Leaves. d. Bracteoles. e. Flower. f. Flower without petals and sepals. g. Sepal. h. Petal. i. Staminal filament. j. Fruit. k. Mericarp. l. Seed. (Based on: a, d-l, *Mueller s.n.*, s.d., NY; b, *Wright 5709*, AK; c, *Godman 22*, K).

Representative specimens examined. **Australia.** New South Wales: North Western Plains, near Tackinbri Camp, 28º53'S, 150º9'E, 10 Oct. 1983, *Canning 5805* (CANB); 15 mi E of Guyra, on Ebor road, 30º12'S, 151º40'E, 9 Jan. 1958, *Vickery 42756* (K); Lake George, 35º2'S, 149º22'E, 8 Feb. 1991, *Canning 6672A* (AK); Southern Tablelands, Bredbo cemetery, 35º57'S, 149º8'E, 23 Oct. 1993, *Crawford 2447* (CANB): Kosciusko National Park, E end of Is. Bend Airstrip, 36º19'S, 148º29'E, 27 Feb. 1992, *Briggs & Zich 2640* (CANB). Queensland: Stanforth, Nov. 1943, *Clemens s.n.* (GH). South Australia: Mt. Lyndhurst, 30º10'S, 138º42'E, Sep. 1899, *Roch 825* (P); Northern Flinders Range, 20 km E of Parachilna, Parachilna on Adelaide-Alice Springs railway, 31º8'S, 138º24'E, 6 Oct. 1960, *Lothian 949* (AD); Northern Lofty, Port Germein, 33º1'S, 138º0'E, 16 May 1958, *Higginson s.n.* (AD); South Eastern, Coorong, house paddock at the old Cantara Station homestead, 36º20'S, 139º44'E, 9 Oct. 1975, *Alcock 5201* (AD); South Eastern, Hundred of MacDonnell, 5 km ESE of Kongorong, 37º55'S, 140º38'E, 20 Sep. 1976, *Rowley 56* (AD). Tasmania: Prime Seal Is., Furneaux group, 40º3'S, 147º45'E, *Whinray 393* (CANB); Macquarie Plains, 42º43'S, 146º55'E, 8 Sep. 1842, *Gunn 259b* (K); in valle juxta monte Torent, 42º46'S, 146º49'E, 25 Oct. 1847 (LD); Hedgerow, Launceston, 43º30'S, 146º2'E, 27 Oct. 1943, *Curtis s.n.* (K). Victoria: Adelaide, 34º55'S, 138º35'E, 17 Aug. 1952, *Kaspiew 67* (NY); Terric State Forest, 45 km W of Echuca Po, 36º8'S, 144º13'E, 2 Sep. 1979, *Beauglehole s.n.* (CANB); Melbourne, 37º47'S, 144º56'E, *Mueller 7122* (P); Sandringham, 37º56'S, 144º59'E, 3 Nov. 1922, *Helms 39* (US); between Bellbrae and Anglesea, 38º20'S, 144º16'E, Nov. 1935, *Lothian s.n.* (AD). Western Australia: Beraking, 32º5'S, 116º19'E, 7 Dec. 1970, *Williams s.n.* (PERTH); Benger, 33º10'S, 115º51'E, 19 Sep. 1953, *Royce 4377* (K, PERTH); Gold Holes, Chester Pass Road, Stirling Ranges National Park, 34º26'S, 118º4'E, 14 Nov. 1982, *Keighery 5984* (PERTH); Walpole National Park, 3 km S of Long Point, 35º1'S, 116º34'E, 24 Sep. 1992, *Wheeler 3311* (PERTH); Dunskey's Beach, West Cape Howe, 20 km W of Albany, 35º7'S, 117º35'E, 27 Nov. 1989, *Keighery 11246* (PERTH). **New Zealand.** New Zealand North Is.: Aupouri Ecological region, Rangaunu Heads, 34º57'S, 173º15'E, Oct. 1897, *Matthews s.n.* (AK); Coromandel Co., southernmost of Ngamotukaraka Is., 36º42'S, 175º23'E, 28 Aug. 1983, *Wright 5709* (AK, G); Auckland, Mt. Wellington, 36º53'S, 174º50'E, 1 Oct. 1983, *Gardner 3899* (AK); Mauku, 37º12'S, 174º49'E, 12 Dec. 1900, *Carse s.n.* (AK); Hawkes Bay Ecological region, Heretaunga Ecological district, Te

Fig. 282. *Geranium retrorsum* (Based on: *Crawford 2447,* CANB, from seeds raised at MA).

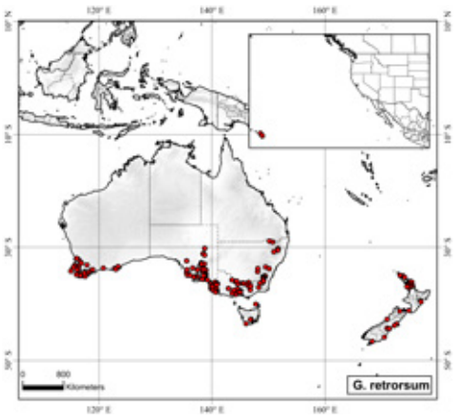


Fig. 283. Distribution of *Geranium retrorsum*.

Awanga beach, 39º38'S, 176º58'E, 10 Sep. 1994, *Gardner 7504* (AD, AK). New Zealand South Is.: Aniseed valley, Nelson, 41º17'S, 173º14'E, 15 Nov. 1980, *Gardner 2772* (AK); N of Hokitika, 42º43'S, 170º57'E, 20 Apr. 1972, *Healy 72* (AK); Canterbury Land district, Canterbury Plains, Leeston, 43º49'S, 172º15'E, 10 Dec. 1994, *Nielsen 10091* (C); Wainono Ecological region, Makikihi Ecological district, Timaru, Selwyn Street, 44º23'S, 171º21'E, 14 June 1975, *Esler s.n.* (AK); Rakiura Ecological region, Foveaux Ecological district, Bluff Hill, 46º37'S, 168º21'E, 23 Apr. 1992, *Gardner 6598* (AK). **USA.** Hawaii: Hawaii Is., Kohala, 19º59'N, 155º40'W, 1865, *Hillebrand 442* (K); Hawaii Is., Waimea, 20º1'N, 155º39'W, 4 Apr. 1948, *Hosaka 3590* (P); Maui Is., Pipe-line Trail, Olinda, 20º48'N, 156º16'W, 19 June 1927, *Degener 18240* (GH, NY).

Discussion. Geranium retrorsum is characterized by a turnip-shaped rootstock, 2-flowered cymules with retrorsely appressed eglandular hairs on the peduncles and pedicels, and short petals. In addition, the rostrum of the fruits lacks a narrowed apex, or has a short narrowed apex only 0.4-1.2 mm long, and the persistent stigma lobes are short [(0.6)0.9-1.2(1.7) mm long]. *Geranium retrorsum* varies in degree of leaf dissection and has occasionally some 1-flowered cymules, especially toward the apex of the inflorescences. It is difficult to differentiate from forms of *G. solanderi* with "coarse hairs" where the indument of the peduncle and pedicel consists of more or less retrorse, but not appressed, hairs.

106. Geranium berteroanum Colla, Nuovo Giorn. Lett., Sci. 24: 143. 1832, ["Berterianum"]. *Geranium proximum* Bertero ex Steud., Flora 39(28): 438. 1856, nom. illeg. Type locality: "Geranium tuberoso proximum. Berter. In Merc. Chil. N. 13. Pag. 643.; Hab. Valparaiso in pascuis declivibus collium". Type: Chile. Valparaíso, Quillota, 32°54'N, 71°16'W, 1829, *C.L. Bertero 1020* (lectotype, designated by Aedo & al. 2005a: 31, BM-000609281!; isolectotype, P!).

Geranium intermedium Bertero ex Colla, Nuovo Giorn. Lett., Sci. 24: 143. 1832, nom. illeg., non E. James, 1823. *Geranium collae* Aedo, Muñoz Garm. & Pando, Anales Jard. Bot. Madrid 56(2): 224. 1998. Type locality: "Hab. in pascuis et sepibus Rancagna". Type: Chile. O'Higgins, Rancagua, 34°30'N, 71°04'W, 1828, *C.L. Bertero s.n.* (lectotype, designated by Aedo & al. 2005a: 31, SGO-51197!).

Geranium patagonicum Hook. f., Fl. Antarct. 2: 252. 1845. *Geranium dissectum* var. *patagonicum* (Hook. f.) Speg., Revista Fac. Agron. Univ. Nac. La Plata 3(30-31): 500. 1897. Type locality: "Hab. Strait of Magalhaens, Port Famine; Capt. King". Type: Chile. Patagonia, Port Famine, 53°38'S, 70°56'W, *P.P. King s.n.* (lectotype, designated by Aedo & al. 2005a: 31, K!).

Geranium apricum Phil., Linnaea 28: 676. 1858. *Geranium berteroanum* var. *apricum* (Phil.) Reiche, Anales Univ. Chile 93: 578. 1895. Type locality: "In provinciae Valdiviae locis apricis invenitur". Type: Chile. Valdivia, San Juan, *F. Philippi 261* (lectotype, designated by Aedo & al. 2005a: 31, SGO-40601!; isolectotypes, LE!, W!).

Geranium submolle Steud., Flora 39(28): 438. 1856. Type locality: "Bertero hrbr. nr. 294 (Quid? alia manis Geranium tuberosum?) Geranium disectum Gay l. c. 384? et? Hook. B. Misc. III. 160. In Pascuis sylvaticis montis La Leona Rancagua Chili". Type: Chile. Rancagua, montis La Leona, 34°30'S, 71°04'W, *C.L. Bertero 294* (lectotype, designated by Aedo & al. 2005a: 32, P-00757995!; isolectotypes, G-00365970!, GH!, MO!).

Geranium andinum Phil., Anales Univ. Chile 82: 727. 1893. Type locality: "In Andibus de Popeta dictis provinciae O'Higgins invenit Fr. Philippi". Type: Chile. O'Higgins, Popeta, Las Leñas, 34°29'S, 70°45'W, Jan. 1881, *F. Philippi s.n.* (lectotype, designated by Aedo & al. 2005a: 32, SGO-51217!).

Geranium caespitosum Phil., Anales Univ. Chile 82: 730. 1893, nom. illeg., non E. James, 1823. *Geranium berteroanum* var. *caespitosum* Phil. ex Reiche, Anales Univ. Chile 93: 578. 1895. *Geranium chilense* Aedo & Muñoz Garm., Kew Bull. 52(3): 725. 1997. Type locality: "Ad thermas de Cauquenes mensi septembri legi". Type: Chile. O'Higgins, baños de Cauquenes, 34°15'S, 70°34'W, Sep. 1879, *F. Philippi s.n.* (lectotype, designated by Aedo & al. 2005a: 32, SGO-51204!, photo P!).

Geranium hispidum Phil., Anales Univ. Chile 82: 732. 1893, nom. illeg., non L. f. 1782. *Geranium berteroanum* var. *hispidum* Phil. ex Reiche, Anales Univ. Chile 93: 578. 1895. *Geranium neohispidum* Aedo & Muñoz Garm., Kew Bull. 52(3): 725. 1997. Type locality: "In collibus apricis praedii Mercedes prov. Santiago, Nov. 1888 legi". Type: Chile. Santiago, Las Mercedes, 33°47'S, 71°45'W, Oct. 1888, *F. Philippi s.n.* (lectotype, designated by Aedo & al. 2005a: 32, SGO-51214!, photos GH!, P!).

Geranium geissei R. Knuth in Engl., Pflanzenr. IV.129 (Heft 53): 70. 1912. Type locality: "Chile: Ohne genauere Standortsangabe (Geisse -- Typus in herb. Berol.!)". Type: Chile. [without locality], *R. Geisse s.n.* (holotype, B destroyed; photos, F!, G!, GH!, NY!). The holotype is no longer extant, and no duplicates were located. None of the Geisse collections at SGO can be associated with this name. The photographs of the holotype are not sufficiently detailed to permit accurate identification, but suggest that the name may be a synonym of *G. berteroanum*.

Perennial herbs, 13.5-59 cm tall. *Rootstock* 5.8-20.4 mm in diameter, vertical, not tuberculate, turnip-shaped, without thickened roots. *Stem* erect or ascending, leafy, not rooting at nodes, stolons absent, without vegetative stems, with patent, eglandular hairs 0.4-1.9 mm long and, sometimes, patent, glandular hairs 0.3-1.1 mm long. *Basal leaves* in a deciduous rosette, cauline leaves opposite; leaf laminas 1.8-9 cm long, 2.6-8.4 cm wide, not peltate, palmatifid [ratio main-sinus length/middle segment length = (0.75)0.80-0.86], polygonal in outline, base cordate, not coriaceous, with nerves not projected, pilose, with appressed, eglandular hairs on both surfaces, sometimes glabrous adaxially; segments 5-7, in 1 plane, middle segment obtriangular, 1.8-10.6 mm wide at the base [ratio segment width at the base/middle segment length = (0.11)0.17-0.22(0.31)], 3-11-lobed in distal half [ratio secondary sinus length/middle segment length = (0.13)0.24-0.38(0.42)]; petioles up to 29.5 cm long, without abscission zone, terete, not swollen, not deflexed in age, with patent, eglandular hairs 0.5-2 mm long and, sometimes, patent, eglandular hairs 0.3-0.9 mm long; stipules 4-9 mm long, 0.6-3 mm wide, lanceolate, free, papery, brownish red, with eglandular hairs on both surfaces and on the margin. *Inflorescence* a monochasial cyme; cymules 2-flowered, solitary [ratio cymule length/leaf length = 0.7-1.1(2.5)]; peduncles (8)17-45(58) mm long, with patent, eglandular hairs 0.2-1.2 mm long and, sometimes, patent, glandular hairs 0.3-1.1 mm long; bracteoles 2.5-6.7 mm long, 0.4-1.1 mm wide, linear-lanceolate, whorled; pedicels 9-27 mm long, with patent, eglandular hairs 0.2-1.2 mm long and, sometimes, patent, glandular hairs 0.3-1.1 mm long. Flowers actinomorphic. *Sepals* (4.4)5.4-6.1(7) mm long, 2-3.4 mm wide, lanceolate, smooth, not accrescent, nerves 3, mucro (0.3)0.6-0.8(0.9) mm long [ratio mucro length/sepal length = (0.07)0.09-0.14(0.16)], with erect-patent, eglandular hairs 0.7-1.8 mm long and, sometimes, patent, glandular hairs 0.3-1.2 mm long on the abaxial surface, glabrous adaxially. *Petals* (5.1)6.5-8(9) mm long, 2.5-4.5 mm wide, erect-patent, rounded or slightly emarginate, without claw, purple, glabrous on both surfaces, ciliate on the basal margin, with hairs 0.2-0.5 mm long. *Stamens* 10, both whorls bearing anthers; filaments 2.5-4.5 mm long, lanceolate, white to yellow, with eglandular hairs 0.1-0.4 mm long on the abaxial surface and margin; anthers 0.4-0.8 mm long, white to pink. Nectaries 5, hemispheric, glabrous. *Gynoecium* 2.9-5.2 mm long, white to pink. *Fruit* 11.4-24.6 mm long, erect, discharge of seed-ejection type; mericarps 2.3-4.2 mm long, 1.1-2.3 mm wide, without a strand of fibers, not compressed at the apex, smooth, without basal beak, with a basal callus, without a basal prong, brown, with erect-patent, eglandular hairs 0.4-1.5 mm long and, sometimes, patent glandular hairs 0.2-0.8 mm long; rostrum 8.5-18.1 mm long, without a narrowed apex, not twisted, with erect-patent, eglandular hairs 0.4-1 mm long and, sometimes, patent, glandular hairs 0.3-1.1 mm long; stigmatic remnants (1.1)1.3-1.7(2.1) mm long, with 5 hairy lobes. *Seeds* 1.3-3.1 mm long, 0.8-1.8 mm wide, finely reticulate, uniformly colored, brown, glabrous. Cotyledons with entire margin. Figs. 284, 285.

Pollen. *Geranium*-type (Aedo & al. 2005a: 7; Bortenschlager 1967: 425 [sub *G. patagonicum*]).

Chromosome number. 2*n* = 52, 56, 84.

Phenology. Collected in flower from January to December.

Distribution. This species ranges from central Chile and Argentina to southern Patagonia (Fig. 286).

Habitat. Roadsides, cultivated fields, dunes, meadows, river banks, dry slopes, shrublands, and *Acacia* Mill., *Araucaria* Juss., *Aristotelia* Lam. and *Nothofagus* Blume forests; 0-3800 m.

Representative specimens examined. **Argentina.** Buenos Aires: Cerro Curamalal Grande, 37°44'S, 62°13'W, 12 Nov. 1928,

Scala s.n. (NY); Tornquist, Sierra de la Ventana, Cerro Ventana, 38º2'S, 62º0'W, *proyecto Ventania 349b* (LP); Sierra de la Ventana, Cerro el Abra, 38º3'S, 61º59'W, 17 Nov. 1969, *Roivainen 376* (H). Chubut: Cushamen, Lo Puelo, playa de los Franceses, 42º4'S, 71º37'W, 25 Feb. 1991, *Cusato & Rossow 4114* (CTES); Lago Futalenfú, 42º54'S, 71º18'W, 9 Jan. 1948, *Soriano 2860* (SI); Escalante, Bahia Solano, 45º39'S, 67º20'W, 14 Nov. 1966, *Barco 311* (UC). Mendoza: Las Heras, Villavicencio, 32º30'S, 69º1'W, 6 Mar. 1942, *Corvas 398* (MERL, SI); Tunuyán, quebrada de la Remonta, 33º33'S, 69º1'W, 19 Dec. 1963, *Ruiz Leal 23079* (CORD, MERL); Nevado San Rafael, Agua de Sapo, 34º36'S, 68º20'W, 26 Jan. 1941, *Ruiz Leal s.n.* (LIL, MERL). Neuquén: Minas, Baños Calientes, pr. Valvarco, 36º42'S, 70º30'W, 31 Jan. 1964, *Boelcke & Correa 11439* (SI); Lago Villarino, 40º26'S, 71º36'W, 1896, *Roth s.n.* (LP); Los Lagos, Fortín Chacabuco, 41º0'S, 71º10'W, 3 Nov. 1949, *Boelcke & Hunziker 3513* (CTES). Río Negro: 6 km de Pilcaniyen, camino de Bariloche, 40º45'S, 70º30'W, 28 Jan. 1944, *Nicora 3677* (SI); Bariloche, 41º8'S, 71º18'W, 5 Jan. 1935, *Cabrera & Job 32* (LP, NY); Nahuel Huapí, el Trebol, 41º44'S, 72º5'W, 27 Dec. 1944, *Meyer 7454* (GH, NY). San Juan: Jachal, Bella Vista, El Salto, 31º8'S, 69º27'W, 1 Feb. 1987, *Kiesling & Megioli 6680* (SI); Calingasta, observatorio El Leoncito, 31º47'S, 69º18'W, 24 Feb. 2008, *Aedo 15475* (MA); Sarmiento, río Bachongo, 31º58'S, 68º54'W, 23 Jan. 1986, *Guaglianone & al. 1479* (SI). Santa Cruz: Deseado, cañadón frente a la estación de Biología Marina, 47º44'S, 65º56'W, Oct. 1970, *Crespo & Troncoso 1694* (SI); Lago Argentino, 50º20'S, 72º18'W, 22 Jan. 1905, *Dusén 5645* (SI); Ouchonaya, canal du Beagle, 54º53'S, 68º10'W, 20 Jan. 1883, *Hahn 12-80bis* (P). Tierra del Fuego: Fuegia, Lago Fagnano, Pumilio shore, 54º35'S, 67º40'W, 18 Mar. 1908, *Skottsberg 247* (S, UPS); Ushuaia, Monte Susanna, 54º50'S, 68º26'W, 1933, *Jordan s.n.* (H); Estancia Harberton, Waru Yeshca in Paso Guarami of Beagle Chanel, 54º52'S, 67º19'W, 23 Feb. 1971, *Goodall 3594* (MICH, SI, UB, UC). **Chile.** Aisén: Coyhaique, 45º34'S, 72º4'W, 25 Jan. 1934, *Espinosa s.n.* (SGO); Coyhaique, road to Lago Atravesado, ca. 4.8 km W of airport, 45º35'S, 72º15'W, 20 Nov. 1993, *Landrum 8181* (CONC, MO); Reserva Nacional Tamango, Cochrane, 47º15'S, 72º33'W, 10 Jan. 1989, *Urrutia s.n.* (CONC). Biobío: Ñuble, Mela, 36º20'S, 72º50'W, 28 Nov. 2000, *Baeza & al. 2039* (MA); parque Hualpén, morro Pompón, 36º48'S, 73º10'W, 21 Nov. 2001, *Aedo 6931* (MA); Concepción, mirador Alemán, 36º50'S, 73º2'W, 4 Nov. 2001, *Aedo 6727* (MA). Coquimbo: cerros del Tofo, 68 km N of La Serena, 29º26'S, 71º15'W, 1 Nov. 1938, *Worth & Morrison 16297* (GH, K, UC); Ovalle, bosque de Talinay, S desembocadura del Limarí, 30º39'S, 71º43'W, 18 Nov. 1940, *Muñoz & Coronel 1267* (SGO); Ovalle, Fray Jorge, Las Papas, 30º40'S, 71º40'W, 20 Aug. 1950, *Jiles 1750* (CONC). La Araucanía: Malleco, Mininco, 37º47'S, 72º28'W, 31 Oct. 1970, *Montero 8423* (CONC); 8 km al N de Yupehue, playa Casas de Piedra, 38º28'S, 73º30'W, 21 Dec. 2001, *Aedo 7185* (MA); pr. Palguin, salto La China, 39º27'S, 71º49'W, 30 Dec. 2001, *Aedo 7296* (MA). Los Lagos: Valdivia, Los Guindos, 39º16'S, 73º11'W, 28 Jan. 1941, *Gunckel 15324* (CONC); Osorno, río Pilmaiquén, la Poza, 40º33'S, 72º50'W, Mar. 1967, *Zollitsch 103* (CONC, M); Ancud, 41º52'S, 73º49'W, 1925, *Pennell 12575* (F, GH, NY, PH, SGO). Magallanes: Puerto Natales, orilla del Lago Grey, 51º7'S, 73º7'W, 20 Jan. 2002, *Aedo 7482* (MA); isla Englefield, Seno Otway, 53º4'S, 71º50'W, 24

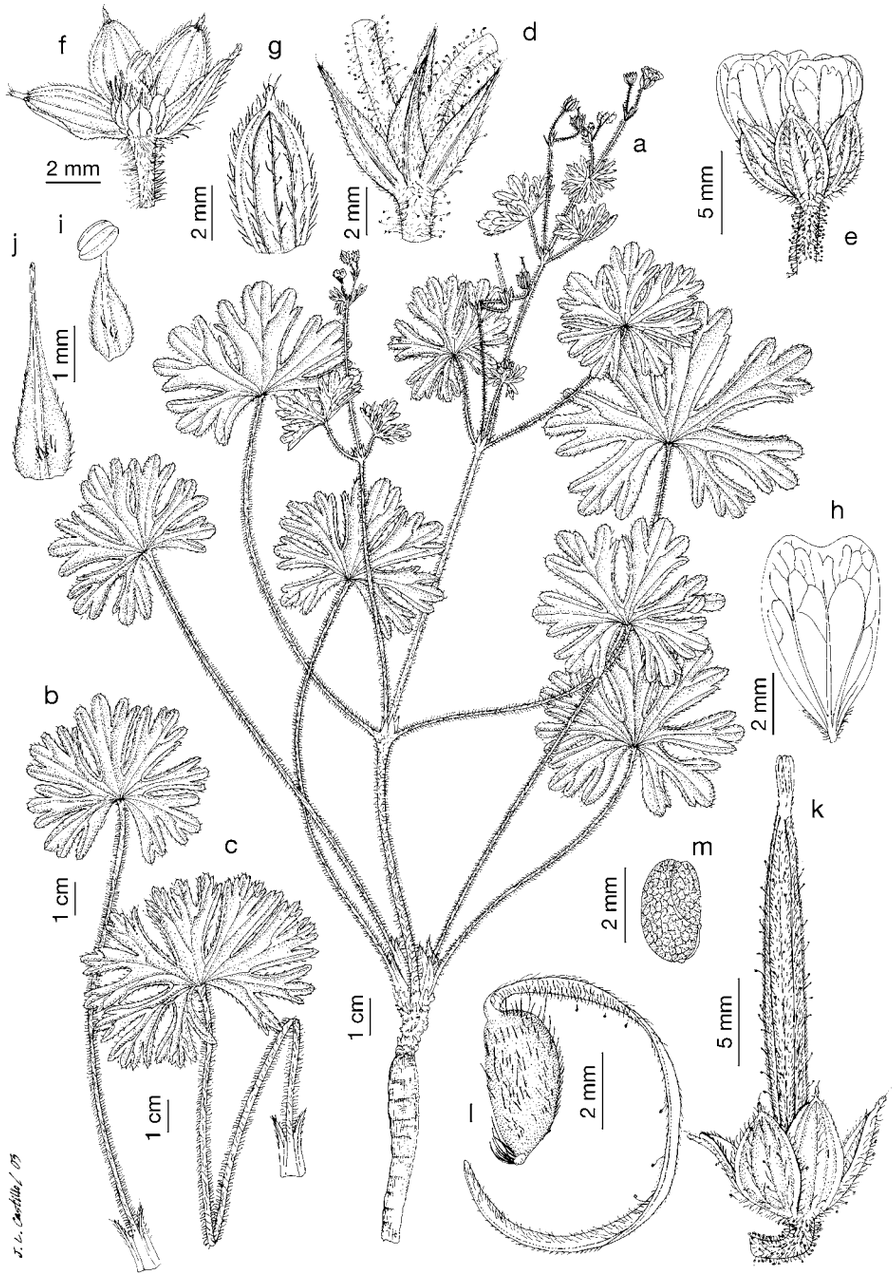


Fig. 284. *Geranium berteroanum*. a. Habit. b, c. Leaves. d. Bracteoles. e. Flower. f. Flower, petals and one sepal removed. g. Sepal. h. Petal. i. Stamen. j. Staminal filament. k. Fruit. l. Mericarp. m. Seed. (Based on: a-e, g-m, *Aedo 7391*, MA; f, *Aedo 6727*, MA).

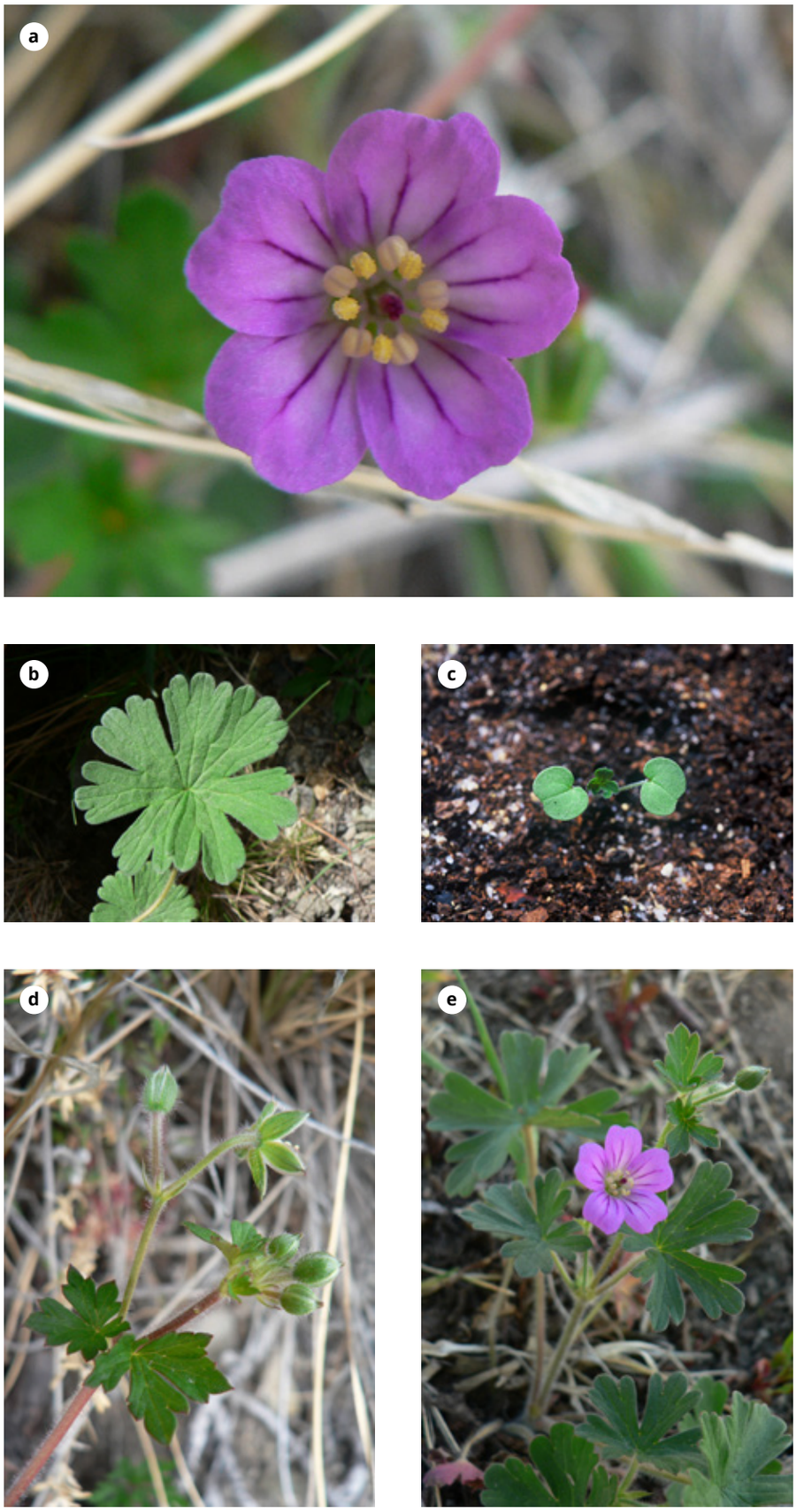


Fig. 285. *Geranium berteroanum* (Based on: a, b,d,e, *Calvo 4297,* MA, photo: J. Calvo; c, *Aedo 7459*, MA).

Feb. 1979, *Pisano & al. 4917* (CONC, GH); Puerto del Hambre, 53°36'S, 70°55'W, 13 Jan. 2002, *Aedo 7391* (MA). Maule: Curicó, Vichucuen, 34°52'S, 72°0'W, Nov. 1961, *Weisser 352* (CONC); Constitución, playa el Cable, 35°21'S, 72°27'W, 14 Dec. 2001, *Aedo 7154* (MA); carretera de Paso Nevado a la laguna de Maule, 35°49'S, 70°49'W, 13 Dec. 2001, *Aedo 7148* (MA). O'Higgins: Rancagua, Hacienda Nevada, 34°10'S, 70°45'W, 12 Nov. 1950, *Gutiérrez 131* (SGO); Hacienda de Cauquenes, cajón del Ciprés, 34°25'S, 70°25'W, 1875, *Philippi s.n.* (M); Colchagua, San Fernando, Termas del Flaco, 34°57'S, 70°26'W, 31 Dec. 1974, *Montero 9701* (CONC). Santiago: Caleu, 33°0'S, 71°0'W, 21 Oct. 1972, *Mahu 10031* (H); Colina, Baños de Colina, 33°11'S, 70°36'W, 8 Nov. 2001, *Aedo 6737* (MA); Lagunillas, 33°58'S, 71°53'W, 16 Sep. 1969, *Mahu 4521* (H). Tierra del Fuego: Bahía Inutil, Estancia Cameron, 53°22'S, 69°16'W, 19 Mar. 1964, *Moore 1064* (SGO); canale di Beagle, islotes les Eclaireurs, 54°52'S, 68°5'W, 24 Jan. 1974, *Lanza 7559* (F); Navarino Is., Puerto Williams, 54°56'S, 67°37'W, 11 Feb. 1959, *Godley 1185* (K, SGO). Valparaíso: Quilpué, Cerro de las Vizcachas, 32°26'S, 70°36'W, 27 Oct. 1973, *Zöllner 7263* (CONC, L); Cerro Campana, 32°58'S, 71°7'W, 21 Nov. 1965, *Solbrig & al. 3607* (GH); Vichuquén, 34°50'S, 72°6'W, Dec. 1861, *Philippi s.n.* (SGO).

Discussion. Geranium berteroanum is a variable and widely distributed species; more than 2800 km separate the northernmost localities in central Chile from the southernmost in Tierra de Fuego. Some specimens have only eglandular hairs while others also have glandular hairs on stems, inflorescences, sepals, the rostrum of fruits, and/or mericarps. Usually

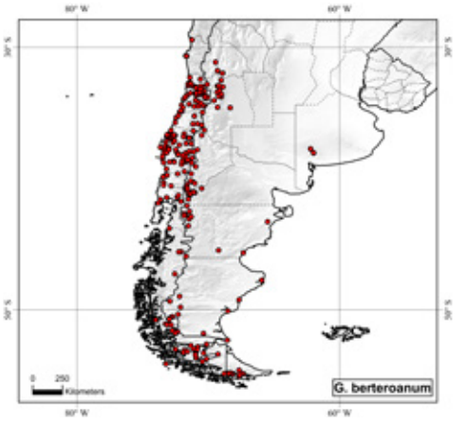


Fig. 286. Distribution of *Geranium berteroanum*.

G. berteroanum can be distinguished from *G. fallax* by its leaves with an obtriangular middle segment (rather than rhombic), and its fruit rostrum without a narrow apex. Yet, plants from central Argentina (provinces of Mendoza, San Juan, San Luis, and Córdoba) are difficult to assign to either *G. berteroanum* or *G. fallax*, especially herbarium specimens. During field work in this region populations were sampled to access variability but did not reveal absolute boundaries. In plants from the southwestern part of Argentina in Mendoza and San Juan a tendency for obtriangular leaves and a short narrow apex on the fruit rostrum is present, whereas plants from northeastern areas of San Luis and Córdoba are more similar to *G. fallax*, although the overlap is considerable. Therefore, some assignments of collections listed under *G. berteroanum* in Aedo & al. (2005a) are here listed as belonging to *G. fallax*: *Stuckert 16629* (CORD), *1708*, *12753* (S); the following collections were cited as *G. fallax* but are here listed as *G. berteroanum*: *Barklay s.n.,* 15 Jan. 1950 (NY), *Guaglianone & al. 1479, 1497* (SI), *Kiesling & Megioli 6680* (SI), *Paci 781* (NY). Admittedly, the key provided in this account may not work very well in this area of contact; perhaps a future, more detailed study will provide a better one.

Geranium skottsbergii, also a species with eglandular and glandular variants, is partially sympatric with *G. berteroanum*, and can be distinguished by its longer petals and more deeply divided leaves. *Geranium solanderi* is endemic to Australia and New Zealand (and occasionally a garden-escape in California, U.SA.), and strongly resembles *G. berteroanum* in its pedicels with patent hairs and many quantitative characters (petal length, sepal mucro length, etc.); however, *G. berteroanum* has longer bracteoles, sepals, and stigmatic remnants than *G. solanderi*.

Geranium submolle was described by Steudel (1856) based on *Bertero 294*, a heterogeneous collection. Most of specimens belong to *G. berteroanum*, but some material of P and G is *G. skottsbergii* and thus excluded from the type material. Gay (1846) recorded *G. pyrenaicum* from Chile and noted that he had only one specimen in his herbarium. Marticorena & Quezada (1985) also listed *G. pyrenaicum* in their check-list for Chile. No new data about this species were provided by Aedo & al. (1998) in their revision of sect. *Batrachioidea*, since no specimen from Chile was available to them. The specimen supporting Gay's report was found at P (Colchagua, Feb. 1831, *Gay s.n.*) and identified as *G. berteroanum*, which refuted the reports of *G. pyrenaicum* in Chile (Aedo 2015). The proposal by Stuessy & Marticorena (1990) to correct the orthography of epithets honouring Bertero is here followed.

107. Geranium limae R. Knuth in Engl., Pflanzenr. IV.129 (Heft 53): 74. 1912. Type locality: "Peru: Lima und St. Lorenz (Gaudichaud a. 1841!)". Type: Peru. Lima, San Lorenzo, 12°05'S, 77°13'W, July 1836, *C. Gaudichaud 4* (lectotype, designated by Aedo & al. 2005a: 38, P-00219771!; isolectotypes, FI-W!, G-00365885!, US-00810869!).

Geranium multiflorum R. Knuth, Bot. Jahrb. Syst. 37: 561. 1906, nom. illeg., non A. Gray, 1854. *Geranium mollendinense* R. Knuth in Engl., Pflanzenr. IV.129 (Heft 53): 580. 1912. Type locality: "Tambo bei Mollendo, auf Felsen in der Loma-Formation zwischen 400-600 m (Weberbauer n. 1579). - Blühend und fruchtend im Oktober". Type: Peru. Arequipa, Tambo, Mollendo, 17°01'S, 72°00'W, *A. Weberbauer 1579* (no original material located).

Perennial herbs, 8-55 cm tall. *Rootstock* 8.7-24.4 mm in diameter, vertical, not tuberculate, turnip-shaped, without thickened roots. *Stem* erect or ascending, leafy, not rooting at nodes, stolons absent, without vegetative stems, with patent to retrorse, not appressed, eglandular hairs 0.5-1.2 mm long. *Basal leaves* in a deciduous rosette, cauline leaves opposite; leaf laminas 1.3-5.5 cm long, 1.7-6.6 cm wide, not peltate, palmatifid [ratio main-sinus length/middle segment length = 0.70-0.80], polygonal in outline, base cordate, not coriaceous, with nerves not projected, pilose, with appressed, eglandular hairs on both surfaces; segments 5(7), in 1 plane, middle segment obtriangular, 3.6-9 mm wide at the base [ratio segment width at the base/middle segment length = (0.20)0.24-0.32(0.42)], 3-11-lobed in distal half [ratio secondary sinus length/middle segment length = (0.14)0.24-0.29(0.34)]; petioles up to 20 cm long, without abscission zone, terete, not swollen, not deflexed in age, with patent to retrorse, appressed, eglandular hairs 0.5-1.4 mm long; stipules 2.5-9 mm long, 0.7-3.4 mm wide, lanceolate, free, papery, brownish red, with eglandular hairs on both surfaces and on the margin. *Inflorescence* a monochasial cyme; cymules 2-flowered, solitary [ratio cymule length/leaf length = 0.4-0.9(2.9)]; peduncles (11)20-37(68) mm long, with patent to retrorse, eglandular hairs 0.4-1.6 mm long; bracteoles 2-5.9 mm long, 0.5-1.9 mm wide, linear-lanceolate, whorled; pedicels 7-22 mm long, with patent to retrorse, eglandular hairs 0.4-1.6 mm long. Flowers actinomorphic. *Sepals* (3.5)4.5-5.5(6.3) mm long, 1.7-4.2 mm wide, lanceolate, smooth, not accrescent, nerves 3, mucro (0.2)0.3-0.4(0.5) mm long [ratio mucro length/sepal length = (0.03)0.05-0.07(0.09)], with erect-patent, eglandular hairs 0.3-1.7 mm long on the abaxial surface, glabrous adaxially. *Petals* (5)5.6-7.5(8.2) mm long, 2-4.6 mm wide, erect-patent, rounded, without claw, purple, glabrous on both surfaces, ciliate on the basal margin, with hairs 0.2-0.5 mm long. *Stamens* 10, both whorls bearing anthers; filaments 2.6-4.9 mm long, lanceolate, yellow, with eglandular hairs 0.1-0.4 mm long on the abaxial surface and margin; anthers 0.4-0.8 mm long, yellow. Nectaries 5, hemispheric, usually with a tuft of hairs at the top, dorsally glabrous. *Gynoecium* 3-5 mm long, pink. *Fruit* 11-21.1 mm long, erect, discharge of seed-ejection type; mericarps 2.7-3.5

mm long, 1.3-2 mm wide, without a strand of fibers, not compressed at the apex, smooth, without basal beak, with a basal callus, without a basal prong, brown, with erect-patent, eglandular hairs 0.4-1.1 mm long; rostrum 7.5-15.4 mm long, without a narrowed apex, not twisted, with erect-patent, eglandular hairs 0.3-1.3 mm long; stigmatic remnants 1.1-1.5(1.8) mm long, with 5 hairy lobes. *Seeds* 1.8-2.5 mm long, 1.1-1.6 mm wide, finely reticulate, uniformly colored, brown, glabrous. Cotyledons with entire margin. Fig. 287.

Pollen. *Geranium*-type (Aedo & al. 2005a: 6).

Chromosome number. Unknown.

Phenology. Collected in flower from January to November.

Distribution. This species ranges through western Peru (Fig. 288).

Habitat. Coastal desert, hillsides with scattered shrubs, on sandy or clayed soils, sometimes in rock crevices; 0-3100 m.

Additional specimens examined. **Peru.** Ancash: Cordillera Negra, pr. Jirac, 9º32'S, 77º43'W, 18 May 2013, *Aedo & Molina 20255* (MA); Recuay, bosque de Noqno, 9º43'S, 77º27'W, 25 May 1988, *Cano 1764* (GH, MO); Santa, lomas de La Chay, 40 km N of Barranca, 10º26'S, 77º57'W, 18 Sep. 1938, *Stork & al. 9207* (GH, UC). Arequipa: Los Cerrilos, W of the Pan. Highway, 52 km S of Nazca (km 500), 15º14'S, 74º57'W, 28 Aug. 1957, *Rahn 162* (C); Camana, ravine N of Atiquipa, 15º47'S, 74º22'W, 20 Sep. 1938, *Worth & Morrison 15665* (GH, UC); lomas de Atiquipa, cerca de Chala, entre Nazca y Chala, 15º48'S, 74º22'W, 20 Oct. 1946, *Ferreyra 1493* (GH, MA, US); lomas de Camaná, 16º37'S, 72º42'W, 10 Nov. 1952, *Ferreyra 8839* (MA); Islay, lomas de Mejia, 17º5'S, 71º54'W, 20 Feb. 1997, *FLSP 261* (NY). La Libertad: Otuzco, Chanchacap-Agallpampa, 7º58'S, 78º34'W, 24 May 1984, *Sagástegui & al. 11679* (C, MO, NY); Cerro Campana, km 565 cerca de Trujillo, 8º0'S, 79º7'W, 18 Aug. 1952, *Ferreyra 8620* (MA); Cerro Campana, 8º0'S, 79º7'W, 18 Oct. 1977, *Sagástegui 9071* (NY). Lambayeque: Chiclayo, Cerro Reque, 6º50'S, 79º46'W, 29 July 1979, *Llatos 497* (NY, GH). Lima: Chancay, 5 km N of Barranca, 10º44'S, 77º46'W, 5 Sep. 1938, *Worth 9117* (G, GH, UC); Huaura, lomas de Lachay, 11º17'S, 77º30'W, 3 Aug. 1996, *Cano & al. 7604* (USM); lomas de Lachay, 11º17'S, 77º30'W, 30 Oct. 1976, *Cerrate 6407* (MA); San Agustín, 11º22'S, 76º45'W, 27 Sep. 1940, *Asplund 13774* (S, G, GH); Chancay, lomas de Doña María, S of Huacho, 11º22'S, 77º26'W, 19 Sep.

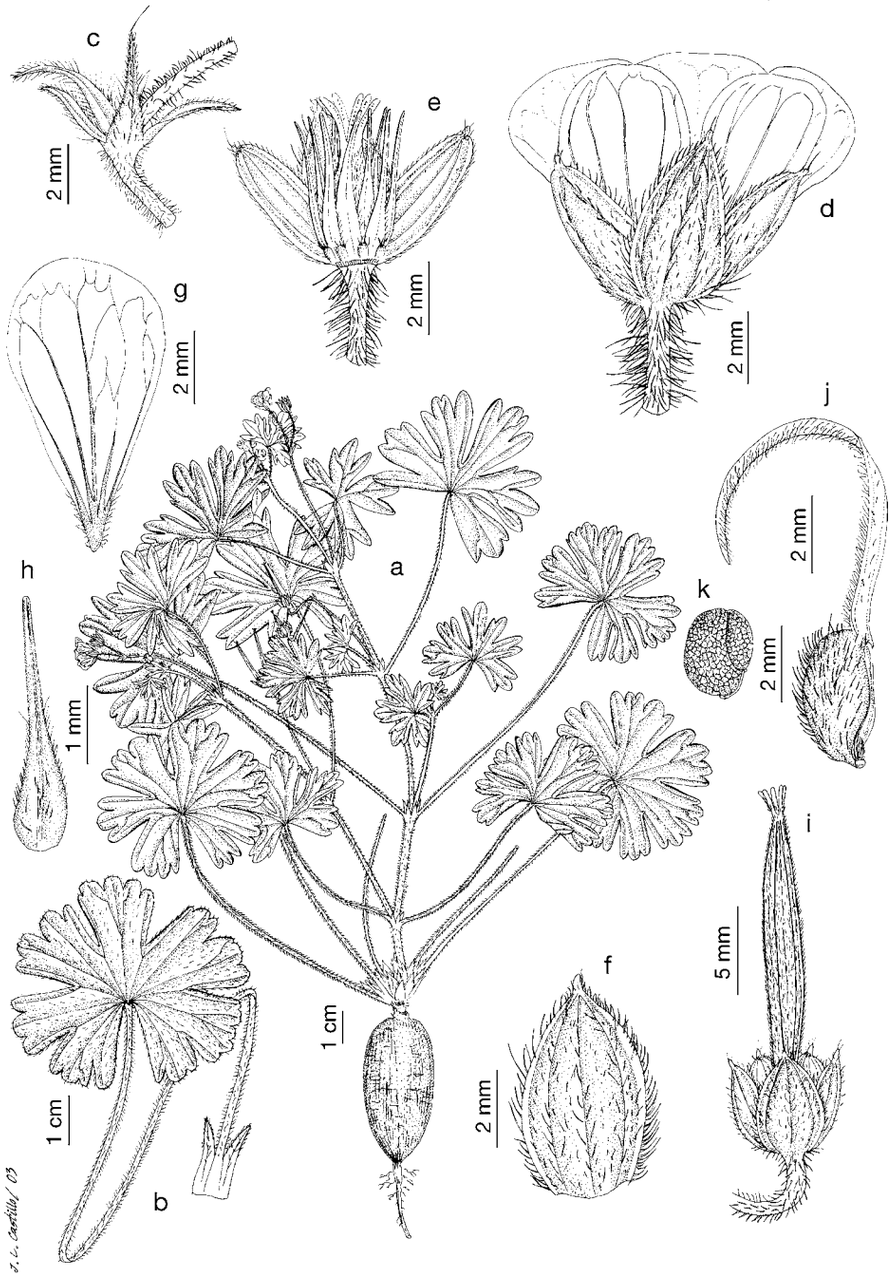


Fig. 287. *Geranium limae*. a. Habit. b. Leaf. c. Bracteoles. d. Flower. e. Flower, two sepals and petals removed. f. Sepal. g. Petal. h. Staminal filament. i. Fruit. j. Mericarp. k. Seed. (Based on: a-c, i-k, *Asplund 13774*, S; d-h, *Ferreyra 2445*, US).

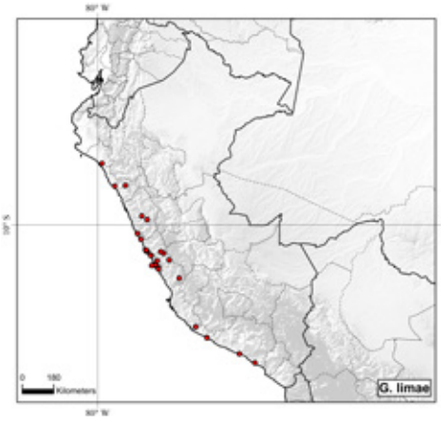


Fig. 288. Distribution of *Geranium limae*.

1938, *Stork & al. 9255* (GH, UC); pr. Canta, 11º27'S, 76º36'W, 25 Mar. 2005, *Aedo & Galán de Mera 10821* (MA); más arriba de Canta, 11º27'S, 76º36'W, Jan. 1963, *Meza 46* (USM); Chancay, 11º33'S, 77º15'W, 24 Sep. 1952, *Ferreyra 8750* (MA); Chancay, Arnedo, 11º34'S, 77º16'W, Oct., *Ruiz & Pavón s.n.* (MA); Huarochiri, Viso, 11º48'S, 76º19'W, 23 Apr. 1939, *Goodspeed & al. 11526* (GH, UC); Mangomarca, 24 km NE de Lima, 11º50'S, 76º56'W, 22 July 1956, *Ferreyra 11797* (MA); Lima, cerros de San Gerónimo, 12º0'S, 77º1'W, 1868, *Wawra 422* (W); Amancaes, 12º1'S, 77º1'W, 23 Sep. 1940, *Asplund 13754* (G, GH, S); lomas de Amancaes, 12º1'S, 77º1'W, 8 Oct. 1955, *Boecher & al. 349* (C, G, GH); lomas S of Lima, 12º3'S, 77º2'W, 31 July 1941, *Grant 7445* (GH); Lima, 12º3'S, 77º2'W, *Nation s.n.* (K); San Lorenzo, 12º5'S, 77º13'W, 1835, *Mathews s.n.* (G, K); Lima, 12º5'S, 77º2'W, *Née s.n.* (MA); isla de San Lorenzo, 12º5'S, 77º13'W, 1838, *Wilkes Exped. s.n.* (US); Atocongo, 12º7'S, 76º56'W, 19 Oct. 1986, *Baldeón 132* (MA); lomas de Atocongo, 12º7'S, 76º56'W, 6 Sep. 2001, *Granda 2450* (MA); 6 km E of Pachacamac, 12º13'S, 76º52'W, 6 Sep. 1953, *Saunders 187* (BM, UC); Atacongo lomas, 32 km S of Lima, 8 km E of Pachacamac ruins, 12º13'S, 76º52'W, 27 Sep. 1938, *Stork & al. 9288* (GH, UC); Lurín, 12º16'S, 76º52'W, 18 Aug. 1953, *Ferreyra 9557* (MA); Yauyos, Cuchapaya, arriba del campo de futbol de Tupe, 12º44'S, 75º48'W, 3 Jan. 1952, *Cerrate 1017* (MA).

Discussion. Geranium limae shares with *G. albicans* and *G. berteroanum* patent hairs on peduncles and pedicels. The differences between *G. limae* and *G. albicans* are indicated under *G. albicans*; their ranges are completely allopatric. *Geranium limae* has shorter sepals with a shorter mucro than *G. berteroanum*, and it also has longer hairs on the rostrum than *G. berteroanum*. The base of the middle segment is wider in *G. limae* than in *G. berteroanum*, and the main sinus of the middle segment is not as deep as in *G. berteroanum*, which gives a less deeply divided appearance to leaves of *G. limae*. The nectaries of *G. limae* usually have a tuft of hairs at the apex but are always glabrous in *G. berteroanum*. Glandular hairs are always absent in *G. limae* but may be present in *G. berteroanum*.

Knuth (1912) noted, erroneously, that Gaudichaud collected the original material of *G. limae* in 1841. Gaudichaud acted as botanist to the *La Bonite* expedition during its circumnavigation of the globe in 1836-1837, and the label of the type specimen clearly states "Juillet 1836." Knuth (1906) based his *Geranium multiflorum* on a Weberbauer collection from southern Peru. Although the holotype is lost, the presence of 2-flowered cymules and patent, eglandular hairs on pedicels noted in the original description indicates *G. multiflorum* is conspecific with *G. limae*.

108. Geranium albicans A. St.-Hil., Fl. Bras. Merid. 1: 83. 1825. Type locality: "Inveni Septembre propè praedium Giribatubà, provinciâ Rio Grande do Sul; et December, propè vicum S. Josephi provinciâ Cisplatinâ". Type: Brazil. Rio Grande do Sul, Giribatubà, 33°41'S, 53°27'W, *A. Saint Hilaire 1897bis* (lectotype, designated by Aedo & al. 2005a: 42, P-00219764!).

Geranium rotundifolium var. *americanum* A. St.-Hil. & Naudin, Ann. Sci. Nat., Bot. ser. 2, 18: 25. 1842, ["americana"]. Type locality: "Prope praedium Giribatuba, prov. Rio Grande do Sul et vicum S. Josephi, rep. dictâ Estado Oriental del Uruguay". Type: Brazil. Rio Grande do Sul, Giribatubà, 33°41'S, 53°27'W, *A. Saint Hilaire 1895* (lectotype, designated by Aedo & al. 2005a: 42, P-00757989!).

Geranium senecioides R. Knuth in Engl., Pflanzenr. IV.129 (Heft 53): 73. 1912, nom. illeg., non Dum. Cours. 1802. *Geranium selloi* Aedo & Muñoz Garm., Kew Bull. 52(3): 726. 1997. Type locality: "Brasilien (Sello n. 3002!, 4022! sub nom. G. albicans)". Type: Brazil. Brasilia meridionalis, *F. Sellow 4022* (lectotype, designated by Aedo & al. 2005a: 43, S-04-394!; isolectotype, LE!).

Perennial herbs, 18-41 cm tall. *Rootstock* 5.9-17.4 mm in diameter, vertical, not tuberculate, turnip-shaped, without thickened roots. *Stem* erect or ascending, leafy, not rooting at nodes, stolons absent, without vegetative stems, with patent, eglandular hairs 1-2.2 mm long. *Basal leaves* in a ± persistent rosette, cauline leaves opposite; leaf laminas 1.6-4.2 cm long, 1.8-5 cm wide, not peltate, palmatifid [ratio main-sinus length/middle segment length = (0.49)0.70-0.78], polygonal in outline, base cordate, not coriaceous, with nerves not projected, pilose on both surfaces, with ± appressed, eglandular hairs; segments 5(7), in 1 plane, middle segment rhombic, 2.1-8 mm wide at the base [ratio segment width at the base/middle segment length = 0.16-0.24(0.29)], 7-12-lobed in distal half [ratio secondary sinus length/middle segment length = (0.25)0.32-0.41]; petioles up to 12 cm long, without abscission zone, terete, not swollen, not deflexed in age, with patent, eglandular hairs 0.9-2.2 mm long; stipules 2-7 mm long, 0.3-1.5 mm wide, lanceolate, free, papery, brownish red, with eglandular hairs on both surfaces and on the margin. *Inflorescence* a monochasial cyme; cymules 2-flowered, solitary [ratio cymule length/leaf length = (0.4)0.9-2.3]; peduncles (3.6)6.5-18(31) mm long, with patent, eglandular hairs 0.7-1.9 mm long; bracteoles 1.6-4.8 mm long, 0.4-1 mm wide, linear-lanceolate, whorled; pedicels 5-36 mm long, with patent, eglandular hairs 0.7-1.9 mm long. Flowers actinomorphic. *Sepals* (4.2)5-5.6(6.5) mm long, 2.3-3.8 mm wide, lanceolate, smooth, not accrescent, nerves 3, mucro 0.2-0.4(0.6) mm long [ratio mucro length/sepal length = (0.03)0.04-0.08(0.11)], with erect-patent, eglandular hairs 0.5-1.5 mm long on the abaxial surface, glabrous adaxially. *Petals* (4)4.5-5.1(6.1) mm long, 1.7-3 mm wide, erect-patent, rounded or slightly emarginate, without claw, purple, sometimes white, glabrous on both surfaces, ciliate on the basal margin, with hairs 0.2-0.3 mm long.

Stamens 10, both whorls bearing anthers; filaments 2-3.8 mm long, lanceolate, yellow, with eglandular hairs 0.2-0.3 mm long on the abaxial surface and margin; anthers 0.4-0.7 mm long, unknown color. Nectaries 5, hemispheric, glabrous. *Gynoecium* 2.5-4.3 mm long, unknown color. *Fruit* 14-18.9 mm long, erect, discharge of seed-ejection type; mericarps 2.5-3.3

mm long, 1.4-1.9 mm wide, without a strand of fibers, not compressed at the apex, smooth, without basal beak, with a basal callus, without a basal prong, brown, with erect-patent, eglandular hairs 0.4-1.4 mm long; rostrum 9.6-14.8 mm long, without a narrowed apex, not twisted, with patent, eglandular hairs 0.4-1.3 mm long; stigmatic remnants 1-1.4(2) mm long, with 5 hairy lobes. *Seeds* 1.2-2.2 mm long, 1-1.4 mm wide, finely reticulate, uniformly colored, brown, glabrous. Cotyledons with entire margin. Fig. 289.

Pollen. *Geranium*-type (Aedo & al. 2005a: 6).

Chromosome number. 2*n* = 28.

Phenology. Collected in flower from September to December.

Distribution. This species ranges from southern Brazil, through Uruguay to northeastern Argentina (Fig. 290).

Habitat. Roadsides, open sandy grounds, rocky places, and grassland; 50-950 m.

Representative specimens examined. **Argentina.** Buenos Aires: Pergamino, 33°45'S, 60°34'W, 18 Sep. 1945, *Burkart 15570* (FI, SI); Pergamino, Urquiza, 33°56'S, 60°22'W, 10 Nov. 1926, *Parodi 7411* (GH, W); Junín, 34°30'S, 61°12'W, 13 Oct. 1929, *Lahitte & Clos 126* (FI); Pellegrini, Salliquedó, Estancia Los Gossos, 36°19'S, 63°0'W, 10 Nov. 1943, *Cabrera 8017* (LP, SI); Cerro Redondo, Olavarria, 36°58'S, 60°10'W, Oct. 1933, *Boffa 42* (LP); Tandil, Cerro de la Azucena, 37°18'S, 59°9'W, 20 Dec. 1959, *Ruiz Leal & Roig 20562* (CORD); Tandil, Alto de Lucero, 37°18'S, 59°9'W, 24 Nov. 1937, *Troncoso 1254* (F, NY, SI); Pigüé, valle Curru-Malal, 37°28'S, 62°5'W, 10 Nov. 1932, *Parodi 10385* (GH); Sierras de Puán, 37°37'S, 62°30'W, 6 Feb. 1901, *Hicken s.n.* (SI); Balcarce, Sierra Balcarce, 37°40'S, 58°40'W, 2 Nov. 1946, *Wall & Sparre s.n.* (S); Balcarce, Sierra Bachicha, 6 km N of the town, 37°46'S, 58°9'W, 2 Nov. 1946, *Wall & Sparre 209* (S); laguna de los Padres, 37°57'S, 57°44'W, Nov. 1913, *Valentini 32* (SI); along road to Balcarce, 10 km N of Mar del Plata, 38°0'S, 57°32'W, 11 Dec. 1938, *Eyerdam & al. 23628* (GH, UC); Tornquist, Sierra de la Ventana, 38°2'S, 62°0'W, 4 Nov. 1941, *Dawson & Núñez 70* (LP); Peralta, Campo La Susana, 38°2'S, 61°40'W, 8 Nov. 1944, *Huidobro 1162* (GH, NY); Tornquist, Sierra de la Ventana, Abra de la Ventana, 38°2'S, 62°0'W, 27 Nov. 1978,

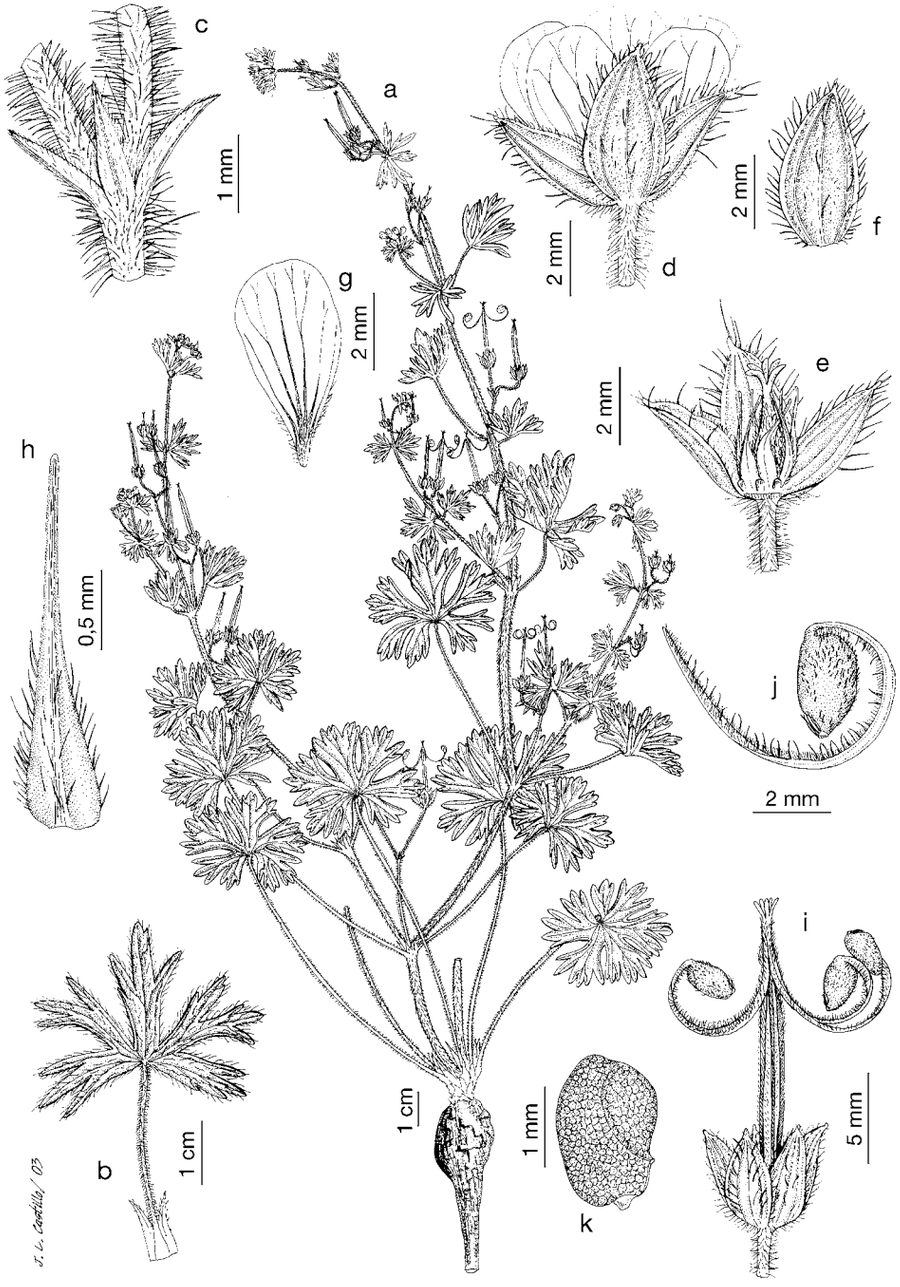


Fig. 289. *Geranium albicans*. a. Habit. b. Leaf. c. Bracteoles. d. Flower. e. Flower, two sepals and petals removed. f. Sepal. g. Petal. h. Staminal filament. i. Fruit. j. Mericarp. k. Seed. (Based on: a-c, i-k, *Wall & Sparre 209*, S; d-h, *Pedersen 4756*, C).

Fig. 290. Distribution of *Geranium albicans*.

proyecto Ventania 2731 (LP); Tornquist, Sierra de la Ventana, Estancia Cerros Colorados, 38º2'S, 62º0'W, 29 Nov. 1979, *proyecto Ventania 913* (LP); Tornquist, Estancia Funke, Cerro Fundación Funke, detrás de la represa, 38º4'S, 62º2'W, 26 Nov. 1978, *proyecto Ventania 247* (LP); Patagones, isla del Jabalí, Rincón del Banco, 40º35'S, 62º12'W, 24 Dec. 1981, *Pedersen 13203* (C, CORD, NY). Córdoba: Ciudad de América, 32º43'S, 63º27'W, 28 Oct. 1974, *Tirel 273* (G); Río Cuarto, 33º8'S, 64º21'W, 10 Dec. 1908, *Stuckert 19428* (CORD). Entre Ríos: Concordia, Salto Grande, 31º13'S, 57º56'W, 12 Oct. 1968, *Cabrera & Sagástegui 19274* (LP); Concordia, arroyo Ayui, 31º16'S, 57º57'W, 23 Sep. 1977, *Troncoso & al. 2090* (NY); Villaguay, Jubileo, 31º44'S, 58º37'W, 24 Oct. 1961, *Pedersen 6313* (C, GH, L, US); Uruguay, Caseros, 32º28'S, 58º29'W, 18 Dec. 1957, *Pedersen 4756* (C); Gualeguay, Estancia San Ambrosio, 33º10'S, 59º14'W, 21 Oct. 1949, *Burkart 18089* (CTES, P). La Pampa: Chapaleufu, 35º12'S, 63º32'W, 30 Nov. 1983, *Steibel & Troiani 7716* (CORD). Río Negro: San Antonio, extremo N de Sierra Grande, frente a Pueblo Viejo, 41º35'S, 65º22'W, 21 Oct. 1979, *Correa & al. 7111* (UC). Santa Fé: Arroyo Frias, 32º57'S, 60º40'W, 15 Jan. 1949, *Morello 4027* (SI). **Brazil.** Rio Grande do Sul: near Caçapava do Sul, 30º30'S, 53º30'W, 9 Nov. 1977, *Pedersen 11965* (C, GH, L); 4 km E de Piratini, 31º27'S, 53º5'W, 11 Oct. 1972, *Lindeman & al. 20673* (CTES, U); Quinta, pr. Rio Grande, 32º4'S, 52º16'W, 8 Nov. 1901, *Malme 269* (S). Santa Catarina: 9 km N de Cruzeiro, 26 km NE de São Joaquim, 28º9'S, 49º45'W, 25 Dec. 1982, *Krapovickas & Schinini 38296* (CTES). **Uruguay.** Cerro Largo: Cerro Largo, Río Negro, Palleros, 32º5'S, 54º52'W, Dec. 1937, *Gallinal & al. 1343* (F); Colonia: Colonia, 34º28'S, 57º50'W, Jan. 1909, *James s.n.* (CAS). Florida: Timote, Santa Clara, 33º39'S, 55º47'W, 8 Oct. 1943, *Gallinal & al. 5290* (MA, MO, U, US). Lavalleja: Estancia Pororó, 34º10'S, 54º54'W, 2 Dec. 1955, *Pedersen 3588* (C); Minas, Cerro Arequita, 34º15'S, 55º16'W, 11 Oct. 1970, *Krapovickas & Cristóbal 16197* (CTES). Maldonado: ruta 12, entre Pan de Azucar y Minas, 34º47'S, 55º14'W, 12 Oct. 1963, *Arrillaga & al. 1616* (F). Montevideo: Montevideo, 34º50'S, 56º10'W, 1826, *Anderson 49* (BM, W); cerro de Montevideo, 34º50'S, 56º10'W, 7 Nov. 1869, *Fruchard s.n.* (P); Montevideo, Cerro Melones, 34º50'S, 56º10'W, 20 Nov. 1876, *Fruchard s.n.* (P). Soriano: Juan Jackson, Monzón-Heber, 33º55'S, 57º12'W, Oct. 1943, *Gallinal & al. 5354* (MA, NY); Juan Jackson, Monzón-Heber, 33º55'S, 57º12'W, Nov. 1943, *Gallinal & al. 782* (F). Tacuarembó: Tacuarembó, 31º44'S, 55º59'W, Nov. 1899, *Pintos s.n.* (CORD).

Discussion. Geranium albicans is characterized by its peduncles and pedicels with eglandular patent hairs, short petals, and a short sepal mucro. The leaves are densely hairy, and the main leaf segment is rhombic in outline. *Geranium albicans* is sometimes confused with eglandular forms of *G. berteroanum*, which has longer petals and obtriangular main leaf segments, as well as a longer sepal mucro and shorter hairs on peduncles and pedicels. *Geranium corecore*, a sympatric species, has shorter hairs on the stems, relatively wider sepals, and retrorse-appressed hairs on pedicels.

109. Geranium magellanicum Hook. f., Fl. Antarct. 2: 251. 1845. Type locality: "Hab. Strait of Magalhaens, Elisabeth Island; C. Darwin, Esq.". Type: Chile. Strait of Magalhaens, Elisabeth Island, 52°52'S, 70°43'W, *C. Darwin s.n.* (lectotype, designated by Porter 1999: 196, K!).

Perennial herbs, 8-34 cm tall. *Rootstock* 5.9-14.1 mm in diameter, vertical, not tuberculate, turnip-shaped, without thickened roots. *Stem* ascending, leafy, not rooting at nodes, stolons absent, without vegetative stems, with patent to retrorse, appressed, eglandular hairs 0.3-1.4 mm long. *Basal leaves* in a ± persistent rosette, cauline leaves opposite; leaf laminas 1.1-4.3 cm long, 1.3-4.4 cm wide, not peltate, palmatifid [ratio main-sinus length/middle segment length = (0.51)0.76-0.86], polygonal in outline, base cordate, not coriaceous, with nerves not projected, pilose, with appressed, eglandular hairs on both surfaces; segments 5(7), in 1 plane, middle segment obtriangular, 1.9-5.2 mm wide at the base [ratio segment width at the base/middle segment length = (0.10)0.17-0.23(0.28)], 3-9-lobed in distal half [ratio secondary sinus length/middle segment length = (0.17)0.25-0.34(0.45)]; petioles up to 14 cm long, without abscission zone, terete, not swollen, not deflexed in age, with patent to retrorse, appressed, eglandular hairs 0.4-1.4 mm long; stipules 3.6-10.5 mm long, 0.9-3 mm wide, lanceolate, free, papery, brownish red, with eglandular hairs on both surfaces and on the margin. *Inflorescence* a monochasial cyme; cymules (1)2-flowered, solitary (cymules of the basal part of the stem usually 1-flowered, a part of them arise directly from the rootstock, and cymules of the upper part 2-flowered) [ratio cymule length/leaf length = (0.4)1-2.5]; peduncles (13)28-40(69) mm long, with patent to retrorse, appressed, eglandular hairs 0.5-1.2 mm long; bracteoles 3.1-7.2 mm long, 0.6-1.8 mm wide, linear-lanceolate, whorled; pedicels 5.4-48.9 mm long, with patent to retrorse, appressed, eglandular hairs 0.5-1.2 mm long. Flowers actinomorphic. *Sepals* 4.7-6(6.5) mm long, 1.9-3.4 mm wide, lanceolate, smooth, not accrescent, nerves 3, mucro (0.2)0.4-0.5(1) mm long [ratio mucro length/sepal length = (0.03)0.07-0.10(0.16)], with erect-patent, eglandular hairs 0.4-1.9 mm long (usually the longest on the margin) on the abaxial surface, glabrous adaxially. *Petals* (3.9)6.2-8(11.7) mm long, 2-5.4 mm wide, erect-patent, rounded, without claw, purple, glabrous on both surfaces, ciliate on the basal margin, with hairs 0.2-0.6 mm long. *Stamens* 10, both whorls bearing anthers; filaments 2.2-4.3 mm long, lanceolate, white to yellow, with eglandular hairs 0.2-0.5 mm long on the abaxial surface and margin; anthers 0.4-1 mm long, yellow. Nectaries 5, hemispheric, glabrous. *Gynoecium* 2.9-5 mm long, pink. *Fruit* 15.3-22.2 mm long, erect, discharge of seed-ejection type; mericarps 3-4 mm long, 1.4-2.1 mm wide, without a strand of fibers, not compressed at the apex, smooth, without basal beak, with a basal callus, without a basal prong, brown, with erect-patent, eglandular hairs 0.4-1.3 mm long; rostrum 10.4-16.5 mm long, without a narrowed apex,

not twisted, with erect-patent, eglandular hairs 0.2-0.7 mm long; stigmatic remnants (1)1.3-1.7(2.1) mm long, with 5 hairy lobes. *Seeds* 2-2.6 mm long, 1.2-1.8 mm wide, finely reticulate, uniformly colored, brown, glabrous. Cotyledons with entire margin. Figs. 291, 292.

Pollen. *Geranium*-type (Aedo & al. 2005a: 6; Bortenschlager 1967: 425).

Chromosome number. 2*n* = 112.

Phenology. Collected in flower from November to April.

Distribution. This species ranges from central Chile and Argentina to Patagonia (Fig. 293).

Habitat. Cultivated fields, bogs with *Acaena* L. or *Gunnera* L., open grassy slopes, and *Nothofagus* Blume and *Araucaria* Juss. forests; 0-1200 m.

Representative specimens examined. **Argentina.** Chubut: territorio del Chubut, 44°24'S, 71°22'W, 28 Jan. 1902, *Hoegberg s.n.* (S); Valle de la Laguna Blanca, 45°52'S, 71°15'W, 12 Jan. 1902, *Koslowsky 71* (BM, CORD, K, Z); río Senguerr, alrededores del Lago Blanco, 45°54'S, 71°15'W, 1903, *Koslowsky 12445* (CTES); Río Negro: San Carlos de Bariloche, 41°9'S, 71°18'W, 20 Feb. 1905, *Buchtien 1332* (GH). Santa Cruz: Patagonia, río Shonon, 31 Jan. 1903, *Dusén s.n.* (H); Lago Argentino, ruta nacional 40, 18 km NW del ACA Tres Lagos, orillas río Shehuen, 49°37'S, 71°30'W, 10 Feb. 1975, *Boelcke & al. 16271* (UC); S shores of lake Argentino, 50°18'S, 72°23'W, 1907, *Furlong 89c* (US, GH); Güer-Aike, río Turbio, 51°36'S, 72°17'W, 16 Feb. 1993, *Roig & al. 14738* (MERL); río Gallegos, Cerro Los Conventos, 51°54'S, 69°21'W, 14 Apr. 1950, *Sleumer 971* (G, LIL). Tierra del Fuego: río Trucha, 22 Feb. 1953, *Ruiz Leal s.n.* (MERL); Estancia Cullen, arroyo Beta, 52°44'S, 68°33'W, 5 Jan. 1972, *Moore &*

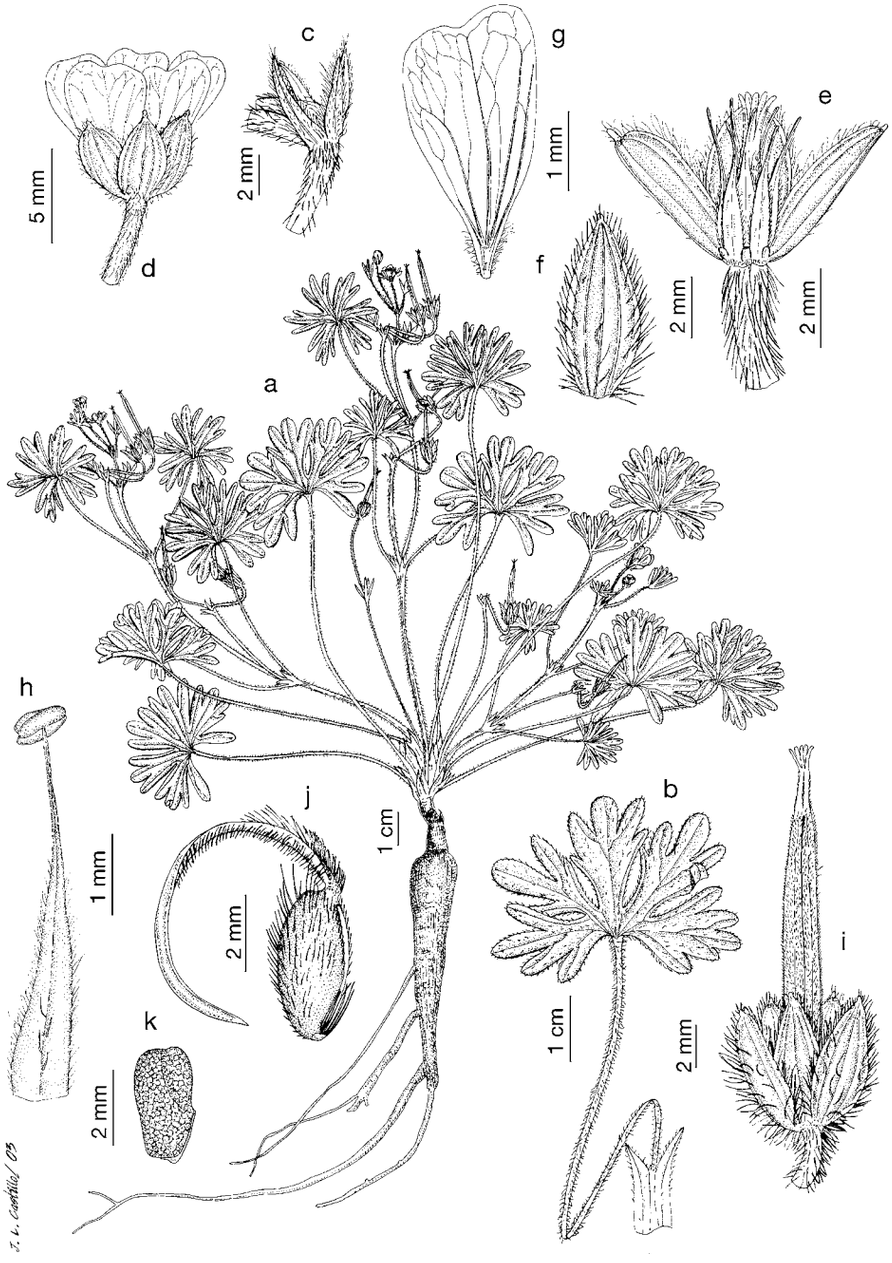


Fig. 291. *Geranium magellanicum*. a. Habit. b. Leaf. c. Bracteoles. d. Flower. e. Flower, two sepals and petals removed. f. Sepal. g. Petal. h. Stamen. i. Fruit. j. Mericarp. k. Seed. (Based on: *Hoegberg s.n.*, *28 Jan. 1902*, S).

Fig. 292. *Geranium magellanicum* (Based on: *Aedo 7445,* MA).

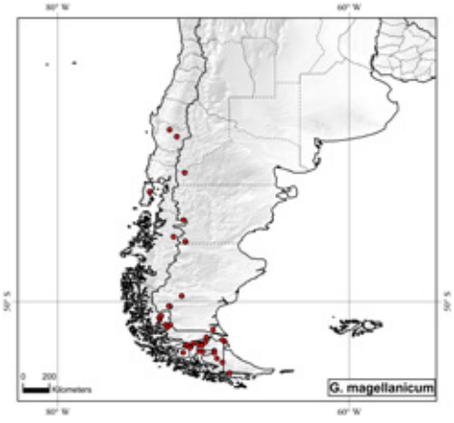


Fig. 293. Distribution of *Geranium magellanicum*.

Goodall 347 (C, SI); Ushuaia, camino de Fique, 54º54'S, 68º13'W, 31 Jan. 1962 (SI). **Chile.** Aisén: cerca río Coyhaique, 45º33'S, 72º4'W, 11 Feb. 1974, *Navas s.n.* (CONC). La Araucanía: Cautín, Victoria, along the road to the Termas, 400 m from hotel Tolhuaca, 38º13'S, 72º20'W, 14 Mar. 1939, *Morrison & Wagenknecht 17516* (BH, G, GH, MO, S, UC); volcán Llaima, estación de esquí Las Araucarias, 38º41'S, 71º50'W, 22 Dec. 2001, *Aedo 7224* (CONC, MA). Los Lagos: Quilquico, 42º28'S, 73º42'W, 15 Dec. 1944, *Acevedo s.n.* (SGO). Magallanes: Torres del Paine, adjacent to Refugio Chileno, 50º58'S, 72º54'W, 8 Dec. 1999, *Gardner & Knees 6188* (E); Puerto Natales, Parque Nacional Torres del Paine, hostería Pehoe, 51º6'S, 73º4'W, 4 Nov. 1990, *Rico 7242* (MA); Parque Nacional Torres del Paine, río Grey, 51º14'S, 73º0'W, 7 Jan. 1988, *Dollenz 1432* (CONC); pr. Puerto Natales, 51º35'S, 72º36'W, 19 Jan. 2002, *Aedo 7471* (CONC , MA); Elisabeth Is., 52º52'S, 70º43'W, *Thomson s.n.* (E); Punta Arenas, río de las Minas, 52º57'S, 71º8'W, 2 Jan. 1952, *Barrientos s.n.* (CONC); Patagonia, isla Contramaestre, 52º57'S, 70º21'W, 17 Dec. 1970, *Pisano 2907* (CONC, MO); Punta Arenas, Tres Brazos, 52º57'S, 71º8'W, Jan. 1960, *Saa s.n.* (CONC); frente a Estancia Río Grande, a 2 km de la playa, 53º2'S, 71º15'W, 28 Nov. 1973, *Dollenz 84* (CONC, GH); Río Seco, en la playa, 53º4'S, 70º52'W, 29 Jan. 1964, Álvarez *50* (CONC); río Tres Paragos al S of Punta Arenas, 53º9'S, 70º57'W, 1 Mar. 1917, *Bonarelli s.n.* (SI); 15 km S of Punta Arenas, 53º9'S, 70º54'W, 6 Jan. 1939, *Eyerdam & al. 24140* (UC, GH); Sandy Point, 53º10'S, 70º56'W, 16 Mar. 1872, *Blake s.n.* (GH); península de Brunswick, camino del Club Andino, 53º30'S, 71º24'W, 8 Jan. 1980, *Dollenz 635* (GH). Tierra del Fuego: bahía de San Gregorio, 52º27'S, 69º48'W, 17 Jan. 2002, *Aedo 7449* (CONC, MA); Santa Catalina, 52º37'S, 68º43'W, 30 Jan. 1962, *Ricardi & Matthei 269* (CONC); Estancia Las Rosas-Bahía Felipe, 52º47'S, 69º53'W, 26 Jan. 1952, *Pfister s.n.* (CONC); Gente Grande, 52º57'S, 70º13'W, 19 Nov. 1928, *Roivainen s.n.* (H); pr. Porvenir, puente Barguetto, 53º0'S, 70º7'W, 17 Jan. 2002, *Aedo 7445* (MA); Bahia Inutil, 53º22'S, 69º16'W, 2 Jan. 1977, *Siebert 210* (M); río Santa María a 60 km, camino S, 53º24'S, 70º18'W, 10 Feb. 1972, *Pisano 3540* (CONC, GH); c 32 km S of Porvenir on road to Caleta Josefina (Onaisín), near Bahía Inutil, 53º26'S, 70º4'W, 2 Dec. 1971, *Moore & Goodall 51* (H, K); río Hondo, 53º31'S, 69º16'W, 10 Feb. 1970, *Pisano 2425* (CONC); Barrancas del Carmen Sylva, 53º54'S, 69º5'W, 5 Feb. 1896, *Dusén 455* (LD, S, UPS); sector Vicuña, lote 12, Forestal Trillium, 54º10'S, 68º42'W, 6 Jan. 1995, *Pisano & al. 7361* (CONC).

Discussion. Geranium magellanicum is easily recognized by its ascending habit and by its unusual inflorescence arrangement. The cymules at the basal part of the stem are usually 1-flowered, and some of them arise directly from the rootstock. The cymules are 2-flowered on the middle and distal portions of the stems. This inflorescence structure suggests that *G. magellanicum* may be allied with *G. sessiliflorum*; however, that species never has 2- flowered cymules. Additionally, *G. magellanicum* has longer fruits and rostra, peduncles, and pedicels than are found in *G. sessiliflorum*; the hairs composing the pedicel indumentum are also longer. The indumentum of *G. magellanicum* on stems, petioles, peduncles, and pedicels varies from patent to retrorse-appressed, but no specimens with glandular hairs were seen. Moore (1983) listed *G. patagonicum* as a synonym of *G. magellanicum*, and thus noted that *G. magellanicum* can have glandular hairs. Barboza & Correa (1988) and Barboza (1996) excluded glandular specimens from *G. magellanicum*, as is done here. *Geranium berteroanum* (including *G. patagonicum*) can be easily differentiated from *G. magellanicum* by its erect to ascending stems with only 2-flowered cymules and by the longer sepal mucro. Barboza (1996) recognized *G. magellanicum* var. *pumilum*, which is here included in *G. parodii*; see that species.

110. Geranium skottsbergii R. Knuth, Repert. Spec. Nov. Regni Veg. 34: 143. 1933. Type locality: "Chile: Prov. Coquimbo (Skottsberg a. 1917 n. 752 -- Typus in herb. Berol.!)". TYPE. Chile. Coquimbo, Fray Jorge, 30°40'S, 71°37'W, 13 Aug. 1917, *C. Skottsberg 752* (holotype, B destroyed; lectotype, designated by Aedo 2012: 384: S-R-2401!; isolectotype, GB-0047718 image!).

Geranium ciliatum Phil., Anales Univ. Chile 82: 727. 1893, nom. illeg., non Cav. 1787. *Geranium berteroanum* var. *ciliatum* Phil. ex Reiche, Anales Univ. Chile 93: 578. 1895. *Geranium philippii* J.F. Macbr., Candollea 6: 7. 1934. Type locality: "Frequens in collibus apricis provinciarum Santiago, Aconcagua, O'Higgins". Type: Chile. Santiago, 33°27'S, 70°40'W, 1856, *F. Philippi s.n.* (lectotype, designated by Aedo & al. 2005a: 45, MA-617453!; isolectotypes, K!, W!).

Perennial herbs, 33-70 cm tall. *Rootstock* 7-17 mm in diameter, vertical, not tuberculate, turnip-shaped, without thickened roots. *Stem* erect or ascending, leafy, not rooting at nodes, stolons absent, without vegetative stems, with patent to retrorse, appressed, eglandular hairs 0.3-1.7 mm long, and, sometimes, patent, glandular hairs 0.3-1.2 mm long. *Basal leaves* in a ± deciduous rosette, cauline leaves opposite; leaf laminas 2.5-7.7 cm long, 2.7-8.2 cm wide, not peltate, palmatifid [ratio main-sinus length/middle segment length = (0.71)0.83-0.90], polygonal in outline, base cordate, not coriaceous, with nerves not projected, pilose, with appressed, eglandular hairs on both surfaces; segments 5-7, in 1 plane, middle segment obtriangular, 2.4-7.9 mm wide at the base [ratio segment width at the base/middle segment length = (0.06)0.10-0.19(0.28)], 3-10-lobed in distal half [ratio secondary sinus length/middle segment length = (0.25)0.40-0.53(0.62)]; petioles up to 38 cm long, without abscission zone, terete, not swollen, not deflexed in age, with patent to retrorse, appressed, eglandular hairs 0.4-2 mm long and, sometimes, patent, glandular hairs 0.3-1.2 mm long; stipules 3.6-9 mm long, 0.6-2 mm wide, lanceolate, free, papery, brownish red, with eglandular hairs on both surfaces and on the margin. *Inflorescence* a monochasial cyme; cymules 2-flowered, solitary [ratio cymule length/leaf length = (0.7)1-2.4]; peduncles (7)18-40(55) mm long, with patent to retrorse, appressed, eglandular hairs 0.4-1.5 mm long and, sometimes, patent, glandular hairs 0.3-1.4 mm long; bracteoles 2.3-6.1 mm long, 0.5-1.1 mm wide, linear-lanceolate, whorled; pedicels 10-31 mm long, with patent to retrorse, appressed, eglandular hairs 0.4-1.5 mm long and, sometimes, patent, glandular hairs 0.3-1.4

mm long. Flowers actinomorphic. *Sepals* 5-6(8) mm long, 2.1-3.8 mm wide, lanceolate, smooth, not accrescent, nerves 3, mucro (0.4)0.7-0.9(1.2) mm long [ratio mucro length/sepal length = (0.08)0.11-0.16(0.22)], with erect-patent, eglandular hairs 1.1-2.2 mm long (usually the longest on the margin) and, sometimes, patent, glandular hairs 0.3-1.4 mm long on the abaxial surface, glabrous adaxially. *Petals* (7)7.9-10.2(14) mm long, 4-7.2 mm wide, erect-patent, rounded or slightly emarginate, without claw, purple, glabrous on both surfaces, ciliate on the basal margin, with hairs 0.2-0.7 mm long. *Stamens* 10, both whorls bearing anthers; filaments 3.1-4.5 mm long, lanceolate, white to yellow, with eglandular hairs 0.2-0.4 mm long on the abaxial surface and margin; anthers 0.4-1.1 mm long, yellow or purple. Nectaries 5, hemispheric, glabrous. *Gynoecium* 3-7 mm long, white to pink. *Fruit* 15.3-20.1 mm long, erect, discharge of seed-ejection type; mericarps 2.5-3.3 mm long, 1.3-2 mm wide, without a strand of fibers, not compressed at the apex, smooth, without basal beak, with a basal callus, without a basal prong, brown, with erect-patent, eglandular hairs 0.3-1.2 mm long; rostrum 10.4-15.3 mm long, without a narrowed apex, not twisted, with erect-patent, eglandular hairs 0.3-1.5 mm long and, sometimes, patent, glandular hairs 0.2-1.3 mm long; stigmatic remnants 1-1.6(2.3) mm long, with 5 hairy lobes. *Seeds* 1.7-2.5 mm long, 1.1-2 mm wide, finely reticulate, uniformly colored, brown, glabrous. Cotyledons with entire margin. Figs. 294, 295.

Pollen. *Geranium*-type (Aedo & al. 2005a: 6).

Chromosome number. 2*n* = c. 39, 52.

Phenology. Collected in flower from January to December.

Distribution. This species ranges through central Chile (Fig. 296).

Habitat. Dunes, dry grassy slopes, shrublands, and *Peumus* Molina forests; 0-1300 m.

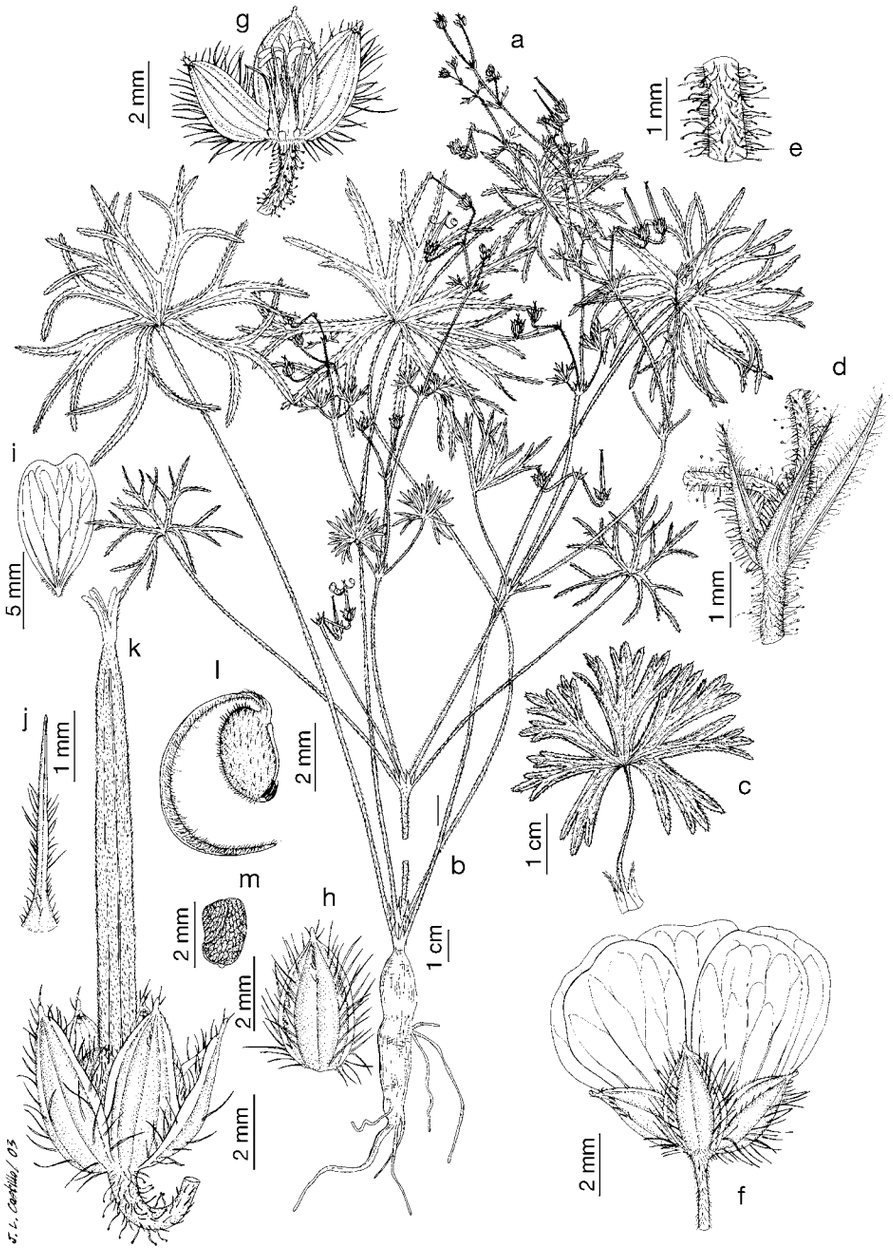


Fig. 294. *Geranium skottsbergii*. a, b. Habit. c. Leaf. d. Bracteoles. e. Peduncle. f. Flower. g. Flower, two sepals and petals removed. h. Sepal. i. Petal. j. Staminal filament. k. Fruit. l. Mericarp. m. Seed. (Based on: a, f, h-j, l, m, *Aedo 6807*, MA; b, *Aedo 6832*, MA; c-e, g, k, *Aedo 6839*, MA).

Representative specimens examined. **Chile.** Aisén: Chile australis, Los Sauces, 8 Aug. 1896, *Dusén 319* (S); Coquimbo: Guayacán, 29°58'S, 71°22'W, Dec. 1951, *Silva s.n.* (CONC); Limarí, Parque Nacional Fray Jorge, Quebrada El Mineral, 30°40'S, 71°38'W, 9 Aug. 1948, *Jiles 682* (CONC). Coquimbo: Illapel, 31°37'S, 71°9'W, 1893, *Geisse s.n.* (SGO); Cuesta de Cavilolén, 31°45'S, 71°19'W, 11 Nov. 2001, *Aedo 6838* (MA); Pichidangui, 32°9'S, 71°30'W, 11 Nov. 2001, *Aedo 6832* (MA). La Araucanía: Purén, 38°1'S, 73°5'W, 1 Nov. 1945, *Montero 4679* (CONC); Traiguén, 38°15'S, 72°40'W, 2 Nov. 1952, *Salazar s.n.* (CONC); Cautín, Temuco, 38°44'S, 72°36'W, Dec. 1946, *Gunckel 36602* (CONC); Cautín, Cunco, 38°55'S, 72°2'W, Jan. 1931, *Barros 24699* (CONC). Maule: Constitución, 35°20'S, 72°25'W, Sep. 1958, *Barnier 286* (CONC); Zarral, Linares, Villanueva, Cerro Alto de [?]alihoro, 35°51'S, 71°36'W, 12 Oct. 1955, *Aravena 16* (CONC); Baños de Cauquenes, 35°58'S, 72°21'W,

1875, *Dessauer s.n.* (M). O'Higgins: San Fernando, Centinela, 34º20'S, 71º28'W, Oct. 1929, *Montero 1599* (CONC); montis La Leona, Rancagua, 34º30'S, 71º4'W, May, *Bertero 294* (P); San Fernando, Cerro Echaurrina, 34º32'S, 71º1'W, 14 Sep. 1921, *Montero 1586* (CONC). Santiago: Santiago, 32º36'S, 71º1'W, 8 Nov. 1918, *Claude Joseph (brother) 201* (US); Termas de Colina, quebrada de la Cocina, 33º11'S, 70º35'W, 22 Sep. 1971, *Mahu 10027* (H); Cerro de Renca, Santiago, 33º24'S, 70º45'W, Sep. 1878, *Philippi s.n.* (SGO); San José de Maipo, 33º38'S, 70º22'W, Sep. 1953, *Gunckel 38542* (CONC); Melipilla, 33º42'S, 71º13'W, *Philippi s.n.* (W); laguna de Aculeo, lado N, 33º51'S, 70º55'W, 18 Sep. 1960, *Mahu 270* (H).Valparaíso: Pichidangui, Cerro Santa Inés, 32º8'S, 71º32'W, 27 Oct. 1981, *Meza & Villagrán 979* (SGO); 3 km al S de Papudo, 32º31'S, 71º28'W, 10 Nov. 2001, *Aedo 6819* (MA); Catapilco, 32º33'S, 71º16'W, Sep. 1865, *Philippi s.n.* (SGO); embalse de los Aromos, 32º56'S, 71º20'W, 10 Nov. 2001, *Aedo 6807* (MA); Parque Nacional La Campana, pr. El Granizo, 32º58'S, 71º7'W, 9 Nov. 2001, *Aedo 6772* (MA); Marga, 40 km al E de Valparaíso, 33º1'S, 71º33'W, Sep. 1911, *Jaffuel 869* (GH).

Discussion. Geranium skottsbergii is easily recognized by its deeply divided leaves with narrow lobes and relatively long petals. Some specimens have only eglandular hairs on stems, petioles, and pedicels; these hairs are sometimes retrorse and appressed, sometimes more or less patent. Some specimens have particularly long hairs on the sepal margin. Plants with glandular and eglandular hairs occur over the entire range of this species. *Geranium skottsbergii* is endemic to central Chile, where it could be confused with *G. berteroanum*, which has shorter petals and less divided leaves. *Geranium corecore*, which is also present in this region, has less divided leaves than *G. skottsbergii*, stems with shorter hairs, a shorter gynoecium, and relatively wider sepals.

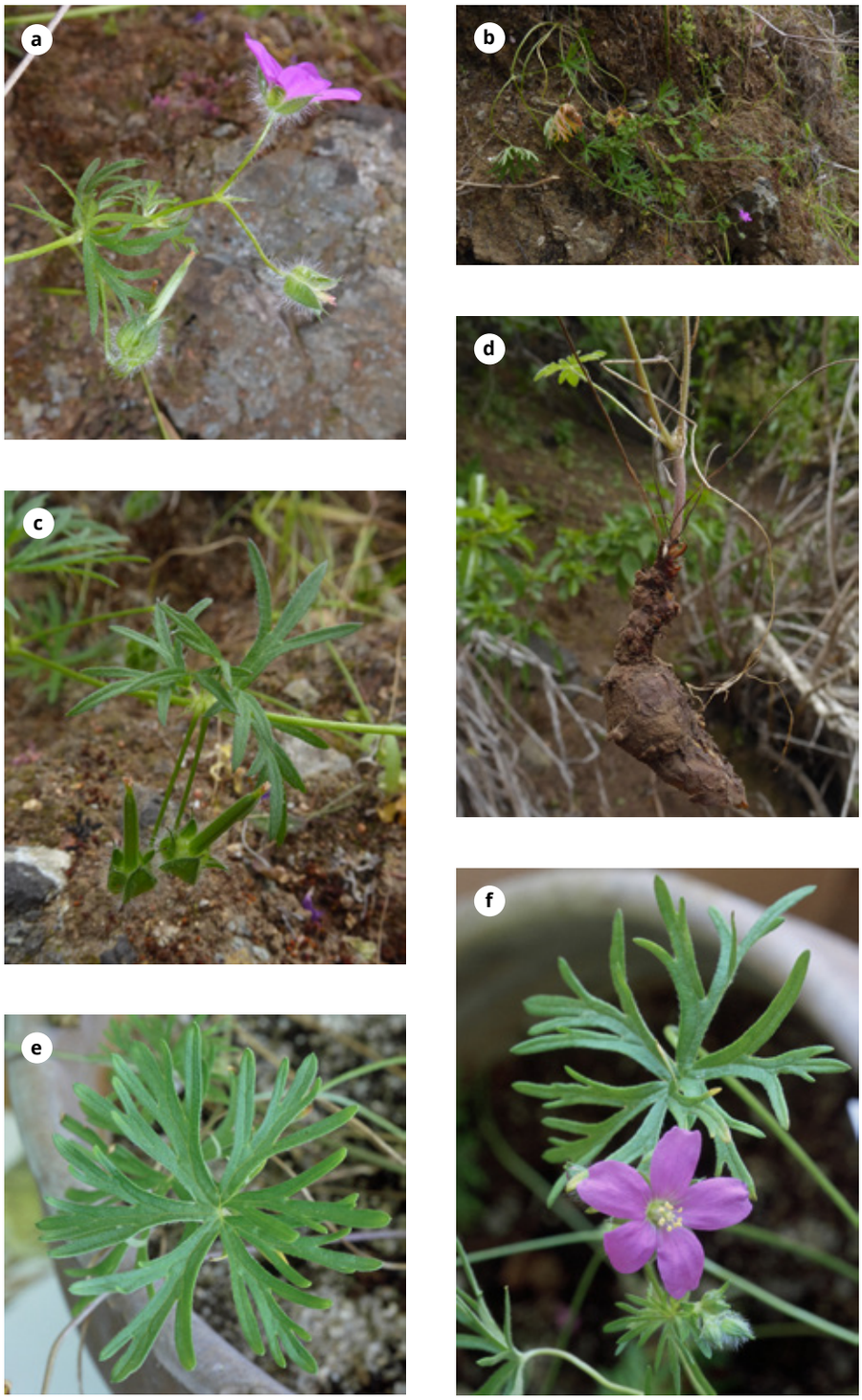


Fig. 295. *Geranium skottsbergii* (Based on: a-d, *Calvo 7807,* SGO, photo: J. Calvo; e, f, *Aedo 6821*, MA).

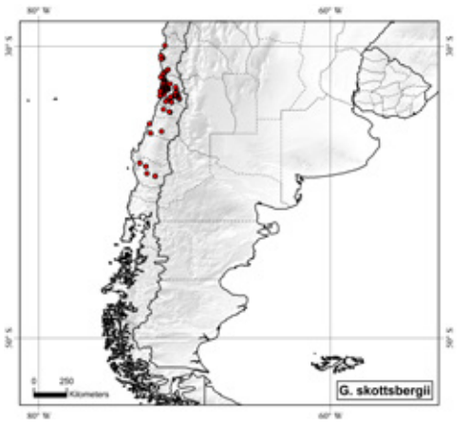


Fig. 296. Distribution of *Geranium skottsbergii*.

111. Geranium core-core Steud., Flora 39(28): 438. 1856. [nom. cons.]. Type locality: "Geranium pusillo affine, Bert. hrbr. nr. 1018. Incolis Core-Core. Geranium rotundifolium Gay. Fl. Chil. I. 383 et var. minor Bert. hrbr. nr. 1460. Quillota Chili et Ins. Juan Fernandez". Type: Chile. Quillota, 32°53'S, 71°16'W, Oct. 1829, *C.L. Bertero 1018* (lectotype, designated by Aedo 2004: 1074, P-00219765!; isolectotypes, G!, MO!).

Geranium rapulum A. St.-Hil. & Naudin, Ann. Sci. Nat., Bot. ser. 2, 18: 25. 1842, [nom. rej.]. Type locality: "Prov. Rio Grande do Sul -- Herb. imp. Bras. et Gaudichaud". Type: Brazil. Rio Grande do Sul, 30°00'S, 54°00'W, 1833, *C. Gaudichaud 1204* (lectotype, designated by Aedo 2004: 1074, P-00147038!; isolectotype, K!).

Geranium commutatum Steud., Flora 39(28): 439. 1856. Type locality: "Clarissimo Schlechtendal in hrb. Lechleriano nr. 259. Geranium intermedium Bert. Mem. Turin. t. 47 videtur, cujus specimen in hrbr. ab unione itineraria edito non prostat, descriptio vero (cfr. Gay Fl. chil. I. 384 et Walp. Rep. I. 450) non paucis recedit. Valdivia Chili". Type: Chile. prope urbem Valdivia, 39°48'S, 73°14'W, *W. Lechler 259* (lectotype, designated by Aedo & al. 2005a: 47, W!; isolectotypes, FI-W!, K!, LE!, P-00757999!).

Geranium ochsenii Phil., Linnaea 28: 676. 1858. *Geranium commutatum* var. *ochsenii* (Phil.) Reiche, Anales Univ. Chile 93: 577. 1895. Type locality: "In dumetis prov. Valdiviae legi". Type: Chile. Los Lagos, Valdivia, San Juan, 39°48'S, 73°14'W, 1855, *F. Philippi 525* (lectotype, designated by Aedo & al. 2005a: 47, W!; isolectotypes, LE!, SGO-51240!, photo P!).

Geranium moorei Phil., Anales Univ. Chile 82: 728. 1893. Type locality: "In praedio 'Todos los Santos' provinciae Curicó legit orn. Eduardus Moore". Type: Chile. Maule, Curicó, Todos los Santos, 34°59'S, 71°14'W, Sep. 1882, *E. Moore s.n.* (lectotype, designated by Aedo & al. 2005a: 47, SGO-40572!, photo P!).

Geranium squamosum Phil., Anales Univ. Chile 82: 733. 1893. Type locality: "Prope S. Vicente haud procul a Talcahuano locis arenosis novembri 1881 legi". Type: Chile. Bíobio, Talcahuano, pr. San Vicente, 36°48'S, 71°53'W, *F. Philippi s.n.* (lectotype, designated by Aedo & al. 2005a: 47, SGO-51249!).

Geranium melanopotamicum Speg., Anales Mus. Nac. Buenos Aires ser. 2, 4: 254. 1902. Type locality: "Hab. In uliginosis sub umbra arbuscularum secus Rio Negro, Febr. 1898 (C.S.)". Type: Argentina. Río Negro, Carmen de Patagones, 40°47'S, 62°58'W, Feb. 1898, *C.L. Spegazzini s.n.* (lectotype, designated by Aedo & al. 2005a: 47, LP-004223 image!; isolectotype, LPS photocopy!).

Geranium subsericeum R. Knuth in Engl., Pflanzenr. IV.129 (Heft 53): 49. 1912. Type locality: "Argentinien: In der Umgebung von Cordoba (Hieronymus in Fl. Arg. n. 78!); Prov. Catamarca, Fuerte de Andalyalá (Schickendantz in Fl. Arg. n. 238!).--Patagonien: Rio Negro (Berg in Fl. Arg. n. 39)". Type: Argentina. Río Negro, 21 Nov. 1874, *C. Berg 39* (lectotype, designated by Aedo & al. 2005a: 47, LP-004222 image!; isolecotype, CORD-00003004!).

Geranium argentinum R. Knuth in Engl., Pflanzenr. IV.129 (Heft 53): 77. 1912. Type locality: "Argentinien: Bei San Francisco in der Provinz Córdoba, auf feuchten Wiesen

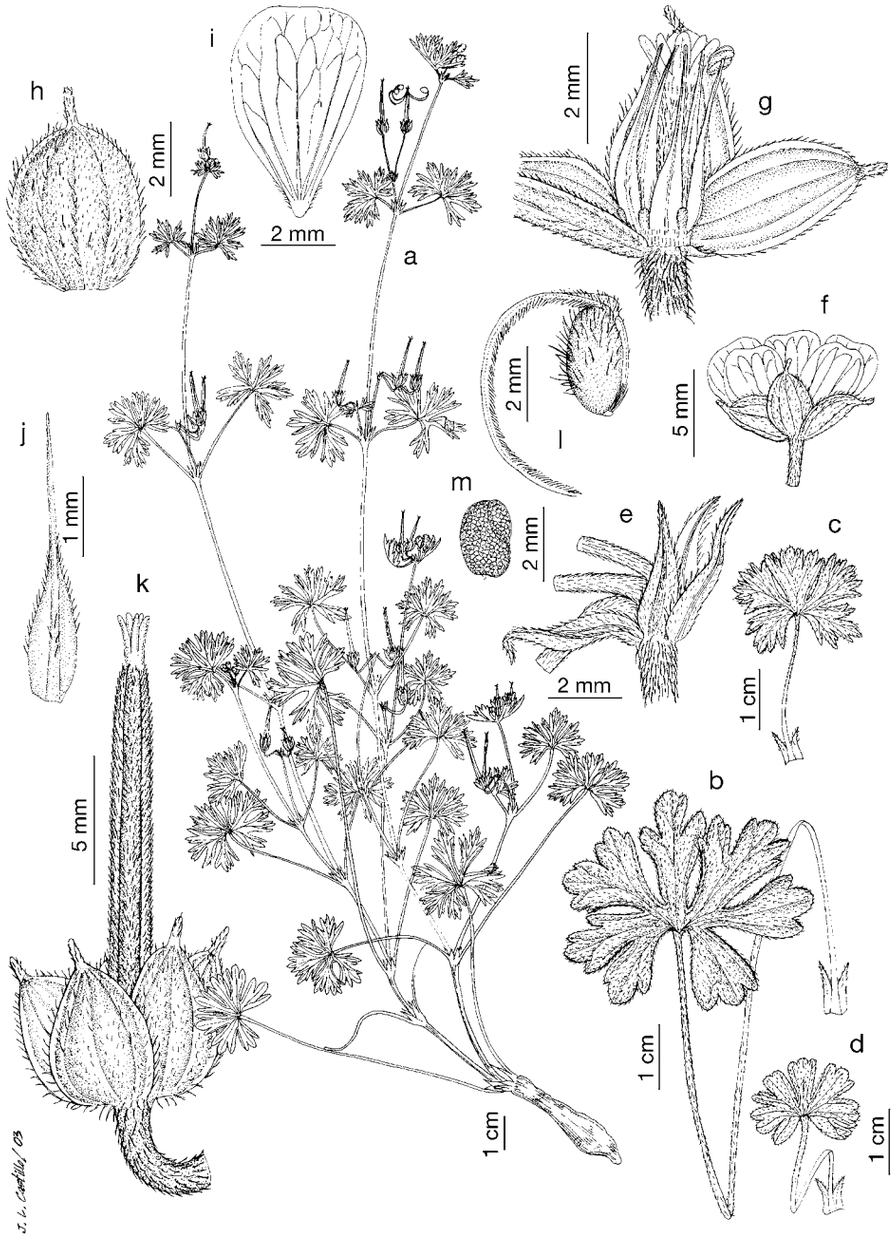


Fig. 297. *Geranium core-core*. a. Habit. b-d. Leaves. e. Bracteoles. f. Flower. g. Flower, two sepals and petals removed. h. Sepal. i. Petal. j. Staminal filament. k. Fruit. l. Mericarp. m. Seed. (Based on: a, c, e-m, *Aedo 7387*, MA; b, *Aedo 7006*, MA; d, *Aedo 7375*, MA).

(Lorentz n. 271 a. 1871!).-- Blüh. Februar.-- Nach Philippi in der Prov. Curicó, Hacienda Todos los Santos". Type: Argentina. Córdoba, San Francisco, 29°40'S, 64°14'W, 1871, *P.G. Lorentz 271* (holotype, B destroyed, photos: F!, G!, GH!; lectotype, designated by Aedo & al. 2005a: 47, CORD-00002995!).

Geranium herrerae R. Knuth, Repert. Spec. Nov. Regni Veg. 28: 1. 1930. Type locality: "Peru: Prov. Urubamba, Allantaitambo, 3000 m (Herrera a. 1924 n. 234 -- Typus in herb. Berol.!). -- Blüh. Mai". Type: Peru. Urubamba, Allantaitambo, 13°16'S, 72°16'W, 1924, *F. Herrera 234* (holotype, B destroyed). Peru. Moquegua: Torata, 16°19'S, 70°43'W, 17-18 Mar. 1925, *A. Weberbauer 7479* (neotype, designated by Aedo & al. 2005a: 47, F!; isoneotypes, G-00365971!, K!, NY!, S!, US image!).

Perennial herbs, 15-75 cm tall. *Rootstock* 4-18.1 mm in diameter, vertical, not tuberculate, turnip-shaped, without thickened roots. *Stem* erect or ascending, leafy, not rooting at nodes, stolons absent, without vegetative stems, with retrorse, appressed, eglandular hairs 0.2-0.5 mm long. *Basal leaves* in a deciduous rosette, cauline leaves opposite; leaf laminas (1.5)1.9-3.9(4.7) cm long, 1.7-5.6 cm wide, not peltate, palmatifid [ratio main-sinus length/middle segment length = (0.57)0.74-0.85], polygonal in outline, base cordate, not coriaceous, with nerves not projected, pilose, with appressed, eglandular hairs on both surfaces; segments 5, in 1 plane, middle segment obtriangular, (1.9)2.7-4.9(8.5) mm wide at the base [ratio segment width at the base/middle segment length = (0.14)0.18-0.27(0.32)], 3-11-lobed in distal half [ratio secondary sinus length/middle segment length = (0.18)0.25-0.37(0.39)]; petioles up to 17 cm long, without abscission zone, terete, not swollen, not deflexed in age, with retrorse, appressed, eglandular hairs 0.2-0.5 mm long; stipules 3.5-8.2 mm long, 0.5-2.5 mm wide, lanceolate, free, papery, brown, with eglandular hairs on abaxial surface and on the margin, glabrous adaxially. *Inflorescence* a monochasial cyme; cymules 2-flowered, solitary [ratio cymule length/leaf length = (0.5)1-2.4]; peduncles (6)13-28(51) mm long, with retrorse, appressed, eglandular hairs 0.2-0.6 mm long; bracteoles 2-4.5 mm long, 0.4-0.9 mm wide, linear-lanceolate, whorled; pedicels (11)14-18(31) mm long, with retrorse, appressed, eglandular hairs 0.2-0.6 mm long. Flowers actinomorphic. *Sepals* 3-4.2(5.5) mm long, 2-4.3 mm wide, ovate, smooth, accrescent, nerves 3, mucro (0.4)0.6-0.9(1.1) mm long [ratio mucro length/sepal length = (0.07)0.13-0.20(0.32)], with antrorse, ± appressed, eglandular hairs 0.1-1.1 mm long on the abaxial surface, glabrous adaxially. *Petals* (3.1)4.1-6(7.1) mm long, (1.7)2.2-2.9(3.5) mm wide, erect-patent, rounded or emarginate, without claw, purple, glabrous on both surfaces, ciliate on the basal margin, with hairs 0.1-0.2 mm long. *Stamens* 10, both whorls bearing anthers; filaments (1.8)2.6-2.9(3.7) mm long, lanceolate, white, glabrous on the abaxial surface, ciliate on the basal margin, with hairs up to 0.1-0.2 mm long; anthers (0.3)0.4-0.6(0.8) mm long, white to pink. Nectaries 5, hemispheric, glabrous. *Gynoecium* 2.3-4 mm long, white. *Fruit* (9.5)15-17(19) mm long, erect, discharge of seed-ejection type; mericarps 2.6-3.2 mm long, 1.2-2.3 mm wide, without a strand of fibers, not compressed at the apex, smooth, without basal beak, with a basal callus, without a basal prong, brown, with erect-patent, eglandular hairs 0.2-1.4 mm long; rostrum 9.1-14.5 mm long, without a narrowed apex, not twisted, with erect-patent, eglandular hairs 0.1-0.7 mm long; stigmatic remnants (0.9)1.1-1.2(1.5) mm long, with 5 hairy lobes. *Seeds* 1.8-2.9 mm long, 1-1.6 mm wide, finely reticulate, uniformly colored, brown, glabrous. Cotyledons with entire margin. Figs. 297, 298.

Pollen. *Geranium*-type (Aedo & al. 2005a: 7).

Chromosome number. 2*n* = 56.

Phenology. Collected in flower from January to December.

Distribution. This species ranges from Ecuador to southern Argentina and it is introduced in southwestern U.S.A. and Europe (Great Britain) (Fig. 299).

Habitat. Roadsides, cultivated ground, beaches, grassy hillsides, along water courses, shrublands, *Myrceugenia* O. Berg and *Nothofagus* Blume forests; 0-4000 m.

Representative specimens examined. **Argentina.** Buenos Aires: Villarino, 60 km W de Pedro Luso, 39º0'S, 62º45'W, Dec. 1964, *Fabris 5614* (LP). Chubut: Los Rápidos, 42º10'S, 71º39'W, 24 Jan. 1945, *Castellanos 151* (K); Esquel, Lago Verde, 42º43'S, 71º43'W, 17 Dec. 2009, *Calvo 4300* (MA). Córdoba: Sierra Chica, Huerta Grande, 31º10'S, 64º20'W, 16 May 1897, *Stuckert 1708* (S); Sierra Achala, pr, Los Gigantes, 31º24'S, 64º48'W, 7 Feb. 2008, *Aedo 15243* (MA). Mendoza: Las Heras, Agua de los Chilenos, 32º31'S, 69º1'W, 12 Dec. 1949, *Cáceres & al. 336* (NY); Las Heras, Villavicencio, 32º31'S, 69º1'W, 12 Feb. 1933, *Ruiz Leal s.n.* (MERL); Uspallata, márgenes del arroyo Chacay, 35º30'S, 69º16'W, 15 Feb. 1984, *Roig 11824* (MERL). Neuquén: Aluminé, 39º13'S, 70º54'W, 20 Dec. 2009, *Calvo 4301* (MA); Lago Lacar, Hua Hum, 40º30'S, 71º18'W, 17 Mar. 1946, *Scolnik 202* (US). Río Negro: Choele Choel, 39º18'S, 65º39'W, Feb. 1948, *Burkart 15905* (SI); parque nacional Nahuel Huapí, Puerto Pañuelo, 41º0'S, 71º30'W, 5 Feb. 1952, *Fabris & Solbrig 216* (LP); San Antonio, Sierra Grande, 41º35'S, 65º22'W, 8 Feb. 1972, *Crespo & al. 2222* (UC). San Juan: Iglesia, alrededores de la Aduana en Arrequintín, rumbo a Paso del Agua Negra, ruta nacional 150, km 98, 30º21'S, 69º30'W, 11 Jan. 1979, *Hunziker & al. 23286* (MA); Calingasta, 31º20'S, 69º24'W, Nov. 1941, *Rodrigo 3038* (LP). Santa Cruz: Puesto San Julián, 49º17'S, 67º43'W, July 1925, *Blake 33* (BM, K). **Bolivia.** Cochabamba: between monte Puncu and Sehuencas, 17º31'S, 65º13'W, 4 Feb. 1995, *Wood 9304* (LPB); Pocona, 17º41'S, 65º25'W, 10 Nov. 1978, *Steinbach 8669* (BM, E, G, GH, K, NY, S). La Paz: La Paz, 16º30'S, 68º9'W, 19 May 1925, *Pennell 14245* (US); Murillo, La Paz-Achocalla, 16º35'S, 68º10'W, 13 May 1982, *Beck & al. 11712* (MA, MO, U). **Brazil.** Brazil, 1815, *Sellow* (BM). Rio de Janeiro: Nova Friburgo, 22º15'S, 42º31'W, 20 Nov. 1951, *Capell s.n.* (RB). **Chile.** Aisén: Chile Chico, 46º33'S, 71º44'W, 12 Dec. 1954, *Pfister s.n.* (CONC). Antofagasta: Toconao, 23º11'S, 68º0'W, 28 Nov. 2001, *Aedo 7006* (MA). Atacama: San Pedro de Atacama, 27º19'S, 70º34'W, 26 Feb. 1946, *Ivanovic s.n.* (CONC); km 8 río Chollay, 29º5'S, 70º8'W, 17 Jan. 1994,

Arancio & al. 94114 (CONC). Biobío: Talcahuano, 36°43'S, 73°6'W, 3 Nov. 2001, *Aedo 6722* (MA); Concepción, mirador Alemán, 36°50'S, 73°2'W, 4 Nov. 2001, *Aedo 6728* (MA). Coquimbo: Serena, escuela agrícola, 29°52'S, 71°16'W, 7 Aug. 1965, *Schilling s.n.* (H); Choapa, Illapel, 31°38'S, 71°10'W, Nov. 1989, *Chiuminato 23* (CONC). Juan Fernández Is.: Isla Más a Tierra, San Juan Bautista, 33°38'S, 78°52'W, 7 Feb. 1990, *López & Peñailillo 11548* (CONC); Isla Más a Fuera, between quebrada Casas and Paso Malo, 33°45'S, 80°46'W, 5 Feb. 1990, *Baeza & Peñailillo 11433* (CONC). La Araucanía: Puerto Saavedra, 38°42'S, 73°15'W, 22 Dec. 2001, *Aedo 7203* (MA); Coi-Coi, La Lobería, 38°50'S, 73°28'W, 21 Dec. 2001, *Aedo 7197* (MA). Los Lagos: Chiloe, playa Puñihuil, 41°55'S, 74°1'W, 6 Jan. 2002, *Aedo 7387* (MA); pr. Futaleufú, 43°10'S, 71°45'W, 5 Jan. 2002, *Aedo 7375* (MA). Maule: Talca, Santa Agueda, 35°6'S, 71°15'W, 9 Nov. 1989, *Bobadilla 126* (CONC); Paso Nevado, 35°43'S, 71°10'W, 13 Dec. 2001, *Aedo 7153* (MA). O'Higgins: Rancagua, La Leonera, 34°2'S, 70°34'W, 9 Dec. 2001, *Aedo 7073* (MA); Baños de Cauquenes, 34°15'S, 70°34'W, 1872, *Reed s.n.* (CONC). Santiago: puente Manzanito, 33°20'S, 70°19'W, 12 Dec. 2001, *Aedo 7130* (MA); Melipilla, Cerro Cantillana, 33°57'S, 70°57'W, 31 Dec. 1995, *Bliss & al. 2364* (CONC). Tarapacá: Arica, quebrada de Socoroma, 18°15'S, 69°38'W, 5 May 1972, *Ricardi & al. 152* (CONC). Valparaíso: Petorca, Pichicuy, 32°23'S, 71°8'W, 18 Jan. 1989, *Lammers & al. 6394* (CONC); Lagunillas, 33°39'S, 70°17'W, 17 Dec. 1968, *Mahu 9915* (H). **Ecuador.** Azuay: Cuenca, 2°52'S, 78°58'W, 17 Sep. 1918, *Rose & al. 22876* (GH, NY, US). Loja: Loja, 3°59'S, 79°12'W, 14 June 1946, *Espinosa 562* (NY); Cajanuma, 16 km al S de Loja, 4°4'S, 79°11'W, 16 July 1947, *1635* (NY). Tungurahua: entre Casigana y El Sueño, al SW de Ambato, 1°15'S,

Fig. 298. *Geranium core-core* (Based on: a-c, *Aedo 7073,* MA; d, e, *Aedo 15243*, MA; f, *Calvo 4301*, MA, photo: J. Calvo).

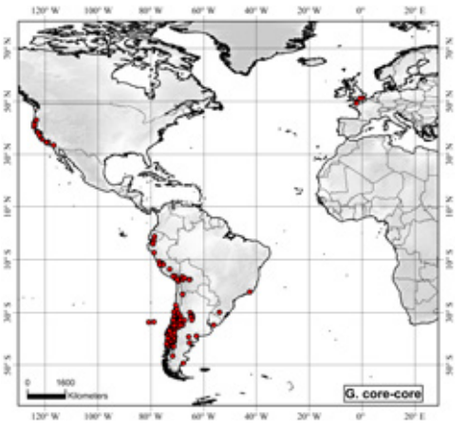


Fig. 299. Distribution of *Geranium core-core*.

78º37'W, 14 Dec. 1944, *Acosta Solís 9303* (F); Ambato a Huachi, 1º17'S, 78º37'W, 29 Oct. 1944, *Acosta Solís 8884* (F). **Great Britain.** Channel Islands: Jersey, rue de Prés, La Becquetterie farm, 49º10'N, 2º4'W, 10 June 1966, *Brooks s.n.* (K); Alderney, railway cutting, 100 y of Whitegates crossing, 49º43'N, 2º11'W, 18 June 1938, *Jackson & Shaw 409* (K). England: Bordon station, North Hants, 51º7'N, 0º51'W, 1961, *Lousley 1874* (E); Kent, Bracken Hill, near Sevenoaks, garden of Mc Clintock, 51º15'N, 0º12'E, Sep. 1979, *Mc Clintock s.n.* (P). **Peru.** Apurimac: Abancay, Ampuy, 13º38'S, 72º52'W, 12 Feb. 1939, *Stork & al. 10628* (G). Arequipa: S slopes of Chachani mountain, 16º11'S, 71º31'W, Mar. 1920, *Hinkley 66* (GH, NY, US). Cajamarca: Contumazá, alrededores de Yetón, 7º22'S, 78º48'W, 1 June 1981, *Sagástegui & al. 9753* (MO). Junín: Contumazá, Singarrán, El Molino-San Martín, 7º22'S, 78º48'W, 1 Nov. 1979, *Sagástegui 9343* (NY). Lima: pr. Canta, 11º27'S, 76º36'W, 25 Mar. 2005, *Aedo & Galán de Mera 10843* (MA). Moquegua: Torata, 17º5'S, 70º51'W, 14 Apr. 2005, *Aedo & Galán de Mera 11358* (MA). Tacna: Tarata, 17º28'S, 70º1'W, 4 Dec. 1997, *Cano 7010* (USM). **Uruguay.** Montevideo: Montevideo, 34º50'S, 56º10'W, *Sellow s.n.* (HAL). **USA.** California: San Diego Co., Nellie, Palomar mountains, 33º21'N, 116º50'W, 25 May 1925, *Jaeger s.n.* (RSA); Del Norte Co., Crescent City, 41º45'N, 124º12'W, 2 June 1925, *Parks 8360* (UC). Oregon: Douglas Co., Riddle Bypass Rd. at Gravel Pit Lane, ca. 2.5 mi. SW of Riddle, 42º55'N, 123º24'W, 3 May 2012, *Carr s.n.* (OSC).

Discussion. Geranium core-core is readily distinguished by its peduncles and pedicels with retrorse-appressed, eglandular hairs, by its shallowly divided leaves, and short petals. It resembles *G. retrorsum*, a species of Australia and New Zealand, which differs most noticeably in sepal shape; *G. retrorsum* has lanceolate sepals, whereas *G. core-core* has broadly ovate sepals. Additionally, *G. core-core* has longer fruits with a longer rostrum than is found in *G. retrorsum*. Two sheets of the type collection, *Bertero 1018*, are kept at G. One is *G. core-core* and the other *G. skottsbergii*. According to the typification proposed by Aedo (2004: 1074) the first is an isolectotype of *G. core-core*, and the second is excluded. *Geranium rapulum* was published fourteen years before *G. core-core*, but it was never taken up, whereas *G. core-core* has been used in many floristic publications about Chile and Argentina. The proposal (Aedo 2004) to conserve the name *G. core-core* over *G. rapulum* was accepted at the Botanical Congress in Vienna in 2006.

Geranium core-core is a South American species introduced in California and Europe. It has been established in Channel Islands and southern England where it has been identified as *G. potentilloides* and/or *Geranium submolle*, a synonym of *G. berteroanum* (Townsend 1964), or as *G. retrorsum* (Kent 1959; Lousley 1962). Yeo (2002b) tentatively used the name *G. herrerae* for this weed, a synonym of *G. core-core*.

112. Geranium tablasense R. Knuth, Meded. Rijks-Herb. 27: 68. 1915. Type locality: "Im Gebüsch der Waldgrenza über Tablas, 3400 m (no. 2181, bl. u. fr. im Mai 1911.-Typus!)". Type: Bolivia. Cochabamba, Tablas, 17°05'S, 65°59'W, May 1911, *T. Herzog 2181* (lectotype, designated by Aedo & al. 2005a: 53, L-0018356!; isolectotype, S-R-2402!).

Perennial herbs, 37-55 cm tall. *Rootstock* 8-8.2 mm in diameter, vertical, not tuberculate, turnip-shaped, with thickened roots. *Stem* erect, leafy, not rooting at nodes, stolons absent, without vegetative stems, with patent to retrorse, not appressed, eglandular hairs 0.3-1.2 mm long and patent, glandular hairs 0.4-0.9 mm long. *Basal leaves* in a ± deciduous rosette, cauline leaves opposite; leaf laminas 3.6-5.4 cm long, 5.1-6.2 cm wide, not peltate, palmatifid [ratio main-sinus length/middle segment length = 0.52-0.61], polygonal in outline, base cordate, not coriaceous, with nerves not projected, pilose, with appressed, eglandular hairs (young leaves sericeous abaxially) on both surfaces; segments 5-7, in 1 plane, middle segment rhombic, 3.2-4.6 mm wide at the base [ratio segment width at the base/middle segment length = 0.09-0.12(0.14)], 10-14-lobed in distal half [ratio secondary sinus length/middle segment length = (0.24)0.27-0.37(0.42)]; petioles up to 8.2 cm long, without abscission zone, terete, not swollen, not deflexed in age, with patent, eglandular hairs 0.3-1.3 mm long; stipules 7.5-9.8 mm long, 2.7-3.2 mm wide, lanceolate, free, papery, brownish red, glabrous or with scattered, eglandular hairs on abaxial surface and on the margin, glabrous adaxially. *Inflorescence* a monochasial cyme; cymules 2-flowered, solitary [ratio cymule length/leaf length = 0.7-2.8]; peduncles (37)40-70(80) mm long, with patent to retrorse, not appressed, eglandular hairs 0.2-0.6 mm long and patent, glandular hairs 0.4-0.9 mm long; bracteoles 2.5-6.7 mm long, 0.6-1.8 mm wide, lanceolate, whorled; pedicels 28-46 mm long, with patent to retrorse, not appressed, eglandular hairs 0.2-0.6 mm long and patent, glandular hairs 0.4-1.3 mm long. Flowers actinomorphic. *Sepals* 7.4-8 mm long, 2.4-3.3 mm wide, lanceolate, smooth, not accrescent, nerves 3, mucro 0.7-1.3(1.4) mm long [ratio mucro length/sepal length = (0.09)0.10-0.16(0.17)], with erect-patent, eglandular hairs 0.5-1.4 mm long and patent, glandular hairs 0.4-1 mm long on the abaxial surface, glabrous adaxially. *Petals* (11.4)13.4-16.4(16.9) mm long, 7.4-8.2 mm wide, erect-patent, emarginate (notch 1.5-1.9 mm deep), with claw 1-3.5 mm long, purple, glabrous, rarely sparsely ciliate on the basal margin, with hairs 0.2-0.5 mm long. *Stamens* 10, both whorls bearing anthers; filaments 6.5-8 mm long, lanceolate, yellow, glabrous on both surfaces, ciliate on the basal margin, with hairs up to 0.1-0.2 mm long; anthers 1.1-1.8 mm long, unknown color. Nectaries 5, hemispheric, glabrous. *Gynoecium* 7-8.2 mm long, unknown color. *Fruit* 24.2-27.7 mm long, erect, discharge of seed-ejection type; mericarps 3.2-4 mm long, 1.6-1.8 mm wide, without a strand of

fibers, not compressed at the apex, smooth, without basal beak, with a basal callus, without a basal prong, brown, with erect-patent, eglandular hairs 0.3-0.9 mm long; rostrum 17-21.1 mm long, with a narrowed apex (2)2.3-3.8(5) mm long, not twisted, with erect-patent, eglandular hairs 0.4-0.9 mm long; stigmatic remnants (2.6)2.8-3.4(3.8) mm long, with 5 glabrous lobes. *Seeds* 2.1-2.2 mm long, 1.1-1.5 mm wide, finely reticulate, uniformly colored, brown, glabrous. Cotyledons with entire margin. Fig. 300.

Pollen. *Geranium*-type (Aedo & al. 2005a: 7).

Chromosome number. Unknown.

Phenology. Collected in flower from March to May.

Distribution. This species ranges through central Bolivia (Fig. 301).

Habitat. Rocky and wet slopes; 2800-3700 m.

Additional specimens examined. **Bolivia.** Cochabamba: km 80 road to Chimoré-Cochabamba, 16°59'S, 65°7'W, Apr. 1939, *Cárdenas 758* (US); bei km 94 der strasse Cochabamba-Todos Santos, 17°12'S, 65°43'W, 22 Apr. 1959, *Diers 870* (P); Incachaca, 17°14'S, 66°28'W, Mar. 1941, *Cárdenas 2180* (GH, PH, S, U); Chapare, road from Aguirre to Incachaca, taking left hand turning 2.5 km, and 16.5 km from Aguirre, 17°20'S, 65°46'W, 10 Mar. 1929, *Hawkes & al. 6680* (C); Chapare, La Aduana, 17°32'S, 65°13'W, 10 Mar. 1929, *Steinbach 9576* (BM, E, F, G, GH, MO, NY, PH, S, U).

Discussion. Geranium tablasense shares with *G. venturianum* and *G. fallax* leaves with rhombic segments and a fruit rostrum with a narrowed apex. It can be distinguished by its longer petals, which show some overlap with *G. venturianum* but not with *G. fallax*. Additionally, the petals of *G. tablasense* are glabrous or rarely with few cilia at the basal margin, whereas the petals are hairy at the basal margin in *G. venturianum* (and at base of abaxial surface) and *G. fallax*. *Geranium venturianum* has longer peduncles, shorter staminal filaments, and a rostrum with a shorter narrowed apex than is found in *G. tablasense*. *Geranium tablasense* differs also in having basal leaves with narrow segments and longer fruits than do *G. venturianum* and *G. fallax*.

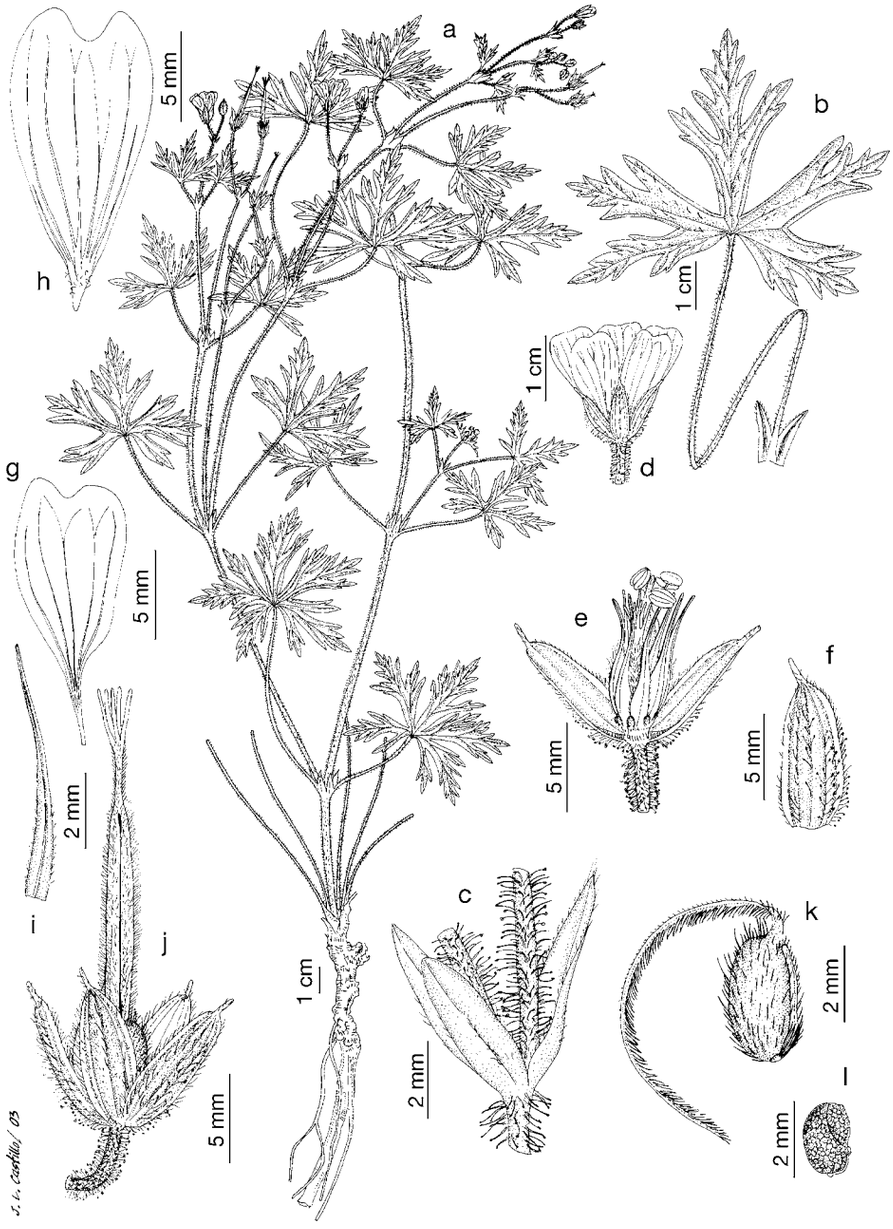


Fig. 300. *Geranium tablasense*. a. Habit. b. Leaf. c. Bracteoles. d. Flower. e. Flower, two sepals and petals removed. f. Sepal. g, h. Petals. i. Staminal filament. j. Fruit. k. Mericarp. l. Seed. (Based on: a, c-i, *Steinbach 9576*, PH; b, *Steinbach 9576*, U; j-l, *Herzog 2181*, L).

Fig. 301. Distribution of *Geranium tablasense*.

113. Geranium venturianum R. Knuth, Repert. Spec. Nov. Regni Veg. 40: 218. 1936. Type locality: "Argentinien: Prov. Tucuman; Dept. Burruyacu, Alto de Medina, 1000 m (Venturi a. 1924 n. 2667!), La Posta, 800 m (Venturi a. 1923 n. 2377!), Cerro del Campo, 2000 m (Venturi a. 1928 n. 7723!); Tafi, Cumbre de Taficillo (Venturi a. 1928 n. 5943!). Prov. de Salta (Venturi a. 1929 n. 9848!)". Type: Argentina. Tucumán, Cerro del Campo, 26°21'S, 64°54'W, 15 Dec. 1928, *S. Venturi 7723* (lectotype, designated by Aedo & al. 2005a: 57, S-09-9951!!; isolectotypes, BM-000797022!, K!, MO-251395!, SI-002108 image!, US-00811070 image!).

Perennial herbs, 27-88 cm tall. *Rootstock* 6.9-13.6 mm in diameter, vertical, not tuberculate, turnip-shaped, with thickened roots. *Stem* erect, leafy, not rooting at nodes, stolons absent, without vegetative stems, with patent, eglandular hairs 0.1-0.9 mm long and, sometimes, patent, glandular hairs 0.2-0.7 mm long. *Basal leaves* in a ± deciduous rosette, cauline leaves opposite; leaf laminas 3.2-7.5 cm long, 4-9.9 cm wide, not peltate, palmatifid [ratio main-sinus length/middle segment length = (0.50)0.80-0.85], polygonal in outline, base cordate, not coriaceous, with nerves not projected, pilose, with appressed, eglandular hairs (young leaves sericeous abaxially) on both surfaces; segments 5-7, in 1 plane, middle segment rhombic, 2.4-12.6 mm wide at the base [ratio segment width at the base/middle segment length = (0.08)0.14-0.23(0.30)], 8-16-lobed in distal half [ratio secondary sinus length/middle segment length = (0.23)0.25-0.31(0.49)]; petioles up to 16.5 cm long, without abscission zone, terete, not swollen, not deflexed in age, with patent, eglandular hairs 0.2-1 mm long and, sometimes, patent, glandular hairs 0.2-0.7 mm long; stipules 3.2-16.7 mm long, 1-5 mm wide, lanceolate, free, papery, brownish red, with eglandular and, sometimes, glandular hairs on both surfaces and on the margin. *Inflorescence* a monochasial cyme; cymules 2-flowered, solitary [ratio cymule length/leaf length = (0.9)1.1-2.1]; peduncles (59)82-151(251) mm long, with patent, eglandular hairs 0.2-0.7 mm long and, sometimes, patent, glandular hairs 0.2-0.8 mm long; bracteoles 2.6-8.9 mm long, 0.5-1.2 mm wide, lanceolate, whorled; pedicels 12.5-46.6 mm long, with patent, eglandular hairs 0.2-0.7 mm long and, sometimes, patent, glandular hairs 0.2-0.8 mm long. Flowers actinomorphic. *Sepals* (5.5)6.5-8.2(8.9) mm long, 1.8-3.7 mm wide, lanceolate, smooth, not accrescent, nerves 3, mucro (0.6)1-1.5(2.1) mm long [ratio mucro length/sepal

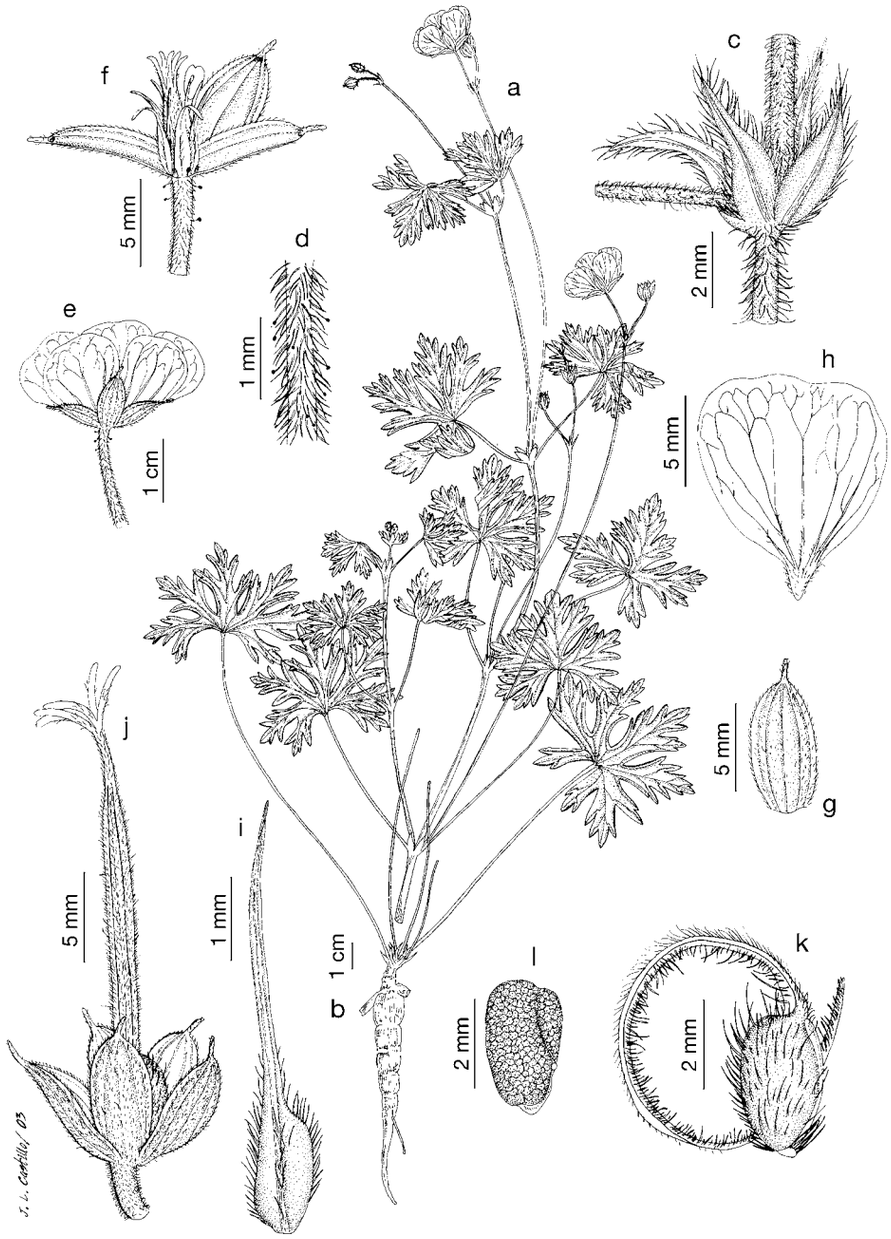


Fig. 302. *Geranium venturianum*. a, b. Habit. c. Bracteoles. d. Peduncle. e. Flower. f. Flower, two sepals and petals removed. g. Sepal. h. Petal. i. Staminal filament. j. Fruit. k. Mericarp. l. Seed. (Based on: a, c-i, *Wood & al. 15287*, LPB; b, *Burkart & al. 30494*, CORD; j-l, *Venturi 2667*, S).

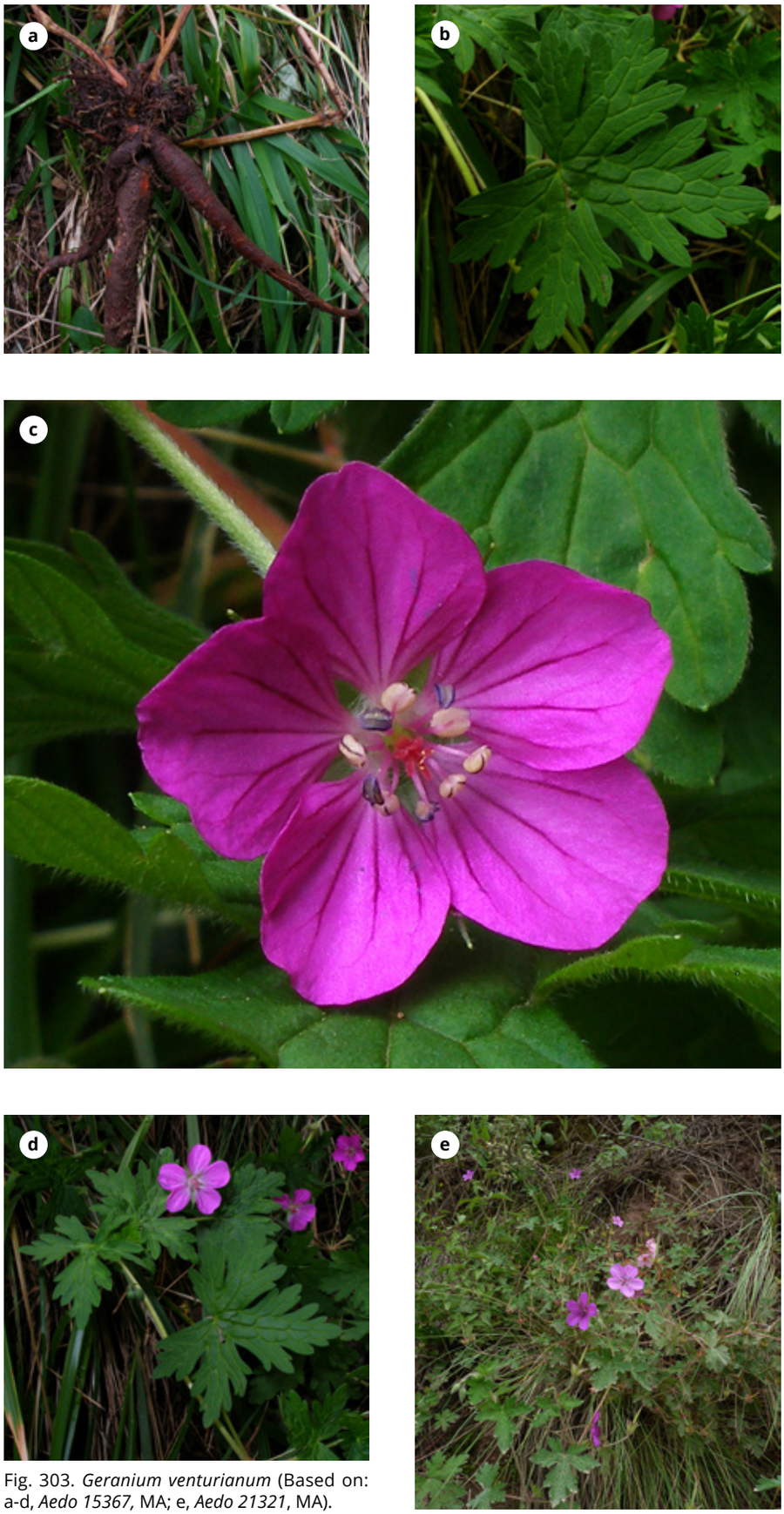


Fig. 303. *Geranium venturianum* (Based on: a-d, *Aedo 15367,* MA; e, *Aedo 21321*, MA).

length = (0.10)0.12-0.22(0.26)], with erect-patent, eglandular hairs 0.3-0.8 mm long and, sometimes, erect-patent, glandular hairs 0.2-0.8 mm long on the abaxial surface, glabrous adaxially. *Petals* (10)11-11.8(14.3) mm long, 5-10.7 mm wide, erect-patent, rounded, without claw, purple, hairy on the base of the abaxial surface and on basal margin, with hairs 0.3-0.8 mm long. *Stamens* 10, both whorls bearing anthers; filaments 4-7.1 mm long, lanceolate, pink, with eglandular hairs 0.2-0.3 mm long on the abaxial surface and margin; anthers 0.5-1.7 mm long, blue. Nectaries 5, hemispheric, usually glabrous. *Gynoecium* 4.5-7 mm long, pink. *Fruit* 19.4-26.7 mm long, erect, discharge of seed-ejection type; mericarps 3-3.7 mm long, 1.3-2.2 mm wide, without a strand of fibers, not compressed at the apex, smooth, without basal beak, with a basal callus, without a basal prong, brown, with erect-patent, eglandular hairs 0.3-1.1 mm long and, sometimes, patent glandular hairs 0.2-0.7 mm long; rostrum 12.8-19.3 mm long, with a narrowed apex 1-2.4 mm long, not twisted, with erect-patent, eglandular hairs 0.3-0.8 mm long and, sometimes, patent, glandular hairs 0.2-0.7 mm long; stigmatic remnants (3)3.2-3.6(5) mm long, with 5 hairy lobes. *Seeds* 1.9-2.4 mm long, 1.2-1.5 mm wide, finely reticulate, uniformly colored, brown, glabrous. Cotyledons with entire margin. Figs. 302, 303.

Pollen. *Geranium*-type (Aedo & al. 2005a: 6).

Chromosome number. Unknown.

Phenology. Collected in flower from October to April.

Distribution. This species ranges from southern Bolivia to northwestern Argentina (Fig. 304).

Habitat. Meadows, grassy slopes, and shrublands; 1000-3200 m.

Representative specimens examined. **Argentina.** Catamarca: Chabarilla, Apr. 1952, *Brücher 9440* (M); Andalgalá, Esquina Grande, 27°17'S, 65°59'W, 12 Feb. 1910, *Jørgensen 1562* (GH, S, US). Jujuy: Capital, lagunas de Yala, 24°7'S, 65°28'W,

4 Dec. 1969, *Cabrera & Kiesling 20164* (LP, SI); Capital, Sierra de Zapla, Mina 9 de Octubre, subida al Cerro Zapla, 24º13'S, 65º3'W, 9 Nov. 1974, *Cabrera & al. 25830* (LP, SI); Capital, Cerro Zapla, camino de la antena, 24º15'S, 65º7'W, 21 Nov. 1986, *Ahumada 5283* (CTES, LIL); Capital, Sierra de Zapla, Mina 9 de Octubre, subida a la antena, 24º15'S, 65º7'W, 23 Jan. 1975, *Zuloaga & Deginani 197* (LP); Santa Bárbara, Sierra El Centinela, 24º16'S, 64º22'W, 6 Jan. 1966, *Cabrera & al. 17303* (CTES, LP). Salta: Rosario de Lerma, quebrada del Toro, ruta 51, km 28, unos 3 km al W de Campo Quijano, 24º55'S, 65º39'W, 26 Apr. 1987, *Novara 6575* (G); Chicoana, Quebrada de Escoipe, cerca de Agua Negra, 25º8'S, 65º41'W, 2 Dec. 1960, *Ruiz Leal 21231* (CORD, MERL); Chicoana, road to Cachi, Cuesta del Obispo, 4.6 km above Pie de la Cuesta, 11.6 km Escoipe, where the road crosses large side quebrada on rigth, 25º9'S, 65º52'W, 5 Mar. 1966, *Hawkes & al. 3715* (C, S); Cuesta del Obispo, 25º11'S, 65º48'W, 19 Mar. 2014, *Aedo 21321* (MA); Guachipas, Alemania, 25º36'S, 65º37'W, 6 Dec. 1929, *Venturi 9848* (K, MO, NY, S); Orán, Cerro Queso Asentado, 25º40'S, 66º26'W, 26 Mar. 1945, *Pierotti 1029* (NY); Chicoana, Cuesta del Obispo, 26º6'S, 64º41'W, 10 Apr. 1982, *Novara 2660* (CORD, MO, S); Capital, quebrada de San Lorenzo, 26º6'S, 64º41'W, 13 Oct. 1926, *Venturi 5070* (GH, S, SI, US). San Luis: Estancia Grande, 33º15'S, 66º11'W, Jan. 1911, *Gerth 61* (L). Tucumán: Trancas, pr. Hualinchay, camino hacia Tolombón, 26º20'S, 65º39'W, 16 Feb. 2008, *Aedo 15367* (MA); Tafí Viejo, La Hoyada, 26º41'S, 65º31'W, 11 Oct. 1922, *Venturi 1913* (GH, MA, US); Tafí Viejo, Sierra de Tucumán, Cuesta de Siambón, 26º42'S, 65º27'W, 18 Mar. 1872, *Lorentz s.n.* (CORD); Chicligasta, La Alvaresada, 26º42'S, 65º26'W, 27 Nov. 1946, *Sparre 938* (S); Burruyacu, Alto de Medina, 26º51'S, 65º3'W, Jan. 1924, *Venturi 2667* (S); Chicligasta, Las Pavas, puente El Bayo, 27º15'S, 65º52'W, 12 Mar. 1924, *Venturi 3089* (F, GH, SI); Chicligasta, La Banderita, 27º17'S, 65º54'W, Feb. 1950, *Brücher 9396* (M). **Bolivia.** Chuquisaca: Tomina, 19º10'S, 64º29'W, Dec. 1845, *Weddell 3786* (P); Azurduy, on descent from Cordillera de los Sombreros towards Tarvita, 19º49'S, 64º32'W, 4 Dec. 1999, *Wood & al. 15287* (LPB); provincia Hernando Siles, primera sección Monteagudo, cantón Fernández, comunidad Vallecito, 20º11'S, 64º17'W, 11 Jan. 2000, *Jiménez & al. 581* (MA, MO); provincia Hernando Siles, 20º12'S, 64º8'W, 23 Dec. 2008, *Apaza & al. 75* (MA, MO); bewteen López Mendoza and Montepuncu, 17º32'S, 65º22'W, 16 Dec. 1994, *Wood 8955* (LPB, S).

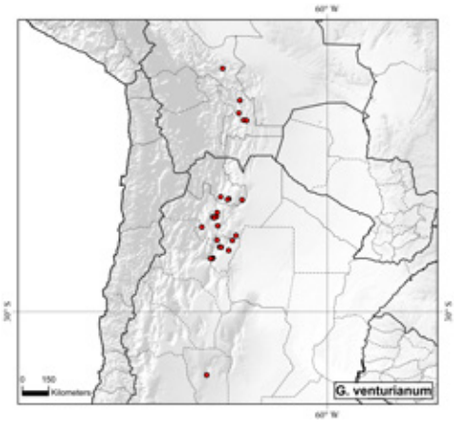


Fig. 304. Distribution of *Geranium venturianum*.

Discussion. Geranium venturianum is distinctive in its long peduncles, which decrease in length towards the apex of the inflorescence; in the description of *G. venturianum* and in the key peduncles of the basal part of the inflorescence are emphasized. Although a small overlap in peduncle length exists between *G. venturianum* and *G. tablasense*, length of petals, staminal filaments, fruit, and rostrum apex permit a ready separation of the species. *Geranium venturianum* varies in the presence of glandular hairs; some specimens only have eglandular hairs, but others have also glandular hairs on stems, inflorescences, sepals, fruit rostra, and/or mericarps. These glandular forms have been occasionally misidentified as "*G. fiebrigianum*" (here listed as a synonym of *G. fallax*) or "*G. patagonicum*" (here listed as a synonym of *G. berteroanum*). *Geranium venturianum* can be distinguished from *G. berteroanum* by its leaves with a rhombic (rather than obtriangular) middle segment and its fruit rostrum with a narrow apex. The best way to distinguish *G. venturianum* from *G. fallax* is by the length of the peduncles, which are clearly longer in *G. venturianum*. Additionally, in *G. venturianum* the fruits (including the narrow apex of the rostrum), stigmatic remnants, bracteoles, sepals, and petals are longer than in *G. fallax*.

114. Geranium fallax Steud., Flora 39(28): 439. 1856. Type locality: "In ruderatis Tabina Peru. Lechler hrbr. nr. 1907". Type: Peru. Puno, Tabina, 14°08'S, 69°32'W, *W. Lechler 1907* (lectotype, designated by Aedo & al. 2005a: 59, P-00219767!; isolectotype, GOET-004063 image!, K-000531425!).

Geranium fiebrigianum R. Knuth, Bot. Jahrb. Syst. 37: 560. 1906. Type locality: "Süd-Bolivia: Calderillo, am Talkopf unweit eines Baches zwischen Gestrüpp, 3300 m (Fiebrig, Pl. austro-boliv. a. 1903-04 n. 2631!). - Blühend und fruchtend im Januar". Type: Bolivia. Tarija, Calderillo, 21°48'S, 63°45'W, 9 Jan. 1904, *K. Fiebrig 2631* (lectotype, designated by Aedo & al. 2005a: 59, P-00219768!; isolectotypes, BM-000603547!, E-00135029!, G!, GOET-004062!, HBG-517310 image!, K!, M!, PR-375707!, US!, W!).

Geranium bolivianum R. Knuth in Engl., Pflanzenr. IV.129 (Heft 53): 575. 1912. Type locality: "Bolivia: Sorata, 3300 m (Rusby, Fl. South America a. 1886 n. 760 sub G. carolinianum -- Typus in herb. Berol.!).-- Blühend Februar". Type: Bolivia. La Paz, Sorata, 15°46'S, 68°38'W, Feb. 1886, *H.H. Rusby 760* (holotype, B destroyed; lectotype, designated by Aedo 2012: 397, P-00757996!; isotypes, BM-000835605!, F!, GH-00338013!, K-000190055!, NY-01364978!, US-00100864 image!).

Geranium filipes Killip, J. Wash. Acad. Sci. 16: 569. 1926. Type locality: "Type in the U.S. National Herbarium, no. 1,281,331, collected at Hacienda, Churú, Province of Paucartambo, Peru, altitude 3,500 meters, January, 1926, by F. L. Herrera (no. 1044)". Type: Peru. Cusco. Paucartambo, Churú, 13°18'S, 71°35'W, Jan. 1926, *F. Herrera 1044* (holotype, US-1281331!).

Geranium fuscicaule R. Knuth, Repert. Spec. Nov. Regni Veg. 28: 7. 1930. Type locality: "Bolivia: Nord-Yungas, Unduavi 3300 m. (Buchtien a. 1912 n. 4602 -- Typus in herb. Berol.!). Dept. Cochabamba, Prov. Chapare, Incachaca, 2300 m (Steinbach a. 1929 n. 8981 in herb. Berol.!)". Type: Bolivia. Nord-Yungas, Unduavi, 16°19'S, 67°54'W, Feb. 1914, *O. Buchtien 4602* (holotype, B destroyed; lectotype, designated by Aedo 2012: 397, HBG!; isotypes, GH-00055012!, UPS!, US-00100887 image!).

Geranium totorense R. Knuth, Repert. Spec. Nov. Regni Veg. 28: 7. 1930. Type locality: "Bolivia: Dept. Cochabamba, Prov. Totora, 3500 m (Steinbach a. 1921 n. 3975 -- Typus!). -- Blühend März". Type: Bolivia. Cochabamba, Totora, 17°43'S, 65°09'W, 1921, *J. Steinbach 3975* (no original material located).

Geranium killipianum R. Knuth, Repert. Spec. Nov. Regni Veg. 34: 144. 1933. Type locality: "Peru: Dept. Lima, Rio Blanco, 3000-3500 m, auf lichten Hügeln (Killip et Smith a. 1929 n. 21644 -- Typus in herb. Berol.). -- Blühend und fruchtend April". Type: Peru. Lima, Río Blanco, 11°44'S, 76°15'W, 15 Apr. 1929, *E.P. Killip & A.C. Smith 21644* (holotype, B destroyed; lectotype, designated by Aedo 2012: 397, NY-00370261!; isotype, US-00100911 image!).

Geranium titicacaense R. Knuth, Repert. Spec. Nov. Regni Veg. 45: 60. 1938. Type locality: "Peru: Prov. Moquegua, Carumas, 3000 m (Weberbauer a. 1925 n. 7307 -- Typus in herb. Berol.!); Dept. Arequipa, Ubinas (Raimondi a. 1864 n. 11723!); ohne Standortsangabe (Raimondi n. 8600!). -- Bolivia: La Paz (Raimondi a. 1865 n. 9713!).-- Blühend Januar bis März". Type: Peru. Moquegua, Carumas, 16°49'S, 70°43'W, 21 Feb.-6 Mar. 1925, *A. Weberbauer 7307* (holotype, B destroyed; lectotype, designated by Aedo 2012: 397, G-00365880!; isotypes, BM-000603554!, K!, S-04-392!, US image!).

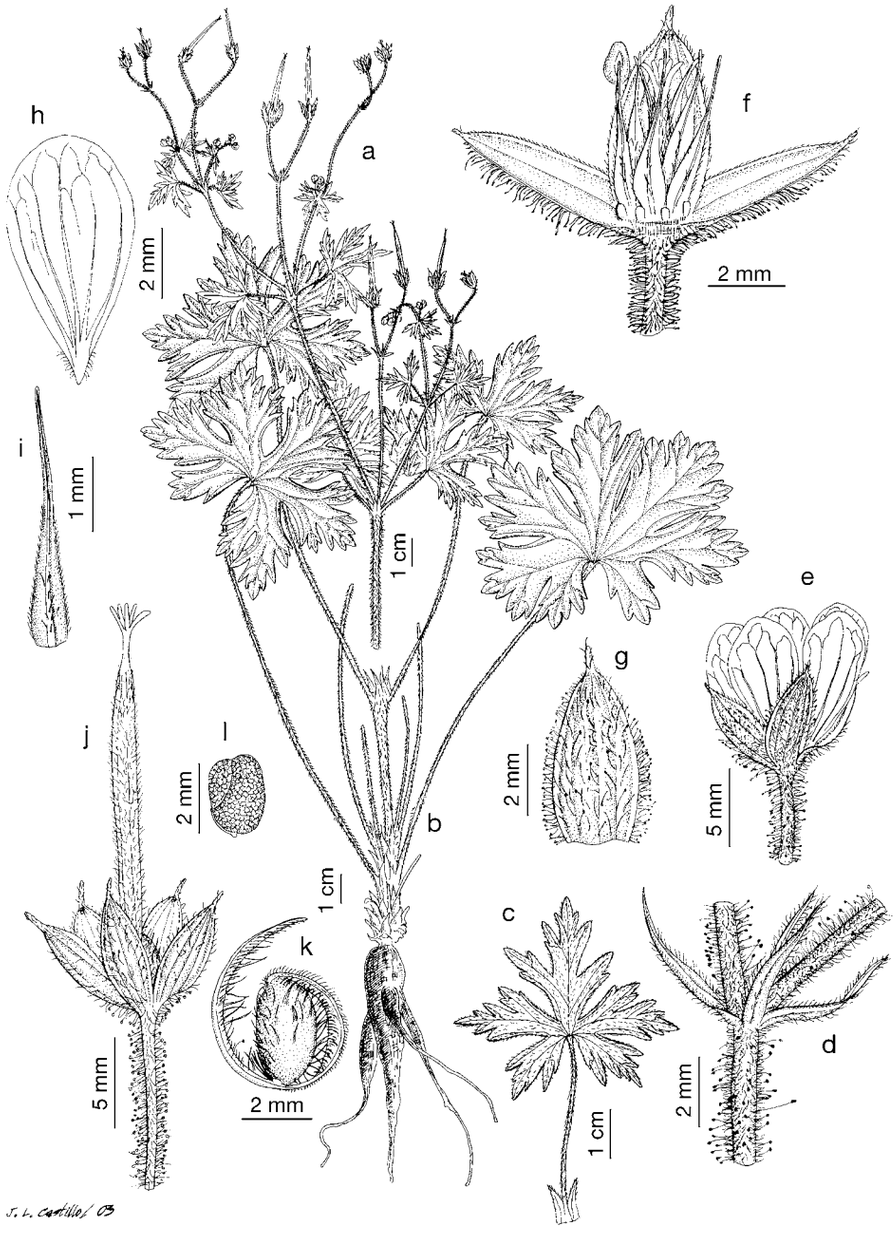


Fig. 305. *Geranium fallax*. a, b. Habit. c. Leaf. d. Bracteoles. e. Flower. f. Flower, two sepals and petals removed. g. Sepal. h. Petal. i. Staminal filament. j. Fruit. k. Mericarp. l. Seed. (Based on: a, c-l, *Beck 13831*, MA; b, *Troncoso 11307*, CORD).

Perennial herbs, 18-85(100) cm tall. *Rootstock* 4.2-12.7 mm in diameter, vertical, not tuberculate, turnip-shaped, with thickened roots. *Stem* erect or ascending, leafy, not rooting at nodes, stolons absent, without vegetative stems, with patent, eglandular hairs 0.4-1.4 mm long and, sometimes, patent, glandular hairs 0.4-0.7 mm long. *Basal leaves* in a deciduous rosette, cauline leaves opposite; leaf laminas 2.4-8.1 cm long, 1.9-8.9 cm wide, not peltate, palmatifid [ratio main-sinus length/middle segment length = 0.77-0.87], polygonal in outline, base cordate, not coriaceous, with nerves not projected, pilose, with appressed, eglandular hairs on both surfaces; segments 5-7, in 1 plane, middle segment rhombic, 3.2-10.6 mm wide at the base [ratio segment width at the base/middle segment length = (0.10)0.13-0.18(0.24)], 4-17-lobed in distal half [ratio secondary sinus length/middle segment length = (0.17)0.21-0.28(0.32)]; petioles up to 16.5 cm long, without abscission zone, terete, not swollen, not deflexed in age, with patent, eglandular hairs 0.4-1.6 mm long and, sometimes, patent, glandular hairs 0.4-0.8 mm long; stipules 3.6-13.4 mm long, 0.9-5 mm wide, lanceolate, free, papery, brownish red, with eglandular hairs on abaxial surface and on the margin (rarely glabrous), glabrous adaxially. *Inflorescence* a monochasial cyme; cymules 2-flowered, solitary [ratio cymule length/leaf length = 0.5-1.1(1.5)]; peduncles (15)31-51(100) mm long, with patent, eglandular hairs 0.3-1.1 mm long and, usually, patent, glandular hairs 0.4-1.2 mm long; bracteoles 2-5.5 mm long, 0.5-1.4 mm wide, linear-lanceolate, whorled; pedicels 26-42 mm long, with patent, eglandular hairs 0.3-1.1 mm long and patent, eglandular hairs 0.4-1.2 mm long. Flowers actinomorphic. *Sepals* (5.2)5.7-6.5(8.2) mm long, 2.2-3.7 mm wide, lanceolate, smooth, not accrescent, nerves 3, mucro (0.3)0.7-0.9(1.3) mm long [ratio mucro length/sepal length = (0.05)0.09-0.15(0.22)], with erect-patent, eglandular hairs 0.4-0.9 mm long and patent, glandu-

lar hairs 0.4-1.2 mm long on the abaxial surface, glabrous adaxially. *Petals* (4)4.7-7.5(9.9) mm long, 1.9-6.3 mm wide, erect-patent, rounded or slightly emarginate, without claw, purple, glabrous on both surfaces, ciliate on the basal margin, with hairs 0.2-0.3 mm long. *Stamens* 10, both whorls bearing anthers; filaments 2-5.3 mm long, lanceolate, yellow, with eglandular hairs 0.2-0.3 mm long on the abaxial surface and margin; anthers 0.4-1.2 mm long, blue. Nectaries 5, hemispheric, glabrous. *Gynoecium* 2.2-5 mm long, purple. *Fruit* 18.1-23.8 mm long, erect, discharge of seed-ejection type; mericarps 2.8-4 mm long, 1.3-2 mm wide, without a strand of fibers, not compressed at the apex, smooth, without basal beak, with a basal callus, without a basal prong, brown to black, with erect-patent, eglandular hairs 0.4-0.9 mm long and patent glandular hairs 0.4-0.9 mm long; rostrum 13.2-17.4 mm long, with a narrowed apex (0)0.9-1.1(1.9) mm long, not twisted, with erect-patent, eglandular hairs 0.2-0.9 mm long and patent, glandular hairs 0.4-1.2 mm long; stigmatic remnants (1.2)1.4-1.7(4) mm long, with 5 hairy lobes. *Seeds* 1.9-2.7 mm long, 0.9-1.5 mm wide, finely reticulate, uniformly colored, brown, glabrous. Cotyledons with entire margin. Figs. 305, 306.

Pollen. *Geranium*-type (Aedo & al. 2005a: 6).

Chromosome number. Unknown.

Phenology. Collected in flower from January to December.

Distribution. This species ranges from central Peru and Bolivia to northwestern Argentina (Fig. 307).

Habitat. Roadsides, cultivated grounds, rocky and grassy slopes, river shores, meadows, shrublands, and *Alnus* Mill., *Eugenia* L., *Podocarpus* Pers., and *Polylepis* Ruiz & Pav. forests; 1200-4300 m.

Representative specimens examined. **Argentina.** Catamarca: pr. mina Capillita, 27°22'S, 66°22'W, 14 Feb. 2008, *Aedo 15346* (MA); El Rodeo, Sierra de Ambato, 28°34'S, 66°7'W, 12 Jan. 1957, *Calderón 1282* (SI). Córdoba: Sierra Achala, pr. Los Gigantes, 31°21'S, 64°48'W, 7 Feb. 2008, *Aedo 15251* (MA); San Javier, Quebrada de Tigre, 32°0'S, 65°0'W, 4 Feb. 1940, *Bridarolli 1416* (LP). Jujuy: Humahuaca, 23°12'S, 65°20'W, 7 Feb. 1941, *Hunziker 1302* (NY);

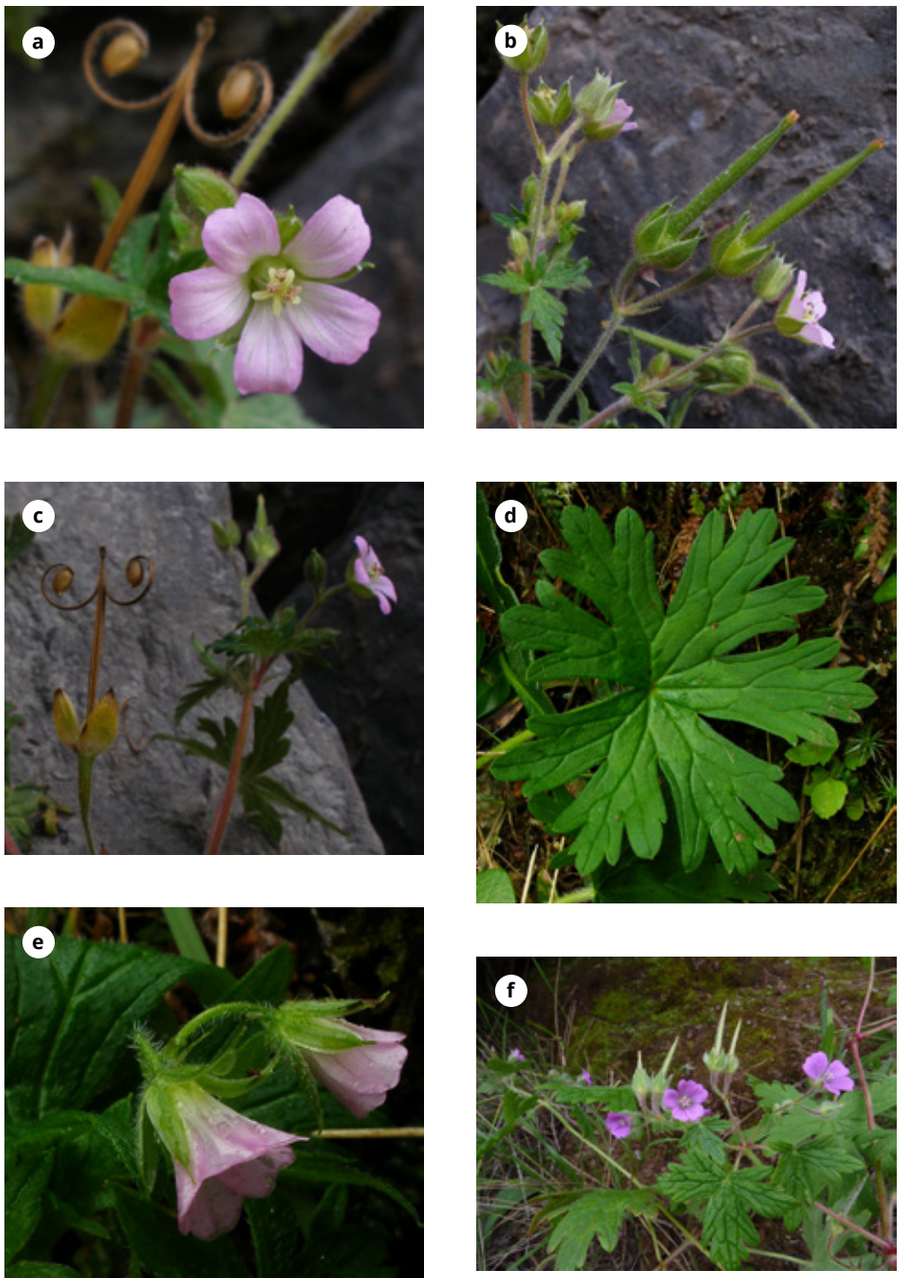


Fig. 306. *Geranium fallax* (Based on: a-c, *Aedo & al. 14587,* MA; d, e, *Aedo 15245,* MA; f, *Aedo 21322,* MA).

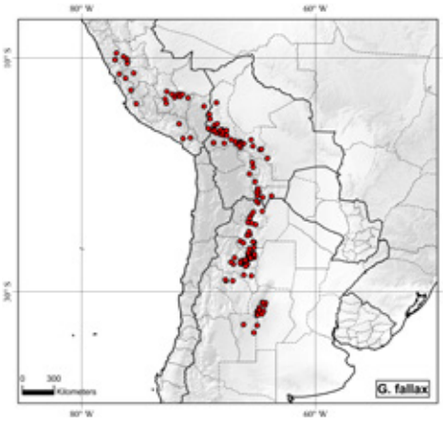


Fig. 307. Distribution of *Geranium fallax*.

Capital, quebrada de Jaire, 24º15'S, 65º7'W, 6 Mar. 1987, *Cabrera & al. 34321* (MO). La Rioja: Famatina, Sierra Famatina cueva de Noronha, 28º58'S, 67º42'W, Feb. 1980, *Cei s.n.* (MERL); Velazco, 29º4'S, 67º4'W, 6 Mar. 1944, *Soriano 932* (SI). Salta: Santa Victoria, Rodeo Pampa, 22º15'S, 65º3'W, 26 Mar. 2014, *Aedo 21477* (MA); pr. Pueblo Viejo, 25º49'S, 66º10'W, 21 Mar. 2014, *Aedo 21384* (MA).San Luis: Pringles, Carolina, 32º49'S, 66º9'W, 5 Feb. 1984, *Del Vitto & Wittenstein 644* (MERL); San Francisco, 33º30'S, 65º16'W, 4 Nov. 1958, *Ruiz Leal s.n.* (MERL). Tucumán: Trancas, pr. Hualinchay, camino hacia Tolombón, 26º20'S, 65º39'W, 16 Feb. 2008, *Aedo 15368* (MA); Tafí del Valle, pr. El Rincón, 26º58'S, 65º45'W, 12 Feb. 2008, *Aedo 15301* (MA). **Bolivia.** Chuquisaca: Sucre-Ravelo, 18º56'S, 65º23'W, 5 Aug. 2007, *Velayos & Aedo 11164* (MA). Cochabamba: Calomi, 17º0'S, 65º30'W, 8 Jan. 1949, *Brooke 5081* (BM, GH, PH, UC); pr. Llavini, 17º39'S, 66º25'W, 29 July 2007, *Aedo & al. 14391* (MA). La Paz: de Unduavi a Puente Villa, 16º19'S, 67º53'W, 12 Aug. 2007, *Aedo & al. 14587* (MA); entre Ovejuyo y Huni, 16º31'S, 67º57'W, 16 Aug. 2007, *Aedo & al. 14749* (MA). Potosí: Quijarro, camino de Potosí a Khucho Ingenio, 5 km antes de llegar a Khucho Ingenio, 19º55'S, 65º39'W, 16 Jan. 1988, *Schulte 92* (MA). Santa Cruz: provincia M.M. Caballero, comunidad La Laguna y subida hacia el Cerro Punguillo y Laguna Brava, 17º48'S, 64º37'W, 7 Nov. 2003, *Vargas & al. 7033* (MO); Vallegrande, Palmarito ca 16 km S de Vallegrande, camino de Pucará, 18º35'S, 64º6'W, 26 Feb. 2002, *Arroyo & al. 1812* (MO). Tarija: Mendez, Paicho Norte, al NE proximo al límite con Sucre, 21º12'S, 64º54'W, 17 Feb. 2007, *Linneo & Perales 921* (MA, MO); Arce, Padcaya, Reserva Nacional Tariquía, campamento Campo los Pinos, 21º55'S, 64º31'W, 3 June 2005, *Serrano & al. 6035* (MA). **Peru.** Ancash: Huari, San Marcos, Yanacancha, campamento de la minera Antamina, 9º34'S, 77º2'W, 25 Mar. 2004, *Cano & al. 3429* (MA); Bolognesi, Usgor, debajo de Chiquian, 10º9'S, 77º9'W, 19 May 1950, *Ferreyra 7568* (MA). Apurimac: at km 20 on Cusco road, 6-7 km NNW from Abancay, 13º30'S, 72º52'W, 19 Dec. 1962, *Iltis & Ugent 715* (BH); quebrada de Quera, Lambrama, Abancai, 13º52'S, 72º46'W, 20 July 1940, *[illegible] 1964* (GH). Arequipa: Cailloma, Coporaque, valle del Colca, 15º38'S, 71º40'W, 2 Sep. 1986, *Treacy 715* (F); Arequipa, 16º53'S, 71º20'W, 4 Apr. 1937, *Stafford 625* (BM, K). Cuzco: Anta, Santa Ana, El Chaccan, 12º52'S, 72º43'W, 28 Jan. 1973, *Brunel 354* (MO); Quispicanchi, entre abra Walla Walla y Marcapata, a 210 km de Cusco, 13º25'S, 70º54'W, 21 Apr. 1988, *Núñez & al. 9080* (MO). Huancavelica: provincia Tayacaja, Andaimarca, entre Colcabamba y Surcubamba, 13º55'S, 75º20'W, 14 Apr. 1954, *Tovar 1817* (USM). Huánuco: Huánuco, Jan. 1787, *Ruiz & Pavón s.n.* (MA); Pillao, 10º17'S, 76º7'W, 20 Feb. 1946, *Woytkowski 34115* (G, MO, UC). Junín: pr. Palca, 11º17'S, 75º33'W, 28 Mar. 2005, *Aedo & Galán de Mera 10948* (MA). Lima: Huarochiri, between Infiernillo and Río Blanco, 11º44'S, 76º15'W, 3 June 1940, *Asplund 11358* (S); Yauyos, Cuchapaya, arriba del camo de futbol de Tupe, 12º44'S, 75º48'W, 3 Jan. 1952, *Cerrate 1017* (MA, USM). Pasco: provincia Cerro, Huariaca, 10º27'S, 76º6'W, 24 June 1940, *Asplund 11958* (S). Puno: Pillahuata, Cerro de Cusilluyoc, 13º7'S, 71º24'W, 3 May 1925, *Pennell 14133* (F, PH).

Discussion. Geranium fallax resembles *G. venturianum* and *G. tablasense*, but unlike these species always has glandular hairs, sometimes restricted to pedicels, sepals, and fruits, but usually spread all over the inflorescence and stem. In *G. fallax* the petals are shorter than in the other two species and glabrous on both surfaces, with cilia on the basal margin; they are glabrous in *G. tablasense*, and hairy on the margin and abaxial base in *G. venturianum*. Additionally, *G. fallax* the narrowed apex of the fruit rostrum is shorter than in *G. venturianum* and *G. tablasense*. Specimens are occasionally misidentified as "*G. patagonicum*" [=*G. berteroanum*], which has leaves with obtriangular (not rhombic) segments. For a detailed discussion of differences between *G. fallax* and *G. berteroanum*, see that species.

Geranium totorense was based on a Steinbach collection from Cochabamba, Bolivia, which is now lost. According to the original description the specimen had glandular hairs on the inflorescence, rhombic leaves, and petals ca. 10 mm long; however, the number of flowers per cymule is not noted. These details and the type locality suggest that *G. totorense* is a synonym of *G. fallax*. The type collection for *G. bolivianum* is heterogeneous. The sheets at BM, F, GH, K, NY, P, and US are *G. fallax*, and the P sheet is here chosen as lectotype, but duplicates at MO, NY, and W have 1-flowered cymules without glandular hairs and belong to *G. soratae*. This typification is in accordance with the original description.

The Sessiliflorum Group—This group is characterized by its scapiform, cushion-like habit, its turnip-shaped rootstock, its eglandular indumentum, and its 1-flowered cymules arising usually directly from the rootstock, sometimes lacking pedicels. The leaves are palmatifid and the petals are usually of small size and without claw.

115. Geranium antrorsum Carolin, Proc. Linn. Soc. New South Wales ser. 2, 89: 357, pl. 6 fig. 14, pl. 7 fig. 10. 1965. Type locality: "Kosciusko Hotel dam, R. Carolin No. 778b, 24.1.1959 (NSW 66132)". Type: Australia. New South Wales, Kosciusko Hotel, 36º24'S, 148º25'E, 24 Jan. 1959, *R.C. Carolin 778b* (holotype, NSW-66132; isotype, K!).

Perennial herbs, 5.5-20 cm tall. *Rootstock* 3.9-11.6 mm in diameter, vertical, not tuberculate, turnip-shaped, without thickened roots. *Stem* scapiform, stolons absent, without vegetative stems. *Basal leaves* in a persistent rosette; leaf laminas (0.9)1.6-2.7(3.3) cm long, 1.3-4 cm wide, not peltate, palmatifid [ratio main-sinus length/middle segment length = 0.56-0.68], polygonal in outline, base cuneate to subtruncate (with basal leaf segments patent or upward), not coriaceous, with nerves not projected, pilose, with appressed, eglandular hairs on both surfaces; segments 5, in 1 plane, middle segment obtriangular, 2.3-6.8 mm wide at the base [ratio segment width at the base/middle segment length = (0.15)0.18-0.29], 3-5(7)-lobed at the apex [ratio secondary sinus length/middle segment length = (0.13)0.15-0.18(0.21)]; petioles up to 16 cm long, without abscission zone, terete, not swollen, not deflexed in age, with patent to antrorse, appressed, eglandular hairs 0.3-1.6 mm long; stipules 5.7-14.4 mm long, 1.2-3.5 mm wide, lanceolate, free, papery, brownish red, with

eglandular hairs on abaxial surface and on the margin, glabrous adaxially. *Cymules* 1-flowered, solitary [ratio cymule length/leaf length = (0.1)0.2-0.4(0.6)]; peduncles 4-12(21) mm long, with antrorse, appressed, eglandular hairs 0.2-1 mm long; bracteoles 3.5-7.1 mm long, 0.8-1.5 mm wide, lanceolate, opposite; pedicels absent or 6.5-37 mm long, with antrorse, appressed, eglandular hairs 0.2-0.9 mm long. Flowers actinomorphic. *Sepals* (4.3)5.1-6.4(8.2) mm long, 1.7-3.2 mm wide, lanceolate, smooth, not accrescent, nerves 3, mucro (1.2)1.3-1.9(2.9) mm long [ratio mucro length/sepal length = (0.20)0.23-0.36(0.45)], with erect-patent, eglandular hairs 0.5-0.8 mm long on the abaxial surface (patent hairs 1-1.4 mm long on the margin), glabrescent adaxially. *Petals* (3.6)4.1-7.4(9.2) mm long, 1.2-4.4 mm wide, erect-patent, rounded, without claw, purple, glabrous. *Stamens* 10, both whorls bearing anthers; filaments 2.4-3.6 mm long, lanceolate, yellow, pilose on the abaxial surface, ciliate on the proximal half, with hairs 0.2-0.3 mm long; anthers 0.6-0.9 mm long, yellow. Nectaries 5, hemispheric, glabrous. *Gynoecium* 2.5-4 mm long, purple. *Fruit* 13.9-16.5 mm long, erect, discharge of seed-ejection type; mericarps 2.6-3.9 mm long, 1.3-1.9 mm wide, without a strand of fibers, not compressed at the apex, smooth, without basal beak, with a basal callus, without a basal prong, brown, with erect-patent, eglandular hairs 0.3-0.8 mm long; rostrum 9-10.6 mm long, without a narrowed apex, not twisted, with erect-patent, eglandular hairs 0.2-0.9 mm long; stigmatic remnants (1)1.4-1.7(2.2) mm long, with 5 hairy lobes. *Seeds* 2-2.9 mm long, 1.2-1.7 mm wide, finely reticulate, uniformly colored, brown, glabrous. Cotyledons with entire margin. Fig. 308.

Pollen. *Geranium*-type (Aedo & al. 2005a: 7).

Chromosome number. Unknown.

Phenology. Collected in flower from December to April.

Distribution. This species ranges through New South Wales and Victoria, in southeastern Australia (Fig. 309).

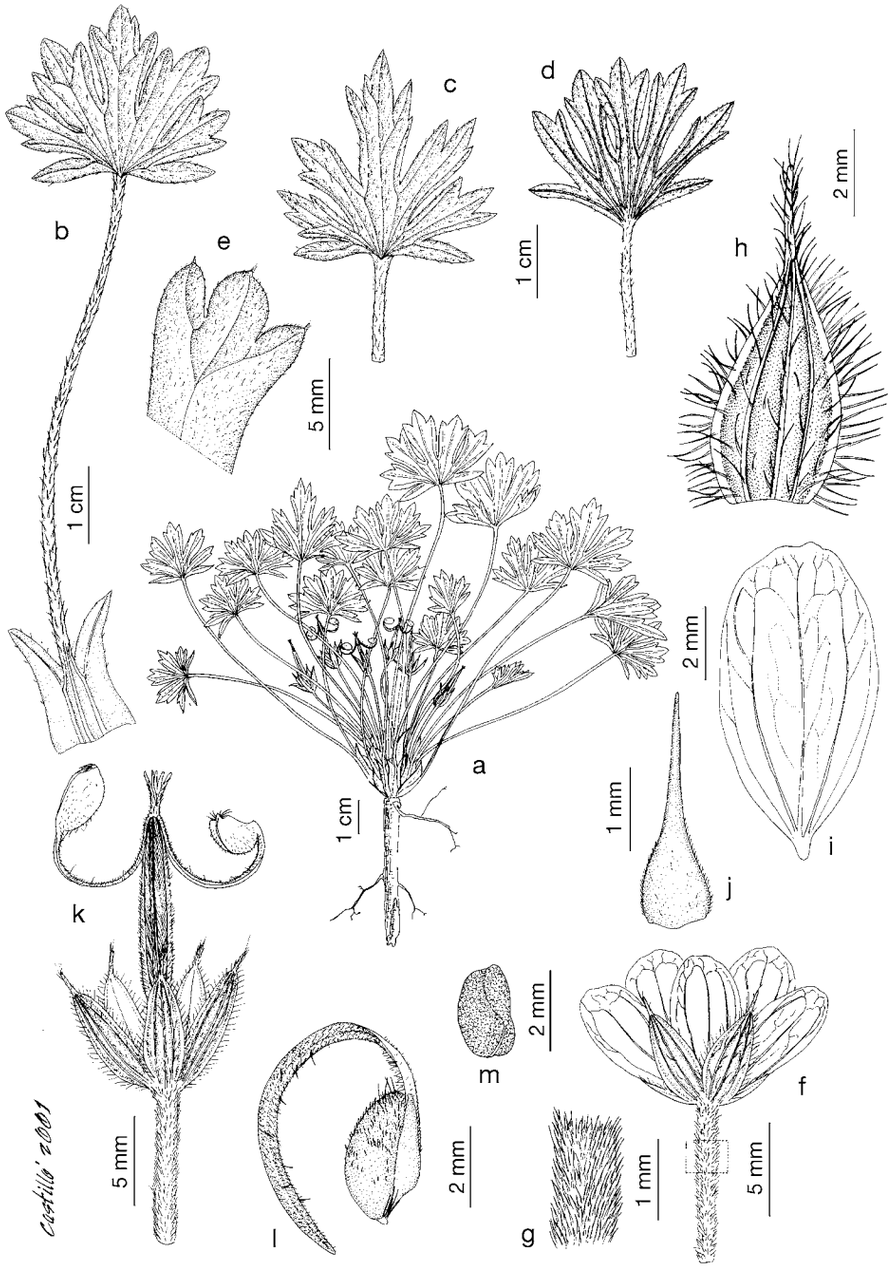


Fig. 308. *Geranium antrorsum*. a. Habit. b-d. Leaves. e. Apex of leaf, adaxial view. f. Flower. g. Pedicel. h. Sepal. i. Petal. j. Staminal filament. k. Fruit. l. Mericarp. m. Seed. (Based on: a, c, k-m, *Carolin 798B*, SYD; b, e, *Eichler 13652*, SYD; d-f, *Carolin s.n.*, *s.d.*, SYD; g-h, j, *Adams 2493*, L; i, *Beauglehole 33303*, SYD).

Fig. 309. Distribution of *Geranium antrorsum*.

Habitat. Dry grassland with dominant *Poa* L. tussocks, and open *Eucalyptus* L'Hér. forests, on granites; 1100-2000 m.

Additional specimens examined. **Australia.** New South Wales: summit of Mt. Franklin, 35°29'S, 148°46'E, 8 Dec. 1984, *Briggs 1760* (SYD); Kiandra-Adaminaby, 35°29'S, 148°52'E, 12 Feb. 1957, *Carolin B103* (SYD); Mt. Gingera, Brindabella Range, 35°35'S, 148°46'E, 19 Jan. 1983, *Coveny 11530* (NSW); Cave Creek, 0.4 km N of the Blue Waterholes, 35°37'S, 148°39'E, 8 Apr. 1969, *Rodd 815* (NSW); Cooleman Plain, Currango, 35°37'S, 148°39'E, Dec. 1962, *Walker 950* (K); Gurrangorambla Creek, Currango Plain, N of Tantangara Dam, 35°40'S, 148°43'E, 19 Jan. 1971, *Thompson 776* (NSW); Cotter River district, between Jack's Creek and the Cotter River, 35°41'S, 148°50'E, 14 Dec. 1960, *Schodde 1220* (NSW); Yarrangobilly Caves, 35°43'S, 148°29'E, 21 Jan. 1959, *Carolin 761* (SYD); Southern Tablelands, Mt. Kosciusko National Park, Yarrangobilly Caves, Castle Walk, 35°43'S, 148°30'E, 11 Jan. 1979, *Jackson & Canning 88* (US); Southern Tablelands, Namadgi National Park, 2 km SSE of Mt. Kelly, Sams Creek, 35°44'S, 148°52'E, 22 Jan. 1992, *Makinson 1036* (NSW); Coopers Swamp, Gourock Range, 25 mi S of Captains Flat, Monaro Shire, 35°56'S, 149°28'E, 11 Dec. 1969, *Adams 2493* (L); Happy Jack's Plain, hedawaters of the H.J. River, 24 km S of Kiandra, 36°1'S, 148°28'E, 17 Jan. 1958, *Thompson s.n.* (NSW); Kosciusko State Park, Happy Jacks Plains, N of Happy Jacks Road, W of Tolbar Road, ca. 20 km WSW od Adaminaby, 36°2'S, 148°31'E, 6 Feb. 1966, *Eichler 19016* (AD, L); Kosciusko National Park, Pipers Creek Valley, 36°21'S, 148°31'E, 26 Jan. 1975, *Thompson 2288* (NSW); Monaro, 36°22'S, 149°3'E, Dec. 1939, *Beadle s.n.* (SYD); White's River Hut, near Guthega, 36°22'S, 148°22'E, Jan., *Carolin 798B* (SYD); White's River Hut, 36°22'S, 148°22'E, Jan., *Carolin s.n.* (SYD); Mt. Kosciusko National Park, Perisher Valley, 36°24'S, 148°25'E, 9 Feb. 1972, *Beamish 1565* (BH); Kosciusko National Park, Mt. Piper, 36°24'S, 148°25'E, 23 Jan. 1976, *Thompson 2435* (NSW); Charlotte Pass, Mt. Kosciusko, 36°25'S, 148°19'E, 5 Feb. 1957, *Carolin B78* (G); between Charlotte Pass and Snowy River, 5.5 km ENE of Mt. Kosciusko, 36°25'S, 148°19'E, 5 Feb. 1957, *Eichler 13652* (AD, SYD); Hotel Kosciusko, 36°27'S, 148°14'E, 21 Jan. 1958, *Woodward s.n.* (SYD); Nimmitable, 36°31'S, 149°16'E, 9 Feb. 1908, *Cambage 1850* (NSW, SYD); Kosciusko National Park, Boogong Creek near Dead Horse Gap, 36°31'S, 148°16'E, 22 Feb. 1976, *Thompson 2398* (NSW).Victoria: Mt. Buffalo National Park, 1.6 km from The Horn turntable toward the Chalet, 36°39'S, 146°46'E, 14 Jan. 1969, *Canning 1764* (L); East Gippsland, Native Dog Plain, Benambra-Wulgulmerang road, 36°53'S, 148°5'E, 7 Jan. 1970, *Beauglehole & al. 33303* (SYD); Horsehair Plain, 34 km from Omeo, toward Hotham Heights, 37°2'S, 147°20'E, 8 Jan. 1969, *Canning 1600* (L); Omeo, 37°5'S, 147°35'E, 1930, *Meebold 5982* (M); Nunniong Plains, East Gippsland, 37°8'S, 147°56'E, 20 Jan. 1971, *Beauglehole 36304* (SYD); Snowy Range, Holmes Plain, Mt. Wellington, 37°30'S, 146°48'E, 27 Dec. 1972, *Beauglehole 40759* (SYD).

Discussion. Geranium *antrorsum* is a stemless species with a vertical rootstock that is short branched at the apex. The leaves are arranged in a rosette and overtop the cymules. The 1-flowered cymules are borne on the rootstock. On the same individual a pair of bracteoles divide the peduncle from the pedicel on some cymules, but peduncles without bracteoles also occur. *Geranium antrorsum* is easily recognized by the patent or upwardly oriented basal leaf segments, giving a cuneate to subtruncate aspect to the leaf, and by the antrorsely appressed eglandular hairs of the peduncles and pedicels. It has usually been considered to be closely related to *G. brevicaule* and *G. sessiliflorum*. Those species, however, have cordate leaves and pedicels with patent to retrorse hairs. In addition, *G. antrorsum* has sepals with a mucro 1.2-2.9 mm long, which shows some overlap with *G. brevicaule* (mucro 0.4-1.9 mm long), but no overlap with *G. sessiliflorum* (mucro 0.3-1.1 mm long).

116. Geranium brevicaule Hook., J. Bot. (Hooker) 1: 252. 1834. *Geranium sessiliflorum* subsp. *brevicaule* (Hook.) Carolin, Proc. Linn. Soc. New South Wales ser. 2, 89: 357. 1965. Type locality: "Mr. Gunn, (n. 256. and n. 324)". Type: Australia. Tasmania, *R.C. Gunn 256* (lectotype, designated by Carolin 1965: 357, K!; isolectotypes, BM-000598340!, F!) [the BM sheet indicates 5 Jan. 1841 as date, which would be a mistake].

Geranium sessiliflorum var. *glabrum* R. Knuth, Bot. Jahrb. Syst. 37: 565. 1906. Type locality: "Neu-Seeland (nach Hooker; Bastian!)". Type: New Zealand. [without locality], *A. Bastian s.n.* (lectotype, designated by Carolin 1965: 357, K!).

Geranium sessiliflorum var. *arenarium* G. Simpson & J.S. Thomson, Trans. & Proc. Roy. Soc. New Zealand 73: 158. 1943. Type locality: "Type specimen from Paterson's Inlet, Stewart Island, in the Herbarium Plant Reseach Boreau, Wellington". Type: New Zealand. Stewart Island, Paterson's Inlet, 47°00'S, 168°00'E, *G. Simpson & J.S. Thomson s.n.* (CHR, not located according to Carolin 1965: 357).

Geranium sessiliflorum var. *maculatum* G. Simpson & J.S. Thomson, Trans. & Proc. Roy. Soc. New Zealand 73: 157. 1943. Type locality: "Type specimen from the shores of Lake Lyndon, between the grassland and the lake, in the Herbarium Plant Reseach Boreau, Wellington". Type: New Zealand. Lake Lyndon, 43°18'S, 171°42' E, *G. Simpson & J.S. Thomson s.n.* (lectotype, designated by Carolin 1965: 356, CHR-75697!).

Geranium sessiliflorum subsp. *novaezelandiae* Carolin, Proc. Linn. Soc. New South Wales ser. 2, 89: 356. 1965. *Geranium sessiliflorum* var. *novaezelandiae* Carolin, Proc. Linn. Soc. New South Wales ser. 2, 89: 356. 1965, nom. illeg. Type locality: "Saddle between Shin & Hodder Rivers, Inland Kaikoura Mts., Marlborough, B. G. Hamlin No. 915, 4 Dec. 1960 (WELT 11508)". Type: New Zealand. Inland Kaikoura Mts., Marlborough, 41°30'S, 173°30' E, 4 Dec. 1960, *B.G. Hamlin 915* (holotype, WELT-11508!; isotype, UC!).

Geranium socolateum Heenan & Molloy, Phytotaxa 415(1): 40, 42 fig. 5. 2019. Type locality: ""NEW ZEALAND. South Canterbury, Manahune, Waratah Road, 520 m, among limestone boulders, on slope and at top of bluffs where it is scattered among herbs and grasses, 16 December 2015, P. B. Heenan s.n. (holotype, CHR 641241!)". Type: New Zealand. South Island, South Canterbury, Manahune, Waratah Road, 44°12'S, 170°40' E, 16 Dec. 2015, *P.B. Heenan s.n.* (holotype, CHR-641241 image!).

Perennial herbs, 2.5-15.5 cm tall. *Rootstock* 3.2-10.5 mm in diameter, vertical, not tuberculate, usually turnip-shaped, without thickened roots. *Stem* scapiform, cushion-like, stolons absent, without vegetative stems. *Basal leaves* in a persistent rosette; leaf laminas (0.7)1-1.7(2.5) cm long, 0.8-3.1 cm wide, not peltate, palmat-

ifid [ratio main-sinus length/middle segment length = 0.70-0.76], polygonal in outline, base cordate (with basal leaf segments downward), not coriaceous, with nerves not projected, pilose, with appressed, eglandular hairs on both surfaces; segments 5, in 1 plane, middle segment obtriangular, 1.1-4.7 mm wide at the base [ratio segment width at the base/middle segment length = (0.19)0.24-0.35(0.42)], 3-7-lobed in distal half [ratio secondary sinus length/middle segment length = (0.10)0.21-0.26(0.35)]; petioles up to 13 cm long, without abscission zone, terete, not swollen, not deflexed in age, with patent to retrorse, appressed, eglandular hairs 0.3-1.2 mm long; stipules 2.7-8.8 mm long, 0.9-2.5 mm wide, lanceolate, free, papery, brownish red, with scattered, eglandular hairs on both surfaces and on the margin. *Cymules* 1-flowered, solitary [ratio cymule length/leaf length = 0.14-1]; peduncles 3-11(16) mm long, with patent to retrorse, eglandular hairs 0.1-1.1 mm long; bracteoles 2-6.5 mm long, 0.6-1.2 mm wide, lanceolate, opposite; pedicels absent or 3.3-43 mm long, usually with patent to retrorse, eglandular hairs 0.1-1.1 mm long. Flowers actinomorphic. *Sepals* (3.3)4.4-5.7(7.1) mm long, 1.4-3.1 mm wide, lanceolate, smooth, not accrescent, nerves 3, mucro (0.4)0.9-1.3(1.9) mm long [ratio mucro length/sepal length = (0.14)0.20-0.26(0.38)], with erect-patent, eglandular hairs 0.3-0.6 mm long on the abaxial surface (patent hairs 1-1.7 mm long on the margin), glabrescent adaxially. *Petals* 2.8-5.5(6.5) mm long, 1-3.1 mm wide, erect-patent, rounded, without claw, deep pink to white, glabrous, rarely sparsely ciliate on the basal margin, with hairs 0.2-0.3 mm long. *Stamens* 10, both whorls bearing anthers; filaments 1.6-3 mm long, lanceolate, yellow, glabrous on the abaxial surface, ciliate on the basal margin, with hairs 0.1-0.2 mm long; anthers 0.4-0.7 mm long, yellow. Nectaries 5, hemispheric, glabrous. *Gynoecium* 2-3.4 mm long, unknown color. *Fruit* 8.4-17.6 mm long, erect, discharge of seed-ejection type; mericarps 2.2-4.1 mm long, 1-1.7 mm wide, without a strand of fibers, not compressed at the apex, smooth, without basal beak, with a basal callus, without a basal prong, brown, with erect-patent, eglandular hairs 0.2-1.1 mm long; rostrum 5.1-11.7 mm long, without a narrowed apex, not twisted, with erect-patent, eglandular hairs 0.1-0.6 mm long; stigmatic remnants 0.9-1.2(1.6) mm long, with 5 hairy lobes. *Seeds* 1.5-2.8 mm long, 0.7-1.4 mm wide, finely reticulate, uniformly colored, brown, glabrous. Cotyledons with entire margin. Fig. 310.

Pollen. *Geranium*-type (Aedo & al. 2005a: 7).

Chromosome number. 2*n* = 52.

Phenology. Collected in flower from January to December.

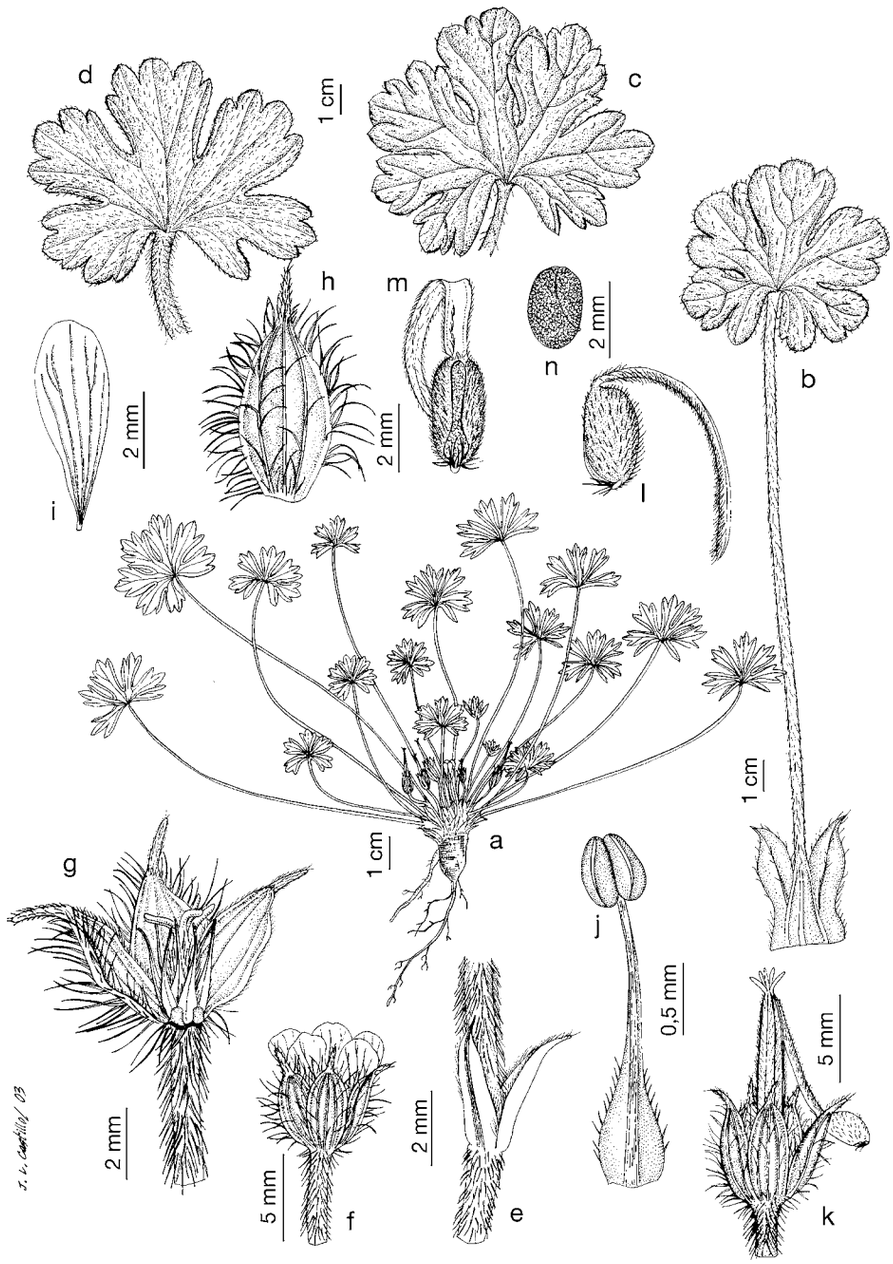


Fig. 310. *Geranium brevicaule*. a. Habit. b-d. Leaves. e. Bracteoles. f. Flower. g. Flower without petals. h. Sepal. i. Petal. j. Stamen. k. Fruit. l, m. Mericarps. n. Seed. (Based on: a, c-n, *Morris 86146*, HO; b, *Hynes s.n.*, AK-223476).

Distribution. This species ranges from southeastern Australia and Tasmania to New Zealand (Fig. 311).

Habitat. Sand dunes, lake shores, grassland, rock crannies on dry coastal hillsides, and open *Eucalyptus* L'Hér. forests; 0-1600 m.

Representative specimens examined. **Australia.** New South Wales: Bankstown City Council's Native Reserve, 7 Sylvan Grove, Picnic Point, 14 Feb. 1989, *Miller 22* (NSW); Kosciusko Hotel Dam, 36º30'S, 148º12'E, 24 Jan. 1959, *Carolin 778a* (K). Tasmania: Preservation Is., 40º29'S, 148º3'E, 7 Oct. 1979, *Harris s.n.* (HO); Ragged Jack, 41º33'S, 147º34'E, 24 Mar. 1980, *Noble 29164* (HO); Ben Lomond, 41º34'S, 147º40'E, Jan. 1979, *Kirkpatrick s.n.* (HO); Arthur Lakes, 41º59'S, 146º55'E, 6 Feb. 1960, *Eichler 16940* (AD); Port Arthur, 43º8'S, 147º50'E, Jan. 1929, *Ecbhin s.n.* (HO). Victoria: Snowfields, Snowy Plain, 37º22'S, 146º44'E, 7 Jan. 1991, *Chesterfield 3013* (AD). **New Zealand.** New Zealand North Is.: Hora Hora, Middle Waikato, 37º59'S, 175º38'E, 16 Nov. 1912, *Petrie s.n.* (WELT); Te Whaiti, 38º35'S, 176º47'E, 14 Jan. 1920, *Matthews S.N.* (AK); plateau at E base of Te Haehaeanga Mt., E of Lake Taupo, 38º41'S, 176º5'E, 13 Feb. 1949, *Fosberg 30464* (NY, RSA); Tewaka Range, 39º15'S, 176º37'E, Jan. 1972, *Druce s.n.* (CHR); Wellington Heads, exposed shore of Cook Strait, 41º18'S, 174º38'E, 30 Mar. 1949, *Walker 5107* (US). New Zealand South Is.: Lake Rotoiti, 41º5'S, 172º50'E, 23 Dec. 1968, *Esler s.n.* (AK); Tophouse, Nelson, 41º46'S, 172º54'E, Nov. 1959, *Woods s.n.* (AK); Lake Lyndon, Porter Pass, 43º15'S, 171º40'E, 30 Dec. 1996, *Hörandl & al. 7849* (NY); Lake Lyndon, 43º15'S, 171º40'E, 9 Apr. 1983, *Moore 8357* (CANB); Hooker valley track to Hooker River, 43º45'S, 170º8'E, 27 Feb. 1981, *Cameron 387* (AK Canterbury, Craigmore, Moa Valley, 44º27'S, 170º57'E, 9 Nov. 2020, *Frank s.n.* (CHR); Stewart Is., Mason Bay, 46º56'S, 167º44'E, 15 Jan. 1940, *Attwood s.n.* (AK).

Fig. 311. Distribution of *Geranium brevicaule*.

Discussion. Geranium brevicaule is quite similar to *G. antrorsum* in general appearance. Both species share a stemless habit, a rosette of leaves longer than the cymules, cymules borne on the rootstock and a relatively long sepal mucro. However, *G. brevicaule* can be easily distinguished by its pedicels with patent to retrorse hairs (antrorse hairs in *G. antrorsum*), and by the downwardly oriented basal leaf segments (patent or upwardly oriented in *G. antrorsum*). In addition, *G. antrorsum* has a longer gynoecium and rostrum than *G. brevicaule*. *Geranium sessiliflorum* is a very variable species with a large geographical distribution in South America, and includes most of the differentiating characters proposed for *G. brevicaule*. Two quantitative characters, however, permit differentiation of the species, although with some overlap. The petals of *G. brevicaule* are shorter than in *G. sessiliflorum*, and the sepal mucro of *G. brevicaule* is longer than in *G. sessiliflorum*. The ratio of mucro length to sepal length also supports this difference. Carolin (1965: 356) considered *G. sessiliflorum* to include two subspecies, one endemic to New Zealand and the other restricted to southeastern continental Australia and Tasmania. He distinguished subsp. *novazelandiae* by the long hairs of the sepals tending to be inserted toward the margin (also on the abaxial surface on subsp. *brevicaule*), the relatively shorter sepal mucro (ca. 1 mm long in subsp. *novazelandiae*, 1 mm or longer in subsp. *brevicaule*), and longer petals (c. 1.5 times as long as the sepals in subsp. novazelandiae and shorter than to slightly exceeding the sepals in subsp. *brevicaule*). On the studied material I was not able to find any difference in sepal indument or mucro length between plants from Australia (including Tasmania) and from New Zealand. Petals of New Zealand plants are sometimes slightly longer than on those in Australian specimens, but great overlap was found in this character. Thus, I prefer to include all these plants within a single taxon that can be more consistently distinguished from the South American *G. sessiliflorum*.

117. Geranium cruentum Heenan & G.M. Rogers, New Zealand J. Bot. 59: 9, 6 fig.2. 2021. Type locality: "NEW ZEALAND. Canterbury, Lincoln, Landcare Research experimental nursery, 2 November 2013, P. B. Heenan s.n. (holotype: CHR 641111; isotypes: AK, CHR 641112, WELT)". Type: New Zealand. South Is., cultivated at Canterbury, Lincoln, Landcare Research experimental nursery from Von River valley, 45º09'S, 168º17'E, 2 Nov. 2013, *P.B. Heenan s.n.* (holotype, CHR-641111 image!; isotypes, AK, CHR-641112, WELT).

Perennial herbs, 7-11 cm tall. *Rootstock* 7.1-8.6 mm in diameter, vertical, not tuberculate, usually turnip-shaped, without thickened roots. *Stem* prostrate to decumbent, scapiform, cushion-like, not rooting at nodes, stolons absent, without vegetative stems. *Basal leaves* in a persistent rosette; leaf laminas 1.1-1.3(2) cm long, 1.3-1.6(2.3) cm wide, not peltate, palmatifid [ratio main-sinus length/middle segment length = 0.66-0.87], polygonal in outline, base cordate (with basal leaf segments downward), not coriaceous, with nerves not projected, sparsely to moderate hairy, with eglandular hairs on both surfaces (glabrous or with hairs restricted to nerves abaxially); segments 5, in 1 plane, middle segment elliptic to obovate, 2.2-3.3 mm wide at the base [ratio segment width at the base/middle segment length = 0.31-0.34], entire, rarely 2-3-lobed in distal half [ratio secondary sinus length/middle segment length = 0.10-0.24]; petioles up to 12.5 cm long, without abscission zone, terete, not swollen, not deflexed in age, with retrorse, appressed, eglandular

hairs 0.1-0.5 mm long; stipules 4-12 mm long, 1.2-6.5 mm wide, lanceolate, free, papery, pale-pink, glabrous. *Cymules* 1-flowered, solitary [ratio cymule length/leaf length = 0.7-0.8]; peduncles 10-24 mm long, with retrorse, appressed, eglandular hairs 0.1-0.5 mm long; bracteoles 3.8-4.8 mm long, 0.6-0.8 mm wide, lanceolate, opposite; pedicels absent or 17-26 mm long, with retrorse, appressed, eglandular hairs 0.2-0.3 mm long. Flowers actinomorphic. *Sepals* 4.2-6.6 mm long, 2-3.2 mm wide, lanceolate, smooth, not accrescent, nerves 3, mucro 1.3-1.5 mm long [ratio mucro length/sepal length = 0.2-0.3], with appressed, eglandular hairs 0.1-0.8 mm long on the abaxial surface (patent hairs 0.7-1.7 mm long on the margin), glabrescent adaxially. *Petals* 4.6-7.4 mm long, 2.3-3.8 mm wide, erect-patent, rounded, without claw, white, with pink veins, glabrous. *Stamens* 10, both whorls bearing anthers; filaments 2.5-3.5 mm long, lanceolate, white, glabrous or ciliate on the basal margin, with hairs 0.1-0.2 mm long; anthers 0.4-0.6 mm long, yellow. Nectaries 5, hemispheric, glabrous. *Gynoecium* 3.1-4 mm long, white. *Fruit* 11.8-13 mm long, erect, discharge of seed-ejection type; mericarps 2.4-2.6 mm long, 1.1-1.2 mm wide, without a strand of fibers, not compressed at the apex, smooth, without basal beak, with a basal callus, without a basal prong, brown, with erect-patent, eglandular hairs 0.4-0.5 mm long; rostrum 7-9 mm long, without a narrowed apex, not twisted, with erect-patent, eglandular hairs 0.1-0.3 mm long; stigmatic remnants 1.2-1.4 mm long, with 5 hairy lobes. *Seeds* 1.8-2.2 mm long, 1.2-1.5 mm wide, finely reticulate, uniformly colored, brown, glabrous. Cotyledons with entire margin. Fig. 312.

Pollen. Ornamentation not studied.

Chromosome number. 2*n* = 52.

Phenology. Collected in flower in November.

Distribution. This species is endemic to southern New Zealand (Fig. 313).

Habitat. Probably in wetlands.

Additional specimens examined. **New Zealand.** New Zealand South Is.: cultivated at Pohara, Golden Bay, from Von River valley, 45º9'S, 168º17'E, 18 Nov. 2001, *Courtney s.n.* (CHR); cultivated from Von

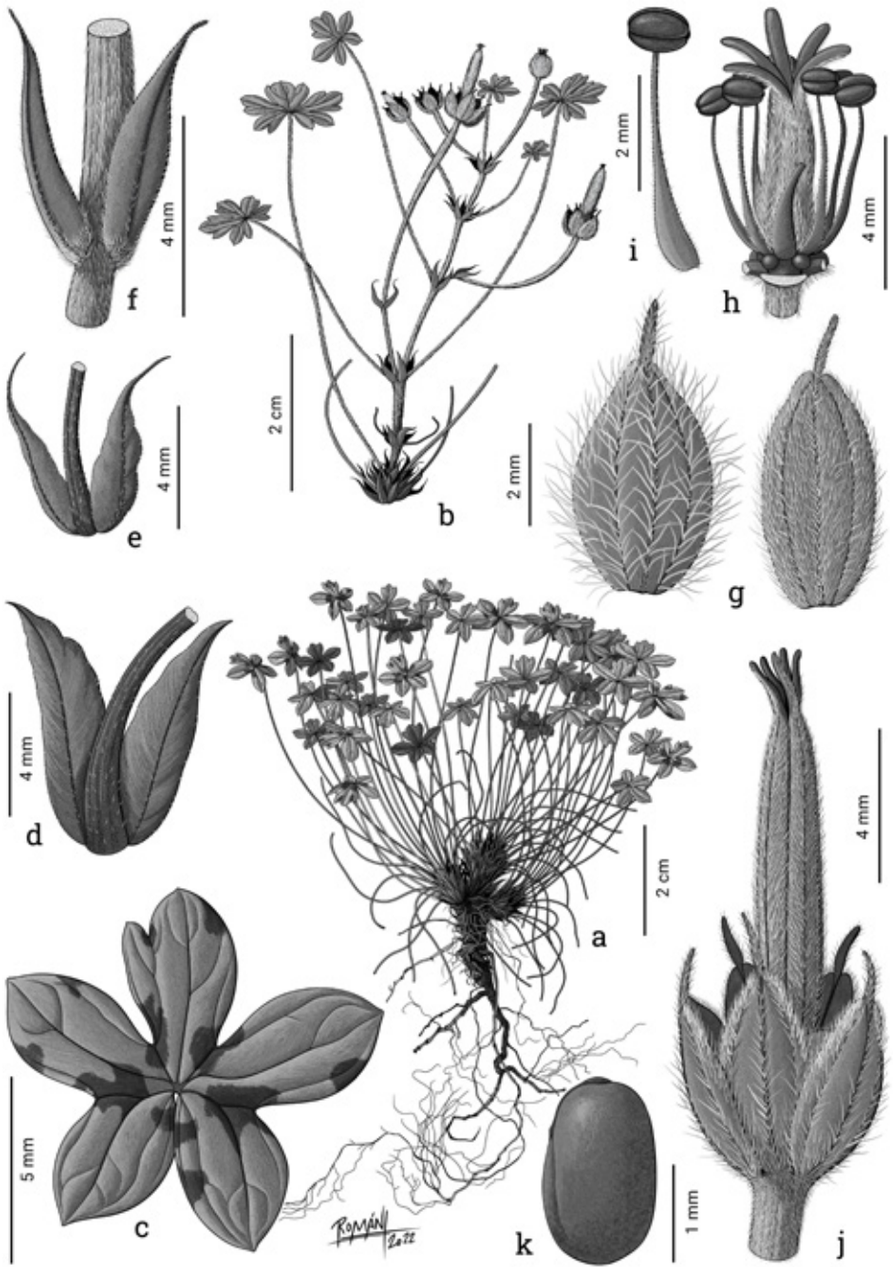


Fig. 312. *Geranium cruentum*. a, b. Habit. c. Leaf. d, e. Stipules. f. Bracteoles. g. Sepals h. Flower, petals removed. i. Staminal filament. j. Fruit. k. Seed. (Based on: a, c, *de Lange 9220*, CHR; b, d-k, *Druce s.n.*, CHR-546319).

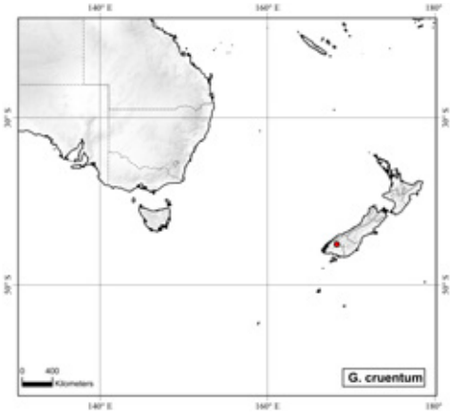


Fig. 313. Distribution of *Geranium cruentum*.

River valley, 45º9'S, 168º17'E, Oct. 2007, *de Lange 9220* (CHR).

Discussion. Geranium cruentum is quite similar to *G. brevicaule* with its scapiform, cushion-like habit and 1-flowered cymules. However, it is easily differentiated by its leaves which have elliptic to obovate segments, usually entire, darkly spotted below the primary sinus. According to Heenan & Rogers (2021) this species "is known from a single collection that was unknowingly made in the Von River valley, Southland. Repeated searching at the original site has not located any additional plants". In the protologue the type and other four additional collections are mentioned, all from cultivated origin.

118. Geranium sessiliflorum Cav., Diss. 4: 198, tab. 77 fig. 2. 1787. Type locality: "Habitat in Freto Magellanico, observatum a Commersonio. V.S. communicatum a D. de Jussieu". Type: Chile. Magallanes, Estrecho de Magallanes, 53°07'S, 70°56'W, *P. Commerson & J. Baret s.n.* (lectotype, indicated by Garilleti 1993: 91, and designated by Aedo & al., 2005: 20, MA-475750!; isolectotypes, FI-W!, P!).

Geranium caespitosum Walp., Nov. Actorum Acad. Caes. Leop.-Carol. Nat. Cur. 19(suppl. 1): 315. 1843, nom. illeg., non. E. James, 1823. Type locality: "Peruvia; Laguna de Titicaca". Type: Peru. Puno, Titicaca, 15°30'S, 70°00'W, *F.J. Meyen s.n.* (lectotype, designated by Aedo & al. 2005a: 20, K!).

Geranium bangii Hieron., Bot. Jahrb. Syst. 21: 314. 1895. Type locality: "Bolivia: crescit in monte Illimani, alt. s. m. 4670 m, mense Decembri florens (coll. boliv. n. 27); prope Capi, mense Martio florens, ubi leg. cl. Miguel Bang (n. 788 partim in Herb. Regio Berol.)". Type: Bolivia. Oruro, Capi, 18°47'S, 68°12'W, Mar. 1890, *M. Bang 788* (lectotype, designated by Knuth 1912: 85, B destroyed; lectotype, designated by Aedo 2012: 261, W!; isolectotypes, BM-000598347!, E-00088895!, F!, GH-00055004!, K!, MO!, NY!, US image!).

Geranium sessiliflorum var. *microphyllum* Kuntze, Revis. Gen. Pl. 3(3): 33. 1898. Type locality: "Bolivia: 4000 m Challapass". Type: Bolivia. Cochabamba, Tapacari, 17°33'S, 66°28'W, 17 Mar. 1892, *O. Kuntze s.n.* (lectotype, designated by Aedo & al. 2005a: 20, NY!).

Geranium sessiliflorum var. *lanatum* R. Knuth, Bot. Jahrb. Syst. 37: 565. 1906. Type locality: "Bolivia (Fiebrig a. 1903-04 n. 3291!)". Type: Bolivia. Without locality [probably from Tarija], *K. Fiebrig 3291* (lectotype, designated by Aedo & al. 2005a: 20, LD-1094628!).

Geranium weberbauerianum R. Knuth, Bot. Jahrb. Syst. 37: 556. 1906. Type locality: "Peru: bei Pucana (Bahnstation in der Richtung Puno-Cuzco) an Felsen in einer engen Schlucht auf Kalk 3700 m (Weberbauer n. 450. - Blühend und fruchtend im Februar)". Type: Peru. Puno, Lampa, Pucara, 15°02'S, 70°20'W, *A. Weberbauer 450* (no original material located).

Geranium sessiliflorum var. *compactum* R. Knuth in Engl., Pflanzenr. IV.129 (Heft 53): 85. 1912. Type locality: "Bolivia: La Paz-Palca-Illimani zwischen 3600-4800 m (Hauthal, Iter austro-americ. a. 1906 n. 323!)". Type: Bolivia. La Paz-Palca-Illimani, 17°21'S, 69°03'W, 1906, *R. Hauthal 323* (lectotype, designated by Aedo & al. 2005a, 20, GOET!).

Geranium tucumanum R. Knuth in Engl., Pflanzenr. IV.129 (Heft 53): 147. 1912. Type locality: "Argentinien: Sierra de Tucuman, bei La Ciénaga (Hieronymus-Lorents in Fl. Arg. a. 1874 n. 584--Typus in herb. Berol. sub nom. G. fallax Steud.!)". Type: Argentina. Tucumán, Sierra de Tucumán, La Ciénaga, 26°46'S, 65°39'W, 10 Jan. 1874, *P.G. Lorentz & G. Hieronymus 584* (holotype, B destroyed; lectotype, designated by Aedo 2012: 261, CORD-00003001!; isolectotype, K!).

Geranium pflanzii R. Knuth in Engl., Pflanzenr. IV.129 (Heft 53): 576. 1912. Type locality: "Bolivia: Palca-la Paz, 4300 m (Pflanz a. 1908 n. 206 -- Typus in herb. Berol.!).-- Blühend Februar". Type: Bolivia. La Paz, Palca-La Paz, 16°32'S, 68°00'W, 1908, *K. Pflanz 206* (holotype, B destroyed; no original material located; photos, G!, GH!, MO!, NY!).

Geranium santacruzense R. Knuth, Repert. Spec. Nov. Regni Veg. 18: 289. 1922, [31 Dec. 1922]. Type locality: "Argentinien: Prov. Santa Cru[z] (Caceres a. 1902 in Herb. Argent. no. 12395 - Typus in herb. Berol.!)". Type: Argentina. Santa Cruz, alrededores de Morro Gay, Río Gallegos, 51°37'S, 69°14'W, 1902, *E. Cáceres 12395* (holotype, B destroyed; lectotype, designated by Aedo 2012: 261, CORD-00003000!).

Geranium razuhillcaense R. Knuth, Repert. Spec. Nov. Regni Veg. 28: 2. 1930, ["razuhillcaënse"]. *Geranium sessiliflorum* var. *albatum* J.F. Macbr., Publ. Field Mus. Nat. Hist., Bot. Ser. 13(3): 533. 1949. Type locality: "Peru: Ayacucho, Prov. Huanta, Mte. Razuhuillca (Weberbauer a. 1926 n. 7495 in Exped. Capt Marshall Field Fund - Typus in Herb. Field Museum!)". Type: Peru. Ayacucho, Huanta, Mte. Razuhuillca, 12°54'S, 74°05'W, 4 Feb. 1926, *A. Weberbauer 7495* (holotype, F!; isotypes, G-00365802!, K!, US image!) [The type designation by Aedo & al. 2005: 20, was an error].

Geranium pallidifolium R. Knuth, Repert. Spec. Nov. Regni Veg. 28: 3. 1930. Type locality: "Bolivia: Nord-Yungas, Unduavi, 3300 m. (Buchtien a. 1912 n. 4128 -- Typus!). Dep. Cochabamba, Prov. Chapare, Cejawiese, 3000 m. (Steinbach a. 1929 n. 9528!) -- Blühend Februar, März". Type: Bolivia. Cochabamba, Chapare, 16°19'S, 67°54'W, 1912, *O. Buchtien 4128* (holotype, B destroyed; isotypes, GH-00055014 image!, NY!, US-00100892 image!) [designation of *Steinbach 9528* as lectotype by Aedo 2012: 262 was a mistake].

Geranium malpasense R. Knuth, Repert. Spec. Nov. Regni Veg. 34: 146. 1933. Type locality: "Bolivia: Cuesta Malpaso, Matten, 3200 m (Troll a. 1927 n. 705 -- Typus in herb. Berol.!). -- Blühend und fruchtend Dezember". Type: Bolivia. Chuquisacá, Cordillera de los Sombreros, Cuesta Malpaso, 19°10'S, 65°00'W, 13 Dec. 1927, *C. Troll 705* (holotype, B-100243720!; isotypes, JE-00004854!, M!).

Geranium staffordianum R. Knuth, Repert. Spec. Nov. Regni Veg. 40: 216. 1936. Type locality: "Peru: Cuzco, 4000 m (Stafford a. 1934 - Typus in herb. Kew!)". Type: Peru. Cuzco, 13°10'S, 71°54'W, Oct. 1933, *D. Stafford 208* (holotype, K!).

Perennial herbs, 2.2-8.9 cm tall. *Rootstock* 2.8-18.9 mm in diameter, vertical, not tuberculate, turnip-shaped, without thickened roots. *Stem* prostrate (when present), usually scapiform, cushion-like, not rooting at nodes, stolons absent, without vegetative stems. *Basal leaves* in a persistent rosette, cauline leaves usually absent, sometimes 1(2) pairs, opposite; leaf laminas (0.7)1.2-1.8(2.7) cm long, 0.8-3.1 cm wide, not peltate, palmatifid [ratio main-sinus length/middle segment length = 0.64-0.92], orbicular to polygonal in outline, base cordate (with basal leaf segments downward), not coriaceous, with nerves not projected, glabrescent to pilose (sometimes densely) on both surfaces, with appressed, eglandular hairs; segments 5, in 1 plane, middle segment rhombic to obtriangular, 0.6-4.1 mm wide at the base [ratio segment width at the base/middle seg-

ment length = (0.08)0.15-0.23(0.35)], 3-12-lobed in distal half [ratio secondary sinus length/middle segment length = (0.21)0.28-0.36(0.54)]; petioles up to 8 cm long, without abscission zone, terete, not swollen, not deflexed in age, with patent to retrorse, appressed, eglandular hairs 0.2-1.7 mm long; stipules 5.5-15.8 mm long, 0.8-3.1 mm wide, lanceolate, free, papery, brownish red, with eglandular hairs on abaxial surface and on the margin, glabrous adaxially. *Cymules* 1-flowered, solitary (rarely in aggregates) [ratio cymule length/leaf length = 0.1-0.8]; peduncles 1-5(14) mm long, with retrorse, appressed, eglandular hairs 0.3-1 mm long; bracteoles 5-6.1 mm long, 1-1.65 mm wide, linear-lanceolate, opposite; pedicels absent or 4-42 mm long, usually with retrorse to patent (rarely antrorse), appressed, eglandular hairs 0.3-1.2 mm long. Flowers actinomorphic. *Sepals* (3.8)4.7-6.2(7.1) mm long, 1.4-3.3 mm wide, lanceolate, smooth, not accrescent, nerves 3, mucro (0.3)0.4-0.7(1.1) mm long [ratio mucro length/sepal length = (0.04)0.07-0.15(0.19)], with erect-patent, eglandular hairs 0.3-0.6 mm long on the abaxial surface (patent hairs 0.9-2.8 mm long on the margin), glabrescent adaxially. *Petals* (4.5)6-12.8 mm long, 1.6-5 mm wide, erect-patent, rounded, rarely emarginate (notch 1 mm deep), without claw, purple, sometimes white, glabrous, rarely sparsely ciliate on the basal margin, with hairs 0.2-0.6 mm long. *Stamens* 10, both whorls bearing anthers; filaments 2.1-4.6 mm long, lanceolate, yellow, with eglandular hairs 0.2-0.3 mm long on the abaxial surface and margin; anthers 0.5-1.1 mm long, yellow. Nectaries 5, hemispheric, glabrous. *Gynoecium* 1.9-5 mm long, yellow. *Fruit* 6.8-19.5 mm long, erect, discharge of seed-ejection type; mericarps 1.8-4.5 mm long, 0.9-2.25 mm wide, without a strand of fibers, not compressed at the apex, smooth, without basal beak, with a basal callus, without a basal prong, brown, with erect-patent, eglandular hairs 0.1-0.6 mm long; rostrum 4.1-13 mm long, without a narrowed apex, not twisted, with erect-patent, eglandular hairs 0.2-1.2 mm long; stigmatic remnants (0.8)1-1.5(2) mm long, with 5 glabrous lobes. *Seeds* 1.1-3.3 mm long, 0.9-2.1 mm wide, finely reticulate, uniformly colored, brown, glabrous. Cotyledons with entire margin. Figs. 314, 315.

Pollen. *Geranium*-type (Aedo & al. 2005a: 6; Bortenschlager 1967: 425).

Chromosome number. 2*n* = 52, 56.

Phenology. Collected in flower from January to December.

Distribution. This species ranges from central Peru to southern Chile and southern Argentina (Fig. 316).

Habitat. Roadsides, beaches, river banks, turf bogs, open rocky slopes, meadows, open moist puna sometimes with low shrubs, and clearing in *Nothofagus* Blume and *Polylepis* Ruiz & Pav. forests; 0-5000 m.

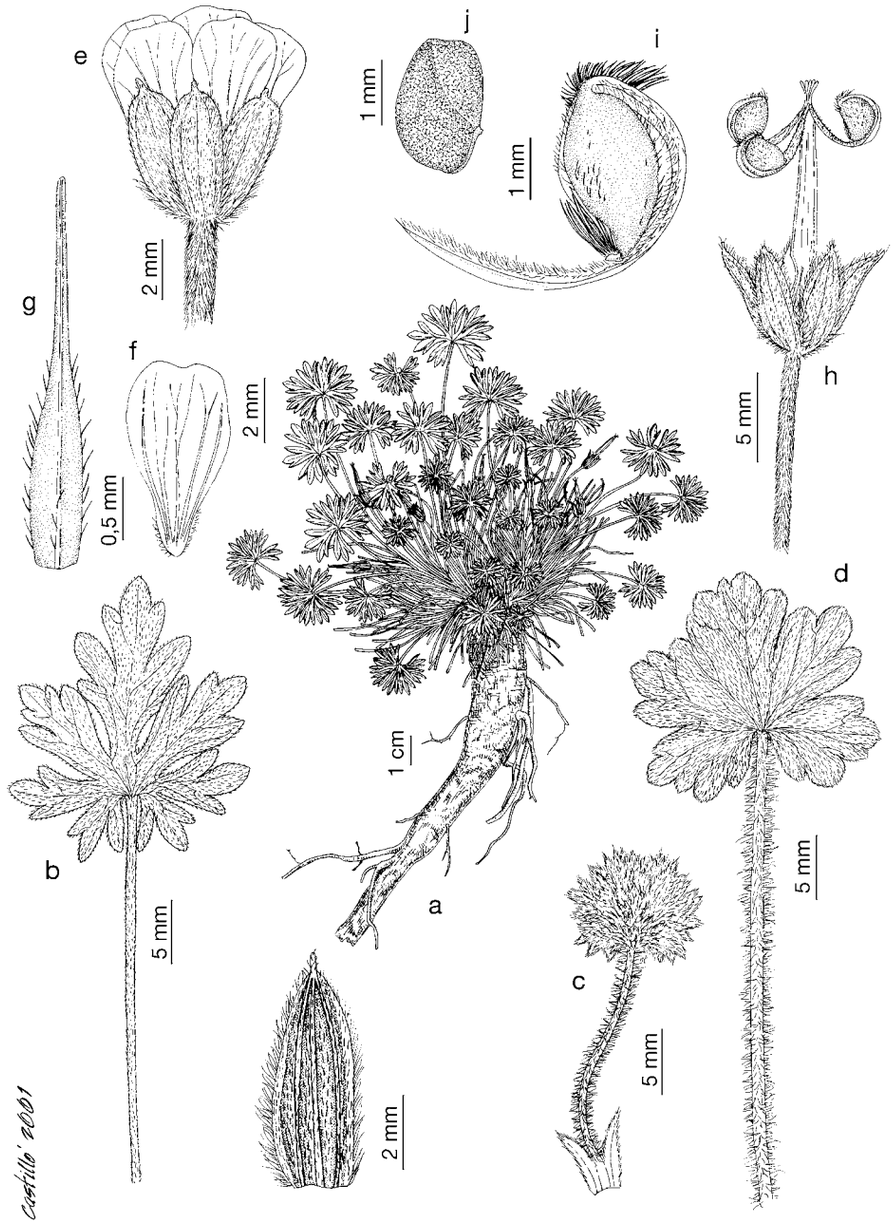


Fig. 314. *Geranium sessiliflorum*. a. Habit. b-d. Leaves. e. Flower. f. Petal. g. Staminal filament. h. Fruit. i. Mericarp. j. Seed. (Based on: a, *Aedo 7500*, MA; b, *Sanches 24b*, LPB; c, *Rossel 101*, LPB; d, *Macbride 3006*, MA; e-g, *Mez y Barrera 1568*, SGO; h-j, *Hohenacker 1160*, S).

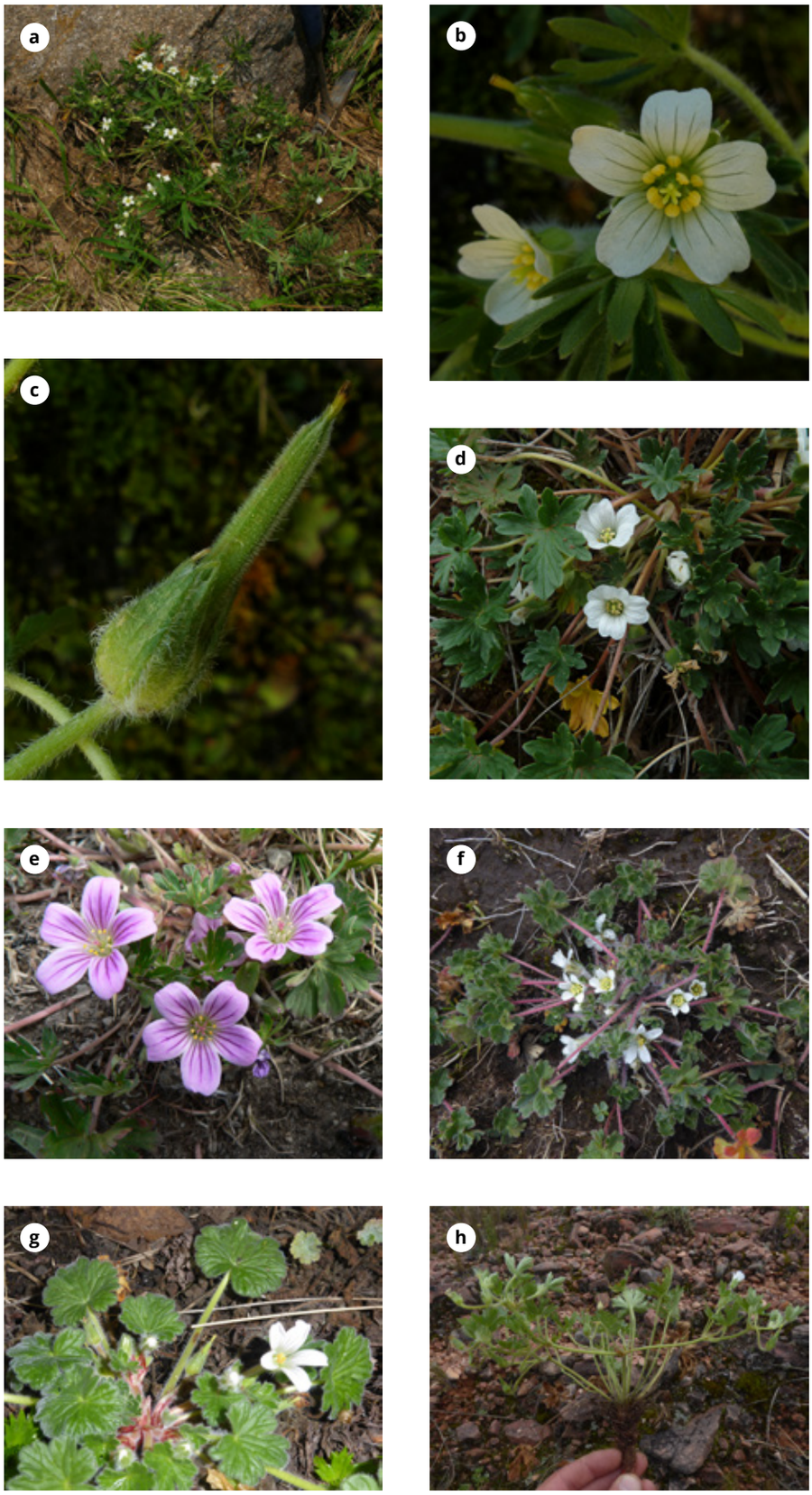


Fig. 315. *Geranium sessiliflorum* (Based on: a-c, *Aedo 15333,* MA; d, *Aedo 21331,* MA; e, *Calvo 4296*, MA, photo: J. Calvo; f, *Calvo 7852*, LPB, photo: J. Calvo; g, *Calvo 7854*, LPB, photo: J. Calvo; h, *Calvo 7886*, HSB, photo: J. Calvo).

Representative specimens examined. **Argentina.** Catamarca: pr. mina Capillita, 27°22'S, 66°22'W, 14 Feb. 2008, *Aedo 15333* (MA). Jujuy: Cochinoca, Abra Pampa, Cerro Huancar, 22°45'S, 65°43'W, Feb. 1963, *Cabrera & al. 15275* (LP). La Rioja: Famatina, camino a la mina Mexicana, 28°58'S, 67°42'W, 19 Feb. 2008, *Aedo 15414* (MA). Mendoza: San Rafael, Los Molles, arriba del Cuchillo, 35°11'S, 69°54'W, 31 Dec. 1949, *Sleumer 654* (B). Neuquén: Copahue, 37°47'S, 71°7'W, 13 Jan. 1973, *Cabrera & al. 22921* (LP). Río Negro: Cerro Catedral, San Carlos de Bariloche, 41°13'S, 71°30'W, 22 Jan. 1964, *Ward s.n.* (MO). Salta: Santa Victoria, Rodeo Pampa, 22°15'S, 65°3'W, 26 Mar. 2014, *Aedo 21476* (MA). Santa Cruz: Chaltén, orilla derecha del río Fitz Roy, 49°20'S, 72°55'W, 14 Dec. 2009, *Calvo 4296* (MA). Tierra del Fuego: Cordón de los Cristales, Estancia Lago Roca, 50°33'S, 72°45'W, 26 Dec. 1958, *James 109* (BM). Tucumán: Trancas, pr. Hualinchay, camino hacia Tolombón, 26°20'S, 65°39'W, 16 Feb. 2008, *Aedo 15365* (MA). **Bolivia.** Chuquisaca: Punilla-Chanauca, Cerro Chataquila, 18°48'S, 64°46'W, 27 Feb. 1994, *Wood 8042* (LPB). Cochabamba: laguna de Wara Wara, 17°17'S, 66°6'W, 30 July 2007, *Aedo & al. 14425* (MA). La Paz: Murillo, NNE de La Paz, valle Achachicala, 3 km subiendo de Kaluyo hacia la cumbre, 16°21'S, 68°4'W, 15 Feb. 2003, *Beck 27992* (MA). Oruro: Avaroa, Challapata, 18°54'S, 66°46'W, 31 Mar. 1921, *Asplund 3272* (S, UPS). Potosí: Linares, inter Kachitambo et Potosí, 19°47'S, 65°49'W, 4 Apr. 1934, *Hammarlund 452* (S). Tarija: Méndez, Sama, 21°28'S, 65°1'W, 23 Mar. 1986, *Ehrich 200* (MA). **Chile.** Aisén: Coyhaique, Reserva Forestal Cerro Castillo, 45°29'S, 72°18'W, 6 Feb. 1986, *Pedersen 14389* (CTES). Biobío: Termas de Chillán, 36°54'S, 71°24'W, 27 Jan. 2002, *Aedo 7500* (MA). Coquimbo: Cordillera del río Mauro, 31°58'S, 71°2'W, Feb., *Reiche s.n.* (SGO). La

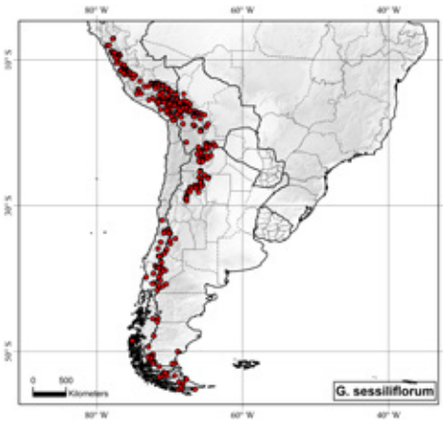


Fig. 316. Distribution of *Geranium sessiliflorum*.

Araucanía: Termas de Tolhuaca, 38º13'S, 71º57'W, 20 Feb. 1935, *Montero 2199* (CONC). Los Lagos: Osorno, Parque Nacional Puyehue, límite con Argentina, 40º35'S, 72º8'W, 14 Feb. 1972, *Muñoz 537* (SGO). Magallanes: Última Esperanza, Sierra de los Baguales, Estancia La Cumbre, campo de la Tropilla, 50º43'S, 72º23'W, 18 Dec. 1986, *Landero 703* (CONC). Maule: Curicó, orillas de la laguna de Teno, 34º59'S, 71º14'W, 10 Mar. 1967, *Marticorena & Matthei 883* (CONC). Santiago: estación de eski Valle Nevado, 33º20'S, 70º14'W, 12 Dec. 2001, *Aedo 7125* (MA). Tarapacá: Aguas Calientes, Tacora, 17º44'S, 69º46'W, 17 Sep. 1955, *Ricardi & al. 3374* (CONC). Tierra del Fuego: Altos de Boquerón, 53º17'S, 69º17'W, 15 Dec. 1971, *Moore & Goodall 19015* (H). **Peru.** Ancash: Cordillera Negra, Abra Chicarhuapunta, 9º6'S, 77º52'W, 19 May 2013, *Aedo & Molina 20268* (MA). Apurimac: Andahuaylas, 13º40'S, 73º25'W, Feb., *Pearce s.n.* (BM). Arequipa: pr. Cabanaconde, 15º36'S, 71º52'W, 2 Apr. 2005, *Aedo & Galán de Mera 11074* (MA). Ayacucho: Laguna Yaurihuiri, about 205 km from Nazca on the road to Abancay, 13º38'S, 72º53'W, 13 Mar. 1987, *Brandbyge 329* (AAU). Cuzco: paso de Tres Cruces, Cerro de Cusilluyoc, 13º7'S, 71º35'W, 3 May 1925, *Pennell 13878* (GH, NY). Huancavelica: Tayacaja, Montepungo, 5 km E of Surcubamba, 12º8'S, 74º41'W, 13 Jan. 1939, *Stork & Horton 10383* (CAL, F). Huánuco: Huamalies, Puños, 9º24'S, 76º47'W, 22 Mar. 2004, *Cano & al. 14011* (MA). Junín: Abra de la Viuda, 11º20'S, 76º25'W, 26 Mar. 2005, *Aedo & Galán de Mera 10882* (MA). La Libertad: pr. Shore, pampa de la Julia, 7º59'S, 78º17'W, 12 June 2009, *Aedo & Leiva 16449* (MA). Lima: pr. Chuncal, 11º22'S, 76º27'W, 25 Mar. 2005, *Aedo & Galán de Mera 10850* (MA). Moquegua: pr. Titiri, 16º28'S, 70º20'W, 10 Apr. 2005, *Aedo & Galán de Mera 11253* (MA). Pasco: road to Huanuco just before Cerro de Pasco, 10º41'S, 76º16'W, 23 Apr. 1960, *Moore & al. 8318* (BH). Puno: Santa Rosa, 13º9'S, 72º32'W, 9 Apr. 2005, *Aedo & Galán de Mera 11223* (MA).Tacna: Tarata, cordillera del Barroso, 17º31'S, 69º51'W, 26 Mar. 1998, *Cano 8209* (USM).

Discussion. Geranium sessiliflorum usually forms dense cushion plants. It has a vertical, turnip-shaped rootstock and sepals with long, patent hairs on the margins (more or less pectinate). It is distributed over a large area with more than 5000 km between the northernmost localities in central Peru and the southernmost in Tierra del Fuego. Although *G. magellanicum* is quite similar to *G. sessiliflorum*, it is easily distinguished by its 2-flowered cymules borne on ascending, leafy stems. This species displays an unusually wide variability in leaf shape and indumentum, stem structure, and fruit size. The leaf outline may be orbicular or polygonal, and more or less divided. The middle leaf segment varies from obtriangular with three lobes to rhombic with twelve lobes. Occasionally, the leaves have a dense indumentum (only in southern Peru, Bolivia, and northern Argentina), although they are usually pilose, with scattered appressed hairs. Pedicels usually have patent to retrorse hairs; however, a few specimens from central and southern Peru have pedicels with antrorse hairs. A continuum of intermediates suggests that these forms do not deserve taxonomic recognition. Some specimens have cymules borne on the rootstock and also elongated internodes bearing a tuft of stipules from which an aggregate of cymules arises; sometimes a pair of leaves is also present at these nodes. These forms have been named *G. tucumanum* in northern Argentina, but they are also present throughout the range of *G. sessiliflorum*. Intermediate forms can be found even on the same herbarium sheet, and *G. tucumanum* is regarded as a synonym of *G. sessiliflorum*. Fruit size also shows a remarkable range of variation, between 6.8 and 19.5 mm long, but it is not correlated with leaf shape, indumentum, or stem structure.

The type of *G. malpasense* has emarginate petals that are 12 mm long, but otherwise it matches other specimens of *G. sessiliflorum*. The type of *G. weberbauerianum* is lost, but a photograph at F and the original description indicate that the name is a synonym of *G. sessiliflorum*.

---

119. Geranium parodii I.M. Johnst., Contr. Gray Herb. 81: 92. 1928. Type locality: "Argentina: predominat on the Pampa de Achala, Sierra de Achala, Prov. Córdoba, ca. 2200 m., Dec. 1-4, 1926, Parodi 7514 (type, Gray Herb.)". Type: Argentina. Córdoba, Sierra de Achala, 31°35'S, 64°50'W, 1 Dec. 1926, *L.R. Parodi 7514* (holotype, GH-00043664!).

Geranium sessiliflorum var. *glabriusculum* Kuntze, Revis. Gen. Pl. 3(3): 33. 1898. Type locality: "Argentina: Sierra Achala (Hieronymus, Galander)". Type: Argentina. Córdoba, Sierra Achala, Pies de los Gigantes, 31°26'S, 64°48'W, 3 Dec. 1878, *G. Hieronymus s.n.* (lectotype, designated by Aedo & al. 2005a: 29, NY!).

Geranium magellanicum var. *multifoliosum* R. Knuth in Engl., Pflanzenr. IV.129 (Heft 53): 70. 1912. Type locality: "Argentinien: Auf der Sierra Achala an Abhängen des Cerro de los Potrerillos (Hieronymus in Fl. Arg. a. 1877 n. 753!)". Type: Argentina. Córdoba, Sierra Achala, Cerro de los Potrerillos, 31°59'S, 64°54'W, 1 Feb. 1877, *G. Hieronymus 753* (lectotype, designated by Aedo & al. 2005a: 29, GOET-004067!; isolectotypes, CORD!, F!).

Geranium magellanicum var. *pumilum* R. Knuth in Engl., Pflanzenr. IV.129 (Heft 53): 70. 1912. Type locality: "Argentinien: Auf der Sierra Achala, im Thale des Rodeo am Fube des Gigantes dei Esquina (Hieronymus in Fl. Arg. a. 1878!); Las Ramadas de San Miguel (Hieronymus in Fl. Arg. a. 1875!, a. 1878!); Cuesta del Gaucho (Hieronymus in Fl. Arg. a. 1876!); Las Encenadas an der Cuesta de Copina (Hieronymus in Fl. Arg. a. 1876!); auf der Sierra de Tucuman dei La Ciénaga (Hieronymus-Lorentz in Fl. Arg. a. 1874, n. 585!)". Type: Argentina. Córdoba, Sierra Achala, Esquina, Quebrada de los Gigantes, 31°26'S, 64°48'W, 3 Dec. 1878, *G. Hieronymus s.n.* (lectotype, designated by Aedo & al. 2005a: 29, G-00365899!).

Perennial herbs, 3.3-21(80) cm tall. *Rootstock* 7-14.3 mm in diameter, vertical, not tuberculate, turnip-shaped, without thickened roots. *Stem* prostrate (when present), usually scapiform, not rooting at nodes, stolons absent, without vegetative stems. *Basal leaves* in a persistent rosette, cauline leaves usually absent, sometimes 1(2) pairs, opposite; leaf laminas (1.1)1.6-2.6(7.7) cm long, 1.1-8.5 cm wide, not peltate, palmatifid [ratio main-sinus length/middle segment length = 0.82-0.90], polygonal in outline, base cordate (with basal leaf segments downward), not coriaceous, with nerves not projected, pilose, with appressed, eglandular hairs on both surfaces; segments 5(6), in 1 plane, middle segment

rhombic to obtriangular, 1.1-4.2 mm wide at the base [ratio segment width at the base/middle segment length = 0.08-0.17(0.20)], 3-9-lobed in distal half [ratio secondary sinus length/ middle segment length = (0.27)0.32-0.40(0.50)]; petioles up to 13 cm long, without abscission zone, terete, not swollen, not deflexed in age, with retrorse, ± appressed, eglandular hairs 0.2-0.5 mm long; stipules 5.1-15.3 mm long, 1.21-2.2 mm wide, lanceolate, free, papery, brownish red, glabrous or with scattered, eglandular hairs on both surfaces and on the margin. *Cymules* 1-flowered, solitary (rarely in aggregates of 2-4 flowers) [ratio cymule length/leaf length = 0.4-1(1.2)]; peduncles 1-94(135) mm long, with retrorse, ± appressed, eglandular hairs 0.1-0.4 mm long; bracteoles 2.3-5.8 mm long, 0.8-1.3 mm wide, linear-lanceolate, opposite; pedicels absent or 14.5-62 mm long, usually with retrorse, ± appressed, eglandular hairs 0.2-0.4 mm long. Flowers actinomorphic. *Sepals* (5.2)6.1-7.2(7.7) mm long, 1.8-3.4 mm wide, lanceolate, smooth, not accrescent, nerves 3, mucro 0.6-0.9(1.4) mm long [ratio mucro length/sepal length = (0.08)0.10-0.15(0.18)], with erect-patent, eglandular hairs 0.4-0.8 mm long on the abaxial surface, glabrous adaxially. *Petals* (9.5)11.5-15.7 mm long, 3.2-9.4 mm wide, erect-patent, rounded, without claw, white, hairy on the base of the abaxial surface, ciliate on the basal margin, with hairs 0.3-0.7 mm long. *Stamens* 10, both whorls bearing anthers; filaments 4.3-5.9 mm long, lanceolate, white to green, with eglandular hairs 0.1-0.4 mm long on the abaxial surface and margin; anthers 0.9-1.4 mm long, yellow. Nectaries 5, hemispheric, with a tuft of hairs at the top, dorsally glabrous. *Gynoecium* 3.7-6.5 mm long, white to green. *Fruit* 16.2-20.4 mm long, erect, discharge of seed-ejection type; mericarps 3.2-4.1 mm long, 1.2-1.8 mm wide, without a strand of fibers, not compressed at the apex, smooth (sometimes with 1-2 transverse veins at the apex), without basal beak, with a basal callus, without a basal prong, brown, with erect-patent, eglandular hairs 0.3-0.6 mm long; rostrum 9.57-13.6 mm long, with a narrowed apex 0.7-1.5 mm long, not twisted, with erect-patent, eglandular hairs 0.2-0.5 mm long; stigmatic remnants (1.7)2-2.3(2.5) mm long, with 5 glabrous lobes. *Seeds* 2.3-2.8 mm long, 1.2-1.4 mm wide, finely reticulate, uniformly colored, brown, glabrous. Cotyledons with entire margin. Figs. 317, 318.

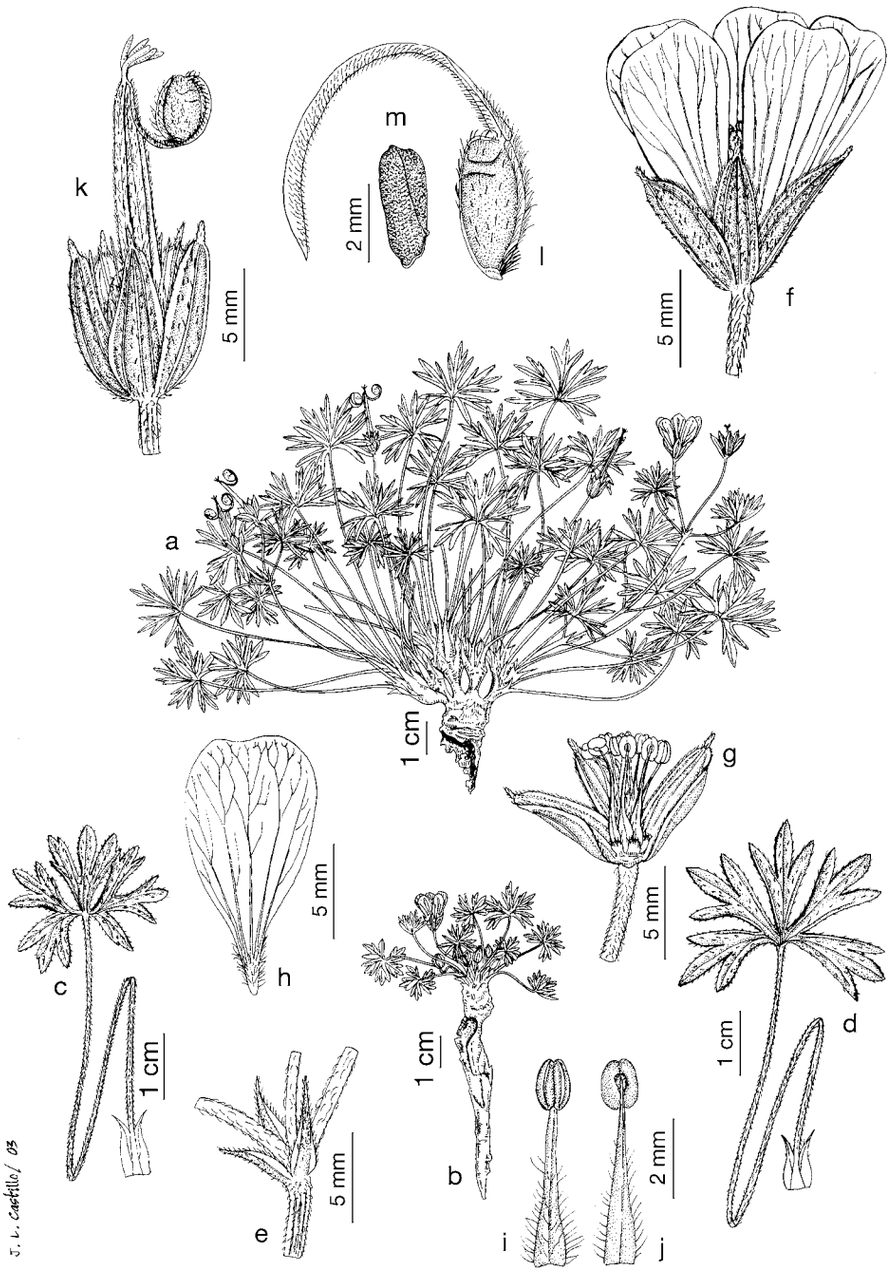


Fig. 317. *Geranium parodii*. a, b. Habit. c, d. Leaves. e. Bracteoles. f. Flower. g. Flower, petals removed. h. Petal. i, j. Stamens. k. Fruit. l. Mericarp. m. Seed. (Based on: a, c, d, f-m, *Hunziker 9622*, BH; b, *Parodi 7514*, GH; e, *Hunziker 1384*, CORD).

Pollen. *Geranium*-type (Aedo & al. 2005a: 6).

Chromosome number. Unknown.

Phenology. Collected in flower from November to February.

Distribution. This species is endemic to northwestern Argentina (Fig. 319).

Habitat. Puna grassland; 1800-2600 m.

Additional specimens examined. **Argentina.** Córdoba: Sierra Achala, pampa de San Luis, 31°17'S, 64°48'W, 7 Feb. 2008, *Aedo 15254* (MA); Cruz del Eye, Sierra de Achala, entre Tanti y pampa de San Luis, 31°19'S, 64°35'W, 15 Dec. 1909, *Stuckert 20629* (CORD); Punilla, Sierra Grande, falda E, El Vallecito, camino a Los Gigantes, 31°24'S, 64°48'W, 3 Dec. 1950, *Hunziker 8658* (MA); San Alberto, Sierra de Achala, Cuesta del Tránsito, 31°34'S, 64°50'W, 5 Jan. 1895, *Kurtz 8339* (CORD, NY); Pampa de Achala, 31°35'S, 64°50'W, 29 Feb. 1920, *Castellanos 728* (SI); Pies de los Gigantes, 31°35'S, 64°49'W, 9 Jan. 1884, *Galander s.n.* (NY); San Alberto, Pampa de Achala, 31°35'S, 64°50'W, 13 Dec. 1945, *Hunziker 1384* (CORD); Pampa de Achala, km 95, 31°35'S, 64°50'W, 13 Jan. 1951, *Krapovickas 7427* (SI); Pampa de Achala, El Condor, 31°35'S, 64°50'W, 19 Dec. 1949, *Meyer & Sleum-*

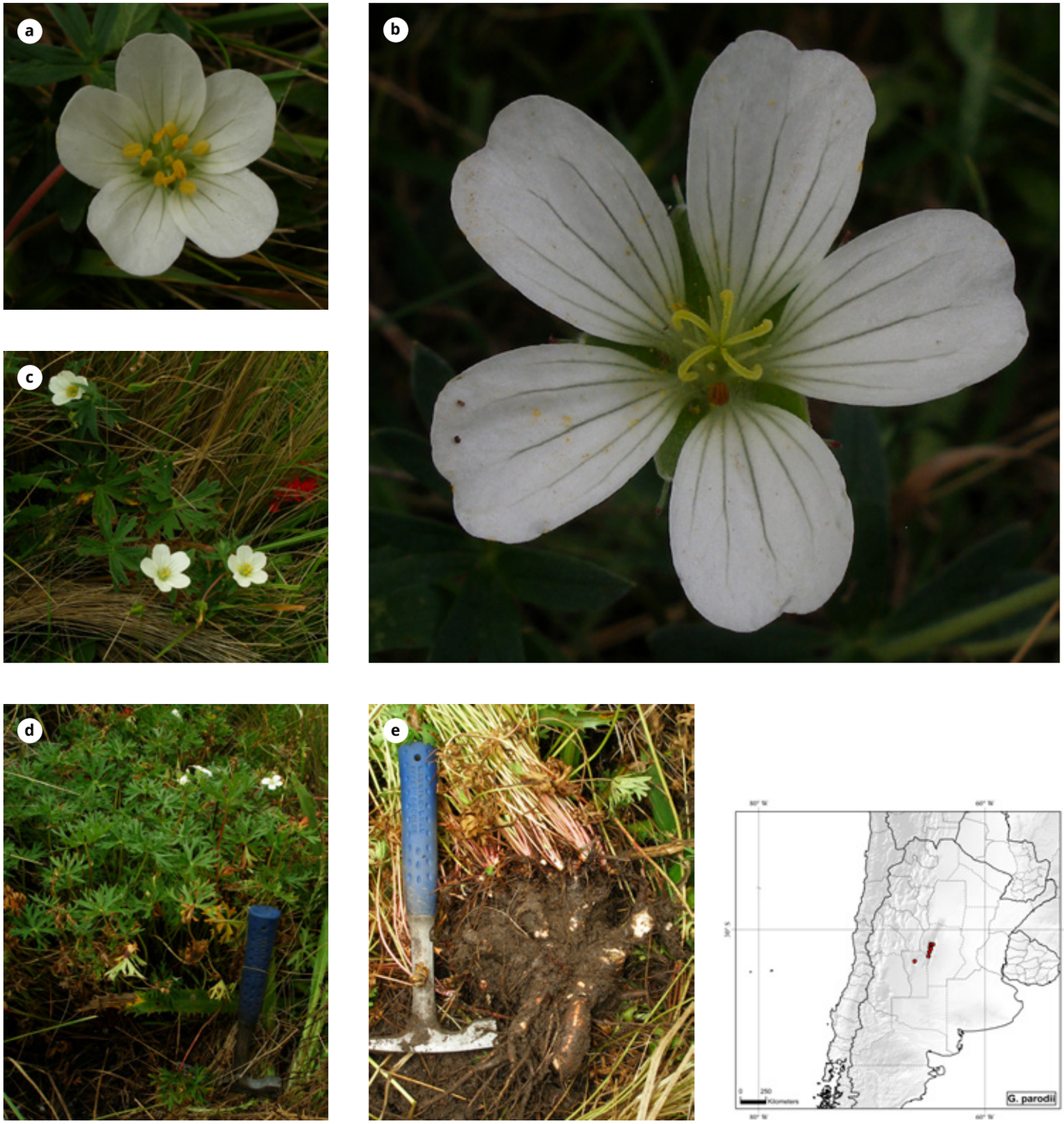


Fig. 318. *Geranium parodii* (Based on: a-c, *Aedo 15254,* MA; d, e, *Aedo 15269,* MA).

Fig. 319. Distribution of *Geranium parodii*.

er 15544 (LIL); Pampa de Achala, 31°35'S, 64°49'W, 22 Nov. 1968, *Ruiz Leal s.n.* (MERL); Achala, 31°35'S, 64°50'W, 27 Dec. 1901, *Stuckert 10889* (S); Achala, 31°35'S, 64°50'W, 18 Dec. 1909, *Stuckert s.n.* (S); Sierra Achala, pampa de San Luis, 31°37'S, 64°52'W, 8 Feb. 2008, *Aedo 15269* (MA); Calamochita, pampa de San Miguel, 31°43'S, 64°47'W, 13 Dec. 1885, *Kurtz 2944* (CORD); Sierra Achala, Cerro de los Potrerillos, 31°59'S, 64°54'W, 1 Feb. 1877, *Hieronymus 281* (P); San Javier, Cerro Champaquí, 31°59'S, 64°56'W, 14 Feb. 1924, *Hosseus 13* (CORD); Calamochita, Sierra Grande, al pie del Cerro Champaqui, 31°59'S, 64°56'W, 15 Jan. 1952, *Hunziker 9622* (BH). San Luis: Sierra de Comechingones, inmediaciones de la cumbre, frente a El Rincón, 32°21'S, 64°59'W, 9 Feb. 1956, *Hunziker 11819* (MA); Merlo, Cuesta M. Bayo, 32°21'S, 65°1'W, 27 Nov. 1910, *Pastore 99* (SI); El Monigote, 32°48'S, 66°13'W, 2 Feb. 1911, *Pastore 36* (SI).

Discussion. Geranium parodii is endemic to the Sierra de Achala of Argentina. It has been described once as a variety of *G. sessiliflorum* and twice of *G. magellanicum*; however, *G. parodii* differs sufficiently to merit specific rank. In *G. parodii* the petals are (9.5)11.5-15.7 mm long, and hairy abaxially and on the margin; *G. sessiliflorum* and *G. magellanicum* have shorter petals (in the case of *G. sessiliflorum* with some overlap) with only a few cilia on the basal margin. Additionally, *G. parodii* has hairy nectaries and a fruit rostrum with a narrowed apex 0.7-1.5 mm long, whereas *G. sessiliflorum* and *G. magellanicum* have glabrous nectaries, and the fruit rostrum lacks a narrowed apex. The sepals of *G. parodii* usually have a mucro longer than that found in *G. sessiliflorum* and *G. magellanicum*, and have a more homogeneous indumentum (without longer hairs on the margin). The fruits and rostrum, pedicels, and gynoecium of *G. parodii* are longer those of *G. sessiliflorum*. *Geranium parodii* shows some variation in plant size and cymule structure. Small specimens have short 1-flowered cymules without a pedicel and show a strong resemblance to *G. sessiliflorum* in habit (some are cushion-like). They are usually found in open habitats among short grasses. In contrast, more robust plants of *G. parodii* are found in areas with tall grasses. These plants have, in addition to cymules borne on the rootstock, elongated internodes bearing a tuft of stipules from which arises an aggregate of cymules. Sometimes a pair of leaves is also present at these nodes. Such cymules can be 1-flowered or aggregates of 2-4 flowers. A continuum of intermediate individuals suggests that these forms do not deserve taxonomic recognition. Petal size, indumentum of petals and nectaries, and rostrum shape are constant and strongly support recognition of *G. parodii* at the rank of species. Knuth (1912) based *G. magellanicum* var. *pumilum* on heterogeneous gatherings, e.g., *Hieronymus 449* is *G. core-core* and *Lorentz & Hieronymus 585* is *G. leucanthum*. Aedo & al. (2005a) designated the G duplicate of *Hieronymus s.n.,* a specimen of *G. parodii*, as lectotype.

The Carolinianum Group—This group is characterized by its erect or ascending habit, its annual life spam, and its usually 2-flowered cymules arranged in dichasial inflorescence. The leaves are palmatifid, alternate in middle of the stem and distally opposite, the sepals are accrescent, and the petals are of small size and without claw.

120. Geranium carolinianum L., Sp. Pl.: 682. 1753. *Geranium atrum* Moench, Methodus: 285. 1794, nom. illeg. *Geranium dissectum* var. *carolinianum* (L.) Hook. f., Handb. N. Zeal. Fl.: 36. 1864. Type locality: "Habitat in Carolina, Virginia". Type: U.S.A. Virginia, *J. Clayton 372* (lectotype, designated by Fawcett & Rendle 1920: 154, BM-000040264 image!).

Geranium lanuginosum Jacq., Pl. Hort. Schoenbr. 2: 8, pl. 140. 1797, nom. illeg., non Lam. 1788. Type locality: [not indicated]. Type: locality and collector unknown, specimen annotated as Hb. Jacq. (lectotype, designated by Aedo 2000: 49, W!).

Geranium lenticulum Raf., New Fl. 2: 34. 1837. Type locality: "West Tennessee and Kentucky". Type: U.S.A. West Tennessee and Kentucky, *C.S. Rafinesque s.n.* (no original material located).

Geranium langloisii Greene, Pittonia 3: 171. 1897. Type locality: "A common weed in gardens and waste lands at St. Martinsville, Louisiana, where it is collected by Rev. Father Langlois, and has been distributed by him as G. carolinianum... ". Type: U.S.A. Louisiana, Saint Martin Co., Saint Martinville, 30°07'N, 91°50'W, 4 Apr. 1892, *A.B. Langlois s.n.* (lectotype, designated by Aedo 2000: 49, NDG-27963!).

Geranium thermale Rydb., Mem. New York Bot. Gard. 1: 478. 1900. Type locality: "Montana: Lo-Lo Hot Springs, 1898, Williams & Griffith". Type: U.S.A. Montana, Lo-Lo Hot Springs, 46°45'N, 114°06'W, 1898, *R. Williams & D. Griffith s.n.* (lectotype, designated by Aedo 2000: 49, NY!).

Geranium sphaerospermum Fernald, Rhodora 37: 298, tab. 372, figs. 1-5. 1935. *Geranium carolinianum* var. *sphaerospermum* (Fernald) Breitung, Amer. Midl. Naturalist 58: 43. 1957. Type locality: "... ; savannahs, swales and peaty depressions in the limestone pavement, Great Cloche Island, June 29, 1934, Fernald & Pease, no. 3405 (type in Gray Herb.)... ". Type: Canada. Ontario, Great Cloche Island, 45°59'N, 81°48'W, 29 June 1934, *M.L.* Fernald *& A.S. Pease 3405* (holotype, GH; isotypes, K!, NY image!, US image!).

Geranium carolinianum var. *confertiflorum* Fernald, Rhodora 37: 300, tab. 374, figs. 1-6. 1935. Type locality: "Dry rocky or sandy soil, southern Maine to Wisconsin, south to Delaware, uplands of North Carolina and Tenessee, and Missouri. Type: open field, North Amherst, Lorain Co., Ohio, June 22, 1924, R. J. Webb, no. 5263 in Gray Herb". Type: U.S.A. Ohio, Lorain Co., North Amherst, 41°23'N, 82°13'W, 22 June 1924, *R.J. Webb 5263* (holotype, GH-00043611!).

Geranium carolinianum f. *albiflorum* B. Boivin, Naturaliste Canad. 93: 1060. 1967. Type locality: "W.J. Dore 20292, Hasting Co., E. of Belleville, Point Anne, 15 June 1963 (DAO), type". Type: Canada. Ontario, Hastings Co., Point Anne, 44°10'N, 77°23'W, 15 June 1963, *W.G. Dore 20292* (holotype, DAO!).

Annual herbs, 10-65(70) cm tall. *Stem* erect, leafy, with patent to retrorse, eglandular hairs 0.2-1.1 mm long and scattered, patent, glandular hairs 0.2-0.7 mm long. *Basal leaves* in a ± deciduous rosette, cauline leaves alternate and upper opposite; leaf laminas (2.1)2.3-3(6.5) cm long, 2.3-8.5 cm wide, not peltate, palmatifid

[ratio main-sinus length/middle segment length = (0.81)0.84-0.89(0.91)], polygonal in outline, base cordate, not coriaceous, with nerves not projected, pilose, with appressed, eglandular hairs on both surfaces; segments 5, in 1 plane, middle segment rhombic, (2)2.1-3.3(3.4) mm wide at the base [ratio segment width at the base/middle segment length = 0.11-0.13(0.17)], (5)8-13-lobed in distal half [ratio secondary sinus length/middle segment length = 0.30-0.32(0.38)]; petioles up to 16 cm long, without abscission zone, terete, not swollen, not deflexed in age, with usually patent, eglandular hairs 0.2-1.1 mm long and scattered, glandular hairs 0.2-0.4 mm long; stipules 4-10 mm long, 0.7-2 mm wide, lanceolate to subulate, free, papery, brown, with eglandular hairs on abaxial surface and on the margin, glabrous adaxially. *Inflorescence* a dichasial cyme with monochasial branches; cymules 2(3)-flowered, in dense aggregates at the top of each branch or solitary in the forks [ratio cymule length/leaf length = (0.5)1-1.3(1.4)]; peduncles 3-25(60) mm long, with patent (sometimes ± retrorse), eglandular 0.2-0.9 mm long and, sometimes, patent, glandular hairs 0.2-0.5 mm long; bracteoles 2.7-4.4 mm long, 0.4-1 mm wide, lanceolate, whorled; pedicels (3)4-6(13) mm long, with patent, sometimes retrorse, not appressed, eglandular hairs 0.2-0.7 mm long and patent, glandular hairs 0.3-0.6 mm long. Flowers actinomorphic. *Sepals* (5)5.1-5.9(6.3) mm long, 2.5-4 mm wide, broadly lanceolate, smooth, accrescent, nerves 3(5), mucro (0.9)1-1.4(2) mm long [ratio mucro length/sepal length = 0.19-0.24], with antrorse to patent, eglandular hairs 0.1-1.4 mm long and patent, glandular hairs 0.2-0.5 mm long on the abaxial surface, glabrous adaxially. *Petals* 4.5-6 mm long, 1.3-2.1 mm wide, erect-patent, rounded or slightly emarginate, without claw, white to pale purple, glabrous on both surfaces, ciliate on the basal margin, with hairs 0.2-0.4 mm long. *Stamens* 10, both whorls bearing anthers; filaments 2.5-3(4) mm long, lanceolate, white, pilose on the abaxial surface, ciliate on the proximal half, with hairs 0.1-0.3 mm long; anthers 0.4-0.6 mm long, yellow. Nectaries 5, hemispheric, glabrous. *Gynoecium* 2.6-5.4 mm long, pink. *Fruit* 15-19(25) mm long, erect, discharge of seed-ejection type; mericarps 2.8-4.5 mm long, 1.4-2.4 mm wide, without a strand of fibers, not compressed at the apex, smooth, without basal beak, with a basal callus, without a basal prong, black, with patent to antrorse, eglandular hairs 0.5-1.9 mm long and, sometimes, patent glandular hairs 0.4-1 mm long; rostrum 11.2-19 mm long, with a narrowed apex 0.5-2 mm long, not twisted, with patent, eglandular hairs 0.1-0.8 mm long and patent, glandular hairs 0.3-0.6 mm long; stigmatic remnants 0.7-1.4 mm long, with 5 hairy lobes. *Seeds* 1.7-2.3 mm long, 1-1.3 mm wide, finely reticulate, uniformly colored, brown, glabrous. Cotyledons with entire margin. Fig. 320.

Pollen. *Geranium*-type (Aedo 2000: 46; Park & Kim 1997: 312).

Chromosome number. 2*n* = 46-48, 52.

Phenology. Collected in flower from February to December.

Distribution. This species ranges through southern Canada, U.S.A. and north Mexico and it is introduced in Bahamas, Dominican Republic, Jamaica, southern South America, Europe (Czech Republic, Finland, Norway and Portugal), China, Japan and Réunion (Fig. 321).

Habitat. Disturbed areas, roadsides, open fields, grassy slopes, prairies, and open deciduous and evergreen forests; 0-2900 m.

Representative specimens examined. **Argentina.** Buenos Aires: Avellaneda, Darsena de Inflamables, Dock Sud, 34º39'S, 58º23'W, 24 Nov. 1945, *Krapovickas 2688* (GH, MO, NY). Catamarca: Puerto Nuevo, 29º30'S, 65º34'W, 11 Dec. 1927, *Parodi 8183* (GH). Chaco: Fontana, 27º24'S, 59º2'W, Mar. 1932, *Meyer 818* (GH). Córdoba: Córdoba, villa Warcalde, orillas del río Primero, 31º24'S, 64º11'W, 23 Oct. 1982, *Barboza 7* (MA). Corrientes: Empedrado, Ruta 12 y acceso a Empedrado, 27º57'S, 58º48'W, 18 Nov. 1986, *Tressens & al. 3230* (CTES). Entre Ríos: Uruguay, Estancia La Selmira, 32º35'S, 58º35'W, 20 Nov. 1964, *Pedersen 7220* (P). Formosa: El Colorado, 24º48'S, 61º32'W, Oct., *Insfrán 932* (CTES, SI). Jujuy: San Pedro, Sierra de Santa Bárbara, 24º13'S, 64º52'W, 12 Dec. 1929, *Venturi 9597* (BM, GH, SI). Misiones: Montecarlo, Colonia Guatambú, 26º34'S, 54º44'W, 19 Oct. 2002, *Keller 1978* (MA). Santa Fé: Rosario, 32º57'S, 60º39'W, *Berndt 5262* (CORD). Tucumán: Chichigacha, Yacuchire, 24 Oct. 1913, *Monetti 1365* (F, GH, SI). **Bahamas.** Grand Bahama, N side of Queen's Highway, E of Freeport Airport roundabout, 26º38'N, 78º25'W, 5 Apr. 1980, *Correll & Popenoe 51235* (F). **Brazil.** Paraná: Serra do Mar, Ypiranga, 25º1'S, 50º35'W, 18 Dec. 1914, *Dusén 16133* (F, GH, MO). Rio Grande do Sul: Passo Fundo, 28º16'S, 52º24'W, 30 Oct. 1971, *Lindeman & al. 8772* (U). São Paulo: São Roque Linha Sorocabana, 26º25'S, 50º47'W, 28 Nov. 1981, *Kerichi 1725* (MO). **Canada.** British Columbia: Chilliwack Valley, 49º10'N, 121º25'W, 27 May 1901, *Spreadborough 34104* (NY). Manitoba: Adam Lake, Turtle Mountain Provincial Park, 49º2'N, 100º4'W, 25 July 1978, *Keleher 470* (DAO). Ontario: Essex Co., Pointe Pelee, 42º48'N, 82º17'W, 5 July 1936, *Marie-Victorin (frère) & al. 45979* (F). Québec: Lac Constance, 46º55'N, 77º38'W, 4 July 1922, *Victorin 15912* (NY). Saskatchewan: Cypress Hills Park, 49º21'N, 109º25'W, 11 July 1947, *Breitung 4654* (MO). **China.** Anhui: ciudad Chizhou, distrito Shitai, pueblo Zhanda, 30º39'N, 117º29'E, 14 Oct. 1999, *Wang Shi Long 693* (MO). Fujian: Fujian, Nanping city, 26º38'N, 118º10'E, 12 May 1993, *Guosheng 5138* (MO). Guangxi: Guangxi, Lin-gui Co., 21º37'N, 108º46'E, 27 Oct. 1994, *Guangzhao 14428* (MO). Hubei: Hupeh, Wuchang, 30º33'N, 114º18'E, 9 May 1980, *Long 60* (KYO). Hunan: Yizhang co., Mt. Mangshan, 25º23'N, 112º56'E, 12 May 2004, *Xiao Bai-Zhong 3476* (GH, MA). Jiangsu: Kaochiao, 32º0'N, 118º50'E, 6 June 1934, *Raed 1133* (BM). Jiangxi: Jiujiang co., Shahe, 27º27'N, 113º58'E, 21 May 1996, *Tan Ceming 9605126* (CAS). Shandong: Qufu Co., Shimen Mt., 36º13'N, 120º29'E, 25 Apr. 2004, *Cheng Yong Guo 1501062* (MA). Zhejiang: ciudad Hangzhou, Liu Heta, 30º16'N, 120º9'E, 8 May 1958, *Zhang Chaofang 5363* (MO). **Czech Republic.** Karlovy Vary: Carlsbad in Bohmen, 50º14'N, 12º52'E, 8 Aug. 1870, *Schlukum s.n.* (BR). **Dominican Republic.** Peravia: 33.9 km N Parque Central de San José de Ocoa en la carretera a Constanza, La Nuez, 18º40'N, 70º35'W, 7 July 1982, *Zanoni & al. 21428* (JBSD). **Finland.** North Savo: Maaninka, Pöljä, 63º8'N, 27º36'E, 6 July 1923, *Kyyhkynen s.n.* (PR). **France.** Réunion: Plaine de Palmistes, 21º7'S, 55º38'E, June, *Bosser 11492* (P). **Jamaica.** Cinehona, 27 May 1903, *Harris*

8577 (F). **Japan.** Honshū: Tokyo, palacio imperial, 35°41'N, 139°45'E, 6 May 2018, *Morales 3442* (MA). **Mexico.** Baja California: Arroyo Santo Tomás, along Río Santo Tomás, ca. 5 mi from highway 1 along road to la Bocana, 31°35'N, 116°30'W, 15 Mar. 1987, *Thorne 61270* (MEXU). Chihuahua: Chihuahua, 28°38'N, 106°5'W, 1852, *Wright s.n.* (GH). **Norway.** Oslo: Thorshaug, 59°54'N, 10°44'E, 26 Sep. 1920, *[illegible] 43* (O). **Paraguay.** Asunción: Asunción, 25°16'S, 57°40'W, Oct. 1986, *Schinini 25269* (CTES, G, UC). **Portugal.** Beira Litoral: Insua de Coselhas, 40°13'N, 8°25'W, 2 June 1958, *Matos s.n.* (COI). **Taiwan.** Nantou Co.: Yossu, 23°50'N, 120°55'E, 28 Oct. 1983, *Kao 9956* (TAI). **Uruguay.** Rivera: Rivera, 30°54'S, 55°31'W, 7 Dec. 1943, *Bartlett 21114* (MICH, GH). **USA.** Alabama: Geneva Co., Alabama highway 153 at the S side of Flat Creek, 31°2'N, 86°5'W, 6 Apr. 2002, *Diamond 13019* (MA). Arizona: Pinal Co., Peppersauce Canyon, 32°32'N, 110°42'W, 27 Apr. 1922, *Wiegand & Upton 3717* (NY). Arkansas: Chicot Co., Chicot, 31°12'N, 91°17'W, 28 Apr. 1940, *Demaree 20939* (MO). California: Los Angeles Co., Avalon, Santa Catalina Is., 33°23'N, 118°25'W, May, *Trask s.n.* (MO). Connecticut: New Haven, 41°18'N, 72°55'W, Aug., *Bucklen s.n.* (MO). Delaware: New Castle Co., Wilmington, Brandywine river, 39°44'N, 75°32'W, 14 May 1846, *Leeds s.n.* (F). District of Columbia: Washington, 38°55'N, 77°0'W, 20 May 1889, *Churchill s.n.* (MO). Florida: Dade Co., along Tennesse Road, near Florida City, 25°26'N, 80°28'W, 27 Feb. 1977, *Correll & al. 48106* (MO). Georgia: Camden Co., St. Mary's R. swamp just S of Kingsland, 30°47'N, 81°41'W, 5 Apr. 1941, *Duncan 3138* (MO). Idaho: Kellys Hot Spring, 17 June 1892, *Mulford s.n.* (MO). Illinois: Union Co., Cobden, 37°31'N, 89°15'W, 23 May 1902, *Earle 689* (NY). Indiana: Posey Co., Hovey's Lake, 37°49'N, 87°57'W, 11 May 1935, *Dawson 1169* (MIN). Iowa: Lee Co., Keokuk, 40°23'N, 91°23'W, 1 June 1897, *Shinck s.n.* (MO). Kansas: Butler Co., Whitewater, 37°57'N, 97°8'W, 4 June 1961, *Harms 1659* (NY). Kentucky: Calloway Co., Junction highway 121 and 280, 3 mi N on 280, 2 mi on dirt road, 36°34'N, 88°9'W, 5 May 1974, *Funk 498* (MO). Louisiana: New Orleans, 29°57'N, 90°4'W, 9 Feb. 1922, *Benke 3208* (F). Maine: Oxford Co., Norway, 44°12'N, 70°32'W, 8 Aug. 1864, *Smith s.n.* (NY). Maryland: Prince George's Co., 0.25 mi E of Potomac River, near Charles Co. line, 38°40'N, 77°1'W, 10 May 1984, *Hill 13625* (MO). Massachusetts: Nantucket Co., Nantucket, 41°17'N, 70°6'W, 6 July 1886, *Churchill s.n.* (MO). Michigan: Berrien Co., Pennellwood, Berrien Springs, 41°56'N, 86°20'W, 6 June 1920, *Pease 17763* (GH). Minnesota: Pipestone Co., Pipestone National Monument, 44°0'N, 96°19'W, 9 June 1967, *Moore & Moore 27127* (MIN). Mississippi: Harrison Co., near Hilton Hotel, Biloxi, 30°23'N, 88°53'W, 15 Apr. 1988, *Hill 19114* (MO). Missouri: Jefferson Co., Howe, 17 May 1941, *Ownbey 731* (MIN). Montana: Madison Co., Ennis, 45°20'N, 111°43'W, 1 Aug. 1950, *Suvan & Dennings s.n.* (MO). Nebrasca: Otoe Co., near Syracuse, 40°39'N, 96°11'W, 28 May 1936, *Osborn 828R* (MO). Nevada: Carson City Co., Carson City, 39°10'N, 119°43'W, 1864, *Anderson 176* (P). New Jersey: Burlington Co., Lumberton, 39°57'N, 74°48'W, 23 May 1923, *Meredith s.n.* (MO). New Mexico: Dona Ana Co., Organ Mts., 32°19'N, 106°33'W, 20 May 1893, *Norton 355* (MO). New York: Westchester Co., Yonkers, 40°55'N, 73°53'W, 26 May 1883, *Schrenk s.n.* (MO). North Carolina: Robeson Co., 8 mi SE of Lumberton, 34°37'N, 79°0'W, 21 Apr. 1957, *Ahles & Ramseur 23787* (MIN). North Dakota: McKenzie Co., Kummer, 47°47'N, 102°54'W, 6 Aug. 1912, *Bergman 2738* (MIN). Ohio: Jackson Co., Liberty, 39°4'N, 82°43'W, 31 May 1936, *Bartley 231* (NY). Oklahoma: Murray Co., Arbuckle

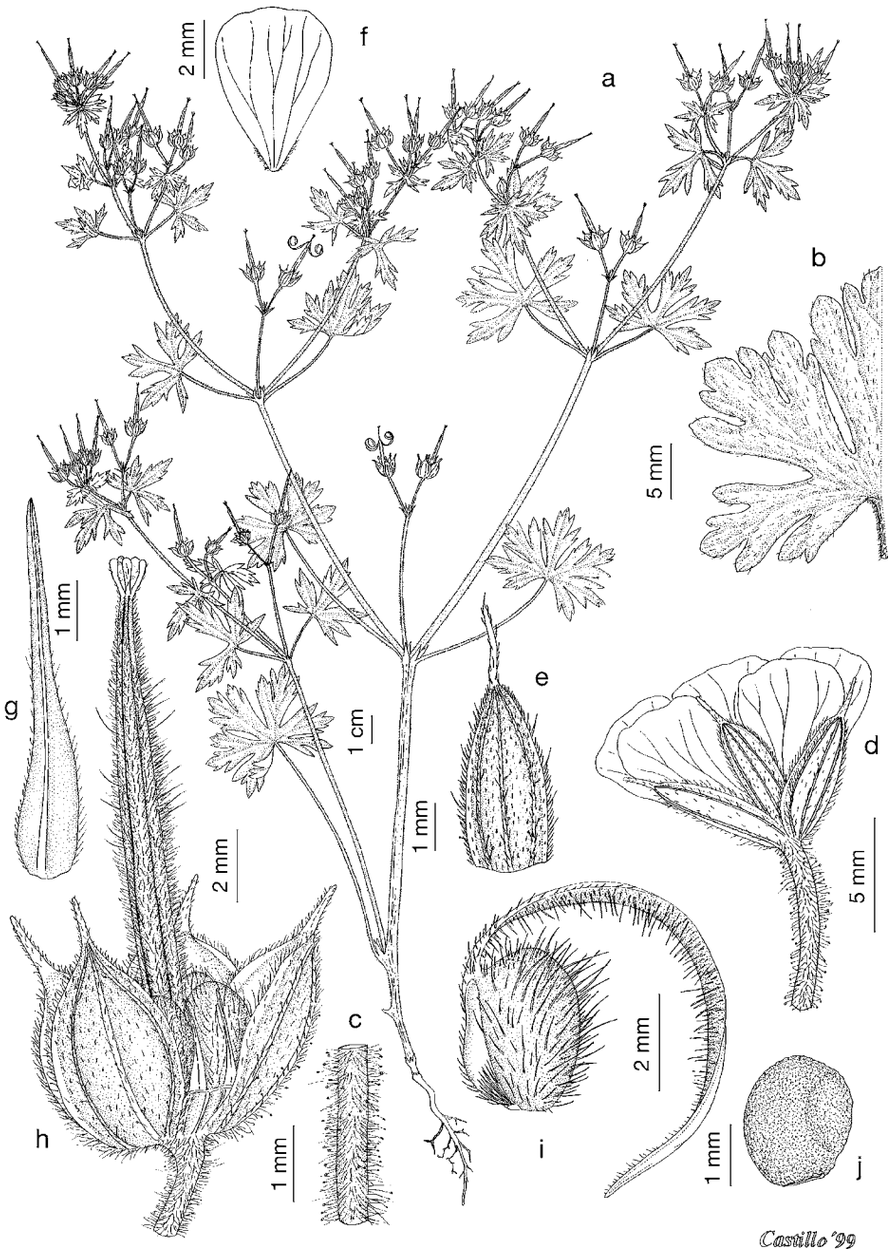


Fig. 320. *Geranium carolinianum*. a. Habit. b. Portion of leaf. c. Peduncle. d. Flower. e. Sepal. f. Petal. g. Staminal filament. h. Fruit. i. Mericarp. j. Seed. (Based on: a-c, h, *Nelson 8903*, NY; d-g, *McCoy 1662*, NY; i-j, *Heller 5808*, MO).

Mts., Turner Falls, 34°25'N, 97°8'W, 5 Sep. 1936, *Demaree 12491* (MIN). Oregon: Klamath Co., Keno, 42°7'N, 121°55'W, 6 July 1920, *Peck 9321* (MO). Pennsylvania: Pickens Co., Clemson, 34°41'N, 82°50'W, 18 May 1907, *House 3371* (NY). Rhode Island: Providence Co., Elmwood, 41°50'N, 71°28'W, 14 June 1890, *Collins s.n.* (MO). South Carolina: Dorchester Co., 33°6'N, 80°23'W, 29 Mar. 1935, *Correll 273* (NY). South Dakota: Mellette Co., upper Missouri, near White river, 43°34'N, 100°35'W, 1839, *Geyer s.n.* (MO). Tennessee: Franklin Co., Cumberland Mt. at Cowan, 35°10'N, 86°1'W, 5 May 1898, *Eggert s.n.* (MO).Texas: Kleberg Co., Kingsville, 27°32'N, 97°53'W, 1940, *Sinclair 129* (MO).Vermont: Orange Co., Newbury, Mt. Pulaski, 44°4'N, 72°4'W, *Wood 196* (NY). Virginia: Nansemond Co., about Suffolk, 36°44'N, 76°37'W, 8 June 1893, *Heller 907* (MO). Washington: Whitman Co., Wawawai, 46°38'N, 117°22'W, 9 June 1894, *Piper s.n.* (F). West Virginia: McDowell Co., Panther State Park, 37°22'N, 81°39'W, 30 June 1986, *Hutton s.n.* (WVA). Wisconsin: Waupaca Co., Waupaca, 44°23'N, 89°4'W, 1907, *Garische s.n.* (MO).

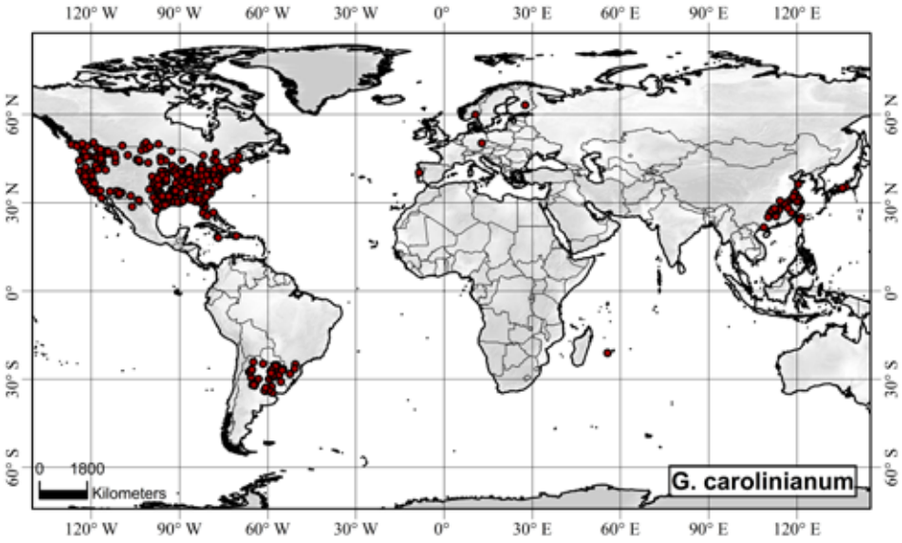


Fig. 321. Distribution of *Geranium carolinianum*.

Discussion. Geranium carolinianum is an annual easily identified by its dense aggregates of cymules at the apex of each branch, and its accrescent and very wide sepals. *Geranium carolinianum* shares with *G. bicknellii* and *G. texanum*, the two other native annuals in North America, an accrescent calyx and blackish mericarps; however, *G. bicknellii* has a distinctive rostrum with a long narrowed apex, and *G. texanum* bears an indumentum of appressed eglandular hairs not present in *G. carolinianum*. *Geranium columbinum* is an Old-World native annual species that could be mistaken for *G. carolinianum* because of its accrescent and wide sepals, but, unlike *G. columbinum*, *G. carolinianum* has long petals, usually opposite leaves (in *G. carolinianum* the cauline leaves at the middle of the stem are alternate), solitary cymules, appressed eglandular hairs on the stem and inflorescence, brownish mericarps with short hairs, and fruits with the rostrum terminating in a well-developed narrowed apex.

A number of minor morphological variants of *G. carolinianum* have been recognized in the literature, of which the most notable is *G. sphaerospermum*. According to Fernald (1935), *G. sphaerospermum* is characterized by its 5-nerved eglandular sepals and its subspherical seeds; yet, these characteristics are within the variation found in *G. carolinianum*. In some individuals the number of nerves per sepal varies between three and five in the same inflorescence; glandular hairs can be restricted to the pedicels or widespread throughout inflorescence and stem; and the seeds can be subspherical to elongate with many intermediate forms. Because all these characters vary considerably but independently, *G. sphaerospermum* was not accorded taxonomic recognition (Aedo 2012). A similar view was presented by McGregor (1986: 581). According to Moore (1943: 102-103), some collections from San Luis Potosí, Mexico, which Watson (1882: 334) referred to *G. carolinianum*, are perennial and may represent *G. tenue*. Examination of these specimens showed that they belong to *G. seemannii* subsp. *seemannii*. *Geranium carolinianum* is known from only two Mexican localities, and additional field work likely would yield more records. Whether *G. carolinianum* is native in the Caribbean is difficult to ascertain, but it is certainly introduced in temperate South America, eastern Asia, and Europe. Shirk & al. (2014) studied the patterns of genetic diversity of *G. carolinianum* using allozymes and microsatellites to discern its colonization history in China. Their results suggest a reduced diversity in China and provide evidence for multiple introductions near Nanjing with subsequent range expansion to the west and south. Sharma & al. (1988) recorded *G. carolinianum* from the Punjab, in northwestern India (*Sharma 9689, 14309, 12497*, PUN), in garden beds. Unfortunately, it has not been possible to study the voucher of such record.

121. Geranium bicknellii Britton, Bull. Torrey Bot. Club 24: 92. 1897. Type locality: "Nova Scotia (?) Maine to Western Ontario and southern New York". Type: U.S.A. New York, Van Cortlandt Park, 40°51'N, 73°52'W, 23 June 1895, *E.P. Bicknell s.n.* (lectotype, designated by Aedo 2000: 41, NY-00335798!).

Geranium carolinianum var. *longipes* S. Watson, Botany [fortieth parallel]: 50. 1871. *Geranium longipes* (S. Watson) Goodd., Bot. Gaz. (Crawfordsville) 37: 56. 1904, nom. illeg., non DC. 1824. *Geranium bicknellii* var. *longipes* (S. Watson) Fernald, Rhodora 37: 297. 1935. Type locality: "This

form also frequent in California and is 111 Parry from Colorado. (206)". Type: U.S.A. Colorado, head-waters of Clear Creek and the alpine ridges lying east of Middle Park, 37°48'N, 106°40'W, 1861, *C.C. Parry 111* (lectotype, designated by Aedo 2000: 41, MO-251017!; isolectotype, US image!) [see also Fernald, 1935: 297].

Geranium nemorale Suksd., Deutsche Bot. Monatsschr. 16: 222. 1898. Type locality: "Im westl. Teil von Klickitat-County, 10. Juni 1891 und früher (1880); in Spokane-County, 1889; in Skamania-County, 1894; und auch bei Milwaukee in Oregon, Juli 1893". Type: U.S.A. Washington, Klickitat Co., 45°52'N, 120°46'W, 10 June 1891, *W.N. Suksdorf 2028* (lectotype, designated by Aedo 2000: 41, MO-251393!; isolectotypes, F!, US image!, WTU-V-000668 image!, WU!) [see also Fernald, 1935: 297].

Geranium venezuelae R. Knuth in Engl., Pflanzenr. IV.129 (Heft 53): 201. 1912. Type locality: "Venezuela: Ohne Standortsangabe (Lansberg -- Typus in herb. Berol.!)". Type: Venezuela, without precise locality, *J.G. Lansberge 492* (holotype, B destroyed; lectotype, designated by Aedo 2012: 49, L!; isolectotype, S!).

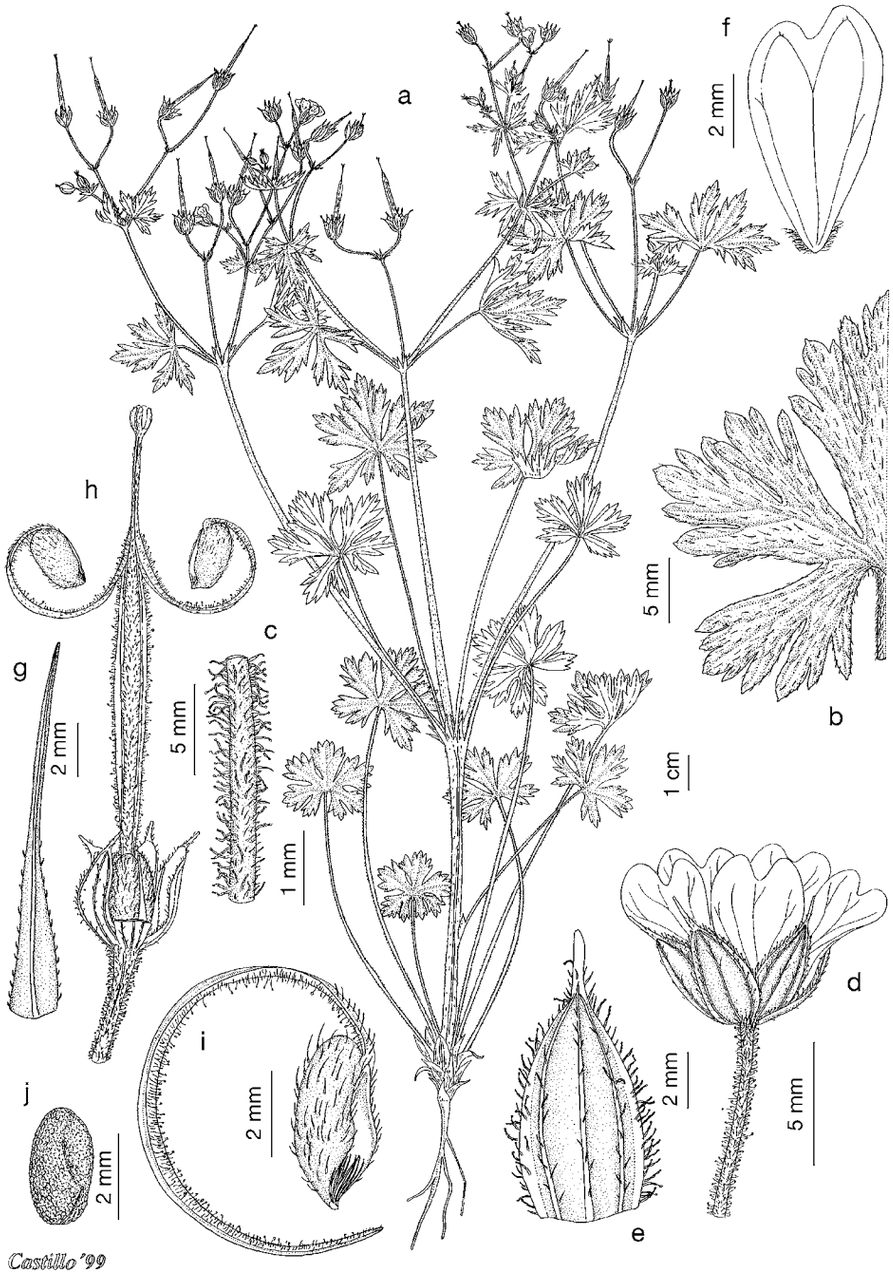


Fig. 322. *Geranium bicknellii*. a. Habit. b. Portion of leaf. c. Peduncle. d. Flower. e. Sepal. f. Petal. g. Staminal filament. h. Fruit. i. Mericarp. j. Seed. (Based on: a-g, *Gorman 6129*, NY; h-j, *Christ & Smith 15221*, NY).

Annual herbs, 10-50(60) cm tall. *Stem* erect or ascending, leafy, with patent, eglandular hairs 0.1-1 mm long and patent, glandular hairs 0.1-0.5 mm long. *Basal leaves* in a ± deciduous rosette, cauline leaves alternate in middle of shoot and upper opposite; leaf laminas (1.2)2.5-6.4 cm long, 1.5-7.7 cm wide, not peltate, palmatifid [ratio main-sinus length/middle segment length = 0.82-0.95], polygonal in outline, base cordate, not coriaceous, with nerves not projected, pilose, with appressed, eglandular hairs on both surfaces; segments 5(7), in 1 plane, middle segment rhombic, 1-2(5) mm wide at the base [ratio segment width at the base/middle segment length = 0.10-0.17], 5-11-lobed in distal half [ratio secondary sinus length/middle segment length = 0.23-0.42]; petioles up to 9 cm long, without abscission zone, terete, not swollen, not deflexed in age, with patent, eglandular hairs 0.2-1 mm long and, usually, patent, glandular hairs 0.2-0.4 mm long; stipules 4.7-9 mm long, 1-2 mm wide, lanceolate, free, papery, brown, with eglandular hairs on abaxial surface and on the margin, glabrous adaxially. *Inflorescence* a dichasial cyme, with monochasial branches; cymules (1)2(3)-flowered, solitary [ratio cymule length/leaf length = 0.9-5.1]; peduncles 10-40(70) mm long, with patent, eglandular hairs 0.1-1 mm long and patent, glandular hairs 0.2-0.4 mm long; bracteoles 2.4-6 mm long, 0.5-1 mm wide, lanceolate, whorled; pedicels absent or 6.6-25 mm long, with patent, eglandular hairs 0.1-1 mm long and patent, glandular hairs 0.2-0.5 mm long. Flowers actinomorphic. *Sepals* 4-6.3 mm long, 2-2.5 mm wide, lanceolate, smooth, accrescent, nerves 3, mucro 0.5-2 mm long [ratio mucro length/sepal length = 0.23-0.30], with antrorse to patent, eglandular hairs 0.2-0.6 mm long and

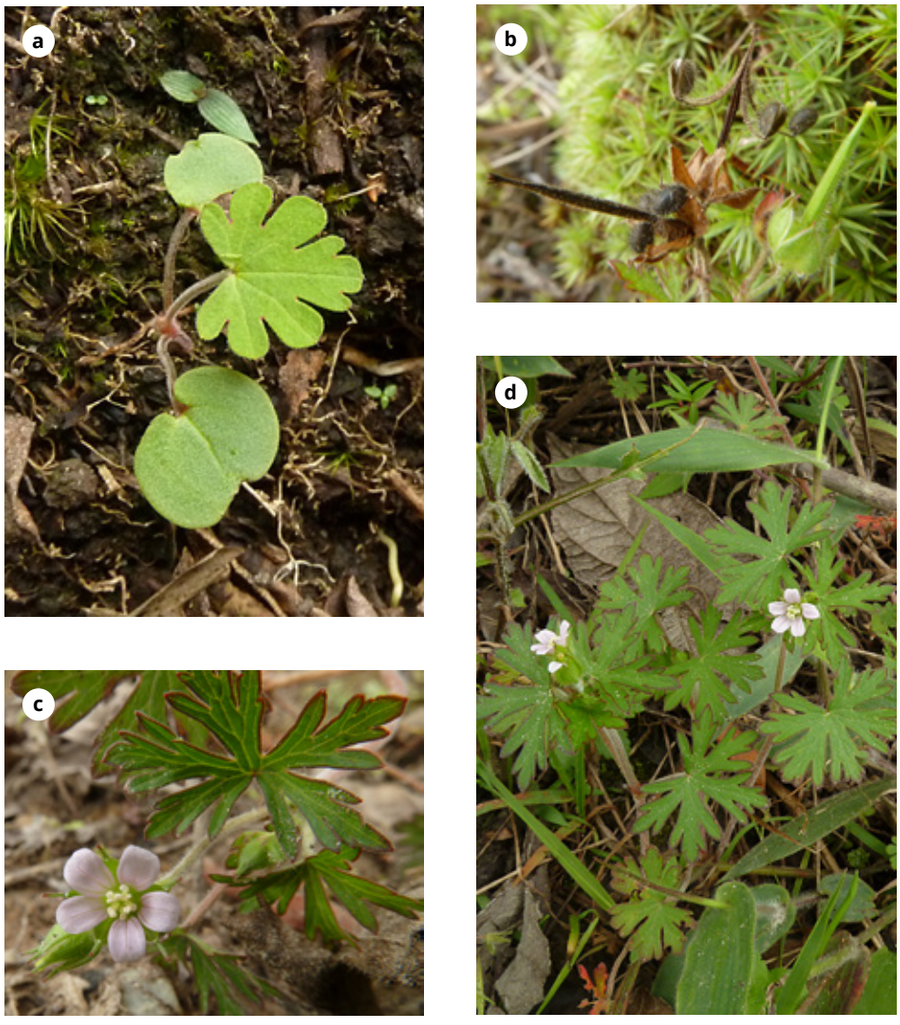


Fig. 323. *Geranium bicknellii* (Based on: a, *Grande & Aedo 2379*, MA; b-d, *Grande & Aedo 2640,* MA).

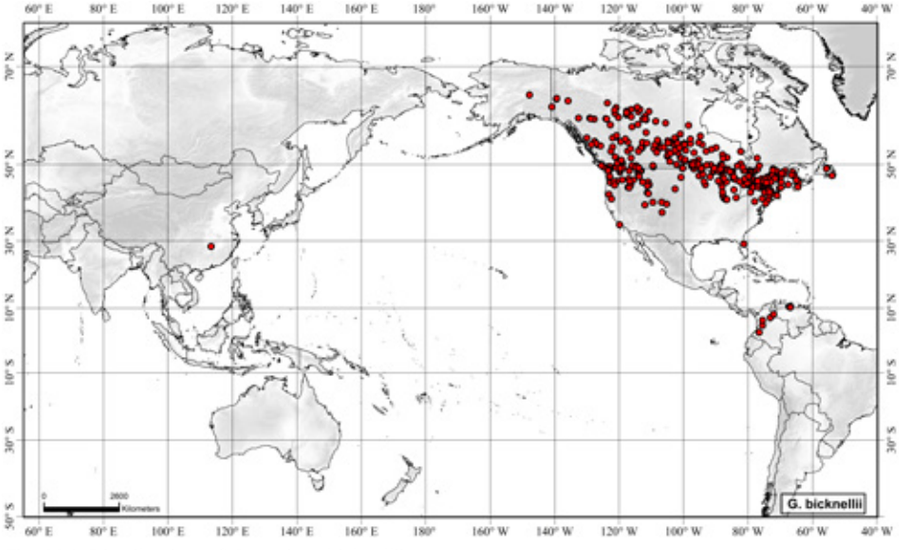


Fig. 324. Distribution of *Geranium bicknellii*.

patent, glandular hairs 0.2-0.5 mm long on the abaxial surface (mainly on the nerves), glabrous adaxially. *Petals* 3.3-6.9 mm long, 1.1-3 mm wide, erect-patent, emarginate (notch ca. 0.5 mm deep), without claw, pale purple, glabrous on both surfaces, ciliate on the basal margin, with hairs 0.2-0.3 mm long. *Stamens* 10, both whorls bearing anthers; filaments 3-4 mm long, lanceolate, white, glabrous except for a some cilia 0.1-0.2 mm long on the proximal half; anthers 0.5-0.6 mm long, dark blue. Nectaries 5, hemispheric, glabrous. *Gynoecium* 3-5 mm long, purple. *Fruit* 18-25 mm long, erect, discharge of seed-ejection type; mericarps 2.8-3.5 mm long, 1.3-2 mm wide, without a strand of fibers, not compressed at the apex, smooth, without basal beak, with a basal callus, without a basal prong, black, with antrorse, eglandular hairs 0.4-1.2 mm long and sometimes, patent, glandular hairs 0.2-0.5 mm long; rostrum 13-21 mm long, with a narrowed apex 2-5.6 mm long, not twisted, with patent, eglandular hairs 0.1-0.3 mm long and patent, glandular hairs 0.2-0.6 mm long; stigmatic remnants 1-1.5 mm long, with 5 hairy lobes. *Seeds* 1.6-2.4 mm long, 0.9-1.3 mm wide, reticulate, uniformly colored, brownish red, glabrous. Cotyledons with entire margin. Figs. 322, 323.

Pollen. *Geranium*-type (Aedo 2000: 46).

Chromosome number. 2*n* = 52.

Phenology. Collected in flower from January to December.

Distribution. This species ranges through Canada and U.S.A. and it is introduced in China, Colombia and Venezuela (Fig. 324).

Habitat. Disturbed areas, meadows, clearings in evergreen and deciduous forests; 0-2700 m.

Representative specimens examined. **Canada.** Alberta: Cameron Lake, 49°1'N, 114°4'W, 17 July 1953, *Breitung 16135* (F). British Columbia: Vancouver Is., Victoria, 48°26'N, 123°22'W, 30 May 1908, *Macoun 78875* (CAN). Manitoba: Lake Breaton, 49°2'N, 100°13'W, 18 Sep. 1938, *Dudley s.n.* (DAO). New Brunswick: Westmoreland Co.,

24 mi W of Berry Mills, 46°7'N, 65°0'W, 30 July 1953, *Bassett & Mulligan 2947* (DAO). Newfoundland Is.: 15 mi N of Placentia Juntion, 47°14'N, 53°58'W, 10 Aug. 1894, *Robinson & Schrenk s.n.* (MO). Northwest Territories: Mackenzie, W of Fort Smith, 60°0'N, 111°53'W, 27 June 1950, *Cody & Loan 4031* (DAO). Nova Scotia: Cumberland Co., New Prospect, 45°26'N, 64°16'W, 26 June 1953, *Schofield 3134* (DAO). Ontario: Port Robinson, 43°2'N, 79°13'W, 15 June 1903, *Misener s.n.* (DAO). Québec: Gatineau Co., Wychwood near Aylmer, 45°23'N, 75°21'W, 19 Aug. 1953, *Bassett 3054* (DAO). Saskatchewan: Edenwold, 50°38'N, 104°15'W, 5 June 1986, *Woo & Thomas 1165* (DAO).Yukon: La Biche River, 60°1'N, 123°54'W, 15 June 1995, *Bennett 95230* (DAO). **China.** Hunan: LiuYang co., N of Shashi, near restaurant and shrub nursery, 28°21'N, 113°24'E, 25 May 2010, *Tucker & Xun-lin Yu 15540* (MO). **Colombia.** Antioquia: vereda Santa Elena, 12 km al E de Medellín, 6°12'N, 75°29'W, 27 Dec. 1980, *Galeano & Bernal 350* (COL). Cauca: Popayán, costado izquierdo del río Palacé, vía a Torotó, 2°27'N, 76°32'W, 24 Jan. 2003, *Ramírez 16219* (COL). Quindio: Mariquita, en el Quindio, 4°38'N, 75°32'W, Aug. 1853, *Triana 3748* (W). Santander: Floridablanca-Tona, El Diviso, 7°1'N, 73°4'W, 22 June 2004, *Fernández Alonso 21607* (MA). **USA.** Alaska: Fairbanks, College, 64°51'N, 147°48'W, 27 July 1931, *Anderson 1270* (NA). California: Santa Barbara Co., San Pedro Canyon, near picnic grounds, Montecito, 34°26'N, 119°50'W, 3 May 1956, *Pollard s.n.* (SBBG). Colorado: Boulder Co., Juleh, 40°0'N, 105°16'W, 24 July 1906, *Daniels s.n.* (MO). Florida: Volusia Co., De Land, 29°1'N, 81°18'W, *Harkness s.n.* (MO). Idaho: Caribou Co., Williamsburg, 42°56'N, 111°15'W, 3 July 1978, *Shultz & Shultz 2710* (NY). Illinois: Cook Co., Glencoe, 42°8'N, 87°45'W, 20 Aug. 1912, *Sherff 1734* (MO). Indiana: Starke Co., 3 mi N of Ora, 41°10'N, 86°33'W, 14 July 1920, *Deam 31855* (IND). Maine: Androscoggin Co., Auburn, 44°5'N, 70°13'W, Aug., *Merrill s.n.* (NY). Massachusetts: Berkshire Co., Bartholomew's Cobble, near Sheffield, 42°6'N, 73°21'W, 23 June 1924, *Freeman s.n.* (NA). Michigan: Midland Co., Sanford, 43°40'N, 84°22'W, 23 June 1928, *Dreisbach 5850* (NY). Minnesota: Hennepin Co., Minneapolis, 44°58'N, 93°15'W, 13 June 1878, *Herrick s.n.* (MO). Montana: Yellowstone Park, Jack Creek Cañon, 44°41'N, 111°14'W, 15 July 1897, *Rydberg & Bessey 4515* (F). New Hampshire: Cheshire Co., Winchester, Forest Lake, 42°46'N, 72°23'W, 13 July 1940, *Manning s.n.* (MO). New Jersey: New Jersey, 40°10'N, 74°30'W, *Knieskern s.n.* (MO). New York: Herkimer Co., Little Falls, 43°2'N, 74°51'W, 4 Oct. 1903, *Haberer 1372* (F). North Dakota: Bottineau Co., Lake Metighose, 48°59'N, 100°21'W, 19 Aug. 1891, *Wright s.n.* (NY). Ohio: Lucas Co., Todd, 41°39'N, 83°40'W, 28 June 1984, *Hardin s.n.* (KE). Oregon: Jackson Co., Wimer, 42°32'N, 123°8'W, 25 June 1892, *Hammond 63* (NY). Pennsylvania: Huntingdon Co., Stone Valley, 40°39'N, 77°55'W, 12 June 1920, *Gre?chwog? s.n.* (NY). South Dakota: Pennington Co., Rapid Canyon, 43°54'N, 102°37'W, 27 July, *Visher 1576* (F). Utah: Uintah Co., Young Spring's Dugway, Uintah Mts., 39°48'N, 112°0'W, 16 July 1902, *Goodding 1395* (MO). Vermont: Rutland Co., Clarendon, 43°30'N, 72°58'W, 26 June 1899, *Eggleston 1089* (MO).Washington: Skamania Co., Little White Salmon River, 45°43'N, 121°38'W, 13 May 1923, *Gorman 6129* (NY). Wisconsin: Milwaukee Co., Milwaukee, 43°2'N, 87°54'W, *Lapham s.n.* (MO).**Venezuela.** Aragua: Colonia Tovar, 10°24'N, 67°17'W, 14 Aug. 2010, *Grande & Aedo 2640* (MA). Distrito Federal: Cerro El Ávila, 10°32'N, 66°51'W, 24 July 2010, *Grande & Aedo 2379* (MA). Táchira: Jáuregui, pr. El Cobre, 8°2'N, 72°3'W, 18 Aug. 1988, *Badillo & al. 7935* (F).

Discussion. Geranium bicknellii shares with *G. carolinianum* and *G. texanum* an accrescent calyx and blackish mericarps; however, it is easily distinguished by the long narrowed apex of the fruit rostrum. Although the calyx of *G. bicknellii* is accrescent, it is narrower than in *G. carolinianum* and *G. texanum*. *Geranium bicknellii* and *G. carolinianum* have long eglandular hairs towards the apex of the mericarps, while in *G. texanum* the mericarp indumentum is homogeneous and consists of shorter hairs. The blackish mericarps of *G. bicknellii* (and allies) are similar to those of *G. bohemicum*, which may be a pyrophytic adaptation. Milberg (1994) suggested that *G. bohemicum* can emerge from a bank of long-lived seeds after forest fires. Abrams & Dickmann (1984) indicated a heat requirement for germination of buried seed of *G. bicknellii*. The different morphologies of the fruits (there is no callus in *G. bohemicum*) suggests that these traits arose independently. Knuth (1912: 54) recorded *G. bicknellii* from Mexico, but Moore (1943: 99) identified these collections as *G. kerberi* R. Knuth. Here these collections are assigned to *G. seemannii* subsp. *seemannii*. The presence of *G. bicknellii* in Venezuela probably is owing to an old introduction. A recent collection in China would indicate that this weed is expanding.

122. Geranium texanum (Trel.) A. Heller, Bull. Torrey Bot. Club 25: 198. 1898. *Geranium carolinianum* var. *texanum* Trel., Mem. Boston Soc. Nat. Hist. 4: 76, pl. 12 fig. 8. 1888. Type locality: "collected near New Braunfels, Texas, by Lindheimer, in 1848... ". Typus: U.S.A. Texas, Comal Co., New Braunfels, 29°42'N, 98°07'W, 1848, *F. Lindheimer s.n.* (lectotype, designated by Aedo 2000: 55, MO-2196467!; isolectotypes, RO!, US image!, W!).

Geranium texanum f. *albiflorum* A.M. Davis, Nat. Leafl. 2: [2]. 1945. Type locality: "The type of this form was collected by the author at Southmost, Cameron County, Texas in March, 1942 and is deposited in the herbarium of the University of Texas". Type: U.S.A. Texas, Cameron Co., 26°07'N, 97°31'W, Mar. 1942, *A.M. Davis s.n.* (holotype, TEX; isotypes, GH!, MO-251391!).

Annual herbs, 10-48 cm tall. *Stem* erect or ascending, leafy, with retrorse, appressed, eglandular hairs 0.1-0.5 mm long. *Basal leaves* in a ± deciduous rosette, cauline leaves alternate in middle of shoot and upper opposite; leaf laminas 1.7-4.7 cm long, 2.2-6 cm wide, not peltate, palmatifid [ratio main-sinus length/middle segment length = 0.75-0.90], polygonal in outline, base cordate, not coriaceous, with nerves not projected, pilose, with appressed, eglandular hairs on both surfaces; segments 5, in 1 plane, middle segment rhombic, 2.1-4 mm wide at the base [ratio segment width at the base/middle segment length = 0.13-0.22], (3)5-9-lobed in distal half [ratio secondary sinus length/middle segment length = 0.25-0.35]; petioles up to 15 cm long, without abscission zone, terete, not swollen, not deflexed in age, with retrorse, appressed, eglandular hairs 0.1-0.4 mm long; stipules 2.6-7 mm long, 1.1-2.9 mm wide, lanceolate to subulate, free, papery, brown, with eglandular hairs on ab-

axial surface and on the margin, glabrous adaxially. *Inflorescence* a dichasial cyme, with monochasial branches; cymules 2-flowered, usually solitary (sometimes in scattered aggregates at the top of each branch) [ratio cymule length/leaf length = 0.4-2.2]; peduncles 10-18(50) mm long, with retrorse, appressed, eglandular hairs 0.1-0.5 mm long; bracteoles 2.4-3.3 mm long, 0.8-0.9 mm wide, lanceolate, whorled; pedicels absent or 4-14.8 mm long, with retrorse, appressed, eglandular hairs 0.1-0.4 mm long. Flowers actinomorphic. *Sepals* 3.4-4.9 mm long, 2.2-3.9 mm wide, broadly lanceolate, smooth, accrescent, nerves 3, mucro 0.6-1.4 mm long [ratio mucro length/sepal length = 0.17-0.18], with antrorse, eglandular hairs 0.1-0.6 mm long on the abaxial surface (mainly on the nerves), glabrous adaxially. *Petals* 4-5 mm long, 1.5-2 mm wide, erect-patent, rounded, without claw, white, glabrous on both surfaces, ciliate on the basal margin, with hairs 0.2-0.3 mm long. *Stamens* 10, external whorl lacking anthers; filaments 2.2-4 mm long, lanceolate to lanceolate with an abruptly narrowed apex, white, glabrous except for a some cilia 0.1-0.2 mm long on the proximal half; anthers 0.3-0.5 mm long, purple. Nectaries 5, hemispheric, glabrous. *Gynoecium* ca. 3 mm long, pink. *Fruit* 14-18.3 mm long, erect, discharge of seed-ejection type; mericarps 2.9-3.5 mm long, 1.3-2 mm wide, without a strand of fibers, not compressed at the apex, smooth, without basal beak, with a basal callus, without a basal prong, ± black, sparsely hairy, with antrorse, eglandular hairs 0.2-0.7 mm long; rostrum 9.7-13.2 mm long, with a narrowed apex 0.5-1 mm long, not twisted, with antrorse, ± appressed, eglandular hairs 0.1-0.3 mm long; stigmatic remnants 0.5-0.7 mm long, with 5 hairy lobes. *Seeds* 1.9-2.2 mm long, 1.6-1.8 mm wide, ± reticulate, uniformly colored, brown, glabrous. Cotyledons with entire margin. Figs. 325, 326.

Pollen. *Geranium*-type (Aedo 2000: 46).

Chromosome number. Unknown.

Phenology. Collected in flower from April to May.

Distribution. This species ranges from Texas and Louisiana to Oklahoma and Alabama, in southern U.S.A. and it is introduced in California and Azores (Fig. 327).

Habitat. Disturbed areas, cultivated fields, clearings, and open forests; 0-700 m.

Representative specimens examined. **Portugal.** Azores: Ilha de São Jorge, 38°40'N, 28°3'W, June, *Carreiro 960* (COI). **USA.** Alabama: Montgomery U.S. Hwy 231, Service Road, 0.08 mi N of Vaughn

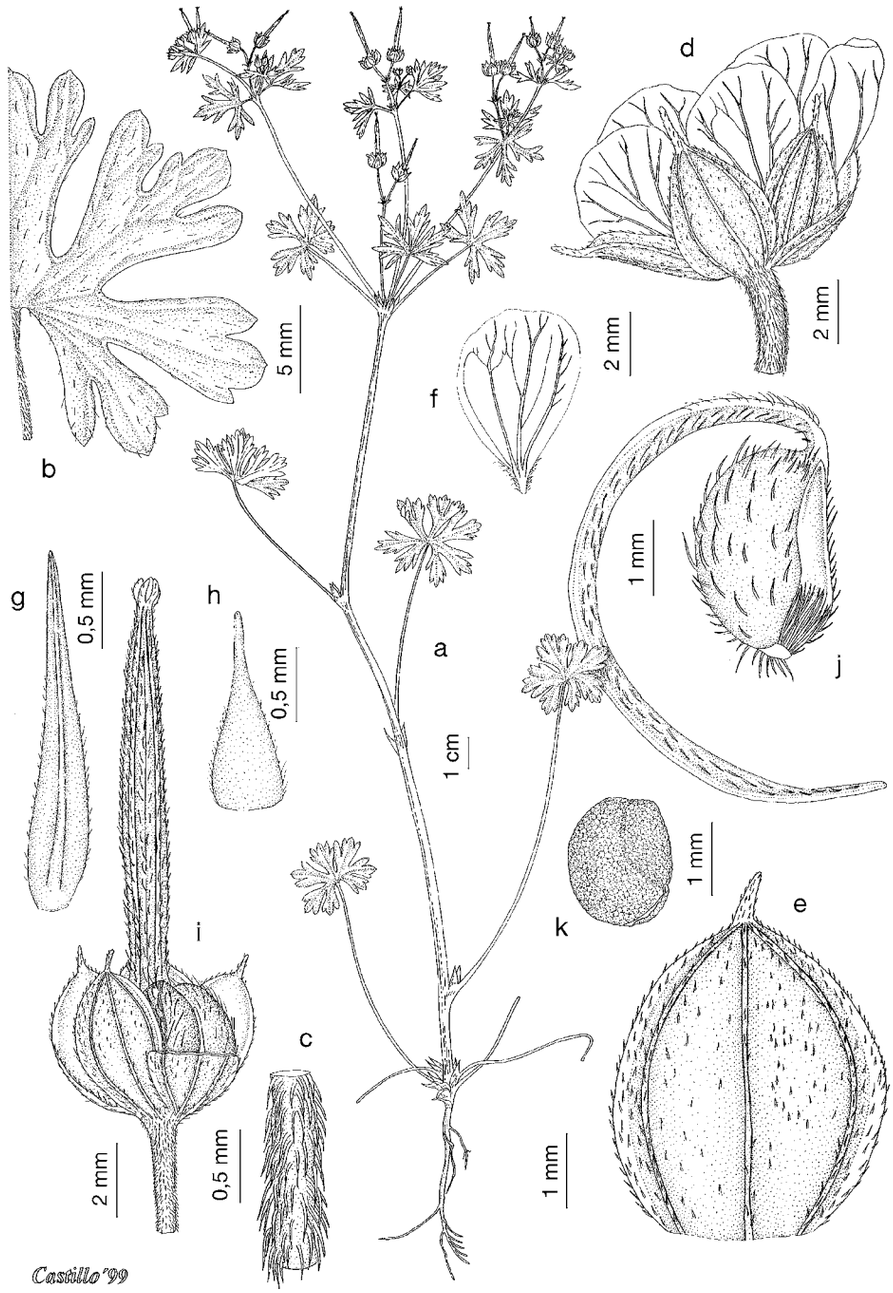


Fig. 325. *Geranium texanum*. a. Habit. b. Portion of leaf. c. Peduncle. d. Flower. e. Sepal. f. Petal. g, h. Staminal filaments. i. Fruit. j. Mericarp. k. Seed. (Based on: a-d, f-i, *Correll & Correll 37050*, GH; e, *Howell s.n.*, *7 June 1936*, NY; j, k, *Thieret 33007*, GH).

Fig. 326. *Geranium texanum* (Based on: *Diamond 29252,* TROY, photo: A. Diamond).

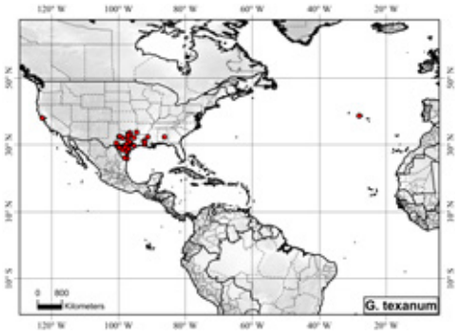


Fig. 327. Distribution of *Geranium texanum*.

Road, parking lot of Olive garde, 32°20'N, 86°13'W, 2 May 2020, *Diamond 29252* (MA). California: Marin Co., Olema, 38°2'N, 122°47'W, 7 June 1936, *Howell s.n.* (NY). Louisiana: Avoyelles Co., 7.5 milles S of Bunkie along road to Whiteville, 30°7'N, 92°11'W, 30 Apr. 1971, *Thieret 33007* (GH); Saint Landry Co., 3.5 milles NW of Whiteville along road to Bunkie, 30°47'N, 92°8'W, 30 Apr. 1971, *Thieret 32999* (GH); Rapides Co., Chambers, 8 mi S of Alexandria, 31°10'N, 92°24'W, 1 May 1971, *Thieret 33064* (GH); Madison Co., Madison, along Tensas River at Sharkey Plantation, W of Quimby, 32°22'N, 91°15'W, 16 Apr. 1948, *Ewan 17559* (MO). Oklahoma: McCurtain Co., Barney Ward Lake, 1.5 mi SW of Tom, 33°44'N, 94°34'W, 29 Apr. 1975, *Taylor 18413* (NY). Texas: Cameron Co., Brownsville, 25°54'N, 97°29'W, 10 Mar. 1924, *Runyon 634* (TEX, US); Hidalgo Co., near Santa Ana National Wildlife Refuge, 26°4'N, 98°8'W, 29 Mar. 1960, *Fleetwood 3205* (TEX); Nueces Co., Corpus Christi, Oso Creek, 27°40'N, 97°19'W, 2 Apr. 1992, *Carr 11692* (TEX); San Patricio Co., 2.5 mi SW of Sinton, 28°2'N, 97°30'W, 22 Mar. 1969, *Correll 36836* (TEX); La Salle Co., 13/4 mi W of Fowlerton, 28°27'N, 98°48'W, 4 May 1938, *Cory 28501* (GH); Victoria Co., Bloomington, 28°38'N, 96°53'W, 13 Mar. 1916, *Palmer 9164* (MO); Victoria Co., Victoria, 28°48'N, 97°0'W, 7 Apr. 1900, *Eggert s.n.* (MO); Uvalde Co., 3 mi S of Uvalde, 29°12'N, 99°47'W, 18 Apr. 1966, *Correll & Rollins 32528* (TEX); Wilson Co., Sutherland Springs, 29°15'N, 98°4'W, 25 Mar. 1937, *Cutler 851* (MO); Bexar Co., Columbia, 29°22'N, 98°31'W, 9 Apr. 1902, *Bush 1319* (MO, US); Bexar Co., San Antonio, 29°25'N, 98°29'W, 15 Apr. 1911, *Clemens 851* (MO); Bexar Co., Austin Chalk, Government Canyon State Park, 29°33'N, 98°44'W, 3 May 1995, *Carr 14568* (TEX); Gonzales Co., Ottine, 29°35'N, 97°35'W, 12 Apr. 1940, *Warnock 20660* (MO, TEX); Harris Co., Houston, near the Union Depot, 29°45'N, 95°21'W, 16 June 1903, *Reverchon 3773* (MO); Fayette Co., on state road 95, 2.1 mi N of I-10 bridge, 0.5 mi N of junction FR154 at small power line crossing road, 29°48'N, 97°13'W, 18 Apr. 1992, *Mayfield 1204* (TEX); Hays Co., 12.3 mi E of San Marcos on highway 80, 29°52'N, 97°50'W, 2 Apr. 1939, *Reese s.n.* (TEX); Fayette Co., 29°54'N, 96°52'W, *Mathes 1314* (W); Edwards Co., Pasture D, Substation no. 14, 29°58'N, 100°18'W, 30 Apr. 1941, *Cory 37056* (GH); Edwards Co., Moody's, 29°58'N, 100°18'W, 6 Apr. 1929, *Cory 487* (GH); Travis Co., 1 mile S of Onion Creek, 30°12'N, 97°35'W, 5 Apr. 1954, *Ely s.n.* (TEX); Sutton Co., Sonora, 30°34'N, 100°38'W, 21 Apr. 1931, *Jones s.n.* (MO); Brazos Co., on the Texas A. & M campus, W of Wellborn road, 30°40'N, 96°22'W, 27 Mar. 1996, *Skinner 117* (MO); Robertson Co., 3 mi S of Hearne along Farm Road 50, at edge of small ponds, 30°52'N, 96°35'W, 20 Apr. 1969, *Correll & Correll 37050* (GH, TEX); McLennan Co., Waco, 31°32'N, 97°8'W, 13 July 1905, *Pace s.n.* (MO); Hill Co., 4 mi N of Whitney, 31°57'N, 97°19'W, 28 Apr. 1960, *Gould 9055* (TEX); Navarro Co., Frost, 32°4'N, 98°48'W, Apr., *Mitchan 47* (TEX); Smith Co., W of Bullard, Tx on FM 344, 32°8'N, 95°19'W, 22 Apr. 1985, *Nixon 14455* (GH); Callahan Co., 4 mi W of Clyde, 32°24'N, 99°29'W, 23 Apr. 1963, *Henderson 63-477* (TEX); Taylor Co., at Camp Barkeley, 32°25'N, 99°51'W, 13 Apr. 1943, *Tolstead 6986* (MO); Taylor Co., W of Hamby, NE of Abiline, 32°31'N, 99°37'W, 23 Apr. 1963, *Mahler 3319* (TEX); Dallas Co., Stultus Prairie, SW corner of Coit Road and Belt Line Road, 32°47'N, 96°48'W, 28 May 1959, *Correll & Johnston 22444* (GH); Dallas Co., inwood road between Valley View Lane and Belt Line Road, 32°47'N, 96°48'W, 25 Apr. 1959, *Hamric & Thompson 16* (NY, TEX); Tarrant Co., 32°49'N, 97°4'W, 1927, *Killian 6937* (TEX); Rockwall Co., 4 mi NW of Rockwall, 32°55'N, 96°27'W, 5 May 1939, *McCart 1694* (MO); Denton Co., Denton, 33°12'N, 97°7'W, 17 Apr. 1939, *McCart 1586* (NY); Grayson Co., Sherman, 33°38'N, 96°36'W, 7 May 1983, *Nee & Diggs 27181* (F, NY).

Discussion. Geranium texanum resembles *G. carolinianum*, from which it can be distinguished by the type of indumentum on the inflorescence and fruit. In *G. texanum* pedicels have retrorse, appressed, eglandular hairs, while *G. carolinianum* usually has patent, glandular and eglandular hairs. Yet, in some forms of *G. carolinianum* glandular hairs are scattered or even absent; in these forms hairs can be retrorse but are never appressed. Fruits of *G. texanum* have scattered, short hairs, whereas the fruits of *G. carolinianum* are densely covered with long hairs towards the apex. Sepals, petals, and fruits are longer in *G. carolinianum* than in *G. texanum*. Two characters suggest that *G. texanum* and *G. carolinianum* may be related: the short narrowed apex of the fruit rostrum and the short pedicels. *Geranium texanum* was described by Aedo (2012: 46) as having ten fertile stamens. However, a close inspection of the new specimens thanks to Alvin Diamond's suggestion (*in litt.*) has shown that in fact the outer whorl

lacks anthers and has very short filaments. *Geranium texanum* is easily distinguished from *G. pusillum*, the other species with only five fertile stamens, by the type of fruit, which is of the seed-ejection type in the former and of the carpel-projection type in the latter. Since *G. texanum* reaches the Mexican border in Cameron Co., Texas, it is probably present in Mexico; however, I could not find any Mexican specimens of this species. Moore (1943: 102) recorded a single sheet from Chihuahua, collected by Wright in 1852 (GH), but that is *G. carolinianum*. Collections of *G. texanum* from California and the Azores probably represent occasional introductions.

The Caespitosum Group—This group is characterized by its usually erect habit, its usually opposite, palmatifid leaves and its 2-flowered cymules arranged in dichasial inflorescence. The petals are of medium size, erect-patent, patent or reflexed, usually without claw, and hairy on 1/5 to 3/4 of their adaxial surface.

123. Geranium caespitosum E. James, Account Exped. Pittsburgh ed. Amer. 2: 3. 1823. *Geranium intermedium* E. James, Account Exped. Pittsburgh Eng. ed. 2: 344, 190. 1823, nom. illeg. Type locality: "About the sandstones ledges we collected a geranium... " ["the base of the Rocky Mountains"]. Type: U.S.A. New Mexico, San Miguel Co., Mora river, 35°43'N, 104°23'W, 18 Aug. 1847, *A. Fendler 89* (neotype, designated by Jones & Jones 1943: 49, GH; isoneotypes, MO-2196462!, NY-00373613 image!, UC, F-0060423!, K-001081654 image!, MA-617379!, P-00757998!, S-14-30690 image!, W!, WU!).

Geranium pentagynum Engelm. in Wisl., Mem. Tour. N. Mexico 90. 1848. Type locality: "On Wolf creek, flowers in June". Type: U.S.A. New Mexico, Wolf Creek, 36°22'N, 106°51'W, 24 June 1846, *F.A. Wislizenus 508* (lectotype, designated by Aedo 2001b: 34, MO-251024!).

Geranium fremontii Torr. ex A. Gray, Amer. Acad. Arts Sci. ser. 2, 4(1): 26. 1849. Type locality: "G. Fremontii (Torr.! in Pl. Frem. cum ic. ined.)... Bottom lands of the Mora River, among shrubs; August. (Also in the Raton Mountains, Lieut. Abert, and probably farther north and west by Col. Fremont.)". Type: U.S.A. New Mexico, Raton Mountains, 36°58'N, 104°27'W, *Abert (Lieutenant) s.n.* (lectotype, designated by Jones & Jones 1943: 45, NY!; isolectotype, GH!).

Geranium gracile Engelm. in A. Gray, Amer. Acad. Arts Sci. ser. 2, 4(1): 27. 1849, nom. illeg., non Ledeb. in Nordm. 1837. *Geranium caespitosum* var. *gracile* Engelm. ex A. Nelson & J.F. Macbr., Bot. Gaz. (Crawfordsville) 55: 376. 1913. Type locality: "Pine woods, on the mountains of Cosiquiriachi, State of Chihuahua; collected in October, by Dr. Wislizenus". Type: Mexico. Chihuahua, Cosiquiriachi, 28°14'N, 106°49'W, *F.A. Wislizenus s.n.* (no original material located).

Geranium fremontii var. *parryi* Engelm. in A. Gray, Amer. J. Sci. Arts ser. 2, 33: 405. 1862. *Geranium parryi* (Engelm.) A. Heller, Cat. N. Amer. Pl. ed. 2, 7. 1900. *Geranium caespitosum* var. *parryi* (Engelm.) W.A. Weber, Phytologia 33: 105. 1976. Type locality: "... plants of Dr. Parry's Collection in the Rocky Mountains in 1861, n. 113...". Type: U.S.A. Colorado, Clear Creek, Middle Park, 37°48'N, 106°40'W, 1861, *C.C. Parry 113* (lectotype, designated by Jones & Jones 1943: 43, NY; isolectotypes, G!, GH, K-001081655!, MO-251019!, P!).

Geranium caespitosum f. *albiflorum* Cockerell, Hardwicke's Sci.-Gossip. 25: 188. 1889. Type locality: "Looking over the herbarium of Mrs. M.E. Cusack, I find several things of interest... All the above-mentioned plants were collected in Western Custer Co., Colorado". Type: U.S.A. Colorado, Western Custer Co., 38°07'N, 105°22'W, *M.E. Cusack s.n.* (no original material located).

Geranium richardsonii var. *intermedium* Kuntze, Revis. Gen. Pl. 1: 93. 1891. Type locality: "Colorado, Rocky Mountains". Type: U.S.A. Colorado, Rocky Mountains, 20 Sep. 1874, *O. Kuntze 3024* (lectotype, designated by Aedo 2001b: 34, NY!).

Geranium atropurpureum A. Heller, Bull. Torrey Bot. Club 25: 195. 1898. *Geranium caespitosum* subsp. *atropurpureum* (A. Heller) W.A. Weber, Phytologia 53: 187. 1983. Type locality: "The description is drawn from our no. 2723, collected along Santa Fé Creek, June to July, 1897. It is very plentyful along the stream, but always in dry ground. It has a range of about 2000 feet, as it was first collected four miles east of Santa Fé, at an elevation of a little over 7000 feet, but later was seen growing on a slope ten milles up the valley, and at an elevation of almost 9000 feet. It was also noticed along the road between Santa Fé and Cañoncito". Type: U.S.A. New Mexico, Santa Fé Creek, 35°41'N, 105°56'W, 17 July 1897, *A. Heller 3723* (lectotype, designated by Aedo 2001b: 34, MO!; isolectotypes, BM!, DS, E-00438334 image!, GH-00043609 image!, ILL, K!, LE!, NDG, NY, P!, POM, US image!) [The collection number is cited erroneously as 2723 in the protologue].

Geranium pattersonii Rydb., Bull. Torrey Bot. Club 29: 242. 1902. Type locality: "Colorado: Gray Peak, 1895, P.A. Rydberg (type in herb. N.Y. Bot. Gard.)". Type: U.S.A. Colorado, Gray Peak, 38°42'N, 104°54'W, 23 Aug. 1895, *P.A. Rydberg s.n.* (lectotype, here designated in second step, NY-00373643!; isolectotype, NY-00373644!).

Geranium cowenii Rydb., Fl. Colorado: 218. 1906. *Geranium fremontii* var. *cowenii* (Rydb.) H.D. Harr., Man. Pl. Colorado: 641. 1954. Type locality: "In the mountains of Colo.-Alt. 6000-7000 ft.-Hills, Larimer Co.; Horsetooth Gulch; Rist Cañon; La Veta". Type: U.S.A. Colorado, Larimer Co., Rist Cañon, 40°38'N, 105°11'W, 16 June 1899, *W.F. Marshall 1157* (holotype, NY-00373614!; isotypes, CS-106155 image!, US image!) [designation of a lectotype by Aedo 2001b: 35, was an error].

Geranium furcatum Hanks in Underw. & Britton (eds.), N. Amer. Fl. 25(1): 16. 1907. *Geranium atropurpureum* var. *furcatum* (Hanks) Kearney & Peebles, J. Wash. Acad. Sci 29: 485. 1939. Type locality: "Type collected in the Grand Cañon of the Colorado, Arizona, August, 1897, T. F. Allen". Type: U.S.A. Arizona, Grand Cañon of the Colorado, 36°10'N, 111°55'W, Aug. 1897, *T.F. Allen s.n.* (lectotype, designated by Jones & Jones 1943: 46, NY-00373623!; isolectotype, UC).

Geranium marginale Rydb. ex Hanks & Small in Underw. & Britton (eds.), N. Amer. Fl. 25(1): 16. 1907. Type locality: "Type collected on the Aquarius Plateau at the head of Poison Creek, Utah, August 4, 1905, P. A. Rydberg & E. C. Carlton 7401". Type: U.S.A. Utah, Aquarius Plateau at the head of Poison Creek, 38°01'N, 111°42'W, 4 Aug. 1905, *P.A. Rydberg & E.C. Carlton 7401* (lectotype, designated by Aedo 2001b: 35, NY-00373639!).

Geranium eremophilum Wooton & Standl., Contr. U.S. Natl. Herb. 16(4): 142. 1913. Type locality: "Type in the U.S. National Herbarium, no. 233003, collected in the San Luis Mountains, September 5, 1893, by Dr. E. A. Mearns (no. 2142)". Type: U.S.A. New Mexico, San Luis Mountains, 31°20'N, 108°45'W, 5 Sep. 1893, *E.A. Mearns 2142* (holotype, US-233003!).

Geranium toquimense A.H. Holmgren & N.H. Holmgren, Brittonia 26: 311, fig. 2.

1974. Type locality: "UNITED STATES: Nevada: Nye County, Toquima Range, head of the N branch of South Fork Pine Creek, T. 11 N., R. 45 E., Sec. 21, elev. 3150 m (10,500 ft), 3 Aug 1964, N. Holmgren & Reveal 1518". Type: U.S.A. Nevada, Nye Co., Toquima Range, head of the N branch of South Fork Pine Creek, 38°52'N, 116°45'W, 3 Aug. 1964, *N.H. Holmgren & J.L. Reveal 1518* (holotype, NY-00373648!; isotypes, BRY, DAO, ID, RSA, UC, US image!, UT, UTC, WTU).

Perennial herbs, 15-70 cm tall. *Rootstock* 4-14 mm in diameter, vertical, not tuberculate, not turnip-shaped, without thickened roots. *Stem* erect or ascending, leafy, not rooting at nodes, stolons absent, without vegetative stems, with patent to retrorse, eglandular hairs 0.1-0.9 mm long, and often patent, glandular hairs 0.2-1.2 mm long. *Basal leaves* in a persistent rosette, cauline leaves opposite; leaf laminas 2.6-7.3 cm long, 3-6.4(7.5) cm wide, not peltate, palmatifid [ratio main-sinus length/middle segment length = 0.72-0.92], polygonal in outline, base cordate, not coriaceous, with nerves not projected, pilose, with appressed, eglandular (and sometimes glandular) hairs on both surfaces; segments 5, in 1 plane, middle segment obtriangular to rhombic, 2.2-7.7(10) mm wide at the base [ratio segment width at the base/middle segment length = 0.09-0.25], 3-8-lobed in distal half [ratio secondary sinus length/middle segment length = 0.12-0.26]; petioles up to 30 cm long, without abscission zone, terete, not swollen, not deflexed in age, with patent to retrorse, eglandular hairs 0.1-0.9 mm long and, often, patent, glandular hairs 0.1-1.1 mm long; stipules 3-11 mm long, 1.2-2.1 mm wide, lanceolate, free, papery, brownish red, with eglandular and, sometimes, glandular hairs on abaxial surface and on the margin, glabrous adaxially. *Inflorescence* a dichasial cyme; cymules 2-flowered, solitary or, rarely, in aggregates at the top of each branch [ratio cymule length/leaf length = 1.8-4.2]; peduncles (8)18-120(170) mm long, with patent to retrorse, eglandular hairs 0.1-0.7 mm long and, sometimes, patent, glandular hairs 0.2-0.6 mm long; bracteoles 4-11 mm long, 0.6-1.5 mm wide, lanceolate, whorled; pedicels 18-33(49) mm long, with patent to retrorse, eglandular hairs 0.1-0.7 mm long and, sometimes, patent, glandular hairs 0.2-0.7 mm long. Flowers actinomorphic. *Sepals* 7.5-11 mm long, 2.7-4.2 mm wide, lanceolate, smooth, not accrescent, nerves 3-5, mucro (0.5)1-1.8 mm long [ratio mucro length/sepal length = 0.11-0.25], with antrorse to patent, eglandular hairs 0.2-1 mm long and patent, glandular hairs 0.1-0.6 mm long on the abaxial surface, usually hairy on the base of the adaxial surface. *Petals* 11-15 mm long, 4-9 mm wide, patent, rounded, without claw, purple, sometimes white, hairy on the basal 1/3-1/2 of their adaxial surface and on the base of the abaxial surface, ciliate on the basal margin, with hairs 1.4-2.8 mm long. *Stamens* 10, both whorls bearing anthers; filaments 8-11.8 mm long, lanceolate, purple, pilose on the abaxial surface, ciliate on the proximal half, with hairs 0.3-1.5 mm long; anthers 1.9-3 mm long, pink. Nectaries 5, hemispheric, with a tuft of hairs at the top, dorsally glabrous. *Gynoecium* 9-13 mm long, purple. *Fruit* 22-31(36) mm long, erect, discharge of seed-ejection type; mericarps 3-4.8 mm long, 2-2.6 mm wide, without a strand of fibers, not compressed at the apex, smooth, without basal beak, with a basal callus, without a basal prong, brown, with ± patent, eglandular hairs 0.2-0.8 mm long and, usually, patent, glandular hairs 0.2-0.8 mm long; rostrum 15-23 mm long, with a narrowed apex 2-3.8 mm long, not twisted, with ± patent, eglandular hairs 0.1-0.5 mm long and, usually, patent, glandular hairs 0.5-0.6 mm long; stigmatic remnants (4)5.8-8 mm long, with 5 glabrous lobes. *Seeds* 2.5-3.5 mm long, 1.6-2.5 mm wide, finely reticulate, uniformly colored, brown, glabrous. Cotyledons with entire margin. Fig. 328.

Pollen. *Geranium*-type (Bortenschlager 1967: 427).

Chromosome number. 2*n* = 52.

Phenology. Collected in flower from March to October.

Distribution. This species ranges from southwestern U.S.A. to northern Mexico (Fig. 329).

Habitat. Disturbed areas, roadsides, rocky slopes, meadows, shrublands, evergreen and deciduous forests; 1100-3300 m.

Representative specimens examined. **Mexico.** Chihuahua: Calera, E of San Isidro, 28°18'N, 108°24'W, 15 Sep. 1934, *Pennell 18789* (NY); km 123 entre Cuauhtmoc y La Junta, 28°24'N, 107°6'W, 12 Aug. 1994, *Yen & Estrada 2955* (CAS); Sierra Madre, Colonia García, 29°59'N, 108°20'W, 5 Aug. 1899, *Townsend & Barber 227* (NY). Coahuila: Ocampo, Sierra Maderas del Carmen, 28°9'N, 108°15'W, 17 Sep. 1989, *Estrada 1792* (XAL); Villa Acuña, Sierra del Carmen, canyon de Sentenela on Hacienda Piedra Blanca, 29°3'N, 102°28'W, 8 July 1936, *Wynd & Mueller 586* (NY); Madera del Carmen, upper end of Dos Canyon at road fork to Campo Uno, 29°25'N, 102°11'W, 23 June 1976, *Fryxell 2714* (NY). Sonora: Yecora, El Aguahuito of Barranca Honda on N slope of Mesa del Campanero, 4.8 km W of Puerto de la Cruz on highway 16, 28°22'N, 109°3'W, 18 Mar. 1998, *Daniel & al. 8587* (CAS); Cerro de las Flores, 30°56'N, 109°57'W, 9 Oct. 1992, *Fishbein & al. 666* (MEXU); Santa Cruz, 31°14'N, 110°35'W, Sep. 1885, *Schott s.n.* (NY). **USA.** Arizona: Cochise Co., Huachuca Mts., Miller Canyon, 31°25'N, 110°14'W, 9 Aug. 1980, *Carter s.n.* (NMC); Coconino Co., Gran Cañón del Colorado, orilla N, Imperial Point, 36°16'N, 111°58'W, 21 Aug. 1997, *Aedo 4424* (MA); Apache Co., Laguna Canyon, 36°53'N, 109°44'W, 10 July 1920, *Clute 30* (MO). Colorado: Archuleta Co., Sheep Cañon, 37°8'N, 107°24'W, 11 July 1901, *Clements & Clements 90* (MO); Colorado: Saguache Co., near Flying M Ranch, 38°16'N, 106°44'W, 8 July 1936, *Rollins 1333* (MO); Larimer Co., Trails End, 40°54'N, 105°27'W, 11 July 1924, *Nelson 10112* (GH). Nevada: White Pine Co., N side of Mt. Sherman, 40°7'N, 115°35'W, 4 Aug. 1939, *Hitchcock & Martin 5667* (GH). New Mexico: Hidalgo Co., Peloncillo Mts., Skeleton Canyon, 31°37'N, 109°5'W, 6 Sep. 1981, *Spellenberg & Spellenberg 6324* (NMC); Eddy Co., Guadalupe Mts., Devils Den Canyon, 32°2'N, 104°49'W, 6 Sep. 1986, *Brunt 16* (NMC); Colfax Co., Raton, 36°54'N, 104°26'W, 1887, *Tracy 92* (MO). Texas: Brewster Co., Chisos Mts., 29°15'N, 103°18'W, 27 July 1931, *Mueller 8050* (F, TEX); Jeff Davis Co., Davis Mts., 30°45'N, 104°5'W, 6 Oct. 1926, *Palmer 32011* (MO);

Culberson Co., Guadalupe Mts., Pine Canyon, 31°54'N, 104°52'W, 5 Sep. 1916, *Young s.n.* (MO). Utah: Kane Co., along Skutumpah Creek, 37°13'N, 112°21'W, 4 Aug. 1976, *Welsh & al. 14233* (MO); Washington Co., Zion National Park, Temple of Sinawava, 37°17'N, 112°56'W, 22 Aug. 1997, *Aedo 4428* (MA); San Juan Co., N slope of Abajo Mts., 37°50'N, 109°27'W, 1 July 1930, *Goodman & Hitchcock 1450* (MO). Wyoming: Albany Co., Jelm, 41°3'N, 106°0'W, 11 Aug. 1900, *Nelson 8061* (MO); Albany Co., plains E of Laramie, 41°18'N, 105°35'W, 12 June 1940, *Cain 55* (MO); Albany Co., near Crow Creek, Laramie hills, 41°18'N, 105°35'W, 11 July 1935, *Rollins 975* (MO); Albany Co., Horseshoe Creek, NW of Laramie, 42°5'N, 106°47'W, 7 Aug. 1858, *Engelmann 186* (MO).

Discussion. Geranium caespitosum is well characterized by its long, usually purplish, adaxially hairy, patent petals. This species shows great variability in distribution and density of the glandular indumentum, even in the same individual. Although *G. caespitosum* has an essentially eglandular indumentum, occasionally specimens occur with glandular hairs on the stem, petioles, or the inflorescence. Furthermore, leaf shape and the portion of petal surface bearing hairs vary considerably, but independently of the presence of a glandular indumentum. According to Moore (1943: 47) *G. caespitosum* (cited as "G. atropurpureum"; see the following paragraph) was unnecessarily divided into several species by previous authors (Jones & Jones 1943; Knuth 1912). Moreover, Welsh & al. (1987: 313) pointed out that division of *G. caespitosum* into several taxa is possible only arbitrarily. In agreement, these forms are not accorded taxonomic recognition here. In *G. caespitosum* the glandular hairs are similar to those of *G. oreganum*, *G. richardsonii*, and *G. viscosissimum*, shorter than in *G. maculatum* and ending in a broad, usually yellow cell. *Geranium caespitosum* could be confused with *G. viscosissimum*, which has larger leaves, stem, and fruits, and shorter stigmatic remnants. *Geranium richardsonii* and *G. wislizeni* have white, erect-patent petals and dorsally hairy nectaries. In addition, *G. wislizeni* has shorter sepals and petals, although with some overlap.

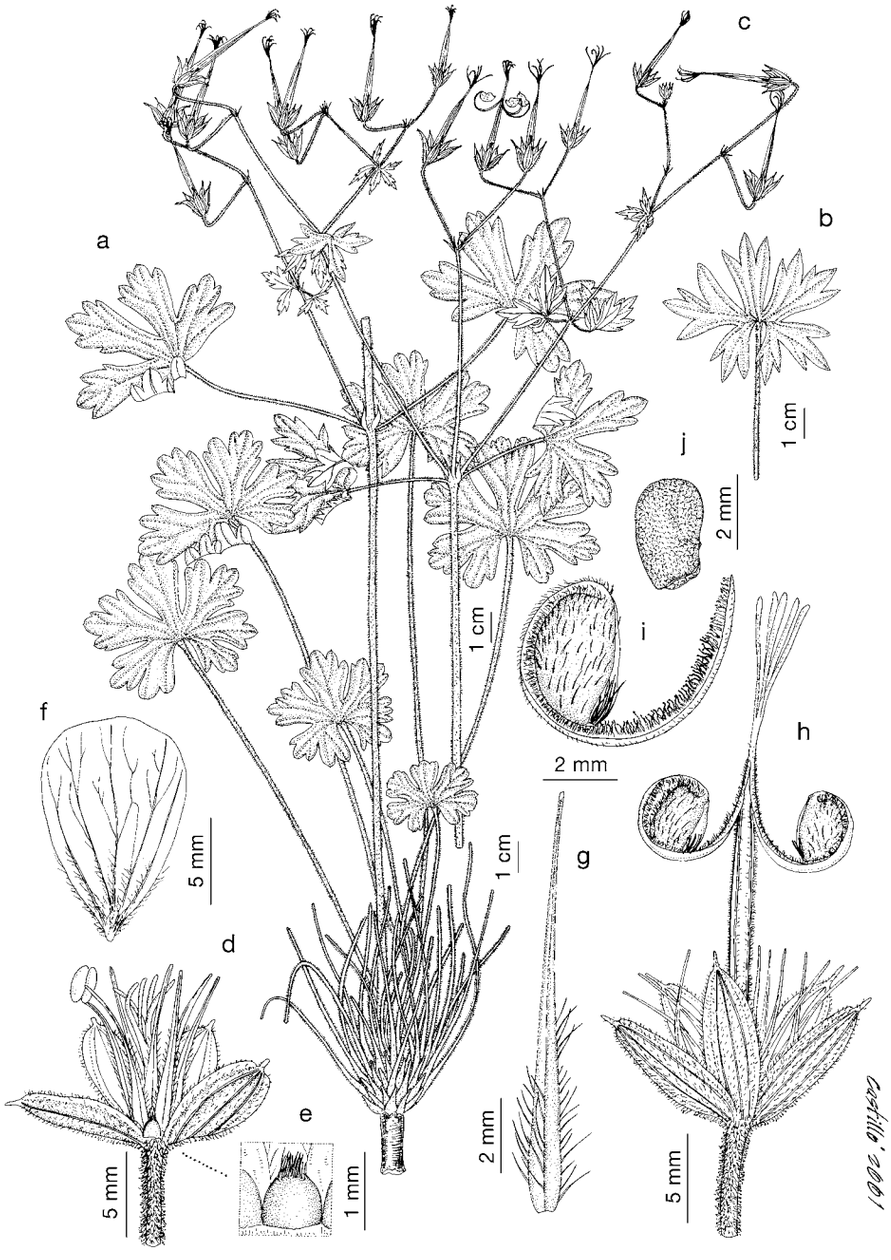


Fig. 328. *Geranium caespitosum*. a. Habit. b. Leaf. c. Inflorescence. d. Flower, petals removed. e. Nectary. f. Petal. g. Staminal filament. h. Fruit. i. Mericarp. j. Seed. (Based on: a, f-j, *Aedo 4424*, MA; b-e, *Hogan 2272*, MA).

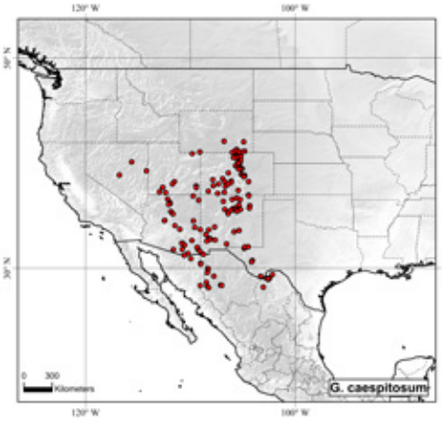


Fig. 329. Distribution of *Geranium caespitosum*.

Moore (1943: 47) considered "G. caespitosum" as nomen dubium and preferred the name *G. atropurpureum* for this species. He recorded as *G. caespitosum* some specimens from Baja California, characterized by longer peduncles towards the base of inflorescence, which are identified here as *G. californicum*.

Osterhout (1923) analyzed the different editions of James publications in relation to the name that should be used for this species. In order to maintain nomenclatural stability I accept that the American edition of *Account of an expedition from Pittsburgh to the Rocky Mountains . . .* (James 1823a) has priority over the English edition (James 1823b). The reverse option would have the name *G. caespitosum*, unquestioned for more than 150 years, displaced by *G. intermedium* E. James.

124. Geranium californicum G.N. Jones & F.F. Jones, Rhodora 45: 38. 1943. *Geranium leucanthum* Small in Underw. & Britton (eds.), N. Amer. Fl. 25(1): 18. 1907, nom. illeg., non Griseb. 1874. Type locality: "Type collected at Pineridge, Fresno County, California, June 15-25, 1900, H. M. Hall & H. P. Chandler 224". Type: U.S.A. California, Fresno Co., Pineridge, 36°47'N, 119°07'W, 15-25 June 1900, *H.M. Hall & H.P. Chandler 224* (lectotype, designated by Jones & Jones 1943: 39, NY; isolectotypes, MO-251018!, UC!, US image!).

Geranium concinnum G.N. Jones & F.F. Jones, Rhodora 45: 36. 1943. Type locality: "California: Kern River, Culbertson 4454". Type: U.S.A. California, Tulare Co., Kern River, 36°18'N, 118°24'W, 3 Aug. 1904, *J.D. Culbertson 4454* (holotype, GH-00043612 image!; isotypes, MO-251026!, NY, UC!).

Perennial herbs, 20-70 cm tall. *Rootstock* 4-15 mm in diameter, vertical, not tuberculate, not turnip-shaped, without thickened roots. *Stem* erect or ascending, leafy, not rooting at nodes, stolons absent, without vegetative stems, with patent to retrorse, eglandular hairs 0.3-1.5 mm long and, often, patent, glandular hairs 0.3-0.5 mm long. *Basal leaves* in a persistent rosette, cauline leaves opposite; leaf laminas 2.4-6 cm long, (2.8)4.1-6(8) cm wide, not peltate, palmatifid [ratio main-sinus length/middle segment length = 0.75-0.92], polygonal in outline, base cordate, not coriaceous, with nerves not projected, pilose, with appressed, eglandular (and sometimes glandular) hairs on both surfaces; segments 5, in 1 plane, middle segment rhombic, 3-7 mm wide at the base [ratio segment width at the base/middle segment length = 0.13-0.25], (3)7-9-lobed in distal half [ratio secondary sinus length/middle segment length = 0.15-0.35]; petioles

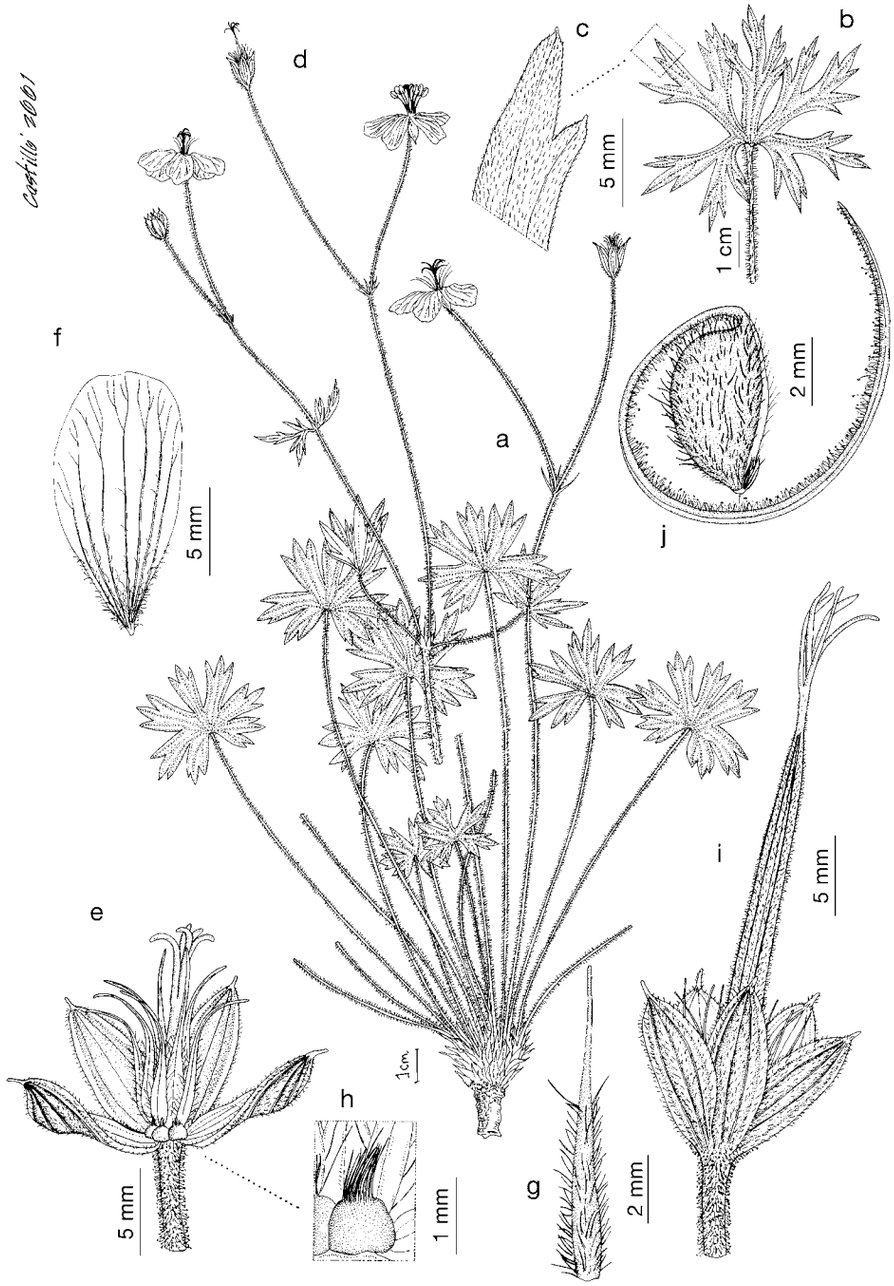


Fig. 330. *Geranium californicum*. a. Habit. b. Leaf. c. Detail of leaf, adaxial side. d. Inflorescence. e. Flower, petals removed. f. Petal. g. Staminal filament. h. Nectary. i. Fruit. j. Mericarp. (Based on: a, d-h, *Hall & Chandler 224*, UC; b, c, *Hall 9234*, UC; i, j, *Ertter 6665*, UC).

up to 32 cm long, without abscission zone, terete, not swollen, not deflexed in age, with patent to retrorse, eglandular hairs 0.3-1.7 mm long and, sometimes, patent, glandular hairs 0.2-0.5 mm long; stipules 2.4-12 mm long, 1.2-2 mm wide, lanceolate, free, papery, brownish red, with eglandular hairs on abaxial surface and on the margin, glabrous adaxially. *Inflorescence* a dichasial cyme; cymules 2-flowered, solitary or, rarely, in aggregates at the top of each branch [ratio cymule length/leaf length = 1.1-7.7]; peduncles (22)82-190(310) mm long, with patent to retrorse, eglandular hairs 0.3-1.6 mm long and patent, glandular hairs 0.2-0.6 mm long; bracteoles 2.2-11 mm long, 0.5-1.5 mm wide, lanceolate, whorled; pedicels (17)44-86 mm long, with patent to retrorse, eglandular hairs 0.2-1 mm long and patent, glandular hairs 0.2-0.6 mm long. Flowers actinomorphic. *Sepals* 6.9-11 mm long, 2.5-4.5 mm wide, lanceolate, smooth, not accrescent, nerves 3-5, mucro (0.6)1-2 mm long [ratio mucro length/sepal length = 0.08-0.26], with antrorse to patent, eglandular hairs 0.2-1.4 mm long and, sometimes, patent, glandular hairs 0.2-0.6 mm long on the abaxial surface, usually hairy on the base of the adaxial surface. *Petals* (10)11-16.9 mm long, 6-11 mm wide, usually patent, rounded, without claw, white, sometimes purple, hairy on the basal 1/2-3/4 of their adaxial surface and on the base of the abaxial surface, ciliate on the basal margin, with hairs 1-1.8 mm long. *Stamens* 10, both whorls bearing anthers; filaments 7-11.3 mm long, lanceolate, white to pink, pilose on the abaxial surface, ciliate on the proximal half, with hairs 0.3-1.4 mm long; anthers 1.7-2.9 mm long, pink. Nectaries 5, hemispheric, with a tuft of hairs at the top, dorsally glabrous. *Gynoecium* 8.1-14 mm long, purple. *Fruit* (29)32-42 mm long, erect, discharge of seed-ejection type; mericarps 4.3-5.7 mm long, 2.1-3.5 mm wide, without a strand of fibers, not compressed at the apex, smooth (with 2 transverse veins at the apex), without basal beak, with a basal callus, without a basal prong, brown, with ± patent eglandular hairs 0.2-1.1 mm long and patent, glandular hairs 0.2-0.6 mm long; rostrum 19-26 mm long, with a narrowed apex (2.9)4-6.1 mm long, not twisted, with ± patent, eglandular hairs 0.1-0.4 mm long and patent, glandular hairs 0.3-0.6 mm long; stigmatic remnants 4.2-8 mm long, with 5 usually hairy lobes. *Seeds* 2.5-3.3 mm long, 1.5-2 mm wide, reticulate, uniformly colored, brown, glabrous. Cotyledons with entire margin. Figs. 330, 331.

Fig. 331. *Geranium californicum* (Based on: a, *Aedo 5450,* MA).

Fig. 332. Distribution of *Geranium californicum*.

Pollen. *Geranium*-type.

Chromosome number. Unknown.

Phenology. Collected in flower from April to October.

Distribution. This species ranges from central California (U.S.A.) to Baja California (Mexico) (Fig. 332).

Habitat. Rocky slopes, damp places, meadows, and conifer and *Quercus* L. forests; 1300-3050 m.

Representative specimens examined. **Mexico.** Baja California: La Corona, Jeffrey pine forest, 30º58'N, 115º35'W, 30 Aug. 1963, *Moran 11249* (RSA); Laguna Hanson, 31º58'N, 115º50'W, 9 July 1938, *Dunkle 5433* (RSA); Mts. Northern Lower California, 7 July 1885, *Orcutt s.n.* (NY); Parque Nacional San Pedro Martir, on Observatory road above forestry camp, N of Vallecitos, 31º2'N, 115º28'W, 19 June 1985, *Thorne & al. 60930* (MEXU, RSA); Sierra de San Pedro Martir, banks of La Sanca, 5 mi NW of La Grulla, 30º55'N, 115º30'W, 17 Sep. 1930, *Wiggins & Demaree 4869* (RSA); Sierra de San Pedro Martir, head of Arroyo Copal, 1.5 km N of Cerro Observatorio, 31º3'N, 115º28'W, 16 July 1988, *Boyd & Ross 2549* (RSA); Sierra de San Pedro Martir, in the National Park, 31º0'N, 115º30'W, 6 July 1980, *Wisura 3784* (RSA); Sierra de San Pedro Martir, La Grulla, 30º50'N, 115º27'W, 4 Sep. 1961, *Wiggins 16595* (UC); Sierra de San Pedro Martir, SW end of Cerro Venado Blanco, N of Observatory, 31º5'N, 115º28'W, 17 July 1988, *Boyd & al. 2591* (RSA); Sierra de San Pedro Martir, Yerba Buena, 31º0'N, 115º27'W, 16 Aug. 1967, *Moran & Thorne 14170* (RSA); Sierra Juarez, rancho Santa Isabel, 31º52'N, 115º48'W, 30 June 1962, *Moran 9820* (RSA); Vallecitos, near to Observatory, 31º2'N, 115º28'W, 18 June 1985, *Thorne & al. 60865* (RSA). **USA.** California: El Dorado Co., Lake Tahoe region, 38º55'N, 119º57'W, 15 July 1904, *Baker s.n.* (RSA); Fresno Co., General Grant Grove, 36º44'N, 118º58'W, 20 July 1892, *Brandegee s.n.* (MO); Kern Co., Piute Mts., French Meadow, 35º27'N, 118º20'W, 19 July 1962, *Twisselmann 7479* (MO); Los Angeles Co., Clifton, 33º49'N, 118º22'W, 1 Oct. 1900, *Davison 610* (JEPS); Madera Co., North Fork, 37º13'N, 119º30'W, 26 Apr. 1934, *Bacigalupi 2273* (UC); Mariposa Co., Big Meadow, 37º42'N, 119º45'W, 6 July 1896, *Jepson 13571* (JEPS); Mono Co., 0.5 mi E Jackass Flat, 38º31'N, 119º22'W, 11 July 1998, *Taylor 16807* (JEPS); Riverside Co., San Jacinto mountains, 33º45'N, 116º40'W, 8 Aug. 1890 (MO); San Bernardino Co., Bear valley, San Berandino mountains, 34º15'N, 116º50'W, 30 July 1902, *Abrams 2831* (MO); San Diego Co., edge of Agua Dulce Creek, 32º52'N, 116º26'W, 21 Aug. 1993, *Hirshberg 238* (RSA); Tulare Co., NW of Olancha Pass, Inyo NF ca 1.5 mi SW of Olancha, 36º12'N, 118º6'W, 8 Aug. 1986, *Ertter & Shevock 6665* (MO, RSA, UC); Tuolumne Co., 2.5 mi W of Strawberry, on Sonora Pass road, 38º14'N, 119º59'W, 20 June 1936, *Wiggins 8513* (RSA); Ventura Co., Frazier Mts., 34º47'N, 119º0'W, 10 July 1905, *Hall 6602* (UC).

Discussion. Geranium californicum is similar to *G. caespitosum* but differs in its usually long peduncles at the base of the inflorescence, longer fruits, longer pedicels, and a longer narrowed apex of the rostrum. All these features show some overlap with those of the allopatric *G. caespitosum*. *Geranium californicum* can be distinguished from *G. viscosissimum* by its narrow leaves and longer stigmatic remnants. *Geranium californicum* usually bears glandular hairs on the inflorescence, although some specimens lack such hairs. The type of *G. concinnum* falls within the range of variation encompassed by my concept of *G. californicum*, which is in agreement with Taylor (1993a: 673). Jones & Jones (1943: 38) distinguished *G. concinnum* from *G. californicum* by the pubescence of pedicels and stems, and shorter stigmatic remnants (4.5-5.5 mm long); however, the type of *G. concinnum* has some stigmatic remnants 6-7 mm long. Also, the variation in pubescence in *G. californicum* includes that found in *G. concinnum*. A specimen from Clifton (Los Angeles Co.) [*Davison 610*, JEPS] has the leaves not deeply divided but matches *G. californicum* in all other characters.

125. Geranium dodecatheoides P. Alexander & Aedo. Type locality: "U.S.A. New Mexico: Lincoln Co., west side of Sierra Blanca, Three Rivers Trail (Tr. 44), 1.7 miles (linear) east of the trailhead, 2.6 miles northwest of LookoutMountain, 1.9 miles southwest of White Horse Hill, Lincoln National Forest, west side of Sierra Blanca, Three Rivers Trail, 1.7 mi E of the trailhead, 2.6 mi NW of Lookout Mountain, 1.9 mi SW of White Horse Hill, 33u249 20.520N, 105u51913.320W, 2300 m, 12 Sep 2010, P.J. Alexander 1230 (HOLO Type:MA-821121!; ISOTYPES: MO!, NMC!, UNM!). Type: U.S.A. New Mexico, Lincoln Co., W side of Sierra Blanca, Three Rivers Trail (Tr. 44), 1.7 miles (linear) E of the trailhead, 2.6 miles NW of Lookout Mountain, 1.9 miles SW of White Horse Hill, 33°24'20.52"N, 105°51'13.32"W, 12 Sep. 2010, *P.J. Alexander 1230* (holotype, MA-821121!; isotypes, MO!, NMC!, UNM!).

Perennial herbs, 40-100 cm tall. *Rootstock* 5.1-9.7 mm in diameter, vertical, not tuberculate, not turnip-shaped, without thickened roots. *Stem* erect, leafy, not rooting at nodes, stolons absent, without vegetative stems, with patent, eglandular hairs 0.6-0.7 mm long and patent, glandular hairs 0.3-0.5 mm long. *Basal leaves* in a ± persistent rosette, cauline leaves opposite; leaf laminas 3.7-4.4 cm long, 4.8-5.6 cm wide, not peltate, palmatifid [ratio main-sinus length/middle segment length = 0.65-0.75], polygonal in outline, base cordate, not coriaceous, with nerves not projected, pilose, with appressed, eglandular and glandular hairs on both surfaces; segments 5, in 1 plane, middle segment obtriangular, 8.9-12.8 mm wide at the base [ratio segment width at the base/middle segment length = 0.30-0.36], 5-7-lobed in distal half [ratio secondary sinus length/middle segment length = 0.15-0.23]; petioles up to 22 cm long, without abscission zone, terete, not swollen, not deflexed in age, with patent, eglandular hairs 0.1-1 mm long and patent, glandular hairs 0.2-0.6 mm long; stipules 5-17 mm long, 1.9-4.9 mm wide, lanceolate, free, papery, brownish red, with eglandular and glandular hairs on abaxial surface and on the margin, glabrous adaxially. *Inflorescence* a dichasial cyme; cymules 2-flowered, solitary [ratio cymule length/leaf length = 1.3-2.5];

peduncles 27-46 mm long, with patent, eglandular hairs 0.2-0.3 mm long and patent, glandular hairs 0.5-0.6 mm long; bracteoles 5.2-8.4 mm long, 0.7-0.8 mm wide, lanceolate, whorled; pedicels 41-59 mm long, with patent, eglandular hairs 0.1-0.3 mm long and patent, glandular hairs 0.3-0.6 mm long. Flowers actinomorphic. *Sepals* 9.1-10.7 mm long, 2.9-3.3 mm wide, lanceolate, smooth, not accrescent, nerves 3, mucro 1.4-1.6 mm long [ratio mucro length/sepal length = 0.14-0.18], with antrorse to patent, eglandular hairs 0.1-0.5 mm long and patent, glandular hairs 0.5-0.8 mm long on the abaxial surface, usually hairy on the base of the adaxial surface, glabrous adaxially. *Petals* 11.9-13.8 mm long, 2.8-4.7 mm wide, reflexed, rounded, with claw 0.8-1.1 mm long, purple, hairy on the basal 1/5-1/4 of their adaxial surface and on the base of the abaxial surface, ciliate on the basal margin, with hairs 2.1-3 mm long. *Stamens* 10, both whorls bearing anthers; filaments 10.9-12.8 mm long, lanceolate, green, pilose on the abaxial surface, ciliate on the proximal half, with hairs 0.3-0.8 mm long; anthers 2-2.4 mm long, yellow with purplish strips. Nectaries 5, hemispheric, glabrous. *Gynoecium* 9.8-12.7 mm long, purple. *Fruit* 29.9-35.8 mm long, erect, discharge of seed-ejection type; mericarps 3.9-4.1 mm long, 1.9-2.4 mm wide, without a strand of fibers, not compressed at the apex, smooth, without basal beak, with a basal callus, without a basal prong, brown, with ± patent eglandular hairs 0.5-0.9 mm long and patent, glandular hairs 0.4-0.7 mm long; rostrum 19.1-24 mm long, with a narrowed apex 6.3-7.3 mm long, not twisted, with ± patent, eglandular hairs 0.1-0.3 mm long and patent, glandular hairs 0.3-0.7 mm long; stigmatic remnants 4.6-5.3 mm long, with 5 glabrous lobes. *Seeds* 2.6-3.1 mm long, 1.5-1.9 mm wide, reticulate, uniformly colored, brown, glabrous. Cotyledons with entire margin. Figs. 333, 334.

Pollen. Ornamentation not studied.

Chromosome number. Unknown.

Phenology. Collected in flower from July to September.

Distribution. This species is endemic to central New Mexico (Fig. 335).

Habitat. Stream banks, talus of granitic boulders and partially burned areas in forest dominated by *Pinus* L., *Pseudotsuga* Carrière, and *Quercus* L.; 2300-3070 m.

Additional specimens examined. **USA.** New Mexico: Lincoln Co., Central Capitan Mountains on the Summit Trail (58) 1.3 miles (linear) east-southeast of the crest road and 4.2 miles (linear) west-northwest of Capitan Peak, 33º35'N, 105º19'W, 26 July

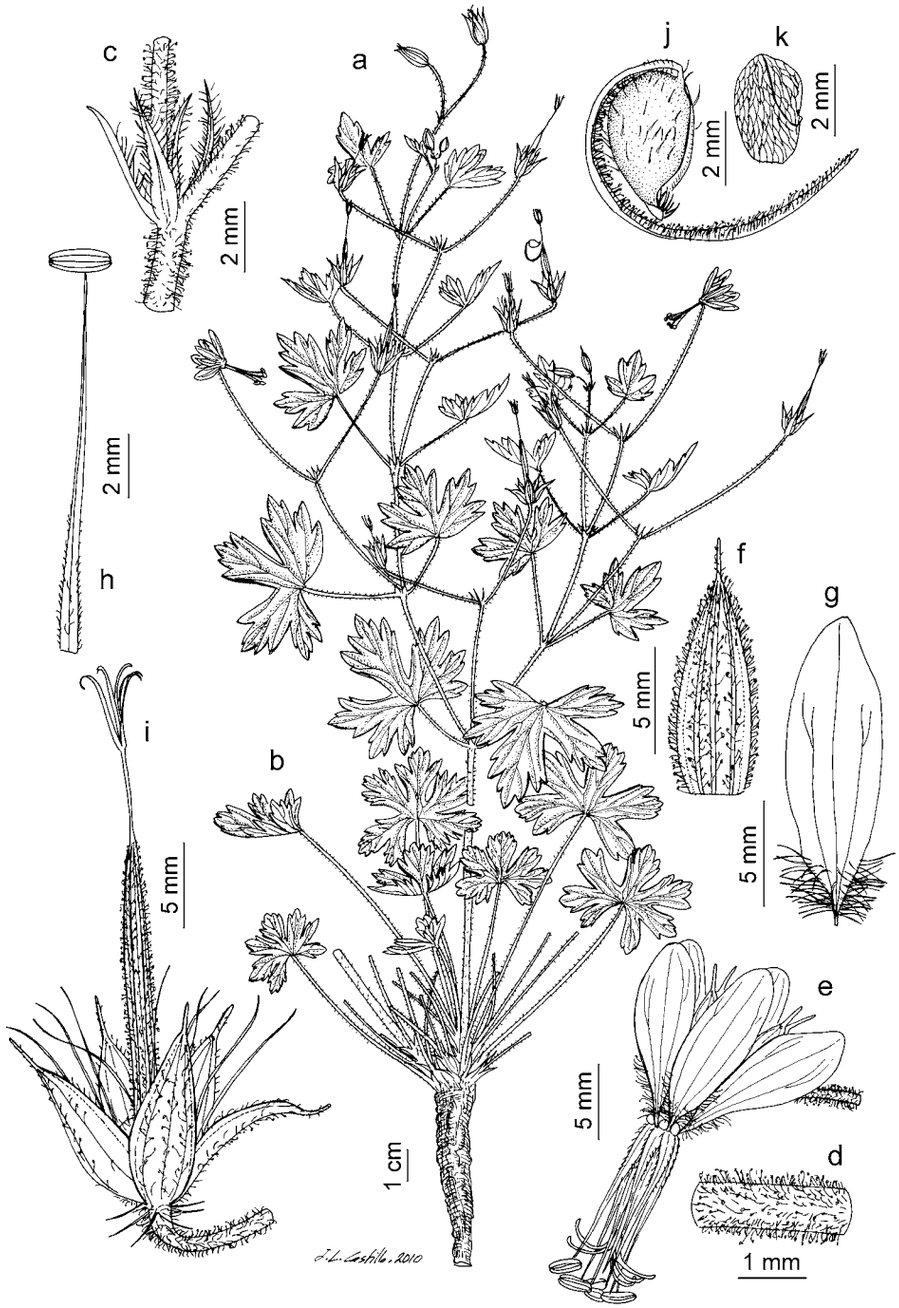


Fig. 333. *Geranium dodecatheoides*. a. Inflorescence. b. Stem base and rootstock. c. Bracteoles. d. Portion of pedicel showing indumentum. e. Flower. f. Sepal. g. Petal. h. Stamen. i. Fruit. j. Mericarp. k. Seed. (Based on: a, c, *Alexander 1230*, MA; b, d-k, *Alexander 1232*, MA).

2014, *Alexander 1454* (NMC); Lincoln Co., Central Capitan Mountains on the Summit Trail (58) 2.3 miles (linear) east-southeast of the crest road and 3.2 miles (linear) west of Capitan Peak, 33º35'N, 105º19'W, 26 July 2014, *Alexander 1457* (NMC); Lincoln Co., South side of the central Capitan Mountains near the Padilla Trail, 3.5 miles WSW of the communications facility, 33º35'N, 105º25'W, 27 July 2014, *Alexander 1459* (NMC); Lincoln Co., Central Capitan Mountains near the end of the crest road, 33º36'N, 105º21'W, 25 July 2014, *Alexander 1453* (NMC).

Discussion. Geranium dodecatheoides is similar to *G. caespitosum*, from which it differs in characters of the leaves and flowers, but most strikingly in petal orientation. The petals are reflexed in *G. dodecatheoides* and patent in *G. caespitosum*. The leaves of *G. dodecatheoides* are less deeply divided than in *G. caespitosum* (ratio main-sinus length/middle segment length: 0.65-0.75 vs. 0.72-0.92) and have the middle segment broader at the base [8.9-12.8 mm vs. 2.2-7.7(10) mm wide]. The petals are of similar length but much narrower in *G. dodecatheoides* (ratio petal width/petal length: 0.23-0.35 vs. 0.54-0.63). In *G. caespitosum* half of the adaxial petal surface is covered with hairs, whereas in *G. dodecatheoides* the hairs are restricted to the proximal quarter of the petal and are usually longer. The staminal filaments of *G. dodecatheoides* are longer than those of *G. caespitosum*, although with some overlap. The filaments of *G. dodecatheoides* are straight and remain more or less aligned with the stigmatic column during both the male and female phases of the flower. In contrast, the stamens soon arch out in *G. caespitosum*. Nectaries are glabrous in *G. dodecatheoides*, but usually have a tuft of hairs at the apex in *G. caespitosum*. Additionally, the narrowed apex of the rostrum is substantially longer in *G. dodecatheoides* than in *G. caespitosum* (6.3-7.3 mm vs. 2-3.8 mm). Both species were found together along the Three Rivers Trail, but no intermediate individuals were seen. *Geranium californicum* shares with *G. dodecatheoides* a fruit-rostrum with a long narrowed apex; however, *G. californicum* is well characterized by its longer peduncles and pedicels. *Geranium richardsonii* occurs in the same region as *G. dodecatheoides* but at higher elevations. *Geranium richardsonii* is easy to differentiate from *G. dodecatheoides* by its longer and more deeply divided leaves, which have more lobes per segment, shorter sepals; larger, usually white, erect-patent petals with hairs in the basal half; shorter staminal filaments; dorsally lanate nectaries; a rostrum with a shorter narrowed apex; and shorter stigmatic remnants.

In the Balkans there are two species with reflexed petals, *G. aristatum* and *G. reflexum*, both in subg. *Erodioidea*, characterized by "*Erodium*-type" fruit dispersal. In contrast, *G. dodecatheoides* has fruits of the "seed-ejection-type", which characteristic of subg. *Geranium* (Yeo 1984). Another group of species with reflexed petals is found in China: *G. delavayi*, *G. pogonanthum*, *G. shensianum*, *G. sinense* and *G. refractum*. They belong to subg. *Geranium*, and, compared to *G. dodecatheoides*, have longer leaves [(3.2)5-10.9 cm vs. 3.7-4.4 cm] with rhombic and many-lobed segments; connate stipules; wider petals [(3.2)4-8.4 mm vs. 2.8-4.7 mm] that sometimes bear hairs but then shorter than those of *G. dodecatheoides*; nectaries usually with a tuft of hairs at the apex (or glabrous but forming a ring around the base of the ovary); and fruits reflexed when immature and with shorter stigmatic remnants.

P. Alexander kindly informed me that since the publication of the species, Ken Heil found *G. dodecatheoides* in a second mountain range, the Capitan Mountains, ca. 50 kilometers northeast of the type locality.

Fig. 334. *Geranium dodecatheoides* (Based on: a, *Alexander 1231,* MA, photo: P. Alexander; b-d, *Alexander 1230,* MA, photo: P. Alexander).

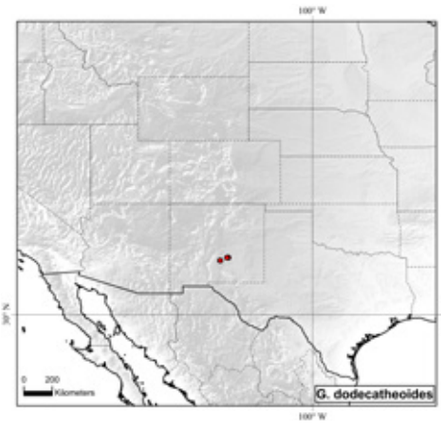


Fig. 335. Distribution of *Geranium dodecatheoides*.

126. Geranium lentum Wooton & Standl., Contr. U.S. Natl. Herb. 16(4): 142. 1913. Type locality: "Type in the U.S. National Herbarium, no. 561079, collected on the West Fork of the Gila, August 7, 1900, by E. O. Wooton". Type: U.S.A. New Mexico, Catron Co., West Fork of Gila, 33°10'N, 108°12'W, 7 Aug. 1900, *E.O. Wooton s.n.* (holotype, US-561079!; isotype, UNM-00126!).

Perennial herbs, 35-90 cm tall. *Rootstock* 5-11.5 mm in diameter, ± horizontal, not tuberculate, not turnip-shaped, without thickened roots. *Stem* erect, leafy, not rooting at nodes, stolons absent, without vegetative stems, with patent, eglandular hairs 0.2-1 mm long and, often, patent, glandular hairs 0.2-0.6 mm long. *Basal leaves* in a persistent rosette, cauline leaves opposite; leaf laminas 2.3-5(7) cm long, 2.8-5.3(9.1) cm wide, not peltate, palmatifid [ratio main-sinus length/middle segment length = 0.70-0.85], polygonal in outline, base cordate, not coriaceous, with nerves not projected, pilose, with appressed, eglandular (and sometimes glandular) hairs on both surfaces; segments 5, in 1 plane, middle segment obtriangular to subrhombic, 3.7-5.1(10.9) mm wide at the base [ratio segment width at the base/middle segment length = 0.14-0.32], 5-9-lobed in distal half [ratio secondary sinus length/middle segment length = 0.13-0.20]; petioles up to 20 cm long, without abscission zone, terete, not swollen, not deflexed in age, with patent, eglandular hairs 0.2-1 mm long and, often, patent, glandular hairs 0.2-0.6 mm long; stipules 3.5-9 mm long, 1-2 mm wide, lanceolate, free, papery, brownish red, with eglandular and, sometimes, glandular hairs on abaxial surface and on the margin, glabrous adaxially. *Inflorescence* a dichasial cyme; cymules 2-flowered, solitary [ratio cymule length/leaf length = 1.2-9.9]; peduncles 16-70(110) mm long, with patent, eglandular hairs 0.1-0.6 mm long and patent, glandular hairs 0.2-0.6 mm long; bracteoles 2.9-4.6 mm long, 0.4-1 mm wide, lanceolate, whorled; pedicels 9-47 mm long, with patent, eglandular hairs 0.1-0.5 mm

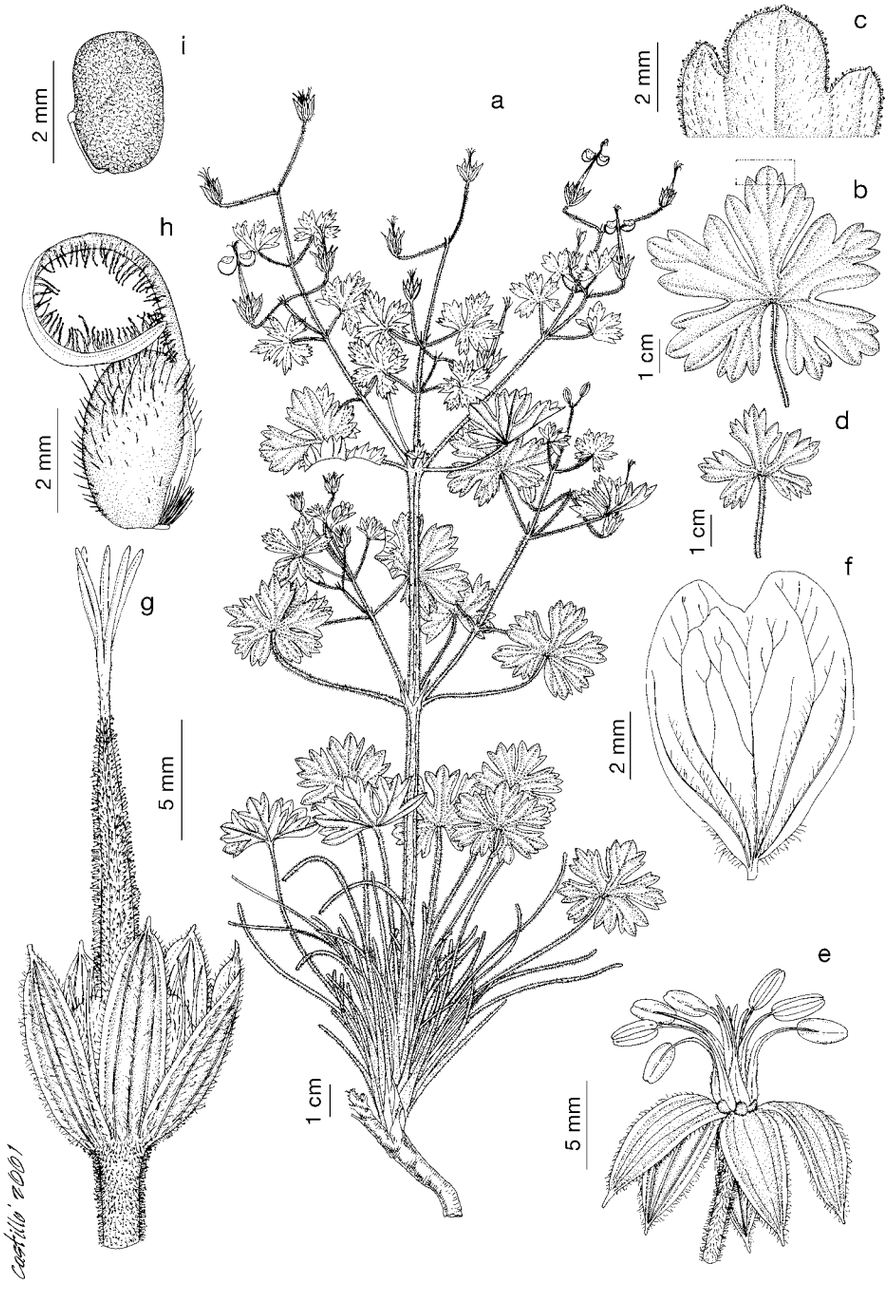


Fig. 336. *Geranium lentum*. a. Habit. b, d. Leaves. c. Detail of leaf, adaxial side. e. Flower, petals removed. f. Petal. g. Fruit. h. Mericarp. i. Seed. (Based on: a, e-i, *Hevron 1377*, ARI; b, c, *Halse 677*, MO; d, *Wooton s.n.*, *7 Aug. 1900*, US).

Fig. 337. Distribution of *Geranium lentum*.

long and patent, glandular hairs 0.2-0.6 mm long. Flowers actinomorphic. *Sepals* 5.4-6.5(8) mm long, 2.2-4 mm wide, lanceolate, smooth, not accrescent, nerves 3-5, mucro 0.5-1.3 mm long [ratio mucro length/sepal length = 0.09-0.18], with ± patent, eglandular hairs 0.2-1(1.4) mm long and patent, glandular hairs 0.2-1 mm long on the abaxial surface, glabrous adaxially. *Petals* 5-9(10.5) mm long, 1.5-5.6 mm wide, patent, rounded (sometimes a notch 0.5-1 mm deep), without claw, white, sometimes pink, hairy on the basal 1/2-3/4 of their adaxial surface and on the base of the abaxial surface, ciliate on the basal margin, with hairs 0.9-1.3 mm long. *Stamens* 10, both whorls bearing anthers; filaments 6-8(10.7) mm long, lanceolate, white to pink, pilose on the abaxial surface, ciliate on the proximal half, with hairs 0.2-1 mm long; anthers 1.2-2 mm long, yellow. Nectaries 5, hemispheric, glabrous. *Gynoecium* 6.1-8.5 mm long, green to pink. *Fruit* 21.5-28.4 mm long, erect, discharge of seed-ejection type; mericarps 3.6-4.1 mm long, 1.5-2.5 mm wide, without a strand of fibers, not compressed at the apex, smooth, without basal beak, with a basal callus, without a basal prong, brown, with ± patent, eglandular hairs 0.2-1 mm long and patent, glandular hairs 0.2-0.7 mm long; rostrum 11-18.4 mm long, with a narrowed apex 1-2(4.7) mm long, not twisted, with ± patent, eglandular hairs 0.1-0.3 mm long and glandular hairs 0.2-0.6 mm long; stigmatic remnants 3.8-5.4 mm long, with 5 glabrous lobes. *Seeds* 2.5-2.9 mm long, 1.5-1.7 mm wide, reticulate, uniformly colored, brown, glabrous. Cotyledons with entire margin. Fig. 336.

Pollen. *Geranium*-type (Aedo 2001a: 17).

Chromosome number. Unknown.

Phenology. Collected in flower from June to September.

Distribution. This species ranges from Arizona to New Mexico, in southwestern U.S.A. (Fig. 337).

Habitat. Roadsides, lava beds, evergreen and deciduous forests; 2100-2600 m.

Additional specimens examined. **USA.** Arizona: Apache Co., 20 mi S of Saint Johns, 34º30'N, 109º21'W, 26 Aug. 1973, *Lehto & al. 11564* (ARIZ, NY); Apache Co., Chusca Mts., Sonsela Buttes, 36º6'N, 109º6'W, 20 Aug. 1991, *Hevron 1377* (ARIZ); Apache Co., Upper Canyon del Muerto, Canyon de Chelly National Monument, 36º8'N, 109º29'W, 12 July 1971, *Halse 483* (ARIZ, MO); Apache Co., Upper Canyon del Muerto, Canyon de Chelly National Monument, 36º8'N, 109º29'W, 12 Aug. 1971, *Halse 677* (MO); Apache Co., Williams Creek Youth Camp, 34º3'N, 109º49'W, 13 Aug. 1970, *Grafelt 70-120* (ARIZ); Graham Co., Coronado National Forest, Pinaleno Mts., at Wet Canyon Campground, 32º39'N, 109º48'W, 11 Sep. 1976, *McGill & Lehto 20577* (NY); Greenlee Co., 10 mi S of Alpine on US route 666, 33º35'N, 109º15'W, 28 June 1992, *Miller & al. 7668* (MO); Greenlee Co., Beaver Creek, between Hannagan Meadows and Buffalo Crosing, 33º43'N, 109º21'W, 23 Aug. 1969, *White s.n.* (ARIZ, MO, UC); Greenlee Co., Beaver Creek, near Sprucedale, White Mts., 33º43'N, 109º21'W, 30 Aug. 1951, *Parker & McClintock 7644* (ARIZ, MO, NY, UC). New Mexico: Catron Co., Johnson Basin, 34º4'N, 108º46'W, 10 July 1978, *E.O.W. 163* (NMC); Catron Co., Mogollon Mts., Indian Creek, 33º18'N, 108º19'W, 10 July 1978, *Moir & Fitzhugh 586* (NMC); Catron Co., Sapillo Creek, 35º34'N, 107º31'W, 31 July 1981, *Knight 1681* (UNM); Cibola Co., Zuñi Mts., Malpais Spring, 35º5'N, 108º1'W, 11 July 1985, *Fletcher 8327* (UNM); Grant Co., Pinos Altos Mts., 32º51'N, 108º14'W, Sep. 1880, *Greene s.n.* (F); Grant Co., Redstone, 32º56'N, 108º11'W, 13 Aug. 1893, *Mulford 834* (MO); Mckinley Co., Rio Zuñi, 35º4'N, 108º50'W, 27 July 1892, *Wooton 353* (NMC); Valencia Co., Bonita Canyon, 34º57'N, 107º56'W, 14 June 1969, *Riffle 1113* (UNM).

Discussion. Geranium lentum is characterized by its short petals, glabrous nectaries, and stigmatic remnants that are 4-5 mm long. *Geranium wislizeni* shares short petals and sepals with *G. lentum*, but it has dorsally hairy nectaries and stigmatic remnants 1.5-3 mm long. I have not found a fully eglandular specimen of *G. lentum*, although some plants lack glandular hairs on the stem. Jones & Jones (1943: 51) recorded *G. lentum* from Texas [Chisos Mts, *Mueller 8050* (F, TEX)], more than 500 km southeast of the nearest locality in New Mexico; I assign *Mueller 8050* to *G. caespitosum*.

127. Geranium wislizeni S. Watson, Proc. Amer. Acad. Arts 21: 421. 1886, ["Wislizeni"]. Type locality: "Norogachi, in clefts of rocks (428) [collected by E. Palmer]; also collected by Dr. Wislizenus on the Llanos mountains, Chihuahua, and referred by Dr. Engelmann (Pl. Fendler, 27) to G. Hernandezii, and by myself (Proc. Amer. Acad. 17. 334) to G. Mexicanum". Type: Mexico. Chihuahua, Norohachi, 29°30'N, 107°45'W, Nov. 1885, *E. Palmer 428* (lectotype, designated by Moore 1943: 33, GH-00043662!; isolectotypes, K!, LE-00002584!, NY-00370259!, US-00100929 image!).

Geranium geoides Small in Underw. & Britton (eds.), N. Amer. Fl. 25(1): 19. 1907. Type locality: "Type collected in the Sierra Madre, Chihuahua, Mexico, September 17, 1887, C. G. Pringle 1203". Type: Mexico. Chihuahua, Sierra Madre, 17 Sep. 1887, *C.G. Pringle 1203* (holotype, NY!; isotypes, F!, GH!, MEXU!, MICH-1192296 image!, US image!, UPS!, US image!, WU!).

Geranium albidum Rydberg ex Hanks & Small, N. Amer. Fl. 25(1): 19. 1907. Type locality: "Type collected near Colonia Garcia, in the Sierra Madre, Chihuahua, Mexico, July 29, 1899, C. H. T. Townsend & C. M. Barber 181". Type: Mexico. Chihuahua: Sierra Madre, Colonia García, 29°59'N, 108°20'W, 29 July 1899, *C.H. Townsend & C.M. Barber 181* (holotype, NY-00373651!; isotypes, BM-000796416!, F-0044698!, G-00388791!, GH-00043618!, K!, MO, P!, CSPU, TEX!, US image!).

Geranium calvescens Briq., Annuaire Conserv. Jard. Bot. Genève 11-12: 186. 1908. Type locality: "Mexicum: in civitate Chihuahua, in faucibus Sierra Madre, 14 oct. f. fr. 1888 (Pringle n. 1578)". Type: Mexico. Chihuahua, in faucibus Sierra Madre, 14 Oct. 1888, *C.G. Pringle 1578* (lectotype, designated by Knuth 1912: 201, G-00365972!; isolectotypes, BM-000796427!, BR-0000005108985 image!, MO, MPU!, P-00147090!, W!, WU!).

Perennial herbs, 20-60 cm tall. *Rootstock* 3-9 mm in diameter, vertical, not tuberculate, not turnip-shaped, without thickened roots. *Stem* erect, leafy, not rooting at nodes, stolons absent, without vegetative stems, with patent to retrorse, appressed, eglandular hairs 0.3-1.2 mm long. *Basal leaves* in a persistent rosette, cauline leaves opposite;

leaf laminas 2.9-6.6(8) cm long, 3.6-7.1(9.8) cm wide, not peltate, palmatifid [ratio main-sinus length/middle segment length = 0.74-0.93], polygonal in outline, base cordate, not coriaceous, with nerves not projected, pilose, with appressed, eglandular (and sometimes glandular) hairs on both surfaces; segments 5, in 1 plane, middle segment rhombic, 4.4-10.5(14.3) mm wide at the base [ratio segment width at the base/middle segment length = 0.10-0.35], 5-15-lobed in distal half [ratio secondary sinus length/middle segment length = 0.11-0.22]; petioles up to 20 cm long, without abscission zone, terete, not swollen, not deflexed in age, with patent to retrorse, eglandular hairs 0.3-1.5 mm long; stipules 3.4-18 mm long, 1-2.4 mm wide, lanceolate, free, papery, brownish red, with eglandular hairs on both surfaces and on the margin. *Inflorescence* a dichasial cyme; cymules 2-flowered, solitary [ratio cymule length/leaf length = 1.3-7.9]; peduncles 19-57(119) mm long, with patent to retrorse, eglandular hairs 0.2-1.2 mm long and, sometimes, patent, glandular hairs 0.2-0.7 mm long; bracteoles 1.7-7.8 mm long, 0.5-1.2 mm wide, lanceolate, whorled; pedicels 4-31 mm long, with patent to retrorse, eglandular hairs 0.2-1.2 mm long and, sometimes, patent, glandular hairs 0.2-0.7 mm long. Flowers actinomorphic. *Sepals* 4.5-5.8(6.8) mm long, 1.7-2.8 mm wide, lanceolate, smooth, not accrescent, nerves 3, mucro 0.7-2.3 mm long [ratio mucro length/sepal length = 0.14-0.42], with antrorse to patent, eglandular hairs 0.3-1.1 mm long and, occasionally, patent, glandular hairs 0.2-0.6 mm long on the abaxial surface, glabrous adaxially. *Petals* 6-10.3(13.1) mm long, 2.9-6.5 mm wide, erect-patent, rounded, without claw, white, hairy on the basal 1/3-1/2 of their adaxial surface and on the base of the abaxial surface, ciliate on the basal margin, with hairs 0.6-1.2 mm long. *Stamens* 10, both whorls bearing anthers; filaments 4-7.6 mm long, lanceolate, white to pink, pilose on the abaxial surface, ciliate on the proximal half, with hairs 0.3-0.8 mm long; anthers 0.6-1.4 mm long, yellow. Nectaries 5, hemispheric, with a tuft of hairs covering all of its surface. *Gynoecium* 3.1-7.7 mm long, yellow. *Fruit* 17-25 mm long, erect, discharge of seed-ejection type; mericarps 2.4-3.7 mm long, 1.4-2 mm wide, without a strand of fibers, not compressed at the apex, smooth, without basal beak, with a basal callus, without a basal prong, brown, with ± patent, eglandular hairs 0.1-0.7 mm long and, sometimes, patent, glandular hairs 0.2-0.4 mm long; rostrum 10.4-17.6 mm long, with a narrowed apex 1.6-2.8(3) mm long, not twisted, with ± patent, eglandular hairs 0.1-0.6 mm long and, usually, glandular hairs 0.4-0.7 mm long; stigmatic remnants 1.5-3.3 mm long, with 5 glabrous lobes. *Seeds* 2-2.5 mm long, 1-1.5 mm wide, reticulate, uniformly colored, brown, glabrous. Cotyledons with entire margin. Fig. 338.

Pollen. *Geranium*-type (Aedo 2001a: 17).

Chromosome number. Unknown.

Phenology. Collected in flower from April to November.

Distribution. This species ranges from southwestern U.S.A. to western Mexico (Fig. 339).

Habitat. Base of cliffs and on rocky slopes, in conifer and *Quercus* L. forests; 200-3300 m.

Representative specimens examined. **Mexico.** Chihuahua: 4.7 mi E Mesa del Huracan on road to Las Varas, 29°39'N, 108°14'W, 21 Aug. 1980, *Warnock & McCormick 2120* (TEX); 46 mi W of Parral on road to Vergel, 27°19'N, 106°22'W, 6 Oct. 1959, *Correll & Gentry 22866* (MO, TEX); arroyo El Cebollín between El Oso and Sierra Oscura, 28°10'N, 108°59'W, 9 Nov. 1986, *Howell s.n.* (ARIZ); at Tonichic on Arroyo Chorro de Agua, 28°13'N, 108°6'W, 30 Sep. 1986, *Martin & O'Rourke 129* (TEX); Bocoyna, E of Gonogochic, E of Creel, 27°50'N, 107°34'W, 21 Aug. 1973, *Bye 4954* (GH); Guadalupe y Calvo, NW side of Cerro Mohinora, 12.5 mi SW of Guadalupe y Calvo, 26°0'N, 107°3'W, 21 Aug. 1988, *McDonald 2511* (MEXU); Madera, paraje El Potrerito, predio Jesús García, 28°1'N, 108°55'W, 12 Sep. 1990, *Rodríguez García 7.1* (MEXU); Ocampo, Parque Nacional Cascada de Basaseachi, Rancho de San Lorenzo, 28°10'N, 108°13'W, 25 Sep. 1994, *Spellenberg & al. 12230* (MEXU, NMC); Sierra Charuco, rancho Byerly, 1946, *Langille 220* (ARIZ); Sierra Madre near Colonia García, 29°59'N, 108°20'W, 5 Aug. 1899, *Rose 222* (F, MEXU, NMC, NY, P, UC); Urique, 1 km NE de Cerocahui, 27°10'N, 108°3'W, 20 Sep. 1987, *Cota 7740* (MO). Durango: 2 km SSE del campamento Cuevecillas, Canelas, 25°6'N, 106°32'W, 6 Aug. 1990, *Benítez 1786* (MEXU); 20 mi W of El Salto, 23°43'N, 105°41'W, 18 Oct. 1965, *Ripley & Barneby 14188* (NY); 3 mi E of El Salto, 23°44'N, 105°26'W, 13 Aug. 1957, *Waterfall 13723* (F); 4 km del ranchito Escondido, Tepehuanes, 25°20'N, 105°43'W, 26 Apr. 1989, *Benítez 515.5* (MEXU); along the dirt road from Hidalgo del Parral toward El Vergel out of San Francisco del Oro, about 57 mi W of Parral and 16 mi W of Ojito, 26°52'N, 105°50'W, 11 Aug. 1971, *Reveal & al. 2751* (GH, MEXU, NY); canyon of the Río Chico, 18 mi W of Durango, 24°2'N, 104°50'W, 24 July 1958, *Correll & Johnston 20090* (NY, P, TEX, UC); Otinapa, Palos Colorados, 24°2'N, 104°55'W, Aug. 1993, *Aceval 482* (IEB); Pueblo Nuevo, 0.4 km E del puerto de Buenos Aires, carretera 40, 23°41'N, 105°43'W, 2 Oct. 1997, *Panero & al. 7325* (NY); Río Chico, W of Durango, 24°2'N, 104°50'W, 27 Aug. 1934, *Pennell 18238* (NY); Sandia Station, 26°36'N, 106°4'W, 19 Oct. 1905, *Pringle 10022* (BM, F, GH, MEXU, NY, P, PR, UC, WRSL); Tepehuanes, Mesa Alta de Canales, 23°57'N, 105°25'W, 6 Sep. 1989, *Bolaños 225* (MEXU); Tepehuanes, ranchería de El Tarahumar, frente a la casa de don Bene, 25°38'N, 106°21'W, 12 Sep. 1989, *Benítez 943* (MEXU). Sonora: Cerro de Capulín, NW of Aribabi, 29°18'N, 109°18'W, 4 Sep. 1939, *White 2719* (ARIZ, GH); El Rancho de la Nacha, 30°28'N, 109°40'W, 14 Aug. 1941, *White 3978* (TEX); El rancho del Roble, NE of El Tigre, 30°40'N, 109°5'W, 2 Sep. 1941, *White 4198* (MEXU, TEX); El Tigre Canyon, E of Esqueda and Lago Angostura, 30°34'N, 109°11'W, 9 Sep. 1961, *Turner & al. 2106* (ARIZ); Los Pinitos, 31°11'N, 110°50'W, 11 Oct. 1890, *Hartman 141* (GH, PH); Mesa El Otro Lado, 1 km NE of Yecora, 28°23'N, 108°54'W, 7 Sep. 1995, *Devender 95-826* (ARIZ); puerto de los Aserraderos, 30°28'N, 109°1'W, 9 Aug. 1940, *White 3147* (ARIZ); Río Maycoba, at crossing with new Hermosillo-Chihuahua highway, 28°23'N, 108°46'W, 20 Oct. 1991, *Joyal & Enriques 1858* (MEXU, TEX); Río Mayo, Saguaribo, 27°21'N, 108°40'W, 2 Nov. 1935, *Gentry 2115* (F, GH, UC). **USA.** Arizona: Cochise Co., Chiricahua Mts., 31°54'N, 109°17'W,

20 Sep. 1896, *Toumey 3* (MO); Cochise Co., Huachuca Mts., Ramsey Canyon, 31°27'N, 110°17'W, 22 Aug. 1910, *Goodding 729* (ARIZ, NY); Pima Co., Santa Catalina Mts., 32°25'N, 110°42'W, 5 Sep. 1904, *Griffiths 7073* (MO); Santa Cruz Co., Sycamore Canyon, 31°25'N, 111°23'W, 6 Oct. 1967, *Keil & al. s.n.* (ARIZ, NY, TEX). New Mexico: Grant Co., Black Range, Gallinas Creek, 32°44'N, 107°51'W, 24 Aug. 1969, *Todsen s.n.* (NMC).

Discussion. Geranium wislizeni is well characterized by its short, white, erect-patent petals covered adaxially by long hairs. *Geranium caespitosum* is partially sympatric, but it has longer, usually purplish and patent petals, and nectaries with a tuft of hairs at the apex. The nectaries of *G. wislizeni* resemble those of *G. richardsonii*, because they are covered dorsally with hairs; this vesture is composed of long hairs in *G. wislizeni* and is short-lanate in *G. richardsonii*. Both species also share with *G. wislizeni* white, erect, patent petals. Where their ranges overlap, the differences between *G. richardsonii* and *G. wislizeni* are sometimes difficult to ascertain; yet, both species are well characterized. *Geranium richardsonii* is usually a robust plant with longer petals, sepals, and fruits, and has glandular hairs on the stem. The variation in glandular indumentum *G. wislizeni* is similar to that found in *G. caespitosum*; therefore lack of glandular hairs cannot be used to separate *G. wislizeni* from *G. lentum*, as proposed by Jones & Jones (1943); see the discussion of *G. lentum*. *Geranium albidum* was recognized by Moore (1943: 28) as a separate species; however, it seems to be only a local form of *G. wislizeni* with deeply divided leaves, narrowed leaf segments, and without any glandular hairs. Other features mentioned by Moore (1943: 28), such as the longer narrowed apex of the rostrum, color of staminal filaments, and petal veins, are also included within the variability of *G. wislizeni*. A set of specimens (*Rose 222*; F, MEXU, NMC, NY, P, UC) obtained at the type locality of *G. albidum* belongs unequivocally to *G. wislizeni*.

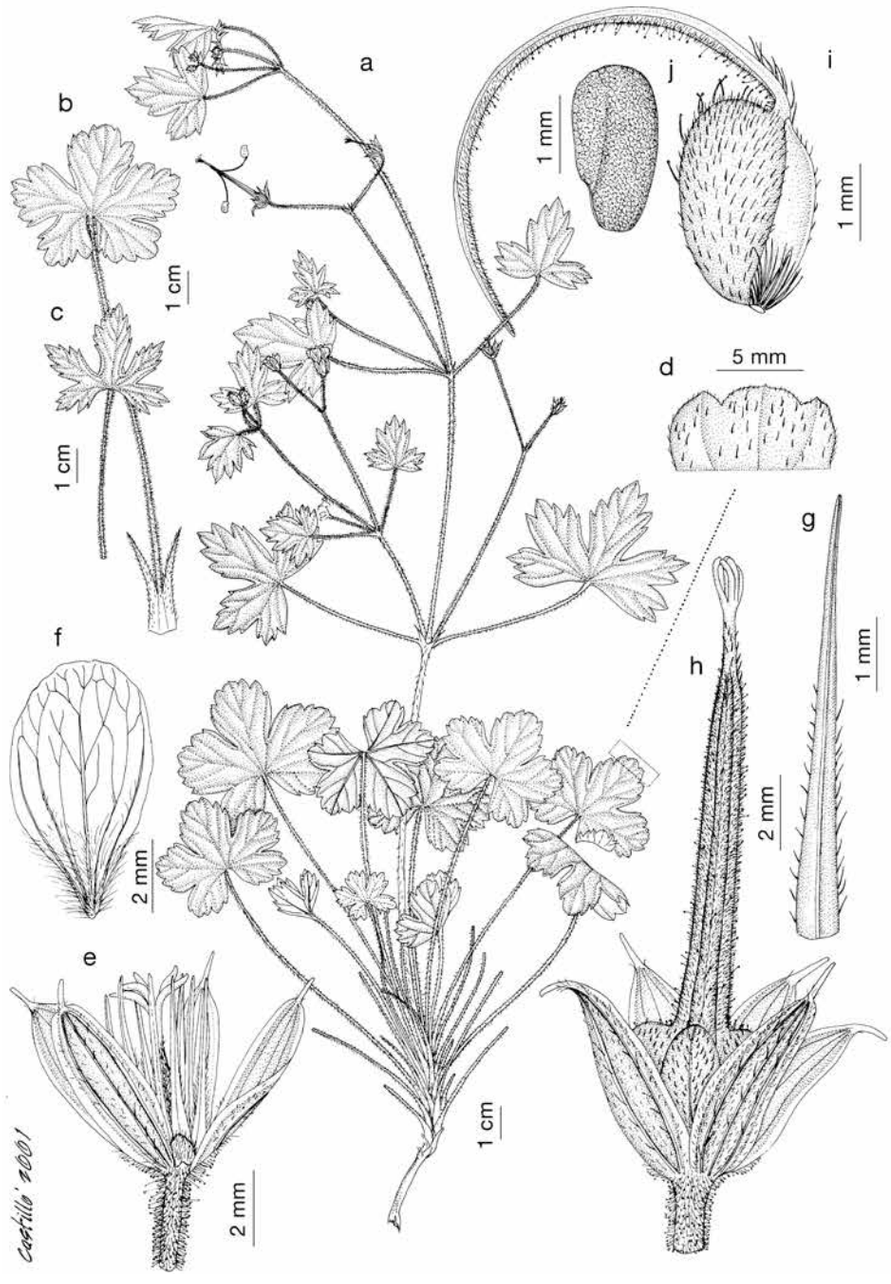


Fig. 338. *Geranium wislizeni*. a. Habit. b. Basal leaf. c. Cauline leaf. d. Detail of leaf, adaxial side. e. Flower, petals removed. f. Petal. g. Staminal filament. h. Fruit. i. Mericarp. j. Seed. (Based on: a, d-j, *Sueur 733*, TEX; b, *Shreve 5029*, UC; c, *Spellenberg & al. 12230*, NMC).

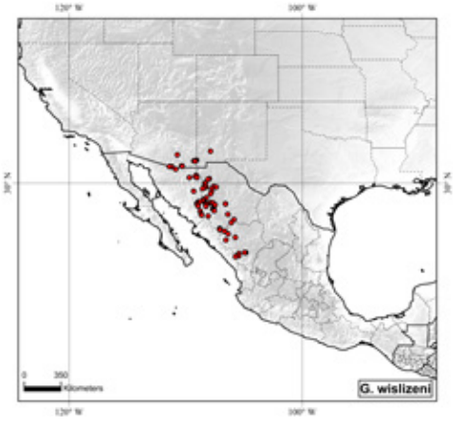


Fig. 339. Distribution of *Geranium wislizeni*.

128. Geranium richardsonii Fisch. & Trautv. in Fisch., C.A. Mey. & Trautv., Index Sem. Hort. Petrop. 4: 37. 1838. *Geranium albiflorum* Hook., Fl. Bor.-Amer. 1: 116, tab. 40. 1831, nom. illeg., non Ledeb. 1829. *Geranium hookerianum* Walp., Repert. Bot. Syst. 1: 450. 1842, nom. illeg. Type locality: "Hab. Vallies in the Rocky Mountains. Drummond". Type: Canada. Rocky Mountains, *T. Drummond s.n.* (lectotype, designated by Aedo 2001b: 49, K-001081651!).

Geranium gracilentum Greene in Rydb., Agric. Exp. Sta. Agric. Coll. Colorado Bull. 100: 218. 1906. Type locality: "In mountain valleys from Colo. to N.M. and Ariz.-Alt. 6000-10,000 ft.-Headwaters of Clear Creek; Pike's Peak; Piedra; Mancos; 4 milles west of Cameron Pass; near Veta Pass; near La Plata Post Office; La Plata Cañon; Columbine, Middle Park; Box Cañon, west of Ouray; Bosworth's; Beaver Creek; bank of Elk River, Routt Co.; Trail Creek bottom; Rico; Silverton; northwest of Dolores". Type: U.S.A. Colorado, Archuleta Co., Piedra, 37°13'N, 107°20'W, July 1899, *C.F. Baker 449* (lectotype, designated by Aedo 2001b: 50, MO!; isolectotypes, BM-000624896!, COI!, E-00438333 image!, F!, G-00388778!, GH!, NY, P!, US image!, W!; choice made in first step byJones & Jones 1943: 35).

Geranium loloense H. St. John, Fl. Southeast Wash. & Idaho: 242. 1937. Type locality: "Idaho: Musselshell, Lolo Trail, Bitterroot Mts., (T. 35 N., R. 6 E., Clearwater Co.), July 14, 1902, C.V. Piper 4027 (type in Herb. State College of Washington)". Type: U.S.A: Idaho, Clearwater Co., Musselshell, Lolo Trail, Bitterroot Mts., 46°21'N, 115°44'W, 14 July 1902, *C.V. Piper 4027* (holotype, WS; isotypes, NY-00373638 image!, US-00100905 image!).

Perennial herbs, 15-90 cm tall. *Rootstock* 5-12 mm in diameter, horizontal, not tuberculate, not turnip-shaped, without thickened roots. *Stem* erect, leafy, not rooting at nodes, stolons absent, without vegetative stems, with patent to retrorse, eglandular hairs 0.3-0.7 mm long and, sometimes, patent, glandular hairs 0.3-0.9 mm long. *Basal leaves* in a persistent rosette, cauline leaves opposite; leaf laminas (3.9)4.5-10.5 cm long, (4.4)6-12.8 cm wide, not peltate, palmatifid [ratio main-sinus length/middle segment length = 0.81-0.90], polygonal in outline, base cordate, not coriaceous, with nerves not projected, pilose, with appressed, eglandular hairs on both surfaces; segments 5(7), in 1 plane, middle segment rhombic, 5-13.3 mm wide at the base [ratio segment width at the base/middle segment length = 0.10-0.27], 6-11(16)-lobed in distal half [ratio secondary sinus length/middle segment length = 0.17-0.30]; petioles up to 44 cm long, without abscission zone, terete, not swollen, not deflexed in age, with patent to retrorse, eglandular hairs 0.2-0.9 mm long and, sometimes, patent, glandular hairs 0.3-0.9 mm long; stipules 4.8-11 mm long, 1.3-4 mm wide, lanceolate, free, papery, brownish red, with eglandular hairs on abaxial surface and on the margin, usually glabrous adaxially. *Inflorescence* a dichasial cyme; cymules 2-flowered, solitary [ratio cymule length/leaf length = 1.5-2.6]; peduncles 25-94(102) mm long, with patent to retrorse, eglandular hairs 0.1-0.8 mm long and, sometimes, patent, glandular hairs 0.2-0.9 mm long; bracteoles 3.3-10 mm long, 0.7-1.7 mm wide, lanceolate, whorled; pedicels 12-30 mm long, with patent to retrorse, eglandular hairs 0.1-0.4 mm long and, usually, patent, glandular hairs 0.2-0.9 mm long. Flowers actinomorphic. *Sepals* (6.5)7-8.2 mm long, 2.1-4.4 mm wide, lanceolate, smooth, not accrescent, nerves 3-5, mucro 1-3 mm long [ratio mucro length/sepal length = 0.18-0.38], with antrorse, appressed, eglandular hairs 0.2-0.7 mm long and patent, glandular hairs 0.3-0.9 mm long on the abaxial surface, glabrous adaxially. *Petals* (12.2)14-20 mm long, 5.8-15 mm wide, erect-patent, rounded, without claw, usually white, hairy on the basal 1/3-1/2 of their adaxial surface and on the base of the abaxial surface, ciliate on the basal margin, with hairs 0.9-1.2 mm long. *Stamens* 10, both whorls bearing anthers; filaments 6.3-9 mm long, lanceolate, purple, pilose on the abaxial surface, ciliate on the proximal half, with hairs 0.2-1 mm long; anthers 1.5-1.7 mm long, lilac or yellow. Nectaries 5, hemispheric, dorsally lanate. *Gynoecium* 5.1-10.5 mm long, green to pink. *Fruit* 19-26(32) mm long, erect, discharge of seed-ejection type; mericarps 3.5-4.9 mm long, 2-3 mm wide, without a strand of fibers, not compressed at the apex, smooth, without basal beak, with a basal callus, without a basal prong, brown, with ± patent, eglandular hairs 0.1-0.6 mm long and patent, glandular hairs 0.3-0.9 mm long; rostrum 13-17(21) mm long, with a narrowed apex 1-2(3.6) mm long, not twisted, with ± patent, eglandular hairs 0.1-0.3 mm long and glandular hairs 0.3-0.9 mm long; stigmatic remnants 3-4.2 mm long, with 5 glabrous lobes. *Seeds* 2.6-3.3 mm long, 1.5-1.9 mm wide, reticulate, uniformly colored, brown, glabrous. Cotyledons with entire margin. Figs. 340, 341.

Pollen. *Geranium*-type (Bortenschlager 1967: 455).

Chromosome number. 2*n* = 52, 56.

Phenology. Collected in flower from March to September.

Distribution. This species ranges through western Canada and western U.S.A. (Fig. 342).

Habitat. Forested roadsides, moist meadows, alpine slopes, open shrublands, evergreen and deciduous forests; 650-4000 m.

Representative specimens examined. **Canada.** Alberta: 10 mi E of Ponoka, 52°42'N, 113°35'W, 12 July 1949, *Frankton 914* (DAO); Eagle Butte, 49°36'N, 110°26'W, 7 July 1952, *Boivin & Alex 9691* (DAO); Waterton National Park, 49°5'N, 116°52'W, 27 Aug. 1980, *Parmelee 5397* (DAO). British Columbia: Babine Lake, 54°48'N, 126°57'W, 8 July 1974, *Krajina & al. s.n.* (DAO); Smithers, 54°46'N, 127°10'W, 12 Aug. 1939, *Groh 542* (DAO); Topley, 54°30'N, 126°15'W, 21 June 1949, *Pillsbury 101* (DAO). Northwest Territories: Canada Tungsten Mine, Flat River, 61°58'N, 128°15'W, 20 July 1967, *Cody & Spicer 16350* (DAO); Hole-in-the-Wall Lake, 61°46'N, 127°16'W, 13 July 1977, *Scotter 24226* (DAO); Nahanni National Park, 61°46'N, 127°11'W, 7 July 1976, *Talbot 6011* (DAO). Saskatchewan: Cypress Hills Prov. Park Centre Block, 49°34'N, 109°47'W, 10 July 1986, *Harms 36318* (DAO); Cypress Hills Provincial Park, 18 mi S of Maple Creek, 49°55'N, 109°29'W, 24 Aug. 1959, *Swink 3083* (F); Maple Creek, 49°54'N, 109°24'W, 14 June 1958, *Boivin & Perron 12095* (DAO). Yukon: Canol Rd., Rose-Lapie R. Pass, mile

105, 61°36'N, 133°5'W, 21 July 1944, *Porsild & Breitung 10920* (WTU); McArthur-Ethel Lake area, 63°4'N, 135°43'W, 7 Aug. 1987, *Gallegher 659* (DAO); Pointed Mountain, 60°28'N, 123°50'W, 22 July 1974, *Lamont 607* (DAO). **USA.** Arizona: Apache Co., Little Colorado River at Greer, 34°0'N, 109°27'W, 21 July 1976, *Lehr 1827* (SD); Pima Co., Rincon Mts., 32°11'N, 110°31'W, 17 Sep. 1909, *Blumer 3372* (MO); Santa Cruz Co., Madera Canyon, Coronado National Forest, 31°42'N, 110°52'W, 9 Sep. 1971, *Beauchamp 3101* (SD). California: El Dorado Co., The Firs, on the lincoln Highway near Echo Lake, 38°50'N, 120°2'W, 30 July 1919, *Heller 13348* (MO); Fresno Co., Huntington Lake, 37°13'N, 119°14'W, 26 July 1917, *Grout 1145* (MO); Tulare Co., Sequoia National Park, Crescent Meadow, 36°33'N, 118°44'W, July, *Parks 5198* (UC); Archuleta Co., 2 mi E of Blanco Basin School, Rio Blanco Creek, 37°7'N, 107°2'W, 17 Aug. 1936, *Rollins 1542* (MO). Colorado: Bent Co., Ruxton Brook, 37°44'N, 103°8'W, 28 June 1901, *Clements & Clements 323* (MO); Boudler Co., Gregory Cañon, 40°0'N, 105°17'W, 16 July 1906, *Daniels 447* (MO); Grand Co., Rocky Mountain National Park, Timber Creek, 40°16'N, 106°9'W, 16 Aug. 1997, *Aedo 4416* (MA); San Miguel Co., Norwood Hill, 38°7'N, 108°17'W, 17 Aug. 1912, *Walker 477* (MO); Summit Co., Breckenridge, 39°28'N, 106°2'W, *Wislizenus s.n.* (MO). Idaho: Bannock Co., Mill Creek, Caribou National Forest, 42°57'N, 112°14'W, 15 July 1952, *Baker s.n.* (WTU); Clark Co., Beaver Creek 3 mi above Spencer, 44°24'N, 112°11'W, 24 June 1939, *Cronquist 1307* (MO); Fremont Co., Henry Lake, 44°35'N, 111°21'W, 10 July 1920, *Payson & Payson 1948* (MO); Valley Co., South Fork of the Salmon River at South Fork Camp, 44°30'N, 116°2'W, 19 July 1954, *Baker 11925* (WTU). Montana: Beaverhead

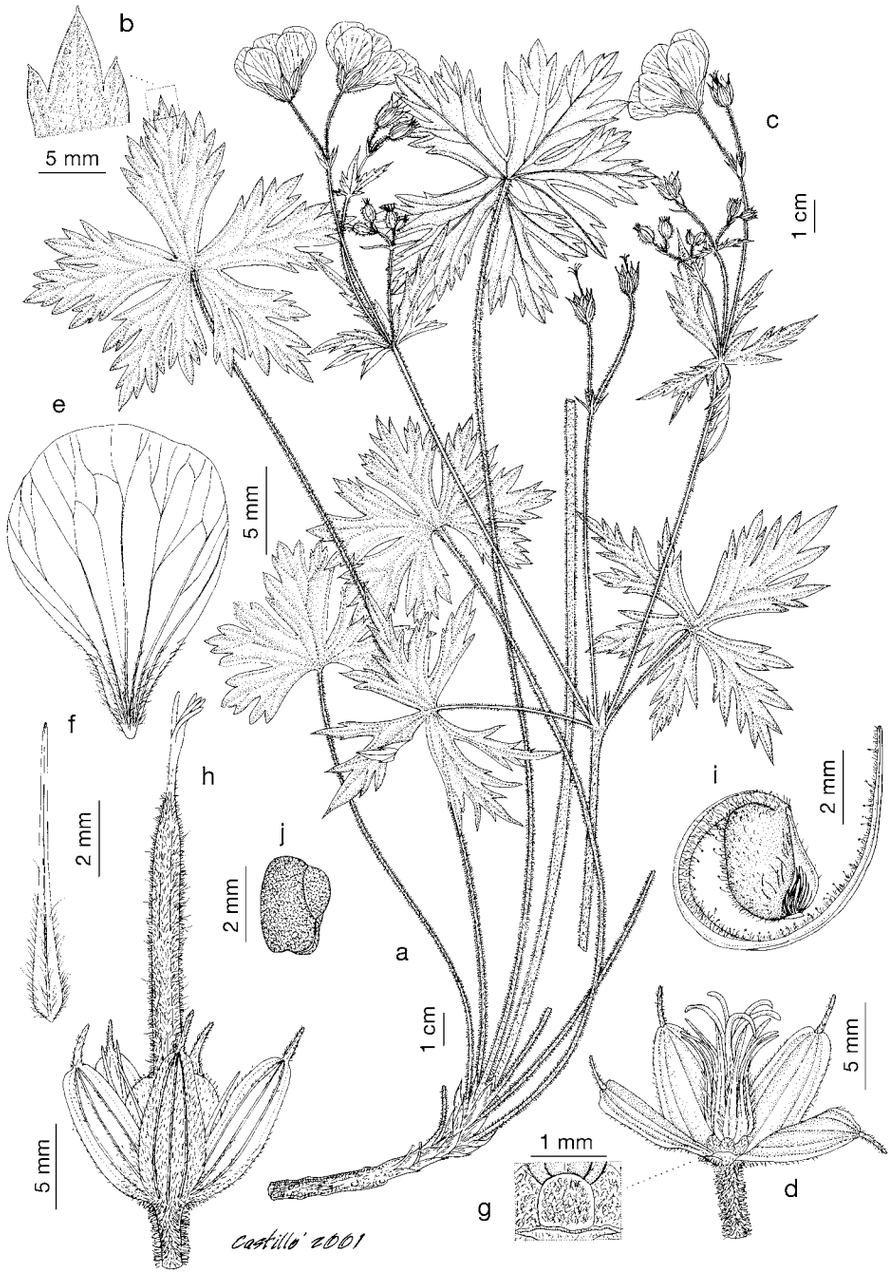


Fig. 340. *Geranium richardsonii*. a. Habit. b. Detail of leaf, adaxial side. c. Inflorescence. d. Flower, petals removed. e. Petal. f. Staminal filament. g. Nectary. h. Fruit. i. Mericarp. j. Seed. (Based on: a-g, *Siplivinsky 1755*, MA; h-j, *Aedo 4435*, MA).

Fig. 341. *Geranium richardsonii* (Based on: *Aedo 4435,* MA).

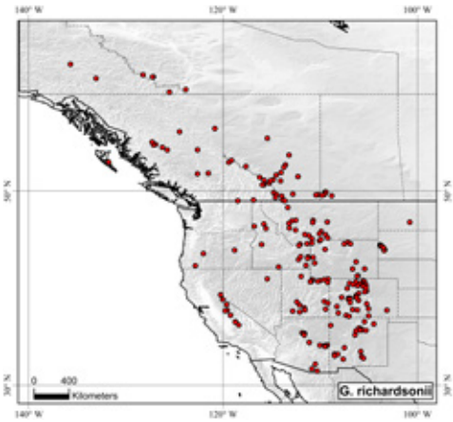


Fig. 342. Distribution of *Geranium richardsonii*.

Co., along Price-Peet Road, ca 0.5 mi W of Pete Creek Divide, 44º32'N, 112º4'W, 12 July 1979, *Lowry II 2490* (MO); Fergus Co., 4 mi up Half Moon Canyon, Big Snowy Mts., 46º49'N, 109º16'W, 5 July 1945, *Hitchcock & Muhlick 11969* (MO); Stillwater Co., Independence, head of Boulder Creek, Absaroka Nat. Forest, 45º31'N, 109º27'W, 7 Aug. 1945, *Hitchcock & Muhlick 13335* (MO); Sweet Grass Co., Half Moon Camp, Big Timber Creek, Crazy Mts., 45º51'N, 109º55'W, 4 Aug. 1945, *Hitchcock & Muhlick 13201* (MO, WTU). Nevada: Elko Co., Camp Halleck, 40º57'N, 115º27'W, Aug., *Palmer 56* (F). New Mexico: Bernalillo Co., Sandia Mts., Balsam Park, 35º11'N, 106º25'W, July, *Ellis 61* (MO); McKinley Co., Chuska Mts., 36º10'N, 108º55'W, July, *Walco 159* (MO); San Miguel Co., Pecos River National Forest, Winsais Ranch, 29 June 1908, *Standley 4013* (MO); Santa Fe Co., vicinity of Santa Fe, Lake Peak, 35º47'N, 105º46'W, 15 July 1926, *Arsène (frère) & Benedict 16055* (MO); Taos Co., Sangre de Cristo Mts., Lake Fork Canyon, 36º33'N, 105º26'W, 22 Aug. 1973, *Holmgren & Holmgren 7360* (WTU). Oregon: Harney Co., 1 mi S of Calamity Guard Station, 43º55'N, 118º49'W, 26 June 1953, *McCutcheon 620* (WVA); Jackson Co., High Cascades E of Medford, 42º19'N, 122º52'W, June, *Heckner s.n.* (WTU); Klamath Co., Crater National Forest, Cascade Mts., Cherry Creek, 43º34'N, 122º2'W, Aug., *Rose 1148* (MO); Sheep Mountain, near Fire Warden's Cabin, 34 mi N of Natal, 49º51'N, 114º48'W, 7 July 1941, *Weber 2342* (MO, WTU). South Dakota: Custer Co., Custer, 46º48'N, 100º47'W, 30 July 1942, *Degener 16284* (NY); Lawrence Co., Spearfish Canyon, 44º28'N, 103º50'W, 31 July 1938, *Hapeman s.n.* (MO); Pennington Co., Rockerville, Black Hills, 43º57'N, 103º21'W, 1906, *White s.n.* (MO). Utah: Daggett Co., 4 mi N of Mt. Home, 40º56'N, 109º11'W, 13 June 1934, *Harrison & Larsen 7590* (MO); Iron Co., Cedar Breaks, above the Breaks, 37º38'N, 112º50'W, 19 July 1929, *Mathias 697* (MO); Piute Co., 2 mi NW junction T29S, R3W, 38º15'N, 112º7'W, 28 July 1976, *Welsh & al. 14110* (MO); Uintah Co., Uinta Mts., E of Mirror Lake, 40º42'N, 110º53'W, 19 Aug. 1955, *Holmgren & Anderson 10964* (MO); Weber Co., Ogden, 41º13'N, 111º58'W, 2 Aug. 1887, *Tracy 612* (MO). Wyoming: Albany Co., 3.6 mi W of Centennial, 41º15'N, 106º12'W, 11 Aug. 1984, *Miller & Lowry II 1939* (MO); Carbon Co., Medicine Bow Range, Arlington, 41º59'N, 106º40'W, 15 July 1988, *Nieto Feliner & Lansac 2090* (MA); Sublette Co., 25 mi W Big Piney, N side of Middle Piney Lake, 42º35'N, 110º34'W, 31 Aug. 1947, *Meyer & Meyer 2404* (MO); Teton Co., Firehole River, 3 mi SW of Loop Rd. Yellowstone National Park, 44º38'N, 110º51'W, 27 June 1960, *Venrick 396* (MO).

Discussion. Geranium richardsonii is readily recognized by its white, long, erect-patent, adaxially hairy petals and its hairy nectaries. In some specimens from Utah, Colorado, and California nectary indumentum is sparse and difficult to see, but the short intermingled hairs cover the entire abaxial side. The presence of glandular hairs varies considerably (as in *G. caespitosum*). Some specimens have abundant glandular hairs on the stem base, petioles, and inflorescence, while others have only few glandular hairs on the pedicels. Surprisingly, this variability has not led to the description of a large number of segregate taxa, as in *G. caespitosum*. *Geranium richardsonii* shares a part of its range with *G. caespitosum* and *G. californicum*, and sometimes it is difficult to differentiate between these species; however, they have usually patent petals and nectaries with a tuft of hairs at the apex. Additionally, *G. californicum* has notably long peduncles. *Geranium richardsonii* closely resembles *G. wislizeni*, a southern species also with hairy nectaries and white petals; see the discussion under the latter.

An account of some aspects of the life history of *G. richardsonii* is provided by Green (1978).

129. Geranium viscosissimum Fisch. & C.A. Mey. in C.A. Mey., Index Sem. Hort. Petrop. 11, Suppl.: 18. 1846, [imprimatur, Dec. 1846, probably 1847]. Type locality: "Hab. in America septentrionali occidentali (Lindl)". Type: North America, based on living plants cultivated at the St. Petersburg botanical garden from seed (from North America) sent by Lindley (lectotype, designated by Aedo 2001b: 55, LE-00014596!).

Geranium nervosum Rydb., Bull. Torrey Bot. Club 28: 34. 1901. *Geranium viscosissimum* var. *nervosum* (Rydb.) C.L. Hitchc. in C.L. Hitchc. & al., Vasc. Pl. Pacific Northw. 3: 383. 1961. *Geranium viscosissimum* subsp. *nervosum* (Rydb.) W.A. Weber, Phytologia 51: 374. 1982. Type locality: "Wyoming: Fish Creek, Teton Forest Reserve, 1897, F. Tweedy, 494 (type)". Type: U.S.A. Wyoming, Fish Creek, Teton Forest Reserve, 43°33'N, 110°14'W, July 1897, *F. Tweedy 494* (holotype, NY-00373641!; isotype, YU-069049 image!).

Geranium strigosum Rydb., Bull. Torrey Bot. Club 29: 243. 1902, nom. illeg., non Burm. f. 1768. *Geranium strigosior* H. St. John, Fl. Southeast Wash. & Idaho: 243. 1937. Type locality: "Wyoming: Copperton, 1901, F. Tweedy, 4591 (type in herb. N.Y. Bot. Gard.". Type: U.S.A. Wyoming, Copperton, 41°08'N, 107°7'W, 20 June 1901, *F. Tweedy 4591* (holotype, NY!; isotype, US image!).

Geranium viscosissimum var. *album* Suksd., Werdenda 1: 24. 1923. *Geranium viscosissimum* f. *album* (Suksd.) H.St. John, Proc. Biol. Soc. Wash. 41: 195. 1928. Type locality: "Bei Spangle, nördlich davon, in Spokane County, 29. Juni 1916, Nr. 8710". Type: U.S.A. Washington, Spokane Co., Spangle, 47°25'N, 117°22'W, 29 June 1916, *W.N. Suksdorf 8710* (lectotype, designated by Aedo 2001b: 55, MO-251015!; isolectotypes, BM-000796996!, GH, ILL, K-001081649!, NY-00373650 image!, UC, WTU-V-001202 image!).

Geranium attenuilobum G.N. Jones & F.F. Jones, Rhodora 45: 40. 1943. Type locality: "California: Jess Valley, Warner Mountains, Modoc Co., July 24, 1925, F.H. Frost 113". Type: U.S.A. California, Modoc Co., Jess Valley, Warner Mountains, 41°14'N, 120°20'W, 24 July 1925, *W.T. Frost 113* (holotype, GH!; isotype, UC-571132 image!).

Perennial herbs, (30)50-90 cm tall. *Rootstock* 6-22 mm in diameter, vertical, not tuberculate, not turnip-shaped, without thickened roots. *Stem* erect, leafy, not rooting at nodes, stolons absent, without vegetative stems, with patent to retrorse, eglandular hairs 0.3-1.9 mm long and, usually, patent, glandular hairs 0.1-0.8 mm long. *Basal leaves* in a persistent rosette, cauline leaves opposite; leaf laminas 6.8-15 cm long, (7.1)10-16 cm wide, not peltate, palmatifid [ratio main-sinus length/ middle segment length = 0.75-0.92], polygonal in outline, base cordate, not coriaceous, with nerves not projected, pilose, with appressed, eglandular (and sometimes glandular) hairs on both surfaces; segments 5-7, in 1 plane, middle segment rhombic, 7-15 mm wide at the base [ratio segment width at the base/middle seg-

ment length = 0.14-0.20], 9-17-lobed in distal half [ratio secondary sinus length/middle segment length = 0.14-0.28(0.40)]; petioles up to 35 cm long, without abscission zone, terete, not swollen, not deflexed in age, with patent to retrorse, eglandular hairs 0.3-1.8 mm long and, sometimes, patent glandular hairs 0.3-0.9 mm long; stipules 8.2-15 mm long, 2-5 mm wide, lanceolate, free, papery, brownish red, with eglandular and, sometimes, glandular hairs on both surfaces and on the margin. *Inflorescence* a dichasial cyme; cymules 2-flowered, solitary or in aggregates at the top of each branch [ratio cymule length/leaf length = (0.8)1.2-5.4]; peduncles 10-80(130) mm long, with patent to retrorse, eglandular hairs 0.2-1.9 mm long and, sometimes, patent, glandular hairs 0.3-0.9 mm long; bracteoles 5-10 mm long, 1-2 mm wide, lanceolate, whorled; pedicels absent or 6-57 mm long, with patent to retrorse, eglandular hairs 0.1-1.9 mm long and, usually, patent, glandular hairs 0.2-0.9 mm long. Flowers actinomorphic. *Sepals* 7.7-11 mm long, 3-4.7 mm wide, lanceolate, smooth, not accrescent, nerves 3-5, mucro 1-2.7 mm long [ratio mucro length/sepal length = 0.20-0.29], with antrorse, appressed, eglandular hairs 0.2-0.8 mm long and patent, glandular hairs 0.3-1.1 mm long on the abaxial surface, usually hairy on the base of the adaxial surface. *Petals* (15.2)17-20 mm long, 9-15 mm wide, erect-patent, rounded, without claw, purple, hairy on the basal 1/3-1/2 of their adaxial surface and on the base of the abaxial surface, ciliate on the basal margin, with hairs 1-1.8 mm long. *Stamens* 10, both whorls bearing anthers; filaments 7.7-12.2 mm long, lanceolate, purple, pilose on the abaxial surface, ciliate on the proximal half, with hairs 0.3-1.8 mm long; anthers 2-2.5 mm long, yellow. Nectaries 5, hemispheric, with a tuft of hairs at the top, dorsally glabrous. *Gynoecium* 7.5-13 mm long, purple. *Fruit* 31-41 mm long, erect, discharge of seed-ejection type; mericarps 4.2-5.5 mm long, 2-3 mm wide, without a strand of fibers, not compressed at the apex, smooth

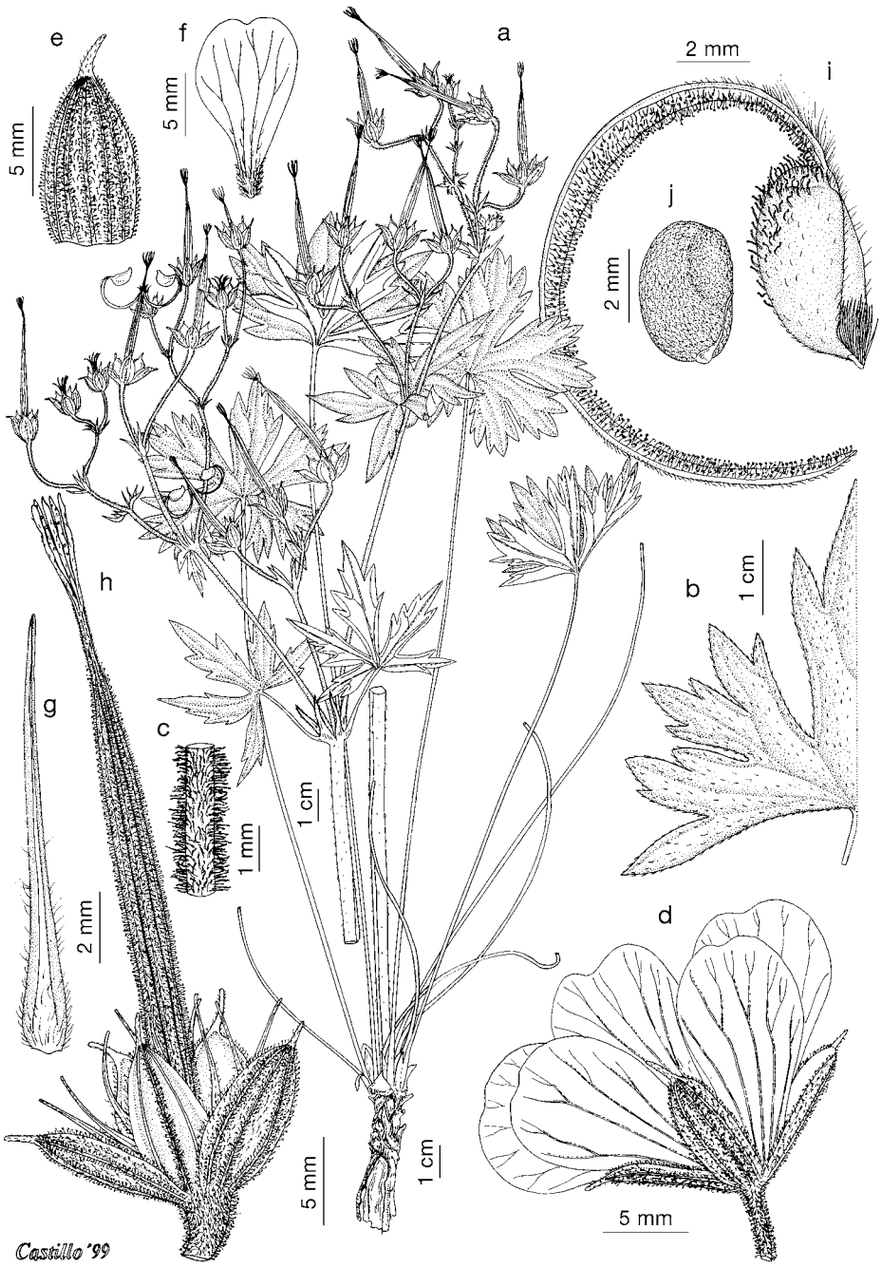


Fig. 343. *Geranium viscosissimum*. a. Habit. b. Portion of leaf. c. Peduncle. d. Flower. e. Sepal. f. Petal. g. Staminal filament. h. Fruit. i. Mericarp. j. Seed. (Based on: a, e, g-j, *Andrews 662*, OSC; b-d, f, *Wagner 1447*, OSC).

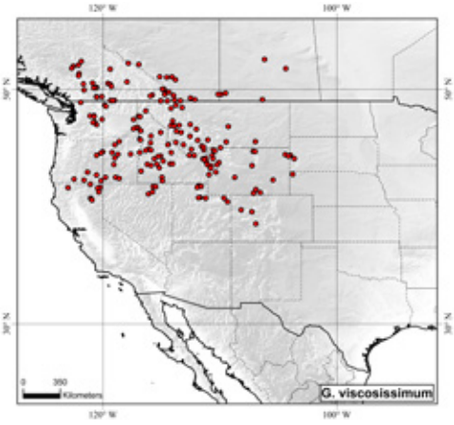


Fig. 344. Distribution of *Geranium viscosissimum*.

(with 2 transverse veins at the apex), without basal beak, with a basal callus, without a basal prong, brown, with ± patent, eglandular hairs 0.2-0.5 mm long and glandular hairs 0.3-0.9 mm long; rostrum 20-29 mm long, with a narrowed apex 3-5.2 mm long, not twisted, with ± patent, eglandular hairs 0.1-0.3 mm long and glandular hairs 0.5-0.9 mm long; stigmatic remnants 3-6(6.8) mm long, with 5 glabrous lobes. *Seeds* 3.1-4 mm long, 1.8-2.5 mm wide, reticulate, uniformly colored, brown, glabrous. Cotyledons with entire margin. Fig. 343.

Pollen. *Geranium*-type.

Chromosome number. 2*n* = 52.

Phenology. Collected in flower from February to September.

Distribution. This species ranges through southwestern Canada and northwestern U.S.A. (Fig. 344).

Habitat. Roadsides, sandy banks, wet meadows, grassy slopes, evergreen and deciduous forests; 300-3200 m.

Representative specimens examined. **Canada.** Alberta: Carway, 49º1'N, 113º22'W, 2 Aug. 1950, *Dore & Breitung 12266* (DAO); Milk River, 49º7'N, 112º7'W, 26 June 1952, *Boivin & Alex s.n.* (DAO); Waterton Lakes, 49º5'N, 113º52'W, 23 July 1940, *Hart 8* (DAO). British Columbia: 2 mi from Dead Lake, 50º27'N, 121º39'W, 25 May 1958, *Beamish & al. 8252* (DAO); Bridesville, 49º2'N, 119º9'W, 25 June 1931, *Eastham s.n.* (DAO); Williams Lake region, Big Lake, 52º23'N, 121º50'W, 10 June 1934, *Murie 1193* (MO). Saskatchewan: Cypress Hills, Battle Creek Ranger Station, 49º34'N, 109º53'W, 13 July 1947, *Breitung 4759* (DAO); Kandahar, 51º46'N, 104º21'W, *Breitung 1637* (DAO); Rivière Bataille, 52º33'N, 106º10'W, 3 Aug. 1858, *Bourgeau s.n.* (P). **USA.** California: Lassen Co., Burgess Spring, 40º42'N, 121º2'W, 12 June 1936, *Short & Gansberg 433* (UC); Modoc Co., 1 mi E of Lake City, 41º38'N, 120º13'W, 12 June 1946, *Alexander & Kellogg 4726* (UC); Siskiyou Co., Quartz Valley, 41º36'N, 122º58'W, 6 June 1910, *Butler 1458* (MO). Colorado: Garfield Co., on Grizzly Creek, 39º33'N, 107º15'W, 19 July 1896, *Baker s.n.* (MO); Garfield Co., upper middle fork of Stuart Creek, 39º42'N, 108º10'W, 18 July 1935, *Graham 9738* (MO); Gunnison Co., Gunnison Watershed, 38º32'N, 106º55'W, 26 July 1901, *Baker 622* (MO). Idaho: Ada Co., Boise, 43º36'N, 116º12'W, 12 June 1934, *Christ 4804* (NY); Boise Co., Clear Creek, 44º4'N, 115º36'W, 4 July 1911, *Clark 78* (MO); Washington Co., Tamarack, 44º36'N, 116º50'W, 8 Aug. 1911, *Clark 204* (MO). Montana: Beaverhead Co., E of summit of Sheep Mt. T14S, R1W, S33, 45º28'N, 113º45'W, 24 Aug. 1979, *Lowry II 3032* (MO); Granite Co., at Eagle Creek, Rock Creek Canyon, 46º25'N, 113º42'W, 6 July 1946, *Hitchcock & Muhlick 14452* (MO); Stillwater Co., at Independence, head of Boulder Creek, Absaroka National Forest, 45º31'N, 109º27'W, 7 Aug. 1945, *Hitchcock & Muhlick 13351* (MO). Nebrasca: Sioux Co., West Hat Creek Canyon, 42º45'N, 103º46'W, 25 July 1940, *Tolstead s.n.* (NEB). Nevada: Elko Co., 10 mi W of Mountain City on Chicken Creek, 41º4'N, 116º6'W, 15 July 1937, *Nichols & Lund 402* (MO); Elko Co., Gold Creek, 41º42'N, 115º42'W, 27 July 1912, *Nelson & Macbride 2129* (MO); Elko Co., Lamoille Canyon, Ruby Mts., 41º41'N, 115º28'W, 28 July 1940, *Munz 16185* (UC). Oregon: Baker Co., Wallowa Mts., Pine Creek, 44º28'N, 117º37'W, 30 June 1935, *Jones 7197* (MO); Harney Co., Catlou Valley, Three Mile Creek, 42º29'N, 118º54'W, 24 June 1937, *Wrews s.n.* (OSC); Wheeler Co., Sewice Creek, 44º40'N, 120º0'W, 12 May 1926, *Gorman 7641* (OSC). South Dakota: Lawrence Co., Iron Creek Lake, Black Hills, 44º22'N, 103º58'W, 26 June 1961, *Comte 4048* (MO); Pennington Co., Castle Creek, near Deerfield, 44º5'N, 103º37'W, 22 June 1929, *Palmer 37480* (MO). Utah: Cache Co., Cache Valley, 41º45'N, 111º49'W, 17 June 1898, *Mulford 137* (MO); Summit Co., Bear River, 40º43'N, 111º12'W, 30 June 1926, *Payson & Payson 4829* (MO); Uintah Co., Uintah Mts., Taylor Mt., 15 mi N of Vernal, 40º43'N, 109º38'W, 24 June 1931, *Graham 6348* (MO). Washington: Chelan Co., Leavenworth, 47º45'N, 120º45'W, 18 May 1928, *Saint John & al. 9495* (MO); Douglas Co., on Badger Mt., 47º26'N, 120º4'W, 1 June 1940, *Thompson 14631* (MO); Whitman Co., Pullman, 46º43'N, 117º10'W, 26 June 1893, *Piper s.n.* (MO). Wyoming: Big Horn Co., head Middle Fork Powder River, 43º29'N, 107º14'W, 18 July 1901, *Goodding 286* (MO); Sheridan Co., above Big Horn, 44º41'N, 106º59'W, 25 June 1897, *Pammel & Stanton s.n.* (MO); Yellowstone National Park, along Mammoth-Tower Falls highway, 3 mi W of Roosevelt Lodge, Washburn Range, 44º50'N, 110º34'W, 22 June 1960, *Venrick 176* (MO).

Discussion. Geranium viscosissimum is sometimes difficult to differentiate from the similar *G. caespitosum*, with which it overlaps in Utah, Colorado, and Wyoming. *Geranium viscosissimum* is of robust stature with very wide basal leaves and short stigmatic remnants, although with some overlap with *G. caespitosum*. The presence of glandular hairs also varies in *G. viscosissimum*. Forms with eglandular stems, and more rarely with eglandular peduncles and pedicels, appear at some localities of its range; however, all possible transitions from eglandular to glandular forms occur, which demonstrate that eglandular specimens do not deserve taxonomic recognition; *G. strigosum* was erected to include such eglandular specimens. Leaf shape and the portion of petal surface bearing hairs vary considerably but independently of the presence of a glandular indumentum; *G. attenuilobum* was segregated to include forms with petals bearing hairs on more than one-third of the surface.

An account of some aspects of the life history of *G. viscosissimum* [as *G. nervosum*] is provided by Green (1978). Spomer (1999) found that some sticky plants as *G. viscosissimum* were protocarnivorous, because they "were capable of digesting arthropods or other organic items trapped on the surface and absorbing the nitrogene".

130. Geranium latum Small in Underw. & Britton (eds.), N. Amer. Fl. 25(1): 18. 1907. Type locality: "Type collected on Popocatepetl, Mexico, August 7 and 8, 1901, J. N. Rose & R. Hay 6065". Type: Mexico. Mexico, Popocatepetl, 19°02'N, 98°39'W, 7-8 Aug. 1901, *J.N. Rose & R. Hay 6065* (holotype, US-00130523 image!).

Geranium pinetorum R. Knuth, Bull. Misc. Inform. 1937(10): 503. 1937, nom. illeg., non Hand. Mazz. 1933. Type locality: "State of Mexico. Discrict of Temascaltepec: Mesón Viejo, 2830 m., in pine forest, Oct. 1932, Hinton 1887 (typus in herb. Kew.); Hornos, in a wet barranca, Jan 1935, Hinton 7199. Salazar, Federal District, 1907, Seler 5282 (Herb. Berol.) San Rafael, District of Tlalmanalco, 1907, Seler 5321 (Herb. Berol.)". Type: Mexico. Mexico, Temascaltepec, Mesón Viejo, 19°10'N, 99°53'W, Oct. 1932, *G.B. Hinton 1887* (holotype,

K-000531449!; isotypes, BM-000796423!, F!, G-00388787!, GH-00043650!, LL, MO-060429!, NY!, US image!).

Perennial herbs, 25-112 cm tall. *Rootstock* 2-6.4 mm in diameter, ± horizontal, not tuberculate, not turnip-shaped, without thickened roots. *Stem* prostrate to ascending, leafy, not rooting at nodes, stolons absent, without vegetative stems, with patent to retrorse, eglandular hairs 0.5-1.4 mm long. *Basal leaves* few, not long persistent, cauline leaves alternate (usually 1(2)) in middle of shoot and upper opposite; leaf laminas 4.2-9.9 cm long, 4.8-10.5 cm wide, not peltate, palmatifid [ratio main-sinus length/middle segment length = 0.74-0.89], polygonal (medium and upper hastate) in outline, base cordate (medium and upper ± truncate), not coriaceous, with nerves not projected, pilose on both surfaces, with ± appressed, eglandular hairs; segments 3-5, in 1 plane, middle segment rhombic, 7-14.3 mm wide at the base [ratio segment width at the base/middle segment length = 0.17-0.37], 7-12(15)-lobed in distal half [ratio secondary sinus length/middle segment length = 0.08-0.19]; petioles up to 22 cm long, without abscission zone, terete, not swollen, not deflexed in age, with patent, eglandular hairs 0.5-1.3 mm long; stipules 3.8-15 mm long, 1-3.2 mm wide, lanceolate, free, papery, brownish red, with eglandular hairs on both surfaces and on the margin. *Inflorescence* a dichasial cyme; cymules 2-flowered, solitary [ratio cymule length/leaf length = 1.5-8]; peduncles (36)44-93(114) mm long, with patent to retrorse, eglandular hairs 0.3-1 mm long and patent, glandular hairs 0.2-0.5 mm long; bracteoles 4.2-8.3 mm long, 0.3-1.1 mm wide, lanceolate, whorled; pedicels (16)19-31(50) mm long, with patent to retrorse, eglandular hairs 0.2-1 mm long and patent, glandular hairs 0.2-0.8 mm long. Flowers actinomorphic. *Sepals* (4.5)5.5-7.7(8.7) mm long, 1.7-3.5 mm wide, lanceolate, smooth, not accrescent, nerves 3, mucro 0.8-3(3) mm long [ratio mucro length/sepal length = 0.13-0.46], with antrorse to patent, eglandular hairs 0.1-1.2 mm long and patent, glandular hairs 0.4-0.8 mm on the abaxial surface, glabrous adaxially. *Petals* (8.5)10-13.1(17.2) mm long, 4.7-10.5 mm wide, erect-patent, rounded or slightly emarginate (notch 0.2-0.6 mm deep), without claw, white to pink, hairy on the basal 1/2-3/4 of their adaxial surface, ciliate on the basal margin, with hairs 1.2-2.1 mm long. *Stamens* 10, both whorls bearing anthers; filaments 4.4-7.8 mm long, lanceolate, purple, pilose on the abaxial surface, ciliate on the proximal half, with hairs (0.7)1.3-1.6(2) mm long; anthers 1.2-1.4 mm long, black. Nectaries 5, hemispheric, with a tuft of hairs covering all of its surface. *Gynoecium* 4.5-8.7 mm long, purple. *Fruit* 23.2-32.4 mm long, erect, discharge of seed-ejection type; mericarps 3.1-4.4 mm long, 1.4-2.1 mm wide, without a strand of fibers, not compressed at the apex, smooth, without basal beak, with a basal callus, without a basal prong, brown, with erect-patent, eglandular hairs 0.3-0.8 mm long and, rarely, patent, glandular hairs 0.4-0.5 mm long; rostrum 15.5-21 mm long, with a narrowed apex 1.7-3.5 mm long, not twisted, with ± patent, eglandular hairs 0.3-0.5 mm long and, rarely, patent, glandular 0.6-0.8 mm long; stigmatic remnants 2.8-4.3 mm long, with 5 glabrous lobes. *Seeds* 2.1-2.5 mm long, 1.5-1.7 mm wide, finely reticulate, uniformly colored, brown, glabrous. Cotyledons with entire margin. Fig. 345.

Pollen. Ornamentation not studied.

Chromosome number. Unknown.

Phenology. Collected in flower from May to November.

Distribution. This species ranges through central Mexico (Fig. 346).

Habitat. Wet slopes, moist ravines, and *Abies* Mill., *Cupressus* L., *Pinus* L., and *Quercus* L. forests; 1700-3350 m.

Additional specimens examined. **Mexico.** Hidalgo: Epazoyucan, El Guajolote, 20°6'N, 98°36'W, 17 June 1984, *Medina & Barrios 2557* (NY); San Vicente, 19°57'N, 98°33'W, 16 Aug. 1937, *Edwards 853* (F); Zimapán, near Rancho Encarnación, on road to highway (km 242) to Encarnación, 20°52'N, 99°12'W, 6 Aug. 1948, *Moore & Wood 4331* (GH, MEXU). Mexico State: 0.25 km E of Puerto Lengua de Vaca near km 68 on Toluca-Morelia highway, 19°27'N, 100°12'W, 27 Sep. 1978, *Iltis & al. 715* (MEXU, MICH, XAL); between México city and Puebla, near Río Frío, W slope of pass, 19°23'N, 98°43'W, 12 July 1938, *Hodgdon 5656* (GH); Ixtapaluca, Llano Grande, 19°59'N, 99°38'W, 7 Oct. 1983, *Ventura 1458* (MEXU); km 10 carretera Amacameca-Tlamacas, cañada de Nexpayantla, 19°5'N, 98°43'W, 20 Oct. 1974, *Polaco 55* (MEXU); La Cima-Jajalpa, 19°8'N, 99°22'W, Aug. 1904, *Kuntze 23719* (NY); Llano Grande, 19°21'N, 98°40'W, 30 July 1950, *Matuda 19282* (MEXU); near km 39 on México-Toluca highway, Salazar, 19°18'N, 99°23'W, 12 Sep. 1946, *Moore 1191* (GH, MEXU, MO, NY); Papayotl, 2 Oct. 1966, *Boege 286* (MEXU); paraje provincial, 25 July 1938, *Balls 5099* (BM, GH); Popocatepelt National Park, 19°2'N, 98°39'W, 11 Sep. 1948, *Straw 29* (GH); Puebla, near río Otlati, 19°21'N, 98°30'W, 13 Aug. 1942, *Weaver 951* (GH); Río Frío, Parque Nacional, Zoquiapan, paraje Loma de San Diego, 19°23'N, 98°43'W, 27 Sep. 1979, *Mancera 28* (MO); Río Frío, Slano Grande, 19°23'N, 98°43'W, 16 Aug. 1928, *Saint Pierre 2183* (MA); Río Molino, Valle del Bravo, 19°11'N, 100°8'W, 1 Nov. 1949, *Moore & Cetto 5480* (BM, GH); San Rafael, 19°14'N, 98°45'W, July 1929, *Lyonnet 498* (NY); Temascaltepec, Cumbre Trojes, 18°56'N, 100°17'W, 9 Aug. 1935, *Hinton 8271* (F, MEXU, MO, NY); Temascaltepec, Mesón Viejo, 19°10'N, 99°53'W, 10 Nov. 1935, *Hinton 8339* (MO, F, NY); vertiente W del Iztaccihuatl, 19°10'N, 98°38'W, 3 Aug. 1958, *Espinosa 32* (MEXU); Villa Allende, cerca de San Miguel, estación experimental de fauna silvestre San Cayetano, 19°21'N, 100°5'W, 31 Aug. 1994, *Vibrans 4816* (MEXU). Michoacán: Ocampo, El Chivatí, 8 km al SE de Ocampo, 19°31'N, 100°16'W, 15 Nov. 1981, *Soto 3663* (MEXU); Zinapécuaro, laguna de los Azufres, 19°48'N, 100°37'W, 30 Aug. 1986, *Díaz & Zamudio 2678* (MEXU). Morelos: km 10 on road from Tres Cumbres to Zempoala, 19°3'N, 99°15'W, 14 Sep. 1946, *Moore 1198* (GH); Lago Zempoala, 19°3'N, 99°7'W, 7 Oct. 1951, *Matuda 25618* (MEXU, GH); Salto de San Antonio, Cuernavaca, 19°3'N, 99°14'W, 5 Aug. 1951, *Matuda 21614* (MEXU); Tres Marías, 19°4'N, 99°13'W, 23 Aug. 1910, *Orcutt 3759* (F, MO, UC). Puebla: Zaragoza, San José Buenavista, 18°39'N, 97°34'W, 21 May 1986, *Ventura 21949* (MEXU).

Discussion. Geranium latum, an endemic of the Meseta Central of Mexico, is well characterized by its adaxially densely hairy petals, staminal filaments with long hairs, nectaries with a tuft of hairs covering the entire surface, dichasially branched, glandular-pubescent inflorescence, and alternate basal cauline leaves. The incomplete specimens seen do not permit a full reconstruction of the basal parts of the plant. *Geranium latum* seems to have a moderately robust rootstock (only a fragment available on two sheets) giving rise to a ± horizontal, thin, lignified branch 6-11 cm long. These branches may remain underground and are not covered by stipule remains. Middle and distal leaves are opposite, but in most specimens one (rarely two) alternate cauline leaf appears between the base and the first branch point. The basal leaves are pentagonal in outline, with five segments, and they form a ± persistent rosette, whereas the cauline leaves are hastate, with a ± truncate base and three segments. The inflorescence of well-developed specimens is dichasial and terminal, sometimes with single cymules at lower nodes. In small specimens the inflorescence may be reduced to one or two terminal cymules. Specimens of *G. latum* are sometimes misidentified as *G. mexicanum*, which differs in that the petals bear hairs only at the base of the adaxial surface, the staminal filaments have short hairs, and the nectaries are glabrous. *Geranium latum* is also partially sympatric with *G. deltoideum*. The species share the dense adaxial petal vesture and nectaries with a tuft of hairs covering the entire surface; however, *G. deltoideum* has short hairs on the staminal filaments and a monochasially branched inflorescence.

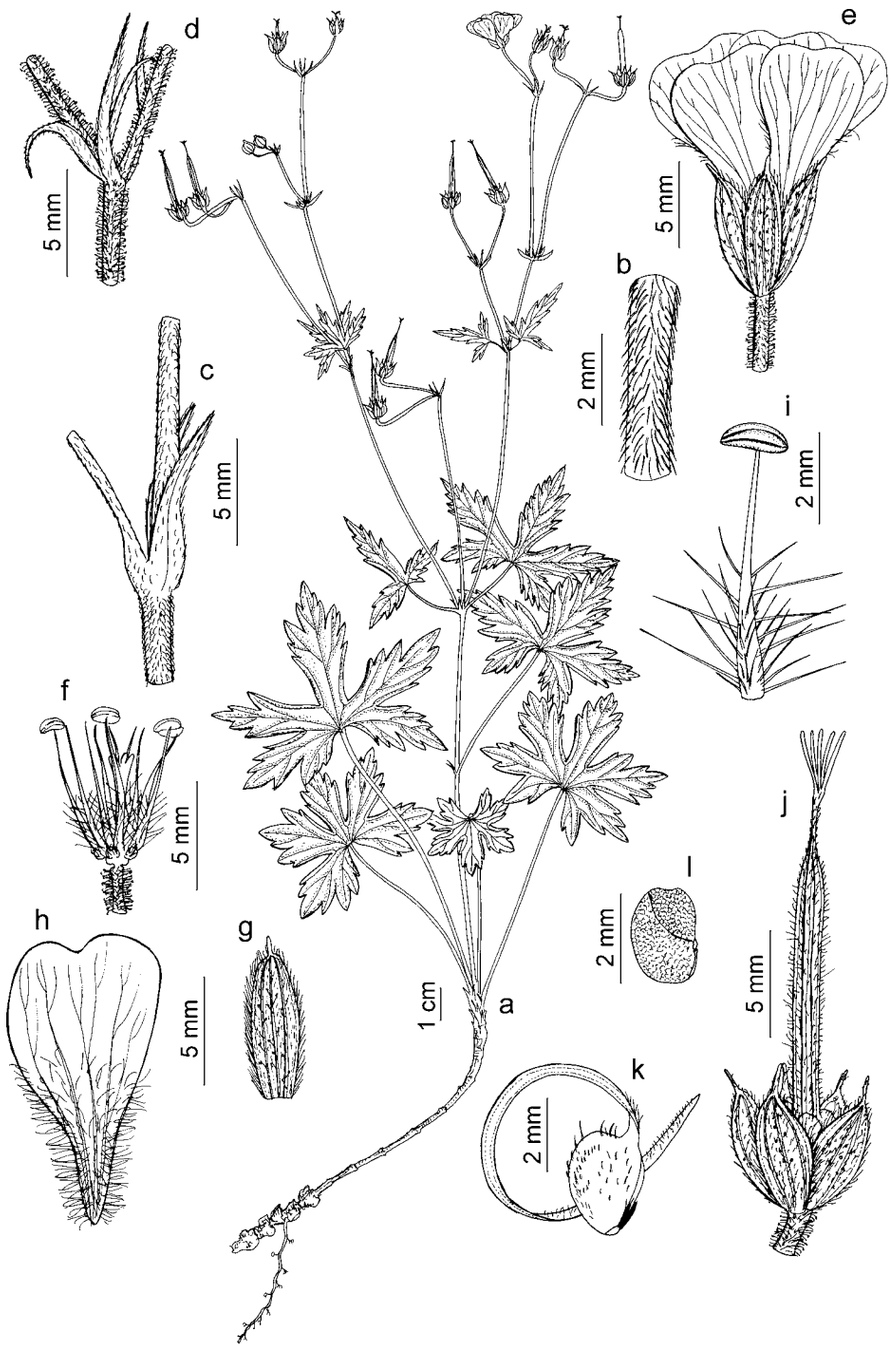


Fig. 345. *Geranium latum*. a. Habit. b. Detail showing stem indumentum. c. Stipules. d. Bracteoles. e. Flower. f. Flower, sepals and petals removed. g. Sepal. h. Petal, adaxial side. i. Stamen. j. Fruit. k. Mericarp. l. Seed. (Based on: a-d, *Moore 1191*, NY; e-i, *Moore & al. 4331*, GH; j-l, *Vibrans 4816*, MEXU).

Fig. 346. Distribution of *Geranium latum*.

131. Geranium tenue Hanks in Underw. & Britton (eds.), N. Amer. Fl. 25(1): 10. 1907. Type locality: "Type collected in San Luis Potosi, Mexico, 1877, J. G. Schaffner 458". Type: Mexico. San Luis Potosí, 22°10'N, 100°58'W, 1877, *J.G. Schaffner 458* (holotype, NY-00370255!).

Perennial herbs, 14-25 cm tall. *Rootstock* 1.5-2.8 mm in diameter, ± horizontal, not tuberculate, not turnip-shaped, without thickened roots. *Stem* erect, leafy, not rooting at nodes, stolons absent, without vegetative stems, with retrorse, appressed eglandular hairs 0.3-0.5 mm long. *Basal leaves* in a ± persistent rosette, cauline leaves opposite; leaf laminas 2-3.2 cm long, 2.3-3.7 cm wide, not peltate, palmatifid [ratio main-sinus length/middle segment length = 0.80-0.88], polygonal in outline, base cordate, not coriaceous, with nerves not projected, pilose on both surfaces, with ± appressed, eglandular hairs; segments 5, in 1 plane, middle segment rhombic, 1.8-3.3 mm wide at the base [ratio segment width at the base/middle segment length = 0.13-0.20], 3-7-lobed in distal half [ratio secondary sinus length/middle segment length = 0.20-0.28]; petioles up to 10 cm long, without abscission zone, terete, not swollen, not deflexed in age, with retrorse, appressed, eglandular hairs 0.4-0.6 mm long; stipules 4.7-9.5 mm long, 0.9-1.8 mm wide, lanceolate, free, papery, brownish red, with eglandular hairs on both surfaces and on the margin. *Inflorescence* a dichasial cyme; cymules 2-flowered, solitary [ratio cymule length/leaf length = 1.3-2.7]; peduncles 52-131 mm long, with retrorse, appressed, eglandular hairs 0.2-0.5 mm long and, rarely, patent, glandular hairs 0.2-0.3 mm long; bracteoles 5.3-8.8 mm long, 0.6-1.1 mm wide, lanceolate, whorled; pedicels 10-22 mm long, with retrorse, appressed, eglandular hairs 0.2-0.5 mm long and, usually, patent, glandular hairs 0.1-0.5 mm long. Flowers actinomorphic. *Sepals* 5.7-7 mm long, 2.3-3 mm wide, lanceolate, smooth, not accrescent, nerves 3, mucro 0.6-

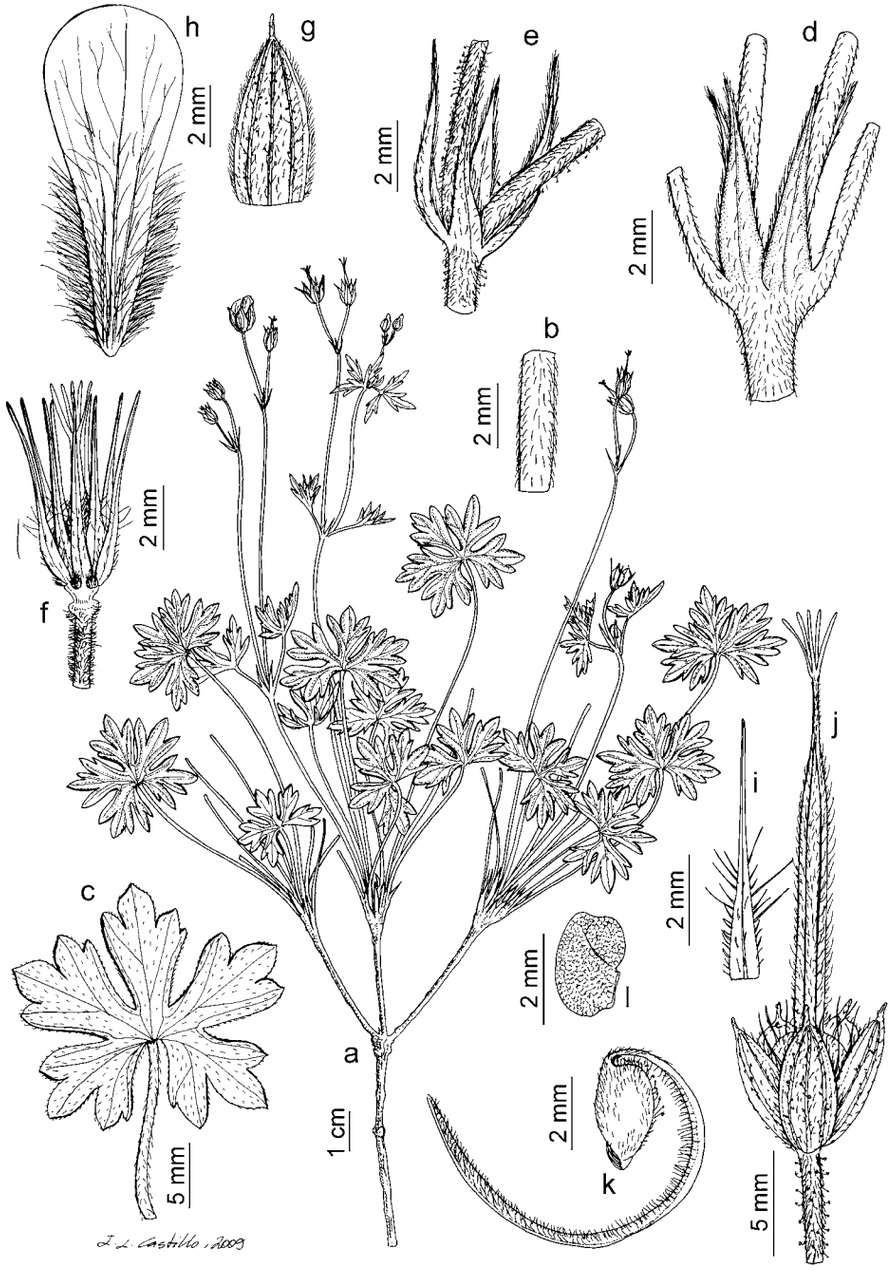


Fig. 347. *Geranium tenue*. a. Habit. b. Detail showing stem indumentum. c. Leaf, adaxial side. d. Stipules. e. Bracteoles. f. Flower, sepals and petals removed. g. Sepal. h. Petal, adaxial side. i. Staminal filament. j. Fruit. k. Mericarp. l. Seed. (Based on: *Schaffner 186*, GH).

Fig. 348. Distribution of *Geranium tenue*.

1.5 mm long [ratio mucro length/sepal length = 0.10-0.20], with ± patent, eglandular hairs 0.5-1.1 mm long and sometimes, patent, glandular hairs 0.2-0.5 mm long on the abaxial surface, sparsely hairy adaxially. *Petals* 10.8-11.3 mm long, 4-5 mm wide, erect-patent, rounded, without claw, white, hairy on the basal 1/2-3/4 of their adaxial surface, ciliate on the basal margin, with hairs 1-1.8 mm long. *Stamens* 10, both whorls bearing anthers; filaments 6.7-7.5 mm long, lanceolate, unknown color, pilose on the abaxial surface, ciliate on the proximal half, with hairs 0.5-1.2 mm long; anthers unknown. Nectaries 5, hemispheric, with a tuft of hairs covering all of its surface. *Gynoecium* 6.5-9 mm long, unknown color. *Fruit* 23.6-29.1 mm long, erect, discharge of seed-ejection type; mericarps 3.4-3.6 mm long, 1.6-1.7 mm wide, without a strand of fibers, not compressed at the apex, smooth, without basal beak, with a basal callus, without a basal prong, brown, with erect-patent, eglandular hairs 0.3-0.4 mm long and patent, glandular hairs 0.4-0.5 mm long; rostrum 17.3-20.4 mm long, with a narrowed apex 2.7-3.4 mm long, not twisted, with ± patent, eglandular hairs 0.3-0.7 mm long and patent, glandular hairs 0.4-0.6 mm long; stigmatic remnants 3.1-3.3 mm long, with 5 glabrous lobes. *Seeds* 2.3-2.4 mm long, 1.5-1.6 mm wide, finely reticulate, uniformly colored, brown, glabrous. Cotyledons with entire margin. Fig. 347.

Pollen. Ornamentation not studied.

Chromosome number. Unknown.

Phenology. Unknown.

Distribution. This species ranges through San Luis Potosí, in central Mexico (Fig. 348).

Habitat. Unknown; 1800-2300 m.

Additional specimens examined. **Mexico.** San Luis Potosí: ex convalli San Luis Potosí, in montibus San Rafael, 22°11'N, 100°40'W, 1877, *Schaffner 187* (GH, MEXU).

Discussion. Geranium tenue resembles *G. latum* in that both have petals with hairs over most of the adaxial surface and nectaries with a tuft of hairs covering the entire surface. Both species also have quite similar basal parts; however, the scarcity of available material for *G. tenue* suggests that confirmation of this trait is needed. *Geranium tenue* has shorter and more deeply divided leaves than *G. latum*, and the middle segment of its leaves has a narrowed base and less lobed apex. In *G. tenue* all leaves are opposite, whereas in *G. latum* the basal leaf is usually alternate. The indumentum of *G. tenue* consists of retrorse, appressed hairs on the stem and inflorescence, and rarely some glandular hairs on pedicels, but in *G. latum* glandular hairs are always present in the inflorescence. The eglandular hairs of the staminal filaments as well as the sepal mucro are shorter in *G. tenue* than in *G. latum*. Because *G. tenue* is poorly collected, such features as petal length, anther morphology, and fruit and seed characters should be reviewed when additional material becomes available. *Geranium wislizeni* is another species similar to *G. tenue*. The rootstock of *G. tenue*, although not well known, seems to be ± horizontal, branched towards the apex, and is much thinner than that of *G. wislizeni*, which has a robust, vertical rootstock. Furthermore, *G. tenue* has shorter leaves that are less lobed per segment and a stem indumentum of retrorse, appressed short eglandular hairs. The ranges of the species are separated by a gap of about 350 km.

The holotype of *G. tenue* is *Schaffner 458* (NY). This sheet bears a printed label (locality, collector, and date) and a handwritten one (identification and collection number), which show two collection numbers: 458 and 186, apparently written by different hands. In MEXU there is a specimen with a similar label, but it has only the number 186 (written by the same hand as that of the NY sheet). In F and GH there are two specimens numbered 186, with a more precise locality ("in montibus San Miguelito") and dated 1876. Specimens at F, GH, and MEXU could be duplicates of the original collection (and thus isotypes) but were labeled at different times and with some minor differences. *Schaffner 190* (GH) and *Parry & Palmer 101* (GH, US) were determined by Watson (1882: 334) as *G. carolinianum*. Moore (1943: 44) discussed this matter under *G. tenue*; he concluded that the specimens are similar to *G. carolinianum* but perennial, and that they may be related to *G. tenue*. I assigned these specimens to *G. seemannii* subsp. *seemannii*.

132. Geranium potosinum H.E. Moore, Contr. Gray Herb. 146: 41, pl. 4 fig. 3. 1943. Type locality: "MEXICO: Nuevo Leon: abundant in the upper pine wood, Peak of Cerro Potosi, Municipio de Galeana, July 21, 1935, Mueller 2257 (G, type; F, isotype)". Type: Mexico. Nuevo León, Galeana, Cerro Potosí, 24°52'N, 100°14'W, 21 July 1935, *C.H. Mueller 2257* (holotype, GH-00043651!; isotypes, F-0044713F!, MICH-1192298 image!, NY-01364989!).

Perennial herbs, 14-33 cm tall. *Rootstock* 1.7-6.8 mm in diameter, vertical, not tuberculate, not turnip-shaped, without thickened roots. *Stem* erect, leafy, not rooting at nodes, stolons absent, without vegetative stems, with retrorse, appressed eglandular hairs 0.4-0.6 mm long. *Basal leaves* in a ± persistent rosette, cauline leaves opposite; leaf laminas 2.2-3.5 cm long, 2.4-3.9 cm wide, not peltate, palmatifid [ratio main-sinus length/middle segment length = 0.83-0.93], polygonal in outline, base cordate, not coriaceous, with nerves not projected, pilose on both surfaces, with ± appressed, eglandular hairs; segments 5, in 1 plane, middle segment rhombic, 3.1-4.6 mm wide at the base [ratio segment width at the base/middle segment length = 0.15-0.26], 5-7-lobed in distal half [ratio secondary sinus length/middle segment length = 0.19-0.33]; petioles up to 13 cm long, without abscission zone, terete, not swollen, not deflexed in

age, with retrorse, appressed, eglandular hairs 0.4-0.7 mm long; stipules 4.7-11.9 mm long, 1.7-2.1 mm wide, lanceolate, free, papery, brownish red, with eglandular hairs on the margin, and sometimes on both surfaces. *Inflorescence* a dichasial cyme; cymules 2-flowered, solitary [ratio cymule length/leaf length = 1.3-3.3]; peduncles 49-96(106) mm long, with retrorse, appressed, eglandular hairs 0.1-0.4 mm long; bracteoles 5.9-9.9 mm long, 1-1.8 mm wide, lanceolate, whorled; pedicels 13-22 mm long, with retrorse, eglandular hairs 0.2-0.3 mm long and, rarely, patent, glandular hairs 0.2-0.4 mm long. Flowers actinomorphic. *Sepals* 6.1-6.2 mm long, 2.5-2.8 mm wide, lanceolate, smooth, not accrescent, nerves 3, mucro 1.2-1.7 mm long [ratio mucro length/sepal length = 0.21-0.28], with ± patent, eglandular hairs 0.5-1.1 mm long on the abaxial surface, glabrous adaxially. *Petals* 12.1-16.1 mm long, 5.7-8.5 mm wide, erect-patent, rounded, without claw, purple, hairy on the basal 1/2-3/4 of their adaxial surface, ciliate on the basal margin, with hairs 0.7-0.9 mm long. *Stamens* 10, both whorls bearing anthers; filaments 4.3-6.9 mm long, lanceolate, purple, pilose on the abaxial surface, ciliate on the proximal half, with hairs 0.4-0.9 mm long; anthers 1.3-1.6 mm long, purple. Nectaries 5, hemispheric, with a tuft of hairs covering all of its surface. *Gynoecium* 4.9-7.8 mm long, purple. *Fruit* 19-20 mm long, erect, discharge of seed-ejection type; mericarps 4.2-4.3 mm long, 1.6-1.7 mm wide, without a strand of fibers, not compressed at the apex, smooth, without basal beak, with a basal callus, without a basal prong, brown, with erect-patent, eglandular hairs 0.6-0.7 mm long; rostrum 12.6-12.7 mm long, with a narrowed apex 0.8-0.9 mm long, not twisted, with ± patent, eglandular hairs 0.1-0.2 mm long; stigmatic remnants 2.1-2.2 mm long, with 5 glabrous lobes. *Seeds* unknown. Cotyledons not studied. Fig. 349.

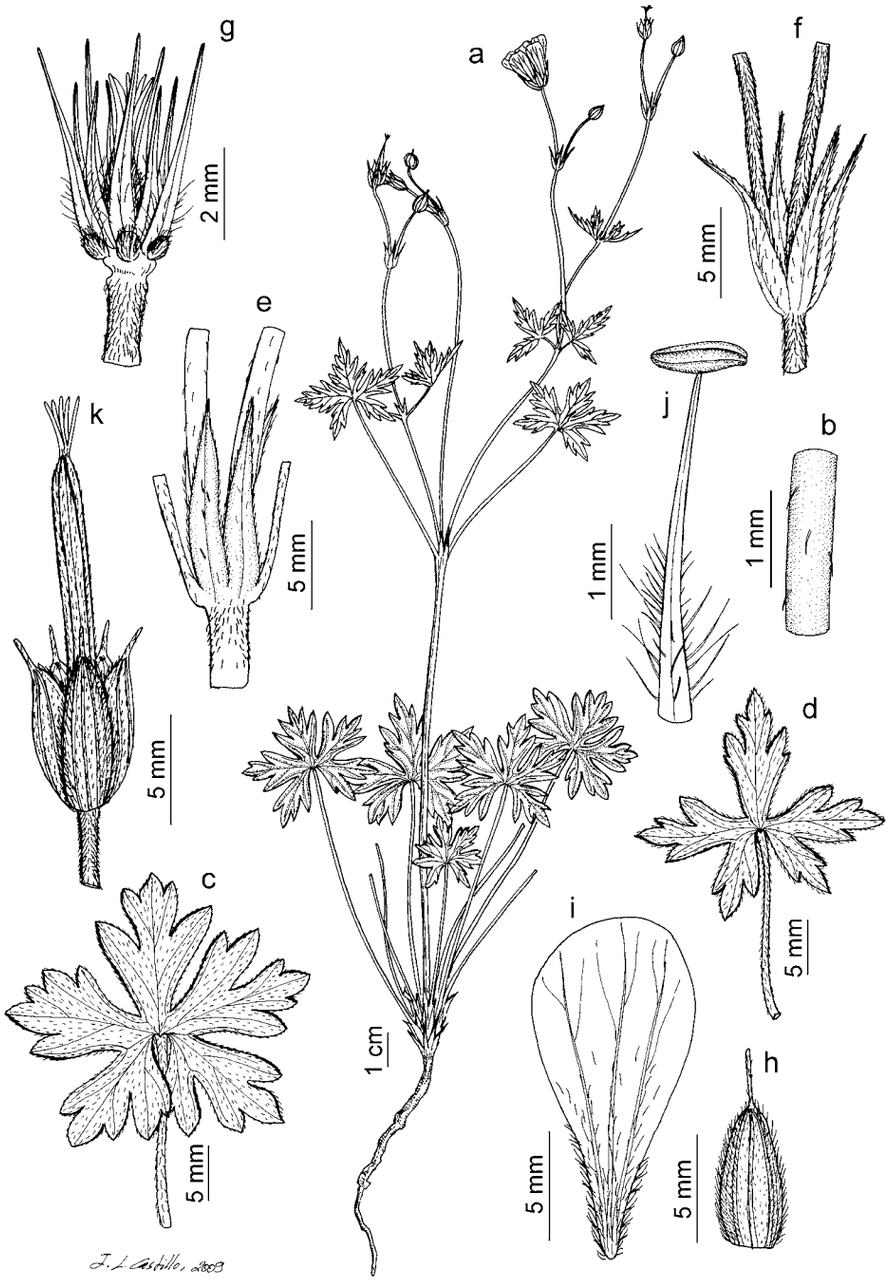


Fig. 349. *Geranium potosinum*. a. Habit. b. Detail showing stem indumentum. c, d. Leaves, adaxial side. e. Stipules. f. Bracteoles. g. Flower, sepals and petals removed. h. Sepal. i. Petal, adaxial side. j. Stamen. k. Fruit. (Based on: a, b, e-k, *Mueller 2257*, F; c, *Hinton & al. 20993*, GH; d, *Sharp 45738*, MEXU).

Fig. 350. Distribution of *Geranium potosinum*.

Pollen. Ornamentation not studied.

Chromosome number. Unknown.

Phenology. Collected in flower from June to July.

Distribution. This species is endemic to Nuevo León and Coahuila, in northeastern Mexico (Fig. 350).

Habitat. Pinus L. and *Quercus* L. forests; 3000-3600 m.

Additional specimens examined. **Mexico.** Coahuila: Arteaga, Sierra El Coahuilon, 25°14'N, 100°18'W, 17 June 1991, *Hinton & al. 20993* (GH, IEB). Nuevo León: near top of Cerro Potosí, near Galeana, 24°52'N, 100°14'W, 16 July 1945, *Sharp 45738* (MEXU).

Discussion. Geranium potosinum is known only from the type locality in the Cerro Potosí and a second locality in Coahuila, over 300 km to the north of the nearest locality recorded for the similar *G. tenue*. Petals of *G. potosinum* are purplish and longer than the white petals of *G. tenue*. The stipules and bracteoles of *G. potosinum* are broader and the sepal mucro is longer than in *G. tenue*, although with some overlap. The indumentum of *G. potosinum* is similar to that of *G. tenue*, although glandular hairs on peduncles, pedicels, and sepals are more frequent in *G. potosinum*. All these features should be considered with some caution, because there are so few specimens to evaluate.

133. Geranium niveum S. Watson, Proc. Amer. Acad. Arts 21: 421. 1886. Type locality: "Norogachi, in moist grassy openings (406) [collected by E. Palmer]". Type: Mexico. Chihuahua, Norogachi, 150 miles north of Batopilas, 29°14'N, 107°41'W, Nov. 1885, *E. Palmer 406* (lectotype, designated by Moore 1943: 19, GH-00043644!; isotype, US-00100896 image!).

Perennial herbs, 26-49 cm tall. *Rootstock* 8-18.5 mm in diameter, ± vertical, not tuberculate, not turnip-shaped, without thickened roots. *Stem* erect, leafy, not rooting at nodes, stolons absent, without vegetative stems, with retrorse, appressed, eglandular hairs 0.2-0.6 mm long. *Basal leaves* in a persistent rosette, cauline leaves opposite; leaf laminas 1.6-4.4 cm long, 2,1-5.6 cm wide, not peltate, palmatisect, polygonal in outline, base cordate, not coriaceous, with nerves not projected, sericeous on both surfaces, with appressed, eglandular hairs; segments 5, in more than 1 plane, middle segment rhombic (with linear-lanceolate lobes), 0.5-1.8 mm wide at the base [ratio segment width at the base/middle segment length = 0.02-0.06], 3(5)-lobed in distal half [ratio secondary sinus length/middle segment length = 0.30-0.64]; petioles up to 16 cm long, without abscission zone, terete, not swollen, not deflexed in age, with retrorse, appressed, eglandular hairs 0.2-0.6 mm long; stipules 4.5-10.4 mm long, 1-2.6 mm wide, lanceolate, free, papery, brownish red, with eglandular hairs on both surfaces and on the margin. *Inflorescence* a dichasial cyme with divaricate-monochasial branches or monochasial cyme; cymules 2-flowered, solitary [ratio cymule length/leaf length = 1.6-9.9]; peduncles 15.6-84.6 mm long, with retrorse to uncinate eglandular hairs 0.2-0.5 mm long and patent, glandular hairs 0.2-0.4 mm long; bracteoles 5.6-12.7 mm long, 0.9-2.9 mm wide, lanceolate, whorled; pedicels 21.7-54.6 mm long, with retrorse to uncinate eglandular hairs 0.1-0.5 mm long and patent, glandular hairs 0.2-0.5 mm long. Flowers actinomorphic. *Sepals* (7.4)8.5-10.6 mm long, 2.8-4.8 mm wide, lanceolate, smooth, not accrescent, nerves 3, mucro 1.2-2.5 mm long [ratio mucro length/sepal length = 0.13-0.26], sericeous, with antrorse, appressed, eglandular hairs 0.2-0.9 mm long and patent, glandular hairs 0.1-0.4 mm on the abaxial surface, glabrous adaxially. *Petals* (13.2)14.5-17.7 mm long, 6.7-11.8 mm wide, patent to retrorse, rounded, without claw, purple, hairy on the basal 1/3-1/2 of their adaxial surface, ciliate on the basal margin, with hairs 1-2 mm long. *Stamens* 10, both whorls bearing anthers; filaments 9.1-15.6 mm long, lanceolate, purple, with eglandular hairs 0.3-0.7(1.2) mm long mostly on the margin; anthers 2.1-2.7 mm long, yellow. Nectaries 5, hemispheric, with a tuft of hairs at the top, dorsally glabrous. *Gynoecium* 8.5-11 mm long, purple. *Fruit* (23.4)29.5-35.6(42) mm long, erect, discharge of seed-ejection type; mericarps 3.9-5.3 mm long, 0.7-2.8 mm wide, without a strand of fibers, not compressed at the apex, smooth, without basal beak, with a basal callus, without a basal prong, brown, with ± patent, eglandular hairs 0.5-1.9 mm long and patent, glandular hairs 0.2-0.6 mm long; rostrum 13.7-27.4 mm long, with a narrowed apex (1.8)2.1-5.3 mm long, not twisted, with ± patent, eglandular hairs 0.1-0.5 mm long and patent, glandular hairs 0.2-0.6 mm long; stigmatic remnants 4.6-7.5 mm long, with 5 glabrous lobes. *Seeds* 2.6-3.9 mm long, 1.8-2.5 mm wide, finely reticulate, uniformly colored, brown, glabrous. Cotyledons with entire margin. Fig. 351.

Pollen. *Geranium*-type (Bortenschlager 1967: 431).

Chromosome number. Unknown.

Phenology. Collected in flower from July to October.

Distribution. This species ranges through western Chihuahua, in northern Mexico (Fig. 352).

Habitat. Margins of cultivated fields, stream banks, meadows, *Pinus* L. and *Quercus* L. forests; 2000-2500 m.

Additional specimens examined. **Mexico.** Chihuahua: 4 mi S of Creel, 27°45'N, 107°38'W, 4 Aug. 1960, *Straw & Forman 1873* (MEXU); 6.3 mi N of Madera, 29°17'N, 108°8'W, 12 Aug. 1965, *Mertz 256* (MEXU); along railroad tracks between Cuatrocientos and Las Barras de Babicora, 29°30'N, 108°1'W, 17 Aug. 1959, *Kruckeberg 4935* (NY); base of Sierra Madre, 16 Sep. 1887, *Pringle 1202* (F, GH, MEXU, NY); Bocoyna, 2.3 mi N of San Juanito road to El Alamito-San Pedro, 27°58'N, 107°35'W, 2 Aug. 1977, *Bye & Weber 7846* (GH); Bocoyna, E of Gonogochic, E of Creel, 27°50'N, 107°34'W, 21 Aug. 1973, *Bye 4649* (GH); Bocoyna, ejido San Ignacio Arareco, E of Gonogochic, near José Lirio abadoned ranchito, 27°44'N, 107°37'W, 21 Aug. 1978, *Bye 8724* (BM); Bocoyna, Huechochi, W

of Panalachi, 27°41'N, 107°24'W, 8 Oct. 1991, *Bye & al. 18265* (MEXU); Bocoyna, N-facing slope S of Rancho Huechochi, 3 km W of Panalachi, 27°40'N, 107°23'W, 14 Sep. 1994, *Bye & al. 19276* (MEXU); Colonia Pacheco, S of the town, Townsite Pasture of the Marion Wilson ranch, 30°3'N, 108°19'W, 1 Aug. 1972, *Wilson & al. 8556* (MEXU); Culebra Mts., 29°24'N, 107°34'W, 18 Aug. 1936, *LeSueur 737* (F, GH, MO); Guachochic, Cusarare, 27°37'N, 107°32'W, 15 Sep. 1973, *Bye 5057* (GH); laguna de Babicora, arroyo el Jaral, Madera, 29°30'N, 108°1'W, 10 Sep. 1994, *Quintana & Estrada 3619* (NY); Madera, 19 km N of La Mesa del Huracán on road to Casas Grandes, 29°48'N, 108°16'W, 12 Oct. 1994, *Spellenberg & al. 12253* (MEXU, NY); Memelichi, Río Mayo, 28°3'N, 108°11'W, 16 Sep. 1936, *Gentry 2756* (F, MEXU, MO); near Colonia García, Sierra Madre, 29°59'N, 108°20'W, 17 July 1899, *Townsend & Barber 141* (MO, F, GH, NY); Sierra Madre, 1 Oct. 1888, *Pringle 1577* (BM, MPU, PR); Sierra Madre Occidental, Llanos de Babicora, 29°30'N, 108°1'W, 19 Sep. 1934, *Pennell 19077* (MEXU); Temosachic, cañón Huahuatán, 10 mi SE of Madera, 29°12'N, 108°7'W, 23 Sep. 1939, *Mueller 3432* (F, GH).

Discussion. Geranium niveum is characterized by its palmatisect leaves with five segments, these divided into three long and narrow lobes and sericeous on both surfaces. The cauline leaves are less lobed towards the apex of the plant and have a shorter petiole. In some cases, leaves at the distal nodes of the inflorescence are sessile and have three narrow and unlobed segments. The inflorescence in small specimens can be monochasial; however, well-developed plants have a dichasial inflorescence with two main branches and one 2-flowered cymule at the branch point. Each branch has a divaricate and usually geniculate, 2-flowered cymule per node. A dense indumentum of appressed eglandular hairs covers most of the plant, and is particularly dense on the leaf lamina, on young petioles, and abaxially on the sepals. Glandular hairs are restricted to the inflorescence; they are found on peduncles, pedicels, the base of sepals, the apex of mericarps, and the rostrum (although the narrow apex of the rostrum is glabrous). It is noteworthy that *G. niveum* has long, patent to retrorse petals, which have

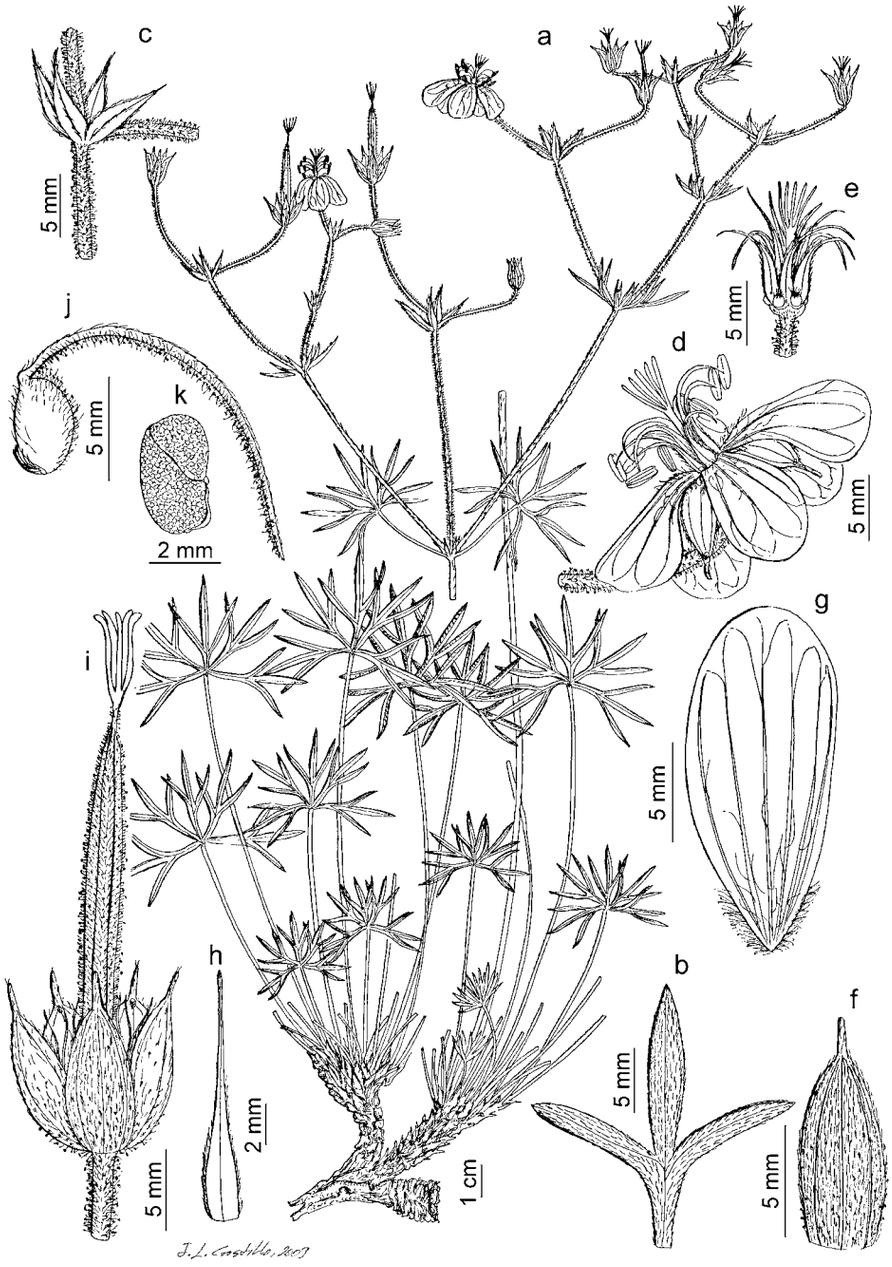


Fig. 351. *Geranium niveum*. a. Habit. b. Detail of leaf segment, adaxial side. c. Bracteoles. d. Flower. e. Flower, sepals and petals removed. f. Sepal. g. Petal. h. Staminal filament. i. Fruit. j. Mericarp. k. Seed. (Based on: a-h, *Spellenberg & al. 12253*, NY; i-k, *Bye 5057*, GH).

Fig. 352. Distribution of *Geranium niveum*.

long eglandular and entwined hairs on the basal half of the adaxial surface, as do many species of the Rocky Mountains (e.g., *G. caespitosum*). *Geranium niveum* shares palmatisect and sericeous leaves with *G. alpicola*, but those of *G. alpicola* are pilose only adaxially and sericeous abaxially. Additionally, the peduncles and pedicels of *G. alpicola* are covered with antrorse, appressed, eglandular hairs, while those of *G. niveum* have retrorse to uncinate eglandular hairs mixed with glandular hairs. Petals of *G. niveum* are longer than those of *G. alpicola* and adaxially hairy. Staminal filaments and anthers are longer in *G. niveum*, and the nectaries have a tuft of hairs at the apex; the nectaries of *G. alpicola* are glabrous.

Other species from North America

134. Geranium maculatum L., Sp. Pl.: 681. 1753. Type locality: "Habitat in Carolina, Virginia, Sibiria". Type: Dillenius, Hort. Eltham. 1, tab.132, fig. 159. 1732 (lectotype, designated by Aedo, 2001: 10). U.S.A. Georgia, Union Co., Chatahooche National Forest, Cooper Creek, 4°47'N, 84°02'W, 9 May 1982, *F.H. Utech & al. 82-030* (epitype, designated by Aedo 2001b: 10, BM-000624808!).

Geranium maculatum var. *album* H.M. Myers, Amer. Naturalist 4: 438. 1870. Type locality: "Binghamton, N.Y.". Type: U.S.A. New York, Binghamton, 42°05'N, 75°55'W, *H.M. Myers s.n.* (no original material located).

Geranium maculatum var. *parviflora* N. Coleman, Kent Sci. Inst. Misc. Publ. 2: 10. 1874. Type locality: "Michigan". Type: U.S.A. Michigan, *N. Coleman s.n.* (no original material located).

Geranium maculatum var. *plenum* Lauman in L.H. Bailey, Cycl. Amer. Hort.: 640. 1900. Type locality: [not indicated]. Type: whitout locality (no original material located).

Geranium maculatum f. *albiflorum* Raf. ex House, Bull. New York State Mus. Nat. Hist. 243-244: 48. 1923. Type locality: "Syracuse, Mrs M. O. Rust (State herbarium) and reported in 35th Rep't N. Y. State Museum 145. 1884". Type: U.S.A. New York, Syracuse, 43°03'N, 76°08'W, *M.O. Rust s.n.* (no original material located).

Perennial herbs, 18-70 cm tall. *Rootstock* 6.6-12 mm in diameter, horizontal, not tuberculate, not turnip-shaped, without thickened roots. *Stem* erect, leafy, not rooting at nodes, stolons absent, without vegetative stems, with patent or retrorse, eglandular hairs 0.3-1.4 mm long, and sometimes, patent, glandular hairs 1.5-1.7 mm long. *Basal leaves* in a persistent rosette, cauline leaves opposite; leaf laminas 5-11.5 cm long, 6.8-14.6 cm wide, not peltate, palmatifid [ratio main-sinus length/middle segment length = 0.82-0.92], polygonal in outline, base cordate, not coriaceous, with nerves not projected, pilose, with appressed, eglandular hairs on both surfaces; segments 5, in 1 plane, middle segment rhombic, 3.5-8.8(12) mm wide at the base [ratio segment width at the base/middle segment length = 0.07-0.16], (7)9-23-lobed in distal half [ratio secondary sinus length/middle segment length = 0.12-0.25]; petioles up to 33 cm long, without abscission zone, terete, not swollen, not deflexed in age, with patent to retrorse, eglandular hairs 0.4-0.9 mm long and, sometimes, patent, glandular hairs 1.1-1.5 mm long; stipules 3.7-13 mm long, 1.2-3.1 mm wide, linear-lanceolate, free, papery, brownish red, with eglandular and glandular hairs on abaxial surface and on the margin, glabrous adaxially. *Inflorescence* a dichasial cyme; cymules 2-flowered, solitary or in aggregates at the top of each branch [ratio cymule length/leaf length = (0.7)1.1-2.2]; peduncles 19-103 mm long, with patent to retrorse, eglandular hairs 0.2-1.4 mm long and, rarely, patent, glandular hairs 0.8-1.5 mm long; bracteoles 2.9-8.1 mm long, 0.5-0.9 mm wide, lanceolate, whorled; pedicels absent or 10-31 mm long, with patent to retrorse, eglandular hairs 0.2-0.9 mm long. Flowers actinomorphic. *Sepals* 6-10.4 mm long, 2.8-4.5 mm wide, lanceolate, smooth, not accrescent, nerves 3-5, mucro 1.3-2.9 mm long [ratio mucro length/sepal length = 0.18-0.34], with antrorse, appressed eglandular hairs 0.2-0.8 mm long and patent, glandular hairs 0.9-2.1 mm long on the abaxial surface, glabrous adaxially. *Petals* 11.6-16.1 mm long, 7.8-12.9 mm wide, erect-patent, rounded, without claw, purple, sometimes white, glabrous on both surfaces, ciliate on the basal margin, with hairs 0.2-0.6 mm long. *Stamens* 10, both whorls bearing anthers; filaments 4.7-8.3 mm long, lanceolate, white, pilose on the abaxial surface, ciliate on the proximal half, with hairs 0.1-0.4 mm long; anthers 2.2-2.5 mm long, yellow or purple. Nectaries 5, hemispheric, with a tuft of hairs at the top, dorsally glabrous. *Gynoecium* 5.6-9.8 mm long, green. *Fruit* 27-34.2 mm long, erect, discharge of seed-ejection type; mericarps 3.5-4.8 mm long, 1.8-2.4 mm wide, without a strand of fibers, not compressed at the apex, smooth, without basal beak, with a basal callus, without a basal prong, brown, with ± patent, eglandular hairs 0.2-0.9 mm long and, patent, glandular hairs 1.1-1.9 mm long; rostrum 17-31 mm long, with a narrowed apex 4.5-7 mm long, not twisted, with erect-patent, eglandular hairs 0.1-0.5 mm long and, rarely, patent, glandular hairs 1-1.2 mm long; stigmatic remnants 1.6-3.6 mm long, with 5 glabrous lobes. *Seeds* 2.3-3.2 mm long, 1.5-1.9 mm wide, reticulate, uniformly colored, brown, glabrous. Cotyledons with entire margin. Figs. 353, 354.

Pollen. *Geranium*-type (Bortenschlager 1967: 427).

Chromosome number. 2*n* = 52.

Phenology. Collected in flower from March to September.

Distribution. This species ranges through central and eastern U.S.A. and southeastern Canada (Fig. 355).

Habitat. Meadows, roadsides, deciduous and evergreen forests; 50-950 m.

Representative specimens examined. **Canada.** Ontario: at road cut-off of highway 401 with Salmon River, 44°12'N, 77°13'W, 30 May 1967, *Baum 67-05-30-0* (DAO); Middlesex Co., Komoka, 42°57'N, 81°26'W, 22 May 1960, *Minshall 4386*

(DAO); Welland Co., Tweleve-mile Creek, 1 mi NE Effingham, 43°4'N, 79°18'W, 19 June 1956, *Fleischmann 88* (DAO). Québec: Vaudreuil Co., Ile Perrot, 45°22'N, 73°57'W, 13 June 1924, *Louis-Marie (père) s.n.* (DAO). **USA.** Alabama: Dekalb Co., N of Fort Payne, 36°26'N, 85°43'W, 27 Apr. 1936, *Svenson 7702* (MO); Talladega Co., by US 280, 1 mi SE Sylacauga, 33°10'N, 86°15'W, 30 Apr. 1972, *Kral 46044* (MO). Arkansas: Garland Co., Crystal Springs, 34°31'N, 93°20'W, 26 Apr. 1941, *Demaree 21977* (MO); Pope Co., Nogo, 35°38'N, 92°52'W, 5 Apr. 1933, *Merrill 129* (MO). Connecticut: Middlesex Co., Middletown, 41°33'N, 72°39'W, 1831 (MO); Tolland Co., Storrs, 41°48'N, 72°15'W, 1905, *Yalkoot* (MO). Delaware: New Castle Co., Greenbank, 39°44'N, 75°38'W, 22 May 1884, *Commons s.n.* (MO). District of Columbia: Washington, 38°53'N, 77°2'W, 20 May 1878, *Chickering s.n.* (MO). Georgia: Bartow Co., small stream E of Allatoona Creek, W of Acworth, 33°57'N, 84°43'W, 17 Apr. 1948, *Duncan 7987* (MO); Washington Co., NW of Tennille, 32°55'N, 83°50'W, 11 Apr. 1904, *Harper 2112* (MO). Illinois: Calhoun Co., Batchtown water tower, 39°1'N, 90°39'W, 17 Apr. 1981, *Ugent & al. 81-12* (MO); Willianson Co., near New Dam Site on Grass Creek at Devils Kitchen, 37°38'N, 89°6'W, 21 Apr. 1941, *McCree 692* (MO). Indiana: Howard Co., 4 mi NW of Kokomo, 40°29'N, 86°8'W, 5 May 1942, *Ek s.n.* (MO); Wells Co., Harrison, 40°41'N, 85°8'W, 14 May 1905, *Deam s.n.* (MO). Iowa: Clayton Co., Osterdock, 42°44'N, 91°9'W, 15 May 1920, *Shimek s.n.* (MO); Webster Co., Woodmans Hollow, 42°25'N, 94°6'W, 30 May 1904, *Churchill 2239* (NEB). Kansas: Cherokee Co., Galena, 37°4'N, 94°37'W, 10 Apr. 1938, *Horr & McGregor E187* (OKL); Wyandotte Co., 39°7'N, 94°43'W, 1897, *Hitchcock 1138* (MO, P). Kentucky: Calloway Co., Backusburg, 36°42'N, 88°28'W, 27 Apr. 1973, *Athey 2242* (MO); Wolfe co., between markers 54 and 55 on Mountain Parkway on S side of road, 37°44'N, 83°29'W, 26 Apr. 1964, *Bevins 77* (MO). Louisiana: Lincoln Co., E of Sugar Creek, 32°42'N, 92°48'W, 7 May 1970, *Thomas 18428* (MO). Maine: York Co., Kennebunkport, 43°21'N, 70°28'W, 7 July 1915, *Pier 86* (MO). Maryland: Baltimore Co., at tributary of Big Gunpowder River, W of Big Falls Road near Monkton, 39°34'N, 76°36'W, 11 May 1981, *Hill 10005* (MO); Prince George's Co., College Park, 38°58'N, 76°56'W, 8 May 1900, *Steward s.n.* (MO). Massachusetts: Berkshire Co., Sheffield, 42°2'N, 73°18'W, 13 June 1919, *Churchill s.n.* (MO); Worcester Co., Lancaster, 42°27'N, 71°40'W, 25 May 1938, *Brown s.n.* (MO). Michigan: Berrien Co., Warren Woods, 41°50'N, 86°37'W, 4 May 1962, *Lowrey s.n.* (NY); Washtenaw Co., Ann Arbor, 42°17'N, 83°44'W, 24 May 1937, *Hermann 8589* (MO). Minnesota: Clay Co., Moorhead, 46°52'N, 96°46'W, 12 July 1912, *Stevens s.n.* (OKL); Sherburne Co., Santiago, 45°32'N, 93°49'W, 12 June 1971, *McCollum 1* (NEB). Mississippi: Montgomery Co., Winona, 33°28'N, 89°43'W, June, *Freiberg s.n.* (MO); Oktibbeha Co., Starkville, 33°27'N, 88°49'W, 5 Apr. 1897, *Tracy s.n.* (MO). Missouri: Howell Co., Tingler Lake Conservation Area, about 7 1/2 mi S of West Plains off Highway 17, 36°36'N, 91°52'W, 3 May 2000, *Summers 9468* (MA); Pulaski Co., SE of Cooksville Ford, 37°50'N, 92°12'W, 4 May 1989, *Ovrebo & Sladewski W0117* (MA). Nebrasca: Brown Co., Long Pine, 42°32'N, 99°42'W, 23 May 1900, *Bates s.n.* (NEB); Lancaster Co., 40°47'N, 96°41'W, 18 June 1909, *Martin s.n.* (NEB). New Hampshire: Cheshire Co., Walpole, 43°8'N, 72°26'W, 23 May 1977, *Boufford 5496* (MO). New Jersey: Camden Co., North Branch of Newton Creek at

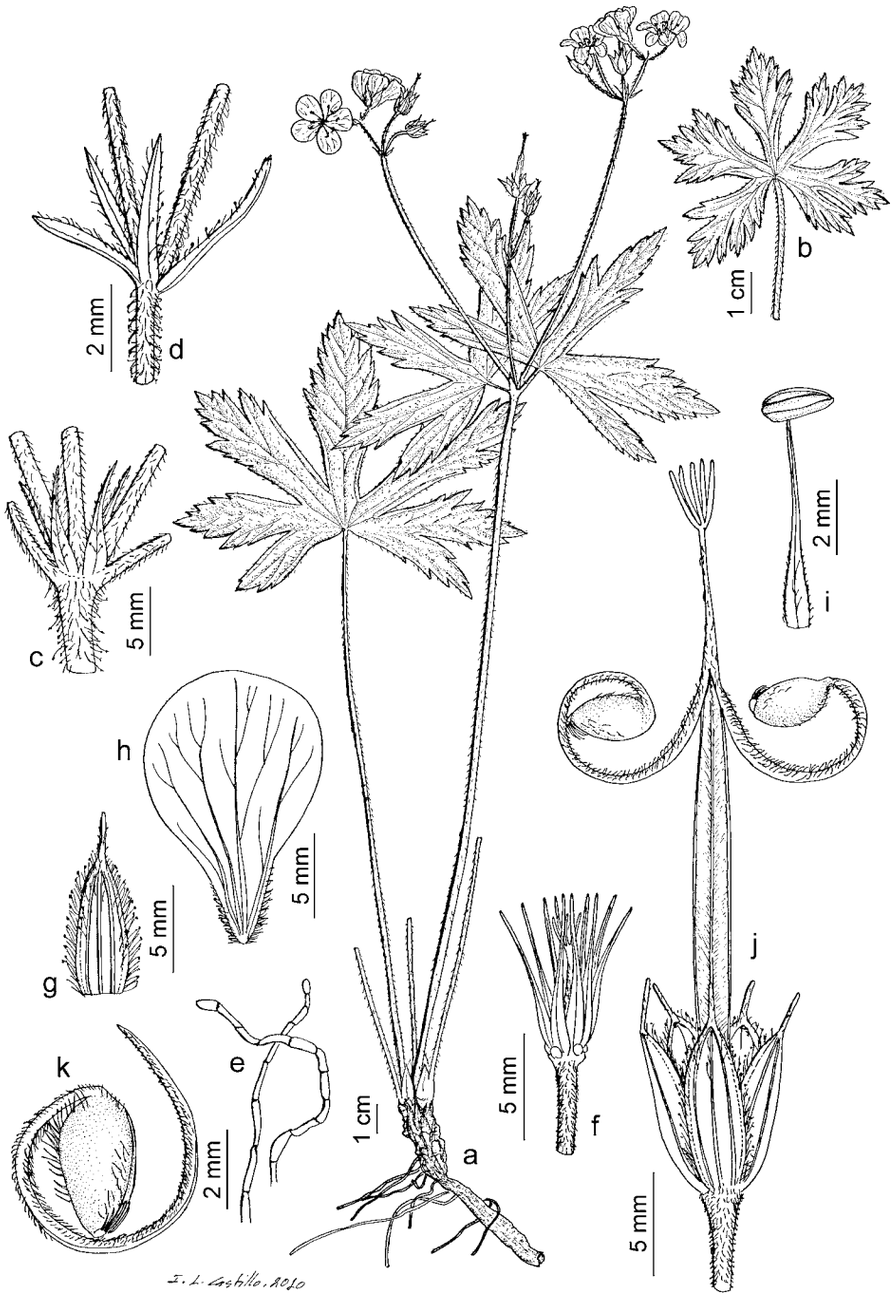


Fig. 353. *Geranium maculatum*. a. Habit. b. Leaf. c. Stipules. d. Bracteoles. e. Stem hairs. f. Flower, petals removed. g. Sepal. h. Petal. i. Stamen. j. Fruit. k. Mericarp. (Based on: a, c, d, *Ovrebo & Sladewski 117*, MA; b, *Ahles 82611*, MA; e-i, *Bennett s.n.*, MA-173703; j-k, *Cavanilles s.n.*, MA-71453).

Fig. 354. *Geranium maculatum* (Based on: *Ulloa 2586,* MO, photo: C. Ulloa).

Fig. 355. Distribution of *Geranium maculatum*.

A.C.R.R., West Collingswood, 39°54'N, 75°7'W, 22 May 1926, *Adams 189* (MO); Union Co., Watchung Reservation Westfield, 25 May 1938, *Drushel 11292* (MO). New York: Albany Co., Loudonville, 42°42'N, 73°45'W, 5 June 1939, *House s.n.* (MO); Tompkins Co., Ithaca, 42°26'N, 76°29'W, 4 June 1891, *Schrenk s.n.* (MO). North Carolina: Jackson Co., SE of hydroelectric plant, S of Tuckasegee, 35°16'N, 83°7'W, 2 May 1991, *Hill 22202* (MO); Pitt Co., Biltmore, 35°36'N, 77°23'W, 11 June 1897, *Chevallier 473b* (P). North Dakota: Cass Co., 1.5 mi N of Fargo, 46°52'N, 96°47'W, 12 June 1970, *Kukla 17* (MO). Ohio: Franklin Co., Columbus, 39°57'N, 83°0'W, 1841, *Gray & Torrey s.n.* (P); Vinton Co., Clinton Twp., lake Alma State Park, W of Little Raccoon Creek, 38°57'N, 82°21'W, 18 Apr. 1965, *O'Dell 113* (MO). Oklahoma: Adair Co., Stilwell, 35°48'N, 94°37'W, 27 Apr. 1968, *Perino & Pierson 184* (OKL); Delaware Co., Dripping ' Springs, 36°10'N, 94°40'W, 6 May 1958, *Wallis 6569* (OKL). Pennsylvania: Chester Co., W Chester, 39°57'N, 75°35'W, *WD s.n.* (P). Rhode Island: Kent Co. Greenwich, 41°40'N, 71°24'W, 27 May 1877, *Congdon s.n.* (P). South Carolina: Aiken Co., Hammond Hills, 33°30'N, 81°59'W, 22 Mar. 1983, *Angerman s.n.* (OKL); Oconee Co., Cleman College, 34°46'N, 83°5'W, 5 Apr. 1906, *House 1772* (MO). Tennessee: Blount Co., Kinzel Spring, 35°41'N, 83°47'W, 25 Apr. 1928, *Anderson s.n.* (MO); Sumner Co., by Bledsoe Creek, 3 mi SSW of Westmoreland, 36°21'N, 86°21'W, 21 Apr. 1975, *Kral 55193* (MO). Vermont: Bennington Co., Pownal, 42°45'N, 73°14'W, 23 May 1962, *Richardson s.n.* (MO); Windham Co., Whitingham, 42°47'N, 72°53'W, 26 July 1915, *Dutton s.n.* (MO). Virginia: Arlington, 38°53'N, 77°5'W, 19 Apr. 1891, *Blanchard s.n.* (MO); Richmond, Westchester Park, 37°33'N, 77°27'W, 13 May 1911, *Churchill s.n.* (MO). West Virginia: Mingo Co., near Varmy school, 37°42'N, 82°9'W, 7 July 1930, *Berkley 975* (MO); Upshur Co., near Buckhannon, 38°59'N, 80°13'W, 10 May 1895, *Pollock s.n.* (MO). Wisconsin: Burnett Co., highway 77 km 35, 45°51'N, 92°23'W, 20 June 1970, *Koch 6759* (NEB); Racine

Co., Caledonia, SW of Five Mile and Short Roads, 42°48'N, 87°55'W, 9 May 1976, *Lorence 1689* (MO).

Discussion. Geranium maculatum has a horizontal rootstock giving rise to an erect aerial stem with a persistent rosette of leaves. The stem is naked up to the first branch point of the inflorescence, where a pair of opposite leaves is always present. The inflorescence is dichasially branched, with 2-flowered cymules on the lower nodes and an aggregate of cymules towards the apex of each branch. In these aggregates the pedicels are usually short or absent. *Geranium maculatum* shows a distinctive indumentum of long glandular hairs ending in a usually reddish narrow cell (this apical cell is of similar width to that of the basal cell). These hairs are always present on sepals and the mericarp apex, usually on stipules and bracteoles, and sometimes on petioles and peduncles. *Geranium maculatum* shows some affinity with *G. sylvaticum* and *G. erianthum*. The three species share a similar rootstock, inflorescence structure, and adaxially glabrous petals. *Geranium maculatum* has nectaries with a tuft of hairs at the apex (not glabrous as in the other two species), and a distinctive glandular indumentum. Additionally, *G. sylvaticum* and *G. erianthum* have cauline alternate leaves, not present in *G. maculatum*. *Geranium maculatum* also shows some similarities with *G. oreganum*. Both species share adaxially glabrous petals, hairy nectaries, and opposite leaves, but *G. oreganum* has longer petals and fruits, and a dense indumentum of glandular hairs on the pedicels (with an apical cell wider than the basal cell). All these species occur allopatrically in North America; *G. maculatum* is the most common perennial species of *Geranium* in the eastern U.S.A. (Jones & Jones 1943: 13).

A detailed account of the life history of *G. maculatum* is provided by Martin (1965). Willson & al. (1979) explored the adaptive aspects of the floral display in *G. maculatum*.

135. Geranium oreganum Howell, Fl. N. W. Amer. 1: 106. 1897. Type locality: "Edge of woods and open places throughout the Willamette valley". Type: U.S.A. Oregon, Pacific Coast Plants, June 1881, *T.J. Howell s.n.* (lectotype, designated by Aedo 2001b: 14, ORE[ex OSC-0000671]!; isolectotype, LE!).

Geranium albiflorum var. *incisum* Nutt. ex Torr. & A. Gray, Fl. N. Amer. 1: 206. 1838. *Geranium hookerianum* var. *incisum* (Nutt. ex Torr. & A. Gray) Walp., Repert. Bot. Syst. 1: 450. 1842. *Geranium incisum* (Nutt. ex Torr. & A. Gray) Howell, Fl. N. W. Amer. 1: 106. 1897, nom. illeg., non Andrews, 1799. *Geranium canum* Rydb. in Underw. & Britton (eds.), N. Amer. Fl. 25(1): 14. 1907. *Geranium viscosissimum* var. *incisum* (Nutt. ex Torr. & A. Gray) N.H. Holmgren, Intermountain Fl. 3A: 332. 1997. Type locality: "Vallies of the Rocky Mountains and Oregon, Nuttall!". Type: U.S.A. Rocky Mountains, Oregon, *T. Nuttall s.n.* (lectotype, designated by Aedo 2001b: 14, BM-000797003!).

Perennial herbs, (15)40-80 cm tall. *Rootstock* 5-8.9 mm in diameter, horizontal, not tuberculate, not turnip-shaped, without thickened roots. *Stem* erect, leafy, not rooting at nodes, stolons absent, without vegetative stems, with patent to retrorse, eglandular hairs 0.2-0.9 mm long. *Basal leaves* in a ± deciduous rosette, cauline leaves opposite; leaf laminas 6-12 cm long, 7-14 cm wide, not peltate, palmatifid [ratio main-sinus length/middle segment length = 0.78-0.90], polygonal in outline, base cordate, not coriaceous, with nerves not projected, pilose, with appressed, eglandular hairs on both surfaces; segments 7, in 1 plane, middle segment rhombic, 5-10 mm wide at the base [ratio segment width at the base/middle segment length = 0.08-0.15], 9-19-lobed in distal half [ratio secondary sinus length/middle segment length = 0.18-0.38]; petioles up to 35 cm long, without abscission zone, terete, not swollen, not deflexed in age, with patent to retrorse, eglandular hairs 0.2-0.7 mm long; stipules 8-12 mm long, 2-3 mm wide, lanceolate, free, papery, brownish red, with eglandular hairs on abaxial surface and on the margin, glabrous adaxially. *Inflorescence* a dichasial cyme; cymules 2-flowered, solitary or, rarely, in aggregates at the top of each branch [ratio cymule length/leaf length = 3.3-4.9]; peduncles 45-110 mm long, with patent to retrorse, eglandular hairs 0.2-0.9 mm long and patent, glandular hairs 0.3-1.1 mm long; bracteoles 4-7 mm long, 1-1.3 mm wide, lanceolate, whorled; pedicels absent or 10-35 mm long, with patent to retrorse, eglandular hairs 0.2-0.7 mm long and patent, glandular hairs 0.3-1.1 mm long. Flowers actinomorphic. *Sepals* 8.6-11 mm long, 3.6-5 mm wide, lanceolate, smooth, not accrescent, nerves 3-5, mucro 1.5-2 mm long [ratio mucro length/sepal length = 0.19-0.24], with patent, eglandular hairs 0.2-0.6 mm long and patent, glandular hairs 0.3-0.7 mm long on the abaxial surface, glabrous adaxially. *Petals* 13-24 mm long, 12-21 mm wide, erect-patent, rounded or slightly emarginate (notch ca. 0.5 mm deep), without claw, purple, glabrous on both surfaces, ciliate on the basal margin, with hairs 0.5-1.1 mm long. *Stamens* 10, both whorls bearing anthers; filaments 8-10.8 mm long, lanceolate, yellow, pilose on the abaxial surface, ciliate on the proximal half, with hairs 0.2-0.6 mm long; anthers 2.5-3 mm long, yellow. Nectaries 5, hemispheric, with a tuft of hairs at the top, dorsally glabrous. *Gynoecium* 6.9-10 mm long, purple. *Fruit* 35-52 mm long, erect, discharge of seed-ejection type; mericarps 4.5-5 mm long, 2.5-3 mm wide, without a strand of fibers, not compressed at the apex, smooth, without basal beak, with a basal callus, without a basal prong, brown, with ± patent, eglandular hairs 0.1-0.3 mm long and patent, glandular hairs 0.3-0.8 mm long; rostrum 27-44 mm long, with a narrowed apex 4-6 mm long, not twisted, with patent, eglandular hairs 0.1-0.4 mm long and patent, glandular hairs 0.3-0.8 mm long; stigmatic remnants 3-6 mm long, with 5 glabrous lobes. *Seeds* 2.8-3 mm long, 2-2.1 mm wide, reticulate, uniformly colored, brown, glabrous. Cotyledons with entire margin. Fig. 356.

Pollen. *Geranium*-type (Aedo 2001a: 17).

Chromosome number. Unknown.

Phenology. Collected in flower from March to October.

Distribution. This species ranges from southern Washington and Oregon to northern California, in northwestern U.S.A. (Fig. 357).

Habitat. Roadsides, moist meadows, slopes, deciduous and evergreen forests; 50-1500 m.

Additional specimens examined. **USA.** California: Humboldt Co., Hubbard's Station, 40°12'N, 123°44'W, 10 June 1899, *Burtt Davy 5393* (UC); Humboldt Co., Middle Yager Creek, 40°34'N, 123°55'W, 18 June 1922, *Tracy 6094* (UC); Humboldt Co., Trinity River, near Willow Creek, 40°56'N, 123°37'W, 4 July 1911, *Tracy 3287* (UC); Humboldt Co., Trinity River, South Fork, 40°20'N, 123°54'W, 27 Apr. 1924, *Tracy 6663* (UC); Siskiyou Co., Hupa Indian Reservation, 41°4'N, 123°48'W, June, *Chandler 1272* (UC); Siskiyou Co., Mt. Shasta, Sisson, 41°24'N, 122°12'W, 13 July 1902, *Setchell s.n.* (UC); Siskiyou Co., Siskiyou mountains, 41°50'N, 123°40'W, July, *Brandegee s.n.* (UC). Oregon: Benton Co., 44°29'N, 123°25'W, June, *Standlee s.n.* (OSC); Benton Co., Corvallis vicinity, MacDonald Forest, 44°33'N, 123°15'W, 3 June 1989, *Chambers 5455* (OSC); Benton Co., NE Corvallis, W of Canterbury Circle, area around Frazier Creek, 44°36'N, 123°19'W, 18 May 1980, *Halse 2178* (OSC); Benton Co., near Corvallis, 44°35'N, 123°16'W, 4 Oct. 1919, *Luedinghaus s.n.* (MO); Benton Co., near Corvallis, 44°35'N, 123°16'W, 31 May 1892, *Mulford s.n.* (MO); Benton Co., SW of Corvallis, 44°35'N, 123°16'W, 16 May 1999, *Halse 5533* (MA); Clackamas Co., Estacada, 45°17'N, 122°19'W, 2 July 1905, *Lyon 112* (F); Douglas Co., Canyonville, 42°55'N, 123°16'W, 7 May 1940, *Gould 1089* (UC); Douglas Co., Thicket 3 mi W Coos junction, 43°25'N, 124°13'W, 27 June 1939, *Peck 20277* (OSC); Jackson Co., 29 mi S of Prospect, 42°45'N, 122°29'W, 3 July 1936, *Thompson 13087* (MO); Jackson Co., Cascade Mts., Jenny Creek, 41°58'N, 122°24'W, 21 June 1925, *Applegate s.n.* (OSC); Jackson Co., Elk Creek into Rogue River, 42°39'N, 122°45'W, 10 June 1930, *Henderson 12973* (OSC); Jackson Co., Grizzly Peak, 42°16'N, 122°37'W, 21 June 1925, *Applegate s.n.* (OSC); Jackson Co., Lily Glen Campground at Howard Prairie Lake on Dead Indian Rd., 42°13'N, 122°22'W, 20 July 1975, *Crosby 316* (OSC); Jackson Co., N of Siskiyou Inn., 42°4'N, 122°36'W, 13 June 1930, *Henderson 12975* (OSC); Jackson Co., Trail, 42°40'N, 122°50'W, 3 June 1924, *Shevwood 806* (OSC); Jackson Co., W Fork Trail Creek, 42°40'N, 122°50'W, 14 May 1954, *Detling 7430* (OSC); Jackson Co., Wimer, 42°32'N, 123°8'W, 23 May 1893, *Hammond 63* (UC); Klamath Co., 8 mi W of Lake of the Woods, 42°22'N, 122°14'W, 5 July 1931, *Peck 16672* (OSC); Klamath Co., Fort Klamath, 42°42'N, 121°59'W, 17 July 1970, *Peck 9560*

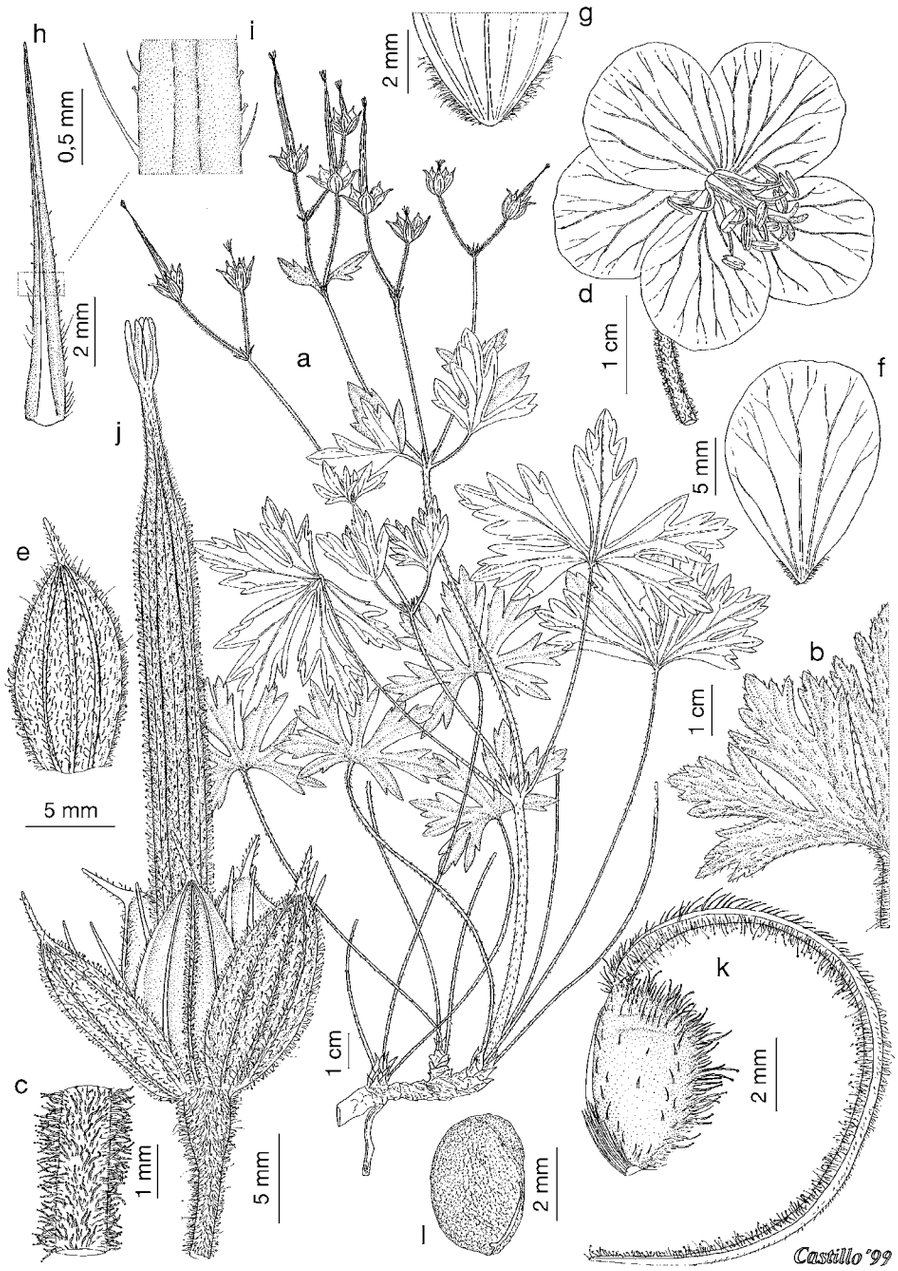


Fig. 356. *Geranium oreganum*. a. Habit. b. Portion of leaf. c. Peduncle. d. Flower. e. Sepal. f. Petal. g. Base of petal. h. Staminal filament. i. Details of staminal filament. j. Fruit. k. Mericarp. l. Seed. (Based on: a-i, *Henderson 12973*, OSC; j-l, *Leach 236*, OSC).

Fig. 357. Distribution of *Geranium oreganum*.

(MO); Klamath Co., Jack Springs, 42°37'N, 122°4'W, 16 June 1931, *Evans 219* (OSC); Lane Co., at junction of Lorane Highway and Cret Drive, 3 mi SW of Eugene, 44°3'N, 123°5'W, 5 July 1934, *Constance 941* (MO); Lane Co., E of Eugene, 44°3'N, 123°5'W, 10 Mar. 1934, *Ontrank s.n.* (OSC); Lane Co., Eugene, 44°3'N, 123°5'W, 27 June 1927, *Leach 236* (OSC); Lane Co., near the Good Bridge over Lower Big Fall Bridge, 43°58'N, 122°52'W, 28 May 1938, *Henderson 18678* (OSC); Lane Co., Spencers Butte, 43°58'N, 123°8'W, 24 June 1930, *Henderson 1270* (OSC); Linn Co., 2 mi NW Peterson Butte, 44°30'N, 122°58'W, 23 May 1966, *Hitchcock 24403* (UC); Linn Co., Crawfordsville, 44°21'N, 122°51'W, 14 June 1931, *Henderson 13642* (OSC); Marion Co., Salem, 44°55'N, 123°1'W, 14 June 1909, *Peck 4770* (OSC); Marion Co., Salem, 44°55'N, 123°1'W, *Reynolds 8972* (OSC); Marion Co., Silver Creek, 45°0'N, 122°50'W, 1871, *Hall 73* (F); Multnomah Co., Eln Is. near Portland, Lake Bene Mts., 45°30'N, 122°35'W, 12 June 1886, *Henderson 158* (MO); Washington Co., Beaverton, 45°29'N, 122°48'W, 15 May 1916, *Sisters of St Mary s.n.* (UC); Washington Co., near Aloha, 45°29'N, 122°51'W, 26 May 1928, *Thompson 4275* (MO); Washington Co., near Forest Grove, 45°31'N, 123°6'W, 10 May 1926, *Thompson 584* (MO); Washington Co., Sherwood, 45°21'N, 122°50'W, 29 May 1951, *Hitchcock 19283* (UC). Washington: Creek Co., Lacamas Creek, 45°35'N, 122°23'W, 1936, *Jones s.n.* (ILL).

Discussion. Geranium oreganum is a robust species similar to the sympatric *G. richardsonii* and *G. viscosissimum*, but it is easily distinguished from these species by its long, glabrous petals. It resembles other perennial species in the Rocky Mountains in its inflorescence structure leaf form and arrangement, and fruit characters. Differences between *G. oreganum* and *G. maculatum* are addressed in the discussion of the latter species. In *G. oreganum* glandular hairs are always present on the inflorescence, sepals, and mericarps; they are similar to glandular hairs of *G. richardsonii* and *G. viscosissimum*, but shorter than in *G. maculatum* and terminate in a broad, usually red cell. Records of this species from Canada (Douglas & al. 1989: 51; Scoggan 1978: 1046) are probably errors for *G. viscossisimum* or *G. ibericum* (Aedo 2001b: 16).

The Mexicanum Group—This group is characterized by its usually erect or ascending habit, its sometimes turnip-shaped rootstock, its usually opposite, palmatifid leaves and its 2-flowered cymules arranged in dichasial inflorescence. The petals are of medium size, erect-patent, without claw, and hairy only on the base.

136. Geranium mexicanum Kunth in Humb., Bonpl. & Kunth, Nov. Gen. Sp. 5: 230. 1822. *Geranium hirtum* Willd. ex Spreng., Syst. Veg. 3: 72. 1826, nom. illeg., non Burm. f. 1759, nec Forssk. 1775. Type locality: "Crescit inter Guanaxuato et Santa Rosa Mexicanorum, alt. 1440 hex.". Type: Mexico. Guanajuato, inter Guanaxuato et Santa Rosa, 21°09'N, 101°06'W, *F.A. Humboldt & A. Bonpland s.n.* (lectotype, designated by Moore 1943: 36, P-00136930!).

Geranium resimum Small in Underw. & Britton (eds.), N. Amer. Fl. 25(1): 12. 1907. *Geranium mexicanum* var. *resimum* (Small) H.E. Moore, Contr. Gray Herb. 146: 36. 1943. Type locality: "Type collected between Santa Gertrudis and Santa Teresa, Tepic, Mexico, August 8, 1897, J. N. Rose 2070". Type: Mexico. Nayarit, between Santa Gertrudis and Santa Teresa, Tepic, 22°26'N, 104°44'W, 8 Aug. 1897, *J.N. Rose 2070* (holotype, NY-00373679!; isotypes, F, US-00100945 image!).

Geranium temascaltepecense R. Knuth, Bull. Misc. Inform. 1937(10): 503. 1937. Type locality: "State of Mexico. Discrict of Temascaltepec: Las Mesas, 2000 m., Aug. 1932, Hinton 1327 (typus in herb. Kew.); Nanchititla, in oak woods, Aug. 1933, Hinton 4533, flowers pink, milky sap". Type: Mexico. Mexico, Temascaltepec, Las Mesas, 19°01'N, 99°58'W, 14 Aug. 1932, *G.B. Hinton 1327* (holotype, K-000190050!; isotypes, BM-000797018!, F!, G-00388783!, GH, LL, MO-060361!, NY-00373681!, US image!).

Perennial herbs, 23-56(70) cm tall. *Rootstock* 4.8-16.3 mm in diameter, vertical, not tuberculate, turnip-shaped, without thickened roots. *Stem* ascending to erect, leafy, not rooting at nodes, stolons absent, without vegetative stems, with patent to retrorse, eglandular hairs 0.1-1 mm long and rarely patent, glandular hairs 0.3-0.4 mm long. *Basal leaves* in a persistent rosette, cauline leaves alternate (usually 1) in middle of shoot and upper opposite; leaf laminas 3.5-8.5 cm long, 4.1-9.6 cm wide, not peltate, palmatifid [ratio main-sinus length/middle segment length = 0.75-0.96], polygonal in outline, base cordate, not coriaceous, with nerves not projected, pilose on both surfaces, with appressed, eglandular hairs; segments 5, in 1 plane, middle segment rhombic, 3.8-9.8 mm wide at the base [ratio segment width at the base/middle segment length = 0.10-0.33], 5-11(19)-lobed in distal half [ratio secondary sinus length/middle segment length = 0.13-0.37]; petioles up to 29 cm long, without abscission zone, terete, not swollen, not deflexed in age, with patent to retrorse, eglandular hairs 0.2-1 mm long; stipules 2.4-6.9 mm long, 0.9-2.3 mm wide, lanceolate, free, papery, brownish red, with eglandular hairs on both surfaces and on the margin. *Inflorescence* a dichasial cyme; cymules 2(4)-flowered, solitary [ratio cymule length/leaf length = 1.3-6.3]; peduncles (105)119-170(235) mm long, with patent to retrorse, eglandular hairs 0.2-0.8 mm long and, usually, patent, glandular hairs 0.3-0.7 mm long; bracteoles 2.6-7 mm long, 0.4-1.3 mm wide, lanceolate, whorled; pedicels 27-87 mm long, with patent to retrorse, eglandular hairs 0.1-0.5 mm long and patent, glandular hairs 0.3-0.6 mm long. Flowers actinomorphic. *Sepals* (5.8)6.5-8.3(9.9) mm long, 2.3-5 mm wide, lanceolate, smooth, not accrescent, nerves 3-5, mucro 0.8-2.2 mm long [ratio mucro length/sepal length = 0.10-0.28], with antrorse to patent, eglandular hairs 0.3-0.7 mm long and patent, glandular hairs 0.3-0.8 mm on the abaxial surface, glabrous adaxially. *Petals* 11-16.1(18.1) mm long, 6.5-11.3 mm wide, erect-patent, rounded, without claw, purple, hairy on the base of the adaxial surface, ciliate on the basal

margin, with hairs 0.4-0.9 mm long. *Stamens* 10, both whorls bearing anthers; filaments 3.3-7.7 mm long, lanceolate, yellow, pilose on the abaxial surface, ciliate on the proximal half, with hairs 0.4-0.8 mm long; anthers 1.4-2.8 mm long, yellow. Nectaries 5, hemispheric, glabrous. *Gynoecium* 4.4-8.1 mm long, yellow. *Fruit* 19.3-39.1 mm long, erect, discharge of seed-ejection type; mericarps 3.6-5.3 mm long, 2-3.3 mm wide, without a strand of fibers, not compressed at the apex, smooth, without basal beak, with a basal callus, without a basal prong, brown, with erect-patent, eglandular hairs 0.4-0.8 mm long and patent, glandular hairs 0.4-0.7 mm long; rostrum (11.1)18-26.9 mm long, with a narrowed apex (0.9)1.1-2.9 mm long, not twisted, with ± patent, eglandular hairs 0.2-0.9 mm long and patent, glandular hairs 0.4-0.6 mm long; stigmatic remnants 2.4-4.7 mm long, with 5 glabrous lobes. *Seeds* 2.5-3.4 mm long, 2-2.8 mm wide, finely reticulate, uniformly colored, brown, glabrous. Cotyledons with entire margin. Fig. 358.

Pollen. *Geranium*-type (Bortenschlager 1967: 433).

Chromosome number. Unknown.

Phenology. Collected in flower from June to October.

Distribution. This species ranges through central and western Mexico (Fig. 359).

Habitat. Roadsides, meadows, shrub-covered slopes, and *Acacia* Mill., *Pinus* L., and *Quercus* L. forests; 1850-2850 m.

Additional specimens examined. **Mexico.** Aguascalientes: Sierra del Laurel, cerca de Calvillo, 21°50'N, 102°43'W, 27 Aug. 1960, *Rzedowski 14079* (MEXU); San José de Gracia, Mesa Montoro, La Escondida, 22°0'N, 102°35'W, 18 Aug. 1997, *García 3959* (MEXU); 12 km SW de La Congoja, San José de Gracia, 22°24'N, 102°19'W, 16 Oct. 1973, *Rzedowski & McVaugh 749* (MICH). Durango: 48 km WNW of Huejuquilla El Alto, Jalisco on road to Canoas, Mezquital, Durango, 22°53'N, 104°14'W, 21 Oct. 1983, *Breedlove 59006* (CAS); Cerro Blanco, Sierra de Michis, a 52 km al SW de Ciudad de Vicente Guerrero, Cer-

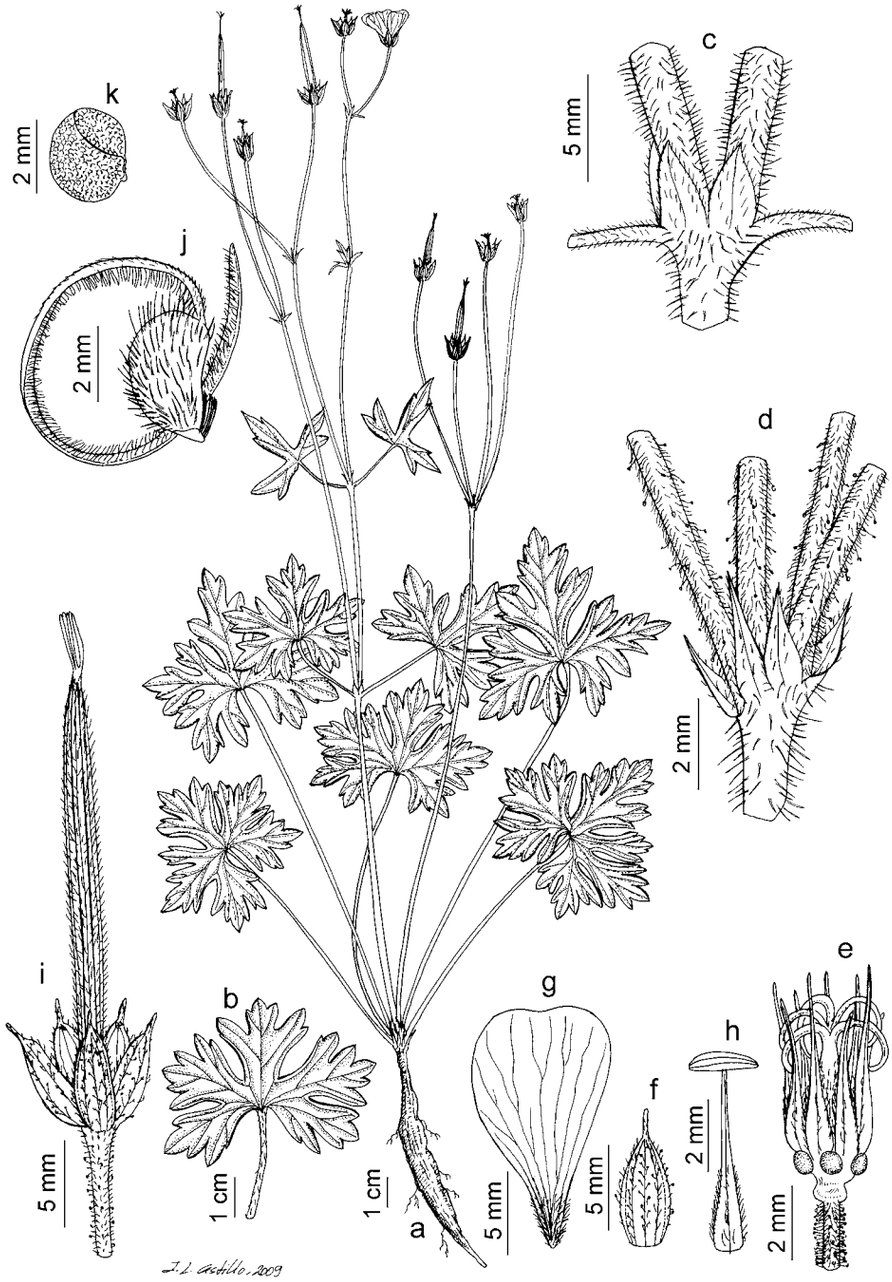


Fig. 358. *Geranium mexicanum*. a. Habit. b. Leaf, adaxial side. c. Stipules. d. Bracteoles. e. Flower, sepals and petals removed. f. Sepal. g. Petal, adaxial side. h. Stamen. i. Fruit. j. Mericarp. k. Seed. (Based on: a-d, *Moore & Wood 4775*, GH; e-h, *Breedlove & Anderson 64382*, CAS; i-k, *Bartholomew & al. 2921*, CAS).

Fig. 359. Distribution of *Geranium mexicanum*.

ro de los Magueycitos, 23º26'N, 104º7'W, 29 Sep. 1975, *Hernández & al. 208* (MEXU); S of Puerto Buenos Aires along Mexican highway 40, between Mazatlan and Durango, 23º41'N, 105º43'W, 24 Aug. 1986, *Breedlove & Anderson 63059* (CAS); 65-75 km SW of Durango city on road to La Flor, 23º51'N, 105º11'W, 17 Sep. 1979, *Breedlove 44236* (CAS). Guanajuato: between Valenciana and Santa Rosa, km 17-18 to Dolores Hidalgo, 21º4'N, 101º12'W, 29 Aug. 1948, *Moore & Wood 4775* (GH); Santa Rosa, 21º9'N, 101º6'W, *Humboldt & Bonpland s.n.* (P); 12 mi on road between Guanajuato and Santa Rosa, 21º9'N, 101º6'W, 29 Sep. 1946, *Moore 1329* (GH); San Felipe, 25 km al NNE de León, 21º17'N, 101º31'W, 8 Aug. 1987, *Galván & Galván 2810* (NY). Guerrero: Taxco de Alarcón, Taxco, 4 km N, Cerro El Huizteco, 18º35'N, 99º38'W, 27 Sep. 1988, *Lorea 4461* (XAL); Taxco de Alarcón, Taxco, 6 km NW, rumbo a Los Cajones, 18º35'N, 99º38'W, 30 June 1997, *Soto 3693* (MEXU). Jalisco: Gómez Farias, 16 km NE de Ciudad Guzmán, carretera a San Andrés y brecha a Paso Hondo, 19º42'N, 103º31'W, 4 Aug. 1988, *Garza 425* (IEB); Cerro de Talcozagua, on Sierra de Tapalpa, 2 km E of Tapalpa, 19º57'N, 103º45'W, 5 Aug. 1960, *Iltis & al. 802* (MEXU); San Martín de Bolaños, Las Vidrieras, 10 km al NW de El Platanar, 21º41'N, 103º49'W, 1 Sep. 1968, *Rzedowski 26149* (CAS); San Martín de Bolaños, Las Treinta Vueltas, 10 km NW de El Platanar, 21º41'N, 103º49'W, 2 Sep. 1968, *Rzedowski 26221* (MEXU, MICH); Bolaños, cañada 1.5 km W de las Berenjenas, 2-3 km al W de las Berenjenitas, 7-8 km W del Crucero Las Vidrieras, 10 km al NW de El Platanar, 21º52'N, 103º55'W, 2 July 1996, *Soto & al. 2436* (MEXU). Mexico State: Tejupilco de Hidalgo, top of Mesa de Nanchititla, 21.8 km W of Estanco and between km 15 and 16 on the Salitre to Canada de Nanchititla road, 18º52'N, 100º28'W, 11 Oct. 1985, *Bartholomew & al. 2921* (CAS, GH, MEXU, NY); Temascaltepec, Cucha, 18º59'N, 99º59'W, 5 Aug. 1934, *Hinton 6393* (BM, GH); Temascaltepec, Las Mesas, 19º1'N, 99º58'W, 15 Aug. 1935, *Hinton 7996* (GH, NY, PH, W). Michoacán: Coalcomán, Sierra Torricillas, 18º47'N, 103º9'W, 11 Oct. 1938, *Hinton 12347* (F, GH, NY); Coalcomán, Sierra Torricillas, 18º47'N, 103º9'W, 18 Oct. 1938, *Hinton 12409* (GH, NY); 32 km SE of Puerto Las Cruces, N of Coalcoman along road to Dos Aguas, Sierra de Coalcoman, 18º48'N, 103º0'W, 17 Sep. 1986, *Breedlove & Anderson 64382* (CAS); 48 kms from Patzcuaro on road to Tacambaro, 19º15'N, 101º28'W, 2 Sep. 1948, *Moore & Wood 4848* (GH); Morelia, Cañada Norte, Pico Azul, 19º43'N, 100º40'W, 31 Aug. 1988, *Medina 1303a* (MEXU). Nayarit: La Yesca, Sierra de Alica, paraje Bajio de las Palas, 21º42'N, 104º23'W, 20 July 1996, *Cházaro & García 7628* (IEB, NY); La Ciénaga, on ridge about 10 mi NW of Mesa del Nayar, 22º5'N, 104º39'W, 30 July 1970, *Norris & Taranto 14566* (MICH); El Nayar, from Mesa del Nayar to Santa Teresa, 22º20'N, 104º39'W, 12 Aug. 1980, *Breedlove & Almeda 45443* (CAS); 105 km WNW of Huejuquilla el Alto along road to Jesus María near side road to Santa Lucía de la Sierra, 22º46'N, 104º55'W, 9 Sep. 1984, *Breedlove 61453* (CAS, MEXU). Zacatecas: 17 km S of Sierra de los Morones, on Sierra de Cicacalco, near ranch Palos Altos, 21º43'N, 103º19'W, 23 July 1976, *Correa 115* (MICH).

Discussion. Geranium mexicanum has a vertical, turnip-shaped rootstock. The ascending aerial stem usually has one alternate leaf near the base or the middle, and 2-3 pairs of opposite, reduced cauline leaves distally. In some specimens, or at least in some herbarium fragments, this alternate leaf is not present. The inflorescence is terminal and dichotomously branched, although some cymules are borne directly on the rootstock. Among the most noticeable features of this species are its long peduncles and pedicels. Cymules of *G. mexicanum* are usually 2-flowered, although frequently cymules with 2, 3, or 4 flowers are found on the same specimen. The indumentum of *G. mexicanum* consists of eglandular hairs scattered on the stem, leaves, and inflorescence, and of glandular hairs usually restricted to the inflorescence. The glandular indumentum varies sometimes in the same specimen, and some cymules have few or no glandular hairs. *Geranium mexicanum* shares with *G. lozanoi* a general appearance, inflorescence structure, and leaf shape; however, *G. lozanoi* never has a glandular indumentum, and the eglandular hairs are short and retrorse-appressed (in *G. mexicanum* eglandular hairs are usually patent). *Geranium mexicanum* may be distinguished from *G. lozanoi* also by the shorter narrowed apex of the rostrum, petals, and sepals. Additionally, the petals are purplish in *G. mexicanum* and white in *G. lozanoi*. As Moore (1943: 36) pointed out, some herbarium specimens of *G. seemannii*, a species well characterized by its short petals, were mislabeled as *G. mexicanum*.

The name *Geranium hirtum* Willd. ex Sprengel (1826: 72) is superfluous, because *G. mexicanum* Kunth was listed as a synonym in the protologue. It is also a later homonym. The epithet "hirtum" was used in *Geranium* by Burman (1759: 48) to name a taxon now transferred to *Pelargonium* L'Hér., and by Forsskål (1775: 123) for another taxon now transferred to *Erodium* L'Hér. Curiously, Knuth (1912: 147) applied *G. hirtum* Spreng. to collections from Colombia that are here included in *G. killipii*.

137. Geranium lozanoi Rose, Contr. U.S. Natl. Herb. 10(3): 108. 1906, ["lozani"]. Type locality: "U. S. National Herbarium no. 461465, collected by C. G. Pringle and F. Lozano near Buena Vista Station, Hidalgo, altitude 2,550 meters, 1904 (no. 8994)". Type: Mexico. Hidalgo, Buena Vista Station, 19°59'N, 98°33'W, 6 Aug. 1904, *C.G. Pringle & F. Lozano 8994* (holotype, US-461465 image!; isotypes, BM!, CSPU, F!, GH, GOET, K!, LE!, NY!, P-00700630!, PR-375710!, UC-137764 image!, W!).

Perennial herbs, 31-43 cm tall. *Rootstock* 5-10 mm in diameter, ± vertical, not tuberculate, turnip-shaped, without thickened roots. *Stem* ascending to erect, leafy, not rooting at nodes, stolons absent, without vegetative stems, with retrorse, appressed, eglandular hairs 0.2-0.5 mm long. *Basal leaves* in a persistent rosette, cauline leaves opposite; leaf laminas 3.6-7 cm long, 4.3-8.8 cm wide, not peltate, palmatifid [ratio main-sinus length/middle segment length = 0.76-0.89], polygonal in outline, base cordate, not coriaceous, with nerves not projected, pilose on both surfaces, with appressed, eglandular hairs; segments 5, in 1 plane, middle segment rhombic, 2.8-9.1 mm wide at the base [ratio segment width at the base/

middle segment length = 0.10-0.34], 9-16(23)-lobed in distal half [ratio secondary sinus length/middle segment length = 0.32-0.49]; petioles up to 21 cm long, without abscission zone, terete, not swollen, not deflexed in age, with retrorse, appressed, eglandular hairs 0.2-0.4 mm long; stipules 3.5-7 mm long, 1.4-3.4 mm wide, lanceolate, free, papery, brownish red, with eglandular hairs on abaxial surface and on the margin, usually glabrous adaxially. *Inflorescence* a dichasial cyme; cymules 2-flowered, solitary [ratio cymule length/leaf length = 1.5-3.9]; peduncles (94)118-170(285) mm long, with retrorse, appressed, eglandular hairs 0.1-0.5 mm long; bracteoles 4.2-7.6 mm long, 0.7-1.4 mm wide, lanceolate, whorled; pedicels 32-81 mm long, with retrorse, appressed, eglandular hairs 0.1-0.6 mm long. Flowers actinomorphic. *Sepals* (7.5)8.4-10.2(12.4) mm long, 3.4-5.7 mm wide, lanceolate, smooth, not accrescent, nerves 3-5, mucro 0.7-2.5 mm long [ratio mucro length/sepal length = 0.09-0.26], with antrorse, ± appressed, eglandular hairs 0.3-1.2 mm long on the abaxial surface, glabrous adaxially. *Petals* 18.4-21.4(23.5) mm long, 9.8-14.7 mm wide, erect-patent, rounded or slightly emarginate (notch 0.4-0.7 mm deep), without claw, white, hairy on the base of the adaxial surface, ciliate on the basal margin, with hairs 0.7-1 mm long. *Stamens* 10, both whorls bearing anthers; filaments 7.7-10.4 mm long, lanceolate, yellow, pilose on the abaxial surface, ciliate on the proximal half, with hairs 0.2-1.6 mm long; anthers 2.3-2.6 mm long, yellow. Nectaries 5, hemispheric, glabrous. *Gynoecium* 8.6-10.9 mm long, unknown color. *Fruit* 28.3-40.4 mm long, erect, discharge of seed-ejection type; mericarps 4-5.5 mm long, 2.1-2.3 mm wide, without a strand of fibers, not compressed at the apex, smooth, without basal beak, with a basal callus, without a basal prong, brown, with erect-patent, eglandular hairs 0.3-0.6 mm long; rostrum 17.4-27.4 mm long, with a narrowed apex 2.3-4.2 mm long, not twisted, with ± patent, eglandular hairs 0.1-0.6 mm long; stigmatic remnants 4.6-7.3 mm long, with 5 glabrous lobes. *Seeds* 2.8-2.9 mm long, 2.2-2.4 mm wide, finely reticulate, uniformly colored, brown, glabrous. Cotyledons with entire margin. Fig. 360.

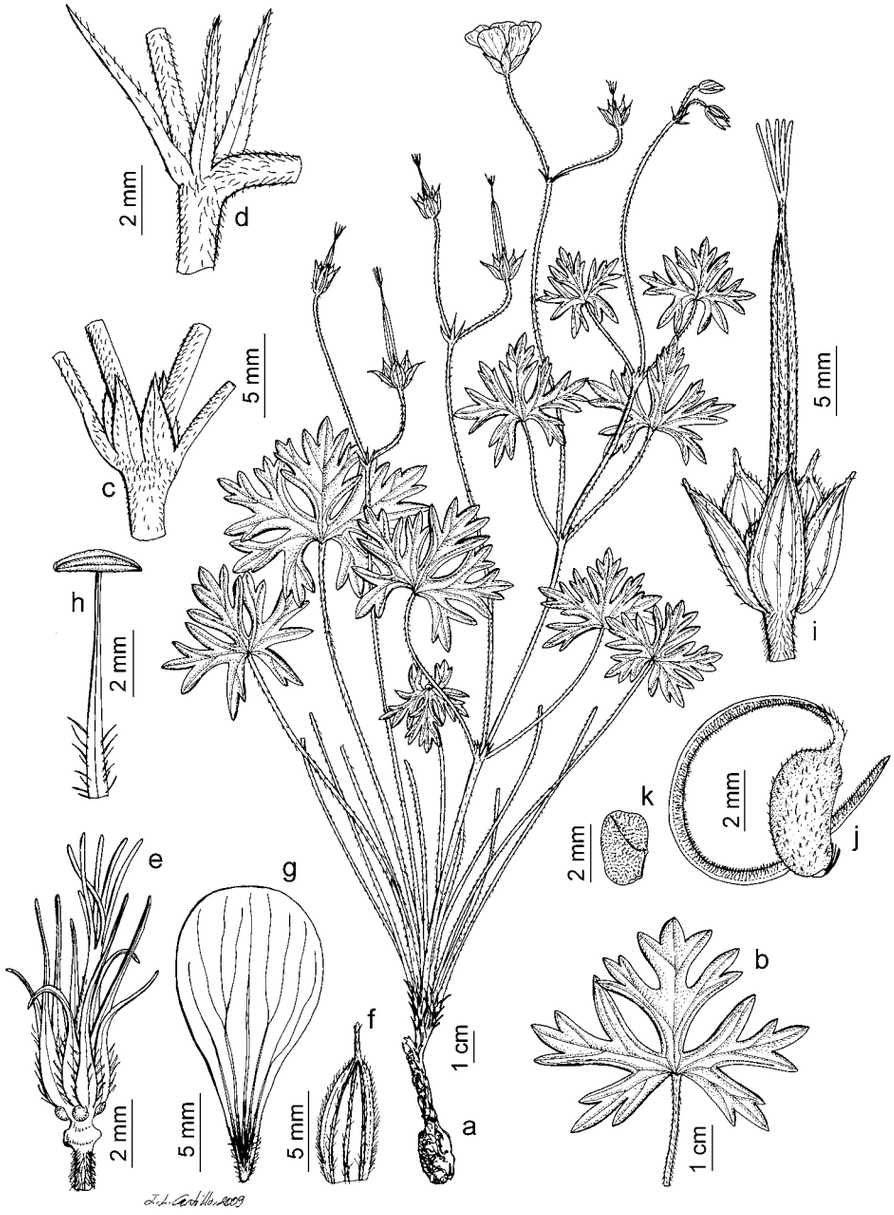


Fig. 360. *Geranium lozanoi*. a. Habit. b. Leaf, adaxial side. c. Stipules. d. Bracteoles. e. Flower, sepals and petals removed. f. Sepal. g. Petal, adaxial side. h. Stamen. i. Fruit. j. Mericarp. k. Seed. (Based on: a, c, d, i-k, *Pringle 8994*, P; b, *Moore & Wood 4881*, GH; e-h, *Moore 3505*, GH).

Fig. 361. Distribution of *Geranium lozanoi*.

Pollen. Ornamentation not studied.

Chromosome number. Unknown.

Phenology. Collected in flower from July to September.

Distribution. This species is endemic to southern Hidalgo, in central Mexico (Fig. 361).

Habitat. Roadsides, furrows of corn fields, and meadows; 2300-2800 m.

Additional specimens examined. **Mexico.** Hidalgo: near Hacienda Cuyamaloya, 20º2'N, 98º32'W, 31 July 1947, *Moore 3505* (GH); between Somoriel and Las Lajas, 20º2'N, 98º29'W, 5 Aug. 1905, *Rose & al. 9208* (NY, P); Tulancingo, between rancho San Alejo and Santa Ana on road to Agua Blanca, 20º7'N, 98º19'W, 7 Sep. 1948, *Moore & Wood 4881* (GH, MEXU).

Discussion. Geranium lozanoi is quite similar to *G. mexicanum* in general appearance but with longer, white petals and an eglandular indumentum. Other differences are discussed under *G. mexicanum*, an allopatric species ranging from Guanajuato to southern Durango. *Geranium lozanoi* is known only from southwestern Hidalgo; I did not locate the specimen *Arsène s.n.* (F) from northern Michoacán cited by Moore (1943: 49). *Geranium lozanoi* has sometimes been confused with *G. schiedeanum*, a sympatric species that is widespread in central Mexico. Both species share deeply divided leaves and long peduncles; however, the petals of *G. lozanoi* are white and longer (with some overlap). Although *G. schiedeanum* sometimes has white petals, this variation seems to be restricted to populations in Guerrero and Oaxaca, 250 km south of the range of *G. lozanoi*. Leaves of *G. lozanoi* are longer than those of *G. schiedeanum*, with wider lobes and middle segment base. Sepals and staminal filaments are longer, and the sepal mucro is shorter, in *G. lozanoi* than in *G. schiedeanum*. According to Moore (1943: 50), *G. lozanoi* is characterized by its sparse, very short, almost scale-like hairs. *Geranium schiedeanum* has longer (with some overlap) and more abundant hairs on stem, petioles, and inflorescences, but it is difficult to differentiate the shapes of eglandular hairs in both species. These hairs may be included in the "subulate" type of Payne (1978), which is common in *Geranium*. In *G. schiedeanum* some hairs have a circular basal portion and others a narrowly elliptic one. The second type appears under the microscope as "plane" or "scale-like", particularly if it is very short. In *G. lozanoi* most of the hairs seem to be of this second type.

138. Geranium crenatifolium H.E. Moore, Contr. Gray Herb. 146: 38. 1943. *Geranium crenatum* S. Watson, Proc. Amer. Acad. Arts 17: 334. 1882, nom. illeg., non Andrews, 1805. Type locality: "At Lerios, Coahuila (136)" ["collected chiefly by Dr. E. Palmer..."]. Type: Mexico. Coahuila, Lerios, 15 leagues E of Saltillo, 25°27'N, 100°41'W, 1880, *E. Palmer 136* (lectotype, designated by Moore 1943: 39, GH-00043624!; isolectotypes, K-000531450!, NY!, P!, US image!).

Perennial herbs, 18-44 cm tall. *Rootstock* 2.9-7.5 mm in diameter, vertical, not tuberculate, not turnip-shaped, without thickened roots. *Stem* erect, leafy (rarely scapiform), not rooting at nodes, stolons absent, without vegetative stems, with patent to retrorse, eglandular hairs (0.3)1-2 mm long and patent, glandular hairs 0.1-0.5 mm long. *Basal leaves* in a ± persistent rosette, cauline leaves opposite; leaf laminas 1.8-5 cm long, 2.4-6 cm wide, not peltate, palmatifid [ratio main-sinus length/middle segment length = 0.68-0.88], polygonal in outline, base cordate, not coriaceous, with nerves not projected, pilose on both surfaces, with appressed, eglandular (and rarely glandular) hairs; segments 5, in 1 plane, middle segment subrhombic to obtriangular, 3.7-10.2 mm wide at the base [ratio segment width at the base/middle segment length = 0.22-0.37], 5-11(16)-lobed in distal half [ratio secondary sinus length/middle segment length = 0.10-0.28]; petioles up to 14 cm long, without abscission zone, terete, not swollen, not deflexed in age, with patent to retrorse, eglandular hairs (0.3)1-1.7 mm long and patent, glandular hairs 0.1-0.5 mm long; stipules 5.8-19.2 mm long, 1.7-4.9 mm wide, lanceolate, free, papery, brownish red, with eglandular and, sometimes, glandular hairs on both surfaces and on the margin. *Inflorescence* a dichasial cyme; cymules 2-flowered, solitary [ratio cymule length/leaf length = 1.6-5.9]; peduncles (19)53-114(150) mm long, with patent to retrorse, eglandular hairs (0.2)0.8-2 mm long and patent, glandular hairs 0.1-0.7 mm long; bracteoles 5-11.5 mm long, 0.8-1.9 mm wide, lanceolate, whorled; pedicels 12-37 mm long, with patent to retrorse, eglandular hairs (0.3)1.1-1.8 mm long and patent, glandular hairs 0.2-0.6 mm long. Flowers actinomorphic. *Sepals* 7.5-9.8 mm long, 2.5-5 mm wide, lanceolate, smooth, not accrescent, nerves 3, mucro 0.4-1.5(1.9) mm long [ratio mucro length/sepal length = 0.05-0.23], with ± patent, eglandular hairs (0.2)0.9-2.4 mm long and patent, glandular hairs 0.2-0.7 mm long on the abaxial surface, glabrous adaxially. *Petals* (15.2)17.1-20.8 mm long, 8.1-14.4 mm wide, erect-patent, rounded or slightly emarginate (notch 0.5-1.1 mm deep), without claw, purple, rarely white, hairy on the base of both surfaces, ciliate on the basal margin, with hairs 0.5-1.5 mm long. *Stamens* 10, both whorls bearing anthers; filaments 4.4-9.7 mm long, lanceolate, purple, pilose on the abaxial surface, ciliate on the proximal half, with hairs 0.5-1.5(2.2) mm long; anthers 1.6-3 mm long, purple. Nectaries 5, hemispheric, glabrous. *Gynoecium* 5.5-9.8 mm long, purple. *Fruit* 26.8-35.6 mm long, erect, discharge of seed-ejection type; mericarps 4.1-5.2 mm long, 1.6-2.6 mm wide, without a strand of fibers, not compressed at the apex, smooth, without basal beak, with a basal callus, without a basal prong, brown, with erect-patent, eglandular hairs 0.4-1.3 mm long and patent, glandu-

lar hairs 0.1-0.6 mm long; rostrum 18.1-27.6 mm long, with a narrowed apex 2.4-5.8 mm long, not twisted, with ± patent, eglandular hairs 0.3-1.2 mm long, and patent, glandular hairs 0.1-0.4 mm long; stigmatic remnants 2-3.4 mm long, with 5 glabrous lobes. *Seeds* 2.7-3 mm long, 1.7-1.8 mm wide, finely reticulate, uniformly colored, brown, glabrous. Cotyledons with entire margin. Fig. 362.

Pollen. Ornamentation not studied.

Chromosome number. Unknown.

Phenology. Collected in flower from May to August.

Distribution. This species ranges from Durango to Nuevo León, in northern Mexico (Fig. 363).

Habitat. Roadsides, streams banks, alpine meadows, open shrubby hillsides, and *Abies* Mill., *Pseudotsuga* Carrière, *Pinus* L., and *Quercus* L. forests; 2200-3850 m.

Additional specimens examined. **Mexico.** Coahuila: Arteaga, Sierra El Coahuilon, 25°14'N, 100°18'W, 17 June 1991, *Hinton & al. 20984* (GH); Arteaga, Sierra El Coahuilon, 25°14'N, 100°18'W, 17 June 1991, *Hinton & al. 20990* (GH); Arteaga, El Coahuilon, Sierra de la Marta, 25°14'N, 100°18'W, 6 Aug. 1987, *Villareal & Carranza 3820* (MEXU); Arteaga, Sierra de la Marta camino al Cerro El Morro, 25°14'N, 100°18'W, 18 June 1985, *Yáñez 169* (MO, MEXU); Arteaga, Sierra Zapalinamé, 25°16'N, 100°56'W, 19 May 1990, *Hinton & al. 20283* (GH, MEXU); Arteaga, Sierra de San Antonio, 25°16'N, 100°29'W, July 1997, *Nájera Castro 12* (MEXU); Arteaga, cañón de Las Vigas, 25°20'N, 100°39'W, 5 May 1988, *Villareal & Carranza 4237* (MEXU); Arteaga, Sierra Los Camargos, 25°29'N, 100°44'W, 19 July 1980, *Hinton & al. 17873* (MEXU, MO); Arteaga, El Paso, 25°38'N, 100°58'W, 22 June 1994, *Hinton & al. 24385* (MEXU, NY). Durango: Cerro Blanco, Sierra de Michis, 52 km al SW de Vicente Guerrero, Mesa del Lobo, 23°27'N, 104°8'W, 22 Aug. 1975, *Serrayo 83* (MEXU); 32.7 mi W of Durango, 23°51'N, 105°8'W, 23 July 1955, *Johnston 2680* (MEXU); 33.7 mi W of Durango, along highway 40, 23°51'N, 105°12'W, 21 July 1975, *Torke & al. 216* (NY); E slopes of Cerro Prieto, 20 airline mi W of Otinapa, 24°8'N, 105°38'W, 10 July 1950, *Maysilles 7343* (MEXU). Nuevo León: Sierra Madre Oriental, N slope of Mt. Sierra Tronconal, canyon de los Charcos & canyon de San Miguel, 15 mi SW of Galeana, above Mesa del Carmen, 24°35'N, 100°7'W, 4 June 1934, *Mueller & Mueller 738* (F, GH, MEXU, NY); Sierra

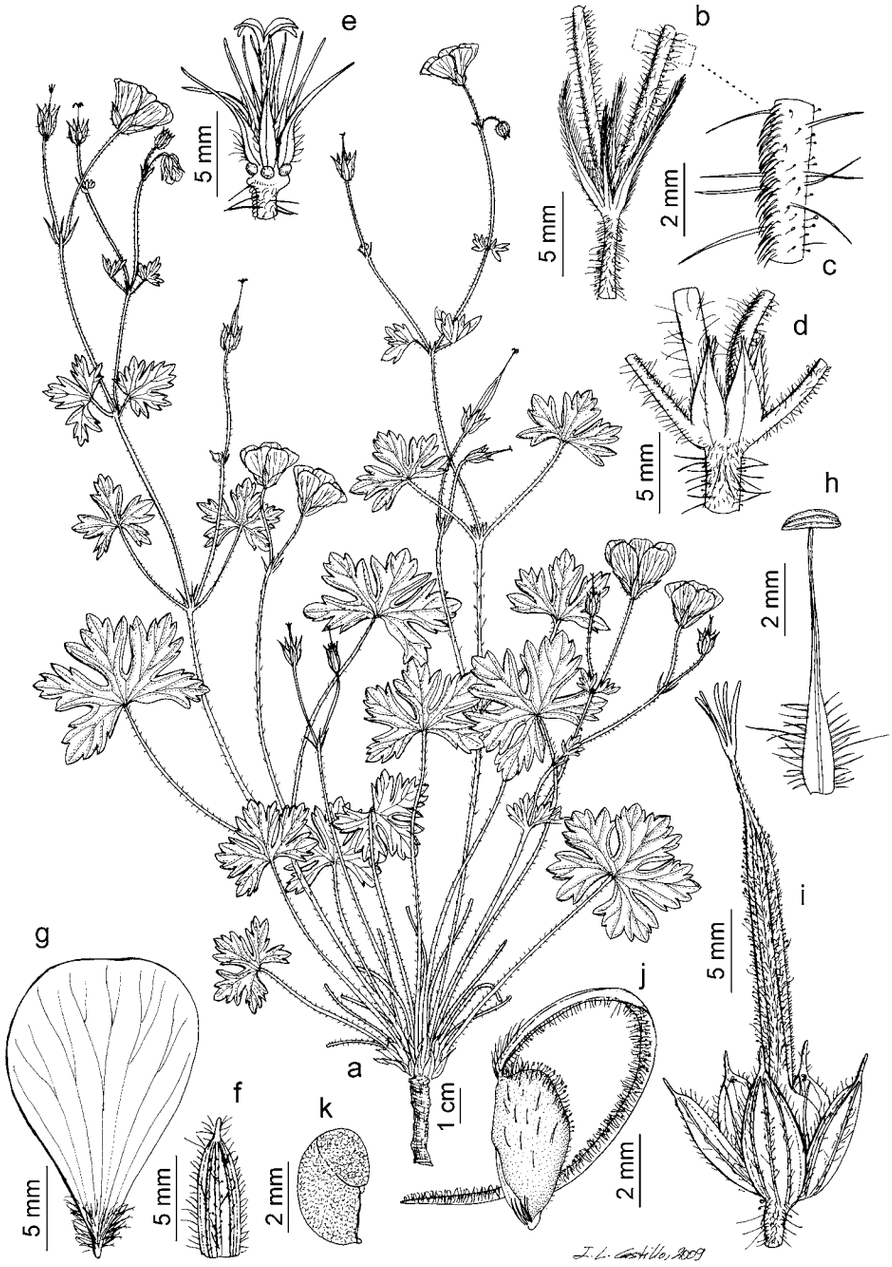


Fig. 362. *Geranium crenatifolium*. a. Habit. b. Bracteoles. c. Detail showing pedicel indumentum. d. Stipules. e. Flower, sepals and petals removed. f. Sepal. g. Petal, adaxial side. h. Stamen. i. Fruit. j. Mericarp. k. Seed. (Based on: a-h, *Stanford & al. 709*, GH; i-k, *McGregor & al. 287*, NY).

Fig. 363. Distribution of *Geranium crenatifolium*.

Madre Oriental, ascent of Sierra Infernillo, 15 mi SW of Galeana, 24º35'N, 100º7'W, 17 June 1934, *Mueller & Mueller 852* (GH); Galeana, Cerro Potosí, 24º52'N, 100º14'W, 24 May 1974, *Duncan 2388* (MICH); Galeana, E face of peak, 24º52'N, 100º14'W, 5 July 1938, *Schneider 1029* (F); Galeana, near peak, 24º52'N, 100º14'W, 20 July 1938, *Schneider 1039* (F); Galeana, slope of Cerro de Potosí, 24º52'N, 100º14'W, 16 July 1945, *Sharp 45754* (MEXU); Cerro de Potosí, E side, above Ejido 18 de Marzo, 24º55'N, 100º16'W, 25 June 1960, *Beaman 3296* (GH); Galeana, Cerro Potosí, 24º55'N, 100º16'W, 7 July 1987, *Estrada 1156* (MEXU); Cerro de Potosí, E facing slope, 24º55'N, 100º16'W, 26 July 1985, *Ginzbarg & al. 227* (MEXU); Cerro de Potosí, 24º55'N, 100º16'W, 21 June 1985, *McDonald 1567* (MO); Cerro de Potosí, 24º55'N, 100º16'W, 26 July 1985, *McDonald 1809* (MO); Cerro Potosí, near microwave tower, 24º55'N, 100º16'W, 8 July 1963, *McGregor & al. 287* (NY); Cerro de Potosí, E slope, 24º55'N, 100º16'W, 22 Aug. 1965, *Mertz 274* (MEXU); Galeana, Cerro Potosí, radio faro Potosí, 11 km al NW del ejido "18 de marzo", o 26 km al NW de Galeana, 24º55'N, 100º16'W, 10 Aug. 1982, *Torres & al. 1051* (MEXU). Tamaupilas: mountain top 7 km SW of Miquihauana, 23º41'N, 99º48'W, 5 Aug. 1941, *Stanford & al. 709* (GH, MO, NY); E and S slopes of Peña Nevada, 23º43'N, 99º48'W, 19 July 1949, *Stanford & al. 2539* (NY); Cañada Joya de Gómez, 23º44'N, 99º23'W, 26 May 1974, *Medrano 7150* (MEXU); El Puerto 3 km al W del Ejido La Marcela, entre Peña Nevada y El Borrado, 23º45'N, 99º49'W, 5 July 1985, *Jiménez 217* (XAL); Hidalgo, 5 km al N de Los Caballos, 23º59'N, 99º29'W, May 1984, *Medrano & al. 14096* (MEXU).

Discussion. Geranium crenatifolium has a vertical rootstock and a ± persistent leaf rosette. The aerial stem is erect, usually with 2-3 nodes of opposite leaves, and ends in a dichasially branched inflorescence. Yet, some specimens have cymules arising directly from the rootstock; occasionally, herbarium samples include only small plants of this stemless type. The indumentum composed of eglandular hairs is a distinctive feature of this species. Inflorescences, stems, and petioles have long, soft, patent eglandular hairs (and also shorter and usually retrorse ones). Short glandular hairs are also present. *Geranium crenatifolium* has long petals with hairs restricted to the base (on both surfaces) and the basal margin. Staminal filaments have also eglandular hairs, some distinctively long. *Geranium crenatifolium* is widespread from southeastern Coahuila to Tamaulipas in the Sierra Madre Oriental. Moore (1951: 252) recorded this species from some localities in the Sierra Madre Occidental (southwestern Durango) 500 km towards the west. These specimens match collections from the main range of the species. Some features found in *G. crenatifolium* are shared by *G. trolliifolium*. Both species have long petals with the indumentum restricted to the base, glabrous nectaries, staminal filaments with long hairs, and long, soft, patent eglandular hairs on inflorescences and stems. *Geranium trolliifolium* differs in its very robust rootstock and usually bears an alternate leaf on the stem. Leaves of *G. trolliifolium* are longer than those of *G. crenatifolium* and have rhombic segments (those of *G. crenatifolium* are usually obtriangular and have fewer lobes). Bracteoles and eglandular hairs are shorter in *G. trolliifolium* than in *G. crenatifolium*, although with some overlap. Cymules of *G. crenatifolium* are 2-flowered, while those of *G. trolliifolium* are 2-6-flowered and sometimes umbel-like.

139. Geranium pringlei Rose, Contr. U.S. Natl. Herb. 10(3): 109. 1906. Type locality: "Type U. S. National Herbarium no. 461451, collected by C. G. Pringle in meadows, Cuyamaloya Station, in eastern Hidalgo, altitude 2,490 meters, August 2, 1904 (no. 8978)". Type: Mexico. Hidalgo, Cuyamaloya Station, 20°02'N, 98°32'W, 2 Aug. 1904, *C.G. Pringle 8978* (holotype, US-461451 image!; isotypes, BM!, CSPU, F-0044714F!, G-00388781!, GH-00043652!, GOET-004069 image!, K-000531451!, LL, MEXU-00015255 image!, MO-060425!, NY-00373676!, P-00700638!, PR-375708!, W!).

Perennial herbs, 28-65 cm tall. *Rootstock* 5-10 mm in diameter, vertical, not tuberculate, not turnip-shaped, without thickened roots. *Stem* erect, leafy, not rooting at nodes, stolons absent, without vegetative stems, with patent, eglandular hairs 2-2.7 mm long. *Basal leaves* in a ± persistent rosette, cauline leaves opposite; leaf laminas 3.6-4.8 cm long, 3.5-6.4 cm wide, not peltate, palmatifid [ratio main-sinus length/middle segment length = 0.75-0.90], polygonal in outline, base cordate, not coriaceous, with nerves not projected, pilose on both surfaces, with ± appressed, eglandular hairs; segments 5, in 1 plane, middle segment rhombic, 4.3-10 mm wide at the base [ratio segment width at the base/middle segment length = 0.16-0.31], 7-11-lobed in distal half [ratio secondary sinus length/middle segment length = 0.16-0.34]; petioles up to 19 cm long, without abscission zone, terete, not swollen, not deflexed in age, with patent, eglandular hairs 1.3-2.5 mm long and rarely, patent, glandular hairs 0.2-0.3 mm long; stipules 6.8-10 mm long, 2.5-4.8 mm wide, lanceolate, free, papery, brownish red, with eglandular hairs on abaxial surface and on the margin, usually glabrous adaxially. *Inflorescence* a dichasial cyme; cymules 2-flowered, solitary [ratio cymule length/leaf length = 2-3.4]; peduncles 106-170 mm long, with patent to retrorse, eglandular hairs (0.2)2-3 mm long and patent, glandular hairs 0.3-0.8 mm long; bracteoles 3.8-8.7 mm long, 1.2-1.6 mm wide, lanceolate, whorled; pedicels 15-28 mm long, with patent to retrorse, eglandular hairs 0.3-1.3 mm long and patent, glandular hairs 0.3-0.9 mm long. Flowers actinomorphic. *Sepals* 8.2-10.4 mm long, 3.4-5.4 mm wide, lanceolate, smooth, not accrescent, nerves 3, mucro 1.1-1.7 mm long [ratio mucro length/sepal length = 0.12-0.18], with ± patent, eglandular hairs (0.2)1.7-2.5 mm long and patent, glandular hairs 0.2-0.7 mm long on the abaxial surface, glabrous adaxially. *Petals* 15-17.8 mm long, 9.7-15.4 mm wide, erect-patent, rounded or slightly emarginate (notch 1-2 mm deep), without claw, purple, hairy on

the base of both surfaces, ciliate on the basal margin, with hairs 0.3-0.6 mm long. *Stamens* 10, both whorls bearing anthers; filaments 6.5-8.4 mm long, lanceolate, pink, pilose on the abaxial surface, ciliate on the proximal half, with hairs 1.1-2.8 mm long; anthers 2.5-2.7 mm long, purple. Nectaries 5, hemispheric, glabrous. *Gynoecium* 6.2-8.7 mm long, purple. *Fruit* 28-34 mm long, erect, discharge of seed-ejection type; mericarps 4-5 mm long, 1.8-2.4 mm wide, without a strand of fibers, not compressed at the apex, smooth, without basal beak, with a basal callus, without a basal prong, brown, with erect-patent, eglandular hairs 0.7-1 mm long and patent, glandular hairs 0.5-0.9 mm long; rostrum 20-26.5 mm long, with a narrowed apex 2.3-4.6 mm long, not twisted, with ± patent, eglandular hairs 0.3-0.4 mm long and patent, glandular hairs 0.3-1.2 mm long; stigmatic remnants 1.6-2.5 mm long, with 5 glabrous or scattered hairy lobes. *Seeds* 2.4-3.1 mm long, 1.4-1.8 mm wide, finely reticulate, uniformly colored, brown, glabrous. Cotyledons with entire margin. Fig. 364.

Pollen. Ornamentation not studied.

Chromosome number. Unknown.

Phenology. Collected in flower from July to August.

Distribution. This species ranges through central Mexico (Fig. 365).

Habitat. Stream banks, meadows, and *Pinus* L. forests; 2000-3100 m.

Additional specimens examined. **Mexico.** ex Nov. Hispania, *Née s.n.* (MA). Hidalgo: Cuyamaloya Station, 20°2'N, 98°32'W, 4 Aug. 1906, *Pringle s.n.* (BC). Mexico State: carretera libre Toluca-México D.F., un poco arriba del poblado La Marquesa, 19°17'N, 99°21'W, 26 July 1996, *Vibrans 5774* (MEXU); entre El Oro y Via Victoria, 19°43'N, 99°56'W, July 1920, *Matuda & al. 30927* (MEXU).

Discussion. Geranium pringlei resembles *G. crenatifolium* in habit, petal size and indumentum, and nectaries, but may be distinguished by some indumentum characters. Eglandular hairs on stems, petioles, peduncles, sepals, and staminal filaments are noticeably longer in *G. pringlei*, although with some overlap. *Geranium*

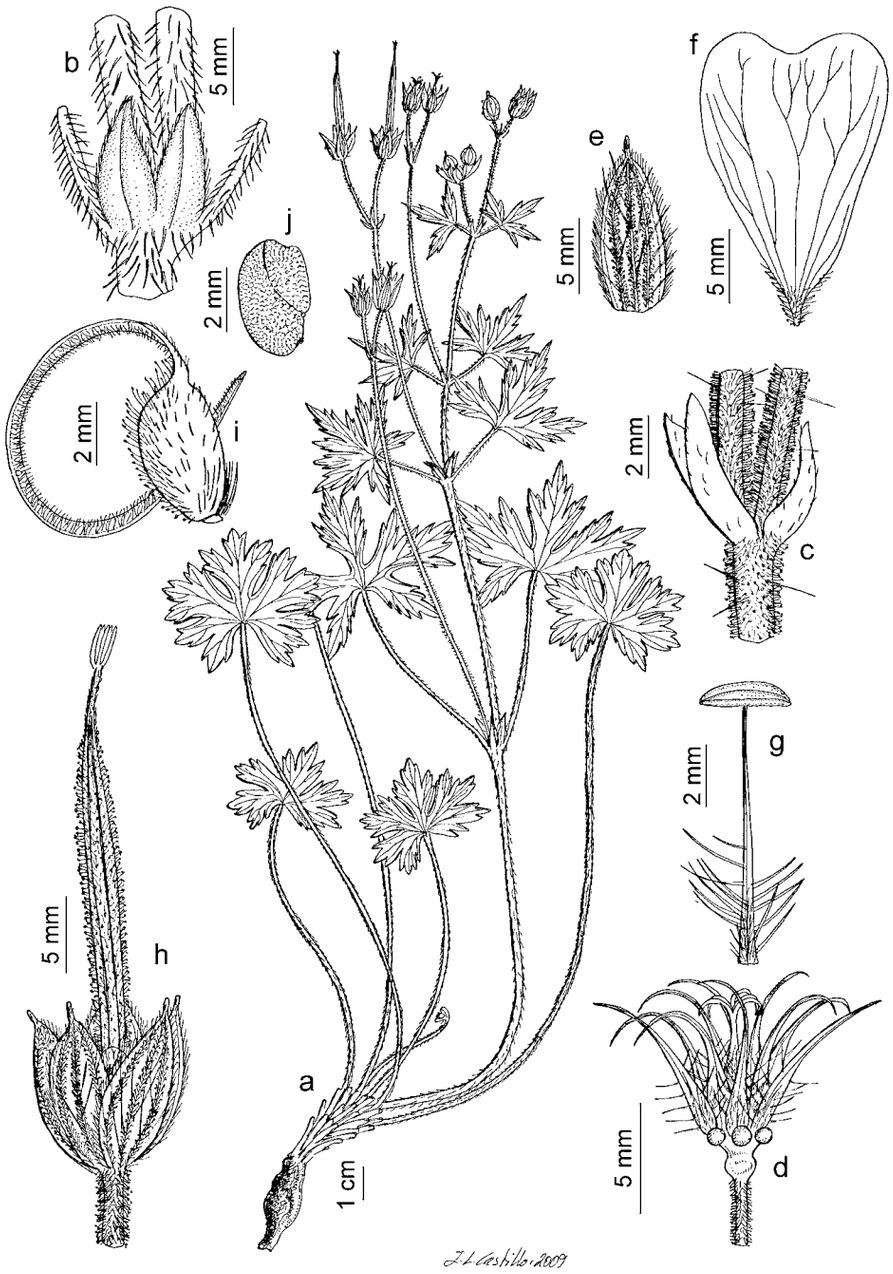


Fig. 364. *Geranium pringlei*. a. Habit. b. Stipules. c. Bracteoles. d. Flower, sepals and petals removed. e. Sepal. f. Petal, adaxial side. g. Stamen. h. Fruit. i. Mericarp. j. Seed. (Based on: a-c, h-j, *Pringle 8978*, GH; d-g, *Vibrans 5774*, MEXU).

Fig. 365. Distribution of *Geranium pringlei*.

pringlei lacks glandular hairs on the stem base (they only appear in the inflorescence); the glandular hairs on the fruit (especially on the rostrum) are longer than in *G. crenatifolium*. Although petals of both species are quite similar, those of *G. pringlei* seem to have shorter and fewer hairs. Also, *G. pringlei* has longer peduncles. Leaf segments in *G. pringlei* are rhombic, and the leaf surface is sparsely pilose, whereas *G. crenatifolium* usually has obtriangular leaf segments and a denser indumentum. The inflorescence of *G. pringlei* is dichasial in most of the specimens of the type collection and in the other two samples. Nevertheless, in some duplicates of the type some of the peduncles occur singly at lower nodes (Moore 1943: 41). Among the nine duplicates of the holotype studied, only the NY isotype shows a single cymule arising directly from the rootstock; however, in *G. crenatifolium* single cymules seem to be fairly frequent. The ranges of these species do not overlap; *G. pringlei* occurs in a zone about 400 km to the south of the southernmost localities of *G. crenatifolium*.

The Potentillifolium Group—This group is characterized by its usually ascending or erect habit, its turnip-shaped rootstock, its opposite, palmatifid leaves and its 1- or 2-flowered cymules arranged in monochasial inflorescence. The petals are of medium size, erect-patent, without claw, and hairy only on the base.

140. Geranium potentillifolium DC., Prodr. 1: 639. 1824, ["potentillaefolium"]. *Geranium pedunculare* Willd. ex Spreng., Syst. Veg. 3: 71. 1826, nom. illeg. Type locality: "in Novâ-Hispaniâ... (v. s. et ic. fl. mex.)". Type: Plate 6331.1783 in the Torner Collection of Sessé and Mociño Biological Illustrations at the Hunt Institute for Botanical Documentation (holotype). Mexico. Without locality, *M. Sessé & J.M. Mociño s.n.* (epitype, designated by Aedo 2012: 126, G-DC!; isoepitypes, BM-000927559!, F-0360135F!, MA-601779!). [Moore 1943: 53, designated as lectotype a copy of the watercolor: De Candolle, Calques Fl. Mexique, tab. 148. 1874].

Perennial herbs, 20-50 cm tall. *Rootstock* 10-18 mm in diameter, ± vertical, not tuberculate, turnip-shaped, without thickened roots. *Stem* ascending, leafy, not rooting at nodes, stolons absent, without vegetative stems, with patent to retrorse, eglandular hairs 0.5-1.3 mm long. *Basal leaves* few, not long persistent, cauline leaves opposite; leaf laminas 1.5-5.2 cm long, 1.6-5.5 cm wide, not peltate, palmatifid [ratio main-sinus length/middle segment length = 0.89-0.98], polygonal in outline, base cordate, not coriaceous, with nerves not projected, with scatered, ± appressed, eglandular hairs on the adaxial surface, and sericeous abaxially; segments (3)5, in 1 plane, middle segment rhombic (with linear-lanceolate lobes), 1.1-3.3 mm wide at the base [ratio segment width at the base/middle segment length = 0.07-0.14], (5)6-12-lobed in distal half [ratio secondary sinus length/middle segment length = 0.36-0.59]; petioles up to 8.3 cm long, without abscission zone, terete, not swollen, not deflexed in age, with patent to retrorse, eglandular hairs 0.4-1.2 mm long; stipules 3-6 mm long, 1-2.5 mm wide, broadly lanceolate, free, papery, brownish red, with eglandular hairs on abaxial surface and on the margin, usually glabrous adaxially. *Inflorescence* a monochasial cyme; cymules 1-flowered, solitary [ratio cymule length/leaf length = 2-4.1]; peduncles 28.1-70(97.7) mm long, with patent to retrorse, eglandular hairs 0.2-1 mm long; bracteoles 3.9-7.9 mm long, 0.4-1.3 mm wide, linear-lanceolate, opposite; pedicels 10-52 mm long, with patent to retrorse, eglandular hairs 0.3-1.2 mm long. Flowers actinomorphic. *Sepals* (5.7)6.2-8.6(9.6) mm long, 2.1-3.6 mm wide, lanceolate, smooth, not accrescent, nerves 3, mucro 1-1.7(3.4) mm long [ratio mucro length/sepal length = 0.17-0.39], with antrorse to patent, eglandular hairs 0.4-1.1 mm long on the abaxial surface, glabrous adaxially. *Petals* (10.7)12.5-14.6(16.8) mm long, 5.8-10.2 mm wide, erect-patent, rounded or slightly emarginate (notch ca. 1 mm deep), without claw, purple, hairy on the base of the adaxial surface, ciliate on the basal margin, with hairs 0.3-0.8 mm long. *Stamens* 10, both whorls bearing anthers; filaments 3.9-6.4 mm long, lanceolate, purple, pilose on the abaxial surface, ciliate on the proximal half, with hairs 0.3-0.7 mm long; anthers 1.2-1.8 mm long, yellow. Nectaries 5, hemispheric, glabrous or with a tuft of hairs at the top. *Gynoecium* 4.9-7.9 mm long, purple. *Fruit* 21.2-34.4 mm long, erect, discharge of seed-ejection type; mericarps 3.4-4.6 mm long, 1.5-2.3 mm wide, without a strand of fibers, not compressed at the apex, smooth, without basal beak, with a basal callus, without a basal prong, brown, with erect-patent, eglandular hairs 0.1-0.5 mm long; rostrum 12.6-23.7 mm long, with a narrowed apex 1.9-4.3 mm long, not twisted, with ± patent, eglandular hairs 0.2-0.5 mm long; stigmatic remnants 2.6-4.3 mm long, with 5 glabrous lobes. *Seeds* 2.2-2.9 mm long, 1.3-1.8 mm wide, finely reticulate, uniformly colored, brown, glabrous. Cotyledons with entire margin. Fig. 366.

Pollen. *Geranium*-type (Bortenschlager 1967: 431).

Chromosome number. Unknown.

Phenology. Collected in flower from March to December.

Distribution. This species ranges through central and southern Mexico (Fig. 367).

Habitat. Roadsides, meadows, rocky hillsides, and *Abies* Mill., *Pinus* L., and *Quercus* L. forests; 1700-4800 m.

Representative specimens examined. **Mexico.** Hidalgo: 50 mi E of México City, 30 May 1972, *Van Cott 1630* (NY); Peñas de los Gachupines, above Pueblo Nuevo on road from Real del Monte to El Chico, 20°11'N, 98°42'W, 1 Aug. 1948, *Moore 4244* (GH); Si-

erra de Pachuca, 20º11'N, 98º43'W, 21 July 1901, *Rose & Hay 5618* (NY); Peña del Cuervo, El Chico, 20º12'N, 98º43'W, May 1900, *Chávez Arias s.n.* (MEXU). Mexico Distrito Federal: Nepanapa, delegación de Milpa Alta, 19º2'N, 99º59'W, 2 Aug. 2002, *César 364* (MEXU); volcán Pelado, ladera W, Tlalpan, 19º9'N, 99º13'W, 8 Aug. 1987, *Sandoval 249* (MEXU); Desierto de los Leones, 19º16'N, 99º18'W, 9 May 2000, *Gutiérrez 701* (MEXU); SW of La Marquesa, 19º17'N, 99º22'W, 26 July 1975, *Wonderly 15* (MEXU, NMC); Los Dinamos, Delegación Contreras, bosque de Oyamel, 19º25'N, 99º34'W, 8 Sep. 1979, *Ventura 3529* (F, MEXU). Mexico State: De N España en Chalma, 18º54'N, 99º26'W, *Née s.n.* (MA); Teacaltitlán, Parque Nacional Nevado de Toluca, ladera W del Cerro Calotepec, 19º3'N, 99º48'W, 13 July 1985, *Sandoval 2* (MEXU); Nevado de Toluca, 1 mi from paved highway, 19º6'N, 99º45'W, 9 Sep. 1967, *Oliver & al. 959* (MO); Temascaltepec, Las Cruces, 19º12'N, 99º53'W, 24 May 1932, *Hinton 782* (MA, NY); Ixtapaluca, Llano Grande, 19º59'N, 99º38'W, 24 June 1979, *Ventura 3414* (F, MEXU, NY). Michoacán: Zitácuaro-Cacique top over Zitácuaro, 19º26'N, 100º22'W, 6 June 1938, *Hinton 11931* (NY); Ciudad Hidalgo, 4 km al NW de Huajumbaro, hacia Los Azufres, 19º40'N, 100º44'W, 27 July 1986, *Zamudio 4170* (MEXU); 19 km al E de Queréndaro, sobre la carretera a Maravatío, 19º48'N, 100º47'W, 13 Oct. 1986, *Rzedowski 40971* (MEXU); Maravatío, Cerro El Calvario de San Miguel El Alto, 19º50'N, 100º16'W, 27 Sep. 1986, *Santos Martínez 1688* (MEXU); Contepec, falda W del Cerro Altamirano, al E de Contepec, 19º58'N, 100º8'W, 8 June 1990, *Madrigal Sánchez 4340* (MEXU). Morelos: Cuernavaca, 18º56'N, 99º10'W, 1857, *Schaffner 977* (BM); Parque Nacional Lagunas Zempoala, near small lake, 19º3'N, 99º18'W, 26 July 1946, *Allison 51* (MEXU); Tres Cumbres, 19º3'N, 99º15'W, 28 May 1950, *Matuda 19180* (MEXU); Parque Nacional Lagunas Zempoala, near laguna n. 3, 19º3'N, 99º18'W, 26 July 1949, *McAdams 35* (MEXU); 1.5 km N of Tres Cumbres, on old highway 95, 19º4'N, 99º14'W, 11 July 1960, *Iltis & al. 86* (MEXU). Oaxaca: 50 mi E of Oaxaca, 16º40'N, 96º10'W, 5 June 1972, *Van Cott 1593* (MO); 29 km NW of Zaachila on road to San Miguel Peras, 16º56'N, 96º57'W, 11 Nov. 1983, *Breedlove 60137* (GH); vicinity of La Cumbre, 30 km NNE of Oaxaca on highway 175 between Oaxaca and Ixtlán de Juarz, 17º10'N, 96º34'W, 4 July 1963, *Tillett 637-122* (RSA); Sierra de San Felipe, 17º11'N, 96º39'W, 10 Sep. 1894, *Smith 653* (NY); Miahuatlán, Quiexobra, 19º43'N, 96º51'W, 9 Aug. 1996, *Hinton 26843* (IEB). Puebla: above Teotitlan del camino on the road to Huautla, 18º12'N,

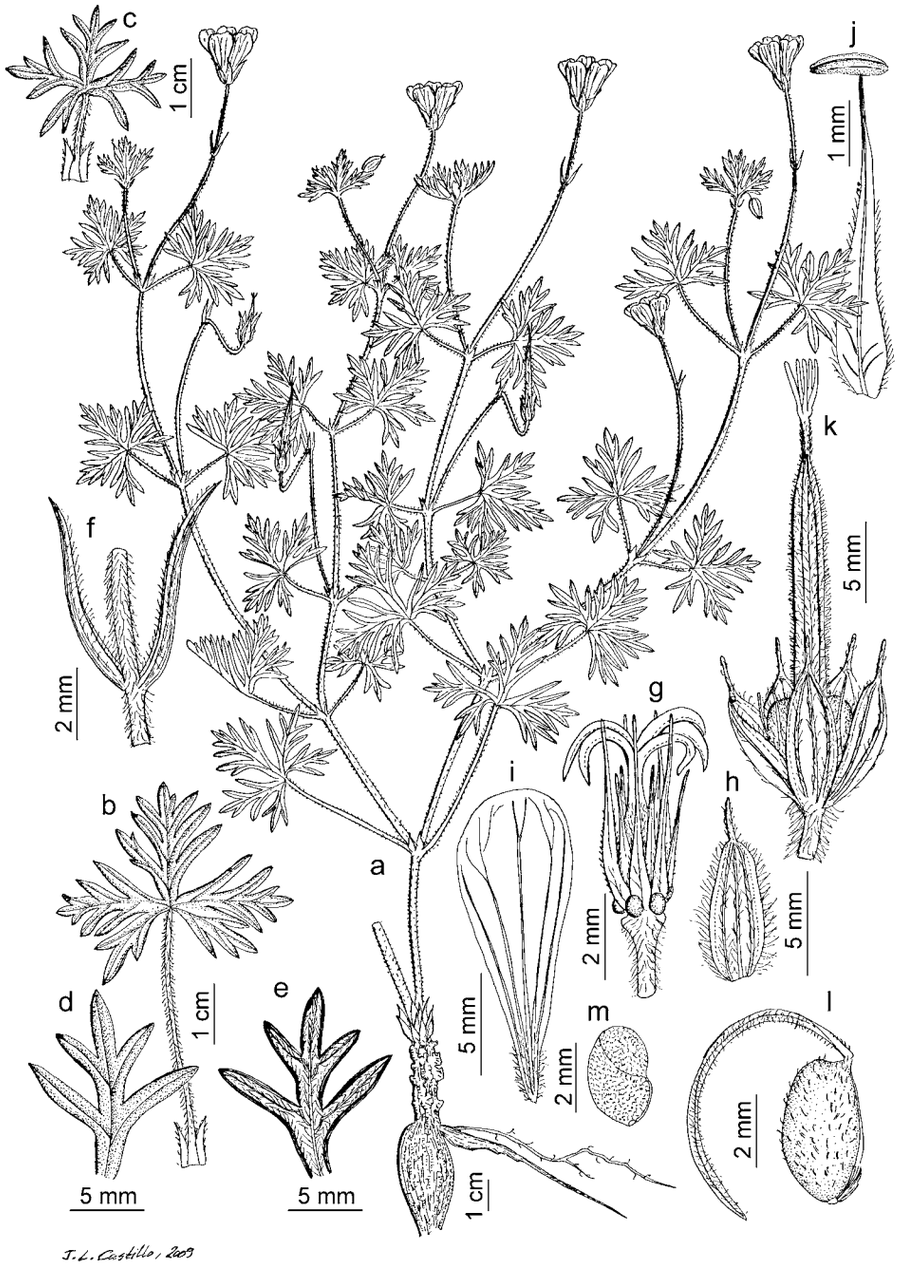


Fig. 366. *Geranium potentillifolium*. a. Habit. b, c. Leaves. d. Detail of leaf segment, adaxial side. e. Detail of leaf segment, abaxial side. f. Bracteoles. g. Flower, sepals and petals removed. h. Sepal. i. Petal. j. Stamen. k. Fruit. l. Mericarp. m. Seed. (Based on: a, b, f-g, *Pringle 6370*, NY; c-e, *Ventura 147*, MEXU; h-m, *Zamudio 4170*, MEXU).

Fig. 367. Distribution of *Geranium potentillifolium*.

97°1'W, 3 Aug. 1961, *Smith & al. 4171* (F, GH, NY); above Coxcatlan, between Apala and the top of Cerro Chichiltepec, 18°15'N, 97°8'W, 17 July 1961, *Smith & al. 3832* (F, NY); Cholula, camino al Cerro Campanario, por el lado NW de Santiago Xalitzintla, 19°5'N, 98°31'W, 24 Aug. 1987, *Tlapa & Ubierna 274* (MEXU); few mi W of San Martín Texmelucan, toward Río Frio, 19°19'N, 98°31'W, 1 Aug. 1953, *Manning & Manning 53701* (GH). Tlaxcala: Ixtenco, atras del albergue CREA, 19°14'N, 97°51'W, 1 July 1993, *Sánchez 326* (MEXU); volcán La Malintzin, albergue CREA, 19°15'N, 98°3'W, 13 Mar. 1990, *Blacio & Buendía s.n.* (MEXU). Veracruz: Cofre de Perote, Perote, 19°28'N, 97°9'W, 29 Aug. 1972, *Dorantes & al. 1627* (CAS, F, MO); Perote, 19°28'N, 97°9'W, May 1945, *Martínez s.n.* (NY); Xalapa, 19°31'N, 97°12'W, *Coulter 764b* (GH); km 7 of road Perote to Cofre de Perote, 19°31'N, 97°12'W, 12 Sep. 1976, *Pankhurst 76/167* (F).

Discussion. Geranium potentillifolium is a spreading or ascending plant arising from a robust rootstock. The rootstock has a ± long and branched apical portion, which is joined to a vertical and turnip-shaped part. Sometimes secondary and smaller turnip-shaped segments are joined to the distal portion of this turnip-shaped part. The indumentum of *G. potentillifolium* is composed of eglandular hairs, which are usually patent to partially retrorse on stem and inflorescences. The hairs are abundant, but the vesture is not sericeous, except abaxially on the leaves, especially when young. In mature leaves this indumentum is not as dense and appressed as in *G. alpicola.* The leaf indumentum is spreading adaxially, with suberect to appressed hairs. As pointed out by Moore (1943: 54), there is considerable variation in size and division of the leaves. The leaves are deeply palmatifid, with usually five segments divided in long and narrow lobes. The lobes often have revolute margins. Some specimens have an unusually long sepal awn (e.g., *Moore 1253*, GH; *Rose & Painter 7923*, NY), but otherwise they agree very well with *G. potentillifolium*. Basal leaves are present in few herbarium specimens and always in a very low number.

Geranium potentillifolium shares with *G. bellum* 1-flowered cymules and deeply divided leaves. Yet, the leaves of *G. potentillifolium* have narrower segments, usually with longer and narrow lobes, that are sericeous abaxially, but in *G. bellum* the lobes are only pilose. The petals of *G. potentillifolium* are purplish but usually white in *G. bellum*. The distribution areas of the two species overlap only in a small region. *Geranium potentillifolium* is found in central Mexico, with some isolated populations in southern Puebla and Oaxaca that are indistinguishable from those of central Mexico. All have lavender petals, short anthers, short peduncles, and leaves that are ± tomentose abaxially.

Moore (1943: 53) designated a copy of the drawing cited in the protologue from *Icones florae mexicanae ineditae* by Sessé and Mociño (De Candolle 1874, tab. 148) as type of *G. potentillifolium*; however, the original drawing (not available in Moore's time) is the accurate choice. The epitype is a specimen at G from Sessé & Mociño herbarium, without any indication of locality, labeled as "herb. Thibaud". According to Burdet (2008), E. Thibaud assembled a herbarium with plants donated by Cavanilles and by Ruiz and Pavón during his stay at Madrid. This herbarium was partially bought by A.P. Candolle. Thus, it is evident that the specimen in Candolle's herbarium (G-DC) is a plant from the Sessé and Mociño expedition obtained by Thibaud in Madrid. At MA there are nine sheets of *G. potentillifolium* in the separate Sessé & Mociño herbarium, four of them labeled as "*Geranium sibiricum*." At BM there are three Sessé & Mociño specimens, all with a handwritten note on the back of the sheet: "Mexico. Herb. Pavon", one labeled as "*Geranium dissectum*/ NE", and other "*Geranium* sp. nova/ de mexico". These specimens were sold by Pavón to Lambert in 1842; part of the Lambert herbarium is now incorporated in the general collection at BM. At F there is a sheet (plus three fragments) labeled "*Geranium sibiricum*/ NE"; none include indication of the collecting locality. The specimens at BM, F, and MA are considered isoepitypes. For information concerning the Sessé & Mociño herbarium, see McVaugh (2000).

141. Geranium bellum Rose, Contr. U.S. Natl. Herb. 10(3): 108. 1906. Type locality: "Type U. S. National Herbarium no. 395386, collected by J. N. Rose and Robert Hay on Sierra de Pachuca, Hidalgo, July 21 and 22, 1901 (no. 5618)". Type: Mexico. Hidalgo, Sierra de Pachuca, 20°11'N, 98°43'W, 21-22 July 1901, *J.N. Rose & R. Hay 5618* (holotype, US-395386 image!).

Perennial herbs, 10-42 cm tall. *Rootstock* 4.2-15.2 mm in diameter, ± vertical, not tuberculate, turnip-shaped, without thickened roots. *Stem* ascending, leafy, not rooting at nodes, stolons absent, without vegetative stems, with ± patent, eglandular hairs 0.9-1.9 mm long. *Basal leaves* in a ± persistent rosette, cauline leaves opposite; leaf laminas 1.5-4.2 cm long, 1.7-5.5 cm wide, not peltate, palmatifid [ratio main-sinus length/middle segment length = 0.78-0.95], polygonal in outline, base cordate, not coriaceous, with nerves not projected, with scatered, ± appressed, eglandular hairs on the adaxial surface, and densely hairy abaxially; segments 5, in 1 plane, middle segment rhombic (with linear-lanceolate lobes), 1.5-4.5 mm wide at the base [ratio segment width at the base/middle segment length = 0.09-0.21], 7-14(17)-lobed in distal half [ratio secondary sinus length/middle segment length = 0.27-0.49]; petioles up to 15 cm long, without abscission zone, terete, not swollen, not deflexed in age, with patent to retrorse, eglandular hairs 0.5-1.7 mm long; stipules 2.6-6.9 mm long, 0.6-2 mm wide, lanceolate, free, papery, brownish red, with eglandular hairs on abaxial surface and on the margin, usually glabrous adaxially. *Inflorescence* a monochasial cyme; cymules 1-flow-

ered, solitary [ratio cymule length/ leaf length = 1.4-3.9]; peduncles 27-85(115) mm long, with patent to retrorse, eglandular hairs 0.4-1.4 mm long; bracteoles 3.7-7.9 mm long, 0.5-0.8 mm wide, linear-lanceolate, opposite; pedicels 13-59 mm long, with patent to retrorse, eglandular hairs 0.4-1.5 mm long. Flowers actinomorphic. *Sepals* 5-7.9(9.6) mm long, 2-3.6 mm wide, lanceolate, smooth, not accrescent, nerves 3(5), mucro 0.5-2 mm long [ratio mucro length/sepal length = 0.10-0.20], with antrorse to patent, eglandular hairs 0.4-1.8 mm long on the abaxial surface, glabrous adaxially. *Petals* (10.4)11.5-15.5(16) mm long, 6-10.8 mm wide, erect-patent, rounded, without claw, white, hairy on the base of the adaxial surface, ciliate on the basal margin, with hairs 0.4-0.9 mm long. *Stamens* 10, both whorls bearing anthers; filaments 4-6.6 mm long, lanceolate, yellow, pilose on the abaxial surface, ciliate on the proximal half, with hairs 0.4-1.3(1.8) mm long; anthers 1.7-2.2 mm long, yellow. Nectaries 5, hemispheric, usually glabrous. *Gynoecium* 9.7-9.2 mm long, yellow. *Fruit* 25-33 mm long, erect, discharge of seed-ejection type; mericarps 3.4-4.5 mm long, 1.8-2.3 mm wide, without a strand of fibers, not compressed at the apex, smooth, without basal beak, with a basal callus, without a basal prong, brown, with erect-patent, eglandular hairs 0.4-1.7 mm long; rostrum 16.8-23.5 mm long, with a narrowed apex 1.5-3.7 mm long, not twisted, with ± patent, eglandular hairs 0.5-1.2 mm long; stigmatic remnants 2.5-4.5 mm long, with 5 glabrous lobes. *Seeds* 2.5-3 mm long, 1.6-1.9 mm wide, finely reticulate, uniformly colored, brown, glabrous. Cotyledons with entire margin. Fig. 368.

Pollen. Ornamentation not studied.

Chromosome number. Unknown.

Phenology. Collected in flower from June to October.

Distribution. This species ranges through central Mexico (Fig. 369).

Habitat. Meadows, and *Abies* Mill., *Pinus* L., and *Quercus* L. forests; 2000-3200 m.

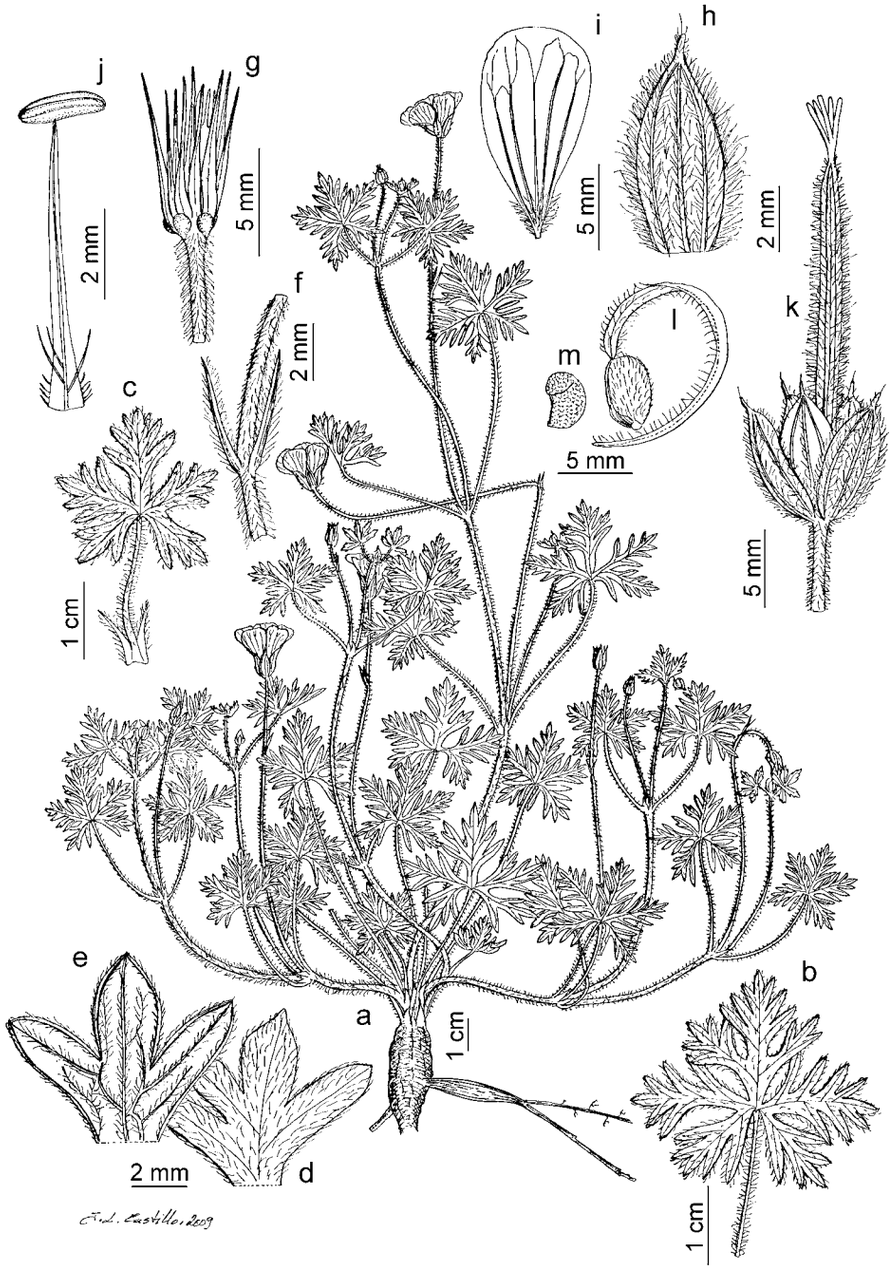


Fig. 368. *Geranium bellum*. a. Habit. b, c. Leaves. d. Detail of leaf segment, adaxial side. e. Detail of leaf segment, abaxial side. f. Bracteoles. g. Flower, sepals and petals removed. h. Sepal. i. Petal. j. Stamen. k. Fruit. l. Mericarp. m. Seed. (Based on: a, f-m, *Pringle 6909*, NY; c, *Moore & Wood 4324*, BM; b, d-e, *Breckon & al. 2320*, MEXU).

Fig. 369. Distribution of *Geranium bellum*.

Additional specimens examined. **Mexico.** Guanajuato: Yichú road, 20 Aug. 1947, *Kenoyer 2323* (GH); Victoria, Cerro El Garbanzo, 20°47'N, 101°10'W, 10 Oct. 1991, *Ventura & López 9666* (MEXU); 10 mi E of Guanajuato, 21°1'N, 101°22'W, 22 June 1963, *Harris 25686* (GH); Guanajuato, 8 km de Santa Rosa, carretera a Dolores Hidalgo, 21°3'N, 101°12'W, 21 July 1992, *Díaz & García 7129* (MEXU); Guanajuato, La Mesa de Hernández Cardosantos, 21°9'N, 101°10'W, 28 Aug. 1997, *Cano-Mares 38* (MEXU); road from Xichú to San Luis de la Paz, 22 mi W Xichú, 21°16'N, 100°22'W, 14 June 1957, *McVaugh 14816* (MICH); Xichú, La Gotera, camino de XIchú, 21°25'N, 100°4'W, 23 July 1991, *Ventura & López 9307* (MEXU); Victoria, rancho San Agustín, 50 km E de San Luis de la Paz, 21°26'N, 100°11'W, 28 June 1986, *Zamudio & al. 4040* (MEXU). Hidalgo: crucero Real del Monte-El Chico, 20°8'N, 98°40'W, 4 Aug. 1975, *García González 112* (MEXU); Tezoantla, 20°8'N, 98°39'W, Sep. 1945, *Martínez s.n.* (GH); 9.5 km al NNE de Pachuca, Real del Monte, 20°9'N, 98°40'W, 10 July 1988, *Galván 2990* (MEXU, NY); Pachuca, 20°9'N, 98°40'W, July 1905, *Purpus 1432* (NY, F, MO); mountains above Pachuca, 20°9'N, 98°40'W, 24 July 1905, *Rose & Hough 4464* (NY); between Pachuca and Real del Monte, 20°9'N, 98°40'W, 19 July 1905, *Rose & al. 8738* (F, NY); mountains above Pachuca, 20°9'N, 98°40'W, 24 July 1905, *Rose & al. 8876* (NY); Parque Nacional El Chico, near Zerezo, 20°10'N, 98°44'W, 20 June 1947, *Moore 3139* (GH); Mineral El Chico, 8 km al NE de Pueblo Nuevo, 20°11'N, 98°42'W, 23 June 1989, *Barquín & Zamora 738* (MEXU); Parque Nacional El Chico, Cerro Zumate, 1.5 km N highway 105 on park road, 11.5 km by road NE of Pachuca, 20°11'N, 98°42'W, 2 July 1978, *Breckon & al. 2320* (GH, MEXU, MO, NY); N-facing slope 7 km NE of Pachuca on highway 105, 20°11'N, 98°42'W, 1 Sep. 1974, *Conrad 3290* (MEXU, MO, NY); 2 km al SSW de El Chico, 20°11'N, 98°42'W, 18 Sep. 1988, *Hernández 262* (MO); El Chico, 20°11'N, 98°42'W, July 1927, *Lyonnet 100* (BM, MEXU); El Chico, 20°11'N, 98°42'W, 29 July 1938, *Lyonnet 2221* (MEXU, MO); Sierra de Pachuca, 20°11'N, 98°42'W, 22 July 1898, *Pringle 6909* (F, GH, MEXU, NY, PR); Hacienda San Miguel Regla, 20°13'N, 98°34'W, 8 Aug. 1948, *Miranda 4479* (MEXU); Lena station, 20°15'N, 99°35'W, 26 Aug. 1905, *Pringle 10021* (F, PR); Zimapán, upper slopes of El Monte on trail from Zimapán to mines of El Monte, 20°45'N, 99°21'W, 11 Aug. 1948, *Moore & Wood 4471* (GH); Zimapán, near rancho Encarnación on road from highway, km 242, to Encarnación, 20°53'N, 99°13'W, 6 Aug. 1948, *Moore & Wood 4324* (BM, GH, MEXU). Mexico State: 6 km al S de Coacalco, Sierra de Guadalupe, 19°36'N, 99°9'W, 17 June 1973, *Rzedowski 30778* (MEXU); 6 km al W de San Cristóbal Ecatepec, parate alta de la Sierra de Guadalupe, 19°36'N, 99°3'W, 18 Aug. 1974, *Rzedowski 32155* (MEXU, MO); 5 km al NW de Cahuacán, sobre el camino a Villa de Carbón, 19°39'N, 99°25'W, 21 June 1964, *Rzedowski 18306* (MEXU, NY); cumbre del Cerro Gordo, cerca de San Martín de las Pirámides, 19°42'N, 98°50'W, 4 Oct. 1964, *Rzedowski 18804* (F). Querétaro: Colón, pico rocoso al E de las instalaciones de televisa, 20°55'N, 100°10'W, 23 July 1998, *Calderón & Flores 160* (IEB); Colón, Cerro Zamorano, a 500 m del puerto el Carmen, pico al SW de las instalaciones de televisa, 20°55'N, 100°11'W, 10 Aug. 1997, *Calderón 54* (IEB); Colón, parte alta del Cerro Zamorano, 20°56'N, 100°11'W, 1 Sep. 1987, *Rzedowski 44432* (MEXU); Colón, parte alta del Cerro Zamorano, 20°56'N, 100°11'W, 27 Aug. 1989, *Rzedowski 48785* (MEXU); Cerro Boludo, 10 km al S de Pinal de Amoles, 20°57'N, 99°56'W, 8 June 1986, *Fernández & Rzedowski 3351* (NY); Pinal de Amoles, parte alta del Cerro Pingüical, 2 km al W de la antena, 21°9'N, 99°39'W, 22 Sep. 1988, *Zamudio & Carranza 6876* (MEXU).

Discussion. Geranium bellum is similar to *G. potentillifolium* in habit, rootstock, and indumentum. The indumentum of *G. bellum* is composed of eglandular hairs, usually longer than those of *G. potentillifolium*, especially on stem and mericarps. Mature leaves of *G. potentillifolium* are sericeous abaxially, while those of *G. bellum* are only densely hairy (i.e., the hairs more abundant than adaxially but the indumentum never sericeous). The anthers of *G. bellum* are always longer than those of *G. potentillifolium,* although with some overlap. Petals of *G. bellum* are white, sometimes with darker veins, and purplish in *G. potentillifolium*. *Geranium bellum* is distributed from central Guanajuato to Hidalgo and northern México state. *Geranium potentillifolium* has a more southerly range, which overlaps with *G. bellum* in southwestern Hidalgo and northern México. The type of *G. bellum* was collected in the Sierra Pachuca in southwestern Hidalgo, where both *G. bellum* and *G. potentillifolium* grow. Unfortunately, this original collection (*Rose & Hay 5618*) is heterogeneous. At NY there are two duplicates of *Rose & Hay 5618* that have discolored petals but with purplish margins, short anthers, and abaxially sericeous leaves. They were identified by Moore (1943: 50-51) as *G. potentillifolium* and are to be excluded from the type collection of *G. bellum*. The holotype of *G. bellum* at US has white petals, and the leaves are not sericeous (anther are not present in this specimen); it agrees with the Rose's (1906) description in the protologue.

142. Geranium andicola Loes., Bull. Herb. Boissier ser. 2, 3(2): 93. 1903. *Geranium andicola* var. *brevipedicellata* Loes., Bull. Herb. Boissier ser. 2, 3(2): 93. 1903, nom. illeg. Type locality: "Hab. in Guatemala. in dept. Quezaltenango et Solola in silva montana inter Totonicapam et Los Encuentros sita: Sel. n. 2371". Type: Guatemala. Quezaltenango/Sololá, in silva montana inter Totonicapam et Los Encuentros, 14°51'N, 91°13'W, 25 Sep. 1896, *C. Seler & E. Seler 2371* (lectotype, designated by Knuth 1912: 171, B destroyed, photo, F!; isolectotype, GH-00043620 image!). [Aedo 2012: 134 designated a neotype (NY-01287726) overlooking that an isolectotype is available at GH].

Geranium andicola var. *longipedicellatum* Loes., Bull. Herb. Boissier ser. 2, 3(2): 93. 1903. *Geranium longipedicellatum* (Loes.) R. Knuth in Engl., Pflanzenr. IV.129 (Heft 53): 171. 1912. Type locality: "Hab. in Guatemala. in dept. Huchuetenango inter Todos los Santos et Chiantla, m Llanos summo in montium jugo sitis in 3000 m altitud., in locis silvarum umbrosis: Sel n. 2755". Type: Guatemala. Huchuetenango inter Todos los Santos et Chiantla, Llanos summo, 15°27'N, 91°33'W, *C. Seler & E. Seler 2755* (lectotype, designated by Knuth 1912: 172, B destroyed, photo F!; isolectotype, GH).

Perennial herbs, 20-62 cm tall. *Rootstock* 5.1-9.8 mm in diameter, ± vertical, not tuberculate, turnip-shaped, without thickened roots. *Stem* ascending, leafy, not rooting at nodes, stolons absent, without vegetative stems,

with retrorse to retrorse-appressed, eglandular hairs 0.3-1 mm long. *Basal leaves* in a ± persistent rosette, cauline leaves opposite; leaf laminas 1.7-5.7 cm long, 2.1-7 cm wide, not peltate, palmatifid [ratio main-sinus length/ middle segment length = 0.80-0.93], polygonal in outline, base cordate, not coriaceous, with nerves not projected, with scattered, ± appressed, eglandular hairs on the adaxial surface, and densely hairy abaxially; segments 5, in 1 plane, middle segment rhombic (with lanceolate lobes), 1.5-5.3 mm wide at the base [ratio segment width at the base/middle segment length = 0.10-0.19], 7-11(28)-lobed in distal half [ratio secondary sinus length/middle segment length = 0.29-0.39]; petioles up to 17 cm long, without abscission zone, terete, not swollen, not deflexed in age, with retrorse to retrorse-appressed, eglandular hairs 0.2-1.1 mm long; stipules 3.4-5.4 mm long, 1.3-3 mm wide, broadly lanceolate, free, papery, brownish red, with eglandular hairs on abaxial surface and on the margin, usually glabrous adaxially. *Inflorescence* a monochasial cyme; cymules 1(2)-flowered, solitary [ratio cymule length/leaf length = 2.2-5.5]; peduncles (77)90-138(215) mm long, with retrorse to retrorse-appressed, eglandular hairs 0.3-0.8 mm long; bracteoles 3.9-5.6 mm long, 0.7-1.4 mm wide, linear-lanceolate, opposite; pedicels 17-72 mm long, with retrorse to retrorse-appressed, eglandular hairs 0.3-0.8 mm long. Flowers actinomorphic. *Sepals* 5.6-8.7 mm long, 2.5-4.4 mm wide, lanceolate, smooth, not accrescent, nerves 3, mucro 0.9-1.9 mm long [ratio mucro length/sepal length = 0.13-0.26], with antrorse to patent, eglandular hairs 0.3-1.1 mm long on the abaxial surface, glabrous adaxially. *Petals* (9.6)10.8-16(19.6) mm long, 4.8-10.7 mm wide, erect-patent, rounded, without claw, white, hairy on the base of the abaxial surface and sometimes along veins, ciliate on the basal margin, with hairs 0.2-1 mm long. *Stamens* 10, both whorls bearing anthers; filaments 4.4-7.3 mm long, lanceolate, yellow, pilose on the abaxial surface, ciliate on the proximal half, with hairs 0.4-1.1 mm long; anthers 1.6-2 mm long, pink. Nectaries 5, hemispheric, glabrous. *Gynoecium* 4.1-8.7 mm long, pale pink. *Fruit* 26-32.7 mm long, erect, discharge of seed-ejection type; mericarps 3.7-5 mm long, 1.6-2.1 mm wide, without a strand of fibers, not compressed at the apex, smooth, without basal beak, with a basal callus, without a basal prong, brown, with erect-patent, eglandular hairs 0.3-1.2 mm long; rostrum 18-23.2 mm long, with a narrowed apex 1.7-3.1 mm long, not twisted, with ± patent, eglandular hairs 0.4-0.9 mm long; stigmatic remnants 3.7-4.2 mm long, with 5 glabrous lobes. *Seeds* ca. 2.7 mm long, 1.7 mm wide, finely reticulate, uniformly colored, brown, glabrous. Cotyledons with entire margin. Fig. 370.

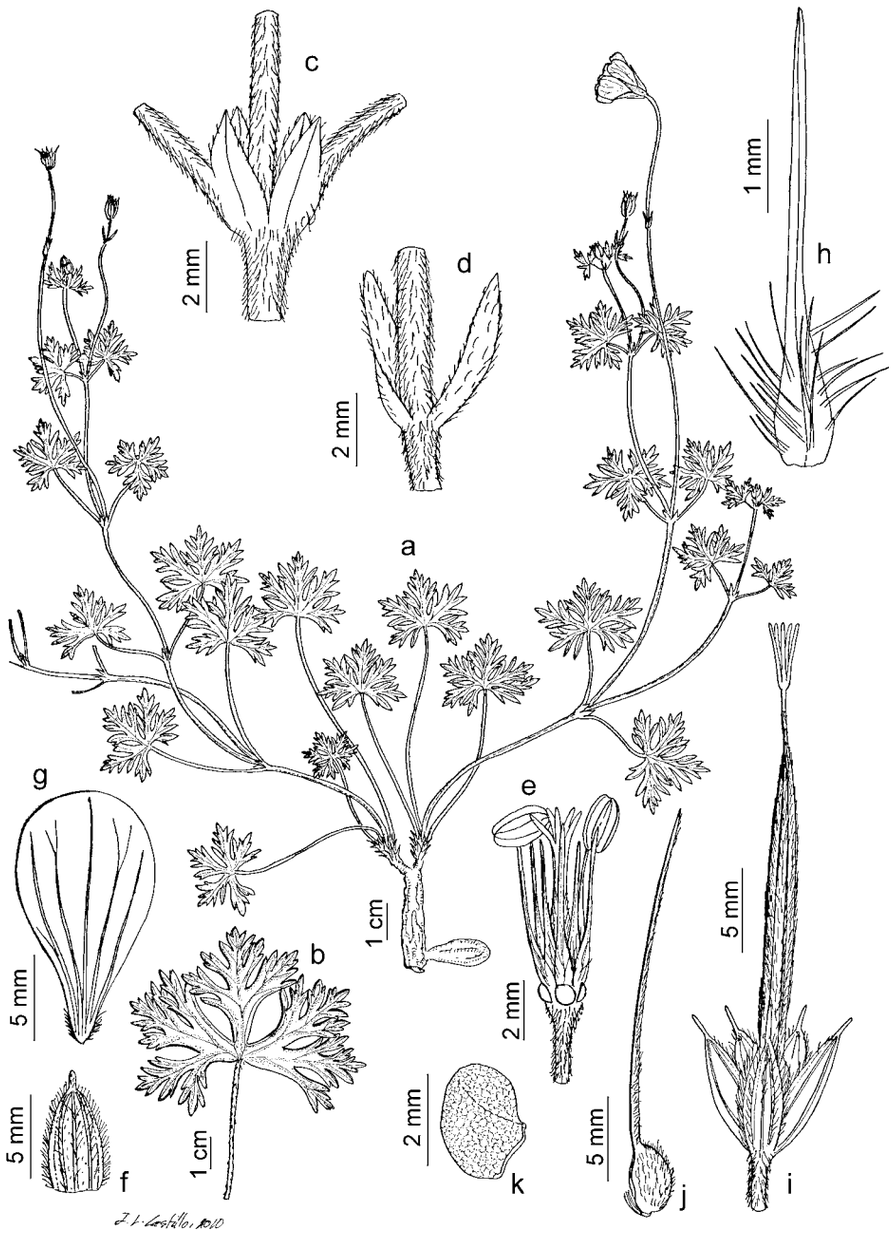


Fig. 370. *Geranium andicola*. a. Habit. b. Leaf. c. Stipules. d. Bracteoles. e. Flower, sepals and petals removed. f. Sepal. g. Petal. h. Staminal filament. i. Fruit. j. Mericarp. k. Seed. (Based on: a, c-h, *Beaman 3008*, GH; b, *Skutch 1238*, GH; i-k, *Breedlove 15102*, MICH).

Pollen. Ornamentation not studied.

Chromosome number. Unknown.

Phenology. Collected in flower from January to November.

Distribution. This species ranges from southern Mexico to Guatemala (Fig. 371).

Habitat. Alpine meadows, or open evergreen cloud forests with *Abies* Mill., *Pinus* L., and *Quercus* L.; 2200-4000 m.

Additional specimens examined. **Guatemala.** Huehuetenango: Sierra de los Cuchumatanes, at km 311 on ruta nacional 9, between Paquix and Chemal, 15º24'N, 91º20'W, 2 Aug. 1959, *Beaman 3008* (GH); Sierra de los Cuchumatanes, between Tojiah and Chemal, at km 320 on ruta nacional 9, 15º24'N, 91º20'W, 29 July 1960, *Beaman 3765* (B, GH, NY); Sierra de los Cuchumatanes, 15º24'N, 91º20'W, 15 Sep. 1934, *Skutch 1238* (GH); Chiantla, 15º24'N, 91º25'W, 10 Aug. 1999, *Véliz & Morales 99.7036* (MEXU); alpine areas in the vicinity of Tunimá, Sierra de los Cuchumatanes, 15º30'N, 91º26'W, 7 July 1942, *Steyermark 48329* (GH); Chiantla, Chancol, 15º30'N, 91º20'W, 29 Apr. 2000, *Véliz & al. 10054* (MEXU); Chiantla, Chancol, 15º30'N, 91º20'W, 23 Jan. 2001, *Véliz & al. 10139* (MEXU); near Tojquia, summit of Sierra de los Cuchumatanes, 15º34'N, 91º29'W, 7 Aug. 1942, *Steyermark 50234* (GH). Quetzaltenango: volcán Santa María, 14º45'N, 91º32'W, 27 July 1934, *Skutch 856* (GH). Sacatepéquez: Sacatepéquez-Escuintla border, volcán de Agua, W rim of the crater, 10 m below the highet point, 14º27'N, 90º44'W, 3 Oct. 1980, *Gereau 734* (NY); volcán de Agua, summit of E rim of crater, 14º28'N, 90º43'W, 31 July 1959, *Beaman 2943* (GH); volcán de Agua, 14º28'N, 90º43'W, 20 May 1994, *Sajtoj & Véliz 94.3708* (MEXU). Totonicapán: 21 kms E of Totonicapan, at km 153 on ruta nacional 1, 14º52'N, 91º13'W, 8 Aug. 1959, *Beaman 3125* (GH). **Mexico.** Chiapas: summit volcán Tacaná, Unión Juárez, 15º7'N, 92º6'W, 30 July 1972, *Breedlove 26696* (MICH); volcán Tacaná, above Talquian, Unión Juárez, 15º7'N, 92º6'W, 11 Nov. 1972, *Breedlove 29388* (MEXU); Mt. Male, near Porvenir, 15º25'N, 92º14'W, 6 July 1941, *Matuda 4705* (GH, NY); NW slope of Cerro Mozotal below the microwave tower along the road from Huixtla to El Porvenir and Siltepec, municipio de Motozintla de Mendoza, 15º26'N, 92º20'W, 19 Sep. 1976, *Breedlove 40270* (MEXU, MICH); SW of Mexican highway 190 near Rancho Nuevo, about 9 mi SE of San Cristóbal de las Casas, 16º38'N, 92º32'W, 20 Aug. 1966, *Breedlove 15102* (MICH, NY). Oaxaca: Juxtlahuaca, San Juan Mixtepec, Cerro Peña Cerrada de Biga a 6 km de La Batea a Santo Domingo Yosoñama, 17º18'N, 97º51'W, 8 Aug. 1987, *Sánchez 26* (IEB).

Fig. 371. Distribution of *Geranium andicola*.

Discussion. Geranium andicola is similar to *G. potentillifolium* and *G. bellum* in habit, rootstock, and indumentum. The indumentum of *G. andicola* is composed of short eglandular hairs, usually retrorse and sometimes appressed, and present on stems, petioles, and inflorescences. Leaves of *G. andicola* are less deeply divided than in *G. potentillifolium* and have broader segments and lobes. The abaxial surface is more hairy than the adaxial one but never sericeous. *Geranium andicola* has always white petals, like *G. bellum*, but short anthers, like *G. potentillifolium*. The most distinctive feature of *G. andicola* is its longer cymules, especially the longer pedicels, although with some overlap with *G. bellum* and *G. potentillifolium*. In two specimens of *G. andicola* both 1-flowered and 2-flowered cymules were found, although in general specimens have only 1-flowered cymules. *Geranium andicola* is found in western Guatemala and adjacent Chiapas (Mexico); it has been collected once in Oaxaca. Plants from Chiapas have peduncles shorter than those of Guatemala but otherwise agree with *G. andicola*. The specimens studied have few well-developed fruits and mature seed. I agree with Moore (1943: 61) that the two varieties described by Loesener are only variants with more or less long cymules that are linked by many intermediate forms.

143. Geranium schiedeanum Schltdl., Linnaea 10: 253. 1835. Type locality: "337. Geranium Schiedeanum... Pr. la Joya Jun 29". Type: Mexico. Veracruz, La Joya, 19°36'N, 97°02'W, 29 June 1829, *C.J. Schiede s.n.* (lectotype, desginated by Aedo 2012: 137, HAL-0076344!).

Geranium palmeri Rose in Underw. & Britton (eds.), N. Amer. Fl. 25(1): 16. 1907. Type locality: "Type collected at Alvarez, San Luis Potosi, Mexico, September 28 to October 3, 1902, E. Palmer 146". Type: Mexico. San Luis Potosí, Álvarez, 22°03'N, 100°37'W, 28 Sep.-3 Oct. 1902, *E. Palmer 146* (lectotype, designated by Moore 1943: 57, US image!; isolectotypes, BM!, F!, GH-00043648!, MO, NY, US).

Geranium pedatifidum Hanks in Underw. & Britton (eds.), N. Amer. Fl. 25(1): 17. 1907. Type locality: "Type collected near Real del Monte, Hidalgo, Mexico, July 19, 1905, J. N. Rose, H. J. Painter & J. S. Rose 8690". Type: Mexico. Hidalgo, Real del Monte, 20°08'N, 98°42'W, 19 July 1905, *J.N. Rose & al. 8690* (holotype, NY!; isotypes, F!, GH-00043649!, MEXU!, MO-060364!, US image!).

Geranium purpusii R. Knuth, Repert. Spec. Nov. Regni Veg. 12: 40. 1913. Type locality: "Mexico: Staat Puebla, auf Feldern bei Esperanza (Purpus a. 1908!).-Die Diagnose rührt von einer im botanischen Garten zu Darmstadt kultivierten Pflanze (Herb. Schenck no. 944)". TYPE: based on a living plant cultivated at a botanical garden in Darmstadt, Germany, voucher: herb. Schenck 944; seed source: Mexico, Puebla, bei Esperanza, 18º51'N, 97º22'W, *C.A. Purpus s.n.* (no original material located).

Geranium arsenianum R. Knuth, Repert. Spec. Nov. Regni Veg. 18: 290. 1922, [31 Dec. 1922]. Type locality: "Mexico: Puebla, 2450 m (Arsine no. 2126 - Typus in Herb. Berol.!)". Type: Mexico. Puebla, 18°51'N, 97°22'W, 16 Nov. 1907, *G. Arsène 2126* (holotype, B destroyed; isotypes, BM-000796982!, GH-00043621!, MO-060370!, MPU!, NY!, US image!).

Perennial herbs, 22-65 cm tall. *Rootstock* 4.2-17.4 mm in diameter, ± vertical, not tuberculate, turnip-shaped, without thickened roots. *Stem* spreading or ascending, leafy, not rooting at

nodes, stolons absent, without vegetative stems, with patent to retrorse, appressed, eglandular hairs 0.4-0.8(1) mm long. *Basal leaves* few, not long persistent, cauline leaves opposite; leaf laminas 2-4.4 cm long, 2.7-5.3 cm wide, not peltate, palmatifid [ratio main-sinus length/middle segment length = 0.83-0.91], polygonal in outline, base cordate, not coriaceous, with nerves not projected, sparsely to densely pilose, with ± appressed, eglandular hairs on both surfaces, sometimes appearing sericeous abaxially; segments 5, in 1 plane, middle segment rhombic, 2-3.8 mm wide at the base [ratio segment width at the base/middle segment length = 0.09-0.21], (6)9-15(20)-lobed in distal half [ratio secondary sinus length/middle segment length = 0.25-0.46]; petioles up to 22 cm long, without abscission zone, terete, not swollen, not deflexed in age, with patent to retrorse, appressed, eglandular hairs 0.3-1.1 mm long; stipules 4.2-8.7 mm long, 0.7-2.8 mm wide, lanceolate, free, papery, brownish red, with eglandular hairs on both surfaces and on the margin. *Inflorescence* a monochasial cyme; cymules 2-flowered, solitary [ratio cymule length/leaf length = 1.5-4.6]; peduncles (49.6)126-175(244) mm long, with patent to retrorse-appressed, eglandular hairs 0.3-0.9 mm long; bracteoles 3.5-11.6 mm long, 0.4-1.8 mm wide, linear-lanceolate, whorled; pedicels 16-90 mm long, with patent to retrorse-appressed, eglandular hairs 0.3-1 mm long. Flowers actinomorphic. *Sepals* (5.5)6.7-7.8(10.1) mm long, 2.6-4 mm wide, lanceolate, smooth, not accrescent, nerves 3, mucro 0.9-2.4(3.4) mm long [ratio mucro length/sepal length = 0.13-0.46], with antrorse to patent, eglandular hairs 0.2-1.3 mm long on all the abaxial surface, hairy adaxially. *Petals* (11.5)15.5-17.9(24.1) mm long, 8.1-14.2 mm wide, erect-patent, rounded or slightly emarginate (notch 0.3-1.2 mm deep), without claw, purple, rarely white or pink, hairy on the base of the adaxial surface, ciliate on the basal margin, with hairs 0.4-0.9 mm long. *Stamens* 10, both whorls bearing anthers; filaments 5.1-8.5 mm long, lanceolate, yellow, pilose on the abaxial surface, ciliate on the proximal half, with hairs 0.4-1.3(2) mm long; anthers 1.7-2.6 mm long, yellow. Nectaries 5, hemispheric, usually with a tuft of hairs at the top, dorsally glabrous. *Gynoecium* 5.1-9.2 mm long, purple. *Fruit* 21.9-37.9 mm long, erect, discharge of seed-ejection type; mericarps 3.5-4.4 mm long, 1.8-2.6 mm wide, without a strand of fibers, not compressed at the apex, smooth, without basal beak, with a basal callus, without a basal prong, brown, with erect-pat-

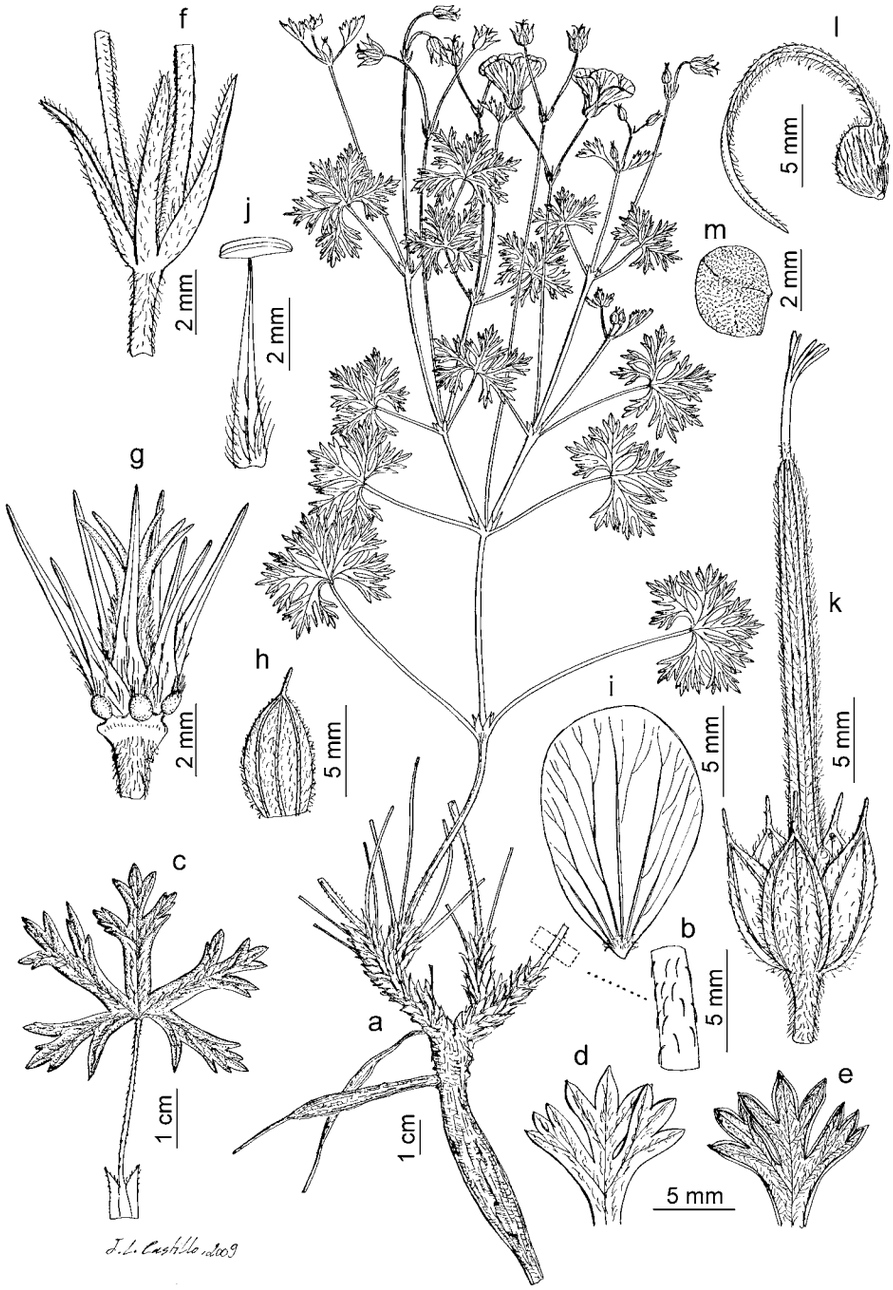


Fig. 372. *Geranium schiedeanum*. a. Habit. b. Detail showing stem indumentum. c. Leaf. d. Detail of leaf segment, adaxial side. e. Detail of leaf segment, abaxial side. f. Bracteoles. g. Flower, sepals and petals removed. h. Sepal. i. Petal. j. Stamen. k. Fruit. l. Mericarp. m. Seed. (Based on: a, b, d-j, *Barkley & Boghdan 39363*, GH; c, *Ventura 18832*, MEXU; k-m, *Arsène 7181*, MPU).

ent, eglandular hairs 0.5-1.5 mm long; rostrum 14.4-26.3 mm long, with a narrowed apex (1)2.1-4.1 mm long, not twisted, with ± patent, eglandular hairs 0.3-1.3 mm long; stigmatic remnants 2.4-4.5 mm long, with 5 glabrous lobes. *Seeds* 2.4-3.1 mm long, 1.6-2.5 mm wide, finely reticulate, uniformly colored, brown, glabrous. Cotyledons with entire margin. Fig. 372.

Pollen. *Geranium*-type (Bortenschlager 1967: 431).

Chromosome number. Unknown.

Phenology. Collected in flower from April to November.

Distribution. This species ranges through central and southern Mexico (Fig. 373).

Habitat. Margins of cultivated fields, moist rocky slopes, grassland, and *Abies* Mill., *Pinus* L., and *Quercus* L. forests; 1500-3600 m.

Representative specimens examined. **Mexico.** Guerrero: Chilpancingo de los Bravos, Ixtamalco, 18 km W of Chilpancingo, on rd to Olmitemi, 17°32'N, 99°40'W, 6 June 1985, *Thomas & Contreras 3712* (NY); Chichihualco, a 25 km al W Xochipala, camino Filo del Caballo, 17°39'N, 99°42'W, 12 June 1982, *Martínez 739* (MEXU). Hidalgo: municipio de Tepeapulco, Cerro Santa Ana, 19°46'N, 98°32'W, 28 Aug. 1975, *Ventura 313* (MEXU, MO); municipio de Cuatepec de Hinojosa, Ejido Aserradero, 20°2'N, 98°19'W, Sep. 1999, *Hernández & Hernández 75* (MEXU); between Somoriel and Las Lajas, 20°2'N, 98°29'W, 5 Aug. 1905, *Rose & al. 9225* (NY); 10 mi E of Tulancingo, near highway 130, 20°5'N, 98°14'W, 29 May 1972, *Van Cott 1444* (GH); Tezoantla, 20°8'N, 98°39'W, Sep. 1945, *Martínez s.n.* (GH); between Pachuca and Real del Monte, 20°8'N, 98°42'W, 31 Aug. 1903, *Rose & al. 6656* (NY); Zimapán, 20°43'N, 99°22'W, *Coulter 764* (NY). Mexico State: de Chalma, 18°54'N, 99°26'W, *Née s.n.* (MA); Toluca, 19°4'N, 100°3'W, *Wawra 1216* (W); Amecameca, 19°6'N, 98°45'W, 26 July 1924, *Fisher s.n.* (F); Tequezquinahuac, Azompan, 19°28'N, 98°49'W, 10 Aug. 1954, *Matuda 31172* (MEXU); 19 km NE de Texcoco, sobre la carretera a Calpulapan, 19°33'N, 98°45'W, 17 Aug. 1971, *Rzedowski 28493* (NY); 20 km NE de Texcoco, km 61.5 de la carretera México-Veracruz, vía Apizaco, 19°35'N, 98°55'W, 9 June 1968, *Ochoa 310* (TEX). Michoacán: Morelia, *Galeotti 4018* (W); E of Morelia, 19°40'N, 101°7'W, 26 June 1969, *Barkley & Boghdan 39363* (GH). Oaxaca: Miahuatlán, San Juan Mixtepec, 2.5 km S at Camp Zhan-Quie Len-Gui, 16°18'N, 96°18'W, 28 Sep. 1996, *Hunn 192* (XAL); above Vivero Rancho Teja, Ixtlán de Juárez, 17°5'N, 96°0'W, 10 July 1973, *McPherson 706* (MICH); Ixtlán, near Loma Grande, 26 km N Oaxaca on highway 175, 17°11'N, 96°34'W, 24 Aug. 1970, *Norris & Taranto 16675* (CAS, MO); Ixtlán, municipio Atepec, near Llano de las Flores, 17°31'N, 96°39'W, 5 Aug. 1981, *Martin 641* (BM, F, NY); Ixtlán, municipio Comaltepec, 12 km S of Comaltepec on road to Macuiltianguis, 17°34'N, 96°34'W, 1 July 1981, *Martin 533* (NY); along highway 175 about 67 km N of Ixtlán de Juárez, 17°47'N, 96°15'W, 20 Aug. 1970, *Norris & Taranto 16232* (CAS); Tepelmeme, 13 km NE de El Rodeo, Portezuelo Mole o Cerro Verde, 18°4'N, 97°18'W, 9 July 1986, *Salinas & al. 3354* (IEB). Puebla: Chinantla, 18°11'N, 98°15'W, May 1841, *Liebmann 3759* (F); San Luis Tultitlanapa, Cerro Verde, 18°11'N, 97°26'W, July 1908, *Purpus 3508* (F, NY); Cerro del Gavilán, 18°35'N, 97°55'W, Aug. 1909, *Purpus 3910* (BM, F); along Tehuacán-Orizaba highway on the W slopes below Puerto del Aire, 18°43'N, 97°24'W, 18 July 1961, *Smith & al. 3891* (F, GH, NY); parque estatal general Lázaro Cárdenas, 19°1'N, 98°6'W, 29 May 1992, *Romero 829* (MEXU); W of río Frío, 40 mi E of México city, 19°16'N, 98°28'W, 1 Aug. 1953, *Manning & Manning 53667a* (GH); Manzanilla, 19°49'N, 97°38'W, 30 July 1908, *Arsène (frère) 7181* (MPU). Querétaro: municipio de Landa, 7-8 km NE de la Lagunita de San Diego, Ciénaga del Cerro Grande, 21°13'N, 99°20'W, 28 Aug. 1991, *Orozco 1284* (MEXU). San Luis Potosí: region of San Luis Potosí, 22°6'N, 100°39'W, 1878, *Parry & Palmer 99* (NY); Sierra Madre Oriental, Sierra de Álvarez, F.C. Potosí & Río Verde, 22°6'N, 100°39'W, 1 Aug. 1934, *Pennell 17817* (GH). Tlaxcala: Capulalpan, 19°35'N, 98°34'W, 24 July 1955, *Gold 291* (MEXU). Veracruz: Jabillas, límite estado de Hidalgo, 19 July 1971, *Nevling & Gómez Pompa 1803* (F); cumbre Acultzingo, 18°43'N, 97°19'W, May 1937, *Matuda 1094* (F); Mt. Orizaba, 19°1'N, 97°14'W, 5 Aug. 1891, *Seaton 175* (F); Cruz Blanca, carretera Perote-Xalapa, 19°37'N, 97°15'W, 15 July 1983, *Narave 859* (MEXU); Volcancillo, 19°38'N, 97°5'W, 26 Sep. 1977, *Ventura 14506* (MEXU, F); municipo Las Vigas, Manzanares, 19°38'N, 97°5'W, 20 Oct. 1972, *Ventura 7220* (MEXU); vereda de Cruz Blanca a Las Minas, 19°40'N, 97°10'W, 17 July 1993, *Durán & Leal 1136* (MEXU); municipio Sebastopol, 3 km al E de La Paz, 19°41'N, 97°5'W, 29 June 1987, *Campos 414* (U); municipio Las Vigas, borde entre las Vigas y Tatatila, 19°42'N, 97°6'W, July 1981, *Cházaro 1582* (F); municipio de Altotonga, Ahuayahualco, 19°46'N, 97°14'W, 3 July 1970, *Ventura 1429* (F, NY).

Fig. 373. Distribution of *Geranium schiedeanum*.

Discussion. Geranium schiedeanum is one of the most common species of cranesbills in central Mexico. It is sympatric and sometimes confused with the similar *G. potentillifolium*. The rootstock of *G. schiedeanum* is like that of *G. potentillifolium* with a vertical and turnip-shaped part, which is joined distally to secondary and smaller turnip-shaped segments. The leaf blades of *G. schiedeanum* are less deeply divided and have an abaxial indumentum not as dense as in *G. potentillifolium*. The peduncles of *G. schiedeanum* are noticeably long; there is little overlap in measurements with those of *G. potentillifolium*. Additionally, *G. schiedeanum* has 2-flowered cymules, whereas *G. potentillifolium* has 1-flowered ones; however, occasionally some 1-flowered cymules are present in plants of *G. schiedeanum*. The petals and staminal filaments of *G. schiedeanum* are longer than those of *G. potentillifolium*, although with some overlap, but the anthers of *G. schiedeanum* exceed those of *G. potentillifolium*. As Moore (1943: 58) pointed out, several species said to be similar to *G. schiedeanum* have been recognized, but the characters intergrade sufficiently to consider them as variants of a single variable species. Among these segregates, *G. arsenianum* is probably the most striking because of its dense indumentum; however, density of indumentum is a variable feature in *G. schiedeanum* that

does not show any correlation with other characters or geography. It is noteworthy that petals of plants from the southern part of the range of *G. schiedeanum* (Guerrero and Oaxaca) are white or pinkish instead of purplish, but no additional features distinguish these populations from those of other parts of the range.

144. Geranium goldmanii Rose ex Hanks & Small in Underw. & Britton (eds.), N. Amer. Fl. 25(1): 17. 1907. Type locality: "Type collected at Teopisca, Chiapas, Mexico, May 7, 1904, E. A. Goldman 946". Type: Mexico. Chiapas, Teopisca, 16°32'N, 92°28'W, 7 May 1904, *E.A. Goldman 946* (holotype, US-00100920 image!).

Perennial herbs, 24-60 cm tall. *Rootstock* 4.5-10.6 mm in diameter, ± vertical, not tuberculate, turnip-shaped, without thickened roots. *Stem* erect or ascending, leafy, not rooting at nodes, stolons absent, without vegetative stems, hirsute, with patent, eglandular hairs (0.4)1-1.7 mm long. *Basal leaves* few, not long persistent, cauline leaves opposite; leaf laminas 1.9-3.7 cm long, 2.4-4.6 cm wide, not peltate, palmatifid [ratio main-sinus length/middle segment length = 0.79-0.93], polygonal in outline, base cordate, not coriaceous, with nerves not projected, pilose on both surfaces, with ± appressed, eglandular hairs; segments 5, in 1 plane, middle segment rhombic, 1.6-4.9 mm wide at the base [ratio segment width at the base/middle segment length = 0.10-0.30], (7)9-13(17)-lobed in distal half [ratio secondary sinus length/middle segment length = 0.19-0.43]; petioles up to 9 cm long, without abscission zone, terete, not swollen, not deflexed in age, hirsute, with patent, eglandular hairs (0.6)1.3-1.9 mm long; stipules 2.4-8.7 mm long, 0.8-2.4 mm wide, lanceolate, free, papery, brownish red, with eglandular hairs on both surfaces and on the margin. *Inflorescence* a monochasial cyme; cymules 2-flowered, solitary [ratio cymule length/leaf length = 3-5.2(12)]; peduncles (83)109-155(178) mm long, hirsute, with patent, eglandular hairs (0.2)1-1.6 mm long; bracteoles 2.6-6.4 mm long, 0.4-0.9 mm wide, linear-lanceolate, whorled; pedicels 11-69 mm long, hirsute, with patent, eglandular hairs 0.3-1.5 mm long. Flowers actinomorphic. *Sepals* (6.3)6.9-8(10.3) mm long, 2.2-4.2 mm wide, lanceolate, smooth, not accrescent, nerves 3, mucro 0.9-2.1 mm long [ratio mucro length/sepal length = 0.13-0.22], glabrous except for some patent, eglandular hairs 0.7-1.6 mm long on the veins of the abaxial surface, glabrous adaxially. *Petals* (11.5)13.7-16.1(18.2) mm long, 6.3-10.6 mm wide, erect-patent, rounded, without claw, purple, hairy on the base of their adaxial surface, ciliate on the basal margin, with hairs 0.4-0.9 mm long. *Stamens* 10, both whorls bearing anthers; filaments 5-7.1 mm long, lanceolate, yellow, pilose on the abaxial surface, ciliate on the proximal half, with hairs 0.2-1.2 mm long; anthers 1.4-2 mm long, yellow. Nectaries 5, hemispheric, usually glabrous. *Gynoecium* 5.4-8.1 mm long, purple. *Fruit* 25-29.4 mm long, erect, discharge of seed-ejection type; mericarps 3.3-4.9 mm long, 1.5-2.1 mm wide, without a strand of fibers, not compressed at the apex, smooth, without basal beak, with a basal callus, without a basal prong, brown, with erect-patent, eglandular hairs 0.3-0.8 mm long; rostrum 16-20.5 mm long, with a narrowed apex 1.4-2.9 mm long, not twisted, with ± patent, eglandular hairs 0.3-0.8 mm long; stigmatic remnants 3.2-5.1 mm long, with 5 glabrous lobes. *Seeds* 2.6-3.2 mm long, 1.6-2 mm wide, finely reticulate, uniformly colored, brown, glabrous. Cotyledons with entire margin. Fig. 374.

Pollen. Ornamentation not studied.

Chromosome number. Unknown.

Phenology. Collected in flower from April to November.

Distribution. This species ranges through Oaxaca and Chiapas, in southern Mexico (Fig. 375).

Habitat. Meadows, stream banks, rocky slopes, and *Liquidambar* L., *Persea* Mill., *Pinus* L., and *Quercus* L. forests; 1600-2500 m.

Additional specimens examined. **Mexico.** Chiapas: Chiapas, *Ghiesbreght 59* (NY); Chiapas, 1864, *Ghiesbreght 657* (BM, GH, NY); along route 190, km 1220-1, 4 July 1965, *Mertz 45* (MEXU); NE [Nueva España], 1798, *Mociño s.n.* (F, MA); carretera de San Cristóbal a Ocosingo, 4-6 km al NE de la desviación a Ocosingo, 16°18'N, 92°6'W, 1 Dec. 1973, *Koch & al. 7375* (UC); Amatenango del Valle, 2 km al S de Amatenango, 16°29'N, 92°25'W, 22 July 1988, *López 564* (MEXU); along route 190, about 10 mi E of Teopisca, 16°30'N, 92°21'W, 24 June 1960, *King 3021* (NY); along route 190, about 13 mi E of San Cristóbal de las Casas, 16°35'N, 92°30'W, 11 June 1960, *King 2814* (NY); Amatenango del Valle, 8 km al N de la cabecera de Amatenango, 16°35'N, 92°25'W, 8 June 1988, *Pérez 567* (MEXU); Jardín Botánico San Cristóbal, km 7 carretera San Cristóbal-Comitán, 16°40'N, 92°35'W, 3 June 1982, *García 445* (XAL); Teopisca, Campo Santiago, km 22 carretera San Cristóbal-Comitán, 16°40'N, 92°35'W, 15 June 1984, *Gómez 19* (XAL); S end of the valley of San Cristóbal de las Casas, 16°42'N, 92°38'W, 15 May 1965, *Breedlove 9920* (F); 4 km al W de San Cristóbal de las Casas, above San Felipe, 16°42'N, 92°39'W, 30 June 1991, *Jones 2008* (MEXU); a 10 km al SW de San Cristóbal de las Casas, por el camino a Zacualpan, 16°43'N, 92°41'W, 23 Nov. 1982, *Cabrera 3743* (MEXU); Cerro San Cristóbal, San Cristóbal de las Casas, 16°44'N, 92°38'W, 5 July 1964, *Breedlove 6005* (F); Huixtán, 500 m entrada a López Mateos, 16°44'N, 92°25'W, 30 June 1994, *Chamé & Luna 76* (MEXU); rancho Pellizzí, a 3 km al E de San Cristóbal de las Casas, 16°44'N, 92°36'W, 20 June 1985, *Méndez 8332* (MEXU); near San Cristóbal de las Casas, 16°44'N, 92°38'W, 18 Sep. 1895, *Nelson 3155* (NY); valley E of Las Casas, 16°45'N, 92°38'W, 20 Apr. 1945, *Alexander 1171* (NY); Zinacantán center, 16°45'N, 92°42'W, 25 May 1966, *Laughlin 962* (F); San Juán Chamula, Las Minas, 16°47'N, 92°40'W, 2 Sep. 1987, *Ruiz 104* (MEXU); 3 km al W de la carretera San Cristóbal de las Casas-Tenejapa, sobre el camino a Matzala, 16°48'N, 92°35'W, 29 Sep. 1983, *Cabrera 5787* (MEXU); barrio Winik ton at Paraje Matsab, municipio of Tenejapa, 16°48'N, 92°31'W, 24 June 1966, *Ton 1042* (GH, NY); 3 km N of Pueblo Nuevo Solistahuacán, 17°6'N, 92°53'W, 18 Sep. 1962, *Lathrop 5248* (UC). Oaxaca: 12 mi S of Guelatao along highway 175 to Oaxaca, 17°10'N, 96°34'W, 16 Aug. 1975,

Davidse 9730 (MO); 134 km SE of Huajuapan on highway 190, 17°16'N, 96°57'W, 25 July 1971, *Gibson & Gibson 2381* (RSA); 12 km N of Ixtlán de Juárez, on the road to Valle Nacional, 17°23'N, 96°25'W, 26 July 1959, *King 2019* (MICH); 12 km N of Ixtlán de Juárez, on the road to Valle Nacional, 17°23'N, 96°25'W, 26 July 1959, *King 2074* (MICH); La Esperanza, highway 180, km 83, 17°30'N, 96°30'W, 3 July 1981, *Hahn 648* (BM, MO, NY).

Discussion. Geranium goldmanii shares with *G. schiedeanum* a similar habit, long peduncles, 2-flowered cymules, and purplish petals. Underground parts of *G. goldmanii* are poorly collected, but the available fragments suggest that it has a rootstock similar to that of *G. schiedeanum.* As Moore (1943: 52) pointed out, *G. goldmanii* is distinguishable from *G. schiedeanum* by the longer and more rigid hairs of the stem base, petioles, peduncles, and sepals. Sepals of *G. goldmanii* are glabrous, except for some long hairs on the veins abaxially, whereas in *G. schiedeanum* the abaxial surface is covered with hairs that are longer on the nerves. Additionally, in *G. goldmanii* the bracteoles, sepal mucro, petals, and staminal filaments are shorter than in *G. schiedeanum*, although with some overlap. The ranges of the two species overlap somewhat only in central Oaxaca. The western populations of *G. andicola* reach central Chiapas and there are sympatric with *G. goldmanii*. Both species share long peduncles, but *G. andicola* is distinguished from *G. goldmanii* chiefly by its 1-flowered cymules and white petals. Additionally, *G. andicola* has shorter hairs stem, petioles, and peduncles although with some overlap. *Geranium goldmanii* was apparently first collected by Mociño. There is a specimen at MA (with a duplicate at F) labeled only as "*Geranium violaceum* / NE" [Nueva España]. According to Arias (1968: 194, 199), Mociño spent about two months in Chiapas towards the end of 1798, during his return from Guatemala to Mexico. It seems to be probable that the specimen was collected at that time.

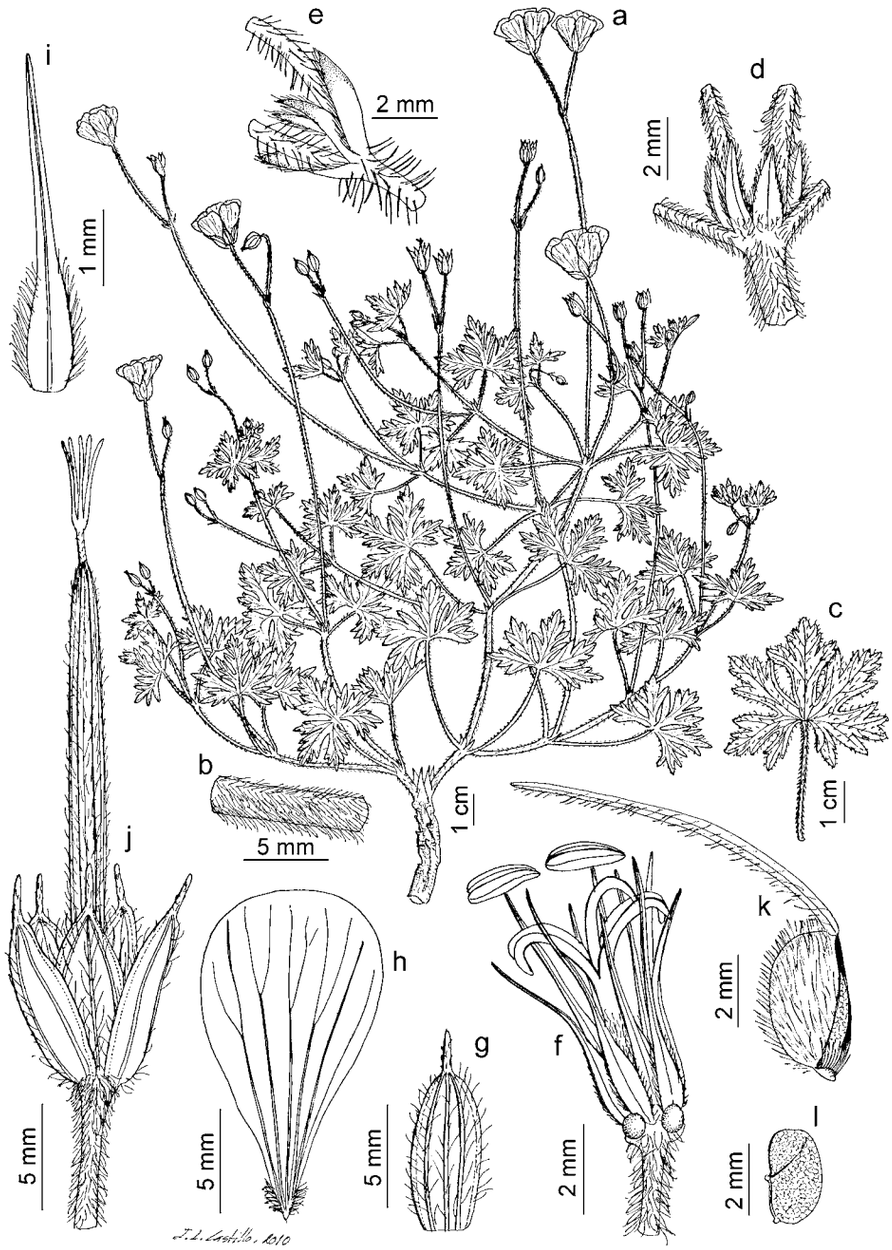


Fig. 374. *Geranium goldmanii*. a. Habit. b. Detail showing stem indumentum. c. Leaf. d. Stipules. e. Bracteoles. f. Flower, sepals and petals removed. g. Sepal. h. Petal. i. Staminal filament. j. Fruit. k. Mericarp. l. Seed. (Based on: a, b, d-i, *Alexander 1171*, NY; c, *Jones 2008*, MEXU; j-l, *Ghiesbreght 657*, GH).

Fig. 375. Distribution of *Geranium goldmanii*.

The Hernandesii Group—This group is characterized by its ascending to erect habit, its not turnip-shaped rootstock, its opposite, palmatifid leaves and its usually 2-flowered cymules arranged in monochasial inflorescence. The petals are of medium size, usually erect-patent, without claw, and usually hairy on 1/4 to 3/4 of their adaxial surface.

145. Geranium hernandesii Moç. & Sessé ex DC., Prodr. 1: 640. 1824. Type locality: "G. Hernandesii (fl. mex. ic. ined.)... in Mexico. Flores palidi. Hern. mex. 293. f. 2". Type: Plate 6331.1076 in the Torner Collection of Sessé and Mociño Biological Illustrations at the Hunt Institute for Botanical Documentation (holotype). Mexico. Without locality, *M. Sessé & J.M. Mociño s.n.* (epitype, designated by Aedo 2012: 148, MA-601774!; isoepitype, F-0360130F!).

Geranium aristatum Small in Underw. & Britton (eds.), N. Amer. Fl. 25(1): 19. 1907, nom. illeg., non Freyn & Sint. 1897. *Geranium aristisepalum* H.E. Moore, Contr. Gray Herb. 146: 63. 1943. Type locality: "Type collected near Santa Fé, Mexico, August 22, 1903, J. N. Rose & J. H. Painter 6496". Type: Mexico. Distrito Federal, Santa Fé, 19°23'N, 99°15'W, 22 Aug. 1903, *J.N. Rose & J.H. Painter 6496* (holotype, NY-00373653!; isotype, US-00100858 image!).

Geranium aristisepalum var. *michoacanum* H.E. Moore, Contr. Gray Herb. 146: 65, pl. 3 fig. 6c. 1943. *Geranium hernandesii* var. *michoacanum* (H.E. Moore) H.E. Moore, Gentes Herb. 8: 251. 1951. Type locality: "MEXICO: Michoacan: ... pine woods, road from Tancitaro to Apatzingan, Municipio Tancitaro, 5000', Aug. 17, 1940, Leawenworth 609 (G, type; F, M, NY, isotypes)". Type: Mexico. Michoacán, road from Tancitaro to Apatzingan, 19°20'N, 102°22'W, 17 Aug. 1940, *W.C. Leawenworth 609* (holotype, GH-00043631!; isoypes, F!, MICH image!, MO-060423!, NY!).

Perennial herbs, 29-83 cm tall. *Rootstock* 12-19 mm in diameter, vertical, not tuberculate, not turnip-shaped, unknown roots. *Stem* erect or ascending, leafy, not rooting at nodes, stolons absent, without vegetative stems, with patent to retrorse, eglandular hairs 0.4-1.9 mm long. *Basal leaves* few, not long persistent, cauline leaves opposite; leaf laminas 4.8-9.4 cm long, 5.2-9.6 cm wide, not peltate, palmatifid [ratio main-sinus length/middle segment length = 0.81-0.96], polygonal (medium and upper hastate) in outline, base cordate, not coriaceous, with nerves not projected, pilose on both surfaces, with appressed, eglandular hairs; segments 3-5, in 1 plane, middle segment rhombic, 4.8-12(15.2) mm wide at the base [ratio segment width at the base/middle segment length = 0.10-0.35], 7-10(16)-lobed in distal half [ratio secondary sinus length/middle segment length = 0.05-0.19]; petioles up to 21 cm long, without abscission zone, terete, not swollen, not deflexed in age, with patent to retrorse, eglandular hairs 0.4-2 mm long; stipules 4.4-10 mm long, 1.3-2.5 mm wide, lanceolate, free, papery, brownish red, with eglandular hairs on both surfaces and on the margin. *Inflorescence* a monochasial cyme; cymules 2-flowered, solitary [ratio cymule length/leaf length = 2.3-3.8]; peduncles (67)111-222(240) mm long, with patent to retrorse, eglandular hairs 0.7-1.4 mm long; bracteoles 3.4-10.8 mm long, 0.4-1.3 mm wide, lanceolate, whorled; pedicels 20-96 mm long, with patent to retrorse, eglandular hairs 0.2-1.4 mm long. Flowers actinomorphic. *Sepals* (7.7)8-9.9 mm long, 3.1-4.6 mm wide, lanceolate, smooth, not accrescent, nerves 3-5, mucro (2.6)2.8-4.8 mm long [ratio mucro length/sepal length = 0.31-0.50], with antrorse to patent, eglandular hairs 0.7-1.4 mm long on the abaxial surface, glabrous adaxially. *Petals* 14-16.8(17.2) mm long, 5.9-12.4 mm wide, erect-patent, rounded or slightly emarginate (notch 0.5-1.2 mm deep), without claw, white, rarely pink, hairy on the basal 1/2-3/4 of their adaxial surface, ciliate on the basal margin, with hairs 0.7-1.5 mm long. *Stamens* 10, both whorls bearing anthers; filaments 6.6-11.3 mm long, lanceolate, yellow, pilose on the abaxial surface, ciliate on the proximal half, with hairs 0.4-1.4 mm long; anthers 1.6-2.2 mm long, blue. Nectaries 5, hemispheric, glabrous. *Gynoecium* 6.2-10.3 mm long, purple. *Fruit* 30.8-45.6 mm long, erect, discharge of seed-ejection type; mericarps 3.8-5 mm long, 2.2-3 mm wide, without a strand of fibers, not compressed at the apex, smooth, without basal beak, with a basal callus, without a basal prong, brown, with erect-patent, eglandular hairs 0.9-1.3 mm long; rostrum 23.2-33.6 mm long, with a narrowed apex (2.8)3.9-4.8(7.6) mm long, not twisted, with ± patent, eglandular hairs 0.5-0.9 mm long; stigmatic remnants 3.6-7.2 mm long, with 5 glabrous lobes. *Seeds* 2.6-3.5 mm long, 1.7-2.7 mm wide, finely reticulate, uniformly colored, brown, glabrous. Cotyledons with entire margin. Fig. 376.

Pollen. *Geranium*-type (Bortenschlager 1967: 433).

Chromosome number. Unknown.

Phenology. Collected in flower from June to October.

Distribution. This species ranges through central Mexico (Fig. 377).

Habitat. Rocky slopes, pastures, and *Pinus* L. and *Quercus* L. forests; 1650-2600 m.

Additional specimens examined. **Mexico.** Hidalgo: Acuautla, 19°20'N, 98°51'W, *Altamirano 126* (MEXU); Cerro de los Pitos, 19°55'N, 98°44'W, 22 July 1951, *Matuda s.n.* (MEXU); El Chico, 20°13'N, 98°44'W, Sep. 1927, *Lyonnet 122* (BM, GH, MEXU, MO, NY); Tizapán, San Ángel, 20°39'N, 98°35'W, 11 Oct. 1928, *Saint Pierre 2143* (P). Jalisco: 32 km NW of Jilotlan de los Dolores, along road from Tecalitlan to Tepalcatepec, 19°27'N, 103°17'W, 16 Sep. 1986, *Breedlove & Anderson 64285* (CAS); Huejotitan, 20°20'N, 103°30'W, July 1912, *Diguet s.n.* (P); SE slopes of Cerro Gordo, above San Ignacio, 12 mi SE of Tepatitlán, 20°46'N, 102°29'W, 29 Aug. 1958, *McVaugh 17488* (MICH); San Martín de Bolaños, Las Treinta Vueltas, 10 km NW de El Platanar, 21°42'N, 103°51'W, 2 Sep. 1968, *Rzedowski 26210* (CAS, IEB, MICH, NY). Mexico Distrito Federal: Tlanepantla, Oct. 1913, *Salazar s.n.* (MEXU); vulcan Toluca, Tenancingo, 19°4'N, 99°44'W, *Heller 426* (W); camino de Toluca, 19°12'N, 99°49'W, 14 Aug. 1936, *Balls 5249* (BM); parte alta del Cerro de Santa Catari-

na, cerca de Santa Martha Astahuacán, 19°19'N, 99°2'W, 8 July 1973, *Rzedowski 30863* (MEXU); circa urbem Mexici, 19°20'N, 99°7'W, *Schmitz 495* (W); entre El Ángel y Tetelpa, 19°22'N, 99°13'W, 13 July 1940, *Altamirano 5162* (MEXU); Mixcoac, 19°23'N, 99°11'W, 11 July 1954, *Gold s.n.* (MEXU); barranca de Santa Fé, near km 18-19 on road from México to Toluca, 19°23'N, 99°15'W, 27 Aug. 1948, *Moore & Wood 4753* (BM, GH, MEXU); Cerro de Tecucingo, 19°23'N, 99°15'W, Sep. 1953, *Paray 30190* (MEXU); barranca above Santa Fé, 19°23'N, 99°15'W, 1 Sep. 1905, *Pringle 13499* (GH); barranca above Santa Fé, 19°23'N, 99°15'W, 12 Aug. 1909, *Pringle 4753* (F); Santa Fé, 19°23'N, 99°15'W, 15 July 1905, *Rose & al. 8627* (MEXU). Mexico State: mountains E of México City along highway 190, 16 July 1978, *Dziekanowski & al. 3068* (MO, NY); Temascaltepec, Tule, 19°6'N, 100°4'W, 22 July 1934, *Hinton 6250* (MO, NY); valle de México, Pedregal, 19°18'N, 99°9'W, 26 June 1865, *Bourgeau 290* (GH, MPU); municipio de Tezcoco, Cerro Tetzcutzingo, 7 km E de Tezcoco, 19°31'N, 98°53'W, 30 July 1979, *Pulido 79* (MEXU). Michoacán: Coalcomán, Sierra Torricillas, 18°46'N, 103°9'W, 24 July 1939, *Hinton 13986* (NY, MEXU); Coalcomán, Sierra Torricillas, 18°46'N, 103°9'W, 29 July 1941, *Hinton 15932* (MEXU, NY); Zitácuaro-Zirahuato, 19°26'N, 100°22'W, 19 Aug. 1938, *Hinton 13119* (NY, MEXU); Morelia, San Miguel, 19°37'N, 101°8'W, 8 Aug. 1912, *Arsène (frère) 9033* (MEXU, MPU); Zinapécuaro, Las Mesas, sobre el camino real, 19°39'N, 101°5'W, 27 Sep. 1988, *Jasso 217* (MEXU); Morelia, 4 km al S de Jesús del Monte, 19°39'N, 101°9'W, 20 July 1986, *Rzedowski 39965* (MEXU); Morelia, Los Filtros Viejos, 2 km E de Morelia, 19°42'N, 101°7'W, 20 July 1991, *Pérez & al. 2207* (MEXU); La Piedad, Cerro Grande, 20°18'N, 102°7'W, 27 Aug. 1986, *Labat 1863* (P).

Discussion. Geranium hernandesii is a robust plant with a more or less erect stem and eglandular indumentum; it has long peduncles, long petals, and a long sepal mucro. The underground parts remain mostly unknown, although a stout vertical rootstock is apparently present. The deciduous basal leaves, seen on only a few specimens, have five segments and a polygonal outline; the middle and distal cauline leaves have three segments and are hastate. The lateral segments of leaves of *G. hernandesii* are usually shorter than the middle

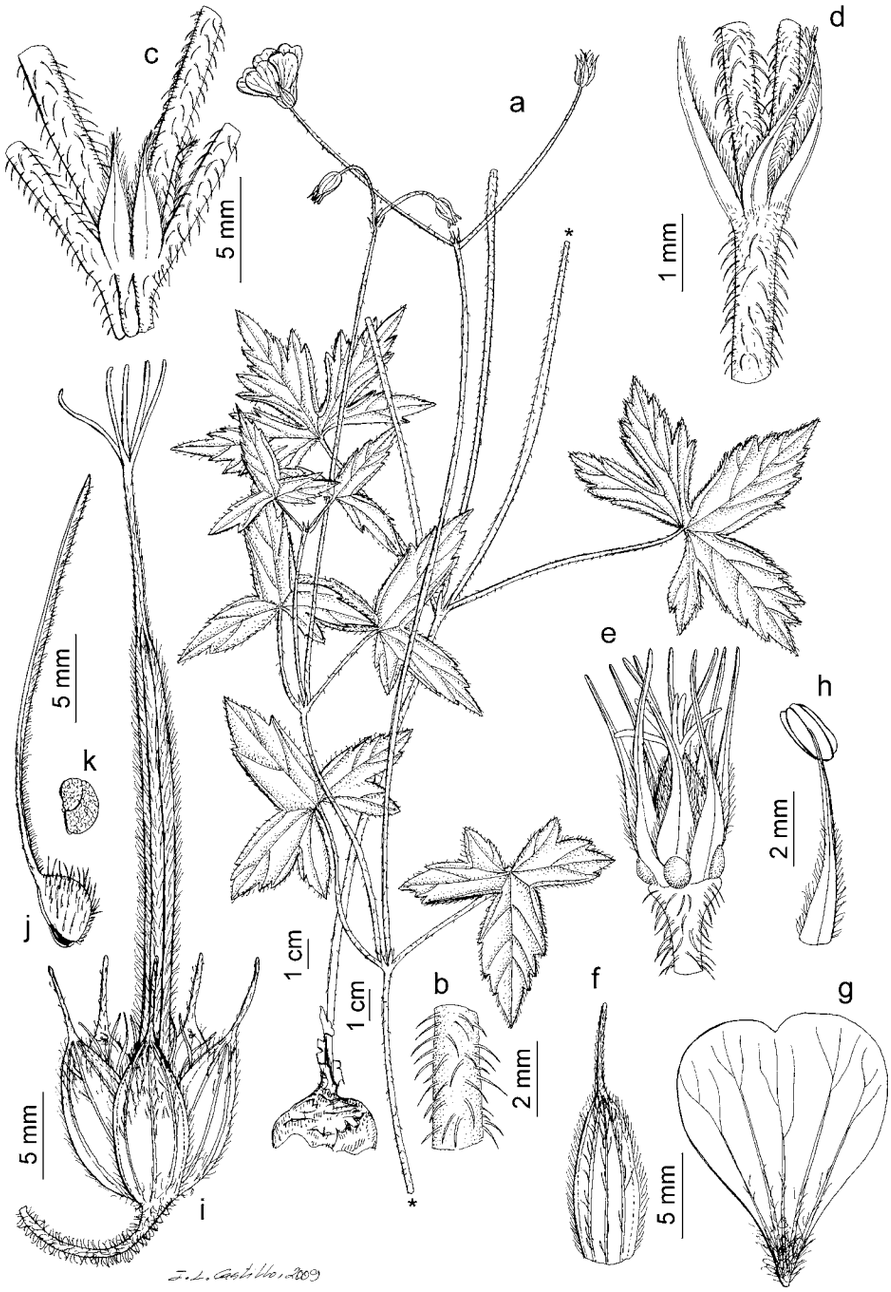


Fig. 376. *Geranium hernandesii*. a. Habit. b. Detail showing stem indumentum. c. Stipules. d. Bracteoles. e. Flower, sepals and petals removed. f. Sepal. g. Petal. h. Stamen. i. Fruit. j. Mericarp. k. Seed. (Based on: a-h, *Hinton 13986*, MEXU; i-k, *Lyonnet 122*, MO).

Fig. 377. Distribution of *Geranium hernandesii*.

one and have basal lobelets. Cymules of *G. hernandesii* are longer than those of *G. deltoideum* owing to the longer peduncles and pedicels, and the sepals are also longer and have a longer mucro. In addition, the petals are also longer in *G. hernandesii* than in *G. deltoideum* and bear long hairs adaxially; they are usually erect-patent, although in some herbarium specimens they seem to be almost patent. The indumentum is always eglandular, and the hairs are usually longer that those of *G. deltoideum*, although with some overlap. The collection *Rzedowski 26210* (CAS, MICH, NY) from Jalisco (Mexico) is unusual. The plants match typical representatives of *G. hernandesii* in the leaves, the long petals (15 mm long), long peduncles (up to 170 mm long), long sepal mucro (4 mm long), and glabrous nectaries; however, glandular hairs are present on the peduncles, pedicels, and sepals. This gathering is provisionally identified as *G. hernandesii*. Additional field work in the northwestern part of the range of *G. hernandesii* may reveal the extent of variability.

Originally, Moore (1943: 66) considered *G. aristisepalum* a separate species; yet, after examining a collection of *G. hernandesii* by Sessé & Mociño at F, Moore (1951: 250) reconsidered and included *G. aristisepalum* within *G. hernandesii*. Moreover, he pointed out that "those specimens to which I formerly applied the name of *G. Hernandesii* now seem to be no more than a southern phase of the more northern *G. deltoideum*". This interpretation is followed by Rzedowski & Rzedowski (1995: 16-19) and also in this work.

Moore (1943: 66) designated a copy of the drawing cited in the protologue from *Icones florae mexicanae ineditae* by Sessé & Mociño (De Candolle 1874, tab. 147) as type of *G. hernandesii*; however, the original drawing (not available at Moore's time) is a more accurate choice. The other original element mentioned by De Candolle (1824: 641) is the drawing published by Hernández (1649: 293 fig. 2); however, this figure shows a plant with the leaves very deeply divided and the basal segments well developed, which differs considerably from present concept of *G. hernandesii*. The epitype is a specimen at MA in the Sessé & Mociño herbarium. It is not mentioned in the protologue but likely the basis for the drawing selected as type.

Trelease (1888: 76) recorded *G. hernandesii* from Huachuca mountains, Arizona (U.S.A.). The voucher (*Lemmon 2651*) for this record was not located; however, according to the key and description provided by Trelease, the specimens he saw may be *G. caespitosum* or perhaps *G. wislizeni*, both found in this area. Surprisingly, Knuth (1912: 196) cited this name in the synonymy of *G. mexicanum* as "*G. Hernandezii* Trelease".

---

146. Geranium deltoideum Rydb. ex Hanks & Small in Underw. & Britton (eds.), N. Amer. Fl. 25(1): 18. 1907. Type locality: "Type collected at San Ramón, Durango, Mexico, April 21 to May 18, 1906, E. Palmer 192". Type: Mexico. Durango, San Ramón, 24°49'N, 105°38'W, 21 Apr.-18 May 1906, *E. Palmer 192* (holotype, NY-00373660!; isotypes, F-0044702F!, GH!, K-000531447!, MO, US-00100879 image!).

Geranium sublaevispermum H.E. Moore, Contr. Gray Herb. 146: 69, pl. 3 fig. 8, pl. 4 figs. 5, 8. 1943. Type locality: "MEXICO: Chihuahua: at base of rocks, in meadow margin, transition, pines, Memelichi, Rio Mayo, 7500', Sept. 16, 1936, Gentry 2740 (G, type; F, M, US, isotypes); scattered in rocks along stream, transition, riparian, pine, woods, Cerro Quicoriche, Rio Mayo, Oct., 6, 1935, Gentry 1937 (US)". Type: Mexico. Chihuahua, Memelichi, Río Mayo, Memelichi [Memelichic], 28°04'N, 108°11'W, 16 Sep. 1936, *H.S. Gentry 2740* (holotype, GH-00043655!; isotypes, ARIZ!, F-0044716F!, K!, MO!, US-00100937 image!).

Perennial herbs, 29-75 cm tall. *Rootstock* 3.9-14.9 mm in diameter, vertical, not tuberculate, not turnip-shaped, unknown roots. *Stem* prostrate to ascending, leafy, not rooting at nodes, stolons absent, without vegetative stems, with patent to retrorse, eglandular hairs 0.3-1 mm long. *Basal leaves* few, not long persistent, cauline leaves opposite; leaf laminas 2.3-8.7 cm long, 2.5-9.2 cm wide, not peltate, palmatifid [ratio main-sinus length/middle segment length = 0.70-0.89], polygonal (medium and upper hastate) in outline, base cordate (medium and upper ± truncate), not coriaceous, with nerves not projected, pilose on both surfaces, with appressed, eglandular hairs and rarely glandular hairs; segments 3-5, in 1 plane, middle segment rhombic, 3.8-10.6(17.9) mm wide at the base [ratio segment width at the base/middle segment length = 0.20-0.38], 7-11(19)-lobed in distal half [ratio secondary sinus length/middle segment length = 0.09-0.19]; petioles up to 12 cm long, without abscission zone, terete, not swollen, not deflexed in age, with patent to retrorse, eglandular hairs 0.4-1.7 mm long; stipules 3.4-11.4 mm long, 0.9-2.8 mm wide, lanceolate, free, papery, brownish red, with eglandular hairs on both surfaces and on the margin. *Inflorescence* a monochasial cyme; cymules 2-flowered, solitary [ratio cymule length/leaf length = 1-5.5]; peduncles (12)21-73(89) mm long, with patent to retrorse, eglandular hairs 0.1-0.7 mm long and, usually, patent, glandular hairs 0.2-0.5 mm long; bracteoles 2-6.8 mm long, 0.3-1.2 mm wide, lanceolate, whorled; pedicels (3)12-33 mm long, with patent to retrorse, eglandular hairs 0.1-0.7 mm long and, usually, patent, glandular hairs 0.2-0.5 mm long. Flowers actinomorphic. *Sepals* 5.3-7.4(8.1) mm long, 2.2-4.1 mm wide, lanceolate, smooth, not accrescent, nerves 3, mucro 0.6-1.7(2.5) mm long [ratio mucro length/sepal length = 0.10-0.32], with antrorse to patent, eglandular hairs 0.3-1.3 mm long and patent, glandular hairs 0.2-0.4 mm on the abaxial surface, glabrous adaxially. *Petals* 8-13(13.9) mm long, 3.9-10.3 mm wide, pat-

ent, rounded or slightly emarginate (notch 0.5-1.7 mm deep), without claw, white to pink, hairy on the basal 1/2-3/4 of their adaxial surface, ciliate on the basal margin, with hairs 0.7-1.6 mm long. *Stamens* 10, both whorls bearing anthers; filaments 5.1-11.1 mm long, lanceolate, yellow, pilose on the abaxial surface, ciliate on the proximal half, with hairs 0.2-0.9(1.5) mm long; anthers 1-1.9 mm long, purple. Nectaries 5, hemispheric, usually with a tuft of hairs covering all of its surface. *Gynoecium* 5.2-13 mm long, purple. *Fruit* 19.9-32.5 mm long, erect, discharge of seed-ejection type; mericarps 3.2-4 mm long, 1.6-2.1 mm wide, without a strand of fibers, not compressed at the apex, smooth, without basal beak, with a basal callus, without a basal prong, brown, with erect-patent, eglandular hairs 0.3-0.7 mm long and, usually, patent, glandular hairs 0.3-0.4 mm long; rostrum 12-21.4 mm long, with a narrowed apex (2.1)2.4-4.2(4.8) mm long, not twisted, with ± patent, eglandular hairs 0.1-0.6 mm long and, usually, patent, glandular hairs 0.2-0.4 mm long; stigmatic remnants 2.6-6.2 mm long, with 5 glabrous lobes. *Seeds* 2.1-2.5 mm long, 1.3-1.8 mm wide, finely reticulate, uniformly colored, brown, glabrous. Cotyledons with entire margin. Fig. 378.

Pollen. Ornamentation not studied.

Chromosome number. 2*n* = 52.

Phenology. Collected in flower from January to December.

Distribution. This species ranges from Sonora to Guerrero, in western Mexico (Fig. 379).

Habitat. Roadsides, cliff bases, moist ravines, meadows, and *Abies* Mill., *Pinus* L., *Pseudotsuga* Carrière, and *Quercus* L. forests; 850-3300 m.

Representative specimens examined. **Mexico.** Chihuahua: Guadalupe y Calvo, NW side of Cerro Mohinora, 12.5 mi SW of Guadalupe y Calvo, 26º0'N, 107º3'W, 27 Aug. 1987, *McDonald 2380* (XAL); Sierra Charuco, rancho Byerly, 27º30'N, 108º45'W, 17 Apr. 1948, *Gentry 8094* (RSA, UC); Ocampo, Parque Nacional Cascada de Basaseachic, 28º11'N, 108º12'W, 26 Apr. 1985, *Spellenberg & al. 8017* (NY). Du-

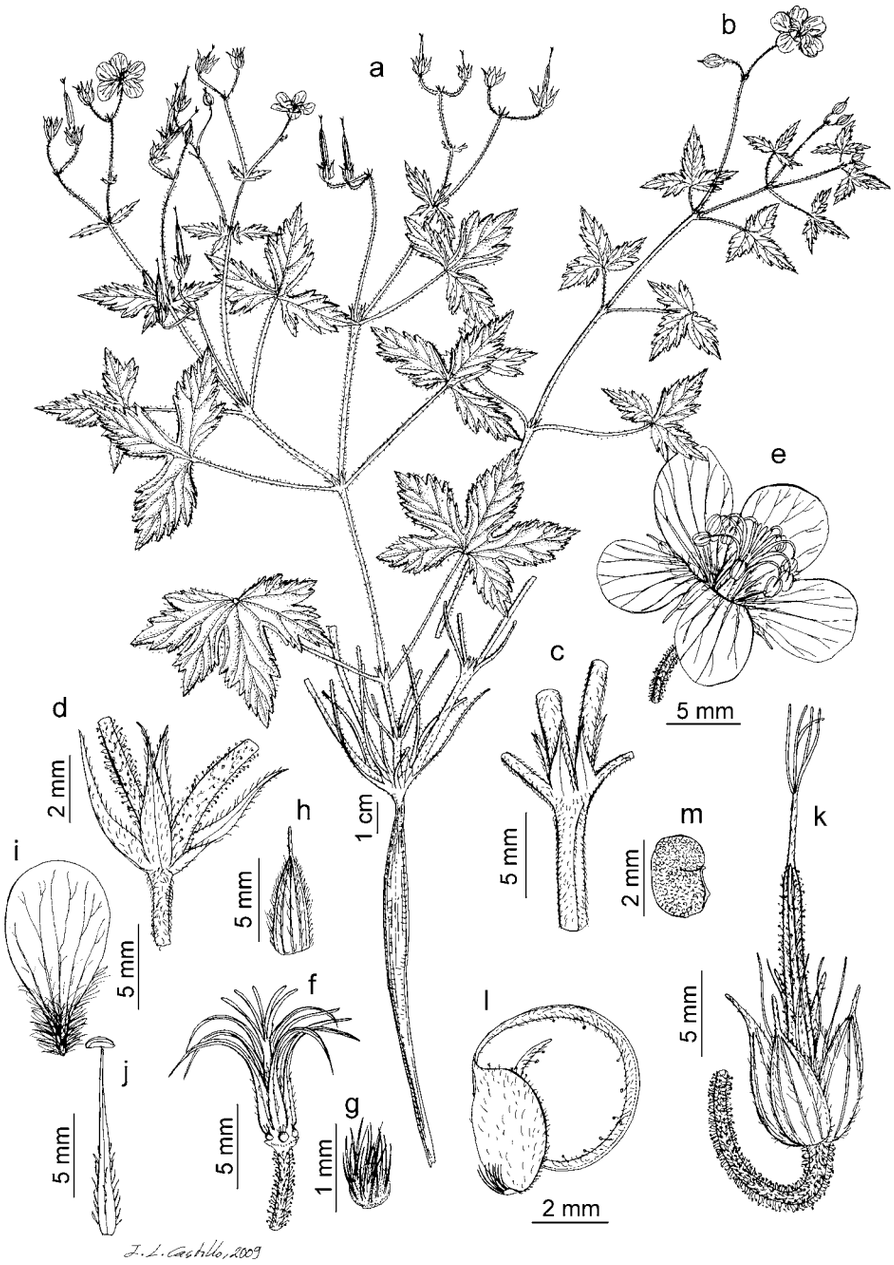


Fig. 378. *Geranium deltoideum*. a, b. Habit. c. Stipules. d. Bracteoles. e. Flower. f. Flower, sepals and petals removed. g. Nectary. h. Sepal. i. Petal. j. Stamen. k. Fruit. l. Mericarp. m. Seed. (Based on: a, c-m, *Moore &Wood 4846*, GH; b, *Koch & Fryxell 77361*, NY).

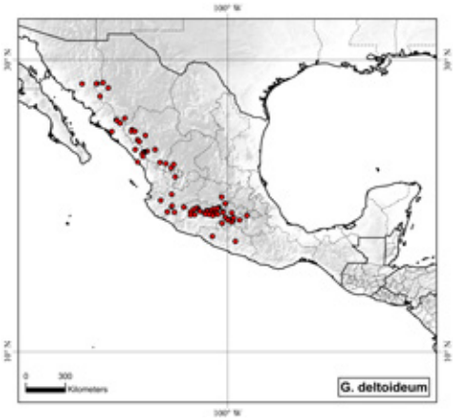


Fig. 379. Distribution of *Geranium deltoideum*.

RANGO: 48 km WNW of Huejuquilla El Alto, Jalisco on road to Canoas, Mezquital, Durango, 22º53'N, 104º14'W, 21 Oct. 1983, *Breedlove 59132* (NY); 50-54 mi WSW of El Salto, rancho Los Ángeles, 23º36'N, 105º48'W, 25 Mar. 1951, *McVaugh 11577* (MICH); SE face of El Espinazo del Diablo, 20 km SE of La Ciudad, 23º42'N, 105º42'W, 12 Sep. 1979, *Breedlove 43950* (MEXU); Canelas, 28.5 km por el camino a Durango, 25º6'N, 106º21'W, 6 Oct. 1985, *González & al. 3456* (MEXU); Topia, 2 km del Valle de Topia hacia Cuevecillas, 25º13'N, 106º33'W, 21 Mar. 1990, *Bravo 665* (MEXU). GUERRERO: 14 km entre Chilpancigo y Tixtla, 17º33'N, 99º27'W, 17 Aug. 1981, *Soto 678* (MEXU); Mina, Chiriagua, 17º54'N, 101º2'W, 19 Nov. 1936, *Hinton 9853* (GH, NY). JALISCO: Nevado de Colima, N slope, below La Joya, 19º33'N, 103º38'W, 20 Nov. 1968, *Boutin & Brandt 2370* (MEXU, MICH); Sierra de Manantlán, 25-30 km SE of Autlán, La Cumbre between El Chante and Cuzalapa, 19º35'N, 104º8'W, 20 Mar. 1965, *McVaugh 23137* (MICH); 8 km SE de Mazamitla, 1 km SE de Dos Aguas, 19º54'N, 103º0'W, 8 Apr. 1988, *Mendoza & al. 3897* (F); cima Cerro Tequila, 20º47'N, 103º50'W, 3 Apr. 1987, *Cházaro & al. 4068* (XAL, MEXU); Bolaños, camino a Huejuquilla el Alto, entre Bajío El Tule y Bajío Las Gallinas, 22º36'N, 103º52'W, 26 Mar. 1992, *Rodríguez & al. 2370* (IEB). MEXICO STATE: Temascaltepec, Anonas, 18º48'N, 100º22'W, 7 Mar. 1933, *Hinton 3567* (NY, F); carretera de cuota de Tenango de Arista a Ixtapan de la Sal, entrada a Villa Guerrero, 18º58'N, 99º38'W, 30 Sep. 1995, *Vibrans 5571* (MEXU); Temascaltepec, La Labor, 19º2'N, 99º58'W, 19 Feb. 1936, *Hinton 8927* (F, MO, NY); highway 56, km 108, road to Valle de Bravo, 19º11'N, 100º8'W, 8 Jan. 1955, *Carlson 2849* (F, GH); highway 150, near Selva Obscura, 67 km of México City, 19º19'N, 98º40'W, 1 Aug. 1971, *Gibson & al. 2538* (BM); Valle de Bravo, El Águila, 19º31'N, 99º42'W, 11 Apr. 1938, *Hinton 13417* (NY). MICHOACÁN: Zinapécuaro, lado SE de la presa la Gachupina, 18 Jan. 1989, *Jasso 784* (MEXU); Morelia, Campanario, 19º24'N, 101º16'W, 19 Nov. 1910, *Arsène (frère) 6568* (MPU); Santa Clara del Cobre, Cerro del Burro, 19º26'N, 101º31'W, 26 Nov. 1990, *Pérez & García 1995* (MEXU); Paracho, Cerro El Águila, 19º35'N, 102º31'W, 12 Dec. 1986, *Díaz Barriga 3455* (MEXU); 10 km al S de Indaparapeo, sobre el camino a Las Peras, 19º47'N, 100º58'W, 23 Dec. 1986, *Rzedowski 42315* (MEXU). MORELOS: C12 mi N of Cuernavaca, along route 95, 19º1'N, 99º10'W, 16 Aug. 1961, *Powell & Edmondson 725* (F, MICH). QUERÉTARO: Chiteje de la Cruz, 20º9'N, 100º9'W, 6 Mar. 1991, *Argüelles 3326* (MEXU); Querétaro, 20º36'N, 100º24'W, 5 July 1992, *González 20* (MEXU). SINALOA: Rosario, E slope of first crest of Sierra Madre Occidental, 6.5 mi W of El Palmita, 42 mi E of Concordia on highway 40, 23º0'N, 106º10'W, 31 Jan. 1962, *Breedlove 1696* (CAS); San Ignacio, San Juan, Conchitas, 23º51'N, 106º20'W, Mar. 1931, *González Ortega 6857* (F); 2 mi E of Las Palmitas, highway 40, 25º5'N, 107º56'W, 25 Dec. 1971, *Norris & al. 20655* (CAS); puerto a Tameapa, 25º39'N, 107º22'W, 6 Mar. 1940, *Gentry 5848* (MEXU, MO, NY); Sierra Surutato, above La Joya in the upper reaches of the Cañon de Tarahumares, 25º53'N, 107º38'W, 9 Mar. 1971, *Breedlove 19275* (MO). SONORA: 6.6 km al W de Yécora, 28º21'N, 109º59'W, 5 Sep. 1996, *Búrquez & al. 96-874* (MEXU); 5.2 km W of Yécora, 28º22'N, 108º57'W, 11 Mar. 1996, *Van Devender & al. 96-90* (MEXU); 14 mi W of Yécora, 28º22'N, 109º0'W, 23 Mar. 1979, *Webster 23838* (MEXU); 3.5 km W of Arroyo Hondo, 9.7 km W of Chihuahua border on Mex. 16, 28º26'N, 108º33'W, 25 Sep. 1997, *Reina & al. 97-1336* (MO). ZACATECAS: Sierra Madre, 22º50'N, 103º41'W, Aug. 1897, *Rose 2370* (NY).

Discussion. Geranium deltoideum is similar to *G. hernandesii*. The leaves of *G. deltoideum* are like to those of *G. hernandesii* in shape although shorter. The indumentum of *G. deltoideum* is composed of short and usually patent eglandular hairs on stems, petioles, and inflorescences; glandular hairs are almost always present on the inflorescence. The peduncles, pedicels, sepal mucro, and petals of *G. deltoideum* are shorter than those of *G. hernandesii*. The nectaries of *G. deltoideum* are covered with hairs over the entire surface, whereas those of *G. hernandesii* are glabrous. As noted above, some errors in nomenclature and circumscription were corrected by Moore (1951: 250). *Geranium deltoideum* is distributed over a large area of Mexico with more than 1500 km between the northernmost localities in Sonora and the southernmost in Guerrero. Within this range, two similar but very local and poorly known species, *G. hystricinum* and *G. gentryi*, also occur. *Geranium deltoideum* differs from *G. hystricinum* by its longer petals and its well-developed narrowed rostrum apex. *Geranium gentryi* and *G. deltoideum* share petals of similar length and a well-developed narrowed rostrum apex; however, *G. gentryi* has erect-patent, deep purplish petals, with shorter and less spreading hairs adaxially, and glabrous nectaries. The leaves of *G. deltoideum* almost always lack glandular hairs, but those of *G. gentryi* are always glandular-hairy. According to Moore (1943: 70), *G. sublaevispermum* resembles *G. deltoideum* in leaf shape, petals, and indumentum. He suggested that *G. sublaevispermum* could be differentiated by its shorter peduncles, pedicels, and fruit, and because its seeds are blackish and finely reticulate. All these characters fall into the variability of *G. deltoideum*, and *G. sublaevispermum* is here considered conspecific.

147. Geranium gentryi H.E. Moore, Contr. Gray Herb. 146: 74, pl. 1 fig. 1, pl. 5 fig. 6. 1943. TYPE LOCALITY: "MEXICO: Sonora: spring waters, Tepopa, Rio Mayo, Mar. 9, 1935, Gentry 1420 (G, type; F, M, isotypes)". TYPE: Mexico. Sonora, Tepopa, Río Mayo, 27°19'N, 108°43'W, 9 Mar. 1935, *H.S. Gentry 1420* (holotype, GH-00043628!; isotypes, BM-000796075!, F!, K-000531441!, MO-060430!, MICH image!).

Perennial herbs, 54-90 cm tall. *Rootstock* and roots unknown. *Stem* ascending, leafy, not rooting at nodes, stolons absent, without vegetative stems, with patent to retrorse, eglandular hairs 0.7-1.4 mm long and patent, glandular hairs 0.4-0.8 mm long. *Basal leaves* unknown, cauline leaves opposite; leaf laminas 3.9-4.4 cm long, 4.1-5.1 cm wide, not peltate, palmatifid [ratio main-sinus length/middle segment length = 0.67-0.76], polygonal (medium and upper hastate) in outline, base cordate to subtruncate, not coriaceous, with nerves not projected, hirsute, with ± patent, eglandular hairs and glandular hairs on both surfaces;

segments 3(5), in 1 plane, middle segment rhombic, 10.3-14.9 mm wide at the base [ratio segment width at the base/middle segment length = 0.29-0.39], 7-9-lobed in distal half [ratio secondary sinus length/middle segment length = 0.08-0.11]; petioles up to 7 cm long, without abscission zone, terete, not swollen, not deflexed in age, with patent to retrorse, eglandular hairs 0.2-1.3 mm long and patent, glandular hairs 0.3-0.8 mm long; stipules 4.7-8.6 mm long, 1.5-2.9 mm wide, lanceolate, free, papery, brownish red, with eglandular hairs on both surfaces and on the margin. *Inflorescence* a monochasial cyme; cymules 2-flowered, solitary [ratio cymule length/leaf length = 1-4.1]; peduncles (34)41-56 mm long, with patent to retrorse, eglandular hairs 0.2-0.7 mm long and patent, glandular hairs 0.7-1.1 mm long; bracteoles 2.5-4.2 mm long, 0.5-0.9 mm wide, lanceolate, whorled; pedicels 17-21 mm long, with patent to retrorse, eglandular hairs 0.1-0.2 mm long and patent, glandular hairs 0.4-0.9 mm long. Flowers actinomorphic. *Sepals* 6.4-7 mm long, 2.8-3.4 mm wide, lanceolate, smooth, not accrescent, nerves 3, mucro 1.1-1.4 mm long [ratio mucro length/sepal length = 0.17-0.22], with antrorse to patent, eglandular hairs 0.2-0.7 mm long and patent, glandular hairs 0.4-1 mm on the abaxial surface, glabrous adaxially. *Petals* 9.7-11.7 mm long, 5.6-6.9 mm wide, erect-patent, rounded or slightly emarginate (notch 0.2-0.3 mm deep), without claw, purple, hairy on the basal 1/4-1/3 of their adaxial surface, ciliate on the basal margin, with hairs 0.3-0.7 mm long. *Stamens* 10, both whorls bearing anthers; filaments 5.8-6.6 mm long, lanceolate, yellow, pilose on the abaxial surface, ciliate on the proximal half, with hairs 0.3-0.4 mm long; anthers 1.5-1.9 mm long, yellow. Nectaries 5, hemispheric, glabrous. *Gynoecium* 6.1-7.7 mm long, yellow. *Fruit* 24.9-28.9 mm long, erect, discharge of seed-ejection type; mericarps 3.4-4.2 mm long,

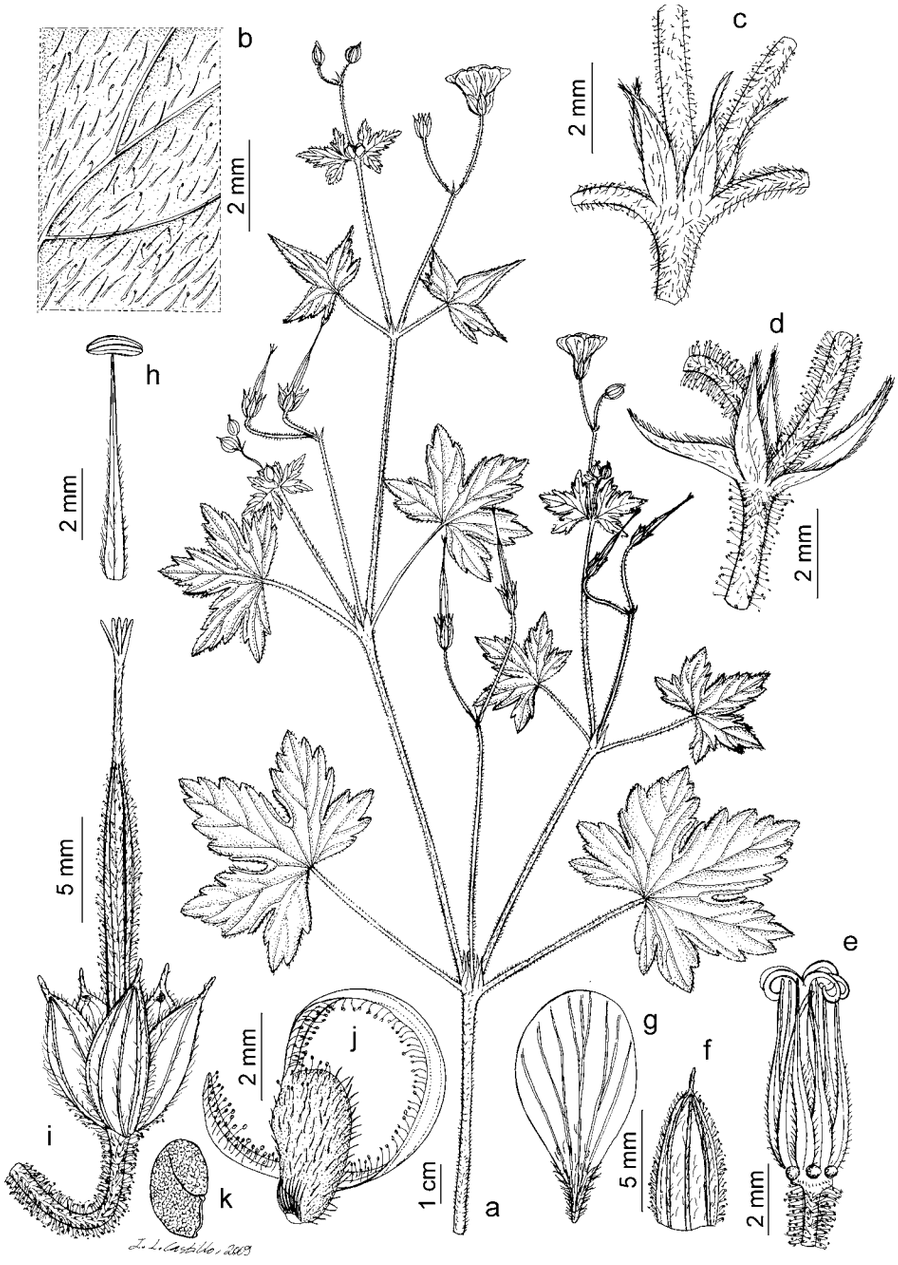


Fig. 380. *Geranium gentryi*. a. Flowering branch. b. Detail showing adaxial leaf indumentum. c. Stipules. d. Bracteoles. e. Flower, sepals and petals removed. f. Sepal. g. Petal. h. Stamen. i. Fruit. j. Mericarp. k. Seed. (Based on: *Gentry 1420*, GH).

Fig. 381. Distribution of *Geranium gentryi*.

1.5-2 mm wide, without a strand of fibers, not compressed at the apex, smooth, without basal beak, with a basal callus, without a basal prong, brown, with erect-patent, eglandular hairs 0.2-0.7 mm long and patent, glandular hairs 0.5-0.8 mm long; rostrum 17.1-20.6 mm long, with a narrowed apex 4.3-5.3 mm long, not twisted, with ± patent, eglandular hairs 0.1-0.2 mm long and, usually, patent, glandular 0.6-0.7 mm long; stigmatic remnants 2.6-2.9 mm long, with 5 glabrous lobes. *Seeds* 2.3-2.5 mm long, 1.2-1.5 mm wide, finely reticulate, uniformly colored, brown, glabrous. Cotyledons not studied. Fig. 380.

Pollen. Ornamentation not studied.

Chromosome number. Unknown.

Phenology. Collected in flower in March.

Distribution. This species is endemic to southern Sonora, in northwestern Mexico (Fig. 381).

Habitat. Stream banks; ca. 1000 m.

Discussion. Geranium gentryi is known only from the incomplete type specimens obtained in southern Sonora, Mexico. Although the basal parts are not known, the species appears to be perennial, given its robust stature. Only cauline leaves are present in the type collection; these have mostly three segments, but some leaves have five segments (the two basal ones not well developed). This suggests that *G. gentryi* may have basal leaves with five segments, as does *G. deltoideum*. *Geranium gentryi* shares with *G. latilobum* and *G. hystricinum* a glandular indumentum on stems, leaves, and inflorescences; it differs from these in its larger and purplish petals. The adaxial indumentum of the petals is restricted to the basal quarter (sometimes third), whereas in *G. latilobum* and *G. hystricinum* the hairs are longer and occur over almost the entire petal. The narrowed apex of the fruit rostrum is well developed in *G. gentryi*, but it is shorter or absent in the other two species.

148. Geranium latilobum H.E. Moore, Contr. Gray Herb. 146: 70, pl. 3 fig. 15. 1943. Type locality: "MEXICO: Jalisco: streamside, Arroyo del Notoguio, San Sebastian, 1500 m., Feb. 13, 1927, Mexia 1671 (G, type; F, M, NY, isotypes)". Type: Mexico. Jalisco, San Sebastián, Arroyo del Notoguio, 20°45'N, 104°51'W, 13 Feb. 1927, *Y. Mexia 1671* (holotype, GH-00043639!; isotypes, BM-000796272!, F!, G-00388788!, MICH image!, MO!, NY!, US).

Perennial herbs, 30-72 cm tall. *Rootstock* 8.6-9.5 mm in diameter, vertical, not tuberculate, not turnip-shaped, unknown roots. *Stem* erect or ascending, leafy, not rooting at nodes, stolons absent, without vegetative stems, with patent to retrorse, eglandular hairs 0.3-2 mm long and, usually, patent, glandular hairs 0.4-0.8 mm long. *Basal leaves* few, not long persistent, cauline leaves opposite; leaf laminas 4.7-10 cm long, 5.2-10.5 cm wide, not peltate, palmatifid [ratio main-sinus length/middle segment length = 0.66-0.87], polygonal (medium and upper hastate) in outline, base cordate to subtruncate, not coriaceous, with nerves not projected, hirsute, with ± patent, eglandular hairs and, usually, glandular hairs on both surfaces; segments 3(5), in 1 plane, middle segment rhombic, (14.6)17.3-25.4 mm wide at the base [ratio segment width at the base/middle segment length = 0.24-0.40], 10-25-lobed in distal half [ratio secondary sinus length/middle segment length = 0.05-0.15]; petioles up to 19 cm long, without abscission zone, terete, not swollen, not deflexed in age, with patent, eglandular hairs 0.2-1.6 mm long and patent, glandular hairs 0.3-0.7 mm long; stipules 2.8-8 mm long, 1.4-3.2 mm wide, broadly lanceolate, free, papery, brownish red, with eglandular hairs on both surfaces and on the margin. *Inflorescence* a monochasial cyme; cymules 2-flowered, solitary [ratio cymule length/leaf length = (0.8)0.9-2.8]; peduncles (20)33-47(59) mm long, with patent to retrorse, eglandular hairs 0.2-1.4 mm long and patent, glandular hairs 0.3-0.8 mm long; bracteoles 1.9-4.4 mm long, 0.5-1 mm wide, lanceolate, whorled; pedicels 9.9-26.5 mm long, with patent to retrorse, eglandular hairs 0.2-1 mm long and patent, glandular hairs 0.4-1 mm long. Flowers actinomorphic. *Sepals* 5.1-6.9(7.9) mm long, 2.2-3.7 mm wide, lanceolate, smooth, not accrescent, nerves 3, mucro (0.8)1.4-1.8(2.1) mm long [ratio mucro length/sepal length = 0.13-0.41], with antrorse to patent, eglandular hairs 0.3-1.6 mm long and, sometimes, patent, glandular hairs 0.4-1 mm on the abaxial surface, glabrous adaxially. *Petals* (6.9)7.2-8.4(9.8) mm long, 2.2-4.9 mm wide, erect-patent, rounded or slightly emarginate (notch 0.5-0.9 mm deep), without claw, white, hairy on the basal 1/2-3/4 of their adaxial surface, ciliate on the basal margin, with hairs 0.9-1.8 mm long. *Stamens* 10, both whorls bearing anthers; filaments 3.9-6.3 mm long, lanceolate, yellow, pilose on the abaxial surface, ciliate on the proximal half, with hairs 0.4-1.1 mm long; anthers 0.9-1.5 mm long, yellow. Nectaries 5, hemispheric, with a tuft of hairs covering all of its surface. *Gynoecium* 4.5-7.3 mm long, yellow. *Fruit* 24.5-28.5 mm long, erect, discharge of seed-ejection type; mericarps 3-4.1 mm long, 1.5-2.1 mm wide, without a strand of fibers, not compressed at the apex, smooth, without basal beak, with a basal callus, without a basal prong, brown, with erect-patent, eglandular hairs 0.6-1.4 mm long and, usually patent, glandular hairs 0.7-1.8 mm long; rostrum 16.6-20.6 mm long, with a narrowed apex 1.7-3.2 mm long, not twisted, with ± patent, eglandular hairs 0.2-0.4 mm long and patent, glandular hairs 0.6-0.9 mm long; stigmatic remnants 2.2-5.1 mm long, with 5 glabrous lobes. *Seeds* 2-2.6 mm long, 1.1-1.5 mm wide, reticulate, uniformly col-

ored, brown, glabrous. Cotyledons with entire margin. Fig. 382.

Pollen. Ornamentation not studied.

Chromosome number. Unknown.

Phenology. Collected in flower from February to December.

Distribution. This species ranges from Durango to Jalisco, in western Mexico (Fig. 383).

Habitat. Streamsides, moist ravines, and *Carpinus* L., *Magnolia* L., *Pinus* L., *Podocarpus* Pers., and *Quercus* L. forests; 1500-2700 m.

Additional specimens examined. **Mexico.** Durango: Pueblo Nuevo, Mexiquillo pr. La Ciudad, 23º42'N, 105º42'W, 23 Mar. 1981, *Vega & Fernando 4057* (MEXU); Sierra Madre Occidental, rim of plateau W of La Ciudad, 3.1 km NW of highway 40, off Neveros rd., upper Arroyo Tascanto watershed, 23º43'N, 105º43'W, 16 Apr. 1999, *Sanders & al. 22694* (RSA); along México highway 10, 10.6 mi E of El Palmito, ca. 57 mi E of Concordia, 23º44'N, 105º32'W, 30 Dec. 1962, *Breedlove 4263* (CAS); Metates, N of Cueva, 23º57'N, 104º50'W, 30 Aug. 1934, *Pennell 18441* (NY). Jalisco: Sierra de Manantlán, 25 km S of El Chante, along an abandoned lumber road across the summit, 2 km E of the pass, 19º33'N, 104º14'W, 4 Feb. 1975, *McVaugh 26125* (MICH); Sierra de Manantlán, 25-30 km SE of Autlán, La Cumbre between El Chante and Cuzalapa, 2 km E of summit, 19º35'N, 104º8'W, 19 Mar. 1965, *McVaugh 23103* (MICH); Real Alto, trail to El Tajo de Santiago, 19º36'N, 103º57'W, 23 Feb. 1927, *Mexia 1743* (MICH); Autlan, Estación Científica Las Joyas, cañada del Laurelito, 19º46'N, 104º22'W, 21 Dec. 1992, *Cuevas & Guzmán 4568* (IEB); 11-12 mi S of Talpa de Allende, in the headwaters of a W branch of Río de Talpa, 20º17'N, 104º48'W, 23 Nov. 1960, *McVaugh 21339* (MICH).

Discussion. Geranium latilobum is a rare species known from only a few localities in Durango and Jalisco (Mexico). The incomplete material collected does not permit a full reconstruction of the basal part of the plant (rootstock, basal leaves). *Geranium latilobum* is quite similar to *G. deltoideum* in leaf outline, petal size, sepal mucro length, and peduncle length; it differs in the longer eglandular hairs on stems, petioles, and inflorescences. Moreover, the glandular indumentum of *G. latilobum* is

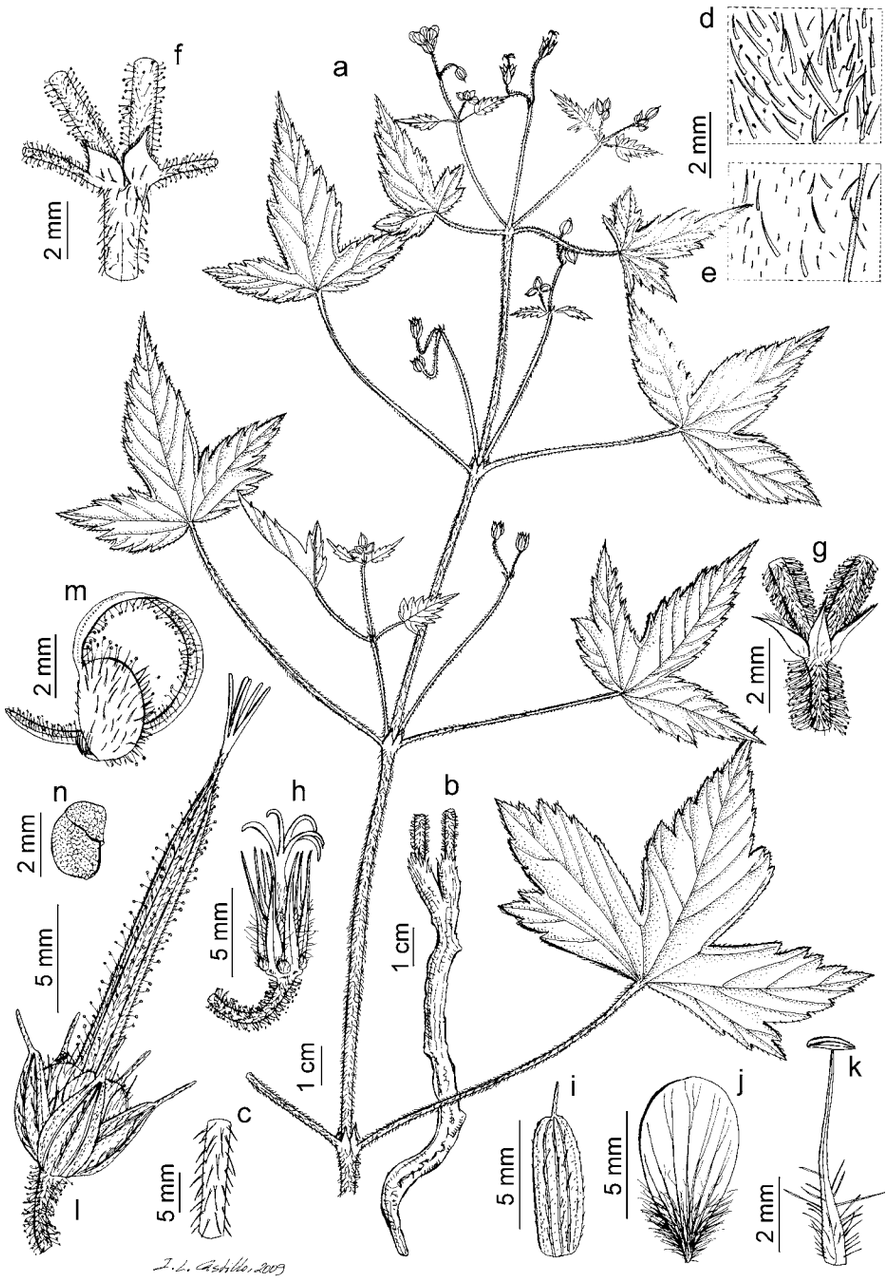


Fig. 382. *Geranium latilobum*. a. Flowering branch. b. Rootstock. c. Detail showing stem indumentum. d, e. Details showing adaxial indumentum of leaf segment. f. Stipules. g. Bracteoles. h. Flower, sepals and petals removed. i. Sepal. j. Petal. k. Stamen. l. Fruit. m. Mericarp. n. Seed. (Based on: a-c, e-n, *Mexia 1671*, BM; d, *Breedlove 4263*, CAS).

Fig. 383. Distribution of *Geranium latilobum*.

present on stems, petioles, and leaf laminas, whereas it restricted to the inflorescence in *G. deltoideum*. The large leaves with broad segments are the most striking feature of *G. latilobum*. These leaves have a central segment with a wider base and are more lobed than in similar species, e.g., *G. hernandesii*, *G. deltoideum*, *G. gentryi*, and *G. hystricinum*. Also, the stipules of *G. latilobum* are wider than those of the other species. The leaf lamina is less deeply divided that that of *G. hernandesii* and *G. deltoideum* and is similar to that of *G. gentryi* and *G. hystricinum*. The specimen *Breedlove 4263* (CAS, from Durango) has leaves with a more hirsute indumentum and with abundant glandular hairs on both surfaces, while in the type collection glandular hairs are scarce (in some leaves no glandular hairs were found) and usually restricted to the base of the leaf (near petiole insertion). On the specimen *Sanders & al. 22694* (RSA, from Durango) the internodes along the middle portion of the stem bear abundant stout eglandular hairs, some of these prickle-like. *Geranium latilobum* may be distinguished further from *G. gentryi* by its shorter and white petals. The rostrum of the fruit of *G. latilobum* has a narrowed apex shorter than that of *G. gentryi*; the rostrum of *G. hystricinum* abruptly ends in the stigmatic remnants.

149. Geranium hystricinum H.E. Moore, Contr. Gray Herb. 146: 72, pl. 3 fig. 10, pl. 5 figs. 3, 7. 1943. Type locality: "MEXICO: Guerrero: by stream in thicket in llano, Puerto Rico, Dist. Mina, 1800 m., Dec. 8, 1939, Hinton 14972 (G, type)". Type: Mexico. Guerrero, Mina, Puerto Rico, 17°38'N, 100°40'W, 8 Dec. 1939, *G.B. Hinton & al. 14972* (holotype, GH-00043635!; isotypes, F-0044706F!, NY-00373666!, US-00100916 image!).

Perennial herbs, 50-200 cm tall. *Rootstock* and roots unknown. *Stem* ascending, leafy, not rooting at nodes, stolons absent, without vegetative stems, with patent to retrorse, eglandular hairs 0.9-2 mm long and patent, glandular hairs 0.5-0.9 mm long. *Basal leaves* unknown, cauline leaves opposite; leaf laminas 2.8-5.3 cm long, 3.3-6.2 cm wide, not peltate, palmatifid [ratio main-sinus length/middle segment length = 0.71-0.79], polygonal (medium and upper hastate) in outline, base cordate to subtruncate, not coriaceous, with nerves not projected, hirsute, with ± patent, eglandular hairs and glandular hairs on both surfaces; segments 3-5, in 1 plane, middle segment rhombic, 7.9-12.9(15.3) mm wide at the base [ratio segment width at the base/middle segment length = 0.28-0.36], 9-16-lobed in distal half [ratio secondary sinus length/middle segment length = 0.07-0.17]; petioles up to 11 cm long, without abscission zone, terete, not swollen, not deflexed in age, with patent to retrorse, eglandular hairs 0.7-1.6 mm long and, patent, glandular hairs 0.3-0.7 mm long; stipules 3.9-7.5 mm long, 1.8-2.5 mm wide, lanceolate, free, papery, brownish red, with eglandular hairs on both surfaces and on the margin. *Inflorescence* a monochasial cyme; cymules 2-flowered, solitary [ratio cymule length/leaf length = 1-3.4]; peduncles 21-72 mm long, with patent to retrorse, eglandular hairs 0.2-1.3 mm long and patent, glandular hairs 0.4-0.9 mm long; bracteoles 3.3-4.1 mm long, 0.9-1.5 mm wide, lanceolate, whorled; pedicels 18-37 mm long, with patent to retrorse, eglandular hairs 0.1-0.3 mm long and patent, glandular hairs 0.6-1 mm long. Flowers actinomorphic. *Sepals* 6.4-7.8 mm long, 3.1-4.4 mm wide, lanceolate, smooth, not accrescent, nerves 3, mucro 0.9-1.9 mm long [ratio mucro length/sepal length = 0.12-0.26], with antrorse to patent, eglandular hairs 0.2-1.5 mm long and patent, glandular hairs 0.6-0.9 mm on the abaxial surface, glabrous adaxially. *Petals* 6.1-8.1 mm long, 3-4.8 mm wide, erect-patent, emarginate (notch 0.5-1.2 mm deep), without claw, white, hairy on the basal 1/2-3/4 of their adaxial surface, ciliate on the basal margin, with hairs 0.7-1.2 mm long. *Stamens* 10, both whorls bearing anthers; filaments 4.2-5.3 mm long, lanceolate, yellow, pilose on the abaxial surface, ciliate on the proximal half, with hairs 0.4-0.8 mm long; anthers 0.9-1.2 mm long, yellow. Nectaries 5, hemispheric, with a tuft of hairs covering all of its surface. *Gynoecium* 4.2-6.5 mm long, yellow. *Fruit* 24.9-26.3 mm long, erect, discharge of seed-ejection type; mericarps 3.3-4.4 mm long, 1.9-2.2 mm wide, without a strand of fibers, not compressed at the apex, smooth (with 1-2 transverse veins at the apex), without basal beak, with a basal callus, without a basal prong, brown, with erect-patent, eglandular hairs 0.6-0.8 mm long and patent, glandular hairs 0.5-1 mm long; rostrum 16.4-18.7 mm long, without a narrowed apex, not twisted, with ± patent, eglandular hairs 0.1-0.4 mm long and, usually, patent, glandular hairs 0.5-0.7 mm long; stigmatic remnants 2.3-3.1 mm long, with 5 glabrous lobes. *Seeds* 2.4-2.7 mm long, 1.4-1.8 mm wide, finely reticulate, uniformly colored, brown, glabrous. Cotyledons with entire margin. Fig. 384.

Pollen. Ornamentation not studied.

Chromosome number. Unknown.

Phenology. Collected in flower from January to August.

Distribution. This species is endemic to central Guerrero, in southern Mexico (Fig. 385).

Habitat. Stream banks with shrub cover; 1800-2400 m.

Additional specimens examined. **Mexico.** Guerrero: Balsamar, 11 km SE hacia la Soledad, 17°33'N, 99°44'W, 28 Jan. 1998, *Calónico 7421* (IEB); Carrizal de Bravo, 15 km SE hacia la Soledad, 17°34'N, 99°47'W, 28 Jan. 1998, *Calónico 7478* (IEB).

Discussion. Geranium hystricinum is quite similar to *G. gentryi*. As Moore (1943: 75) stated, both species are

alike in habit, indumentum, and leaf shape. *Geranium hystricinum* has been collected only a few times, and some aspects of the base of the plant remain unknown. The comments about life-span and basal leaves presented above for *G. gentryi* are applicable to *G. hystricinum*. The petals of *G. hystricinum* are short, white, and deeply notched, whereas those of *G. gentryi* are long, purplish, and slightly or not notched. Moreover, in G. *hystricinum* the petals are hairy adaxially with eglandular, long hairs reaching the apex, while in *G. gentryi* the hairs are shorter and restricted to the basal area. The fruit of *G. hystricinum* has a rostrum that ends abruptly in stigmatic remnants; it has a distinct narrowed apex in *G. gentryi*.

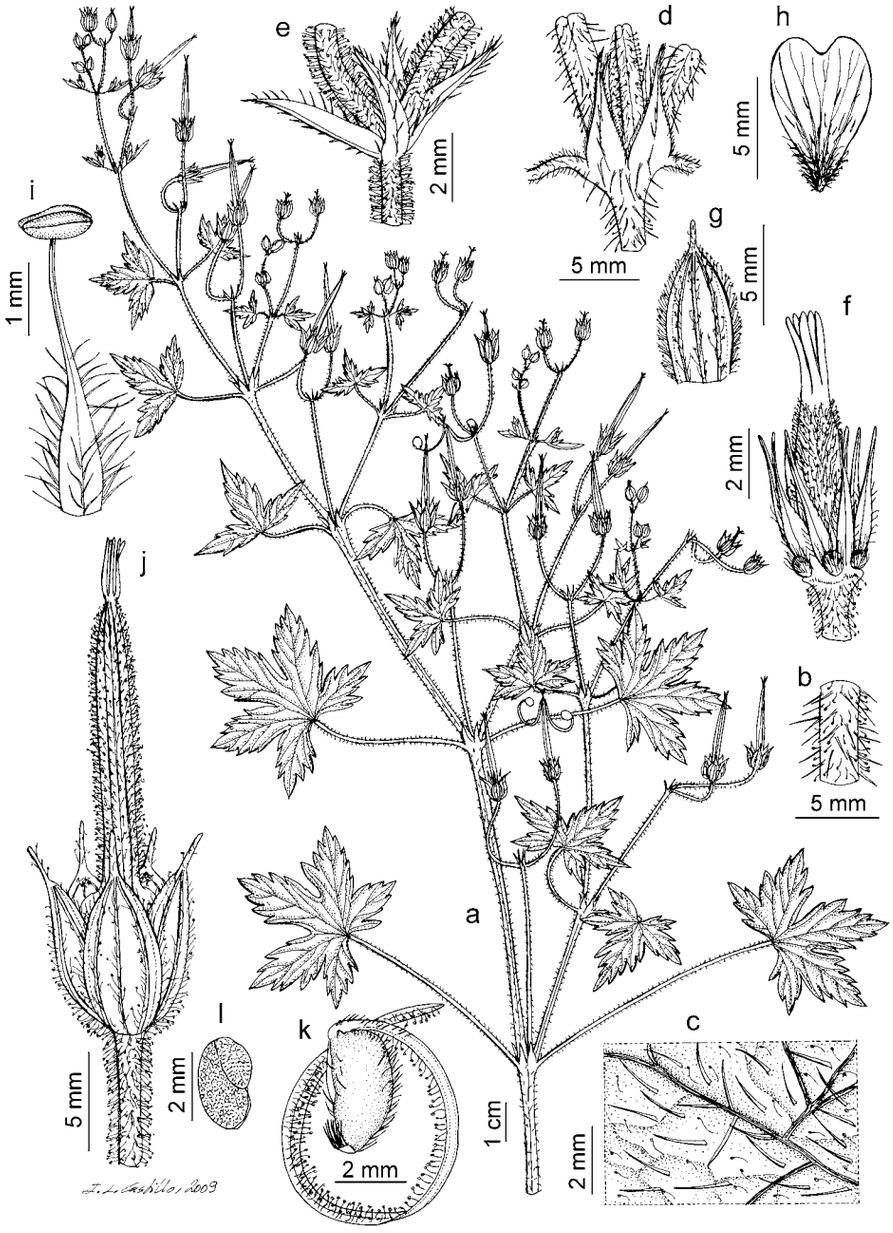


Fig. 384. *Geranium hystricinum*. a. Flowering branch. b. Detail showing stem indumentum. c. Detail showing adaxial leaf indumentum. d. Stipules. e. Bracteoles. f. Flower, sepals and petals removed. g. Sepal. h. Petal. i. Stamen. j. Fruit. k. Mericarp. l. Seed. (Based on: *Hinton 14972*, F).

150. Geranium lilacinum R. Knuth, Bull. Misc. Inform. 1937(10): 502. 1937. Type locality: "State of Mexico. Discrict of Temascaltepec: Sierrita, in pine forest, Feb. 1936, Hinton 8945 (typus in herb. Kew.); Hornos in a wet barranca, Jan. 1935, Hinton 7199". Type: Mexico. Mexico, Temascaltepec, Sierrita, 18°58'N, 99°55'W, 23 Feb. 1936, *G.B. Hinton 8945* (holotype, K-000531440!; isotypes, BM-000796084!, F!, GH-00043640!, LL, MO!, NY-00373669!, US).

Perennial herbs, 32-62(200) cm tall. *Rootstock* 3.1-5.8 mm in diameter, ± vertical, not tuberculate, not turnip-shaped, without thickened roots. *Stem* prostrate to ascending, leafy, not rooting at nodes, stolons absent, without vegetative stems, with patent to retrorse, eglandular hairs 0.5-1 mm long. *Basal leaves* in a ± persistent rosette, cauline leaves opposite; leaf laminas 2.7-6.9 cm long, 3-8 cm wide, not peltate, palmatifid [ratio main-sinus length/middle segment length = 0.80-0.91], polygonal (medium and upper hastate) in outline, base cordate to subtruncate, not coriaceous, with nerves not projected, pilose on both surfaces, with ± appressed, eglandular hairs; segments 3-5, in 1 plane, middle segment rhombic, 4.9-7.9(14.6) mm wide at the base [ratio segment width at the base/ middle segment length = 0.16-0.29],

Fig. 385. Distribution of *Geranium hystricinum*.

9-13(17)-lobed in distal half [ratio secondary sinus length/middle segment length = 0.12-0.27]; petioles up to 12 cm long, without abscission zone, terete, not swollen, not deflexed in age, with patent to retrorse, eglandular hairs 0.3-1.2 mm long and, sometimes, patent, glandular hairs 0.4-0.7 mm long; stipules 4-8.5 mm long, 0.5-1.3 mm wide, lanceolate, free, papery, brownish red, with eglandular hairs on both surfaces and on the margin. *Inflorescence* a monochasial cyme; cymules 2-flowered, solitary [ratio cymule length/leaf length = 1.2-3.3]; peduncles (27)40-60(83) mm long, with patent to retrorse, eglandular hairs 0.2-0.8 mm long and patent, glandular hairs 0.3-1.2 mm long; bracteoles 2.5-5.8 mm long, 0.4-0.7 mm wide, lanceolate, whorled; pedicels 9.3-18.3 mm long, with patent to retrorse, eglandular hairs 0.2-0.6 mm long and patent, glandular hairs 0.7-1.2 mm long. Flowers actinomorphic. *Sepals* 4.9-6.7 mm long, 2.3-3.7 mm wide, lanceolate, smooth, not accrescent, nerves 3, mucro 1-1.9 mm long [ratio mucro length/sepal length = 0.16-0.34], with antrorse to patent, eglandular hairs 0.2-0.9 mm long and patent, glandular hairs 0.5-1.2 mm on the abaxial surface, glabrous adaxially. *Petals* (10)11.3-12.9(15) mm long, 5-6.9 mm wide, erect-patent, rounded, without claw, purple, hairy on the base of the adaxial surface, ciliate on the basal margin, with hairs 0.3-0.6 mm long. *Stamens* 10, both whorls bearing anthers; filaments 5.1-8 mm long, lanceolate, yellow, pilose on the abaxial surface, ciliate on the proximal half, with hairs 0.4-0.9 mm long; anthers 0.9-1.5 mm long, yellow. Nectaries 5, hemispheric, glabrous. *Gynoecium* 4.5-7.7 mm long, yellow. *Fruit* 24-31 mm long, erect, discharge of seed-ejection type; mericarps 3.4-4 mm long, 1.5-2 mm wide, without a strand of fibers, not compressed at the apex, smooth, without basal beak, with a basal callus, without a basal prong, brown, with erect-patent, eglandular hairs 0.4-0.7 mm long and patent, glandular hairs 0.7-1.1 mm long; rostrum 16.9-23.5 mm long, with a narrowed apex 2.4-5 mm long, not twisted, with ± patent, eglandular hairs 0.2-0.4 mm long and patent, glandular hairs 0.7-1.2 mm long; stigmatic remnants 2.7-3.5 mm long, with 5 glabrous lobes. *Seeds* 2.2-2.5 mm long, 1.1-1.5 mm wide, finely reticulate, uniformly colored, brown, glabrous. Cotyledons with entire margin. Fig. 386.

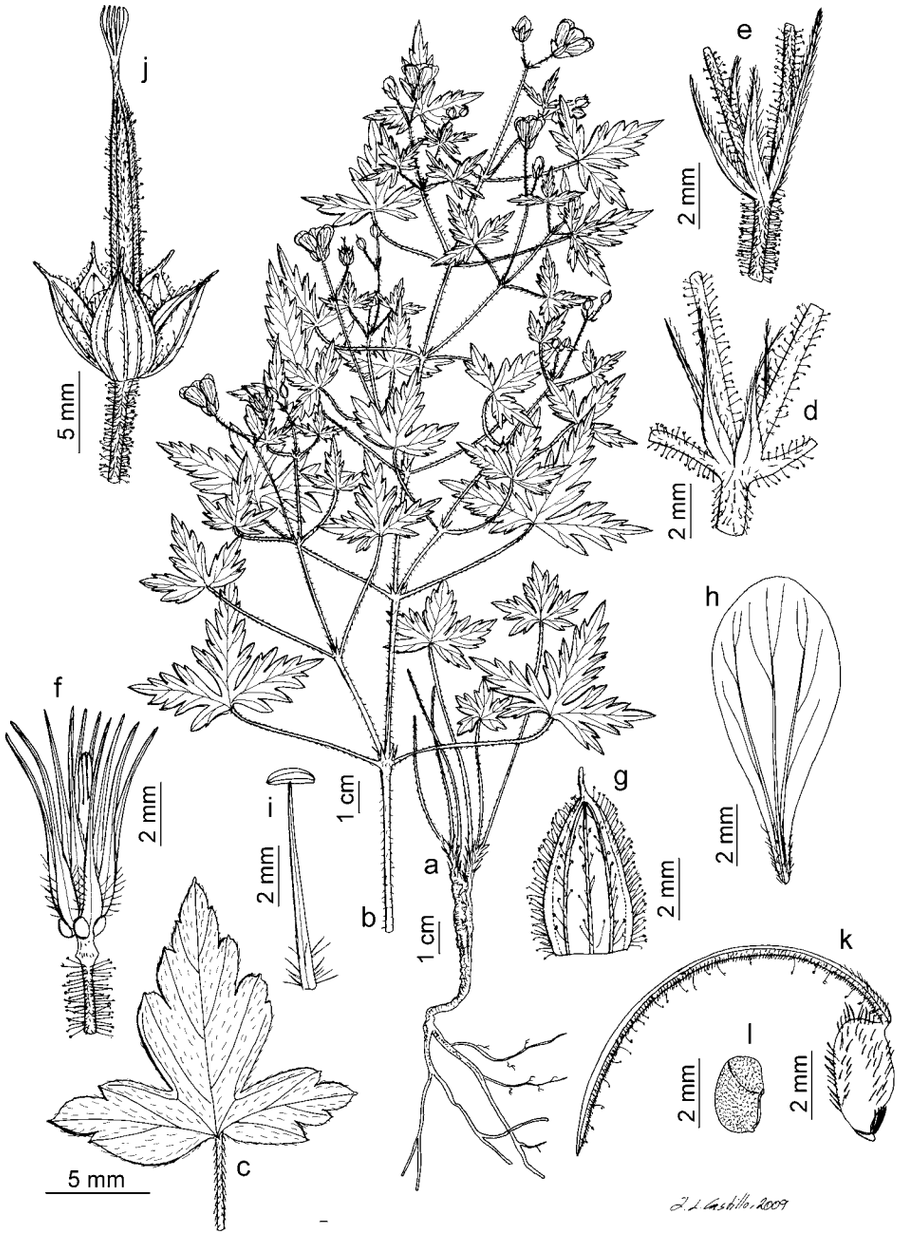


Fig. 386. *Geranium lilacinum*. a, b. Habit. c. Leaf, adaxial side. d. Stipules. e. Bracteoles. f. Flower, sepals and petals removed. g. Sepal. h. Petal, adaxial side. i. Stamen. j. Fruit. k. Mericarp. l. Seed. (Based on: a, b, d-i, *Mexia 9095*, F; c, j-l, *Ventura 559*, MO).

Pollen. Ornamentation not studied.

Chromosome number. Unknown.

Phenology. Collected in flower from January to December.

Distribution. This species ranges through central Mexico (Fig. 387).

Habitat. Wet ravines and ridges with *Abies* Mill., *Carpinus* L., *Pinus* L., and *Quercus* L. forests; 2000-3000 m.

Additional specimens examined. **Mexico.** Guerrero: Galeana, Pie de la Cuesta, Toro Muerto, 17°13'N, 100°16'W, 17 Dec. 1937, *Hinton 11078* (BM, F, NY); 1-3 km NW of Puerto El Gallo, 17°29'N, 100°10'W, 11 Nov. 1973, *Breedlove 36061* (MO); a 7 km de Tlatlauquitepec dirección Zapotitlan Tablas, 17°31'N, 98°47'W, 7 Feb. 1981, *Núñez 37* (MEXU); Asoleadero, 15 km W of Camotla, Chichihualco, 45 km W of Chilpancingo, 17°32'N, 99°52'W, 2 Dec. 1963, *Feddema 2839* (MICH); 10 km W of Camotla, Chichihualco, 40 km W of Chilpancingo, 17°33'N, 99°50'W, 30 Nov. 1963, *Feddema 2758* (MICH); Leonardo Bravo, Balsamar, 6 km al NE, a Filo de Caballo, 17°35'N, 99°49'W, 9 Nov. 1997, *Soto 6756* (MEXU). Mexico Distrito Federal: cañada de Contreras, 19°16'N, 99°16'W, 8 Mar. 1964, *Castorena 3* (MEXU). Mexico State: Temascaltepec, Los Hornos, 19°3'N, 99°56'W, 28 Jan. 1934, *Hinton 5423* (F, NY); Temascaltepec, Los Hornos, 19°3'N, 99°56'W, 13 Jan. 1935, *Hinton 7199* (GH, MO, NY); Amecameca, Cerro Venacho, ladera W, 19°6'N, 98°45'W, 7 Jan. 1979, *Rzedowski 36045* (MEXU, MO); Tlalmanalco, Cañadas, 3 km al S de San Rafael, 19°10'N, 98°41'W, 13 Feb. 1975, *Rzedowski 32713* (MO); Ixtacciuatl, 19°11'N, 98°39'W, Jan. 1909, *Purpus 3731* (BM, F, MO, NY); Tlalmanalco, San Rafael, 19°11'N, 98°42'W, 20 Feb. 1983, *Ventura 559* (MEXU, MO). Michoacán: Zitácuaro, Cerro El Cacique, 19°26'N, 100°21'W, 25 Mar. 1978, *Lorea 61* (MEXU); 4 km al E de San José de la Cumbre, carretera Morelia-Mil Cumbres, 19°40'N, 100°51'W, 23 Feb. 1986, *Rzedowski 39460* (MEXU); Queréndaro, Cañada del Real, cerca de San José de la Cumbre, 19°40'N, 100°51'W, 12 Apr. 1986, *Santos Martínez 1297* (MEXU); Senguio, alrededores de Rosa Azul, 5 km al S de Chincua, 19°48'N, 100°27'W, 15 Feb. 1989, *Rzedowski 48255* (MEXU). Morelos: Cuernavaca, Sierra Morelos, 18°56'N, 99°10'W, 3 Jan. 1970, *Hinton 17491bis* (MO). San Luis Potosí: in montibus San Miguelito, 22°2'N, 101°0'W, 1876, *Schaffner 191* (GH).

Fig. 387. Distribution of *Geranium lilacinum*.

Discussion. Geranium lilacinum, an endemic of central Mexico, is quite similar to *G. deltoideum*. Both species share a prostrate to ascending habit with polygonal leaves towards the base, hastate middle and distal leaves, and glandular hairs restricted to the inflorescence. According to labels, *G. lilacinum* reaches a height of 2 m, although herbarium specimens show only small fragments. The petals of *G. lilacinum* have an indumentum of short hairs restricted to the base of the adaxial surface and the basal margin, whereas in *G. deltoideum* such hairs are longer and spread over most of the adaxial surface. Additionally, *G. lilacinum* has erect-patent purplish petals, and *G. deltoideum* has patent and white to pinkish petals. Glandular hairs on the inflorescence, sepals, and fruits are longer in *G. lilacinum* than in *G. deltoideum*, although with some overlap, and nectaries are glabrous in the first and hairy in the second. According to Rzedowski & Rzedowski (1995: 24), both species can be found growing together and flowering at the same time, but they are easy to differentiate by the characters listed.

151. Geranium hintonii H.E. Moore, Contr. Gray Herb. 146: 80, pl. 1 fig. 5. 1943. Type locality: "MEXICO: Guerrero: open pine and fir forest, Teotepec, Dist. Mina, 3200 m., Nov. 5, 1939, Hinton 14787 (G, type)". Type: Mexico. Guerrero, Mina,Teotepec, 17°28'N, 100°03'W, 5 Nov. 1939, *G.B. Hinton & al. 14787* (holotype, GH-00043633!; isotypes, F-0044705F!, NY-00373665!, US-00100917 image!).

Perennial herbs, 15-68 cm tall. *Rootstock* 2.6-6 mm in diameter, ± vertical, not tuberculate, not turnip-shaped, without thickened roots. *Stem* prostrate to ascending, leafy, rooting at nodes, stolons absent, without vegetative stems, with patent to retrorse, eglandular hairs 0.6-1.3 mm long. *Basal leaves* in a persistent rosette, cauline leaves opposite; leaf laminas 1.5-4.7 cm long, 1.6-5.4 cm wide, not peltate, palmatifid [ratio main-sinus length/middle segment length = 0.77-0.93], polygonal in outline, base cordate, not coriaceous, with nerves not projected, pilose on both surfaces, with ± appressed, eglandular hairs; segments 5, in 1 plane, middle segment rhombic, 1.8-3.8 mm wide at the base [ratio segment width at the base/middle segment length = 0.09-0.18], 3-5(9)-lobed in distal half [ratio secondary sinus length/middle segment length = 0.21-0.31]; petioles up to 14 cm long, without abscission zone, terete, not swollen, not deflexed in age, with patent, eglandular hairs 0.5-1.3 mm long; stipules 2.9-8.1 mm long, 1-2 mm wide, lanceolate, free, papery, brownish red, with eglandular hairs on both surfaces and on the margin. *Inflorescence* a monochasial cyme; cymules 2-flowered, solitary [ratio cymule length/leaf length = 1.9-4.3]; peduncles 24-54(91) mm long, with patent to retrorse, eglandular hairs 0.3-1.5 mm long and, sometimes, patent, glandular hairs 0.2-0.9 mm long; bracteoles 3.1-6.9 mm long, 0.4-1.5 mm wide, lanceolate, whorled; pedicels 8-30 mm long, with patent to retrorse, eglandular hairs 0.3-1.5 mm long and patent, glandular hairs 0.3-0.8 mm long. Flowers actinomorphic. *Sepals* 4.9-7.7 mm long, 1.8-3.1 mm wide, lanceolate, smooth, not accrescent, nerves 3, mucro 0.5-1.3 mm long [ratio mucro length/sepal length = 0.11-0.19], with antrorse to patent, eglandular hairs 0.5-1.2 mm long and patent, glandular hairs 0.4-1.4 mm on the abaxial surface, glabrous adaxially. *Petals* 11.5-15.9 mm long, 5.6-7.2 mm wide, erect-patent, emarginate (notch 0.7-1.5 mm deep), without claw, purple, hairy on the basal 1/3-1/2 of their adaxial surface, ciliate on the basal margin, with hairs 0.6-1 mm long. *Stamens* 10, both whorls bearing anthers; filaments 4.6-7.6 mm long,

lanceolate, yellow, pilose on the abaxial surface, ciliate on the proximal half, with hairs 0.4-0.8 mm long; anthers 0.8-1.4 mm long, yellow. Nectaries 5, hemispheric, glabrous. *Gynoecium* 4.3-7.6 mm long, purple. *Fruit* 20.4-20.7 mm long, erect, discharge of seed-ejection type; mericarps 3.2-3.3 mm long, 1.3-1.7 mm wide, without a strand of fibers, not compressed at the apex, smooth, without basal beak, with a basal callus, without a basal prong, brown, with erect-patent, eglandular hairs 0.5-0.9 mm long and rarely patent, glandular hairs 0.7-0.8 mm long; rostrum 13.3-13.7 mm long, with a narrowed apex 2.7-2.9 mm long, not twisted, with ± patent, eglandular hairs 0.3-0.4 mm long and patent, glandular 0.4-0.5 mm long; stigmatic remnants 2.7-3 mm long, with 5 glabrous lobes. *Seeds* 2.1-2.3 mm long, 1.1-1.2 mm wide, finely reticulate, uniformly colored, brown, glabrous. Cotyledons with entire margin. Fig. 388.

Pollen. Ornamentation not studied.

Chromosome number. Unknown.

Phenology. Collected in flower from January to December.

Distribution. This species is endemic to central Guerrero, in southern Mexico (Fig. 389).

Habitat. Slopes with *Abies* Mill., *Alnus* Mill., *Pinus* L., or *Quercus* L. patches; 2650-3200 m.

Additional specimens examined. **Mexico.** Guerrero: W side of Cerro Teotepec, near the summit, 17º28'N, 100º5'W, 21 Oct. 1984, *Breedlove 61986* (MEXU, MO, NY); ENE of Puerto El Gallo, 17º29'N, 100º10'W, 11 Nov. 1973, *Breedlove 36097* (MO); vertiente SW del Cerro Teotepec, 17º29'N, 100º12'W, 29 Jan. 1965, *Rzedowski & McVaugh 235* (MICH); Asoleadero, 15 km W of Camotla, Chichihualco, 45 km W of Chilpancingo, 17º32'N, 99º52'W, 2 Dec. 1963, *Feddema 2854* (MICH); Tlacotepec, camino Filo de Caballo-Atoyac, desviación hacia Toro Muerto, 4 km del entronque con el camino Filo de Caballo-Atoyac, 17º34'N, 100º16'W, 20 Oct. 1982, *Koch & Fryxell 82123* (F, MO, NY).

Discussion. Geranium hintonii has a vertical, thin rootstock giving rise to some prostrate to ascending aerial stems. These stems root at the nodes and have 2-flowered cymules arising singly. The indumentum consists of thin, eglandular hairs on stems, pet-

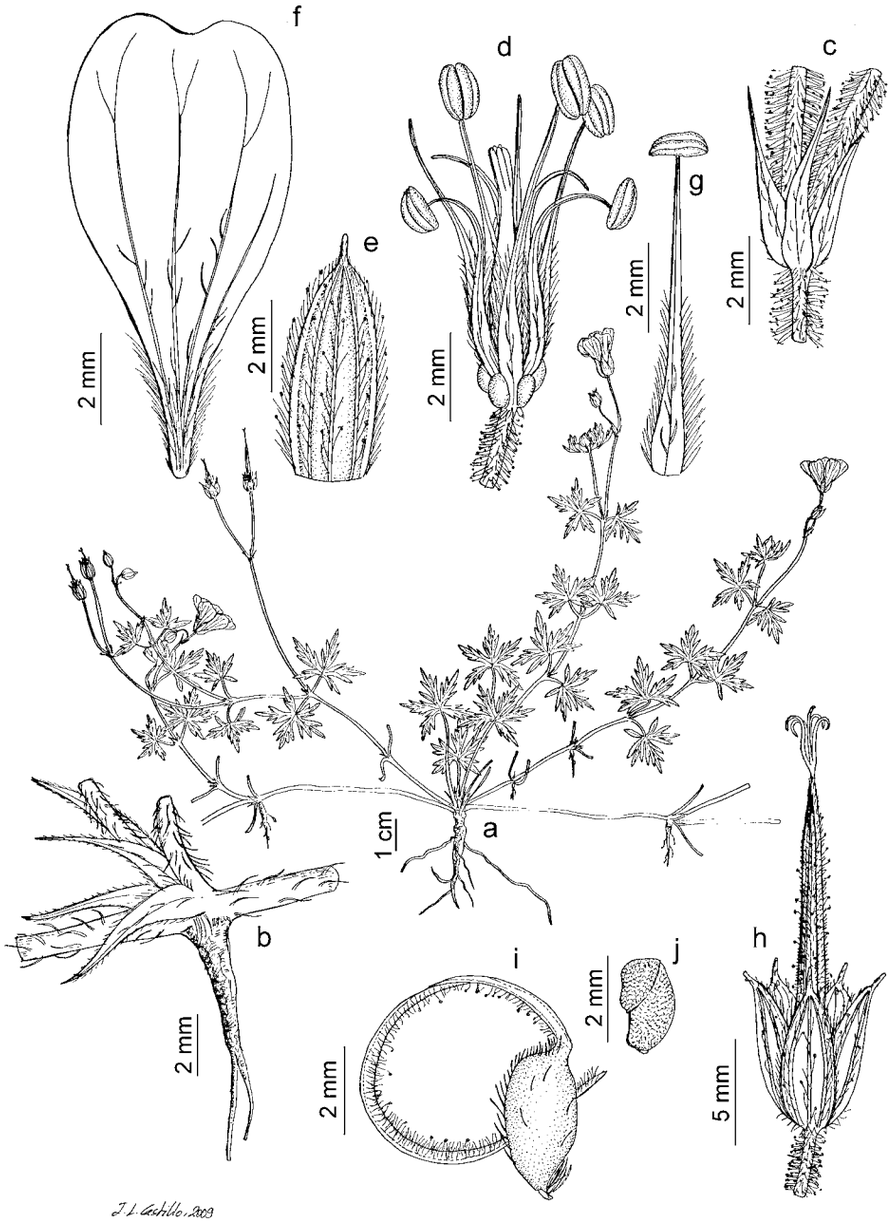


Fig. 388. *Geranium hintonii*. a. Habit. b. Rooting node. c. Bracteoles. d. Flower, sepals and petals removed. e. Sepal. f. Petal, adaxial side. g. Stamen. h. Fruit. i. Mericarp. j. Seed. (Based on: a-g, *Koch & Fryxell 82123*, F; h-j, *Breedlove 36097*, MO).

Fig. 389. Distribution of *Geranium hintonii*.

ioles, and leaves. The inflorescences also bear abundant glandular hairs, especially on pedicels and sepals. The petals are long, emarginate, and hairy adaxially. These hairs are usually restricted to the basal third of the adaxial surface, although sometimes they reach the center. *Geranium hintonii* shares with *G. monanthum* a similar leaf shape, inflorescence structure, emarginate and hairy petals, and glabrous nectaries; however, *G. monanthum* differs in its 1-flowered cymules, ovate stipules, and a typical indumentum composed of retrorse, appressed, eglandular hairs extending from the stem base to the inflorescence (with some patent, glandular hairs on the stem). Additionally, the apex of stems of *G. monanthum* ends in a bud without leaves, while in *G. hintonii* the stems terminate in a cymule. Both species have well-defined allopatric ranges in the Sierra Madre del Sur, *G. hintonii* in Guerrero and *G. monanthum* in Oaxaca.

152. Geranium monanthum Small in Underw. & Britton (eds.), N. Amer. Fl. 25(1): 21. 1907. Type locality: "Type collected on the northwest side, near the summit, of Mt. Zempoaltepec, Oaxaca, Mexico, July 9, 1894, E. W. Nelson 659". Type: Mexico. Oaxaca, Mt. Zempoaltepec, 17°10'N, 95°59'W, 9 July 1894, *E.W. Nelson 659* (holotype, US-00130525 image!).

Perennial herbs, 17-27 cm tall. *Rootstock* 1.7-3.2 mm in diameter, ± horizontal, not tuberculate, not turnip-shaped, without thickened roots. *Stem* ascending, leafy, not rooting at nodes, stolons absent, without vegetative stems, with retrorse, appressed, eglandular hairs 0.2-0.3 mm long and patent, glandular hairs 0.6-1.4 mm long. *Basal leaves* unknown, cauline leaves opposite; leaf laminas 1.7-2.7 cm long, 2.1-3.2 cm wide, not peltate, palmatifid [ratio main-sinus length/middle segment length = 0.82-0.90], polygonal in outline, base cordate, not coriaceous, with nerves not projected, with scatered, ± appressed, eglandular hairs on both surfaces; segments 5, in 1 plane, middle segment rhombic (with lanceolate lobes), 1.8-5.1 mm wide at the base [ratio segment width at the base/middle segment length = 0.14-0.30], 5-8-lobed in distal half [ratio secondary sinus length/middle segment length = 0.28-0.43]; petioles up to 4 cm long, without abscission zone, terete, not swollen, not deflexed in age, with retrorse, appressed, eglandular hairs 0.2-0.4 mm long; stipules 3.9-6.9 mm long, 1.1-3.7 mm wide, ovate, free, papery, brownish red, with eglandular hairs on abaxial surface

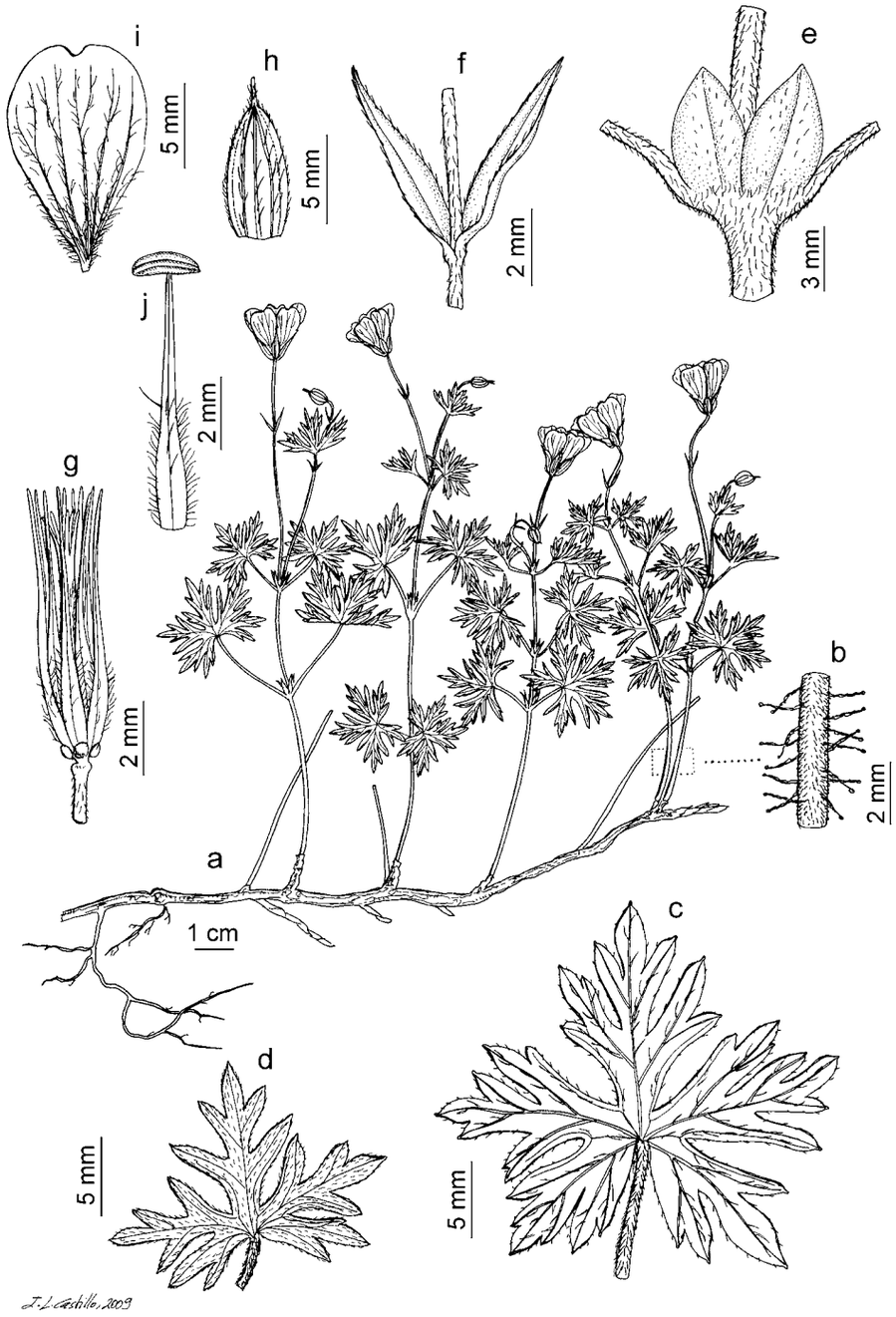


Fig. 390. *Geranium monanthum*. a. Habit. b. Detail showing stem indumentum. c. Leaf, abaxial side. d. Leaf, adaxial side. e. Stipules. f. Bracteoles. g. Flower, sepals and petals removed. h. Sepal. i. Petal, adaxial side. f. Stamen. (Based on: *Camp 2624*, NY).

and on the margin, usually glabrous adaxially. *Inflorescence* a monochasial cyme; cymules 1-flowered, solitary [ratio cymule length/leaf length = 2.4-3.6]; peduncles 14-51 mm long, with retrorse, appressed, eglandular hairs 0.2-0.4 mm long; bracteoles 3.3-7.3 mm long, 0.7-1.6 mm wide, lanceolate, opposite; pedicels 10.7-20.9 mm long, with retrorse, appressed, eglandular hairs 0.2-0.3 mm long. Flowers actinomorphic. *Sepals* 5.5-8.2 mm long, 2.1-3.6 mm wide, lanceolate, smooth, not accrescent, nerves 3, mucro 1.2-2.1 mm long [ratio mucro length/sepal length = 0.17-0.31], with antrorse to patent, eglandular hairs 0.3-1.1 mm long on the abaxial surface, almost glabrous adaxially. *Petals* (9.9)11.7-14.1 mm long, 6.7-9.2 mm wide, erect-patent, emarginate (notch 0.6-1.9 mm deep), without claw, white to lavender, hairy on the basal 3/4 of their adaxial surface and on the base of the abaxial surface, ciliate on the basal margin, with hairs 0.6-1.4 mm long. *Stamens* 10, both whorls bearing anthers; filaments 5.9-7.5 mm long, lanceolate, yellow, pilose on the abaxial surface, ciliate on the proximal half, with hairs 0.3-0.7 mm long; anthers 1.4-1.8 mm long, yellow. Nectaries 5, hemispheric, glabrous. *Gynoecium* 6.1-8.9 mm long, yellow. *Fruit* unknown. *Seeds* unknown. Cotyledons not studied. Fig. 390.

Pollen. Ornamentation not studied.

Chromosome number. Unknown.

Fig. 391. Distribution of *Geranium monanthum*.

Phenology. Collected in flower from February to November.

Distribution. This species is endemic to central Oaxaca, in southern Mexico (Fig. 391).

Habitat. On clay and loam soil, in secondary growth and *Pinus* L.-*Quercus* L. forests; 2400-3400 m.

Additional specimens examined. **Mexico.** Oaxaca: Zempoaltepetl, top of the mountain, 17º10'N, 95º59'W, 19 Feb. 1937, *Camp 2624* (GH, MICH, NY, P, RSA); between Yalina and Natividad, 17º15'N, 96º21'W, 4 Nov. 1952, *Oberg s.n.* (CAS); Ixtlán, municipio de Ixtlan, 2 km N of the turnoff to Ixtlan de Juarez on highway 175, 17º20'N, 96º27'W, 5 Mar. 1981, *Martin 403* (CAS, MO).

Discussion. The rootstock of *G. monanthum* is horizontal, relatively long and slim, and has several aerial stems arising from it at intervals. The available specimens do not include a basal leaf (nor dry vestiges) at the base of aerial stems. Broad, brown stipules enclose the base of stems and especially the growing tip. The indumentum of *G. monanthum* is mostly constituted of short, appressed, eglandular hairs; however, at the base of aerial stems there are a few long and thin, glandular hairs. It is noteworthy that petals of *G. monanthum* have long, spreading, eglandular hairs on most of the adaxial surface and some at the base of the abaxial surface. Moore (1943: 56) assigned *G. monanthum* to his series *Bella* with doubts because of its superficial resemblance to *G. potentillifolium*; however, *G. monanthum* most likely is allied with *G. hintonii*.

The Seemannii Group—This group is characterized by its trailing and ascending habit, its palmatifid or palmatisect, opposite leaves, and its 2-flowered cymules arranged in monochasial inflorescence. The petals are of small size and hairy on basal margins and on the base of the adaxial surface.

153. Geranium seemannii Peyr., Linnaea 30: 66. 1859 [21 Feb. 1859]. *Geranium seemannii* var. *macranthum* Briq., Annuaire Conserv. Jard. Bot. Genève 11-12: 190. 1908. *Geranium mexicanum* var. *macranthum* (Briq.) R. Knuth in Engl., Pflanzenr. IV.129 (Heft 53): 197. 1912. Type locality: "Hab. Toluca, Cocustepec, 8800'. Heller coll. n. 325, 258, 273. Oaxaca (Galeotti coll. n. 4024, 4019!). Berland coll. n. 829!". Type: Mexico. Oaxaca, monts de la Côte Pacif[ique], 1840, *H. Galeotti 4024* (lectotype, designated by Moore 1943: 84, G-00388792!; isolectotypes, K-001089531!, P-00493021!, US, W!).

Perennial herbs, 10-200 cm tall. *Rootstock* 1.7-9.4 mm in diameter, vertical, not tuberculate, not turnip-shaped, without thickened roots. *Stem* trailing and ascending, leafy, sometimes rooting at nodes, stolons absent, without vegetative stems, with patent, eglandular hairs 0.5-2 mm long and, rarely, patent, glandular hairs 0.7-0.8 mm long. *Basal leaves* in a ± deciduous rosette, cauline leaves opposite; leaf laminas 1.9-6.1 cm long, 2.2-7.4 cm wide, not peltate, palmatifid [ratio main-sinus length/middle segment length = (0.77)0.79-0.88(0.92)], polygonal in outline, base cordate, not coriaceous, with nerves not projected, pilose, with appressed, eglandular hairs on both surfaces; segments 5, in 1 plane, middle segment rhombic, 1.4-10.8 mm wide at the base [ratio segment width at the base/middle segment length = (0.09)0.11-0.25(0.30)], (5)9-20-lobed in distal half [ratio secondary sinus length/middle segment length = 0.15-0.31(0.41)]; petioles up to 25 cm long, without abscission zone, terete, not swollen, not deflexed in age, with patent, eglandular hairs 0.3-1.8 mm long and, rarely, patent, glandular hairs 0.6-0.8 mm long; stipules 3.3-11.6 mm long, 0.6-2.3 mm wide, linear-lanceolate (sometimes with a short bifid apex), free, papery, brownish red, with eglandular hairs on both surfaces

and on the margin. *Inflorescence* a monochasial cyme; cymules 2-flowered, solitary [ratio cymule length/leaf length = (0.3)0.8-4.9]; peduncles (9)18-87(111) mm long, with patent to retrorse, eglandular hairs 0.2-1.7 mm long and, usually, patent, glandular hairs 0.3-1.2 mm long; bracteoles 2.2-7.3 mm long, 0.2-1.5 mm wide, linear-lanceolate, whorled; pedicels 2-39.4 mm long, with patent to retrorse, eglandular hairs 0.2-1 mm long and patent, glandular hairs 0.4-1.2 mm long. Flowers actinomorphic. *Sepals* (3.4)4.3-6.4(7.5) mm long, 1.6-3.5 mm wide, lanceolate, smooth, not accrescent, nerves 3, mucro (0.3)0.7-1.1(1.8) mm long [ratio mucro length/sepal length = 0.06-0.33], with erect-patent, eglandular hairs 0.1-1.2 mm long and patent, glandular hairs 0.4-1.3 mm long on the abaxial surface, glabrous adaxially. *Petals* 3.5-13.9 mm long, 1.6-7.4 mm wide, erect-patent, slightly emarginate (notch 0.3-1.3 mm deep), without claw, purple, rarely white, glabrous on both surfaces or hairy on the base of the adaxial surface, ciliate on the basal margin, with hairs 0.1-0.6 mm long. *Stamens* 10, both whorls bearing anthers; filaments 1.7-6.5 mm long, lanceolate, white, pilose on the abaxial surface, ciliate on the proximal half, with eglandular hairs 0.1-0.7 mm long on the abaxial surface and margin; anthers 0.3-1.7 mm long, yellow. Nectaries 5, hemispheric, glabrous. *Gynoecium* 2.2-7.6 mm long, yellow or purple. *Fruit* 15.2-23.5 mm long, erect, discharge of seed-ejection type; mericarps 2.4-3.8 mm long, 1-2 mm wide, without a strand of fibers, not compressed at the apex, smooth (with 1 transverse vein at the apex), without basal beak, with a basal callus, without a basal prong, brown, with erect-patent, eglandular hairs 0.3-1 mm long and usually, patent, glandular hairs 0.3-1.2 mm long; rostrum 10.1-17.7 mm long, with a narrowed apex (0.5)0.7-2.7(3.8) mm long, not twisted, with erect-patent, eglandular hairs 0.1-0.9 mm long and patent, glandular hairs 0.5-1.3 mm long; stigmatic remnants 1-3.6 mm long, with 5 sometimes hairy lobes. *Seeds* 1.9-2.5 mm long, 1.1-1.7 mm wide, finely reticulate, uniformly colored, brown, glabrous. Cotyledons with entire margin.

Pollen. Ornamentation not studied.

Chromosome number. 2*n* = 52.

Phenology. Collected in flower from January to December.

Distribution. This species ranges from southern U.S.A., through Mexico, Guatemala, El Salvador, Honduras, Nicaragua and Costa Rica to Panama and it is introduced in Ecuador.

Habitat. Disturbed areas, streamsides, meadows, pastures, shrubby slopes, and forests; 50-4100 m.

1. Petals (3.5)4.5-6.4(9.1) mm long; ratio main-sinus length/middle segment length = (0.77)0.79-0.85(0.90). **153a**. subsp. **seemannii**

1. Petals 10-12.3(13.9) mm long; ratio main-sinus length/middle segment length = (0.80)0.84-0.88(0.92). **153b**. subsp. **repens**

153a. Geranium seemannii subsp. **seemannii** Peyr., Linnaea 30: 66. 1859.

Geranium flaccidum Small in Underw. & Britton (eds.), N. Amer. Fl. 25(1): 11. 1907. Type locality: "Type collected at La Chuparosa, Lower California, October 16, 1893, T. S. Brandegee". Type: Mexico. Lower California, La Chuparosa, 26°52'N, 112°20'W, 16 Oct. 1893, *J.S. Brandegee s.n.* (holotype, NY-00373662!; isotype, US-00100886 image!).

Geranium regale Rydb. in Underw. & Britton (eds.), N. Amer. Fl. 25(1): 11. 1907. Type locality: "Type collected between Pachuca and Real del Monte, Hidalgo, Mexico: July 19, 1905, J. N. Rose, J. H. Painter & J. S. Rose 8675". Type: Mexico. Hidalgo, between Pachuca and Real del Monte, 20°08'N, 98°40'W, 19 July 1905, *J.N. Rose & al. 8675* (holotype, NY-00373678!; isotypes, GH-00043656 image!, US).

Geranium vulcanicola Rydb. in Underw. & Britton (eds.), N. Amer. Fl. 25(1): 12. 1907. Type locality: "Type collected on Ixtaccihuatl, Mexico, October, 1905, C. A. Purpus 1691". Type: Mexico. México, Ixtaccihuatl, 19°11'N, 98°39'W, Oct. 1905, *C.A. Purpus 1691* (holotype, NY-00370258!; isotypes, MO-060366!, US).

Geranium seemannii var. *minoriflorum* Briq., Annuaire Conserv. Jard. Bot. Genève 11-12: 190. 1908. *Geranium mexicanum* var. *minoriflorum* (Briq.) R. Knuth in Engl., Pflanzenr. IV.129 (Heft 53): 197. 1912. Type locality: "Linden (ann. 1840); Galeotti n. 4019 et 4029; Berlandier n. 706 et 783 (partim ad var. sequentem vergens!)". Type: Mexico. 1844, Yavejia [Yavesía], 17°14'N, 96°24'W, 1844, *H. Galeotti 4029* (lectotype, designated by Aedo 2012: 169, P-00758019!; isolectotypes, BR-0000013347017 image!, W!).

Geranium subulato-stipulatum R. Knuth in Engl., Pflanzenr. IV.129 (Heft 53): 199. 1912. Type locality: "Mexiko: Thal von Mexiko (Ascherborn!, Bourgeau, Herb. Comm. scient. Mex. n. 273!, Pringle, Pl. mexic. a. 1899 n. 7917!).-- Blühend und fruchtend Juli bis August". Type: Mexico. Valley of Mexico, 14 Aug. 1899, *C.G. Pringle 7917* (lectotype, designated by Moore 1943: 97, B destroyed; lectotype, designated by Aedo 2012: 169, GH-00043657!; isolectotypes, F!, MO!, US).

Geranium guatemalense R. Knuth in Engl., Pflanzenr. IV. 129 (Heft 53): 200.1912. Type locality: "Guatemala: Dept. Quiché, bei San Miguel Uspantán (Heyde-Lux, Pl. Guatemal. ed. Smith n. 2914!); Dept. Huehuetenango, im Bergwald oberhalb Todos los Santos (C. et Ed. Seler, Pl. mexic. n. 2940!); Dept. Quetzaltenango und Sololá, zwischen Totonicapa und Los Encuentros (C. et Ed. Seler, Pl. mexic. n. 2351!)". Type: Guatemala. Quiché: San Miguel Uspantán, 15°23'N, 90°50'W, Apr. 1892, *E.T. Heyde & E. Lux 2914* (lectotype, designated by Moore,1943: B destroyed; lectotype, designated by Aedo 2012: 169, GH-00043630!; isolectotypes, K!, M-0307199!, MO, NY!, US).

Geranium kerberi R. Knuth in Engl., Pflanzenr. IV. 129 (Heft 53): 200. 1912. Type locality: "Mittel-Amerika: Von Mexiko durch Guatemala bis Columbien; eine typische Gebüschpflanze.-- Mexiko: San José del Oros (Schiede a. 1831!); Prov. Hidalgo, bei Zacualtipan (C. et Ed. Seler, Pl. mexic. n. 145!); Maltrata (Kerber n. 259!); Tezuantla (Ehrenberg n. 867!).-- Columbien, Paramo de la Culata (Moritz n. 1244!)". Type: Mexico. Hidalgo: bei Zacualtipán, 20°39'N, 98°39'W, Mar. 1888, *C. Seler & E. Seler 145* (lectotype, designated by Moore 1943: 99, B destroyed; lectotype, designated by Aedo 2012: 169, GH-00043638!).

Geranium culminicola H.E. Moore, Contr. Gray Herb. 146: 95, pl. 3 fig. 20, pl. 5 fig. 8. 1943. Type locality: "GUATEMALA: Quetzaltenango: open summit, Volcán Santa María, 12,400', July 26, 1934, Skutch 841 (G, type; F, isotype)". Type: Guatemala. Quetzaltenango, Volcán Santa María,

14°45'N, 91°33'W, 26 July 1934, *A.F. Skutch 841* (holotype, GH-00043626!; isotype, F).

Leaves palmatifid [ratio main-sinus length/middle segment length = (0.77)0.79-0.85(0.90)]; segments 5, middle segment (3)4.2-10.8 mm wide at the base [ratio segment width at the base/middle segment length = (0.10)0.17-0.25(0.30)], (5)9-20-lobed in distal half [ratio secondary sinus length/middle segment length = 0.15-0.24(0.28)]. *Peduncles* (9)18-37(84) mm long; pedicels 2-20.3 mm long. Sepals (3.4)4.3-5.3(7.3) mm long. *Petals* (3.5)4.5-6.4(9.1) mm long, 1.6-4.6 mm wide. *Filaments* 1.7-4.7 mm long; anthers 0.3-1 mm long. *Fruit* rostrum 10.1-17.2 mm long, with a narrowed apex (0.5)0.7-1.5(2.9) mm long; stigmatic remnants 1-2.7 mm long, with 5 sometimes hairy lobes. Figs. 392 a-m, 393.

Pollen. Ornamentation not studied.

Chromosome number. 2*n* = 52.

Phenology. Collected in flower from January to December.

Distribution. This subspecies ranges from southern U.S.A., through Mexico, Guatemala, El Salvador, Honduras, Nicaragua and Costa Rica to Panama and it is introduced in Ecuador (Fig. 394).

Habitat. Roadsides and waste places, margins of cultivated fields, damp grounds, streamsides, meadows, pastures, shrubby slopes, and *Abies* Mill., *Alnus* Mill., *Cupressus* L., *Magnolia* L., *Pinus* L., *Podocarpus* Pers. and *Quercus* L. forests; 50-4100 m.

Representative specimens examined. **Costa Rica.** Alajuela: Palmira del Naranjo, 10°12'N, 84°23'W, Apr. 1921, *Brenes 3525* (NY). Cartago: road summit on cerro de la Muerte, 9°33'N, 83°43'W, 28 Aug. 1967, *Raven 22081* (CAS). San José: valle de los Leones, lower part Valle de los Conejos, along río Talari, 9°27'N, 83°31'W, 21 Aug. 1971, *Burger & Gómez 8205* (NY). **Ecuador.** Chimborazo: Riobamba, 1°40'S, 78°38'W, 1857, *Spruce 5858* (BM, G, GH, LD, MPU, NY, P, W). Imbabura: Otavalo, 0°14'N, 78°16'W, 12 Dec. 1966, *Sparre 13511* (AAU, NY, S). Pichincha: Puéllaro, 0°4'N, 78°24'W, 16 Apr. 1950, *Acosta Solís 16480* (F). Tungurahua: vicinity of Ambato, 1°17'S, 78°37'W, *Pachano 81* (GH, NY). **El Salvador.** Chalatenango: San Ignacio, km 8 hacai El Pital, 14°19'N, 89°11'W, 17 Aug. 2004, *Linares 7646* (MEXU). San Salvador: volcán San Salvador, El Boquerón, 13°45'N, 89°16'W, 24 Feb. 1968, *Molina 21642* (NY). Santa Ana: Montaña Montecristo, 14°24'N, 89°35'W, 22 May 1963, *Molina 12551* (G, NY). **Guatemala.** Alta Verapaz: along río Cobán, between Santa Cruz and Tactic, 15°20'N, 90°20'W, 26 Jan. 1969, *Williams & al. 4122* (NY). Chimaltenango: road to Iximche ruins, Tecpán, 14°47'N, 91°1'W, 12 Jan. 1966, *Molina & al. 16104* (NY). El Progreso: near Finca Piamonte, 4 Jan. 1992, *Steyermark 43444* (GH). Huehuetenango: near Chemal, summit of Sierra de los Cuchumatanes, 8 Aug. 1942, *Steyermark 50288* (GH). Quetzaltenango: volcán Santa María, 14°45'N, 91°33'W, 12 Aug. 1960, *Beaman 4099* (GH, NY). Quiché: old Quiché ruins of ciudad Gumarcaj near Santa Cruz de Quiché, 15°1'N, 91°8'W, 23 Dec. 1972, *Williams & al. 41672* (BM). Sacatepéquez: volcán Acatenango, 14°31'N, 90°53'W,

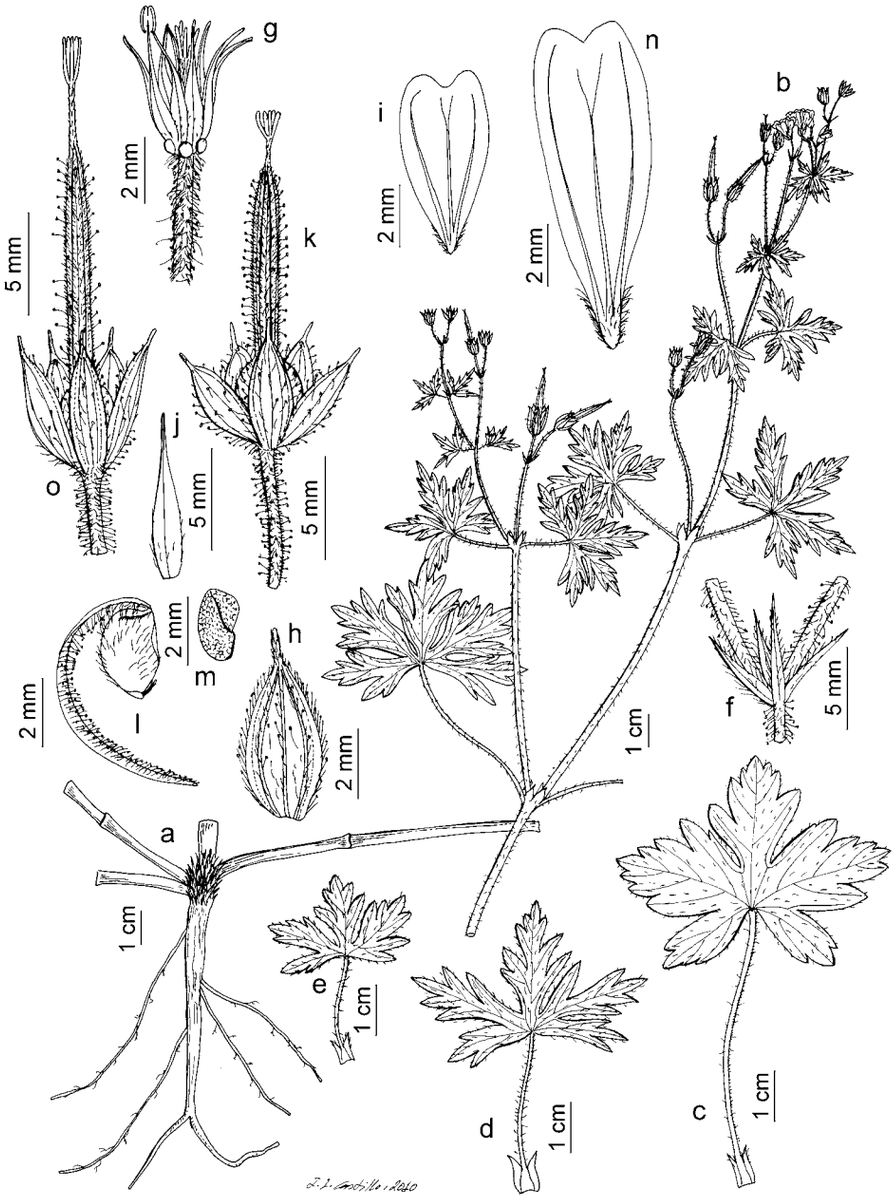


Fig. 392. *Geranium seemannii.* subsp. *seemannii*: a, b. Habit. c-e. Leaves, adaxial side. f. Bracteoles. g. Flower, sepals and petals removed. h. Sepal. i. Petal, adaxial side. j. Staminal filament. k. Fruit. l. Mericarp. m. Seed. *Geranium seemannii* subsp. *repens*: n. Petal, adaxial side. o. Fruit. (Based on: a, k-m, *Bye 28378*, MEXU; b, d, *Ramírez 430*, INB; c, *Asplund 6109*, S; e, *Moore 1183*, GH; f-j, *Hinton 16815*, GH; n, o, *Steyermark 43445*, GH).

Fig. 393. *Geranium seemannii* subsp. *seemannii* (Based on: *Aedo 24392,* MA).

10 Apr. 2000, *Véliz & al. 8338* (MEXU). San Marcos: road to Tajumulco volcano, near San Andrés, 15°4'N, 91°53'W, 2 Jan. 1965, *Williams & al. 27019* (NY). Santa Rosa: km 19.5 on Barbarena-El Salvdor road from Guatemala City, 14°22'N, 90°25'W, 17 Nov. 1940, *Moore 285* (GH, MEXU). Sololá: W slope of volcán Atitlán, 14°36'N, 91°12'W, 15 Dec. 1979, *Ericsson 79/385* (S). **Honduras.** El Paraíso: Yuscarán, Cerro Monserrat, 13°56'N, 86°51'W, 27 Aug. 1978, *Espinal 121* (BM). Francisco Morazán: Tatumbla, Cerro Uyuca, 14°1'N, 87°5'W, 8 Apr. 1970, *Hernández 5008* (GH). Lempira: near Gracias, montaña de Celaque, 14°38'N, 88°42'W, 20 Sep. 1991, *Chorley 326* (BM). Ocotepeque: El Portillo on Cordillera Merendón, 14°18'N, 89°0'W, 28 Apr. 1968, *Molina 22308* (NY). **Mexico.** Aguascalientes: Calvillo, 1 km al S del Garruño, Los Alisos, 21°51'N, 102°43'W, 13 Aug. 1997, *García 3938* (MEXU). Baja California Sur: S of Pico La Aguja, Sierra La Laguna, 23°34'N, 110°4'W, 22 Oct. 1977, *Breedlove & Axelrod 43401* (MEXU). Chiapas: Union Juarez, slope of volcán Tacaná above Talquian, 15°5'N, 92°5'W, 13 Dec. 1976, *Breedlove 42576* (CAS, MEXU). (CAS). Chihuahua: 5 km N of Humira, 27°25'N, 107°29'W, 9 Oct. 2001, *Bye & al. 28378* (MEXU). Coahuila: 24 km NW of Fraile, 25°3'N, 101°18'W, 15 July 1941, *Stanford & al. 379* (CAS, GH, NY). Durango: 3.8 mi W of El Salto, 23°45'N, 105°25'W, 1 Sep. 1967, *Oliver & al. 710* (MEXU). Guanajuato: 8-10 km NE of Santa Rosa, Dolores Hidalgo, 21°4'N, 101°12'W, 17 Sep. 1967, *McVaugh 23938* (MICH). Guerrero: Mina, barranca del Ranchito, Sierra Madre del Sur, 17°7'N, 100°6'W, 8 Jan. 1938, *Mexia 9095* (B, F, GH, MO, NY). Hidalgo: San Vicente, 19°47'N, 98°35'W, 16 Aug. 1937, *Edwards 830* (CAS, F). Jalisco: Sierra del Halo, near a lumber road leaving the Colima highwa 7 mi SSW of Tecalitlán, 19°24'N, 103°23'W, 28 Nov. 1959, *McVaugh 1133* (MICH). Mexico Distrito Federal: Milpa Alta, volcán Tlaloc, 19°6'N, 99°1'W, 23 July 1986, *Zamudio s.n.* (MEXU). Mexico State: Temascaltepec, Ocotepec, 18°52'N, 100°3'W, 12 July 1932, *Hinton 2891* (S, BM, GH). Michoacán: Coalcomán, Sierra Torricillas, 18°47'N, 103°9'W, 11 Oct. 1938, *Hinton 12344* (CAS, F, GH, NY). Morelos: Campo Turista km 60 carretera Cuernavaca, 18°54'N, 99°13'W, 7 Sep. 1952, *Gallegos 449* (MEXU). Nayarit: Tepic, 5 km de la terracería al Cuarenteño, que empieza a 500 m al W del Izote, 21°29'N, 104°59'W, 29 Jan. 1990, *Téllez 12579* (MEXU). Nuevo León: Peña Nevada, 26 mi NE of Dr Arroyo, 62 mi NE of Matahuala, W side of mountain known locally as Picacho Onofre, 23°45'N, 99°50'W, 4 July 1959, *Beaman 2709* (GH). Oaxaca: campamento Río de Molino, 4 km al SW de San Miguel Suchistepec, 16°4'N, 96°28'W, 21 Sep. 1965, *Rzedowski 20997* (CAS). Puebla: San Baltazar pres de Pueb-

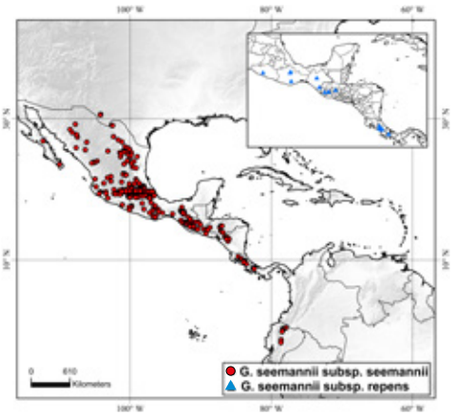


Fig. 394. Distribution of *Geranium seemannii.*

la, 19º2'N, 98º12'W, 20 Sep. 1909, *Nicolas (frère) s.n.* (GH, NY). Querétaro: Colón, parte alta de Cerro Zamorano, 20º48'N, 100º7'W, 1 Sep. 1987, *Rzedowski 44468* (MEXU). San Luis Potosí: El Derrumbe, km 216 carretera federal 70, pr. San Francisco, 22º3'N, 100º34'W, 9 July 2000, *Charco & al. 1470* (MEXU). Sinaloa: Ocurahui, Sierra Surotato, 25º55'N, 107º39'W, 1 Sep. 1941, *Gentry 6291* (ARIZ, GH, MO, NY). Tamaupilas: Gomez Farias, Rancho del Cielo, 23º3'N, 99º9'W, 28 Aug. 1952, *Sharp & al. 52176* (MEXU). Tlaxcala: Huamantla 2 km camino a Los Pilares, 19º16'N, 97º56'W, 15 Aug. 1988, *Flores 5* (MEXU). Veracruz: Rincón Grande al E de Jalapilla, 18º50'N, 97º5'W, 25 Oct. 1967, *Rosas 721* (F, GH). Zacatecas: Sierra de los Morones, near Plateado, 21º40'N, 103º12'W, 2 Sep. 1897, *Rose 3635* (NY). **Nicaragua.** Estelí: Estelí, cerro Quiabuc, 13º6'N, 86º25'W, 16 Feb. 2017, *Aedo 24392* (MA). Madriz: San José de Cusmapa, 1 km del Cerro de Buenavista, 13º18'N, 86º36'W, 4 Jan. 1982, *Moreno 14297* (NY). Matagalpa: Santa María de Ostuma, 12º40'N, 86º9'W, 8 Jan. 1963, *Williams & al. 23504* (G). **Panama.** Chiriquí: pr. Boquete, Finca Collins El Velo, 8º47'N, 82º26'W, 12 Mar. 1963, *Stern & al. 1999* (MICH). **USA.** Texas: Jeff Davis Co., Goat Canyon, 30º34'N, 104º13'W, 14 Sep. 1935, *Hinckley 404b* (NY).

153b. Geranium seemannii subsp. **repens** (H.E. Moore) Aedo, Syst. Bot. Monogr. 95: 171. 2012. *Geranium repens* H.E. Moore, Contr. Gray Herb. 146: 78. 1943. *Geranium pulchrum* C.V. Morton, Phytologia 1: 147. 1935, nom. illeg., non N.E. Br. 1895. Type locality: "Type in the U.S. National Herbarium, no. 1,587,112, collected at Santa Elena, Dept. Chimaltenango, Guatemala, alt. about 2850 meters, November 25, 1933, by A.F. Skutch (No. 709)". Type: Guatemala. Chimaltenango, Santa Elena, 14°48'N, 91°01'W, 25 Nov. 1933, *A.F. Skutch 709* (holotype, US image!; isotype, GH-00043653!).

Geranium clarum Small in Underw. & Britton (eds.), N. Amer. Fl. 25(1): 19. 1907. Type locality: "Type collected on the west slope of Mt. Zempoaltepec, Oaxaca, Mexico, July 5-13, 1894, E. H. Nelson 552". Type: Mexico. Oaxaca, Mt. Zempoaltepec, 17°10'N, 95°59'W, 5-13 July 1894, *E.H. Nelson 552* (holotype, US-00100868 image!).

Geranium miahuatlanum B.L. Turner, Phytologia 81: 1, 3 fig. 1. 1996. Type locality: "Mexico. Oaxaca: Mpio. Miahuatlán, San Agustín, 2735 m, swamp in pine forest, forming colonies, 5 Aug 1996, Hinton & al. 26744 (HOLOTYPE: TEX!)". Type: Mexico. Oaxaca, Miahuatlán, San Agustín, 16°17'N, 96°20'W, 5 Aug. 1996, *G.B. Hinton & al. 26744* (holotype, TEX-00208229 image!; isotype, CIIDIR-022544 image!).

Leaves palmatifid [ratio main-sinus length/middle segment length = (0.80)0.84-0.88(0.92)]; segments 5, middle segment 1.4-4.3(6.6) mm wide at the base [ratio segment width at the base/middle segment length = (0.09)0.11-0.16(0.20)], 5-14-lobed in distal half [ratio secondary sinus length/middle segment length = 0.16-0.31(0.41)]. *Peduncles* (35)46-87(111) mm long; pedicels 6.8-39.4 mm long. *Sepals* (4.8)5.6-6.4(7.5) mm long. *Petals* 10-12.3(13.9) mm long, 4.1-7.4 mm wide. *Filaments* 4.3-6.5 mm long; anthers 0.8-1.7 mm long. *Fruit* rostrum 13-17.7 mm long, with a narrowed apex (1.6)1.8-2.7(3.8) mm long; stigmatic remnants 1.9-3.6 mm long, with 5 glabrous lobes. Fig. 392 n, o.

Pollen. Ornamentation not studied.

Chromosome number. 2*n* = 52.

Phenology. Collected in flower from January to November.

Distribution. This subspecies ranges from southern Mexico, through Guatemala and Costa Rica to Panama (Fig. 394).

Habitat. Roadsides, open grazed slopes, and *Abies* Mill., *Cupressus* L., *Pinus* L., and *Quercus* L. forests; 2500-3900 m.

Additional specimens examined. **Costa Rica.** Cartago: Cartago, 1841, *Friedrichsthal 1383* (W); volcán Irazú, 9º58'N, 83º51'W, 16 Aug. 1993, *Aedo 2942* (MA); Oreamuno, volcán Irazú, cuenca del Sarapiquí, 9º58'N, 83º51'W, 30 Apr. 2003, *Alfaro & Quirós 4245* (MA); on volcan Irazú, 9º58'N, 83º51'W, 29 Aug. 1971, *Burger & Burger 8152* (BM, G, GH, S); volcan Irazú, 9º58'N, 83º51'W, 6 Apr. 1932, *Kupper 1014* (M); just below crater of volcan Irazú, 9º58'N, 83º51'W, 16 July 1961, *Rossbach 3278* (GH); volcan Irazú, 9º58'N, 83º51'W, 4 Aug. 1920, *Rowlee & Stork 930* (NY); behind crater of volcan Irazú, 9º58'N, 83º51'W, 9 July 1955, *Schubert 825* (GH). Limón: Chirripó National Park, between Casa da Administración and peak, 9º29'N, 83º27'W, 13 Feb. 1983, *Garwood & al. 1216* (BM). San José: cantón de Pérez Zelendón, Parque Nacional Chirripó, cordillera de Talamanca, 9º27'N, 83º30'W, 15 Oct. 2001, *Alfaro 439* (INB); along the trail from Canaán to Chirripó via Los Ángeles above the río Talari, 9º30'N, 83º31'W, 19 Jan. 1970, *Burger & Liesner 7423* (GH, S); entre Buena Vista y Cerro Frío, 9º31'N, 83º42'W, 27 Nov. 1964, *Jiménez 2679* (BM, G); Cerro las Vueltas, massif de Buena Vista, 9º37'N, 83º51'W, Jan. 1897, *Pittier 10512* (W). **Guatemala.** El Progreso: Sierra de Las Minas, hills between Finca Piamonte and slopes SE of Finca Piamonte, 15º2'N, 90º3'W, 4 Feb. 1942, *Steyermark 43445* (GH). Quetzaltenango: volcán Santa María, 14º45'N, 91º33'W, 27 July 1934, *Skutch 860* (GH). **Mexico.** Chiapas: Motozintla de Mendoza, NW slope of Cerro Mozotal below the microwave tower along the road from Huixtla to El Porvenir and Siltepec, 15º26'N, 92º20'W, 30 Dec. 1972, *Breedlove 31200* (CAS). camino de Nachig a Zinacantán, 16º45'N, 92º42'W, 21 Nov. 1988, *López 130* (MEXU). Guerrero: Galeana, Piedra Ancha, 17º30'N, 100º19'W, 30 Oct. 1939, *Hinton 14759* (GH, NY, RSA). Oaxaca: Miahuatlán, San Agustín, 16º17'N, 96º20'W, 5 Aug. 1996, *Hinton & al. 26759* (IEB, TEX); upper slopes of Sierra Juárez, 27 km N Ixtlan at km 85 on road to Tuxtepec, 17º30'N, 96º30'W, 16 Sep. 1965, *Roe 1982* (CAS, F); between Oaxaca and Valel nacional, 40.4 km N of Ixtlan de Juárez, 17º38'N, 96º24'W, 22 Oct. 1985, *Bartholomew & al. 3302* (GH). Chiriquí: Potrero Muleto, volcán Chiriquí, Boquete, 8º48'N, 82º32'W, 18 July 1938, *Davison 1007* (GH); Loma Larga to summit, volcán de Chiriquí, 8º48'N, 82º32'W, 4 June 1938, *Woodson & al. 1049* (GH, NY); Potrero Muleto, volcán Chiriquí, Boquete, 8º48'N, 82º32'W, 13 July 1940, *Woodson & Schery 378* (GH); carretera de subida al volcán Barú, 8º49'N, 82º32'W, 23 Aug. 1999, *Ibañez & al. 949* (MA); E side of volcán Barú, on road from Boquete

to near summit, 8º49'N, 82º32'W, 24 July 1975, *Mori & Bolten 7424* (MEXU).

Discussion. Geranium seemannii, a weedy and widespread species of Mexico and Central America, is well characterized by its vertical rootstock, trailing or ascending aerial stems (sometimes rooting at the nodes), the usual presence of a glandular indumentum on inflorescences, glabrous nectaries, and short and glabrous petals. Moore (1943: 82) recognized the variability of plants belonging to his series *Vulcanicola*; he stated: "Nearly every character varies inconstantly with little decisive geographic significance", and, specifically in *G. seemannii*, "... there is considerable variation throughout the range of this species but, without a better knowledge of distribution and stability of phases, the description of minor variations would only add to the confusion" (Moore 1943: 87). Yet, he described or accepted as species seven of these variants, most of them in central Mexico. Later authors, who worked in the region, considered this analytical point of view as impracticable (Arreguín 1979: 358; Rzedowski & Rzedowski 1995: 35; Utrera-Barillas 2000: 31) and placed most of the segregate names in synonymy. They agreed that only *G. cruceroense* can be clearly separated from *G. seemannii* by its palmatisect leaves, which is in accordance with my observations. Moore (1943) recognized two species in Central America: *G. guatemalense* and *G. repens*. He compared *G. guatemalense* with *G. seemannii* and pointed out that both species "... are very close in general floral characters, differing chiefly in habit and leaf characters", with *G. guatemalense* less robust and having more deeply divided leaves. Yet, I have found significant variation in habit and leaf-division throughout the range of *G. seemannii* and therefore consider *G. guatemalense* a synonym of *G. seemannii*. Moore's view was accepted by Standley & Steyermark (1946: 371) for Guatemala and by MacBryde (1968: 202) for Panama. According to these authors, *G. guatemalense* occurs at intermediate elevations, and it is characterized by its less divided leaves, short petals, and fruits with a short rostrum apex; *G. repens* is a species of higher elevations, with deeply dissected leaves, long petals, and fruits with a long rostrum apex. Burger (1991: 20), in his treatment of *Geranium* of Costa Rica, preferred to submerge *G. repens* within *G. guatemalense*, since " ... the flowers are remarkably alike and the distinctions of length of the stylar beak in fruit seem insignificant". He continued, "These differences appear to be clinal and may be worthy of subspecific recognition". I agree with Burger (1991: 20), since the cited combination of characters is only found in higher mountains of southern Mexico, Guatemala, Costa Rica, and Panama. In other regions of its range, *G. seemannii* can have deeply divided leaves, a long rostrum apex, or even long petals (but shorter than 10 mm), but I have never observed all these features on the same individual. Populations of *G. seemannii* with the more common array of characteristics have also been sampled in the mountains of Central America and apparently occur at the same localities and elevations as those with aspects of *G. repens*. Thus, some doubts remain about the status of subsp. *repens*, and field work perhaps may lead to an understanding of the variation within populations and the stability of key characters of this taxon. In summary, plants here identified as subsp. *repens* are recognized basically by the long petals. Additionally, this subspecies has the leaves more deeply divided (with narrow lobes, and deeper first and secondary divisions), and longer peduncles, pedicels, sepals, staminal filaments, anthers, rostrum apex, and stigmatic remnants, although with more or less broad overlap. Knuth (1912: 196) used the name *G. mexicanum* for *G. seemannii*. He was followed by later botanists until Moore (1943: 86) clarified the correct application of both names, and rightly noted the original use of *G. mexicanum* for plants with longer pedicels and petals.

Specimens of *G. seemannii* subsp. *seemannii* collected around Quito and Loja (Ecuador) match Mexican plants very well. They occur in disturbed habitats near these cities and are probably introduced weeds. In Ecuador *G. seemannii* subsp. *seemannii* could be confused with *G. killipii*, but it usually has leaves with the middle segments more lobed, shorter petals, shorter peduncles and pedicels, and a shorter rostrum apex than found in *G. killipii*.

Geranium seemannii subsp. *repens* may be confused with *G. lilacinum*, which is well characterized by its middle and distal cauline leaves that are hastate in outline and have broader and shallower segments. *Geranium clarum* seems to be a form of subsp. *repens* without glandular hairs from Oaxaca, and the name is here provisionally placed in synonymy. The type is an incomplete specimen (digital image seen). Field work at the type locality may help to clarify the status of this taxon.

154. Geranium cruceroense R. Knuth, Bull. Misc. Inform. 1937(10): 502. 1937, ["cruceroënse"]. Type locality: "State of Mexico. Discrict of Temascaltepec: Crucero Agua Blanca, on the llano, 3250 m., Aug. 1933, Hinton 4617 (typus in herb. Kew.), 'flower white'; Crucero, 2880 m., July 1933, Hinton 4188". Type: Mexico. Mexico, Temascaltepec, Crucero Agua Blanca, 19°8'N, 99°50'W, 30 Aug. 1933, *G.B. Hinton 4617* (holotype, K-000531442!; isotypes, BM!, F!, GH-00043625!, LL, MO-060432!, NY!, US-00100874 image!).

Geranium radiatum Small in Underw. & Britton (eds.), N. Amer. Fl. 25(1): 11. 1907, nom. illeg., non Andrews 1802. Type locality: "Type collected on the Sierra de Pachuca, Hidalgo, Mexico, July 21 and 22, 1901, J. N. Rose & R. Hay 5620". Type: Mexico. Hidalgo, Sierra de Pachuca, 20°11'N,

98°42'W, 21-22 July 1901, *J.N. Rose & R. Hay 5620* (holotype, NY-00373677!; isotypes, F, US-00100948 image!).

Perennial herbs, 16-35(40) cm tall. *Rootstock* 1.3-6.2 mm in diameter, vertical, not tuberculate, not turnip-shaped, without thickened roots. *Stem* trailing and ascending, leafy, not rooting at nodes, stolons absent, without vegetative stems, with retrorse, appressed, eglandular hairs 0.2-4 mm long. *Basal leaves* in a persistent rosette, cauline leaves opposite; leaf laminas 1.4-2.9 cm long, 1.6-4 cm wide, not peltate, palmatisect, polygonal in outline, base cordate, not coriaceous, with nerves not projected, pilose, with appressed, eglandular hairs on both surfaces; segments 5, in 1 plane, middle segment rhombic, 0.3-2.2 mm wide at the base [ratio segment width at the base/middle segment length = (0.04)0.07-0.10(0.12)], 5-12-lobed in distal half [ratio secondary sinus length/middle segment length = 0.26-0.44]; petioles up to 11 cm long, without abscission zone, terete, not swollen, not deflexed in age, with retrorse, appressed, eglandular hairs 0.1-0.5 mm long; stipules 2.6-8.3 mm long, 0.8-1.8 mm wide, lanceolate, free, papery, brownish red, with eglandular hairs on both surfaces and on the margin. *Inflorescence* a monochasial cyme; cymules 2-flowered, solitary [ratio cymule length/leaf length = (0.9)1.3-1.9]; peduncles (11)13-23(66) mm long, with patent to retrorse, eglandular hairs 0.2-0.6 mm long and patent, glandular hairs 0.2-0.8 mm long; bracteoles 2.7-5.4 mm long, 0.5-1 mm wide, linear-lanceolate, whorled; pedicels 3.7-10.5 mm long, with patent to retrorse, eglandular hairs 0.2-0.3 mm long and patent, glandular hairs 0.2-0.7 mm long. Flowers actinomorphic. *Sepals* (3.3)4.4-5.1(5.6) mm long, 1.5-3.1 mm wide, lanceolate, smooth, not accrescent, nerves 3, mucro (0.2)0.2-0.3(0.6) mm long [ratio mucro length/sepal length = 0.05-0.12], with erect-patent, eglandular hairs 0.2-0.5 mm long and patent, glandular hairs 0.4-0.7 mm long on the abaxial surface, glabrous adaxially. *Petals* (4.2)5.1-6.4(6.8) mm long, 1.6-3 mm wide, erect-patent, slightly emarginate (notch 0.3-0.7 mm deep), without claw, white, glabrous or ciliate on the basal margin, with hairs 0.1-0.4 mm long. *Stamens* 10, both whorls bearing anthers; filaments 2.2-3.8 mm long, lanceolate, white, pilose on the abaxial surface, ciliate on the proximal half, with eglandular hairs 0.1-0.2 mm long on the abaxial surface and margin; anthers 0.4-0.8 mm long, yellow. Nectaries 5, hemispheric, glabrous. *Gynoecium* 2.5-4 mm long, yellow. *Fruit* 15-19 mm long, erect, discharge of seed-ejection type; mericarps 2.5-3.3 mm long, 1.2-1.8 mm wide, without a strand of fibers, not compressed at the apex, smooth (with 1 transverse vein at the apex), without basal beak, with a basal callus, without a basal

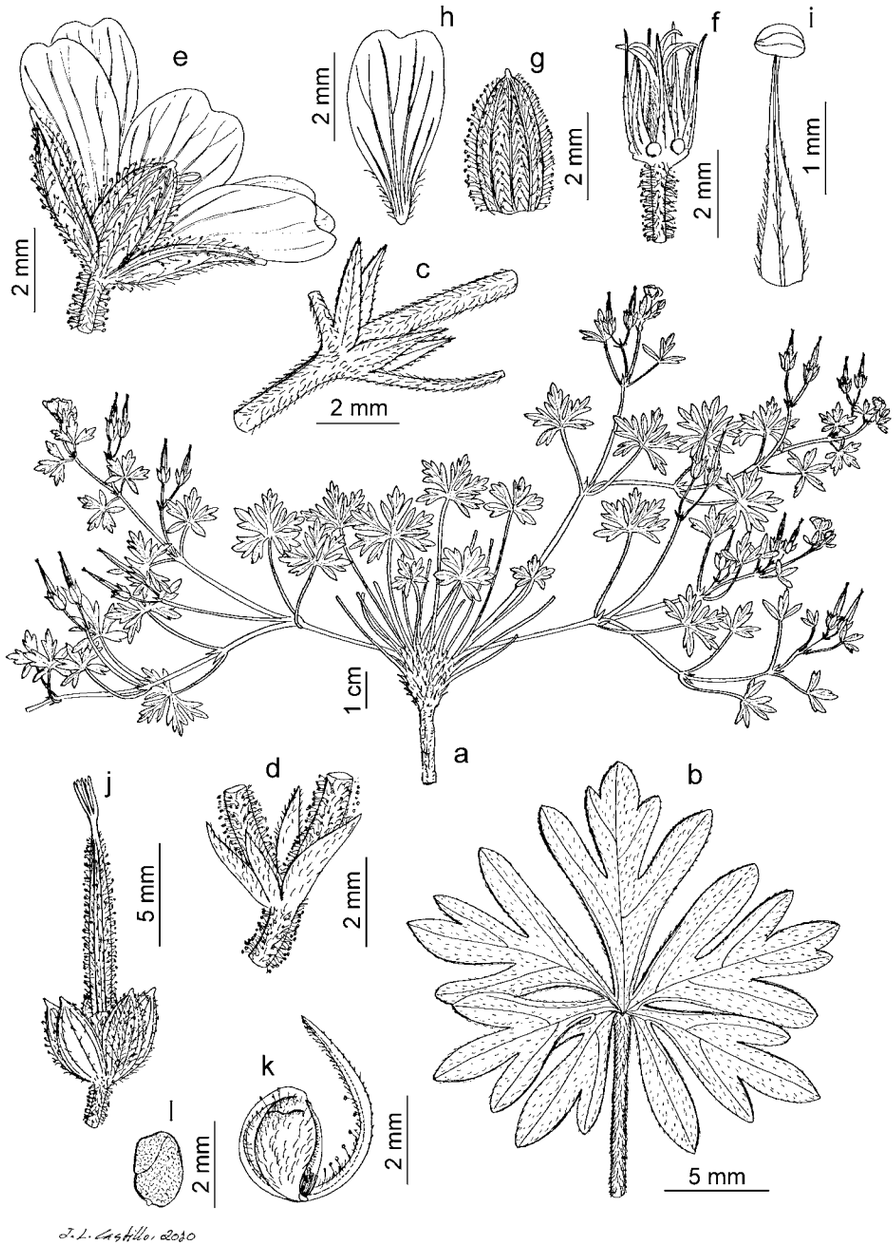


Fig. 395. *Geranium cruceroense*. a. Habit. b. Leaf. c. Stipules. d. Bracteoles. e. Flower. f. Flower, sepals and petals removed. g. Sepal. h. Petal. i. Stamen. j Fruit. k. Mericarp. l. Seed. (Based on: a-i, *Moore 1254*, GH; j-l, *Moore 1226*, BM).

prong, brown, with erect-patent, eglandular hairs 0.3-0.4 mm long and, usually, patent, glandular hairs 0.4-0.8 mm long; rostrum 10.3-13.1 mm long, with a narrowed apex (0.5)0.7-1(1.5) mm long, not twisted, with erect-patent, eglandular hairs 0.1-0.2 mm long and patent, glandular hairs 0.5-0.8 mm long; stigmatic remnants 1.3-2 mm long, with 5 glabrous lobes. *Seeds* 1.7-2.1 mm long, 0.8-1.3 mm wide, finely reticulate, uniformly colored, brown, glabrous. Cotyledons with entire margin. Fig. 395.

Pollen. Ornamentation not studied.

Chromosome number. Unknown.

Phenology. Collected in flower from May to November.

Distribution. This species ranges through central Mexico (Fig. 396).

Habitat. Roadsides, open slopes, stream banks, meadows, and *Abies* Mill. and *Pinus* L. forests; 2700-3850 m.

Additional specimens examined. **Mexico.** Hidalgo: Pachuca, Parque Nacional El Chico, Mineral del Chico, 20º11'N, 98º42'W, 17 Oct. 1946, *Moore 1537* (GH, MEXU, MO, NY). Mexico Distrito Federal: Desierto de los Leones, 19º8'N, 99º12'W, 8 Sep. 1946, *Moore 1173* (GH). Mexico State: 3 kms N of Paso Cortés on road to Iztaccihuatl, 19º5'N, 98º39'W, 8 July 1960, *Beaman 3518* (GH); 12.1 mi up road from Amecameca to Paso Cortés, 19º5'N, 98º39'W, 22 Sep. 1946, *Moore 1254* (F, GH, MEXU, NY); 55 km SE México City, 19º5'N, 98º55'W, 7 May 1942, *Weaver 728* (GH); road to Nevado de Toluca, 19º6'N, 99º45'W, 10 Apr. 1940, *Moore 89* (MEXU); Temascaltepec, Crucero, 19º8'N, 99º50'W, 28 July 1935, *Hinton 7971* (GH, NY); 10 mi on road from Zinacantepec to Nevado de Toluca, 19º9'N, 99º48'W, 19 Sep. 1946, *Moore 1226* (BM, GH); abov timerlne Mt. Ixtaccíhuatl, 19º10'N, 98º40'W, 22 Sep. 1946, *Moore 1249* (GH); vertiente SW del Ixtaccíhuatl, La Joya, cañada de Alcalican, 19º10'N, 98º40'W, 1 Nov. 1965, *Rzedowski 21589* (CAS); Ixtapaluca, Llano Tepochaico, 10 km S del Llano Grande, 19º15'N, 98º41'W, 12 Aug. 1980, *Rzedowski 36803* (MEXU); La Cima, 19º18'N, 99º22'W, 5 Sep. 1959, *Degener 26245* (NY); Ixtapaluca, estación experimental de investigación y enseñanza de Zoquiapan, 8 km al S de Río Frío, Llano de Aculco, 19º18'N, 98º54'W, 11 July 1975, *Koch 75327* (F, MEXU, NY); La Cima, Jajalpa, 19º18'N, 99º22'W, Aug. 1904, *Kuntze 23777* (NY); estación experimental de investigación y enseñanza de Zoquiapan, 19º18'N, 98º54'W, July 1976, *Obieta 57* (MEXU); estación experimental de investigación y enseñanza de Zoquiapan, 19º18'N, 98º54'W, July 1976, *Obieta 62* (MEXU); La Cima, 19º18'N, 99º22'W, 24 Aug. 1910, *Orcutt 4234* (BM, F, GH); La Cima, 19º18'N, 99º22'W, 30 Aug. 1905, *Pringle 13497* (CAS); serranía de Ajusco, 19º18'N, 99º22'W, 23 Aug. 1896, *Pringle 7305* (GH); estación experimental de investigación y enseñanza de Zoquiapan, 8 km al S de Río Frío, Llano San Miguel, 19º18'N, 98º54'W, 26 Aug. 1978, *Vega 454* (MEXU); at Llano Grande gap, near Río Frio, 19º21'N, 98º40'W, 28 July 1944, *Sharp 4487* (MEXU); Chalco, Llano de Aculco, 10 km al SW de Río Frío, 19º23'N, 98º47'W, 15 Aug. 1972, *Rzedowski 29110* (MEXU). Michoacán: Santa Clara del Cobre, alrededores de la lagunita de San Gregorio, 19º24'N, 101º32'W, 8 Oct. 1995, *Rzedowski 52786* (MEXU).

Fig. 396. Distribution of *Geranium cruceroense*.

Discussion. Geranium cruceroense shares with *G. seemannii* subsp. *seemannii* a similar habit, short petals with a usually ciliate base and an emarginate apex, glabrous nectaries, and a fruit rostrum with a short narrowed apex. *Geranium cruceroense* is set apart by its palmatisect leaves with distinctive deep and narrow lobes and by a very short sepal mucro. Additionally, the stems and petioles have an indumentum of short, retrorse, appressed, eglandular hairs. The original spelling of the epithet is "*cruceroënse*". According to Art. 60.7 of the ICN, the diaeresis may be omitted. I chose to do so for several reasons. IPNI listes "*cruceroense*" in accordance with *Index Kewensis*; the record from the *Gray Card Index* reads "*cruceroeense*", an erroneous substitution for the diaresis. In some floristic publications the spelling "*cruceroense*" prevails (e.g., Arreguín 1979: 356; Utrera-Barillas 2000: 16), although Rzedowski & Rzedowski (1995: 14) retained the diaresis. Also, the use of stress marks may be a disadvantage for computer searches.

Other species from Mexico

155. Geranium alpicola Loes., Bull. Herb. Boissier ser. 2, 3(2): 92. 1903. Type locality: "Hab. in Guatemala. in dept. Quezaltenango in Llanos montium supra Tolonicapam, et in dep. Huchuetenango in silva montana supra Todos los Santos sita et in pratis atque ad silva margines in Llanos summo in jugo montium sitis in 2800 3000 m altitudine: Sel n. 2377, 2939, 3228". Type: Guatemala. Quezaltenango, Totonicapán, 14°55'N, 91°22'W, 3000 m, 25 Sep. 1896, *C. Seler & E. Seler 2377* (lectotype, designated by Moore 1943: 20, B destroyed; lectotype, designated in Aedo 2012: 95, GH-00043619!).

Geranium nelsonii Rose in Underw. & Britton (eds.), N. Amer. Fl. 25(1): 20. 1907. Type locality: "Type collected on the summit of Mt. Zempoaltepec, Oaxaca, Mexico, July 9, 1894, E. W. Nelson 622". Type: Mexico. Oaxaca, Mt. Zempoaltepec, 17°10'N, 95°59'W, 9 July 1894, *E.W. Nelson 622* (lectotype, designated by Moore 1943: 20, US-00100899 image!).

Perennial herbs, 4-30 cm tall. *Rootstock* 3.3-11.2 mm in diameter, ± vertical, not tuberculate, not turnip-shaped, without thickened roots. *Stem* erect or ascending, leafy (rarely scapiform), not rooting at nodes, stolons absent, without vegetative stems, with antrorse, appressed, eglandular hairs 0.2-0.5 mm long. *Basal leaves* in a persistent rosette, cauline leaves opposite; leaf laminas 1.3-3.2 cm long, 1.7-3.5 cm wide, not peltate, palmatisect, polygonal in out-

line, base cordate, not coriaceous, with nerves not projected, pilose on the adaxial surface and sericeous on the abaxial surface, with antrorse, appressed, eglandular hairs; segments 5(7), in 1 plane, middle segment rhombic (with linear-lanceolate lobes), 0.4-0.8 mm wide at the base [ratio segment width at the base/ middle segment length = 0.03-0.09], 3-7(8)-lobed in distal half [ratio secondary sinus length/middle segment length = 0.50-0.84]; petioles up to 11 cm long, without abscission zone, terete, not swollen, not deflexed in age, with antrorse, appressed, eglandular hairs 0.2-0.5 mm long; stipules 3.6-8.4 mm long, 0.8-2 mm wide, lanceolate, free, papery, dark reddish, with eglandular hairs on both surfaces and on the margin. *Inflorescence* a dichasial cyme; cymules 2-flowered, solitary [ratio cymule length/leaf length = 1.4-7.2]; peduncles 15-138 mm long, sericeous, with antrorse, appressed, eglandular hairs 0.2-0.6 mm long; bracteoles 3.2-9.7 mm long, 0.5-1.4 mm wide, linear-lanceolate, whorled; pedicels 11-57 mm long, sericeous, with antrorse, appressed, eglandular hairs 0.2-0.5 mm long. Flowers actinomorphic. *Sepals* 6.2-8.7 mm long, 2.1-3.5 mm wide, lanceolate, smooth, not accrescent, nerves 3(5), mucro 0.7-1.6 mm long [ratio mucro length/ sepal length = 0.10-0.24], sericeous, with antrorse, appressed, eglandular hairs 0.3-0.7 mm long on the abaxial surface, hairy adaxially. *Petals* (9.8)10.9-14.6 mm long, 5.4-9.5 mm wide, erect-patent, rounded, without claw, purple, hairy on both surfaces, mainly on the base of the adaxial surface, ciliate on the basal margin, with hairs 0.3-0.5 mm long. *Stamens* 10, both whorls bearing anthers; filaments 3.9-5.9 mm long, lanceolate, yellow, with eglandular hairs 0.3-0.8 mm long on the abaxial surface and margin; anthers 1-1.5 mm long, yellow. Nectaries 5, hemispheric, glabrous. *Gynoecium* 4.3-6.3 mm long, pale pink. *Fruit* 21.3-29.4 mm long, ± reflexed, discharge of seed-ejection type; mericarps 3.1-3.7 mm long, 1.1-1.9 mm wide, without a strand of fibers, not compressed at the apex, smooth, without basal beak, with a basal callus, without a basal prong, brown, with antrorse, ± appressed, eglandular hairs 0.5-0.8 mm long; rostrum 15.1-21.1 mm long, with a narrowed apex 2.2-5.8 mm long, not twisted, sericeous, with antrorse, ± appressed, eglandular hairs 0.3-0.6 mm long; stigmatic remnants 2.8-3.6 mm long, with 5 glabrous lobes. *Seeds* 2.1-2.6 mm long, 1.4-1.6 mm wide, finely reticulate, uniformly colored, brown, glabrous. Cotyledons with entire margin. Fig. 397.

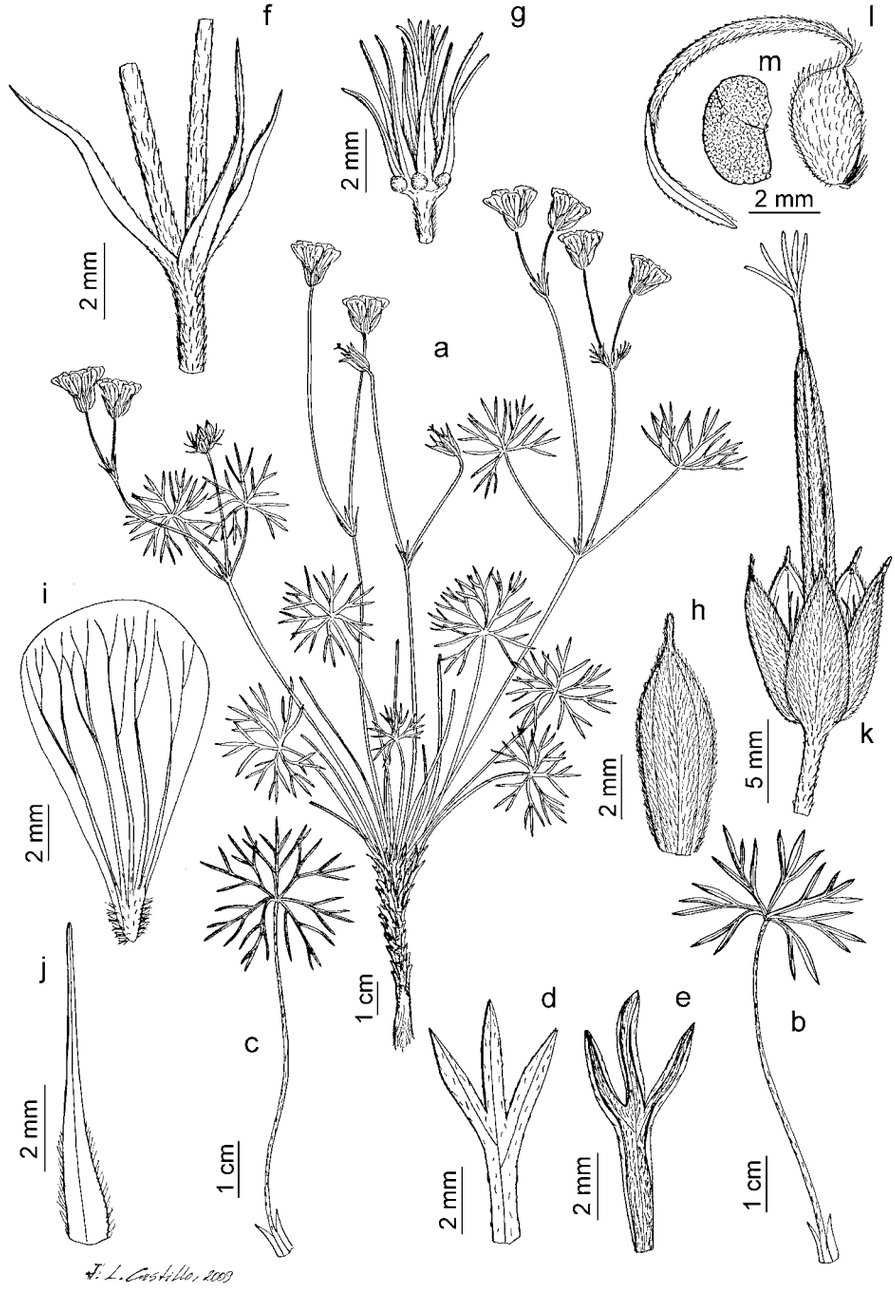


Fig. 397. *Geranium alpicola*. a. Habit. b, c. Leaves. d. Detail of leaf segment, adaxial side. e. Detail of leaf segment, abaxial side. f. Bracteoles. g. Flower, sepals and petals removed. h. Sepal. i. Petal. j. Staminal filament. k. Fruit. l. Mericarp. m. Seed. (Based on: a, c, f-j, *Ventura 16129*, NY; b, d, e, *Beaman 3792*, GH; k-m, *Beaman 3039*, GH).

Pollen. *Geranium*-type (Bortenschlager 1967: 431).

Chromosome number. Unknown.

Phenology. Collected in flower from January to October.

Distribution. This species ranges from southern Mexico to Guatemala (Fig. 398).

Habitat. Alpine meadows and open *Pinus* L. forests; 2700-4050 m.

Additional specimens examined. **Guatemala.** Huehuetenango: Chiantla, La Capellanía, 15º24'N, 91º25'W, 10 Aug. 1999, *Véliz & Morales 99.7160* (MEXU); Todos Santos, 15º31'N, 91º46'W, 19 June 1896, *Seler & Seler 2939* (GH); Todos Santos Cuchumatán, Chichim, 15º31'N, 91º46'W, 10 Aug. 1999, *Véliz & Morales 997240* (MEXU); San Juan Ixcoy, Ul-xemal, 15º32'N, 91º29'W, 4 July 2001, *Véliz & Véliz 11448* (MEXU); Sierra de los Cuchumatanes, between Paquix and Chemal at km 311 on ruta nacional 9, 15º33'N, 91º30'W, 2 Aug. 1959, *Beaman 2998* (GH); Sierra de los Cuchumatanes, between Tojiah and Chemal at km 320 on ruta nacional 9, 15º33'N, 91º30'W, 29 July 1960, *Beaman 3766* (GH); Sierra de los Cuchumatanes, between Tojiah and Chemal at km 319.5 on ruta nacional 9, 15º33'N, 91º30'W, 30 July 1960, *Beaman 3792* (GH); Sierra de los Cuchumatanes, between Chemal and San Juan Ixcoy, kms 324-325 on ruta nacional 9, 15º36'N, 91º30'W, 4 Aug. 1959, *Beaman 3039* (GH); San Juan Ixcoy, Chanchocal, 15º36'N, 91º31'W, 29 Aug. 2000, *Véliz & al. 10148* (MEXU); alpine zone of Cuchumatanes Mts., 47 km N of Huehuetenango on road 9N, 15º40'N, 91º30'W, 30 July 1965, *Roe & al. 658* (G); Sierra de los Cuchumatanes, 15º40'N, 91º30'W, 15 Sep. 1934, *Skutch 1262* (GH). Sacatepéquez: volcán Acatenango, 14º31'N, 90º53'W, 25 Oct. 2002, *García 205* (MEXU). San Marcos: volcán Tajumulco, E side of peak, 15º2'N, 91º54'W, 9 Aug. 1959, *Beaman 3174* (GH); San Marcos Tuichán, volcán Tajumulco, 15º4'N, 91º52'W, 26 May 2000, *Garriga de Gallardo & al. 2M.9104* (MEXU); Sierra Madre, auf Altos bei Tejutla, 15º7'N, 91º48'W, June 1882, *Lehmann 1515* (BM). Totonicapán: on the Tecum Uman Ridge at km 154 on ruta nacional 1, 20 kms E of Totonicapan, 14º52'N, 91º13'W, 14 Aug. 1960, *Beaman 4174* (GH); Cerro Quicné, 14º52'N, 91º13'W, 3 Feb. 1941, *Hunnewell 17151* (GH); Sierra María Tecum E of Totonicapan, 14º52'N, 91º13'W, 25 June 1947, *Williams 13164* (GH, MEXU). **Mexico.** Oaxaca: Ixtlán, Llano de las Flores, 20 km E of Ixtlan, on highway, 17º23'N, 96º24'W, 22 July 1960, *Beaman 3728* (GH); Atepec, Ixtlan, Llano de las Flores, 17º23'N, 96º24'W, 15 May 1969, *MacDougall s.n.* (NY); Llano de las Flores km 80, 5 km SE of Oaxaca, 17º25'N, 96º32'W, 15 Jan. 1968, *Carlson 3915* (F); Zempoaltepec, 17º25'N, 95º58'W, June 1842, *Liebmann s.n.* (F); Ixtlán, Atepec, near Llano de las Flores, 17º25'N, 96º32'W, 5 Aug. 1981, *Martin 639* (BM, CAS, NY); Atepec, camino de Atepec, 17º25'N, 96º32'W, 24 May 1979, *Ventura 16129* (F, NY); on knoll 1 mile by lumber road above km 77, 13 mi N of Ixtlán, 17º28'N, 96º24'W, 19 July 1968, *Anderson & Anderson 4834* (NY). Veracruz: La Zimiento, Cofre de Perote, 19º29'N, 97º8'W, 27 May 1938, *Balls 4638* (BM).

Fig. 398. Distribution of *Geranium alpicola*.

Discussion. Geranium alpicola is easily identified by its distinctive, deeply divided leaves, usually in five segments and each divided into 3-8 narrow, long lobes. The adaxial surface has scattered appressed hairs, and the margins are somewhat recurved. Thus, the abaxial surface is like a channel covered by a dense sericeous indumentum. The characteristic indumentum of antrorse, appressed, eglandular hairs covers the entire plant in variable densities, but is sericeous only on sepals, the abaxial leaf surface, and fruits. In some cases, the nerves stand out from the white sepal surface by their purplish color. Although most of the fruit is sericeous, the narrow apex of the rostrum and the stigmatic remnants are glabrous. As Moore (1943: 21) pointed out, *G. alpicola* is variable in the length of the stem. Some small herbarium specimens have cymules arising only from the rootstock. Specimens with well-developed aerial stems bearing 1-3 pairs of opposite leaves are more common, although in these plants it is not rare to find some cymules arising directly from the rootstock as well. Moore (1943: 21) suggested that this variation is related to environmental conditions and noted some resemblance among *G. alpicola* and stemless species from South America, such as *G. humboldtii* or *G. sibbaldioides*; however, these species differ in their 1-flowered cymules, leaves with few lobes per segment, stipules ending in 1-3 bristles, and shorter fruits without a narrowed apex.

156. Geranium madrense Rose ex Hanks & Small in Underw. & Britton (eds.), N. Amer. Fl. 25(1): 17. 1907. Type locality: "Type collected near Santa Teresa, Tepic, Mexico, August 10, 1897, J. N. Rose 2161". Type: Mexico. Nayarit [Territorio de Tepic], Santa Teresa, 22°28'N, 104°44'W, 10 Aug. 1897, *J.N. Rose 2161* (lectotype, designated by Moore 1943: 22, US-00100904 image!; isolectotypes, GH-00043643!, NY-00373671!).

Perennial herbs, 25-35 cm tall. *Rootstock* 9-9.2 mm in diameter, ± vertical, not tuberculate, not turnip-shaped, without thickened roots. *Stem* erect, leafy, not rooting at nodes, stolons absent, without vegetative stems, with retrorse, appressed, eglandular hairs 0.2-0.4 mm long. *Basal leaves* in a persistent rosette, cauline leaves opposite; leaf laminas 3-3.2 cm long, 3-3.3 cm wide, not peltate, palmatisect, polygonal in outline, base cordate, not coriaceous, with nerves not projected, pilose on both surfaces, with appressed, eglandular hairs; segments 5, in more than 1 plane, middle segment rhombic (with linear-lanceolate

lobes), ca. 0.7 mm wide at the base [ratio segment width at the base/ middle segment length = ca. 0.03], 3(4)-lobed in distal half [ratio secondary sinus length/middle segment length = 0.47-0.57]; petioles up to 12 cm long, without abscission zone, terete, not swollen, not deflexed in age, with retrorse, appressed, eglandular hairs 0.2-0.4 mm long; stipules 3.4-5.8 mm long, 0.6-1 mm wide, lanceolate, free, papery, brownish red, with scattered, eglandular hairs on both surfaces and on the margin. *Inflorescence* a dichasial cyme; cymules 2-flowered, solitary [ratio cymule length/leaf length = 1.8-7.2]; peduncles 39-100 mm long, with retrorse to uncinate eglandular hairs 0.1-0.2 mm long and patent, glandular hairs 0.2-0.5 mm long; bracteoles 3.5-4.5 mm long, 0.6-0.8 mm wide, lanceolate, whorled; pedicels 19.5-47 mm long, with retrorse to uncinate eglandular hairs 0.1-0.3 mm long and patent, glandular hairs 0.2-0.5 mm long. Flowers actinomorphic. *Sepals* 9.3-10 mm long, 2.3-3.2 mm wide, lanceolate, smooth, not accrescent, nerves 3-5, mucro 0.4-1.3 mm long [ratio mucro length/sepal length = 0.05-0.14], with antrorse, appressed, eglandular hairs 0.2-0.5 mm long and patent, glandular hairs 0.2-0.5 mm on the abaxial surface, glabrous adaxially. *Petals* 15.3-16 mm long, 9.3-10 mm wide, erect-patent, rounded, without claw, purple, hairy on both surfaces, mainly on the base of the adaxial surface, ciliate on the basal margin, with hairs 0.3-0.5 mm long. *Stamens* 10, both whorls bearing anthers; filaments 8.9-9.1 mm long, lanceolate, unknown color, with eglandular hairs 0.3-0.4 mm long mostly on the margin; anthers 2-2.2 mm long, unknown color. Nectaries 5, hemispheric, glabrous. *Gynoecium* 8-9 mm long, unknown color. *Fruit* 36-37 mm long, erect, discharge of seed-ejection type; mericarps 5.4-5.5 mm long, 2.7 mm wide, without a strand of fibers, not compressed at the apex, smooth, without basal beak, with a basal callus, without a basal prong, brown, with erect-patent, eglandular hairs 0.2-0.4 mm long and, patent, glandular hairs 0.2-0.5 mm long; rostrum 28-29 mm long, with a narrowed apex 4-4.2 mm long, not twisted, with ± patent, eglandular hairs 0.1-0.3 mm long and patent, glandular hairs 0.2-0.4 mm long; stigmatic remnants 2-3 mm long, with 5 glabrous lobes. *Seeds* unknown. Cotyledons not studied. Fig. 399.

Pollen. Ornamentation not studied.

Chromosome number. Unknown.

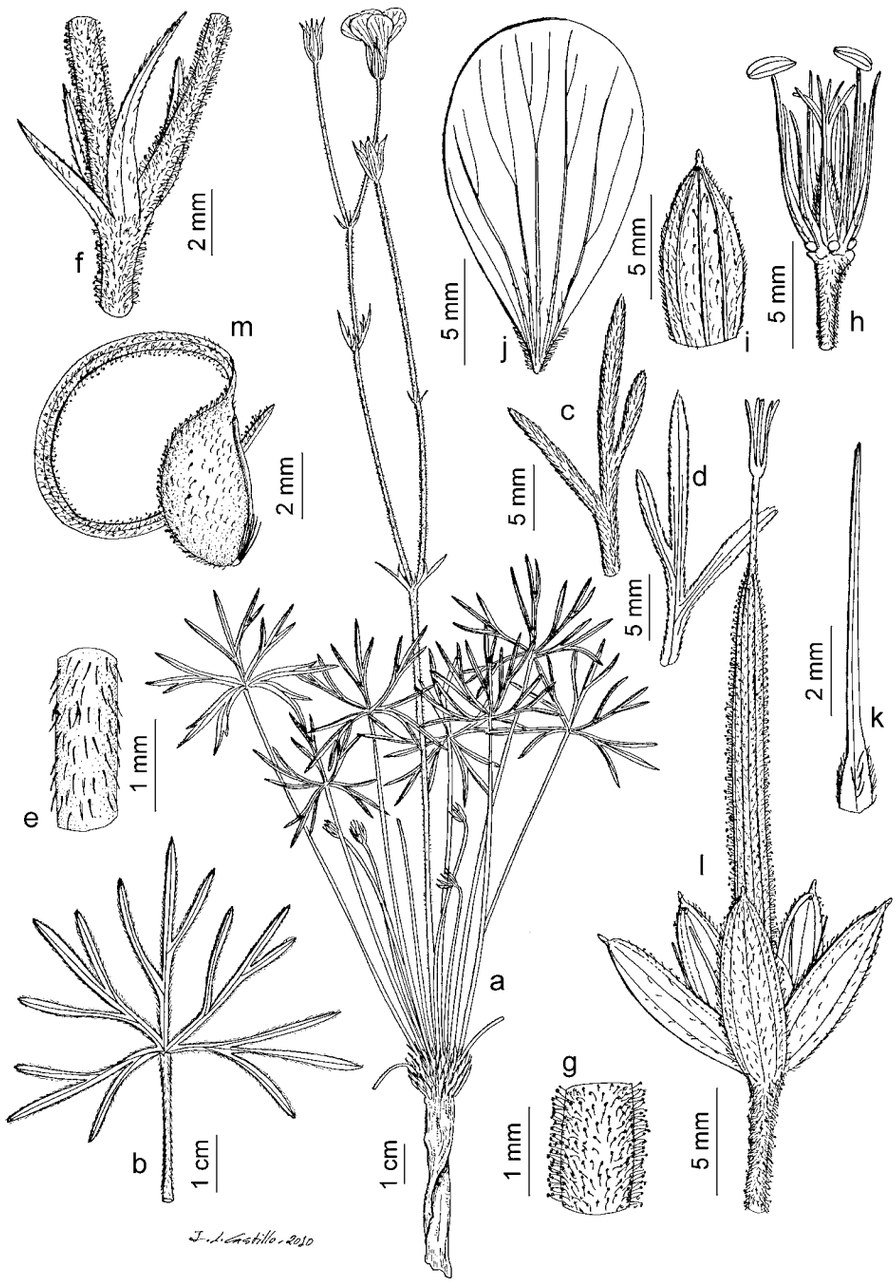


Fig. 399. *Geranium madrense*. a. Habit. b. Leaf. c. Leaf lobes, abaxial side. d. Leaf lobes, adaxial side. e. Detail showing petiole indumentum. f. Bracteoles. g. Detail showing peduncle indumentum. h. Flower, sepals and petals removed. i. Sepal. j. Petal, adaxial side. k. Staminal filament. l. Fruit. m. Mericarp. (Based on: *Rose 2161*, GH, NY).

Phenology. Collected in flower in August.

Distribution. This species is endemic to northern Nayarit, in western Mexico (Fig. 400).

Habitat. Unknown; ca. 2000 m.

Discussion. Geranium madrense is known only from the type, collected in Nayarit, Mexico. It is easily recognized by its deeply dissected leaves with five segments divided in three or four long and narrow lobes. The leaves are sericeous on both surfaces when young, but they soon lose most the indumentum and retain only scattered hairs. The petals are hairy only at the base, mainly adaxially and on the margin. *Geranium madrense* can be easily differentiated from *G. alpicola* by its inflorescence with glandular hairs. Additionally, *G. madrense* has retrorse to uncinate, eglandular hairs on peduncles and pedicels, whereas *G. alpicola* has antrorse, appressed eglandular hairs. Both species share petals with the indumentum restricted to the base and glabrous nectaries. The morphological variability of *G. madrense* is unknown, because only two sheets of the type collection were available to me for study. *Geranium madrense* was recorded from Durango (González Elizondo & al. 1991), but I did not see the voucher (*Pennell 18293*, MEXU).

Fig. 400. Distribution of *Geranium madrense*.

157. Geranium charucanum Standl., Publ. Field Mus. Nat. Hist., Bot. Ser. 22(1): 32. 1940. Type locality: "Mexico: Sierra Charuco, Río Fuerte, Chihuahua, riparian, September 13, 1935, Howard Scott Gentry 1813 (type in Herb. Field Mus.)". Type: Mexico. Chihuahua, Sierra Charuco, Río Fuerte, 27°35'N, 108°44'W, 13 Sep. 1935, *H.S. Gentry 1813* (holotype, F-0044700F!; isotypes, GH-00043622!, MO-060433!).

Perennial herbs, 32-110 cm tall. *Rootstock* 3.3-6 mm in diameter, ± vertical, not tuberculate, not turnip-shaped, without thickened roots. *Stem* erect, leafy, not rooting at nodes, stolons absent, without vegetative stems, with retrorse, appressed, eglandular hairs 0.2-0.5 mm long. *Basal leaves* unknown, cauline leaves usually opposite; leaf laminas 3.7-10.7 cm long, 5.3-11.6 cm wide, not peltate, usually palmatisect, polygonal in outline, base cordate, not coriaceous, with nerves not projected, pilose on both surfaces, with appressed, eglandular hairs; segments 5, in 1 plane, middle segment rhombic (with lanceolate lobes), 0.6-1(7.6) mm wide at the base [ratio segment width at the base/middle segment length = 0.01-0.02], 5-10(13)-lobed in distal half [ratio secondary sinus length/ middle segment length = 0.10-0.45]; petioles up to 41 cm long, without abscission zone, terete, not swollen, not deflexed in age, with retrorse, appressed, eglandular hairs 0.2-0.5 mm long; stipules 4-9.8 mm long, 1-2.9 mm wide, lanceolate, free, papery, brownish red, with scattered, eglandular hairs on both surfaces and on the margin. *Inflorescence* a dichasial cyme; cymules 2-flowered, solitary [ratio cymule length/ leaf length = 1.1-7.8]; peduncles 49-131(290) mm long, with retrorse, appressed, eglandular hairs 0.2-0.4 mm long; bracteoles 3.2-7 mm long, 0.6-1.3 mm wide, lanceolate, whorled; pedicels 12-70 mm long, with retrorse, appressed, eglandular hairs 0.2-0.4 mm long. Flowers actinomorphic. *Sepals* 5.5-8.5 mm long, 2.8-4.1 mm wide, lanceolate, smooth, not accrescent, nerves 3-5, mucro 0.6-2.9 mm long [ratio mucro length/sepal length = 0.10-0.38], with antrorse, appressed, eglandular hairs 0.2-0.5 mm long on the abaxial surface, glabrous adaxially. *Petals* 13.4-16.3(17.5) mm long, 6.2-12.1 mm wide, erect-patent, rounded or slightly emarginate (notch ca. 0.4 mm deep), without claw, purple, hairy on both surfaces, mainly on the base of the adaxial surface, ciliate on the basal margin, with hairs 0.2-0.8 mm long. *Stamens* 10, both whorls bearing anthers; filaments 4.4-7.2 mm long, lanceolate, purple, pilose on the abaxial surface, ciliate on the proximal half, with hairs 0.3-0.9 mm long; anthers 0.9-2.2 mm long, yellow. Nectaries 5, hemispheric, usually glabrous. *Gynoecium* 5.8-7.9 mm long, purple. *Fruit* 21.1-33.6 mm long, erect, discharge of seed-ejection type; mericarps 3.9-4.6 mm long, 1.8-2.3 mm wide, without a strand of fibers, not compressed at the apex, smooth, without basal beak, with a basal callus, without a basal prong, brown, with erect-patent, eglandular hairs 0.4-0.8 mm long; rostrum 13.9-23.7 mm long, with a narrowed apex 1.8-4.6 mm long, not twisted, with erect-patent, eglandular hairs 0.4-0.6 mm long; stigmatic remnants 3-3.7 mm long, with 5 glabrous lobes. *Seeds* 2.8-3.3 mm long, 2.1-2.2 mm wide, reticulate, uniformly colored, brown, glabrous. Cotyledons with entire margin. Fig. 401.

Pollen. Ornamentation not studied.

Chromosome number. Unknown.

Phenology. Collected in flower from August to September.

Distribution. This species ranges from central Chihuahua to northern Sinaloa, in northern Mexico (Fig. 402).

Habitat. Meadows and rocky areas in *Cupressus* L., *Pinus* L., and *Quercus* L. forests; 1500-2100 m.

Additional specimens examined. **Mexico.** Chihuahua: pr. Areponapuchic, slopes of Barranca de Urique, 27°30'N, 107°50'W,

20 Aug. 1954, *Knobloch 1322* (MICH); Río Mayo region, Sierra Canelo, 27°42'N, 108°40'W, 27 Aug. 1936, *Gentry 2481* (F, MEXU); Río Mayo region, Loreto, 27°44'N, 108°33'W, 3 Sep. 1936, *Gentry 2576* (MEXU, MO); Río Mayo region, Yepachic, 28°24'N, 108°20'W, 15 Aug. 1987, *Martin & al. s.n.* (MEXU). Sinaloa: Ocurahui, Sierra Surotato, 25°55'N, 107°39'W, 10 Sep. 1941, *Gentry 6341* (MICH, MO, NY). Sonora: Cerro Sahuarivo, E of San Bernardo, along stream río Curahui, 27°21'N, 108°40'W, 7 Aug. 1935, *Pennell 19591* (NY); Río Mayo region, Sahuaribo Waterfall vicinity 2 km N of Sahuaribo on road to Curohui, 27°21'N, 108°40'W, 20 Aug. 1992, *Martin & al. s.n.* (MO, RSA).

Discussion. Geranium charucanum is a robust species of which the basal parts (i.e., rootstock, basal leaves, etc.), are only imperfectly known. I saw only one specimen with one fragment of rootstock and a few basal leaves (*Martin & al. s.n.*, MEXU-641544). The middle and distal leaves are palmatisect with narrow and rhombic segments, similar to those of *G. niveum*, *G. alpicola*, and *G. madrense*; however, *G. charucanum* has shorter and wider lobes than the other species. The collection *Gentry 6341* (MICH, NY) includes a detached leaf that is deeply palmatifid, not palmatisect like the cauline leaves, and perhaps is a basal leaf. *Geranium charucanum* usually has opposite leaves, although some specimens have an alternate leaf on the middle part of the stem. The leaves are always opposite in the inflorescence, and the distal ones have fewer segments and lobes, which is similar to the pattern found in *G. niveum*, *G. alpicola*, and *G. madrense*. The indumentum of *G. charucanum* is composed of short, retrorse, appressed eglandular hairs and present on the stems, petioles, and inflorescences, whereas *G. alpicola* has antrorse hairs. Additionally, the leaves of *G. alpicola* are sericeous abaxially, and those of *G. charucanum* have only scattered hairs. In some specimens of *G. charucanum* a sericeous indumentum is present on young petioles and sepals, but these structures soon lose most of this covering and retain only scattered hairs. *Geranium niveum* and *G. madrense* have glandular hairs on the inflorescence, which have not been found in *G. charucanum* and *G. alpicola*.

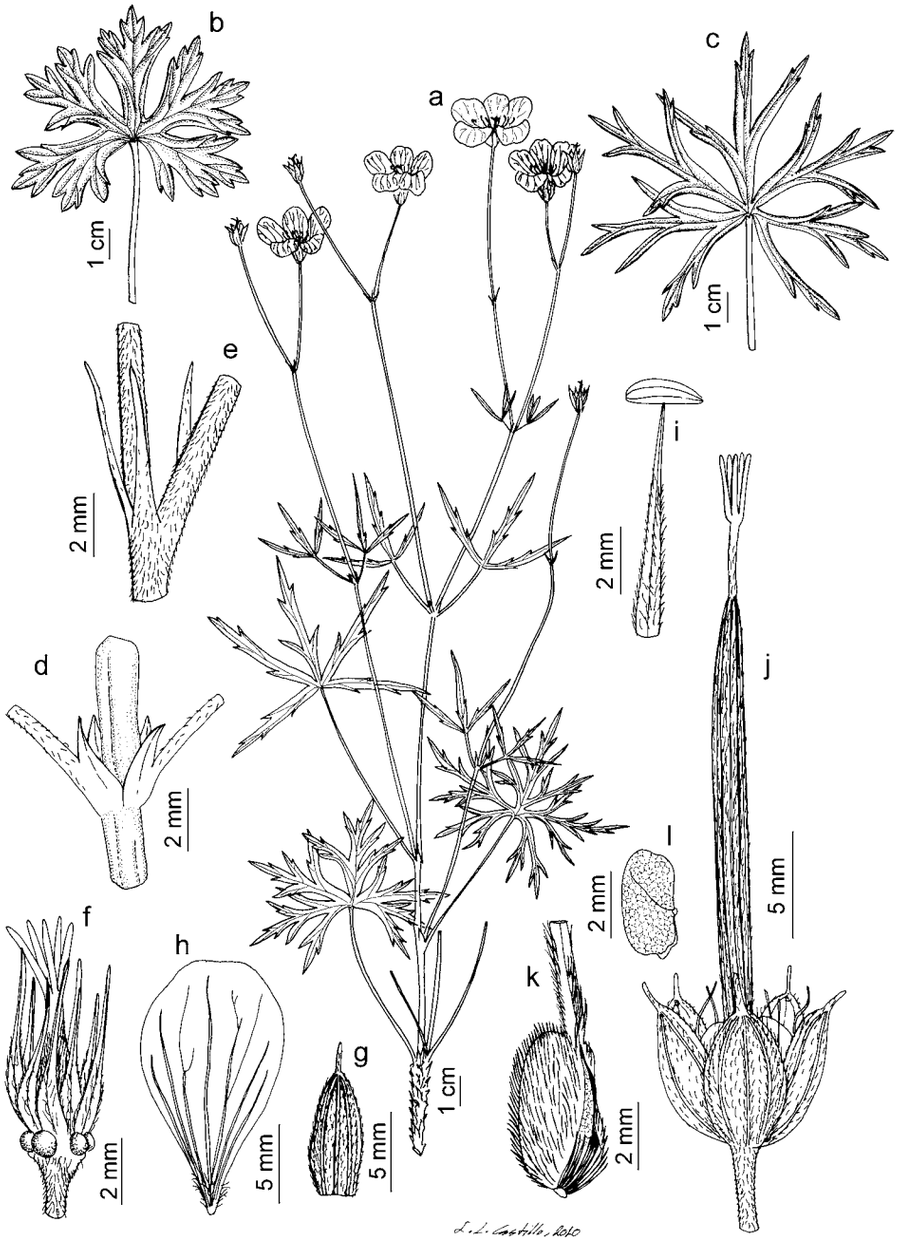


Fig. 401. *Geranium charucanum*. a. Habit. b, c. Leaves. d. Stipules. e. Bracteoles. f. Flower, sepals and petals removed. g. Sepal. h. Petal, adaxial side. i. Stamen. j. Fruit. k. Mericarp. l. Seed. (Based on: a, d-i, *Gentry 1813*, MO; b, j-l, *Gentry 1813*, NY; c, *Gentry 2576*, MO).

Fig. 402. Distribution of *Geranium charucanum*.

158. Geranium oaxacanum H.E. Moore, Contr. Gray Herb. 146: 30, pl. 1 fig. 2. 1943. Type locality: "MEXICO: Oaxaca: Sierra de San Felipe, 7000', Sept. 10, 1894, Pringle 4866 (G, type; F, G, M, NY, US, isotypes); vicinity of Cerro San Felipe, 7000-8500', Sept. 1, 1894, Nelson 1174 (US); Cerro de San Felipe, 2000 m., Aug. 22, 1897, Conzatti & Gonzalez 436 (G); Cerro San Felipe 7000', Sept. 23, 1895, Conzatti 711 (G); 18 miles southwest of the city of Oaxaca, 7000-9500', Sept. 10-20, 1894, Nelson 1370 (G, US); inter San Andres and San Miguel, Oct. 1842, Liebmann 3753 (US); Sierra, 7000-8000', Sept. 1840, Galeotti 4022 (NY, US); Oaxaca, 1750 m., July-Aug., 1900, Conzatti & Gonzalez 13 (US)". Type: Mexico. Oaxaca, Sierra de San Felipe, 17°11'N, 96°39'W, 10 Sep. 1894, *C.G. Pringle 4866* (holotype, GH-00043647!; isotypes, BM-000536632!, F-0093177F!, K!, LE!, M, NY-00373672!, P-00700632!, PH!, S-G-2850!, US-01108045 image!, W!).

Perennial herbs, 30-72 cm tall. *Rootstock* 15-44 mm in diameter, vertical, not tuberculate, turnip-shaped, without thickened roots. *Stem* erect, leafy, not rooting at nodes, stolons absent, without vegetative stems, with patent, eglandular hairs 0.5-1.4 mm long. *Basal leaves* few, not long persistent, cauline leaves verticillate in basal nodes and opposite towards the apex; leaf laminas 4.1-9.5 cm long, 4.9-12.2 cm wide, not peltate, palmatifid [ratio main-sinus length/middle segment length = 0.70-0.90], polygonal (medium and upper hastate) in outline, base cordate (medium and upper ± truncate), not coriaceous, with nerves not projected, pilose on both surfaces, with ± appressed, eglandular hairs; segments 3-5, in 1 plane, middle segment rhombic, 8.9-15(21.4) mm wide at the base [ratio segment width at the base/middle segment length = 0.18-0.41], 5-8(11)-lobed in distal half [ratio secondary sinus length/middle segment length = 0.07-0.14]; petioles up to 17 cm long, without abscission zone, terete, not swollen, not deflexed in age, with patent to retrorse, eglandular hairs 0.4-1.4 mm long; stipules 3.5-10 mm long, 0.6-2.3 mm wide, lanceolate, free, papery, brownish red, with eglandular hairs on both surfaces and on the margin. *Inflorescence* a dichasial cyme; cymules 2-flowered, solitary [ratio cymule length/leaf length = 1.7-8.1]; peduncles (34)54-92(100) mm long, with patent to retrorse, eglandular hairs 0.1-1.3 mm long and, usually, patent, glandular hairs 0.3-0.5 mm long; bracteoles 3.4-6.2 mm long, 0.4-1.1 mm wide, lanceolate, whorled; pedicels 13-69 mm long, with patent to retrorse, eglandular hairs 0.1-1 mm long and, usually, patent, glandular hairs 0.2-0.9 mm long. Flowers actinomorphic. *Sepals* (5.5)6-6.7(10) mm long, 2.4-3.2 mm wide, lanceolate, smooth, not accrescent, nerves 3, mucro (1.8)2.2-4.8 mm long [ratio mucro length/sepal length = 0.28-0.71], with antrorse to patent, eglandular hairs 0.3-1 mm long and, rarely, patent, glandular hairs 0.3-1.1 mm on the abaxial surface, glabrous adaxially. *Petals* (9.8)11.7-14.9(17.9) mm long, 5-12.3 mm wide, erect-patent, rounded, without claw, purple, hairy on the basal 1/4-1/3 of their adaxial surface, ciliate on the basal margin, with hairs 0.4-1.1 mm long. *Stamens* 10, both whorls bearing anthers; filaments 5.7-9.3 mm long, lanceolate, purple, pilose on the abaxial surface, ciliate on the proximal half, with hairs 0.2-0.7 mm long; anthers 0.9-1.8 mm long, yellow. Nectaries 5, hemispheric, glabrous. *Gynoecium* 6.9-9.2 mm long, purple. *Fruit* 28.5-37.1 mm long, erect, discharge of seed-ejection type; mericarps 3.4-4.9 mm long, 1.6-2.8 mm wide, without a strand of fibers, not compressed at the apex, smooth, without basal beak, with a basal callus, without a basal prong, brown, with erect-patent, eglandular hairs 0.5-1.1 mm long and rarely patent, glandular hairs 0.5-0.6 mm long; rostrum 19.1-25 mm long, with a narrowed apex (1.8)2.7-3.8(5.9) mm long, not twisted, with ± patent, eglandular hairs 0.2-0.8 mm long and, sometimes, patent, glandular hairs 0.4-0.8 mm long; stigmatic remnants 3.1-7.2 mm long, with 5 glabrous lobes. *Seeds* 2.8-3.1 mm long, 2-2.1 mm wide, finely reticulate, uniformly colored, brown, glabrous. Cotyledons with entire margin. Fig. 403.

Pollen. Ornamentation not studied.

Chromosome number. Unknown.

Phenology. Collected in flower from August to November.

Distribution. This species ranges through southern Mexico (Fig. 404).

Habitat. Open ridges and steep slopes with sparse second-growth *Quercus* L., or mixed *Pinus* L.-*Quercus* L. forests; 1800-2300 m.

Additional specimens examined. **Mexico.** forêt de Cajalpa dans une barranca, 1865, *Hahn s.n.* (P). Guerrero: summit of mountains NE of Chilpancingo on road to Chilapa, 17°32'N, 99°14'W, 19 Aug. 1948, *Moore & Wood 4648* (BM, GH, MEXU). Oaxaca: Cordillera, Sep. 1840, *Galeotti 4022* (NY, P, W); province d'Oaxaca, 1842, *Ghiesbreght s.n.* (P); inter San Andrés & San Miguel, 16°8'N, 96°27'W, Oct. 1842, *Liebmann 14905* (C); inter San Andrés & San Miguel, 16°8'N, 96°27'W, Oct. 1842, *Liebmann 3753* (C); portillo San Andrés, Miahuatlán, km 125, 16°12'N, 96°31'W, 14 Oct. 1967, *MacDougall s.n.* (NY); S of Portilla Lachao, Juquilla, 16°14'N, 97°8'W, 26 Sep. 1969, *MacDougall 820* (NY); 90-100 km SW of Sola de Vega along road to Puerto Escondido, 16°16'N, 97°14'W, 25 Oct. 1984, *Breedlove 62046* (CAS); 15 km NW of Zaachila on road to San Miguel Peras, 16°57'N, 96°52'W, 11 Nov. 1983, *Breedlove 60072* (CAS, NY); 18 mi SW of the city of Oaxaca, 16°57'N, 97°0'W, 10 Sep. 1894, *Nelson 1370* (GH); Zempoaltepetl, along the trail from Santo Domingo Albarradas to Mitla, 30-50 km WSW of summit, 17°1'N, 96°13'W, 19 Aug. 1950, *Hallberg 1072* (MICH); Cerro San Felipe, 17°11'N, 96°39'W, 22 Aug. 1897, *Conzatti & González 436* (GH); Cerro San Felipe, 17°11'N, 96°39'W, 23 Sep. 1895, *Conzatti 711* (GH); Cerro San Felipe, 17°11'N, 96°39'W, 1902, *Gadow s.n.* (BM); above San Felipe, 17°11'N, 96°39'W, 6 Sep. 1945, *Sharp 45897* (GH).

Discussion. Geranium oaxacanum has a vertical, short and stout, turnip-shaped rootstock giving rise to an erect aerial stem. Most specimens show a trait unknown in another spe-

cies of *Geranium*: a whorl of 3-6 leaves at the first branch point of the inflorescence. Sometimes a second whorl of leaves is present between the base and the first branch point. Leaves of *G. oaxacanum* are hastate and with three segments, similar to the leaves of *G. hernandesii*. Few herbarium specimens show basal leaves, since these soon fall. They are pentagonal in outline and have five segments. Petals are usually hairy on 1/4-1/3 of the adaxial surface; rarely, hairs are present only at the base. A glandular indumentum is present on the inflorescence of most specimens, but in some rare individuals peduncles, pedicels, and sepals lack this type of hairs. No specimens showed both of these exceptional characters. *Geranium oaxacanum* may be mistaken for *G. hernandesii*, especially given the similar leaf shape; however, *G. oaxacanum* has a dichasial inflorescence, shorter peduncles (with some overlap), and usually a glandular indumentum on the inflorescence. Both species share a long sepal mucro, but the sepals of *G. oaxacanum* are shorter than those of *G. hernandesii*. Additionally, leaves of *G. oaxacanum* are whorled at the first branch point. *Geranium oaxacanum* shares with *G. latum* a dichasial inflorescence and adaxially hairy petals, but *G. latum* has nectaries with a tuft of hairs covering its entire surface (not glabrous as in *G. oaxacanum*) and alternate cauline leaves.

Fig. 404. Distribution of *Geranium oaxacanum*.

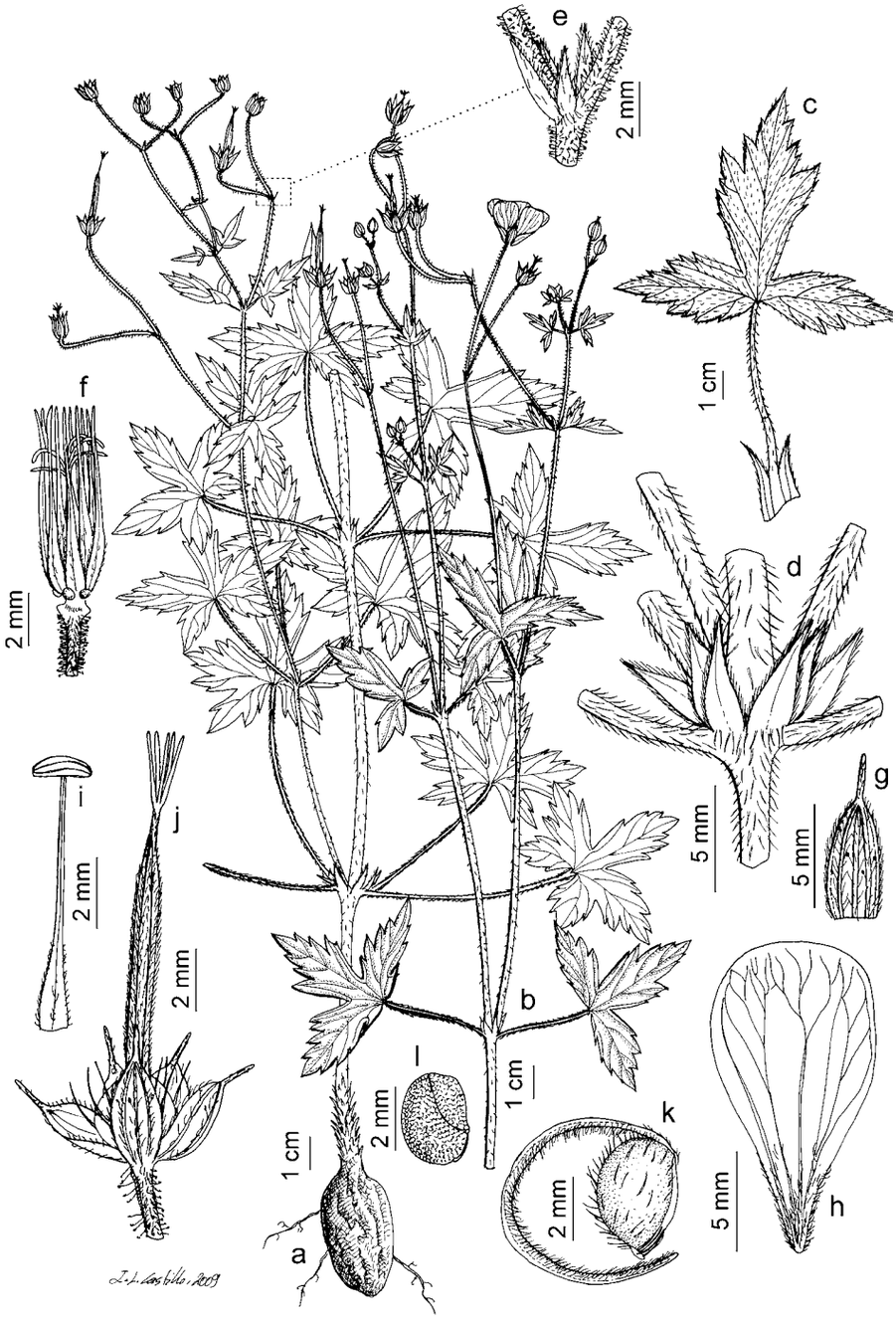


Fig. 403. *Geranium oaxacanum*. a, b. Habit. c. Leaf, adaxial side. d. Stipules. e. Bracteoles. f. Flower, sepals and petals removed. g. Sepal. h. Petal, adaxial side. i. Stamen. j. Fruit. k. Mericarp. l. Seed. (Based on: a, b, d, e, *Pringle 4866*, K; c, *Liebmann 14905*, C; f-i, *MacDougall s.n.*, *14 Oct. 1967*, NY; j-l, *Conzatti 711*, GH).

159. Geranium trolliifolium Small in Underw. & Britton (eds.), N. Amer. Fl. 25(1): 14. 1907. Type locality: "Type collected in the Sierra Madre, near Colonia Garcia, Chihuahua, Mexico, June 16, 1899, C. H. T. Townsend & C. M. Barber 34". Type: Mexico. Chihuahua, Sierra Madre, near Colonia García, 29°59′ N, 108°20′W, 16 June 1899, *C.H. Townsend & C.M. Barber 34* (lectotype, designated by Moore 1943:

16, NY-00370256!; isolectotypes, BM-000796407!, CSPU, F!, G-00388777!, GH!, K-000531445!, MO!, NMC!, P-00758027!, US-00100933 image!).

Geranium madrense M.E. Jones, Contr. W. Bot. 12: 6. 1908, nom. illeg., non Rose, 1907. Type locality: "Meadow Valley and Chuichupa, Chihuahua, Mex., 7,000 feet alt., in meadows, Sept. 17, 1903". Type: Mexico. Chihuahua, Meadow Valley and Chuichupa [Chuhuichupa], 29°36'N, 108°23'W, 17 Sep. 1903, *M.E. Jones s.n.* (lectotype, designated by Moore 1943: 16, CSPU; isolectotypes, GH, RSA-0003717 image!).

Perennial herbs, 16-41 cm tall. *Rootstock* 10-33 mm in diameter, vertical, not tuberculate, not turnip-shaped, without thickened roots. *Stem* erect, leafy, not rooting at nodes, stolons absent, without vegetative stems, with patent, eglandular hairs 0.2-1.9 mm long and, usually, patent, glandular hairs 0.2-0.9 mm long. *Basal leaves* in a ± persistent rosette, cauline leaves alternate (usually 1) in middle of shoot and upper opposite; leaf laminas 3.9-7.3 cm long, 4.3-8.6 cm wide, not peltate, palmatifid [ratio main-sinus length/middle segment length = 0.71-0.89], polygonal in outline, base cordate, not coriaceous, with nerves not projected, pilose on both surfaces, with ± appressed, eglandular hairs; segments 5, in 1 plane, middle segment rhombic, 4-10(15.4) mm wide at the base [ratio segment width at the base/middle segment length = 0.12-0.34], 8-21-lobed in distal half [ratio secondary sinus length/middle segment length = 0.19-0.45]; petioles up to 19 cm long, without abscission zone, terete, not swollen, not deflexed in age, with patent, eglandular hairs 0.2-1.6 mm long and rarely, patent, glandular hairs 0.2-0.6 mm long; stipules 4.7-14.3 mm long, 1.4-3.3 mm wide, lanceolate, free, papery, brownish red, with eglandular hairs on abaxial surface and on the margin, usually glabrous adaxially. *Inflorescence* a dichasial cyme; cymules 2-6-flowered, solitary or in aggregates at the top of each branch [ratio cymule length/leaf length = 1.6-4.2]; peduncles 16-72(90) mm long, with patent to retrorse, eglandular hairs 0.2-1.5 mm long and patent, glandular hairs 0.3-0.5 mm long; bracteoles 1.3-5.2 mm long, 0.3-1.3 mm wide, lanceolate, whorled; pedicels absent or 14-38.9 mm long, usually with patent to retrorse, eglandular hairs 0.1-0.3 mm long and patent, glandular hairs 0.3-0.6 mm long. Flowers actinomorphic. *Sepals* 7.3-9.5(11.5) mm long, 2.9-4.7 mm wide, lanceolate, smooth, not accrescent, nerves 3, mucro (0.9)1.2-2.1 mm long [ratio mucro length/sepal length = 0.11-0.27], with ± patent, eglandular hairs 0.1-1.8 mm long and patent, glandular hairs 0.3-0.7 mm long on the abaxial surface, glabrous adaxially. *Petals* (14.9)15.4-19.1(23.5) mm long, 9.1-14.6 mm wide, erect-patent, rounded or slightly emarginate (notch 0.4-0.5 mm deep), without claw, purple, hairy on the base of both surfaces, ciliate on the basal margin, with hairs 0.4-1.6 mm long. *Stamens* 10, both whorls bearing anthers; filaments 7.4-12.4 mm long, lanceolate, purple, pilose on the abaxial surface, ciliate on the proximal half, with hairs (1.2)1.5-2.8 mm long; anthers 2-3 mm long, blue. Nectaries 5, hemispheric, glabrous. *Gynoecium* 6.8-10.8 mm long, purple. *Fruit* 30.2-44.5 mm long, erect, discharge of seed-ejection type; mericarps 4.8-5.8 mm long, 2-3 mm wide, without a strand of fibers, not compressed at the apex, smooth (with 1-2 transverse veins at the apex), without basal beak, with a basal callus, without a basal prong, brown, with ± patent, eglandular hairs 0.2-1.3 mm long and patent, glandular hairs 0.4-0.6 mm long; rostrum 19-34.3 mm long, with a narrowed apex 2.8-6 mm long, not twisted, with ± patent, eglandular hairs 0.2-0.8 mm long and patent, glandular hairs 0.5-0.7 mm long; stigmatic remnants 2.9-4 mm long, with 5 glabrous lobes. *Seeds* 3.1-4 mm long, 1.9-2.5 mm wide, reticulate, uniformly colored, brown, glabrous. Cotyledons with entire margin. Fig. 405.

Pollen. Ornamentation not studied.

Chromosome number. Unknown.

Phenology. Collected in flower from June to September.

Distribution. This species ranges from Chihuahua to Durango, in northern Mexico (Fig. 406).

Habitat. Roadsides, old fields, open meadows, and *Cupressus* L., *Pinus* L., *Quercus* L., and *Pseudotsuga* Carrière forests; 2200-2700 m.

Additional specimens examined. **Mexico.** Chihuahua: Chihuahua, July 1969, *Soule 20* (MO); municipio Bocoyna, along trail near Cueva Sebastián, SE of Creel, 27°41'N, 107°35'W, 19 July 1971, *Bye 1548* (MEXU); Creel, 27°41'N, 107°35'W, 20 July 1983, *Saiki M-36* (F); Bocoyna valley, between Bocoyna and Creel, 27°46'N, 107°36'W, 13 July 1973, *Bye 4190* (GH); Bocoyna valley, egido San Ignacio Arareco, E of Gonogochic, in plowed-up llano near José Lirio's abandoned ranchito, 27°46'N, 108°0'W, 21 Aug. 1978, *Bye 8723* (BM); 1 mile S of San Juanito, 27°57'N, 107°36'W, 3 Aug. 1960, *Straw & Forman 1860* (MEXU); municipio de Bocoyna, 2.3 mi N of San Juanito, road to El Alamito-San Pedro, 28°0'N, 107°35'W, 2 Aug. 1977, *Bye & Weber 7845* (GH, MEXU); near Concheño, 28°18'N, 108°12'W, 1 July 1936, *LeSueur 734* (F, MO); Chuichupa, 29°36'N, 108°23'W, 4 Aug. 1937, *LeSueur 1359* (F); mound valley S of Pacheco, 30°5'N, 108°20'W, 12 July 1891, *Hartman 692* (GH). Durango: Súchil, San Juan de Michis, 23°27'N, 104°8'W, 6 Aug. 1981, *González & Acevedo 1808* (MEXU); 17 km S de El Salto, cerca del paraje La Remuda, 23°40'N, 104°24'W, 25 July 1981, *González 1760* (MEXU); 2.2 mi beyond La Ciudad near km 1113 on highway 40 to Mazatlán, 23°41'N, 105°43'W, 4 Sep. 1961, *Moore & Bunting 8664* (MEXU); along highway 40 km 1072-3, 10 km from Las Adjuntas, 23°43'N, 105°35'W, 10 Aug. 1965, *Mertz 227* (MEXU); along the highway between Llano Grande and Las Rucias, 56 mi by road S-SW of Durango, 23°44'N, 105°32'W, 24 June 1950, *Maysilles 7083* (NY); 5.5 mi E of El Salto, 23°44'N, 105°26'W, 12 Aug. 1957, *Waterfall 13668* (F, GH); along the highway between Llano Grande and Las Rucias, 90 mi by road S-SW of Durango, few mi W of El Salto, 23°45'N, 105°24'W, 24 June 1950, *Maysilles 7098* (NY); along highway 40 at La Campana, 0.5 mi N of the highway, 2.5 mi W of Las Adjuntas and 13.6 mi W of El Salto, 23°45'N, 105°33'W, 8 Aug. 1971, *Reveal & al. 2690* (NY); 5.4 mi W of El Salto, 23°46'N, 105°21'W, 23 July 1955, *Johnston 2697* (MEXU); El Salto, aserraderos, 23°46'N, 105°21'W, 28 Aug. 1934, *Pennell 18293* (NY, GH); 4 mi E of El Salto on road to Durango,

23º47'N, 105º19'W, 25 Aug. 1957, *Solbrig & Ornduff 4638* (GH, NY); near Estación Coyotes, 23º49'N, 105º20'W, 13 Aug. 1974, *Breedlove 36490* (MO); Hacienda Coyotes, 6 kms E de El Salto, 23º49'N, 105º20'W, 1 July 1982, *Hernández 7524* (MEXU); 27 mi E of El Salto, at river, on route 40, 23º51'N, 104º58'W, 20 Aug. 1979, *Wagner & Solomon 4271* (MEXU, MO); 31 mi W of Durango, route 40, 23º52'N, 105º3'W, 24 July 1958, *Correll & Johnston 20105* (NY); 31 mi W of Durango, route 40, 23º52'N, 105º3'W, 24 July 1958, *Correll & Johnston 20107* (GH, MO); 28 mi NE of El Salto on route 40, 23º53'N, 104º58'W, 17 July 1964, *Johnson & Johnson 1910* (MEXU); road to El Salto, 33 mi by road SW of Durango, 23º55'N, 105º0'W, 30 June 1969, *Webster & Breckon 15528* (MEXU); Santiago Papasquiaro, Los Altares, 25º0'N, 105º54'W, 28 July 1990, *Benítez 1601* (MEXU); Santiago Papasquiaro, Los Altares, 25º0'N, 105º54'W, 28 July 1990, *Bravo 1000* (MEXU); Santiago Papasquiaro, Puente El Cajón, 10 km de Los Altares camino a Cuevecillas, 25º5'N, 105º52'W, 27 July 1990, *Bravo 940* (MEXU).

Discussion. Geranium trolliifolium is a robust plant with a very thick, vertical rootstock that is not napiform (at least on the specimens examined). The indumentum of this species is composed of long and usually patent, soft, eglandular hairs on stems, petioles, and inflorescences. Glandular hairs are always present on the inflorescence and often on the basal part of the stem, but more rarely on the petioles. Bracteoles sometimes terminate in a bundle of bristles. Eglandular hairs of staminal filaments are noticeably long and give a characteristic pectinate aspect to these filaments. Glandular hairs of mericarps are usually concentrated towards the apex. In *G. trolliifolium* the rosette leaves are not as deeply divided as those of the stem. In most specimens, the stem bears one alternate leaf, and pairs of opposite leaves are found at the nodes of the inflorescence, although in some cases the stem is naked up to the first branch point of the inflorescence. The inflorescence is usually dichasial with 2-6-flowered cymules and sometimes umbel-like, when the pedicels are reduced or absent. In some specimens an axillary

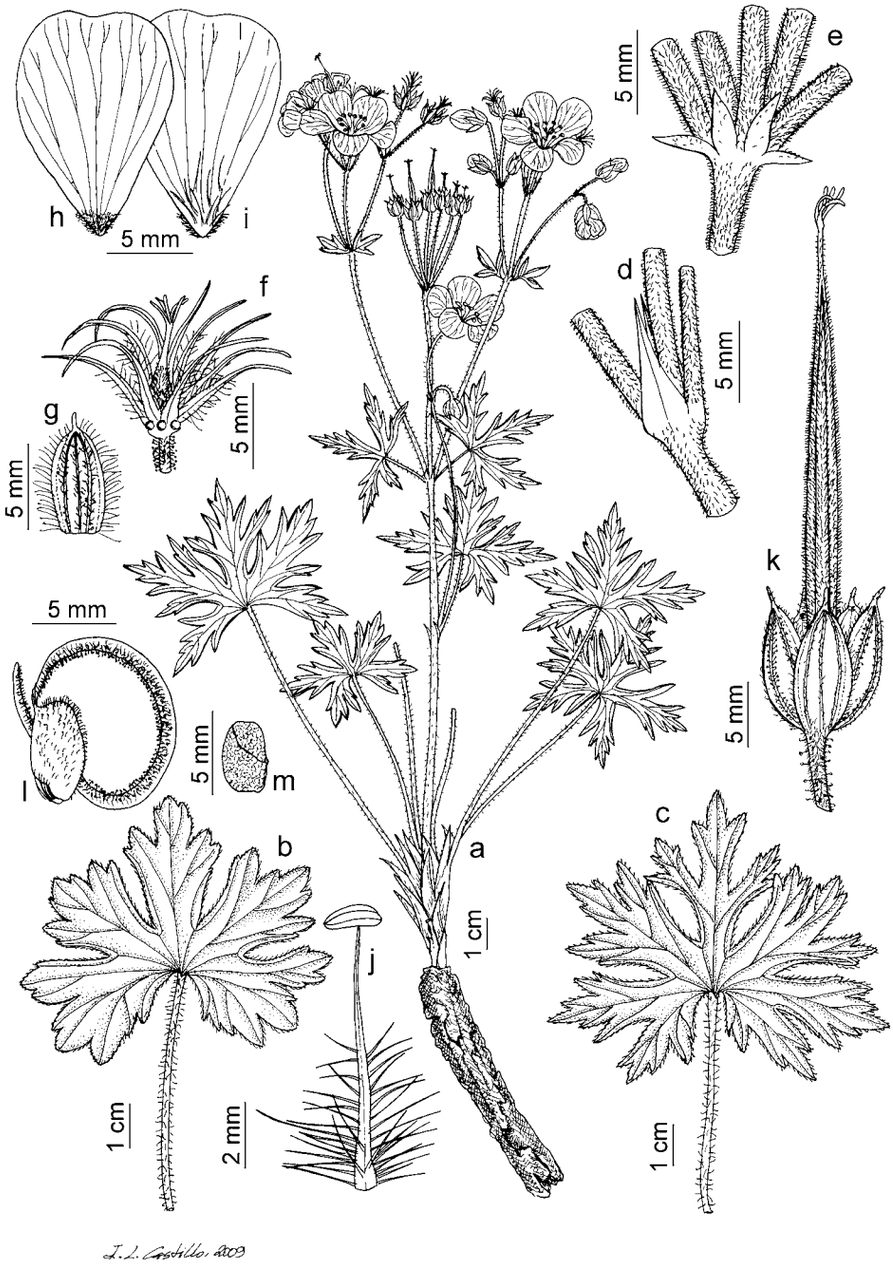


Fig. 405. *Geranium trolliifolium*. a. Habit. b, c. Leaves. d. Stipules. e. Bracteoles. f. Flower, sepals and petals removed. g. Sepal. h. Petal, abaxial side. i. Petal, adaxial side. j. Stamen. k. Fruit. l. Mericarp. m. Seed. (Based on: a, f-j, *Johnston 2697*, MEXU; c, k-m, *Bye 1548*, MEXU; b, d, e, *Pennell 18293*, GH).

Fig. 406. Distribution of *Geranium trolliifolium*.

cymule grows below the main portion of the inflorescence; this complex arrangement gives the inflorescence a corymbose aspect.

According to Moore (1943: 17), *G. trolliifolium* is allied with *G. oreganum* or *G. viscosissimum* because of its robust habit, simple rootstocks, and compact inflorescences. Yet, these species have opposite leaves, hairy nectaries, and usually solitary cymules (and *G. viscosissimum* also has adaxially hairy petals). If leaf and inflorescence arrangement (and nectary indumentum) are taken into consideration, then *G. trolliifolium* is more similar to *G. sylvaticum* or *G. erianthum*. On the other hand, *G. mexicanum* and *G. trolliifolium* share a stem bearing an alternate leaf and glabrous nectaries. In both species cymules may be multiflowered, but in *G. mexicanum* the peduncles are noticeable longer. *Geranium trolliifolium* shares with *G. crenatifolium* long, soft, patent eglandular hairs on the inflorescence and stem. The affinities of *G. trolliifolium* remain uncertain.

160. Geranium campanulatum Paray, Bol. Soc. Bot. México 16: 22, 23 fig. 2. 1954. Type locality: "Tipo en el Herb. Nac. del Inst. Biol. Méx., ex herbario Paray, Núm. 609, colectado en claros de bosques de pino y encino, de formación volcánica en los "Llanos de la Garza", atrás o sea al norte del pueblo y peña llamada Silleta de Xilitla San Luis Potosí. Crece en un área muy reducida como de 2 Kms. de largo y ancho, entre dos sierras, una llamada de la Silleta de Xilitla y la otra, sierra de San Juan, como a 20 Kms. al norte del pueblo de Xilitla S. Luis Potosí. Altitud sobre el nivel del mar, unos 1,500 m. Prefiere los lugares abiertos, asoleados y terrenos volcánicos. Florece en los meses de Febrero y Abril. La especie fue colectada el 25 de Marzo, cuando estaba en plena floración". Type: Mexico. San Luis Potosí, Silleta de Xilitla, Llanos de la Garza, 21°30'N, 99°05'W, 25 Mar. 1953, *L. Paray 609* (holotype, ENCB-003240 image!; isotype, MEXU-00015267 image!).

Perennial herbs, 40-80 cm tall. *Rootstock* 3.1-7.3 mm in diameter, unknown roots. *Stem* erect, leafy, not rooting at nodes, stolons absent, without vegetative stems, with patent, eglandular hairs 0.5-1.4 mm long and patent, glandular hairs 0.4-0.5 mm long. *Basal leaves* unknown, cauline leaves opposite; leaf laminas 5.5-10.5 cm long, 6-13 cm wide, not peltate, palmatifid [ratio main-sinus length/middle segment length = 0.74-0.85], polygonal in outline, base cordate, not coriaceous, with nerves not projected, pilose on both surfaces, with appressed, eglandular hairs; segments 5, in 1 plane, middle segment rhombic, 10-19.2 mm wide at the base [ratio segment width at the base/middle segment length = 0.25-0.28], 25-29-lobed in distal half [ratio secondary sinus length/middle segment length = 0.17-0.19]; petioles up to 25 cm long, without abscission zone, terete, not swollen, not deflexed in age, with patent, eglandular hairs 0.6-1.3 mm long and, sometimes, patent, glandular hairs 0.2-0.5 mm long; stipules 10-17 mm long, 2.9-5.3 mm wide, broadly lanceolate, free, papery, brownish red, with eglandular hairs on abaxial surface and on the margin, usually glabrous adaxially. *Inflorescence* a dichasial cyme; cymules 2-flowered, solitary [ratio cymule length/leaf length = 2-3]; peduncles 33-41(100) mm long, with patent, eglandular hairs 0.3-1.8 mm long and patent, glandular hairs 0.4-0.8 mm long; bracteoles 5.7-8.3 mm long, 1.1-1.4 mm wide, lanceolate, whorled; pedicels 10-14(24) mm long, with patent, eglandular hairs 0.3-1.2 mm long and patent, glandular hairs 0.2-0.7 mm long. Flowers actinomorphic. *Sepals* 10.6-12.3(15.2) mm long, 4.2-5.6 mm wide, lanceolate, smooth, not accrescent, nerves 5, mucro 3-4.2 mm long [ratio mucro length/sepal length = 0.26-0.33], with ± patent, eglandular hairs 0.3-1.4 mm long and patent, glandular hairs 0.4-0.9 mm long on the abaxial surface, glabrous adaxially. *Petals* 19-26(35) mm long, 9.1-14 mm wide, erect-patent, rounded, without claw, purple, hairy on the base of the adaxial surface, ciliate on the basal margin, with hairs 0.4-0.6 mm long. *Stamens* 10, both whorls bearing anthers; filaments 16-24(30) mm long, lanceolate, yellow, pilose on the abaxial surface, ciliate on the proximal half, with hairs 0.9-1.8 mm long; anthers 2.5-2.9 mm long, yellow. Nectaries 5, hemispheric, glabrous. *Gynoecium* 11-22 mm long, yellow. *Fruit* 40-45 mm long, erect, discharge of seed-ejection type; mericarps 4-4.3 mm long, 1.7-2.1 mm wide, without a strand of fibers, not compressed at the apex, smooth, without basal beak, with a basal callus, without a basal prong, brown, with erect-patent, eglandular hairs 0.4-0.9 mm long and patent, glandular hairs 0.5-0.7 mm long; rostrum 33.7-37.1 mm long, with a narrowed apex 15-18.3 mm long, not twisted, with ± patent, eglandular hairs 0.3-0.6 mm long and patent, glandular hairs 0.3-0.5 mm long; stigmatic remnants 2.6-3.3 mm long, with 5 glabrous lobes. *Seeds* 3.9-5 mm long, 1.1-1.2 mm wide, reticulate, uniformly colored, brown, glabrous. Cotyledons with entire margin. Fig. 407.

Pollen. Ornamentation not studied.

Chromosome number. Unknown.

Phenology. Collected in flower from March to April.

Distribution. This species is endemic to Querétaro and San Luis Potosí, in central Mexico (Fig. 408).

Habitat. Rocky open places among patches of *Cupressus* L., *Pinus* L., and *Quercus* L.; 1500-2300 m.

Additional specimens examined. **Mexico.** Querétaro: Jalpan, Llano de las Avispas, 21°11'N, 99°22'W, 4 Apr. 1991, *Díaz & Carranza 6568* (IEB, MICH, MO).

Discussion. Geranium campanulatum, a rarely collected endemic of central Mexico, is well characterized by its long petals. According to Paray

(1954: 24) and Rzedowski & Rzedowski (1995: 14), the petals vary from 25 to 35 mm long, although in the specimens examined they are a little shorter. Paray (1954) indicated that the corolla is bell-shaped, which is difficult to discern on dry specimens. *Geranium campanulatum* also has long sepals with a long mucro, long staminal filaments, and fruits with the rostrum terminating in a noticeably long narrowed apex. Glandular hairs are restricted to the inflorescence and distal parts of the stem, while eglandular hairs are found on the entire plant. It is noteworthy that eglandular hairs on the stem and petioles are long and soft, resembling those of *G. trolliifolium*. The underground parts of *G. campanulatum* are unknown. On the available specimens the basal part of the stem is covered by old stipules and petiole remnants. The cauline leaves are all opposite, unlike in *G. trolliifolium*, which usually has some alternate leaves. The inflorescence appears to be dichasial, with isolated 2-flowered cymules, not multiflowered cymules in umbel-like aggregates, as in *G. trolliifolium*. The affinity of *G. campanulatum* is difficult to ascertain without more complete material; it resembles *G. trolliifolium* in some aspects, such as the indumentum and robust habit.

Fig. 408. Distribution of *Geranium campanulatum*.

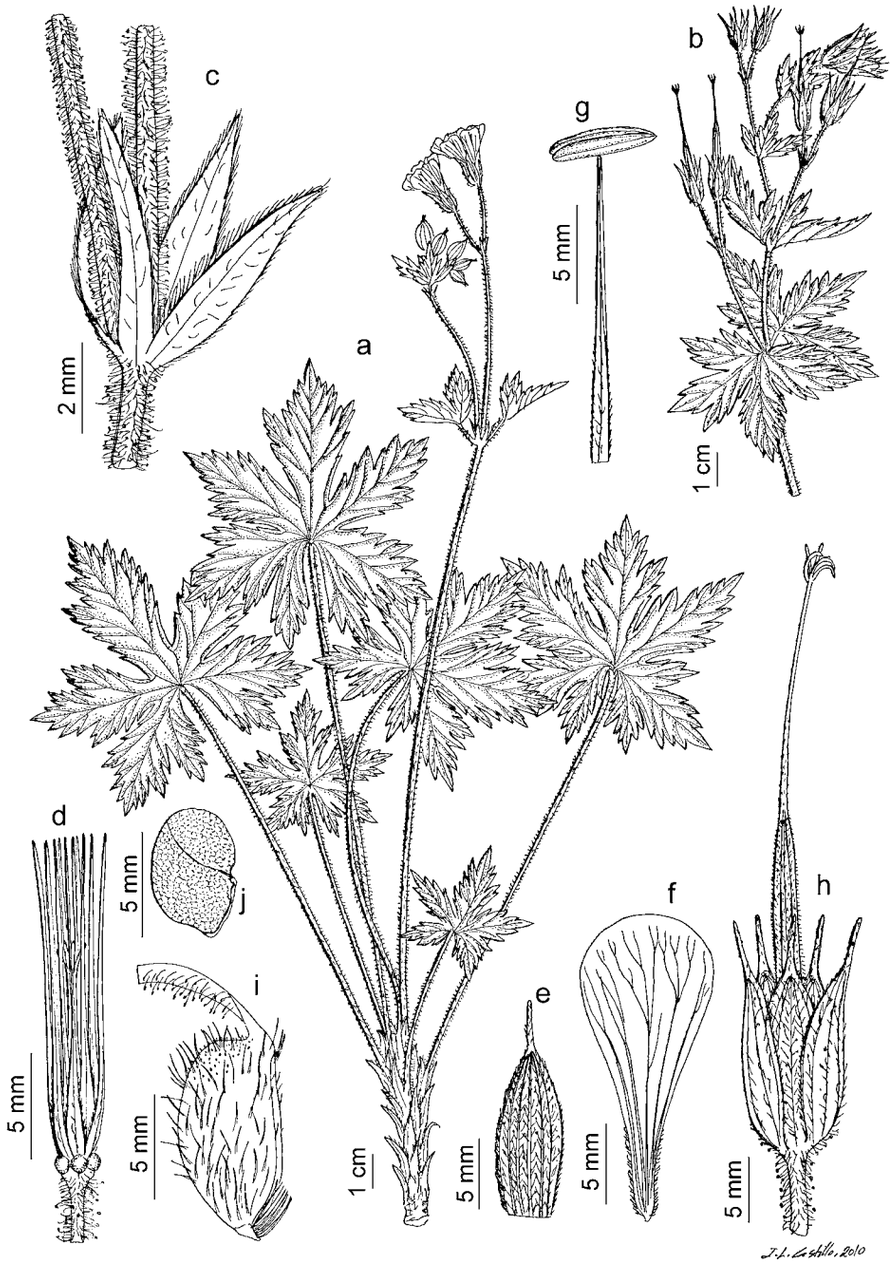


Fig. 407. *Geranium campanulatum*. a. Habit. b. Detail of inflorescence. c. Bracteoles. d. Flower, sepals and petals removed. e. Sepal. f. Petal. g. Stamen. h. Fruit. i. Mericarp. j. Seed. (Based on: *Díaz & Carranza 6568*, IEB, MO).

161. Geranium mooreanum Aedo, Acta Bot. Mexicana 95: 39, fig. 1. 2011. Type locality: "México. Jalisco. Sierra de Manantlán, La Cumbre, 19°35'N, 104°08'W, 20-III-1965, McVaugh 23134 (holótipo, MICH!)". Type: Mexico. Jalisco, Sierra de Manantlán, La Cumbre, 19°35'N, 104°08'W, 20 Mar. 1965, *R. McVaugh 23134* (holotype, MICH!).

Perennial herbs, 36-94 cm tall. *Rootstock* 7-8 mm in diameter, ± vertical, not tuberculate, not turnip-shaped, without thickened roots. *Stem* erect, leafy, not rooting at nodes, stolons absent, without vegetative stems, with ± patent, eglandular hairs 1.5-2.8 mm long. *Basal leaves* in a persistent rosette, cauline leaves opposite; leaf

laminas 4.9-13.8 cm long, 5.4-15.3 cm wide, not peltate, palmatifid [ratio main-sinus length/middle segment length = 0.78-0.87], polygonal, sometimes subhastate in outline, base cordate, not coriaceous, with nerves not projected, pilose on both surfaces, with appressed, eglandular hairs; segments 3-5, in 1 plane, middle segment rhombic, 8.7-25.1 mm wide at the base [ratio segment width at the base/middle segment length = 0.21-0.31], 15-25-lobed in distal half [ratio secondary sinus length/middle segment length = 0.11-0.15]; petioles up to 20 cm long, without abscission zone, terete, not swollen, not deflexed in age, with patent, eglandular hairs 0.4-2.1 mm long and, rarely, patent, glandular hairs 0.4-0.7 mm long; stipules 6.3-10.1 mm long, 3.1-5.4 mm wide, broadly lanceolate, free, papery, brownish red, with eglandular hairs on both surfaces and on the margin. *Inflorescence* a dichasial cyme with monochasial branches; cymules 2-flowered, solitary [ratio cymule length/leaf length = 1.4-2.3]; peduncles (43)55-73(100) mm long, with patent, eglandular hairs 0.4-1.7 mm long and patent, glandular hairs 0.6-1.3 mm long; bracteoles 3.5-5.6 mm long, 1-2.6 mm wide, lanceolate, whorled; pedicels 15-24 mm long, with patent, eglandular hairs 0.4-1.5 mm long and patent, glandular hairs 0.5-1 mm long. Flowers actinomorphic. *Sepals* 7.5-9.7(10.3) mm long, 3.2-4.3 mm wide, lanceolate, smooth, not accrescent, nerves 3-5, mucro (1.6)1.9-2.8 mm long [ratio mucro length/sepal length = 0.21-0.31], with ± patent, eglandular hairs 0.6-1.2 mm long and patent, glandular hairs 0.4-1.2 mm long on the abaxial surface, glabrous adaxially. *Petals* 18.2-20.1(23) mm long, 10-14.3 mm wide, erect-patent, rounded, without claw, purple, glabrous on both surfaces, ciliate on the basal margin, with hairs 0.3-0.7 mm long. *Stamens* 10, both whorls bearing anthers; filaments 9.9-11.1(12.3) mm long, lanceolate, yellow, pilose on the abaxial surface, ciliate on the proximal half, with hairs 0.5-1.1 mm long; anthers 2.7-2.9 mm long, yellow. Nectaries 5, hemispheric, glabrous. *Gynoecium* 9.5-12.5 mm long, purple. *Fruit* 37.2-42.9 mm long, reflexed, discharge of seed-ejection

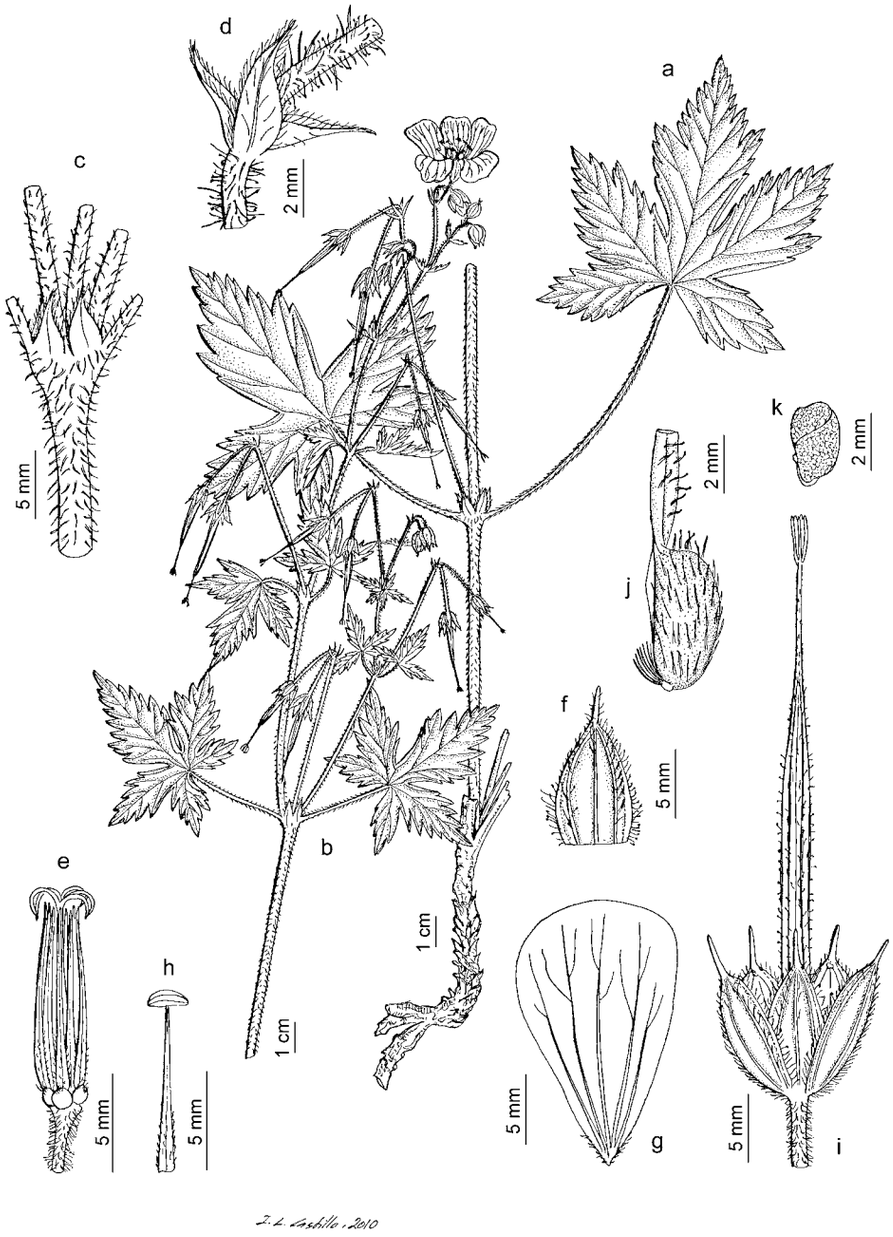


Fig. 409. *Geranium mooreanum*. a, b. Habit. c. Stipules. d. Bracteoles. e. Flower, sepals and petals removed. f. Sepal. g. Petal. h. Stamen. i. Fruit. j. Mericarp. k. Seed. (Based on: a, i-k, *McVaugh 23134*, MICH; b-h, *Boutin& Kimnach 2999*, MEXU).

Fig. 410. Distribution of *Geranium mooreanum*.

type; mericarps 4-5.6 mm long, 2.4-2.6 mm wide, without a strand of fibers, not compressed at the apex, smooth, without basal beak, with a basal callus, without a basal prong, brown, with erect-patent, eglandular hairs 0.9-1.2 mm long and patent, glandular hairs 0.7-0.9 mm long on the apex; rostrum 27.3-32.3 mm long, with a narrowed apex 6.8-10 mm long, not twisted, with ± patent, eglandular hairs 0.3-0.4 mm long and patent, glandular hairs 0.7-1.1 mm long; stigmatic remnants 2.8-3.7 mm long, with 5 glabrous lobes. *Seeds* 2.6-3.1 mm long, 1.6-2.2 mm wide, finely reticulate, uniformly colored, brown, glabrous. Cotyledons with entire margin. Fig. 409.

Pollen. Ornamentation not studied.

Chromosome number. Unknown.

Phenology. Collected in flower from January to November.

Distribution. This species is endemic to southern Jalisco, in western Mexico (Fig. 410).

Habitat. Steep slopes in *Abies* Mill., *Pinus* L., and *Quercus* L. forests; 2250-3000 m.

Additional specimens examined. **Mexico.** Jalisco: Sierra de Manantlán, 27-36 km SE of Autlán, about 3.6 km from Aserradero San Miguel Uno, SW of the divide toward Manzanillo, 19º31'N, 104º13'W, 4 Nov. 1952, *McVaugh 13898* (MICH); Sierra de Manantlán, W of El Guisar, 19º33'N, 104º8'W, 30 Jan. 1970, *Boutin & Kimnach 2999* (CAS, MEXU); along lumber road, 0.3 km E of Cerro La Cumbre-Rincón de Manantlán, at crossing of first small stream, N end of Sierra de Manantlán Central, 17.7 km S of El Chante, 19º33'N, 104º13'W, 6 Jan. 1980, *Sorensen & al. 7882* (MEXU).

Discussion. Geranium mooreanum resembles *G. campanulatum* in general appearance, inflorescence structure and size, and petal indumentum. Both share a robust habit, glandular indumentum restricted to the inflorescence, and glabrous nectaries. The petals of *G. campanulatum* are longer than those of *G. mooreanum*, although with some overlap. Additionally, the sepal mucro, staminal filaments, and the narrowed apex of the rostrum are longer in *G. mooreanum*. The fruit of *G. mooreanum* is reflexed when mature, whereas it is erect in *G. campanulatum*. In some specimens *G. mooreanum* the cauline leaves may have three segments and are subhastate in outline, as in *G. lilacinum*, but the leaves are longer and have more lobes per segment. Additionally, *G. mooreanum* can be clearly differentiated from *G. lilacinum* by its longer sepal mucro, petals, staminal filaments, anthers, and narrowed apex of the rostrum. It is endemic to the Sierra de Manantlán, about 500 km west of the localities recorded for *G. campanulatum*. In this region of southern Jalisco *G. deltoideum* and *G. latilobum* also occur, both with shorter adaxially hairy petals, as does *G. seemannii* subsp. *seemannii*, with very short and almost glabrous petals.

162. Geranium unguiculatum H.E. Moore, Contr. Gray Herb. 146: 24, pl. 2 fig. 5, pl. 4 figs. 2, 7. 1943. Type locality: "MEXICO: Guerrero: steep, rocky slopes in oak forest, Yesceros-Cruz Pacifica, Dist. Mina, 2550 m., Nov. 26, 1939, Hinton 14906 (G, Type)". Type: Mexico. Guerrero, Mina, Yesceros-Cruz Pacífica, 17°40'N, 100°29'W, 26 Nov. 1939, *G.B. Hinton & al. 14906* (holotype, GH-00043661!; isotypes, NY-00370257!, RSA!, US-00997342 image!).

Perennial herbs, 70-150 cm tall. *Rootstock* and roots unknown. *Stem* erect, leafy, not rooting at nodes, stolons absent, without vegetative stems, with retrorse, appressed, eglandular hairs 0.3-0.5 mm long. *Basal leaves* unknown, cauline leaves opposite; leaf laminas 7.6-11.2 cm long, 9.3-11.9 cm wide, not peltate, palmatifid [ratio main-sinus length/middle segment length = 0.76-0.84], polygonal in outline, base cordate, not coriaceous, with nerves not projected, with ± appressed, eglandular hairs on both surfaces; segments 5, in 1 plane, middle segment rhombic, 9.4-19.3 mm wide at the base [ratio segment width at the base/middle segment length = 0.14-0.24], 8-17-lobed in distal half [ratio secondary sinus length/middle segment length = 0.15-0.19]; petioles up to 26 cm long, without abscission zone, terete, not swollen, not deflexed in age, with retrorse, appressed, eglandular hairs 0.3-0.6 mm long; stipules 3.2-7.5 mm long, 1.9-4.1 mm wide, broadly lanceolate, free, papery, brownish red, with eglandular hairs on both surfaces and on the margin. *Inflorescence* a dichasial cyme; cymules 2-flowered, solitary [ratio cymule length/leaf length = 3.6-8]; peduncles 16-23(31) mm long, with patent, eglandular hairs 0.2-0.5 mm long and patent, glandular hairs 0.2-0.9 mm long; bracteoles 1.6-3.8 mm long, 0.5-1.4 mm wide, lanceolate, whorled; pedicels 13.2-21.5 mm long, with patent, eglandular hairs 0.2-0.4 mm long and patent, glandular hairs 0.3-0.8 mm long. Flowers actinomorphic. *Sepals* 3.5-5.3 mm long, 1.6-2.6 mm wide, lanceolate, smooth, not accrescent, nerves 3, mucro 0.4-0.9(1.1) mm long [ratio mucro length/sepal length = 0.13-0.29], with antrorse to patent, eglandular hairs 0.1-0.3 mm long and patent, glandular hairs 0.2-0.8 mm long on the abaxial surface, glabrous adaxially. *Petals* 18-22(26.2) mm long, 4.4-9.9 mm wide, erect-patent, rounded, with claw 6.1-11.1 mm long, pink, hairy on the base of the adaxial surface, ciliate on the basal margin, with hairs 0.3-0.6 mm long. *Stamens* 10, both whorls bearing anthers; filaments 4.3-5.4 mm long, lanceolate, purple, pilose on the abaxial surface, ciliate on the proximal half, with hairs 0.2-0.3 mm long; anthers 0.5-0.9 mm long, unknown color. Nectaries 5, hemispheric, dorsally hairy. *Gynoecium* 4.3-6.5 mm long, purple. *Fruit* 25.5-27.2 mm long, erect, discharge of seed-ejection type; mericarps 3.5-3.7 mm long, 1.9-2.4 mm wide, without a strand of fibers, not compressed at the apex, smooth, without basal beak, with a basal callus, without a basal prong, brown, with ± patent, eglandular hairs 0.3-

0.6 mm long, and patent, glandular hairs 0.6-1.1 mm long; rostrum 17.1-21 mm long, with a narrowed apex 1.7-2.7 mm long, not twisted, with ± patent, eglandular hairs 0.2-0.3 mm long and patent, glandular hairs 0.6-1 mm long; stigmatic remnants 1.9-4.3 mm long, with 5 glabrous lobes. *Seeds* 2.5-2.6 mm long, 1.7-1.8 mm wide, reticulate, uniformly colored, brown, glabrous. Cotyledons with entire margin. Fig. 411.

Pollen. Ornamentation not studied.

Chromosome number. Unknown.

Phenology. Collected in flower from October to November.

Distribution. This species is endemic to western Guerrero, in southwestern Mexico (Fig. 412).

Habitat. Steep rocky slopes, cliffs, and *Abies* Mill., *Pinus* L., and *Quercus* L. forests; 1900-3200 m.

Additional specimens examined. **Mexico.** Guerrero: Mina, Fresnos-Cuesta, 18°12'N, 101°17'W, 21 Oct. 1936, *Hinton 9736* (F, MEXU, MICH, MO, NY, RSA, P).

Discussion. Geranium unguiculatum is a robust species to 1.5 m tall, according to herbarium labels. Neither of the two collections examined included a rootstock, roots, basal leaves, and basal parts of the stem. The middle and distal leaves are palmatifid and opposite. The indumentum of this species is composed of short and ± appressed eglandular hairs on stem, petioles, and leaf surfaces. The inflorescence has also glandular hairs on peduncles, pedicels, the sepal base, and in the fruits on the apex of mericarps and on the rostrum. The inflorescence has a general dichasial structure and some divaricate branches. The leaves are abruptly reduced in size from the second node of the inflorescence towards the apex. The nectaries are completely covered with short white hairs. Among the most distinctive features of *G. unguiculatum* are the long petals with a very long claw (6.1-11.1 mm). As Moore (1943: 25) pointed out, the affinity of *G. unguiculatum* to other species is unknown.

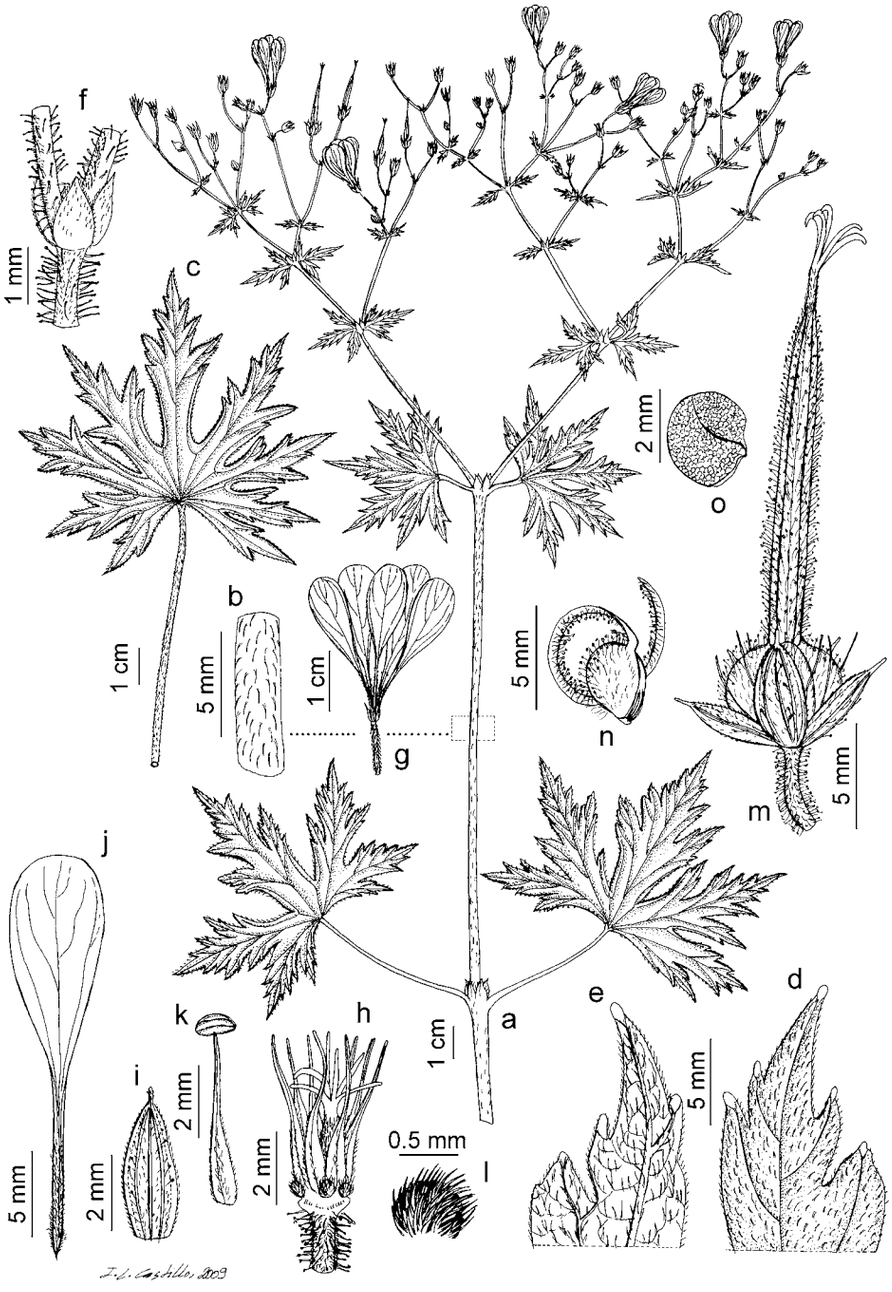


Fig. 411. *Geranium unguiculatum*. a. Habit. b. Detail showing stem indumentum. c. Leaf. d. Detail of leaf segment, adaxial side. e. Detail of leaf segment, abaxial side. f. Bracteoles. g. Flower. h. Flower, sepals and petals removed. i. Sepal. j. Petal. k. Stamen. l. Nectary. m. Fruit. n. Mericarp. o. Seed. (Based on: a, b, d-o, *Hinton 14906*, NY; c, *Hinton 9736*, P).

Fig. 412. Distribution of *Geranium unguiculatum*.

163. Geranium durangense H.E. Moore, Brittonia 15: 95, 94 fig. 2. 1963. Type locality: "MEXICO: Durango: Dry pineland, El Salto (Aserraderos) 2570-2800 m, 28 Aug 1934, Francis W. Pennell 18334 (US, Holotype); along highway between Llano Grande and Las Rucias, 65 miles by road s s w of C. Durango, upland meadows in openings in pine forest, 2400-2500 m, 24 June 1950, James H. Maysilles 7086 (MICH); about 5 miles n of railroad at Coyotes (45 airline miles w of C. Durango), gentle west-facing slopes of broad arroyo, tributary to Río del Presidio, open grasslands with patches of oak-pine woodlands, 2400-2500 m, 28 Jun 1950, Maysilles 7154 (MICH), 7156 (MICH); east slopes of Cerro Prieto (about 20 airline miles w of Otinapa), dry, open, rocky woodlands of oak, pine and Arbutus, 300-3100 m, 10 Jul 1950, Maysilles 7372 (MICH)". Type: Mexico. Durango, El Salto, 23°46'N, 105°21'W, 28 Aug. 1934, *F.W. Pennell 18334* (holotype, US-00100881 image!; isotype, NY-00373656!).

Perennial herbs, 23-55 cm tall. *Rootstock* 2.9-5.8 mm in diameter, ± vertical, not tuberculate, not turnip-shaped, unknown roots. *Stem* erect, leafy, not rooting at nodes, stolons absent, without vegetative stems, with retrorse, curved, eglandular hairs 0.3-0.6 mm long. *Basal leaves* in a ± persistent rosette, cauline leaves alternate in middle of shoot and upper opposite; leaf laminas 2.7-6.1 cm long, 3.7-7.6 cm wide, not peltate, palmatifid [ratio main-sinus length/middle segment length = 0.80-0.91], polygonal in outline, base cordate, not coriaceous, with nerves not projected, pilose on both surfaces, with ± appressed, eglandular hairs; segments 5, in 1 plane, middle segment rhombic, 2.8-9.3 mm wide at the base [ratio segment width at the base/middle segment length = 0.12-0.25], 7-10(15)-lobed in distal half [ratio secondary sinus length/middle segment length = 0.16-0.31]; petioles up to 21 cm long, without abscission zone, terete, not swollen, not deflexed in age, with retrorse, curved, eglandular hairs 0.3-0.7 mm long; stipules 4.8-9 mm long, 2.1-2.9 mm wide, lanceolate, free, papery, brownish red, with eglandular hairs on both surfaces and on the margin. *Inflorescence* a monochasial cyme; cymules 2-flowered, solitary [ratio cymule length/leaf length = 1.3-4.4]; peduncles (24)44-73(126) mm long, with retrorse, curved, eglandular hairs 0.3-0.8 mm long; bracteoles 3.1-6.2 mm long, 0.8-1.3 mm wide, lanceolate, whorled; pedicels 4.9-31.4 mm long, with retrorse, curved, eglandular hairs 0.2-0.8 mm long. Flowers actinomorphic. *Sepals* 4.2-6.2 mm long, 2.1-4.5 mm wide, lanceolate, smooth, not accrescent, nerves 3, mucro 0.1-0.8 mm long [ratio mucro length/sepal length = 0.07-0.15], with antrorse, curved, eglandular hairs 0.2-0.7 mm long on the veins of the abaxial surface, glabrous adaxially. *Petals* (7.8)9.2-11 mm long, 4-8.8 mm wide, erect-patent, rounded, without claw, deep purple, glabrous. *Stamens* 10, both whorls bearing anthers; filaments 4.5-6.3 mm long, lanceolate, purple, glabrous on both surfaces, ciliate on the basal margin, with hairs up to 0.1-0.2 mm long; anthers 1.2-1.9 mm long, yellow. Nectaries 5, hemispheric, glabrous. *Gynoecium* 4.1-6.7 mm long, purple. *Fruit* 31.8-33.6 mm long, erect, discharge of seed-ejection type; mericarps 4.2-4.8 mm long, 2.2-2.7 mm wide, without a strand of fibers, not compressed at the apex, smooth, without basal beak, with a basal callus, without a basal prong, brown, with erect-patent, eglandular hairs 0.5-0.6 mm long; rostrum 22-23.8 mm long, with a narrowed apex 1.2-2 mm long, not twisted, with ± patent, eglandular hairs 0.2-0.4 mm long; stigmatic remnants 3.4-4.2 mm long, with 5 glabrous lobes. *Seeds* 3.1-3.6 mm long, 2.3-2.5 mm wide, finely reticulate, uniformly colored, brown, glabrous. Cotyledons with entire margin. Fig. 413.

Pollen. Ornamentation not studied.

Chromosome number. Unknown.

Phenology. Collected in flower from June to September.

Distribution. This species ranges through central and western Durango, in western Mexico (Fig. 414).

Habitat. Meadows, and open rocky areas, *Pinus* L. and *Quercus* L. forests; 2000-3000 m.

Additional specimens examined. **Mexico.** Durango: 8-10 km al S de El Salto, hacia Pueblo Nuevo, 23º42'N, 105º22'W, 3 July 1982, *Hernández & Tenorio 7601* (MEXU); 5.4 mi. W of El Salto, 23º44'N, 105º26'W, 23 July 1955, *Ettlinger 2698* (MEXU, MICH); along highway between Llano Grande and Las Rucias, 65 mi by road SSW of Durango City, 23º44'N, 105º33'W, 24 June 1950, *Maysilles 7086* (MICH); 8 km W of El Salto on the Durango-Mazatlan highway, 23º45'N, 105º23'W, 22 June 1973, *Johnston & al. 11441E* (MEXU); El Salto, al NE del pueblo, 23º48'N, 105º20'W, 1 Aug. 1979, *González Casares s.n.* (MEXU); pr. Mil Diez, 2 km al N de El Salto, 23º48'N, 105º21'W, 29 June 1982, *Hernández & Tenorio 7503* (MEXU, MO); 5 mi N of railroad at Coyotes, broad arroyo tibutary to río Presidio, 23º49'N, 105º20'W, 28 June 1950, *Maysilles 7154* (MICH); 5 mi N of railroad at Coyotes, broad arroyo tibutary to río Presidio, 23º49'N, 105º20'W, 28 June 1950, *Maysilles 7156* (MICH); along highway 40, km 1024-25, E of Hacienda Coyotes, 23º49'N, 105º19'W, 22 June 1965, *Mertz 24* (MEXU); 55-60 km SW of Durango City on road to La Flor, 23º52'N, 105º6'W, 16 Sep. 1979, *Breedlove 44135* (MEXU); E slopes of Cerro Prieto, 20 mi W of Otinapa, 24º3'N, 105º24'W, 10 July 1950, *Maysilles 7372* (MICH); Mezquital, Ojo de Agua, 20 km de La Escondida por el camino a Los Charcos, 24º26'N, 104º39'W, 18 June 1985, *González & al. 1757* (MEXU); 20 air km WNW of Santiago Papasquiaro, 3.3 mi by Topia road, N crest of sierra from junction with road to antenna, 25º5'N, 105º48'W, 9 July 1983, *Corral 208* (NY); 30-35 kms al W de Tepehuanes hacia Topia, 25º18'N, 106º2'W, 22 July 1982, *Hernández 8169* (MEXU).

Discussion. Geranium durangense is easily identified by its glabrous and deep purplish petals, glabrous nectaries, and staminal filaments bearing short hairs only on the margin. The underground part of *G. durangense* is not well known. The small fragments available in herbaria suggest that the species has a vertical rootstock. The inflorescence shows a monochasial

pattern, although towards the apex it ends in some dichasial branches. Moore (1963: 95) described this species as having glandular hairs. In fact, *G. durangense* has minute (less than 0.1 mm long) sessile glands on the inflorescence and leaves. This type of gland is usually omitted in descriptions, because they are found in many species of *Geranium* (although not in the same density). *Geranium durangense* does have an unusual eglandular hairs; they are short, stout, and curved. According to Moore (1963: 95) *G. durangense* is quite similar to *G. latum*. Both species share alternate leaves on the basal part of the stem; however, *G. latum* has adaxially hairy petals, hairy nectaries, staminal filaments with long hairs, and dichasially branched inflorescences. As Moore (1963: 95) pointed out, *G. durangense* may be related to *G. mexicanum*, a species with glabrous nectaries, short hairs on staminal filaments, and petals hairy only at the base. *Geranium mexicanum* has opposite leaves, long peduncles, cymules 2-4-flowered, and a dichasial inflorescence with glandular hairs.

Fig. 414. Distribution of *Geranium durangense*.

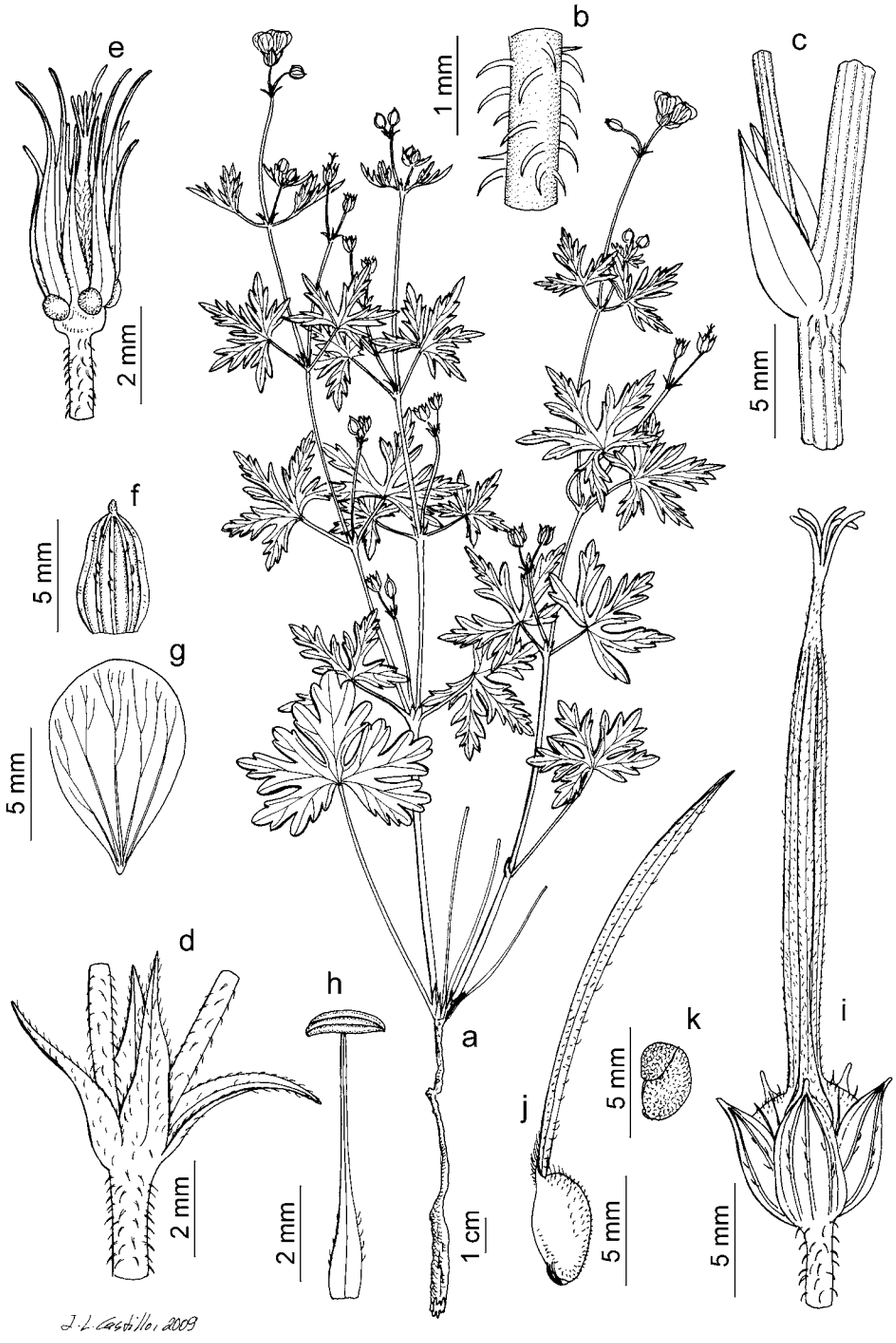


Fig. 413. *Geranium durangense*. a. Habit. b. Detail showing peduncle indumentum. c. Stipules. d. Bracteoles. e. Flower, sepals and petals removed. f. Sepal. g. Petal, adaxial side. h. Stamen. i. Fruit. j. Mericarp. k. Seed. (Based on: a-h, *Hernández 7503*, MEXU; i-k, *Breedlove 44135*, MEXU).

The collection *Pringle 10022* was distributed in the set of exsiccatae "*Plantae Mexicanae 1905*" with a printed label bearing the name "*Geranium durangensis* Rose", a name that was never published. Moore (1943: 34) correctly identified this Pringle collection as *G. wislizeni,* but did not refer to the unpublished name when he (Moore 1963: 95) proposed his new species *Geranium durangense*.

The Sibbaldioides Group—This group is characterized by its scapiform, cushion-like habit, its not turnip-shaped rootstock, its eglandular indumentum, and its 1-flowered cymules arising directly from the rootstock, usually lacking pedicels. The leaves are usually palmatifid, sometimes palmatisect or digitate and in *G. azorelloides* entire with tridentate apex. The petals are

usually of small size and without claw. The first fourteen species may suite a subgroup characterized by its leaves usually glabrescent and with stipules ending in 1-3 bristles.

164. Geranium azorelloides Sandwith, Bull. Misc. Inform. 1929: 121. 1929. *Geranium guanacosense* R. Knuth, Repert. Spec. Nov. Regni Veg. 40: 219. 1936, nom. illeg. Type locality: "Colombia. Cauca; Páramo de Guanacas, prov. Popayan, 3200 m., November 1882, Lehmann 2139". Type: Colombia. Cauca, Páramo de Guanacos, 2°31'N, 76°11'W, Nov. 1882, *F.C. Lehmann 2139* (lectotype, designated by Aedo & al. 2002: 231, K-000531430!; isolectotypes, BH-fragment!, BM-000598363!, US-938458!).

Perennial herbs, 2-8 cm tall. *Rootstock* 2-3 mm in diameter, ± vertical, not tuberculate, not turnip-shaped, without thickened roots. *Stem* scapiform, cushion-like, stolons absent, with short vegetative stems. *Basal leaves* in a persistent rosette; leaf laminas 0.9-1.6 cm long, 0.3-0.8 cm wide, not peltate, entire with tridentate apex [ratio main-sinus length/middle segment length = 0.25-0.50], obtriangular in outline, base cuneate, ± coriaceous, with nerves not projected, usually glabrous, sometimes with erect-patent, eglandular cilia 0.2-0.5 mm long on the margin, each segment ending in 1-2 bristles 0.3-1.2 mm long; segments 3, in 1 plane, middle segment lanceolate, 1(3)-lobed at the apex; petioles up to 2.5 cm long, without abscission zone, terete, not swollen, not deflexed in age, with retrorse, appressed, eglandular hairs 0.2-0.5 mm long; stipules 8-11.7 mm long, 1-4 mm wide, lanceolate, free, papery, brownish red, glabrous on both surfaces, ending in 1-2 bristles 0.4-0.7 mm long. *Cymules* 1-flowered, solitary [ratio cymule length/leaf length = 0.7-0.8]; peduncles 4-9 mm long, with retrorse, appressed, eglandular hairs 0.3-0.5 mm long; bracteoles 9-10 mm long, 1.8-2 mm wide, lanceolate, opposite; pedicels 10-17 mm long, with retrorse, appressed, eglandular hairs 0.3-0.5 mm long. Flowers actinomorphic. *Sepals* 6.5-7.5 mm long, 1.7-2.2 mm wide, lanceolate, smooth, not accrescent, nerves 3, mucro 0.5-0.7 mm long [ratio mucro length/sepal length = 0.07-0.09], with erect-patent, eglandular hairs 0.3-0.5 mm long on the margin, glabrous on both surfaces, ending in 1-2 bristles 0.4-0.6 mm long. *Petals* 12-14 mm long, 4-4.5 mm wide, erect-patent, slightly emarginate (notch ca. 0.5 mm deep), without claw, purple, glabrous. *Stamens* 10, both whorls bearing anthers; filaments 3.5-4 mm

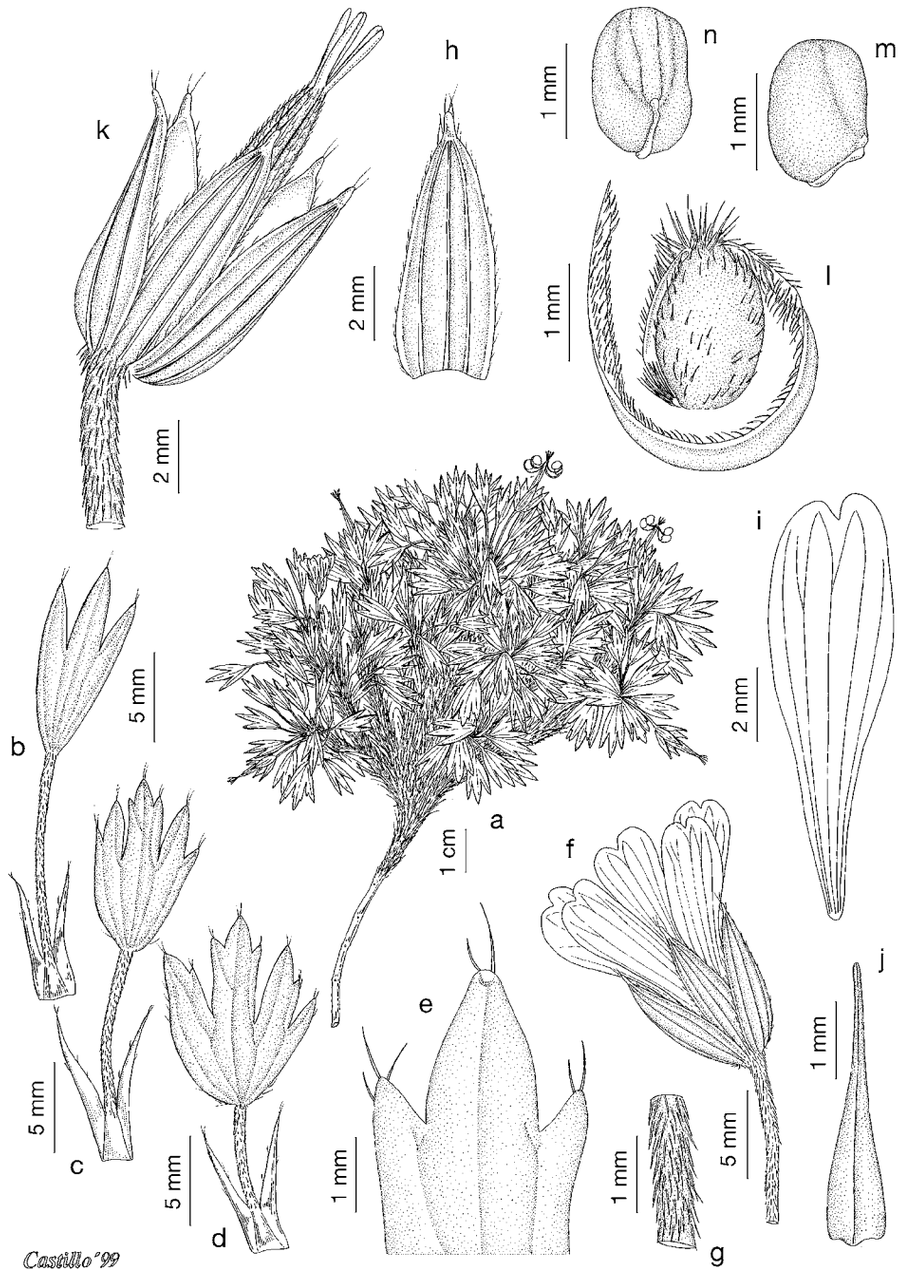


Fig. 415. *Geranium azorelloides*. a. Habit. b-d. Leaves. e. Apex of middle segment of leaf. f. Flower. g. Peduncle. h. Sepal. i. Petal. j. Staminal filament. k. Fruit. l. Mericarp. m, n. Seeds. (Based on: *Barclay & Juajibioy 5983*, MO).

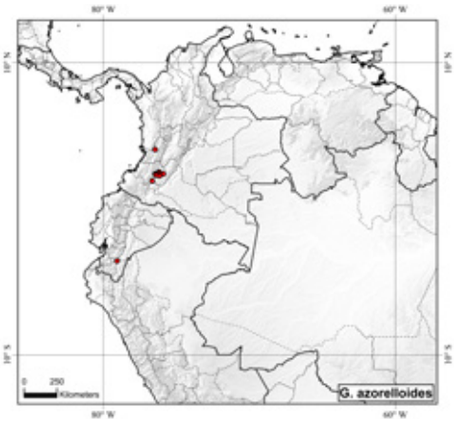


Fig. 416. Distribution of *Geranium azorelloides*.

long, lanceolate, yellow, glabrous, or with few eglandular hairs 0.1-0.2 mm long on the margin; anthers ca. 0.7 mm long, purple. Nectaries 5, hemispheric, glabrous. *Gynoecium* ca. 4 mm long, purple. *Fruit* 10-10.5 mm long, erect, discharge of seed-ejection type; mericarps 1.7-2 mm long, 1.1 mm wide, without a strand of fibers, not compressed at the apex, smooth, without basal beak, with a basal callus, without a basal prong, brown, with antrorse, ± appressed, eglandular hairs 0.1-0.2 mm long on the surface and eglandular hairs 0.5-0.8 mm long on the margin; rostrum 6.5-7 mm long, without a narrowed apex, not twisted, with erect-patent, eglandular hairs 0.1-0.2 mm long; stigmatic remnants ca. 1.5 mm long, with 5 glabrous lobes. *Seeds* ca. 1.5 mm long, 1 mm wide, finely reticulate, uniformly colored, brown, glabrous. Cotyledons with entire margin. Fig. 415.

Pollen. *Geranium*-type (Aedo & al. 2002: 217).

Chromosome number. Unknown.

Phenology. Collected in flower from March to October.

Distribution. This species ranges from southwestern Colombia to southern Ecuador (Fig. 416).

Habitat. Lake shores, wet or boggy areas on paramo with *Espeletia* Mutis ex Bonpl.; 3000-3450 m.

Additional specimens examined. **Colombia.** Cauca: Macizo Colombiano, Páramo de Las Papas, alrededores de la laguna de Cusiyaco, 1º54'N, 76º39'W, 7 Oct. 1958, *Barclay & Juajibioy 5983* (MO); Macizo Colombiano, alrededores de la laguna de Cusiyaco, sector Valencia, 1º54'N, 76º39'W, 16 Sep. 1987, *Duque 566* (COL); Macizo Colombiano, alrededores de la laguna de Cusiyaco, 1º54'N, 76º39'W, 7 Oct. 1958, *Idrobo 3996* (COL, MA); Puracé, 2º18'N, 76º23'W, 2 Apr. 1939, *Sneidern 2325* (S); Puracé, Parque Nacional de Puracé, laguna San Rafael, 2º22'N, 76º21'W, 24 June 1986, *Beck 13065* (LPB); Puracé, estación de San Rafael, cabaña Inderena, 2º22'N, 76º21'W, 18 Apr. 1982, *Torres 933* (COL); Puracé, Parque Nacional de Puracé, 2º23'N, 76º27'W, 4 Oct. 1984, *Lozano & al. 4541* (COL); Cordillera Central, Páramo de Juntas, extensión of Páramo de Guanacas, km 53, 2º27'N, 76º15'W, 12 Oct. 1961, *Cuatrecasas & Willard 26343* (COL, MA). Cauca-Huila: Moscopán road, 35 km by air SE of Popayán, 2º15'N, 76º9'W, 27 Dec. 1944, *Grant 10638* (US); La Plata, 2º23'N, 75º53'W, 29 Mar. 1939, *Sneidern 2327* (S). Valle: Riofrío-Darién, Páramo del Duende, 4º3'N, 76º27'W, 23 July 1998, *Vargas 4842* (HUA, MO). **Ecuador.** Cañar: Cordillera Cordoncillo, Tres Lagunas, along road from Babes (ca 2 km E of Urdaneta) towards 28 de Mayo, 3º35'S, 79º4'W, 10 Nov. 2018, *Sklenář & al. 15768* (PRC).

Discussion. Geranium azorelloides is a species with a striking leaf lamina, obtriangular in outline and with three shallowly incised segments at the apex. The only other species of *Geranium* with such a leaf lamina are *G. jahnii* (Venezuela) and some representatives of sect. *Neurophyllodes* (endemic to Hawaii); however, in these the petiole is articulated at the lamina or at the stipules, whereas *G. azorelloides* lacks such articulation. *Geranium azorelloides* is stemless; it has bristles at the apex of the stipules and sepals, and has vegetative stems, like some Andean species. *Geranium azorelloides* usually has a glabrous leaf lamina, but some specimens have patent cilia on the margin (*Beck 13065*, (LPB; *Cuatrecasas & Willard 26343*, COL). In most of the specimens examined, the segments of the leaf laminas are entire at the apex, but occasionally these segments have 1-2 lateral teeth (e.g., *Barclay & Juajibioy 5983*, MO).

165. Geranium sibbaldioides Benth., Pl. Hartw. 2: 166. 1845. Type locality: "Hacienda de Antisana". Type: Ecuador. Antisana, 0°30'S, 70°10'W, 4 Feb. 1826, *K. Hartweg 126* (lectotype, designated by Aedo & al. 2002: 273, K!).

Perennial herbs, 2-28 cm tall. *Rootstock* 0.8-7.2 mm in diameter, vertical, not tuberculate, not turnip-shaped, without thickened roots. *Stem* scapiform, cushion-like, stolons absent, with short vegetative stems. *Basal leaves* in a persistent rosette; leaf laminas 0.4-1.4 cm long, 0.7-1.9 cm wide, not peltate, palmatifid [ratio main-sinus length/middle segment length = 0.75-0.92], polygonal in outline, base cordate, not coriaceous, with nerves not projected, glabrous or pilose on both surfaces, with antrorse, eglandular cilia 0.1-0.2 mm long on the margin, each segment ending in 1-3 bristles 0.2-0.7 mm long; segments 5, in 1 plane, middle segment lanceolate to obtriangular, 0.5-1.8 mm wide at the base [ratio segment width at the base/middle segment length = 0.11-0.24], 1-3-lobed at the apex [ratio secondary sinus length/middle segment length = 0.19-0.30]; petioles up to 5 cm long, without abscission zone, terete, not swollen, not deflexed in age, with retrorse, usually appressed, eglandular hairs 0.1-0.7 mm long; stipules 4.9-12 mm long, 0.6-1.7 mm wide, lanceolate (with a setaceous apex 1.5-3.1 mm long), free, papery, brownish red, with eglandular hairs on abaxial surface and on the margin, glabrous adaxially (ending in 1-3 bristles 0.1-0.8 mm long). *Cymules* 1-flowered, solitary [ratio cymule length/leaf length = 0.5-1.8]; peduncles 6-27 mm long, with patent or retrorse, appressed, eglandular hairs 0.2-0.5 mm long; bracteoles absent or 3.5-9.7 mm long, 0.8-2.6 mm wide, linear-lanceolate, opposite; pedicels absent or 4-37.9 mm long, with retrorse, appressed, eglandular hairs 0.1-0.5 mm long. Flowers actinomorphic. *Sepals* 4.2-8 mm long, 1.2-2.5 mm wide, lanceolate, smooth, not accrescent, nerves 3, mucro 0.2-1.2

mm long [ratio mucro length/sepal length = 0.07-0.23], with erect-patent, eglandular hairs 0.1-1 mm long on the abaxial surface and margin, glabrous adaxially, ending in 1-4 bristles 0.2-0.7 mm long. *Petals* 5-13.2 mm long, 2.2-5.1 mm wide, erect-patent, rounded, without claw, white to pink, glabrous or hairy on both surfaces, ciliate on the basal margin, with hairs 0.1-0.2 mm long. *Stamens* 10, both whorls bearing anthers; filaments 1.7-4.1 mm long, lanceolate, white, glabrous, or with few eglandular hairs 0.1-0.3 mm long on the abaxial surface and margin; anthers 0.5-0.9 mm long, yellow. Nectaries 5, hemispheric, glabrous. *Gynoecium* 2.5-4.1 mm long, yellow. *Fruit* 7.1-11.6 mm long, usually erect, discharge of seed-ejection type; mericarps 1.6-3.1 mm long, 0.7-1.7 mm wide, without a strand of fibers, not compressed at the apex, smooth, without basal beak, with a basal callus, without a basal callus, brown, with antrorse, ± appressed, eglandular hairs 0.1-0.5 mm long; rostrum 4.1-7.5 mm long, without a narrowed apex, not twisted, with erect-patent, eglandular hairs 0.1-0.5 mm long; stigmatic remnants 0.6-1.8 mm long, with 5 glabrous lobes. *Seeds* 1.1-2.2 mm long, 0.6-1.3 mm wide, finely reticulate, uniformly colored, brown, glabrous. Cotyledons with entire margin.

Pollen. *Geranium*-type (Aedo & al. 2002: 217).

Chromosome number. Unknown.

Phenology. Collected in flower from January to December.

Distribution. This species ranges from western Venezuela to western Bolivia.

Habitat. Wet puna, grassy paramo and edge of forests; 1900-5000 m.

1. Leaves with eglandular hairs on both surfaces, sometimes only adaxially.
165c. subsp. **elongatum**
1. Leaves glabrous on both surfaces.
2. Leaves with middle segment broadly lanceolate, 1(2)-lobed at the apex.
165a. subsp. **sibbaldioides**
2. Leaves with middle segment obtriangular, 3(4)-lobed at the apex.
165b. subsp. **beckianum**

165a. Geranium sibbaldioides Benth. subsp. **sibbaldioides**

Geranium cucullatum Kunth in Humb., Bonpl. & Kunth, Nov. Gen. Sp. 5: 231. 1822, nom. illeg., non L. 1753. *Geranium ciliatum* Willd. ex Spreng., Syst. Veg. 3: 71. 1826, nom. illeg., non Cav. 1787. *Geranium bolivarianum* Dayton, Phytologia 4: 245. 1953. Type locality: "Crescit in frigidis montium Popayanensium, prope Parameto de Almaguer, alt. 1690 hex.". Type: Colombia. Cauca, Popayán, Almaguer, 1°54'N, 76°51'W, *F.A. Humboldt & A. Bonpland s.n.* (lectotype, designated by Knuth 1912: 88, B-W-12531-01-0 image!; isolectotypes, H-1367036!, HAL!, P-00136927!).

Geranium igualatense R. Knuth, Repert. Spec. Nov. Regni Veg. 28: 88. 1930. Type locality: "Ecuador: Paramo des Igualata, -- 4000 m, gemein (Rimbach n. 426 -- Typus in herb. Berol.!)". Type: Ecuador. Tungurahua, Paramo des Igualata, 1°30'S, 78°37'W, *A. Rimbach 426* (holotype, B destroyed).

Geranium igualatense var. *laxius* R. Knuth, Repert. Spec. Nov. Regni Veg. 28: 89. 1930. Type locality: "Ecuador: An demselben Standort, in 2800 m Höbe". Type: Ecuador. Tungurahua, Paramo des Igualata, 1°30'S, 78°37'W, *A. Rimbach s.n.* (no original material located).

Leaf lamina glabrous on both surfaces, with antrorse, eglandular cilia 0.1-0.2 mm long on the margin, each segment with 1-3 terminal bristles 0.2-0.6 mm long; middle segment broadly lanceolate, 0.6-1.8 mm wide at the base (ratio segment width at the base/middle segment length = 0.12-0.24), 1(2)-lobed at the apex. *Sepals* 4.2-6.8 mm long, with a mucro 0.5-0.9 mm long, glabrous adaxially, with 1-3 terminal bristles 0.3-0.6 mm long. *Petals* (6.1)7.1-9.2 (11) mm long, white to pink. Figs. 417 a-c, f-k, 418.

Pollen. Geranium-type (Aedo & al. 2002: 217).

Chromosome number. Unknown.

Phenology. Collected in flower from January to December.

Distribution. This subspecies ranges from southern Colombia, through Ecuador to northern Peru (Fig. 421).

Habitat. Bogs, lake shores, or grassy paramo with patches of *Espeletia* Mutis ex Bonpl. and *Polylepis* Ruiz & Pav.; 2700-5000 m.

Representative specimens examined. **Colombia.** Cauca: Macizo Colombiano, Páramo de las Papas, pr. Valencia, 1°54'N, 76°39'W, 24 Sep. 1958, *Barclay & Juajibioy 5751* (MO); Páramo de las Papas, entre San Sebastián y Valencia, 1°54'N, 76°39'W, 17 Sep. 1958, *Barclay 5752* (COL). Nariño: Cumbal, volcán Chiles, 0°49'N, 77°50'W, 23 Oct. 1978, *Sturm 117* (COL); volcán Galeras, 1°12'N, 77°15'W, 4 June 1946, *Schultes & Villarreal 7954* (BH, COL). **Ecuador.** Azuay: in vicinity of Toreador, between Molleturo and Quinoas, 2°45'S, 79°26'W, 15 June 1943, *Steyermark 53189* (BH, F, NY); 3,3 km S de Las Nieves, S de Cajas, 3°18'S, 78°8'W, 9 Nov. 1991, *Holm-Nielsen & Øllgaard 7* (C). Azuáy-Morona Santiago: Muletrack Sevilla de Oro-Méndez, at the pass and adjacent slopes, Páramo de Castillo, 2°48'S, 78°36'W, 16 Sep. 1976, Øllgaard *& Balslev 9580* (AAU, MO, NY). Cañar: Cerro Yanguán, NE of Pindiling, 2°36'S, 78°40'W, 13 Dec. 1980, *Holm-Nielsen & al. 29276* (AAU, LD, MO, NY). Carchi: Páramo del Ángel, 0°41'N, 77°52'W, 5 Aug. 2006, *Aedo 13353bis* (MA); volcán Chiles, 0°48'N, 77°57'W, 23 June 1995, *Sklenář & Kosteckova 661* (NY). Chimborazo: ladera S del volcán Chimborazo, pr. Urbina, 1°27'S, 78°45'W, 31 Aug. 2006, *Aedo 13234* (MA); Mt. Tioloma, 2°18'S, 78°38'W, Mar., *Rivet 4250* (P). Chimborazo-Morona-Santiago: trail Alao-Huamboya, between Cuspipaccha and 3700 m, 1°47'S, 78°25'W, 7 May 1982, Øllgaard *& al. 38212* (AAU). Cotopaxi: near origin of Río Langoa, E of Latacunga, Laguna Salayambo Cocha, 0°56'S, 78°25'W, 30 Sep. 1976, Øllgaard *& Balslev 9866* (AAU, MO, NY). El Oro: Tioloma, NE Zaruma, Hacienda Ambocas, 3°45'S, 79°37'W, 30 Aug. 1947, *Espinosa 2040* (NY). Imbabura: road Ibarra-Mariano Acosta, at the pass, Hacienda Yura Cruz, 0°20'N, 78°0'W, 10 Aug. 1976, Øllgaard *& Balslev 8663* (AAU, MO, NY); Nevado Cotacachi, 0°21'N, 78°21'W, 8 Sep. 1995, *Sklenář & Kosteckova 112-18* (NY). Loja: Saraguro, pr. Fierro Urco, 3°42'S, 79°18'W, 28 July 2006, *Aedo 13221* (MA); Parque Nacional Podocarpus, Lagunas de Compadre, 4°12'S, 79°6'W, 29 Nov. 1995, *Pedersen & al. 104436* (AAU). Morona-Santiago: Gualaceo-Macas road, E of the pass, 3°1'S, 78°38'W, 23 Oct. 1984, *Jørgensen & al. 56231* (AAU, MO); Páramo de Matanga, km 38 on road Sigsig-Gualaquiza, 3°12'S, 78°47'W, 14 Dec. 1980, *Holm-Nielsen & al. 29465* (AAU). Napo: Laguna San Marcos, E of volcán Cayambe, 0°7'N, 77°58'W, 5 July 1944, *Drew E-185* (NY, P, US); Cordillera de

los Llanganates, Cerro Hermoso, 1º13'S, 78º18'W, 12 Nov. 1980, *Holm-Nielsen & Jaramillo 28740* (AAU). Napo-Pastaza: alrededores de la Cordillera de los Llanganati, Chihuila Sacha, lower slopes of Ainchilibí, 1º13'S, 78º15'W, 25 Aug. 1959, *Barclay & Juajibioy 9082* (MO). Pichincha: reserva Cayambe-Coca, vía a Baeza, 0º19'S, 78º11'W, 14 July 2006, *Aedo & Ulloa 12931* (MA); Chaparro de Sebritana, Sector Oriental de las Haciendas Pedregal y Yanurcu, 0º29'S, 78º32'W, 7 July 1944, *Acosta Solís 8341* (F). Sucumbíos: Cerro El Mirador, 3 km al SW de Cocha Seca, 0º20'N, 77º25'W, 2 Mar. 1992, *Gavilanes & Funk 871* (GH, NY). Tungurahua: Santiago de Pillaro, Los Llanganates, alrededores de Laguna Yanacocha y sendero al río Golpe, a 6 km de la laguna Pisayambo, 1º6'S, 78º18'W, 14 Mar. 1995, *Vargas & Sandoval 407* (MA); Cordillera de los Langanates, at Río Verde Grande at base of Cerro Hermoso, 2.5 km SW of the summit, 1º14'S, 78º18'W, 12 Nov. 1980, *Holm-Nielsen & Jaramillo 28619* (AAU, MO). **Peru.** Cajamarca: pr. Cerro Yanahuanga, 6º51'S, 78º36'W, 17 June 2009, *Aedo 16542* (MA); Cajamarca, Minas Conga, sector El Águila, 6º51'S, 78º21'W, 4 Oct. 2005, *Granda 2512* (MA). La Libertad: Pataz, Parcoy, cercanías puesto vigilancia de Ventanas, 7º58'S, 77º26'W, 7 June 2001, *León & al. 5078* (USM); Santiago de Chuco, Lagunas Los Ángeles, El Toro y alrededores, 8º9'S, 78º11'W, 29 Oct. 2002, *Cano & al. 12684* (USM). San Martín: Mariscal Cáceres, Pampa de Cuyes, 7º38'S, 77º28'W, 25 July 2000, *León & Young 4537* (USM); Mariscal Cáceres, Pampa del Cuy, NW sector Río Abiseo National Park, 7º40'S, 77º30'W, 2 Mar. 1988, *León & Young 1230* (MO).

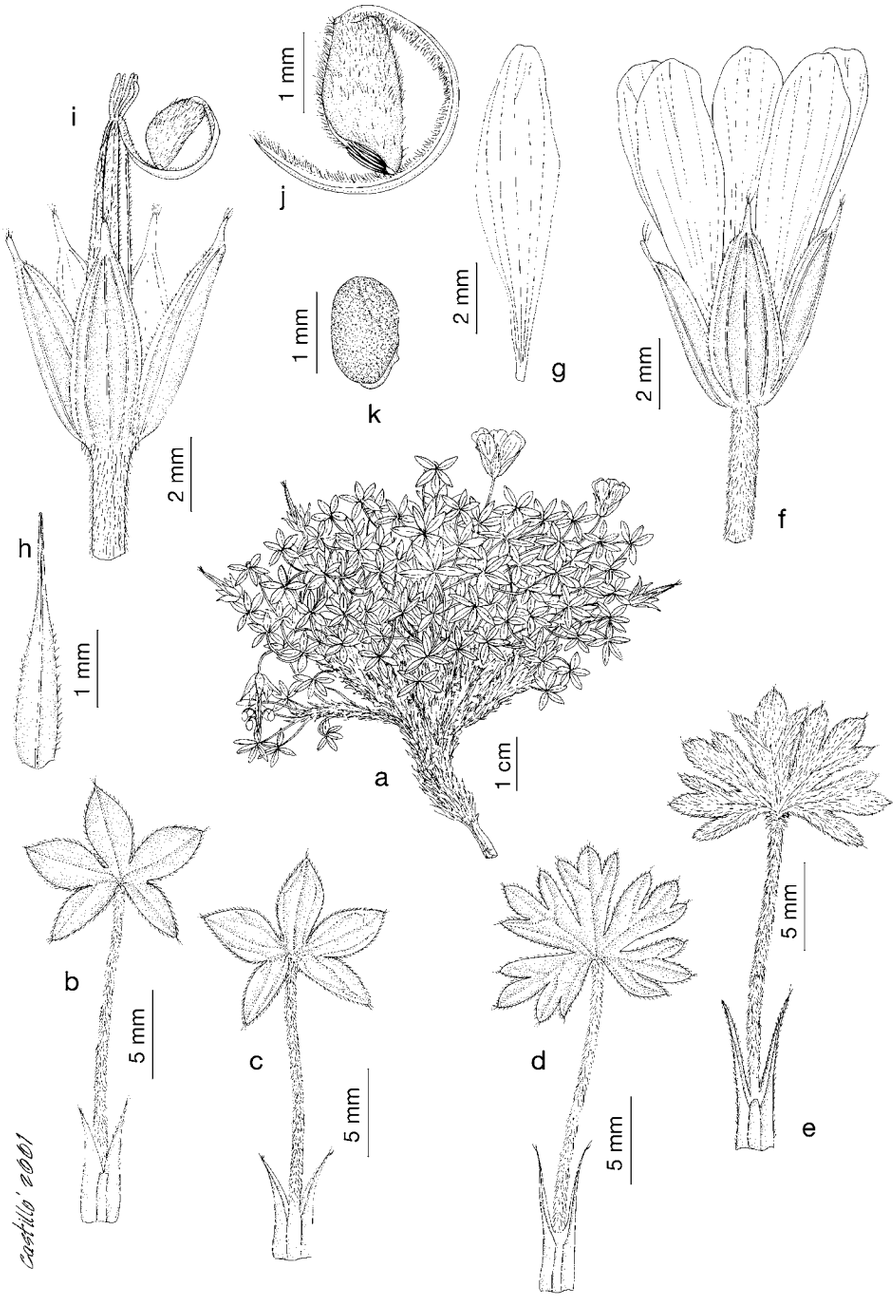


Fig. 417. *Geranium sibbaldioides* subsp. *sibbaldioides*: a. Habit. b. Leaf, adaxial side. c. Leaf, abaxial side. f. Flower. g. Petal. h. Staminal filament. i. Fruit. j. Mericarp. k. Seed. (Based on: a-c, f-k, *Holm-Nielsen & al. 5422*, F). *Geranium sibbaldioides* subsp. *beckianum.* d. Leaf, adaxial side. (Based on: *Solomon 18194*, LPB). *Geranium sibbaldioides* subsp. *elongatum.* e. Leaf, adaxial side (Based on: *Moar 874*, COL).

Fig. 418. *Geranium sibbaldioides* subsp. *sibbaldioides* (Based on: *Aedo & Ulloa 13103,* MA).

165b. Geranium sibbaldioides subsp. **beckianum** Aedo, Anales Jard. Bot. Madrid 58: 184. 2000. Type locality: "Bolivia. La Paz, Nor Yungas, pasando Unduavi hacia Cotapata, 3 May 1993, Beck 19987 (holotype, MA-628702!)". Type: Bolivia. La Paz, Nor Yungas, pasando Unduavi hacia Cotapata, 16°19'S, 67°54'W, 3 May 1993, *S.G. Beck 19987* (holotype, MA-628702!).

Leaf lamina glabrous on both surfaces, with antrorse, eglandular cilia 0.1-0.2 mm long on the margin, each segment with 1-3 terminal bristles 0.2-0.7 mm long; middle segment obtriangular (with lanceolate lobes), 0.5-1.7 mm wide at the base (ratio segment width at the base/middle segment length = 0.11-0.19), 3 (4)-lobed at the apex (ratio secondary sinus length/middle segment length = 0.20-0.35). *Sepals* (4.8) 5.4-6.3 (6.8) mm long, with a mucro (0.6)0.7-0.8(1.2) mm long, with scattered erect-patent, eglandular hairs 0.2-0.4 mm long on base of abaxial surface and margin, glabrous adaxially, with 1-3 terminal bristles 0.3-0.6 mm long. *Petals* (7.8)10.1-11.5(13.2) mm long, usually white. Figs. 417 d, 419.

Pollen. *Geranium*-type (Aedo & al. 2002: 217).

Chromosome number. Unknown.

Phenology. Collected in flower from January to December.

Distribution. This subspecies ranges from southern Ecuador, through Peru to western Bolivia (Fig. 421).

Habitat. Boggy or wet areas in puna, sometimes among shrubs, at edge of *Polylepis* Ruiz & Pav. forests; 2300-4300 m.

Representative specimens examined. **Bolivia.** La Paz: provincia Franz Tamayo, PN. Madidi, entre Queara y Mojos, cuesta de Calistía hacia Tambo Quemado, 14°41'S, 68°59'W, 25 Feb. 2008, *Fuentes & al. 12021* (MA, MO); Nor Yungas, Unduavi, 16°19'S, 67°54'W, 12 Feb. 1907, *Buchtien 610* (W). **Ecuador.** Azuay: Páramo del Castillo, trail between Sevilla de Oro and Mendez, 2°48'S, 78°37'W, 17 Dec. 1944, *Camp 1633* (NY). Chimborazo: Riobamba, Pungala, Comunidad Alao-Llactapamba, parque Nacional Sangay, Páramo de Culebrillas, 1°58'S, 78°28'W, 17 Aug. 1990, *Cerón & al. 11830* (MA). Loja: Fierro Urco, Saraguro-Loja, km 12.4 turoff towards Fierro Urco, km 23.8, 3°43'S, 79°19'W, 6 Dec. 1994, *Jørgensen & al. 1237* (QCA); Parque Nacional Podocarpus, Cerro Toledo, pr. Yangana, 4°23'S, 79°6'W, 26 July 2006, *Aedo, Gutiérrez & C. Ulloa 13191* (C, MA, QCA). Napo: road Quito-Baeza, 1 km along take-off road to telecommunication antenna in the pass, Páramo de Guamaní, 0°17'S, 78°9'W, 12 Oct. 1976, Øllgaard & *Balslev 10156* (AAU); Cordillera de los Llanganatis, NE side of Laguna Encantada, lower slope of Cerro Negro, 1°11'S, 78°12'W, 16 Mar. 1983, *Holm-Nielsen & al. 41775* (AAU). Pichincha: NW slope of Mt. Corazón, 0°31'S, 78°36'W, 27 Aug. 1955, *Asplund 17091* (S); E slope of Mt. Corazón, 0°31'S, 78°36'W, 30 Aug. 1955, *Asplund 17512* (S). Tungurahua: Santiago de Pillaro, Parque Nacional Llanganates, camino desde el valle de los Frailejones hasta el Páramo de Soguillas, 1°8'S, 78°16'W, 15 Nov. 1999, *Narváez & al. 515* (MA); Banos Cantón, Parque Nacional Llanganates, Páramo de Soguillas-valle de los Frailejones, 1°10'S, 78°16'W, 12 Oct. 1998, *Vargas & al. 2792* (MA). **Peru.** Amazonas: Bagua, Cordillera Colán, NE of La Peca, 5°36'S, 78°26'W, 8 Sep. 1978, *Barbour 3423* (F, G, MO); Chachapoyas, Chachapoyas-Celendín road, Cerro Calla-Calla, the summit between the Marañón river valley and the Utcubamba river drainage, 6°50'S, 77°51'W, 27 May 1984, *Smith & Cabanillas 7214* (MA, MO). Ancash: Huari, Huascarán National Park, quebrada Pucaraju, a lateral valley of Quebrada Rurichinchay, 9°21'S, 77°17'W, 15 June 1986, *Smith & al. 12680* (ISC, MO, USM). Cajamarca: Jaén, Sallique, Lanchal, La Cocha, 5°40'S, 79°14'W, 28 June 1998, *Díaz & al. 9725* (MA, MO); jalca de Kumulca, 7°2'S, 78°15'W, 16 June 2009, *Aedo 16518* (MA). Cuzco: Abra de Málaga, 3 km Quillabamba, 12°49'S, 72°47'W, 9 Mar. 1971, *Ellenberg 5006* (AAU, NY). Urubamba, a 88 y 112 km de Cusco, Santuario Historico de Machupichu y el camino Inca, 13°9'S, 72°31'W, 16 Mar. 1988, *Núñez & Luna 8869* (MO). Huánuco: Tambo de Vaca, 9°50'S, 76°45'W, 10 June 1923, *Macbride 4401* (NY); Junín: Satipo, cor-

Fig. 419. *Geranium sibbaldioides* subsp. *beckianum* (Based on: a, *Aedo & al. 13191,* MA; b-d, *Aedo 16518,* MA).

dillera de Vilcabamba, río Ene slope, near summit of divide, 11°39'S, 73°40'W, 8 June 1997, *Boyle 4236* (MA, USM). La Libertad: Bolivar, Uchumarca, Vira Vira ruins, 6°53'S, 77°44'W, 4 Nov. 2012, *Zambrana & al. 8766* (MA); Pataz, Manachaqui, 10 km NE Pataz, 7°40'S, 77°30'W, 28 Feb. 1988, *León & Young 1092* (MO). Pasco: Oxapampa, Santa Barbara, 7°40'S, 77°30'W, 2 Aug. 1984, *Smith 8097* (AAU, MO); Oxapampa, Huancabamba, Parque Nacional Yanachaga-Chemillen, sector Santa Barbara, 10°20'S, 75°38'W, 11 Mar. 2004, *Vázquez & al. 29994* (MA). Puno: Tabina, 14°8'S, 69°32'W, July, *Lechler 2099* (HAL). San Martín: Mariscal Cáceres, NW corner Río Abiseo National Park, Puerta del Monte, 7°0'S, 77°0'W, 10 July 1987, *Young & León 4353* (F); Mariscal Cáceres, Pampa de Cuyes, 7°39'S, 77°28'W, 25 July 2000, *León & Young 4534* (USM).

165c. Geranium sibbaldioides subsp. **elongatum** (Wedd.) Aedo, Anales Jard. Bot. Madrid 58: 184. 2000. *Geranium cucullatum* var. *elongatum* Wedd., Chlor. Andina 2: 285. 1861. *Geranium sibbaldioides* var. *elongatum* (Wedd.) J.F. Macbr., Candollea 6: 7. 1934. Type locality: "paramo d'Usaguin! (Goudot).-Équateur: hacienda de Antisana! (Hartweg); haut plateau, au pied de l'Antisana!, h. 3950 m. (Jameson, exsicc., ann. 1856, n. 496).-Pérou: Cordillères des provinces de Cuzco! et de Carabaya! (Gay; Lechler, exsicc., n. 2518)". Type: Colombia. Cundinamarca, Páramo de Usaquén, 4°42'N, 74°02'W, 1844, *J. Goudot s.n.* (lectotype, designated by Aedo & al. 2002: 277, P-00147075!; isolectotypes, FI!, G!).

Geranium mogotocorense R. Knuth, Repert. Spec. Nov. Regni Veg. 28: 88. 1930. Type locality: "Colombia: Dept. Santander, Paramo de Mogotocoro, bei Vetas, 3700-3800 m (Killip et Smith a. 1927 n. 17626 -- Typus in Un. St. Nat. Herb. n. 1353188!)". Type: Colombia. Santander, Vetas, Páramo de Mogotocoro, 7°12'N, 72°59'W, 18 Jan. 1927, *E.P. Killip & A.C. Smith 17626* (holotype, US-1353188!).

Geranium cuatrecasasii R. Knuth, Repert. Spec. Nov. Regni Veg. 34: 143. 1933. Type locality: "Colombia: Dept. Tolima, Alto del Condor (Cuatrecasas a. 1932 -- Typus!). -- Blühend Mai". Type: Colombia. Tolima, Alto del Condor, 4°40'N, 75°19'W, 14 May 1932, *J. Cuatrecasas 2277* (lectotype, designated by Aedo & al. 2002: 277, MA-252455!).

Fig. 420. *Geranium sibbaldioides* subsp. *elongatum* (Based on: *Grande & Aedo 2621,* MA).

Leaf lamina pilose, with ± scattered subpatent, eglandular hairs on both surfaces (sometimes only adaxially), each segment with 1-3 terminal bristles 0.3-0.7 mm long; middle segment lanceolate, sometimes obtriangular (with lanceolate lobes), 0.7-1.3 mm wide at the base (ratio segment width at the base/ middle segment length = 0.15-0.20), 1(3)-lobed at the apex (ratio secondary sinus length/middle segment length = 0.19-0.30). *Sepals* 4-8 mm long, with a mucro 0.2-0.6 mm long, with erect-patent eglandular hairs 0.3-1 mm long abaxially and on the margin, glabrous adaxially, with 1-4 terminal bristles 0.2-0.7 mm long. *Petals* 5-9(13) mm long, white to pink. Fig. 417 e, 420.

Pollen. *Geranium*-type (Aedo & al. 2002: 217).

Chromosome number. Unknown.

Phenology. Collected in flower from January to December.

Distribution. This subspecies ranges from western Venezuela, through Colombia to northern Ecuador (Figure 421).

Habitat. Bogs, wet grassy areas, rocky slopes, on *Azorella* Lam. hummocks, and in *Espeletia* Mutis ex Bonpl. and *Polylepis* Ruiz & Pav. stands; 1900-4400 m.

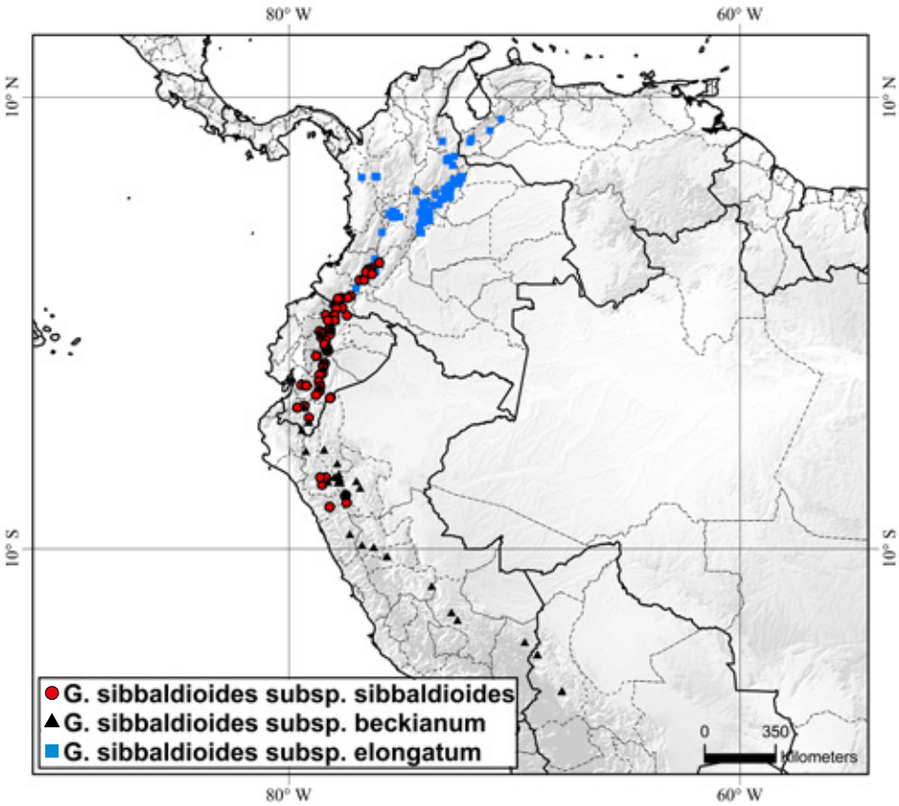


Fig. 421 Distribution of *Geranium sibbaldioides*.

Representative specimens examined. **Colombia.** Antioquia: Urrao, Inspección Jaiperá, Páramo de Frontino, vereda el Chuscal, Llanogrande, 6°27'N, 76°46'W, 5 Apr. 1989, *Callejas & al. 7603* (HUA, MA). Arauca: Sierra Nevada del Cocuy, cabeceras de la Quebrada El Playón, Patio Bolos, 6°24'N, 72°27'W, 7 Mar. 1973, *Cleef 8833* (COL, U). Boyacá: Chinavita, Cerro Mamapacha, 5°15'N, 73°20'W, 11 Dec. 1998, *Stancik 1588* (COL, PRC). Boyacá-Santander: Páramo del Almorzadero, 6°59'N, 72°44'W, 8 July 1966, *Schulz & Rodríguez 544* (F, U). Caldas: debajo del Nevado de Santa Isabel, páramos en Plan de Cóndor, cabeceras del río Otún, 4°47'N, 75°26'W, 20 Nov. 1946, *Cuatrecasas 23151c* (F). Caldas-Tolima: Nevado del Ruiz, páramos entre Termales y Nevado y Líbano, 4°50'N, 75°33'W, 13 Dec. 1958, *Barclay & Juajibioy 6373* (COL, MO). Cauca: Palmira, La Nevera, Las Guacas, 1°32'N, 77°1'W, 12 Mar. 1990, *Sarria 1060* (COL). César-Norte de Santander: entre Abrego y Las Jurisdicciones, Cerro de Oroque, 8°3'N, 73°11'W, 22 May 1969, *García Barriga & Jaramillo 19811* (COL, NY). Cundinamarca: Páramo de Sumapaz, near headwaters of Río San Juan, Alto San Juan, 4°5'N, 74°12'W, 9 Aug. 1943, *Fosberg 20761* (NY, U). Huila: Puracé, Moscopán, 2°15'N, 76°9'W, July 1948, *Yepes Agredo 516* (COL). Meta: Guamal, Parque Nacional de Sumapaz, entre el río Gallo y el Cerro Diamante, 4°0'N, 74°7'W, 1 Feb. 2002, *Betancur & Neira 9578* (COL). Nariño: Cumbal, colina cercana al pueblo, 0°54'N, 77°47'W, 20 Oct. 1978, *Sturm & Abouchaar 24* (COL). Norte de Santander: E slope of Páramo de Santurbán, toward Mutiscua, 7°12'N, 72°59'W, 20 Feb. 1927, *Killip & Smith 19585* (F, NY, S). Quindio: Páramo de Quindio, 4°42'N, 75°25'W, 15 Aug. 1922, *Pennell & Hazen 9827* (GH, NY). Risaralda: Pereira, Parque de los Nevados, afluente del río Otún, 4°49'N, 75°29'W, 16 Jan. 1980, *Jaramillo & al. 5617* (COL). Santander: Cordillera Oriental, Páramo del Almorzadero, on road between Chitagá and Cerrito, 7 km S of highest point of paramo, 6°59'N, 72°44'W, 31 Dec. 1959, *Barclay & Juajibioy 10346* (COL, MO). Tolima: Páramo del Nevado del Tolima, 4°40'N, 75°19'W, 14 May 1932, *Cuatrecasas 2274* (MA). Valle: Hoya del río Bugalagrande, Barragán, Páramo de Bavaya, Corrales, 4°1'N, 75°52'W, 24 Apr. 1946, *Cuatrecasas 20580* (F). **Ecuador.** Azuay: Páramo de Patococha, toward military antennas, 3°0'S, 78°39'W, 1 Nov. 2018, *Sklenář & al. 15599* (MA). Napo: Reserva Ecológica Antisana, carretera Pifo-Baeza, Páramo de la Virgen, 0°20'S, 78°12'W, 23 Nov. 1998, *Freire & al. 2854* (MA). **Venezuela.** Mérida: Páramo El Batallón, 8°10'N, 71°54'W, 18 Nov. 1976, *Charpin & al. 13546* (G, MA); Sierra Nevada, de Loma Redonda ad laguna de los Anteojos, 8°32'N, 71°5'W, 2 Nov. 1976, *Bernardi & al. 17134* (G). Táchira: La Grita, Páramo del Rosal, 8°1'N, 71°58'W, 8 Oct. 1965, *Bernardi 10856* (G, Z); Páramo del Batallón, 8°8'N, 71°54'W, 9 Aug. 2010, *Grande & Aedo 2621* (MA); Páramo Batallón, sector de la Laguna Larga, entrando por las Porqueras, 8°10'N, 71°54'W, 29 Dec. 1976, *Stergios 869* (PORT). Trujillo: Bocono, Páramo de Guirigay, Monumento Natural Teta de Niquitao-Guirigay, sector Las Veguitas, 9°2'N, 70°35'W, 20 Aug. 2002, *Dorr & al. 9125* (MA).

Discussion. Geranium sibbaldioides is extremely variable in indumentum and leaf shape throughout its range, from western Venezuela to northern Bolivia. The type material was collected in Ecuador by Hartweg. This lectotype and most specimens of *G. sibbaldioides* from southern Colombia and Ecuador have leaves with five entire segments, glabrous on both surfaces (with antrorse cilia on the margin); the petioles usually have retrorse, appressed hairs, and the sepals are almost glabrous (with few hairs towards the base). Some specimens sharing these characters have also been collected in northern Peru. Specimens from western Venezuela and northern and central Colombia (and rarely northern Ecuador) usually have the leaf laminas hairy on one or both surfaces and the sepals more or less hairy, the leaf segments are not always entire (often the middle segment is entire, and the lateral ones are 2-3-lobed; rarely the middle segment may be 3-lobed and obtriangular), and sometimes the petioles have patent hairs. Other specimens from southern Ecuador, Peru, and northern Bolivia show a different combination of features: they have glabrous leaves (with antrorse cilia on the margin) with obtriangular 3-lobed segments and almost glabrous sepals. These combinations of characters are correlated with different geographi-

cal ranges, and thus three subspecies are recognized; however, the character suites are not always constant, and a few specimens are difficult to assign to a particular subspecies.

Geranium igualatense was based on *Rimbach 426* (B), which was destroyed during the Second World War; no duplicates of this collection were found. Jørgensen & León (1999: 492) considered it conspecific with *G. sibbaldioides*, an opinion here confirmed after examining the original description (Knuth 1930b: 88).

A collection of subsp. *beckianum* (*Barbour 3423*, F, MO) from Peru shows rather more divided leaves than usual but otherwise falls within the circumscription of the subspecies.

Geranium cucullatum var. *elongatum* was described by Weddell (1861) as a taxon with hairy leaves; however, the original material cited by him is heterogeneous, covering all the variability of *G. sibbaldioides*: a) glabrous-leaved specimens from Ecuador agree with *G. sibbaldioides* subsp. *sibbaldioides* (*Jameson 496*, E!, P!), b) glabrous-leaved specimens from Peru (i.e., *Lechler 2518*, HAL!, P!, W!) agree with *G. sibbaldioides* subsp. *beckianum*, and c) a hairy-leaved specimen from Colombia (*Goudot s.n.,* P!), the lectotype for *G. cucullatum* var. *elongatum* (Aedo & al. 2002), chosen in agreement with the protologue and Knuth's (1912) monograph. Consequently, the correct name for specimens from western Venezuela and Colombia is *G. sibbaldioides* subsp. *elongatum*. A specimen of subsp. *elongatum*, *Rangel & al. 1582* (COL), with exceptionally long petals (13 mm) was collected in Colombia (Boyacá, Sierra Nevada del Cocuy). It can be distinguished from *G. paludosum* (a similar species with long petals) by its leaves with lanceolate, entire segments, which are hairy on both surfaces.

166. Geranium loxense Halfd.-Niels., Nordic J. Bot. 16(3): 273, 274 fig. 5. 1996. Type locality: "Madsen 86287, Ecuador, Prov. Loja, Parque Nacional Podocarpus, Cerro Toledo, montane forest and páramo (79°07'W, 04°23'S), alt. 2500-3400 m, 30 Oct 1989 (AAU holotype)". Type: Ecuador. Loja, Parque Nacional Podocarpus, Cerro Toledo, 4°73'N, 79°07'W, 30 Oct. 1989, *J.E. Madsen 86287* (holotype, AAU!; isotypes, QCA!, LOJA!).

Perennial shrubby, 4-30 cm tall. *Rootstock* 1.6-4.7 mm in diameter, vertical, not tuberculate, not turnip-shaped, without thickened roots. *Stem* erect, leafy, not rooting at nodes, stolons absent, with short vegetative stems, glabrous, densely clothed with imbricate persistent stipules and petioles. *Basal leaves* deciduous, cauline leaves alternate; leaf laminas 0.5-1.4 cm long, 0.9-1.7 cm wide, not peltate, palmatifid [ratio main-sinus length/middle segment length = 0.74-0.91], polygonal in outline, base cordate, not coriaceous, with nerves not projected, usually glabrous on both surfaces, with antrorse, eglandular cilia 0.1-0.2 mm long on the margin, each segment ending in 1-3 bristles 0.2-0.6 mm long; segments 5, in 1 plane, middle segment obtriangular (with lanceolate lobes), 0.5-1.2 mm wide at the base [ratio segment width at the base/middle segment length = 0.07-0.15], (1)3(4)-lobed at the apex [ratio secondary sinus length/middle segment length = 0.13-0.39]; petioles up to 6 cm long, without abscission zone, terete, not swollen, not deflexed in age, with retrorse, appressed, eglandular hairs 0.1-0.5 mm long; stipules 3.8-14.2 mm long, 0.6-2.3 mm wide, lanceolate (with a setaceous apex 1.7-4.3 mm long), free, papery, brownish red, with eglandular hairs on abaxial surface and on the margin, glabrous adaxially (ending in 1-2 bristles 0.2-0.5 mm long). Cymules 1-flowered, solitary [ratio cymule length/leaf length = (0.5)1.1-1.8]; peduncles (2.1)3.1-7.9(9.8) mm long, with retrorse, appressed, eglandular hairs 0.2-0.4 mm long; bracteoles 5.1-12.3 mm long, 0.7-2.6 mm wide, linear-lanceolate, opposite; pedicels (4.1)5.9-13.7(20.5) mm long, with retrorse, appressed, eglandular hairs 0.2-0.3 mm long. Flowers actinomorphic. *Sepals* (4.8)5.4-6.3(7.4) mm long, 1.1-2.2 mm wide, lanceolate, smooth, not accrescent, nerves 3, mucro (0.6)0.8-1.2(1.3) mm long [ratio mucro length/sepal length = 0.10-0.22], with scattered, erect-patent, eglandular hairs 0.1-0.4 mm long on margin on the abaxial surface, glabrous adaxially, ending in 1-2 bristles 0.3-0.6 mm long. *Petals* (7.5)8.5-10.6(11) mm long, 1.4-4.7 mm wide, erect-patent, rounded or slightly emarginate (notch 0.3-0.7 mm deep), without claw, purple, glabrous on both surfaces, sometimes ciliate on the basal margin, with hairs 0.1-0.2 mm long. *Stamens* 10, both whorls bearing anthers; filaments 2.4-3.9 mm long, lanceolate, white, glabrous, or with few eglandular hairs 0.1-0.4 mm long on the abaxial surface and margin; anthers 0.6-0.8 mm long, yellow. Nectaries 5, hemispheric, glabrous. *Gynoecium* 2.9-4.2 mm long, pink. *Fruit* 9.4-13.8 mm long, reflexed, discharge of seed-ejection type; mericarps 2-3.4 mm long, 1-1.5 mm wide, without a strand of fibers, not compressed at the apex, smooth, without basal beak, with a basal callus, without a basal prong, brown, with antrorse, ± appressed, eglandular hairs 0.1-0.3 mm long; rostrum 5.4-8.8 mm long, without a narrowed apex, not twisted, with erect-patent, eglandular hairs 0.1-0.3 mm long; stigmatic remnants 0.5-1.4 mm long, with 5 glabrous lobes. *Seeds* 1.7-2.1 mm long, 0.9-1.1 mm wide, finely reticulate, uniformly colored, brown, glabrous. Cotyledons with entire margin. Figs. 422, 423.

Pollen. Ornamentation not studied.

Chromosome number. Unknown.

Phenology. Collected in flower from January to December.

Distribution. This species ranges from southern Ecuador to northern Peru (Fig. 424).

Habitat. Wet or rocky slopes among pockets of dwarf shrubs of *Puya* Molina and *Chusquea* Kunth, and edge of montane forests; 3000-3700 m.

Additional specimens examined. **Ecuador.** Azuay: road Gualaceo-General Plaza Gutiérrez, Limón, km 25, at the pass of La Virgen, and up to antennas, 3º0'S, 78º39'W, 13 Nov. 2000, *Jørgensen & al. 2324* (LOJA, MA); road Gualaceo-General Plaza Gutiérrez, Limón, km 25.2, 3º1'S, 78º39'W, 12 Jan. 2000, *Jørgensen & al. 1849* (MA, MO); road Gualaceo-General Plaza Gutiérrez, Limón, km 25, at the pass of La Virgen, and up to antennas, 3º1'S, 78º39'W, 13 Nov. 2000, *Jørgensen & al. 2321* (LOJA, MA); road Gualaceo-Limón, summit of cordillera Zapote Najda, around La Virgen, 3º2'S, 78º37'W, 18 Nov. 1988, *Harling 25977* (QCA). Loja: Parque Nacional Podocarpus, El Tiro, 4º1'S, 79º8'W, 8 July 1999, *Cabrera & al. 412* (LOJA); Parque Nacional Podocarpus, above Centro de Información, 4º5'S, 79º10'W, 24 Feb. 1985, Øllgaard *& al. 58093* (AAU); Parque Nacional Podocarpus, mountain crest E of Nudo de Cajanuma, above Centro de información, 4º5'S, 79º10'W, 7 June 1988, Øllgaard *74666* (AAU); Cajanuma, 4º6'S, 79º10'W, 20 Jan. 2002, *Lozano & al. 501* (LOJA); refugio de Cajanuma, 4º7'S, 79º9'W, 15 Dec. 1991, *Keating 7* (QCA); refugio de Cajanuma, 4º7'S, 79º9'W, 15 Dec. 1991, *Keating 8* (QCA); Horta-Naque, 4º12'S, 79º12'W, 9 Nov. 1946, *Espinosa 1000* (NY); Horta-Naque, 4º12'S, 79º13'W, 9 Nov. 1946, *Espinosa 984* (NY, LOJA); Parque Nacional Podocarpus, La Miradora, 4º12'S, 79º13'W, 8 Nov. 1991, *Halfdan-Nielsen & Monteros s.n.* (C); Laguna Banderillas, 4º13'S, 79º7'W, 21 Mar. 2002, *Merino & al. 1126* (LOJA); Laguna Banderillas, 4º13'S, 79º7'W, 22 Mar. 2002, *Merino & al. 1242* (LOJA); Parque Nacional Podocarpus, Cerro Toledo, 20 km from Yangana, 4º20'S, 79º6'W, 20 Apr. 1992, *Luteyn & Romoleroux 14515* (C, NY); Parque Nacional Podocarpus, Cerro Toledo, 20 km from Yangana, 4º20'S, 79º6'W, 20 Apr. 1992, *Luteyn & Romoleroux 14516* (C, NY, QCA); road from Yangana to Cerro Toledo km 18-22 to the antennas, 4º22'S, 79º6'W, 3 Nov. 2000, *Jørgensen & al. 2206* (MA); Parque Nacional Podocarpus, Cerro Toledo, pr. Yangana, 4º23'S, 79º6'W, 26 July 2006, *Aedo, Gutiérrez & C. Ulloa 13190* (MA); Parque Nacional Podocarpus, Cerro Toledo, pr. Yangana, 4º23'S, 79º6'W, 26 July 2006, *Aedo, Gutiérrez & C. Ulloa 13192* (MA); Yangana-Valladolid, track to Sierra Toledo, km 16, 4º23'S, 79º6'W, 14 Nov. 1997, *Lewis & Klitgaard 3717* (AAU); Yangana-Valladolid, km 1.1, track to Sierra Toledo, km 16, 4º23'S, 79º6'W, 14 Nov. 1997, *Lewis & Klitgaard 3723* (MA, AAU, QCA); Yangana-Valladolid, km 1.1, track to Sierra Toledo, km 18.7, c. km 1 from military station, 4º23'S, 79º6'W, 14 Nov. 1997, *Lewis & Klitgaard 3723B* (MA, QCA); Parque Nacional Podocarpus, Cerro Toledo, 4º23'S, 79º7'W, 1 Dec. 1988, *Madsen & al. 75657* (AAU, QCA); Parque Nacional Podocarpus, Cerro Toledo, 4º23'S, 79º20'W, 21 July 1989, *Madsen & al. 86095* (AAU); Parque Nacional Podocarpus, Páramo de Cerro Toledo, 4º23'S, 79º7'W, Jan. 1995, *Palacios 12871* (MO); Cerro Toledo, 4º24'S, 79º6'W, 28 Sep. 1999, *Cabrera & al. 503* (LOJA); Parque Nacional Podocarpus, Cerro Toledo, E of Yangana, 4º24'S, 79º6'W, 23 Feb. 1985, Øllgaard *& al. 58033* (AAU); Parque Nacional Podocarpus, Cerro Toledo E of Yangana, 4º24'S, 79º6'W, 26 Feb. 1985, Øllgaard *& al. 58182* (AAU); Cerro Toledo, hacia Numbala Bajo, 4º26'S, 79º6'W, 23 Nov. 2000, *Endara & al. 657* (QCA); Amaluza, 4º42'S, 79º35'W, 8 Aug. 1999, *Smeets & Wijingaarden 650* (QCA). Morona-Santiago: Páramo de Matanga, km 36 on road Sigsig-Gualaquiza, 3º11'S, 78º47'W, 14 Dec. 1980, *Holm-Nielsen & al. 29389* (AAU); Páramo de Matanga, km 36 on road Sigsig-Gualaquiza, 3º11'S,

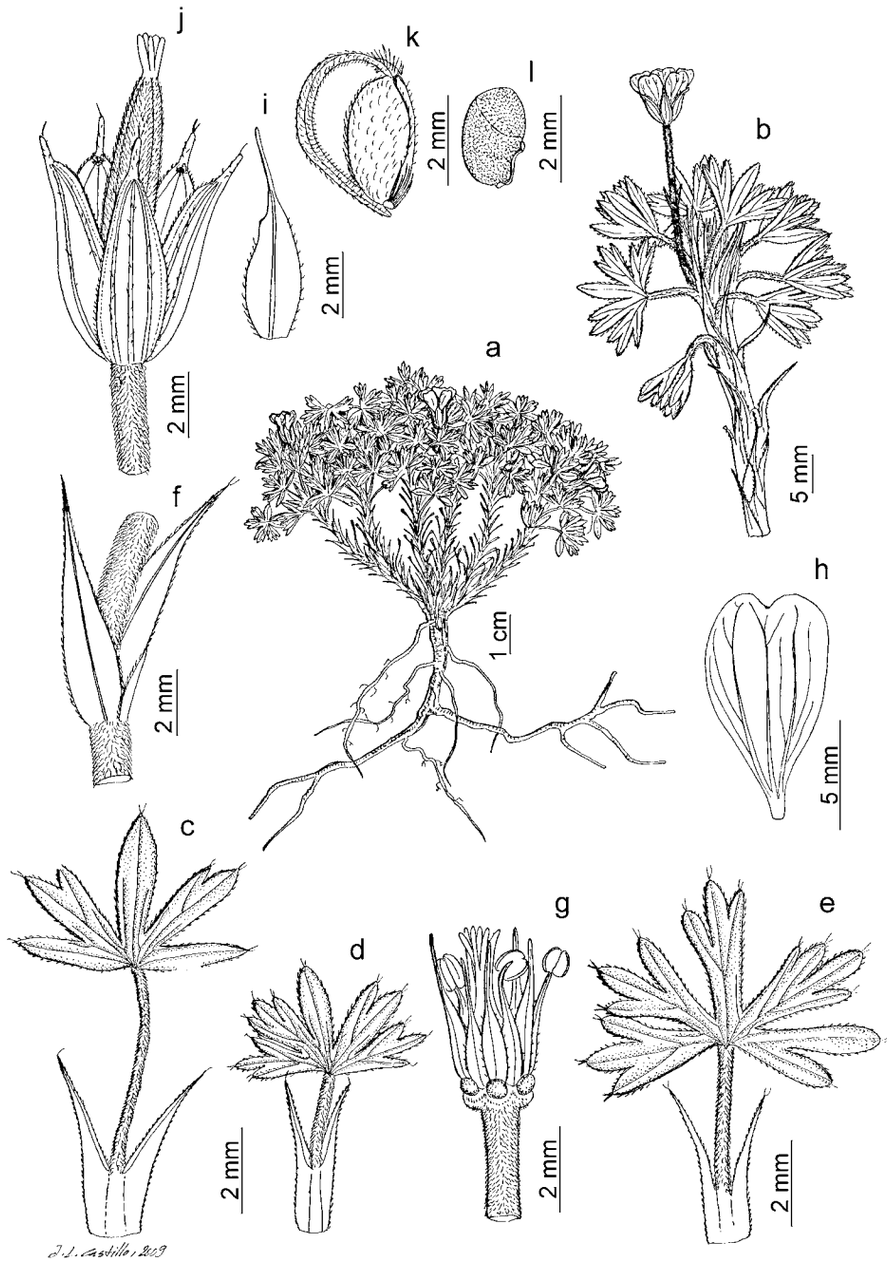


Fig. 422. *Geranium loxense*. a. Habit. b. Branch. c-e. Leaves. f. Bracteoles. g. Flower, sepals and petals removed. h. Petal. i. Staminal filament. j. Fruit. k. Mericarp. l. Seed. (Based on: a, b, d-l, *Aedo & al. 13190*, MA; c, *Lewis & Klitgaard 3723*, MA).

Fig. 423. *Geranium loxense* (Based on: *Aedo & Ulloa 13190*, MA).

Fig. 424. Distribution of *Geranium loxense*.

78°47'W, 14 Dec. 1980, *Holm-Nielsen & al. 29430* (AAU). **Peru.** Cajamarca: Sallique, El Páramo, Huacabrava, 5°40'S, 79°19'W, 22 July 1998, *Campos & al. 5329* (MA, MO).

Discussion. Geranium loxense is a dwarf shrub with an erect main stem (usually hidden by mosses) that is branched towards the middle. The branches and usually the main stem are covered by old stipules. *Geranium loxense* is also well characterized by its purplish petals and reflexed fruits. Herbarium specimens of *G. loxense* can be confused with *G. sibbaldioides* subsp. *beckianum*, which is a prostrate herb that usually forms a lax cushion; the short vegetative stems are also covered by old stipules. *Geranium sibbaldioides* subsp. *beckianum* usually has white flowers and erect fruits. *Geranium loxense* also differs in some quantitative characters but with some overlap: stipules with a longer setaceous apex, shorter pedicels, and longer sepal mucros, petals, and seeds. It is noteworthy that the two taxa are sympatric, but no intermediate forms have been recorded.

The leaves of *G. loxense* are usually glabrous, except on the margin. In some specimens from the Cerro Toledo (Loja) the leaves bear hairs on the nerves or only abaxially; yet, the leaves of the holotype and other collections from the same area are glabrous. The middle segment usually has three lobes, although leaves with 1-2(4) lobes are occasionally found. *Geranium loxense* was overlooked in Aedo & al. (2002), and some specimens listed were misidentified as *G. sibbaldioides* subsp. *beckianum*.

167. Geranium alonsoi Aedo, J. Torrey Bot. Soc. 134: 534, 536 fig. 1. 2007. Type locality: "Colombia. Cundinamarca, Villapinzón, de Villapinzón a Umbita, 21 May 1998, Fernández Alonso et al. 15573 (holotype, MA-641407; isotypes, COL! HUA!)". Type: Colombia. Cundinamarca, Villapinzón, de Villapinzón a Umbita, 5°13'N, 73°31'W, 21 May 1998, *J.L. Fernández Alonso & al. 15573* (holotype, MA-641407!; isotypes, COL!, HUA!).

Perennial herbs, 20-69 cm tall. *Rootstock* 0.9-2.7 mm in diameter, ± vertical, not tuberculate, not turnip-shaped, without thickened roots. *Stem* scapiform, cushion-like, stolons absent, with vegetative stems. *Basal leaves* in a persistent rosette; leaf laminas 0.9-2.1 cm long, 1.3-2.3 cm wide, not peltate, palmatifid [ratio main-sinus length/middle segment length = 0.80-0.94], polygonal in outline, base cordate, not coriaceous, with nerves not projected, glabrous on both surfaces (sometimes ± hairy on abaxial surface), with antrorse, eglandular cilia 0.1-0.2 mm long on the

margin, each segment ending in 1-3 bristles 0.3-0.8 mm long; segments 5, in 1 plane, middle segment lanceolate, sometimes obtriangular (with lanceolate lobes), 0.7-1.2 mm wide at the base [ratio segment width at the base/middle segment length = 0.08-0.13], 1(3)-lobed at the apex [ratio secondary sinus length/middle segment length = 0.46-0.58]; petioles up to 2.7 cm long, without abscission zone, terete, not swollen, not deflexed in age, with retrorse, appressed, eglandular hairs 0.1-0.4 mm long; stipules 7.5-11.7 mm long, 1.1-2.5 mm wide, lanceolate (with a setaceous apex 2.8-4.3 mm long), free, papery, brownish red, with eglandular hairs on abaxial surface and on the margin, glabrous adaxially (ending in 1-3 bristles 0.4-0.8 mm long). *Cymules* 1-flowered, solitary [ratio cymule length/leaf length = (1.9)2.6-4.2]; peduncles 11-34.9 mm long, with retrorse, appressed, eglandular hairs 0.1-0.4 mm long; bracteoles 5-9.2 mm long, 0.7-1.2 mm wide, linear-lanceolate, opposite; pedicels 21-80 mm long, with retrorse, appressed, eglandular hairs 0.1-0.4 mm long. Flowers actinomorphic. *Sepals* 5-8.3 mm long, 1.9-2.8 mm wide, lanceolate, smooth, not accrescent, nerves 3, mucro 0.4-1.2 mm long [ratio mucro length/sepal length = 0.07-0.17], with scattered, erect-patent, eglandular hairs 0.4-1.2 mm long on base of abaxial surface and margin, minutely hairy adaxially, ending in 1-3 bristles 0.4-0.8 mm long. *Petals* 7.6-14.1 mm long, 3.4-7.3 mm wide, erect-patent, rounded, without claw, purple, hairy on both surfaces, mainly on the base of the adaxial surface, ciliate on the basal margin, with hairs 0.2-0.3 mm long. *Stamens* 10, both whorls bearing anthers; filaments 2.8-4 mm long, lanceolate, yellow, glabrous, or with few eglandular hairs 0.2-0.4 mm long on the abaxial surface and margin; anthers 0.8-1.1 mm long, yellow. Nectaries 5, hemispheric, glabrous. *Gynoecium* 3.8-6.1 mm long, yellow. *Fruit* 10.6-14.8 mm long, erect, discharge of seed-ejection type; mericarps 2.2-3.3 mm long, 1.2-1.7 mm wide, without a strand of fibers, not compressed at the apex, smooth, without basal beak, with a basal callus, without a basal prong, brown, with antrorse, ± appressed, eglandular hairs 0.1-0.3 mm long; rostrum 6.4-9.4 mm long, without a narrowed apex, not twisted, with erect-patent, eglandular hairs 0.2-0.3 mm long; stigmatic remnants 1.2-2.1 mm long, with 5 glabrous lobes. *Seeds* 1.5-2 mm long, 0.9-1.3 mm wide, finely reticulate, uniformly colored, brown, glabrous. Cotyledons with entire margin. Fig. 425.

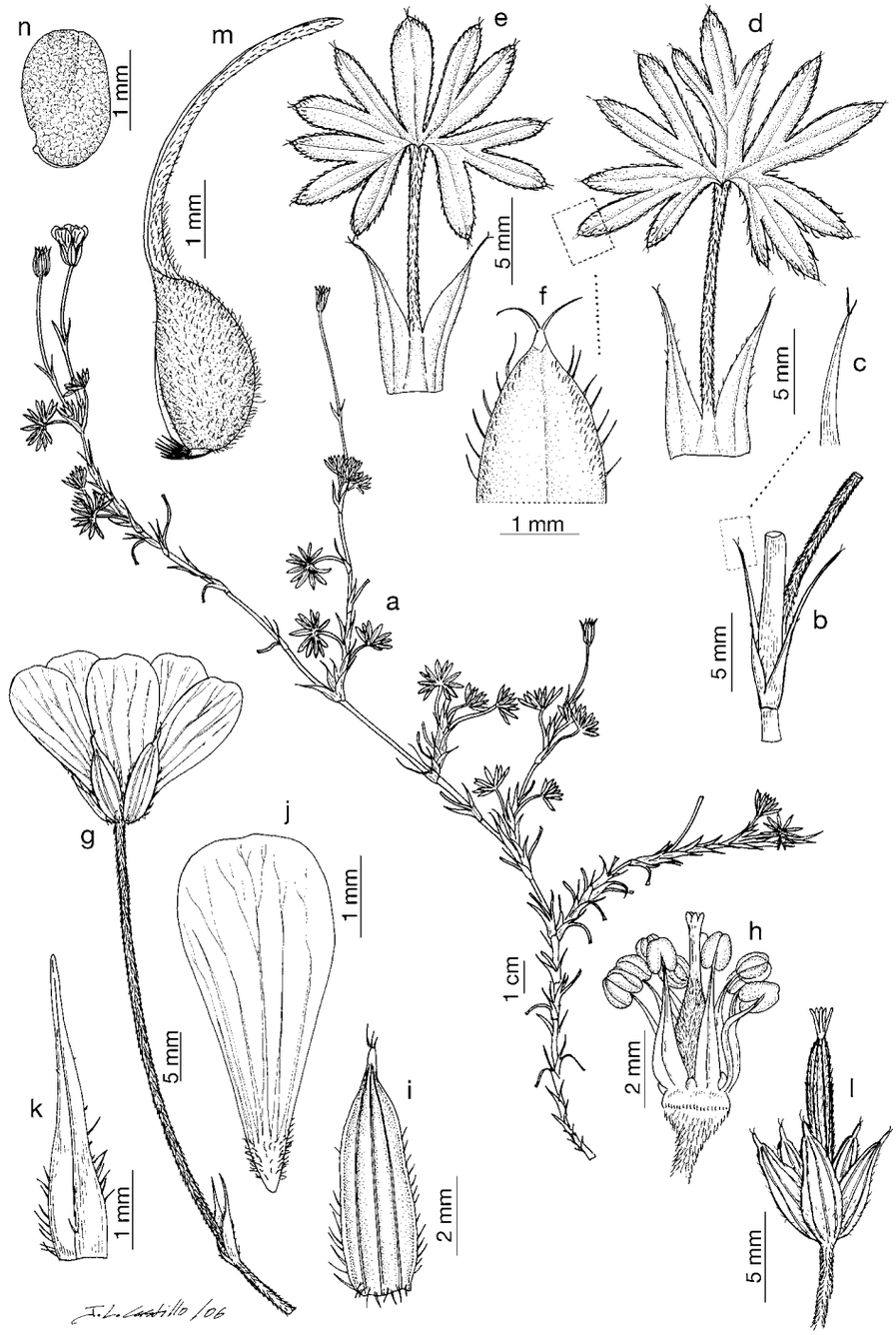


Fig. 425. *Geranium alonsoi*. a. Habit. b. Stipules. c. Stipule apex. d, e. Leaves. f. Leaf lobe apex. g. Cymule. h. Flower, sepals and petals removed. i. Sepal. j. Petal. k. Staminal filament. l. Fruit. m. Mericarp. n. Seed. (Based on: a-c, e-f, *Langenheim 3519*, MICH; d, j, *Barclay 7582*, COL; g-i, k-l, *Bejarano 208*, COL; m, n, *Fernández Alonso & al. 15557*, MA).

Pollen. Ornamentation not studied.

Chromosome number. Unknown.

Phenology. Collected in flower from January to December.

Distribution. This species ranges through central Colombia (Boyacá and Cundinamarca) (Fig. 426).

Habitat. Mossy and wet sites along water courses and in boggy areas dominated by *Polylepis* Ruiz & Pav. and *Espeletia* Mutis ex Bonpl.; 2800-3700 m.

Additional specimens examined. **Colombia.** Boyacá: municipio de Aquitania, vereda Suse, sector above the road between Suse and Sisvaca, km 2, 5º27'N, 72º56'W, 13 Jan. 1999, *Stancik 1934* (PRC); Páramo de Bijagual, 5º28'N, 73º11'W, 16 Oct. 1963, *Espinal & Montenegro 1375* (COL); Toca, vereda La Colorada, Páramo de Santo Ecce Homo, 5º34'N, 73º12'W, 24 Apr. 1982, *Bejarano 208* (COL, MICH); Villa de Leyva, Santuario de Fauna y Flora de Iguaque, de Las Cabañas a la laguna, 5º37'N, 73º33'W, 13 Dec. 2002, *Fernández Alonso & al. 20112* (COL); Villa de Leyva, Santuario de Iguaque, 5º37'N, 73º33'W, 20 July 1979, *Melampy 242* (COL); Villa de Leyva, 5º37'N, 73º33'W, 20 July 1979, *Melampy 244* (MO); Villa de Leyva, Santuario de Fauna y Flora de Iguaque, 5º37'N, 73º33'W, *Piragua & al. 28* (COL); Duitama, Páramo de La Rusia, 5º40'N, 73º5'W, 14 May 1982, *Arrieta & Castillo 82* (COL); Páramo Ruso, 5º40'N, 73º5'W, 12 July 1968, *Barkley 38C148* (GH, MICH); quebrada de Becerra, NW de Duitama, 5º40'N, 73º5'W, 4 Aug. 1940, *Cuatrecasas 10391* (COL, F); Páramo de la Rusia near La Osera, station 83 along road between Duitama and Charalá, 5º40'N, 73º5'W, 20 Aug. 1953, *Langenheim 3519* (COL, MICH); Duitama, vereda el Carmen, Páramo de la Rusia, 5º40'N, 73º5'W, 14 May 1982, *Rodríguez & Rojas 47* (COL, MO); Gambita, vereda el Carmen, Páramo de la Rusia, 5º40'N, 73º5'W, 14 May 1982, *Valbuena & Harker 50* (COL); Tunja, laguna de Iguaque, 5º41'N, 73º26'W, 9 June 2001, *Madriñán 2103* (COL); Páramo de Monguí, Laguna Colorada, 5º43'N, 72º50'W, 1 Sep. 1998, *Calleja & al. 202* (COL, MA); upper río Surba, 15 NW of Duitama, 5º55'N, 73º7'W, 7 May 1944, *Fosberg 21901* (NY, P); Santa Rosa de Viterbo, subida al Páramo del Consuelo y Pan de Azucar, 5º56'N, 73º3'W, 28 Mar. 2009, *Fernández Alonso 27742* (MA); Tutasa, km 10 of the road to El Páramo, 6º2'N, 72º51'W, 23 Feb. 1999, *Stancik & Medina 2430* (COL, PRC); Páramo de Güina entre Belén y Susacón, 6º10'N, 72º46'W, 6 May 1959, *Barclay 7582* (COL); Páramo de Güina entre Belén y Susacón, 6º10'N, 72º49'W, 7 May 1959, *Barclay & Juajibioy 7630* (COL, MO); Páramo de Güina, 6º10'N, 72º50'W, 2 Oct. 1986, *Rangel & al. 4069* (COL, MA). Cundinamarca: Villapinzón, 5º13'N, 73º31'W, May 1998, *Cortés & Sandra 1608* (COL); Villapinzón a Umbita, 5º13'N, 73º31'W, 21 May 1998, *Fernández Alonso & al. 15557* (COL, MA); Villapinzón a Umbita, 5º13'N, 73º31'W, 21 May 1998, *Fernández Alonso & al. 15565* (COL, MA).

Fig. 426. Distribution of *Geranium alonsoi*.

Discussion. Geranium alonsoi is an endemic of central Colombia. Among the species of *Geranium* that grow in the Colombian paramos, it resembles most closely *G. sibbaldioides* subsp. *elongatum*, from which it is easily differentiated by its longer cymules, which exceed adjacent leaves. Cymules of *G. alonsoi* have a well-developed peduncle, a pair of bracteoles, and a pedicel, whereas in *G. sibbaldioides* subsp. *elongatum* the cymules have only a short peduncle. Additionally, leaves of *G. alonsoi* are glabrous or have scattered hairs abaxially and on the margin, and are less deeply divided than those of *G. sibbaldioides* subsp. *elongatum*, which has abundant hairs at least abaxially. The fruits of *G. alonsoi* are shorter than those of *G. sibbaldioides* subsp. *elongatum*. *Geranium costaricense* also resembles *G. alonsoi*; however, the differences between them becomes apparent on closer inspection. In *G. costaricense* the leaf segments are 3-9-lobed at the apex and not deeply divided, the cymules are short (ratio cymule length/leaf length = 0.4-1.4), and the rostrum has a narrowed apex. In contrast, *G. alonsoi* has the leaf segments 1(3)-lobed at the apex and deeply divided, the cymules are long [ratio cymule length/leaf length = (1.9)2.6-4.2], and the rostrum lacks a narrowed apex. In addition, the geographical ranges of *G. costaricense* and *G. alonsoi* do not overlap; *G. costaricense* is endemic to Costa Rica and Panama.

168. Geranium costaricense H.E. Moore, Gentes Herb. 8(3): 253. 1951. *Geranium cucullatum* var. *multifidum* Suess., Bot. Jahrb. Syst. 72: 276. 1942. Type locality: "Chirripógrande 3450 m; 27.IV.32, Nr. 1298". Type: Costa Rica. Limón, Chirripó Grande, 9°30'N, 83°30'W, 27 Apr. 1932, *W. Kupper 1298* (lectotype, designated by Moore 1951: 253, M!).

Perennial herbs, 4-14 cm tall. *Rootstock* 4-11 mm in diameter, ± vertical, not tuberculate, not turnip-shaped, without thickened roots. *Stem* scapiform, cushion-like, stolons absent, with long vegetative stems. *Basal leaves* in a persistent rosette; leaf laminas (1.5)1.9-2.8 cm long, (1.7)1.9-2.8 cm wide, not peltate, palmatifid [ratio main-sinus length/middle segment length = 0.75-0.88], polygonal in outline, base cordate, not coriaceous, with nerves not projected, glabrous on both surfaces (rarely with scattered appressed, eglandular hairs on both surfaces), with antrorse, eglandular cilia 0.1-0.2 mm long on the margin, each segment ending in 1-3 bristles 0.3-0.5 mm long; segments 5(7), in 1 plane, middle segment obtriangular to rhombic (with linear-lanceolate lobes), 0.9-2 mm wide at the base [ratio segment width at the base/middle segment length = 0.07-0.11], 3-9-lobed in distal half [ratio secondary sinus length/middle segment

length = 0.33-0.53]; petioles up to 9 cm long, without abscission zone, terete, not swollen, not deflexed in age, with retrorse, appressed, eglandular hairs 0.1-0.7 mm long; stipules 7.7-19 mm long, 1.2-3 mm wide, lanceolate, free, papery, brownish red, with eglandular hairs on abaxial surface and on the margin, glabrous adaxially (ending in 1-3 bristles 0.3-0.6 mm long). *Cymules* 1-flowered, solitary [ratio cymule length/leaf length = 0.4-1.4]; peduncles 8-53 mm long, with retrorse, appressed, eglandular hairs 0.2-0.4 mm long; bracteoles 5.5-9 mm long, 1-1.7 mm wide, lanceolate, opposite; pedicels 11-64 mm long, with retrorse, appressed, eglandular hairs 0.2-0.5 mm long. Flowers actinomorphic. *Sepals* 5.5-7.4 mm long, 2-3.6 mm wide, lanceolate, smooth, not accrescent, nerves 3-5, mucro 0.4-1.3 mm long [ratio mucro length/sepal length = 0.05-0.17], with scattered, erect-patent, eglandular hairs 0.2-0.6 mm long on base of abaxial surface and margin, usually glabrous adaxially, ending in 1-3 bristles 0.4-0.6 mm long. *Petals* 8.2-14 mm long, 3.4-8.1 mm wide, erect-patent, rounded, without claw, white, sometimes purple, glabrous on both surfaces, sometimes hairy on the base of the abaxial surface, ciliate on the basal margin, with hairs 0.3-0.4 mm long. *Stamens* 10, both whorls bearing anthers; filaments 3.4-5 mm long, lanceolate, yellow, with eglandular hairs 0.2-0.6 mm long on the abaxial surface and margin; anthers 0.8-1.2 mm long, yellow. Nectaries 5, hemispheric, glabrous. *Gynoecium* 4.2-6.5 mm long, purple. *Fruit* 12-14.5 mm long, erect, discharge of seed-ejection type; mericarps 2.5-3 mm long, 1.2-1.3 mm wide, without a strand of fibers, not compressed at the apex, smooth, without basal beak, with a basal callus, without a basal prong, brown, with antrorse, ± appressed, eglandular hairs 0.2-0.4 mm long; rostrum 9-9.5 mm long, with a narrowed apex 0.5-1 mm long, not twisted, with erect-patent, eglandular hairs 0.1 mm long; stigmatic remnants 1.5-2 mm long, with 5 glabrous lobes. *Seeds* 1.9-2.1 mm long, 0.9-1.2 mm wide, finely reticulate, uniformly colored, brown, glabrous. Cotyledons with entire margin. Fig. 427.

Pollen. *Geranium*-type (Aedo & al. 2002: 217).

Chromosome number. Unknown.

Phenology. Collected in flower from January to August.

Distribution. This species ranges from central and eastern Costa Rica to western Panama (Fig. 428).

Habitat. Low boggy depressions with *Blechnum* L., *Isoetes* L., and *Sphagnum* L., and *Puya* Molina bogs in open forests; 2250-3450 m.

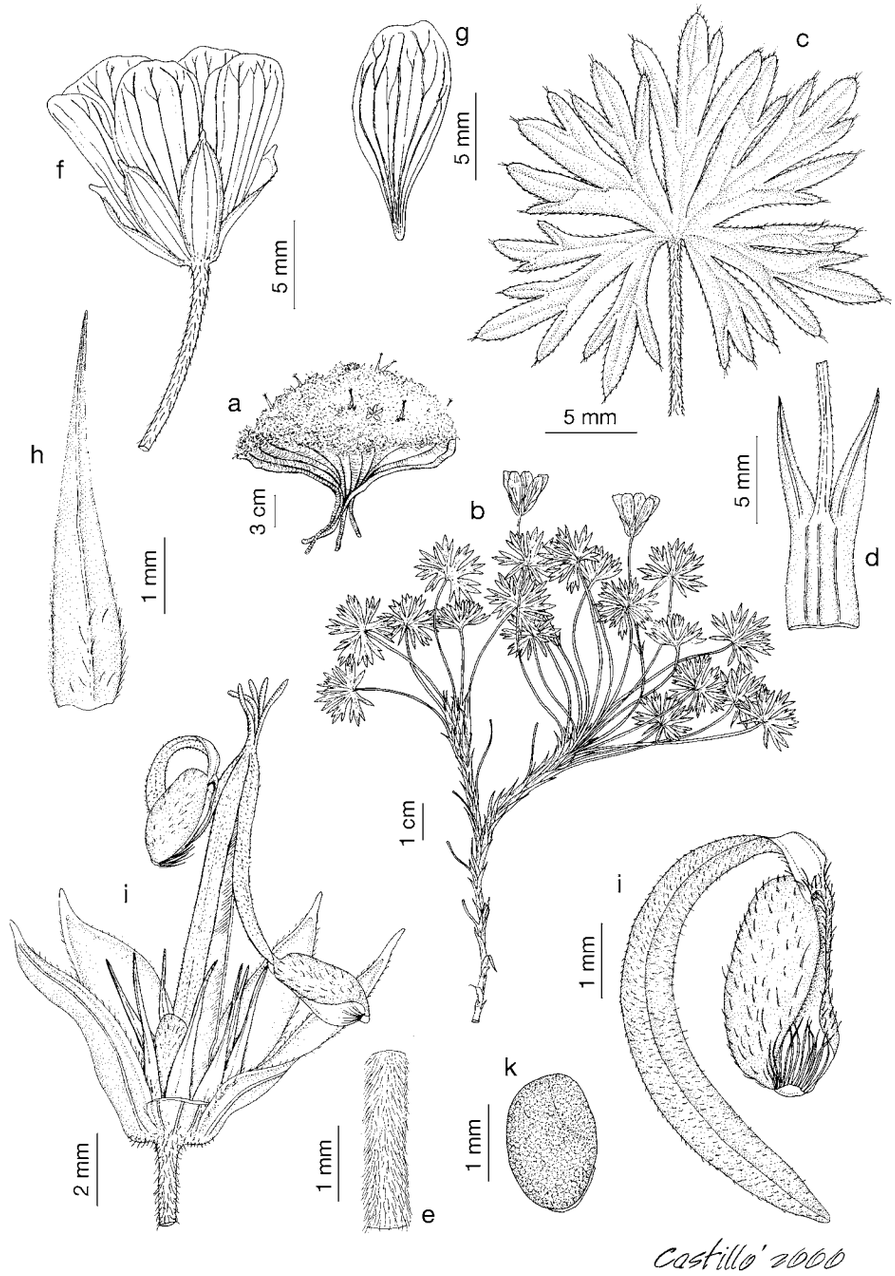


Fig. 427. *Geranium costaricense*. a. Habit. b. Flowering branch. c. Leaf. d. Stipules. e. Peduncle. f. Flower. g. Petal. h. Staminal filament. i. Fruit. j. Mericarp. k. Seed. (Based on: a, b, f-h, *Almeda & Nakai 4763*, CAL; c-e, i-k, *Wilbur 20321*, DUKE).

Additional specimens examined. **Costa Rica.** Cartago: Paraíso, R.F. Los Santos, cuenca del Savegre, cerro de la Muerte, antiguo sendero de la Muerte, 9°33'N, 83°44'W, 7 July 2000, *Morales 7306* (MA); at km 73 Interamerican Highway, 9°36'N, 83°46'W, 22 July 1966, *Davidse & Pohl 687* (MEXU); along the Cartago-San José line beside the Pan American Highway about 24 km W of Villa Mills at km 73, 9°36'N, 83°46'W, 28 Mar. 1967, *Wilbur & Stone 8801* (DUKE); near Ojo de Agua, Cordillera de Talamanca, 9°37'N, 83°48'W, 26 Jan. 1965, *Williams & al. 28290* (DUKE, NY); near El Trinidad and km 72 along the Interamerican Highway, about 20 km SE from El Empalme, 9°40'N, 83°53'W, 25 May 1968, *Burger & Stolze 5265* (BM); 19.8 km SW of El Empalme, 9°40'N, 83°53'W, 20 Aug. 1968, *Weaver 1410* (DUKE); steep slopes along the Carretera Interamericana about 18 km SE of El Empalme, 9°40'N, 83°51'W, 8 June 1972, *Wilbur 17524* (DUKE); about 18 km SE of El Empalme on the Interamerican Highway, 9°40'N, 83°51'W, 12 July 1976, *Wilbur 20321* (DUKE). Cartago-San José: Cordillera de Talamanca, about 19 km S of El Empalme, 9°40'N, 83°53'W, 6 Mar. 1981, *Almeda & Nakai 4763* (CAS). Limón: Talamanca, Parque Nacional La Amistad, Tararia, Bratsi, valle del Silencio, 9°6'N, 82°58'W, 26 June 2003, *Alfaro 4702* (MA); cantón de Talamanca, Parque Nacional Chirripó, cordillera de Talamanca, estación Crestones, sendero al valle de los Conejos, 9°27'N, 83°29'W, 24 Jan. 1996, *Aguilar & Morales 4458* (INB); Chirripó National Park, around hut at valle de los Lagos, 9°29'N, 83°27'W, 15 Feb. 1983, *Garwood & al. 1275* (BM). Limón-Punta Arenas: Cordillera de Talamanca, Cerro Kasir, 9°12'N, 83°3'W, 20 Sep. 1984, *Davidse & Herrera 29409* (BM). San José: cantón de Pérez Zeledón, Parque Nacional Chirripo, cuenca Terraba-Sierpe, valle de los Conejos, 9°27'N, 83°29'W, 17 July 1998, *Alfaro 1719* (INB); cantón de Pérez Zeledón, Parque Nacional Chirripo, cuenca Terraba-Sierpe, 9°27'N, 83°30'W, 7 Feb. 2000, *Alfaro & al. 2163* (INB); bog '3 de junio' near Pan American Highway, Talamanca Range, 9°30'N, 83°42'W, 25 Feb. 1965, *Lent 404* (NY); cantón de Pérez Zeledón, near town San Gerardo, Páramo of Cerro de la Muerte, 9°33'N, 83°45'W, 21 July 2004, *Moran & al. 7381* (NY); Cerro de la Muerte, 73 km from San José on the Pan American Highway, 9°34'N, 83°45'W, 22 July 1966, *Anderson & Mori 224* (CAS). **Panama.** Bocas del Toro: Valle de Silencio, 9°10'N, 82°50'W, 8 Aug. 1979, *Antonio 1560* (BM).

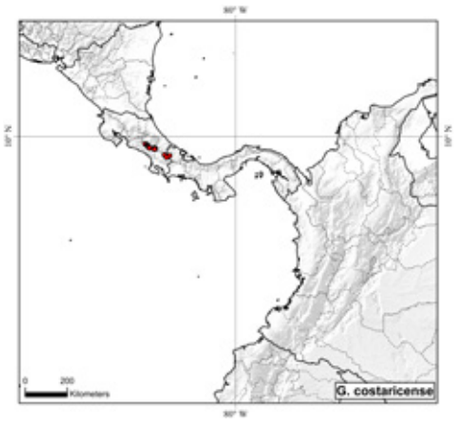


Fig. 428. Distribution of *Geranium costaricense*.

Discussion. Geranium costaricense has been considered closely allied with *G. sibbaldioides* (Burger, 1991: 18; Moore 1951: 253), a stemless species from Andes that is readily distinguished by its leaves. *Geranium sibbaldioides* has leaf laminas 0.4-1.3 cm long (1.5-2.8 cm long in *G. costaricense*), with a middle segment 1-3(4)-lobed at apex (3-9-lobed in *G. costaricense*). The nearest populations of *G. sibbaldioides* to those of *G. costaricense* are in northern Colombia, separated by more than 800 km. In this area *G. sibbaldioides* is represented by subsp. *elongatum*, which has hairy leaves (at least adaxially), while *G. costaricense* has glabrous leaves, except on the margins. *Geranium costaricense* is also similar to *G. foreroi* and *G. paludosum*, both restricted to northern Colombia. *Geranium costaricense* has much larger and more deeply divided leaves than *G. foreroi* and *G. paludosum*, and also a distinctive fruit feature: a rostrum with a narrowed apex 0.5-1 mm long, which is absent in the fruits of *G. foreroi* and *G. paludosum.*

169. Geranium campii H.E. Moore, Brittonia 15: 92, 93 fig. 1. 1963. Type locality: "ECUADOR: Azuay: Páramo and sub-páramo area north and northwest of the Páramo del Castillo (ca. 6-8 km n n e of Sevilla de Oro); alt. 10000-11200 ft, 31 Aug 1945 W. H. Camp E-5138 (Holotype, NY; isotype, BH)". Type: Ecuador. Azuay, Páramo del Castillo, 2°48'S, 78°37'W, 31 Aug. 1945, *W.H. Camp E-5138* (holotype, NY-00468263!; isotype, BH!).

Perennial herbs, 2-9 cm tall. *Rootstock* 2-6.8 mm in diameter, vertical, not tuberculate, not turnip-shaped, without thickened roots. *Stem* scapiform, cushion-like, stolons absent, with short vegetative stems. *Basal leaves* in a persistent rosette; leaf laminas 0.35-1 cm long, 0.62-1.6 cm wide, not peltate, deeply palmatifid, tripartite [ratio main-sinus length/middle segment length = 0.86-0.92], triangular in outline, base rounded, not coriaceous, with nerves not projected, densely hairy on adaxial surface and usually on abaxial surface; segments 3(5), in 1 plane, middle segment broadly lanceolate, 0.5-1.4 mm wide at the base [ratio segment width at the base/middle segment length = 0.09-0.16], entire; petioles up to 4 cm long, without abscission zone, terete, not swollen, not deflexed in age, with patent (sometimes retrorse, appressed), eglandular hairs 0.2-0.5 mm long; stipules 5.6-10 mm long, 0.9-2 mm wide, lanceolate, free, papery, brownish red, with eglandular hairs on abaxial surface and on the margin, glabrous adaxially (ending in 1-3 bristles 0.2-0.4 mm long). *Cymules* 1-flowered, solitary [ratio cymule length/leaf length = 0.7-1.1]; peduncles 4-11 mm long, with patent, eglandular hairs 0.2-0.4 mm long; bracteoles 4-7 mm long, 0.5-1 mm wide, linear-lanceolate, opposite; pedicels absent or 7-30 mm long, with patent, eglandular hairs 0.2-0.5 mm long. Flowers actinomorphic. *Sepals* 4.3-5.6 mm long, 1.5-2.8 mm wide, lanceolate, smooth, not accrescent, nerves 3, mucro 0.4-0.8 mm long [ratio mucro length/sepal length = 0.16-0.20], with erect-patent, eglandular hairs 0.1-0.5 mm long on base of abaxial surface and margin, glabrous adaxially, ending in 1-3 bristles 0.2-0.6 mm long.

Petals 6-9 mm long, 2.2-3.5 mm wide, erect-patent, rounded, without claw, purple or white, glabrous.

Stamens 10, both whorls bearing anthers; filaments 2-3.5 mm long, lanceolate, white, glabrous, or with few eglandular hairs 0.1-0.2 mm long on the abaxial surface and margin; anthers 0.5-0.8 mm long, yellow. Nectaries 5, hemispheric, glabrous. *Gynoecium* 2.4-4 mm long, purple. *Fruit* 8.5-11.8 mm long, erect, discharge of seed-ejection type; mericarps 2.1-2.5 mm long, 0.7-1.2 mm wide, without a strand of fibers, not compressed at the apex, smooth, without basal beak, with a basal callus, without a basal prong, brown, with antrorse, ± appressed, eglandular hairs 0.1-0.3 mm long; rostrum 5.2-7 mm long, without a narrowed apex, not twisted, with erect-patent, eglandular hairs 0.1-0.2 mm long; stigmatic remnants 0.8-1.5 mm long, with 5 glabrous lobes. *Seeds* 1.4-1.8 mm long, 0.8-1 mm wide, finely reticulate, uniformly colored, brown, glabrous. Cotyledons with entire margin. Figs. 429, 430.

Pollen. *Geranium*-type (Aedo & al. 2002: 216).

Chromosome number. Unknown.

Phenology. Collected in flower from January to November.

Distribution. This species ranges from southern Ecuador to northern Peru (Fig. 431).

Habitat. Moss cushions, bogs or tussock-grass areas in paramo and upper montane forests; 3000-3850 m.

Additional specimens examined. **Ecuador.** Azuay: Cordillera Oriental, alrededores del Páramo de Patococha, entre Gualacéo y Limón, 3°7'S, 79°6'W, 6 Aug. 1959, *Barclay & Juajibioy 8666* (MO); Nudo de Tinajillas, 32 km S Cuenca, 3°13'S, 79°4'W, 8 Feb. 1945, *Fosberg & Giler 22852* (US); Cordillera de Alpachaca, headwaters of the río Jubones, between the ríos Girón & León, Pan-Amer km 79, 3°21'S, 79°8'W, 29 Aug. 1944, *Camp 399* (NY). Loja: de Jima a San Miguel, 3°13'S, 78°57'W, 18 July 2006, *Aedo, Minga & Ulloa 13049* (MA); Loma de Oro, 10 km al S de Saraguro, 3°40'S, 79°17'W, 24 Sep. 1982, *Balslev & Steere 3217* (NY); Fierro Urco, 10 km S of Saraguro, 3°41'S, 79°17'W, 25 Oct. 1996, *Ellemann 2741* (AAU); road Loja-Cuenca, km 50, track to Fierro Urco km 12, 3°41'S, 79°17'W, 25 Oct. 1996, *Lewis & Lozano 2741* (MA); road Piching-Fierro Urcu, c. km 10, 3°41'S, 79°20'W, 20 Jan. 1990, *Madsen 86766* (AAU); Saraguro, pr. Fierro Urco, 3°42'S, 79°18'W, 28 July 2006, *Aedo 13220* (MA); road Loja-Saraguro km 52, track to Fierro Urco km 6.5, 3°42'S, 79°18'W, 14 Nov. 1996, *Lewis & Lozano 2792* (AAU, MA); Fierro Urco, Saraguro-Loja, km 12.4 turn-off towards Fierro Urco, km 23.8, 3°43'S, 79°19'W, Mar., *Jørgensen & al. 1237* (MO, NY); Chuquiribamba, 3°50'S, 79°20'W, 17 Nov. 1876, *André 4455* (F, GH, K, NY); road Loma del Oro, S of Saraguro, toward Fierro Urcu, c. km 13, 3°57'S, 79°35'W, 12 Mar. 1989, Øllgaard *& al. 90971* (AAU, MO, QCA); Parque Nacional Podocarpus, Cerro Toledo, pr. Yangana, 4°22'S, 79°6'W, 26 July 2006, *Aedo, Gutiérrez & C. Ulloa 13188* (MA); Parque Nacional Podocarpus, road Yangana-Cerro Toledo, at entrance to crest, 4°23'S, 79°6'W, 26 Feb. 1985, Øll-

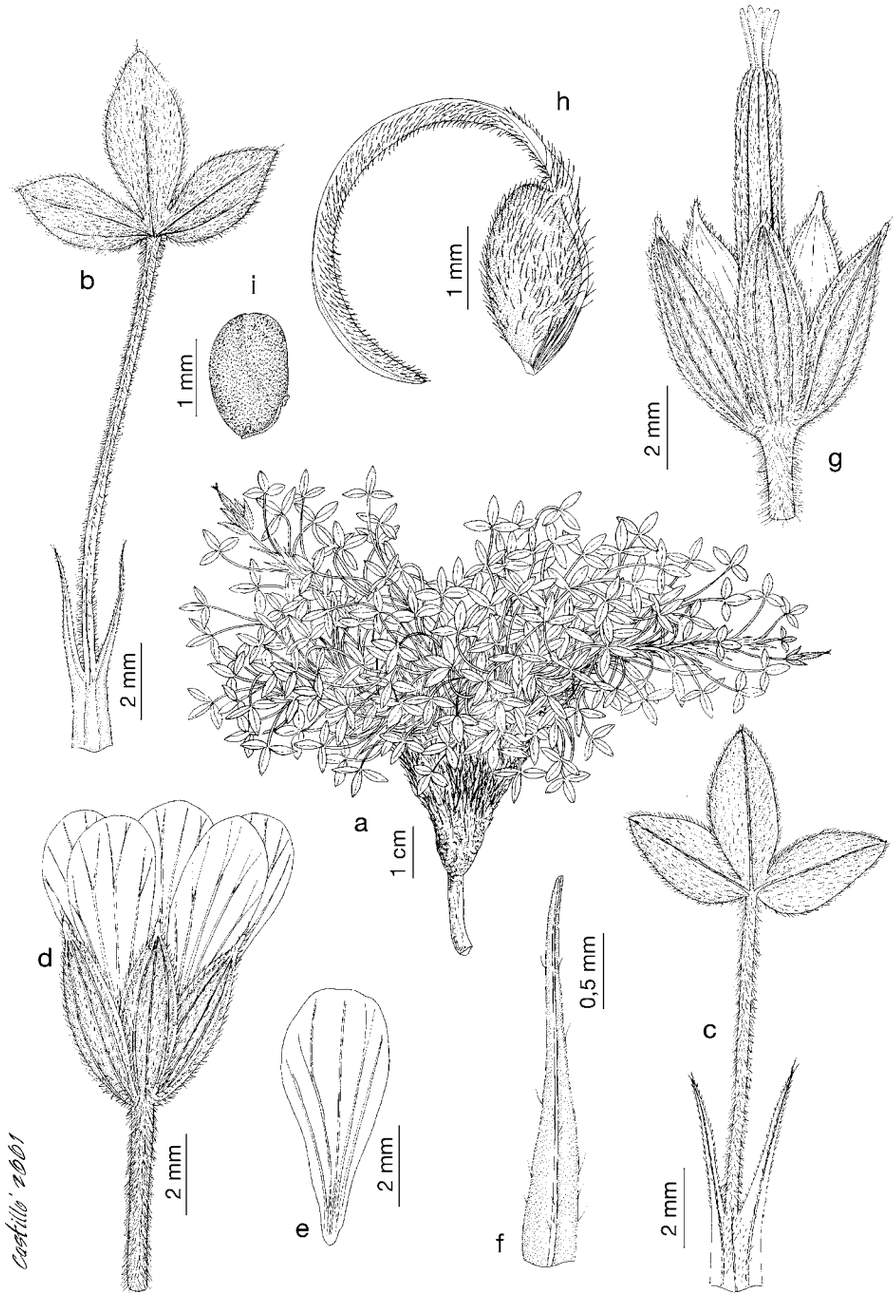


Fig. 429. *Geranium campii*. a. Habit. b. Leaf, adaxial side. c. Leaf, abaxial side. d. Flower. e. Petal. f. Staminal filament. g. Fruit. h. Mericarp. i. Seed. (Based on: a-f, *Øllgaard & al. 90971*, MO; g-i, *André 4455*, GH).

Fig. 430. *Geranium campii* (Based on: a, b, *Aedo & al. 13188,* MA; c, d, *Aedo & al. 13220*, MA).

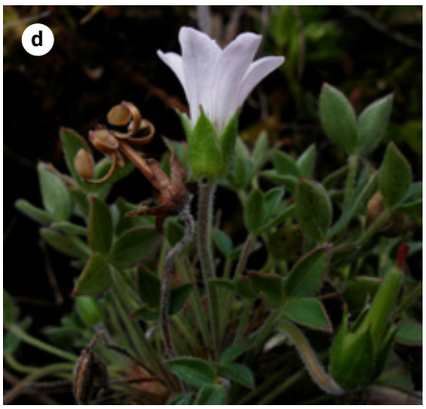


Fig. 431. Distribution of *Geranium campii*.

gaard *& al. 58262* (AAU). **Peru.** Cajamarca: Jaén, cerro arriba de Aguas Verdes, 6°50'S, 77°51'W, 10 Nov. 1999, *Díaz & Campos 10950* (MA, MO).

Discussion. As Moore (1963: 92) pointed out, *G. campii* is similar to *G. sibbaldioides* but differs in the tripartite leaf-blades that are hairy at least adaxially, in the usually patent hairs on petioles and peduncles, and in the hairy sepals. The circumscription of *G. campii* presented in Aedo & al. (2002: 234) is here expanded to include plants with the leaves mainly tripartite and with broadly lanceolate segments. Some specimens have a few leaves with 4(5) segments. Leaf indumentum also varies from densely hairy on both surfaces to hairy only adaxially. *Geranium campii* is endemic to southern Ecuador and northern Peru, where it is sympatric with *G. sibbaldioides* in similar wet habitats in the paramos. Some intermediate specimens with a variable combination of characters, including leaves with five segments and hairy only adaxially, petioles and peduncles with retrorse hairs, and almost glabrous sepals have been collected in this region. These plants cannot be readily assigned to either *G. campii* or *G. sibbaldioides*. Additional collections and a focused field study may help to elucidate this variability, which may be a result of hybridization. During field studies, both species were found growing on the same cushion (*Aedo 13220*: *G. campii*; *Aedo 13221*: *G. sibbaldioides* subsp. *sibbaldioides*) without intermediate forms.

170. Geranium rhomboidale H.E. Moore, Gentes Herb. 8: 255, 256 fig. 103. 1951. Type locality: "Colombia: comisaría del Putumayo; Páramo de San Antonio, entre La Laguna de La Concha y el Valle de Sibundoy, alt. ca. 3000-3200 m., February 13, 1942, R. E. Schultes 3238 (BH. type); alta cuenca del Río Putumayo, filo de la cordillera entre El Encano y Sibundoy; Páramo de San Antonio de Bordoncillo, alt. 3250 m., January 4, 1941, J. Cuatrecasas 11741 (US.); road from Sibundoy to Pasto, between La María and Páramo de San Antonio, alt. 2900-3180 m., June 1, 1946, Schultes & M. Villarreal 7825 (BH.)". Type: Colombia. Putumayo, Páramo de San Antonio, entre La Laguna de La Concha y el Valle de Sibundoy, 1°10'N, 77°00'W, 13 Feb. 1942, *R.E. Schultes 3238* (holotype, BH!; isotypes, GH-00055015!, ILL-00006672 image!).

Perennial herbs, 2-5 cm tall. *Rootstock* 2.4-5 mm in diameter, ± vertical, not tuberculate, not turnip-shaped, without thickened roots. *Stem* scapiform, cushion-like, stolons absent, with short vegetative stems. *Basal leaves* in a persistent rosette; leaf laminas 0.5-0.8(1.2) cm long, 0.5-1(1.6) cm wide, not peltate, digitate (lateral segments upward) [ratio main-sinus length/middle segment length = 0.55-0.75], polygonal to obtriangular in outline, base rounded to cuneate, ± coriaceous, with nerves not projected, glabrous on both surfaces, with patent, eglandular cilia 0.4-0.8 mm long on the margin, each segment ending in 1-2 bristles 0.5-0.8 mm long; segments 3(5), in 1 plane, middle segment obtriangular (with lanceolate lobes), 1.4-2.4 mm wide at the base [ratio segment width at the base/middle segment length = 0.24-0.36], (2)3-lobed at the apex [ratio secondary sinus length/middle segment length = 0.08-0.26]; petioles up to 2.5 cm long, without abscission zone, terete, not swollen, not deflexed in age, with retrorse to retrorse-appressed, eglandular hairs 0.2-0.5 mm long; stipules 5.2-13 mm long, 0.9-1.5 mm wide, lanceolate (with a setaceous apex 0.7-5 mm long), free, papery, brownish red, with eglandular hairs on abaxial surface and on the margin, glabrous adaxially (ending in 1-3 bristles 0.4-0.8 mm long). *Cymules* 1-flowered, solitary [ratio cymule length/leaf length = 0.9-1.4]; peduncles 4-20 mm long, with retrorse to retrorse-appressed, eglandular hairs 0.3-0.6 mm long; bracteoles absent. Flowers actinomorphic. *Sepals* 5.5-8 mm long, 1.5-2.2 mm wide, lanceolate, smooth, not accrescent, nerves 3, mucro 0.3-0.9 mm long [ratio mucro length/sepal length = 0.05-0.16], with erect-patent, eglandular hairs 0.4-1 mm long on margin (sometimes on the base of abaxial surface), glabrous adaxially, ending in 1-2 bristles 0.4-0.6 mm long. *Petals* 8.5-13.6 mm long, 2.2-5.6 mm wide, erect-patent, rounded, without claw, purple, glabrous. *Stamens* 10, both whorls bearing anthers; filaments 2.5-4.1 mm long, lanceolate, yellow, glabrous or with scattered hairs 0.1-0.2 mm long; anthers 0.6-0.7 mm long, yellow. Nectaries 5, hemispheric, glabrous. *Gynoecium* 3-4.1 mm long, yellow. *Fruit* 8-11 mm long, erect, discharge of seed-ejection type; mericarps 1.3-2.2 mm long, 0.8-1.2 mm wide, without a strand of fibers, not compressed at the apex, smooth, without basal beak, with a basal callus, without a basal prong, brown, glabrous or with antrorse, ± appressed, eglandular hairs 0.1-0.2 mm long; rostrum 4.5-8 mm long, without a narrowed apex, not twisted, with erect-patent, eglandular hairs 0.1-0.3 mm long; stigmatic remnants 0.7-1.2 mm long, with 5 glabrous lobes. *Seeds* 1.4-1.5 mm long, 0.8-0.9 mm wide, finely reticulate, uniformly colored, brown, glabrous. Cotyledons with entire margin. Figs. 432, 433.

Pollen. *Geranium*-type (Aedo & al. 2002: 217).

Chromosome number. Unknown.

Phenology. Collected in flower from January to November.

Distribution. This species ranges through central and southwestern Colombia (Figs. 434).

Habitat. Mossy and wet places with *Espeletia* Mutis ex Bonpl. and grassy tussock; 2900-3600 m.

Additional specimens examined. **Colombia.** Cauca: Macizo Colombiano, Páramo de Las Papas, colinas SE de la Laguna La Magdalena, vertiente del Magdalena, 1°55'N, 76°36'W, 12 Sep. 1958, *Idrobo & al. 3277* (COL, MA, P); Macizo Colombiano, Páramo de Las Papas, El Boquerón y alrededores de la Laguna La Magdalena, 1°55'N, 76°36'W, 16 Oct. 1958, *Idrobo & Barclay 4059* (COL); Páramo del Buey, 35 km E de Pasto, 1°59'N, 76°35'W, 5 Nov. 1950, *Espinosa 3090* (NY). Cauca-Huila: Macizo Colombiano, Páramo de Las Papas, colinas SE de la Laguna La Magdalena sobre el Cerro La Carona y El Boquerón, vertiente del Magdalena, 1°55'N, 76°36'W, 8 Sep. 1958, *Idrobo & al. 3099* (COL). Huila: San Agustín, Páramo de Las Papas, Laguna La Magdalena, 1°55'N, 76°36'W, 2 Apr. 1995, *Rubiano & Moreno 462* (COL). Meta: Concepción, Páramo de la Gallina, vereda Juradito, 4°4'N, 73°44'W, 24 Feb. 1999, *Stancik & Medina 2491* (COL). Nariño: Páramo de Quilinsayaco, entre El Encano y Santiago, 1°11'N, 77°3'W, 21 Oct. 1959, *Barclay & Juajibioy 9466* (MO); bei Pasto, 1°12'N, 77°16'W, 1 Nov. 1878, *Lehmann s.n.* (W). Putumayo: Santiago, Páramo del Bordoncillo, 1°7'N, 77°4'W, 12 Dec. 2017, *Buira 3285* (MA); between Lake Cocha and Santiago, 1°10'N, 77°0'W, 3 May 1939, *Alston 8347* (BM, P, S, U, US); carretera entre El Encano y Sibundoy, Páramo El Capuchino, 1°10'N, 77°0'W, 7 Oct. 1965, *García Barriga & al. 18592* (COL); alta cuenca del río Putumayo, filo de la Cordillera entre El Encano y Sibundoy, Páramo de San Antonio del Bordoncillo, 1°11'N, 77°6'W, 4 Jan. 1941, *Cuatrecasas 11741* (COL); Santiago, Vereda San Antonio de Bellavista, Páramo de San Antonio del Bordoncillo, 1°11'N, 77°6'W, 30 Jan. 1993, *Muñoz & Ramírez 171* (COL); Santiago, Vereda San Antonio de Bellavista, Páramo de San Antonio del Bordoncillo, 1°11'N, 77°6'W, 30 Jan. 1993, *Muñoz & Ramírez 256* (COL, MA); road from Sibundoy to Pasto, between La María and Páramo de San Antonio, 1°25'N, 77°7'W, 1 June 1946, *Schultes & Villarreal 7825* (BH, COL, K, US).

Discussion. Geranium rhomboidale is characterized by digitate leaf blades with usually three segments. The lateral segments are directed

upwards and the middle segment is 3-lobed. The leaves are glabrous but have patent long cilia on the margin. As reported by Moore (1951: 257), *G. azorelloides*, *G. jahnii*, and *G. maniculatum* closely resemble *G. rhomboidale* but differ in leaf characters. *Geranium jahnii* has very narrow leaves that are apically tridentate and have an articulated petiole; *G. azorelloides* is quite similar to *G. jahnii* but without an articulated petiole. In *G. maniculatum* the leaves have the middle leaf segment entire and are glabrous or bear short, antrorse hairs.

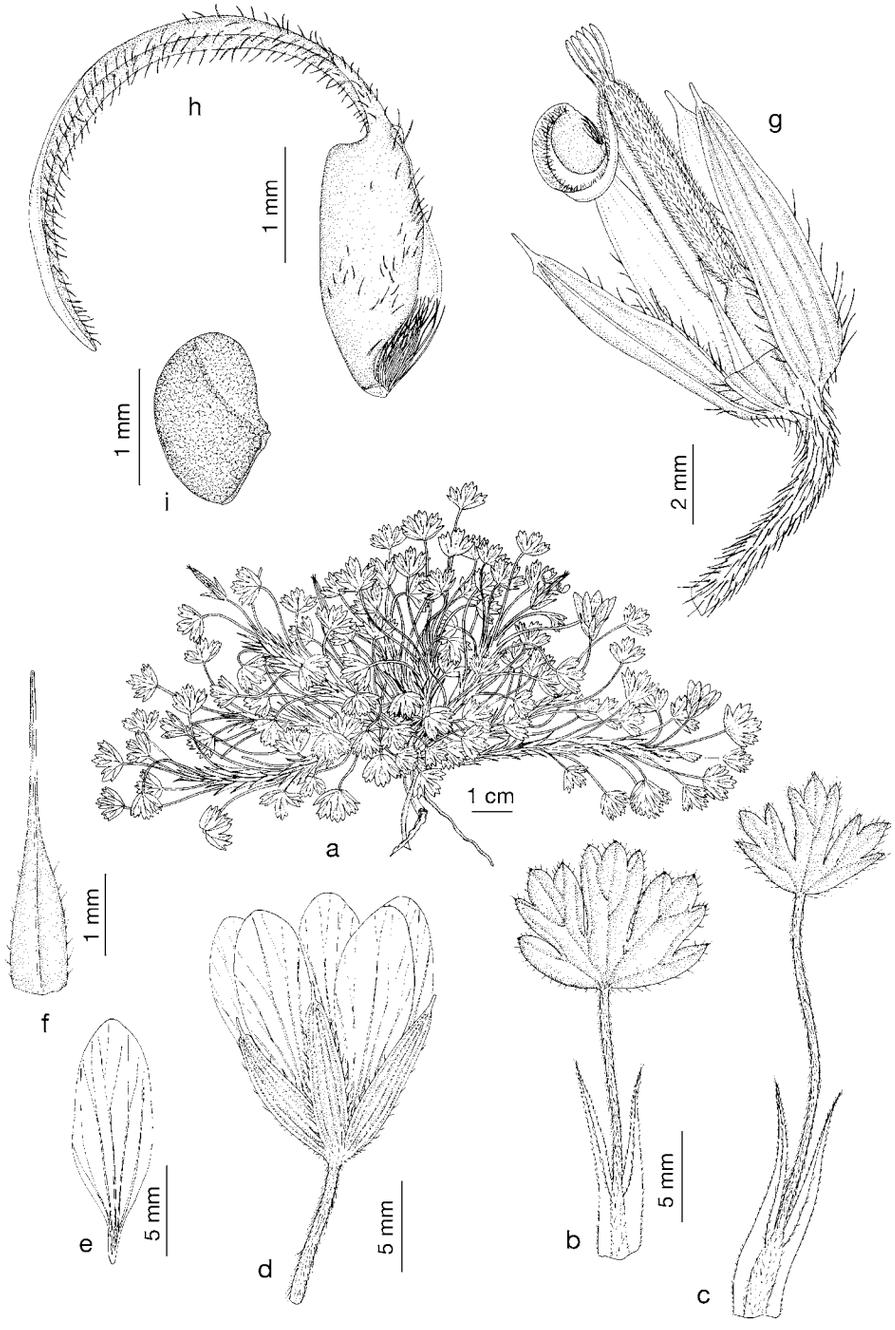


Fig. 432. *Geranium rhomboidale*. a. Habit. b, c. Leaves. d. Flower. e. Petal. f. Staminal filament. g. Fruit. h. Mericarp. i. Seed. (Based on: a, b, *Alston 8347*, S; d-f, *Schultes 3238*, GH; c, g-i, *Schultes & Villarreal 7825*, US).

Fig. 433. *Geranium rhomboidale* (Based on: *Calvo 8073,* CAUP, photo: J. Calvo).

Fig. 434. Distribution of *Geranium rhomboidale*.

171. Geranium maniculatum H.E. Moore, Gentes Herb. 8: 254 fig. 102. 1951. Type locality: "Ecuador: Province Azuay; páramos in the vicinity of Toreador, between Molleturo and Quinoas, alt. 3810-3930 m., June 15, 1943, Steyermark 53159 (BH. type, F. isotype)". Type: Ecuador. Azuay, páramos in the vicinity of Toreador, between Molleturo and Quinoas, 2°45'S, 79°26'W, 15

June 1943, *J.A. Steyermark 53159* (holotype, BH!; isotypes, F-0060431F!, NY!, US-00100903 image!).

Perennial herbs, 2-4 cm tall. *Rootstock* 2-4 mm in diameter, vertical, not tuberculate, not turnip-shaped, without thickened roots. *Stem* scapiform, cushion-like, stolons absent, with short vegetative stems. *Basal leaves* in a persistent rosette; leaf laminas 0.6-1.2 cm long, 0.5-1.6 cm wide, not peltate, digitate (lateral segments upward) [ratio main-sinus length/middle segment length = 0.65-0.85], polygonal to obtriangular in outline, base rounded to cuneate, not coriaceous, with nerves not projected, glabrous on both surfaces, sometimes with antrorse, eglandular cilia 0.1-0.2 mm long on the margin, each segment ending in 1-3 bristles 0.3-0.6 mm long; segments (3)5, in 1 plane, middle segment lanceolate, 0.5-1.7 mm wide at the base [ratio segment width at the base/middle segment length = 0.08-0.16], entire; petioles up to 2.4 cm long, without abscission zone, terete, not swollen, not deflexed in age, with retrorse, appressed, eglandular hairs 0.2-0.4 mm long; stipules 4.7-10 mm long, 0.8-1.5 mm wide, lanceolate, free, papery, brownish red, with eglandular hairs on abaxial surface and on the margin, glabrous adaxially (ending in 1-3 bristles 0.2-0.7 mm long). *Cymules* 1-flowered, solitary [ratio cymule length/leaf length = 0.7-0.9]; peduncles 5-13 mm long, with retrorse, appressed, eglandular hairs 0.3-0.4 mm long; bracteoles absent. Flowers actinomorphic. *Sepals* 4.7-7 mm long, 1.2-2.3 mm wide, lanceolate, smooth, not accrescent, nerves 3, mucro 0.2-0.6 mm long [ratio mucro length/sepal length = 0.09-0.14], glabrous or with scattered, erect-patent, eglandular hairs 0.1-0.3 mm long on base of abaxial surface and margin, glabrous adaxially, ending in 1-3 bristles 0.4-0.7 mm long. *Petals* 6.1-12 mm long, 1.7-3.5 mm wide, erect-patent, rounded, without claw, white to pink, glabrous, sometimes ciliate on the basal margin, with hairs 0.1-0.2 mm long. *Stamens* 10, both whorls bearing anthers; filaments 2.5-4 mm long, lanceolate, white, glabrous, or with few eglandular hairs 0.1-0.3 mm long on the abaxial surface and margin; anthers 0.5-0.7 mm long, yellow. Nectaries 5, hemispheric, glabrous. *Gynoecium* 2.4-4 mm long, yellow. *Fruit* 7.2-9.6 mm long, erect, discharge of seed-ejection type; mericarps 1.7-2.2 mm long, 1-1.1 mm wide, without a strand of fibers, not compressed at the apex, smooth, without basal beak, with a basal callus, without a basal prong, brown, glabrous or with antrorse, ± appressed, eglandular hairs 0.2-0.3 mm long; rostrum 4-5.6 mm long, without a narrowed apex, not twisted, with erect-patent, eglandular hairs 0.1-0.2 mm long; stigmatic remnants 0.9-1.2 mm long, with 5 glabrous lobes. *Seeds* 1.3-1.6 mm long, 0.8-0.9 mm wide, finely reticulate, uniformly colored, brown, glabrous. Cotyledons with entire margin. Figs. 435, 436.

Pollen. *Geranium*-type (Aedo & al. 2002: 217).

Chromosome number. Unknown.

Phenology. Collected in flower from January to November.

Distribution. This species ranges from western Colombia, through Ecuador to northern Peru (Fig. 437).

Habitat. Boggy depressions, tussock, grassy areas, and lake shores; 3300-5000 m.

Additional specimens examined. **Colombia.** Antioquia: Urrao, Inspección Jaiperá, vereda el Chuscal, Páramo de Frontino, sitios Pico de Águila-la Laguna, 6°27'N, 76°46'W (MA); Urrao, Inspección Jaiperá, vereda el Chuscal, Páramo de Frontino, sitios Pico de Águila-la Laguna, 6°27'N, 76°46'W, 6 Apr. 1989, *Callejas & al. 7692* (HUA, NY); Páramo of Morro Frontino, N Urrao, 6°30'N, 76°7'W, 11 Mar. 1944, *Core 411* (US). **Ecuador.** Azuay: Parque Nacional Cajas, road Cuenca-Sayausí-Molleturo km 36, trail to Paragüillas, at the pass, 2°45'S, 79°14'W, 21 Nov. 2000, *Jørgensen & al. 2424* (MA); Páramo de Cajas, Laguna Toreadora, 2°46'S, 79°13'W, 20 July 2006, *Aedo & Ulloa 13104* (MA); Parque Nacional Cajas, road Cuenca-Sayausí-Molleturo, above Laguna Toreadora, 2°46'S, 79°14'W, 17 Nov. 2000, *Jørgensen & al. 2390* (MA); Parque Nacional Las Cajas, Laguna Toreadora, 2°53'S, 79°8'W, 19 Apr. 1998, *Clark 5003* (MO). Carchi: Páramo del Ángel, towards Tulcán, 0°40'N, 77°55'W, 21 June 1939, *Asplund 7057* (S); Páramo del Ángel, 0°40'N, 77°55'W, 23 Aug. 1957, *Barclay 5128* (COL, MA); Páramo del Ángel, road Tulcán-El Ángel, 29 km S of Tulcán, 0°40'N, 77°55'W, 4 Apr. 1976, *Weber & Gradstein s.n.* (U); Páramo del Ángel, 0°41'N, 77°52'W, 5 Aug. 2006, *Aedo 13354* (MA); volcán Chiles, 1.5 km SW from the top, 0°48'N, 77°56'W, 15 July 1999, *Kulisek 156* (PRC). Chimborazo: ladera S del volcán Chimborazo, pr. Urbina, 1°27'S, 78°5'W, 31 July 2006, *Aedo 13233* (MA); Cerro Chimborazo neben dem derrubio von Pucahuaico, 1°28'S, 78°48'W, 11 Aug. 1935, *Heinrichs 962b* (G); Cerro Chimborazo, neben dem derrumbo von Pucahuaico, 1°28'S, 78°47'W, 11 Aug. 1935, *Heinrichs 965* (G); Collanes valley, Páramo de los Altares, 1°40'S, 78°24'W, 3 Sep. 1987, *Ramsay & Merrow 353* (QCA). Napo: Páramo de Guamani, in lake N of Paso de la Virgen, 0°17'S, 78°10'W, 10 June 1984, *Laegaard 52267* (AAU, QCA); Páramo de Guamani, road Quito-Baeza, 1 km along take-off road to telecommunication antenna in the pass, 0°17'S, 78°9'W, 7 Oct. 1976, Øllgaard *& Balslev 10065* (AAU); Páramo de Guamaní, road Quito-Baeza, 6 km NW of laguna de Papallacta, 0°19'S, 78°7'W, 19 June 1976, Øllgaard *& Balslev 8119* (AAU); Páramo de Papallacta, 0°21'S, 78°6'W, 26 Aug. 1977, *MAF 59* (AAU); Napo-Pastaza: near volcán Sarahurcu, Laguna Yanacocha, 1°16'S, 78°49'W, 10 Jan. 1953, *Prescott 103* (NY). Pichincha: NE de Cayambe, laguna de Chiqui, 0°7'N, 78°16'W, 4 June 1944, *Acosta Solís 8157* (F); Cayambe, volcán Cayambe, 0°7'N, 77°58'W, 2 Mar. 1959, *Harling 4393* (S); between Pifo and Papallacta, 0°19'S, 78°12'W, Jan., *Fagerlind & Wibom s.n.* (QCA); Páramo de Guamaní, carretera Pifo-Papallacta km 27, 0°19'S, 78°12'W, 13 Jan. 1990, *León 1190* (QCA); Antisana, 0°28'S, 78°12'W, July 1903, *Meyer s.n.* (JE). Tungurahua: Alto de Pasa, 1°16'S, 78°44'W, 28 Oct. 1944, *Acosta Solís 8743* (F). **Peru.** Cajamarca: prov. Cajamarca, Minas Conga, sector El Águila, 6°51'S, 78°21'W, 4 Oct. 2005, *Granda 2513* (MA).

Discussion. Geranium maniculatum is characterized by the digitate leaf blade with usually five segments. The lateral segments are directed upwards, and the middle segment is entire and lanceolate. The leaves are usually glabrous, but some specimens have short antrorse hairs on

the margin. *Geranium sibbaldioides* and *G. rhomboidale* are two species similar to *G. maniculatum*. *Geranium sibbaldioides* subsp. *sibbaldioides* may be distinguished by leaf characters: the lateral segment directed upward, the middle segment narrowly lanceolate, and the margin usually glabrous. *Geranium sibbaldioides* subsp. *elongatum* is easily recognized by its hairy leaves, while *G. sibbaldioides* subsp. *beckianum* has a middle segment that is 3-lobed at the apex. In *G. maniculatum* the fruit and the sepal mucro are shorter than in *G. rhomboidale*. Other leaf features that distinguish them are noted under *G. rhomboidale*.

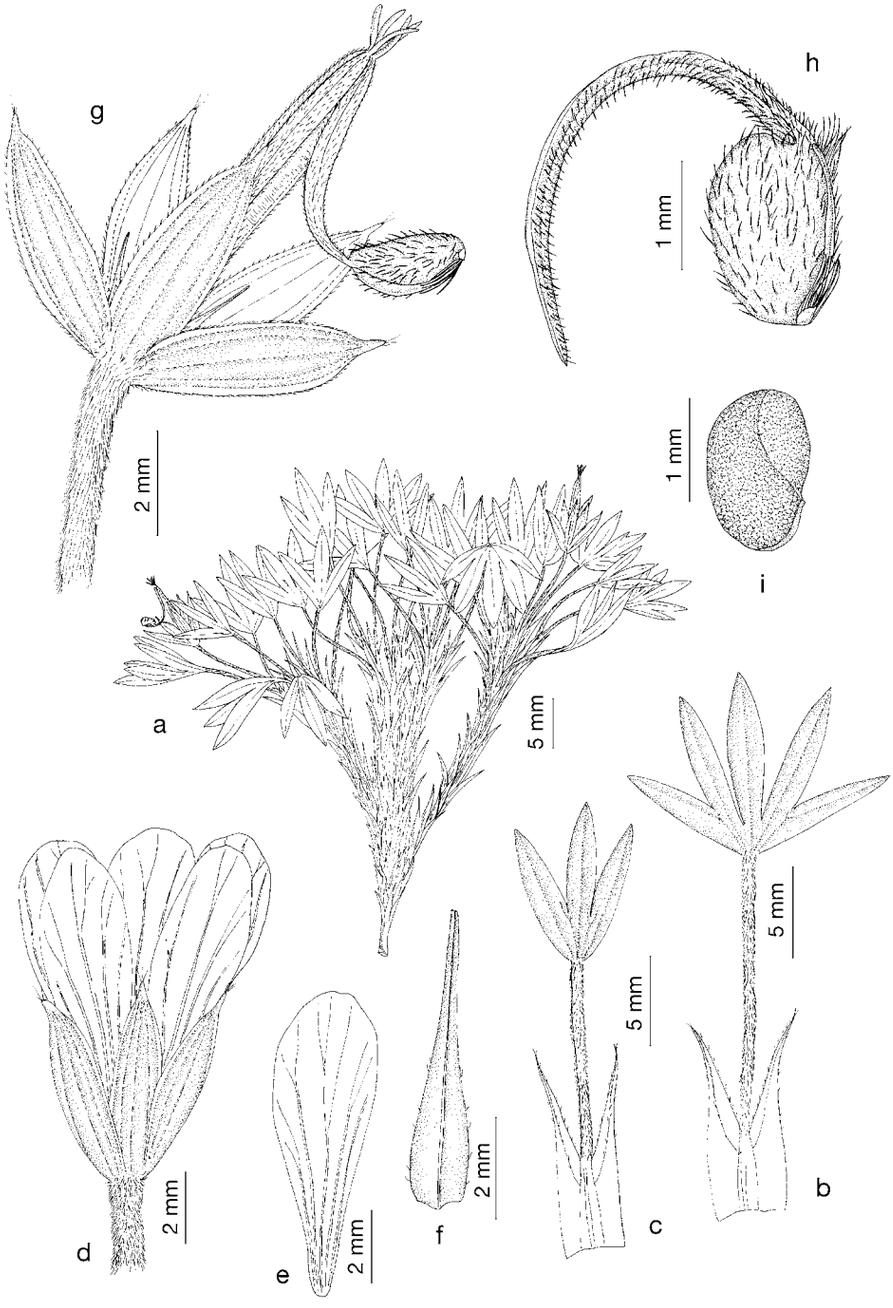


Fig. 435. *Geranium maniculatum*. a. Habit. b, c. Leaves. d. Flower. e. Petal. f. Staminal filament. g. Fruit. h. Mericarp. i. Seed. (Based on: a-f, *Harling 4393*, S; g-i, *Weber & Gradstein s.n.*, *4 Apr. 1976*, U).

Fig. 436. *Geranium maniculatum* (Based on: *Aedo & Ulloa 13104,* MA).

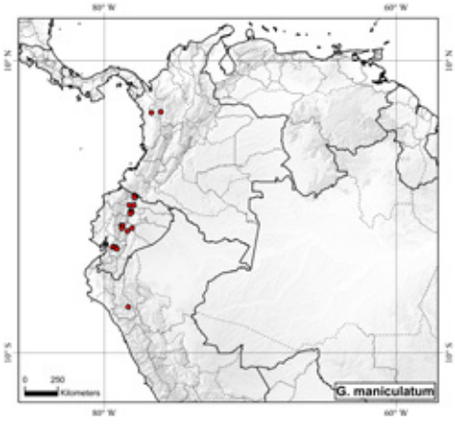


Fig. 437. Distribution of *Geranium maniculatum*.

172. Geranium foreroi Aedo, Anales Jard. Bot. Madrid 58: 183. 2000. Type locality: "Colombia. Magdalena, Sierra Nevada de Santa Marta, 1 km al NW de la quebrada de la laguna Río Frío, en dirección al pico José Hilario, 31-VII-1972, Forero &. Kirkbride 635 (COL-191289!)". Type: Colombia. Magdalena, Sierra Nevada de Santa Marta, 1 km al NW de la quebrada de la laguna Río Frío, en dirección al pico José Hilario, 10°55'N, 73°53'W, 31 July 1972, *E. Forero & J.H. Kirkbride 635* (holotype, COL-191289!; isotype, NY-01364985!).

Perennial herbs, 2-8 cm tall. *Rootstock* 2.5-4 mm in diameter, ± vertical, not tuberculate, not turnip-shaped, without thickened roots. *Stem* scapiform, cushion-like, stolons absent, with short vegetative stems. *Basal leaves* in a persistent rosette; leaf laminas 0.9-2.3 cm long, 1.3-2.5 cm wide, not peltate, palmatifid [ratio main-sinus length/middle segment length = 0.70-0.86], polygonal in outline, base cordate, not coriaceous, with nerves not projected, glabrous on both surfaces, with antrorse, eglandular cilia 0.1-0.4 mm long on the margin, usually each segment ending in 1-3 bristles 0.2-0.5 mm long; segments 5, in 1 plane, middle segment obtriangular (with linear-lanceolate lobes), 1-1.9 mm wide at the base [ratio segment width at the base/middle segment length = 0.12-0.14], 3-lobed at the apex [ratio secondary sinus length/middle segment length = 0.26-0.34]; petioles up to 4 cm long, without abscission zone, terete, not swollen, not deflexed in age, with patent, eglandular hairs 0.2-0.7 mm long; stipules 6-13.7 mm long, 0.9-2 mm wide, lanceolate, free, papery, brownish red, with eglandular hairs on abaxial surface and on the margin, glabrous adaxially (ending in 1-3 bristles 0.2-0.5 mm long). *Cymules* 1-flowered, solitary [ratio cymule length/leaf length = 1-1.3]; peduncles 20-31 mm long, with patent, eglandular hairs 0.1-0.7 mm long; bracteoles absent.

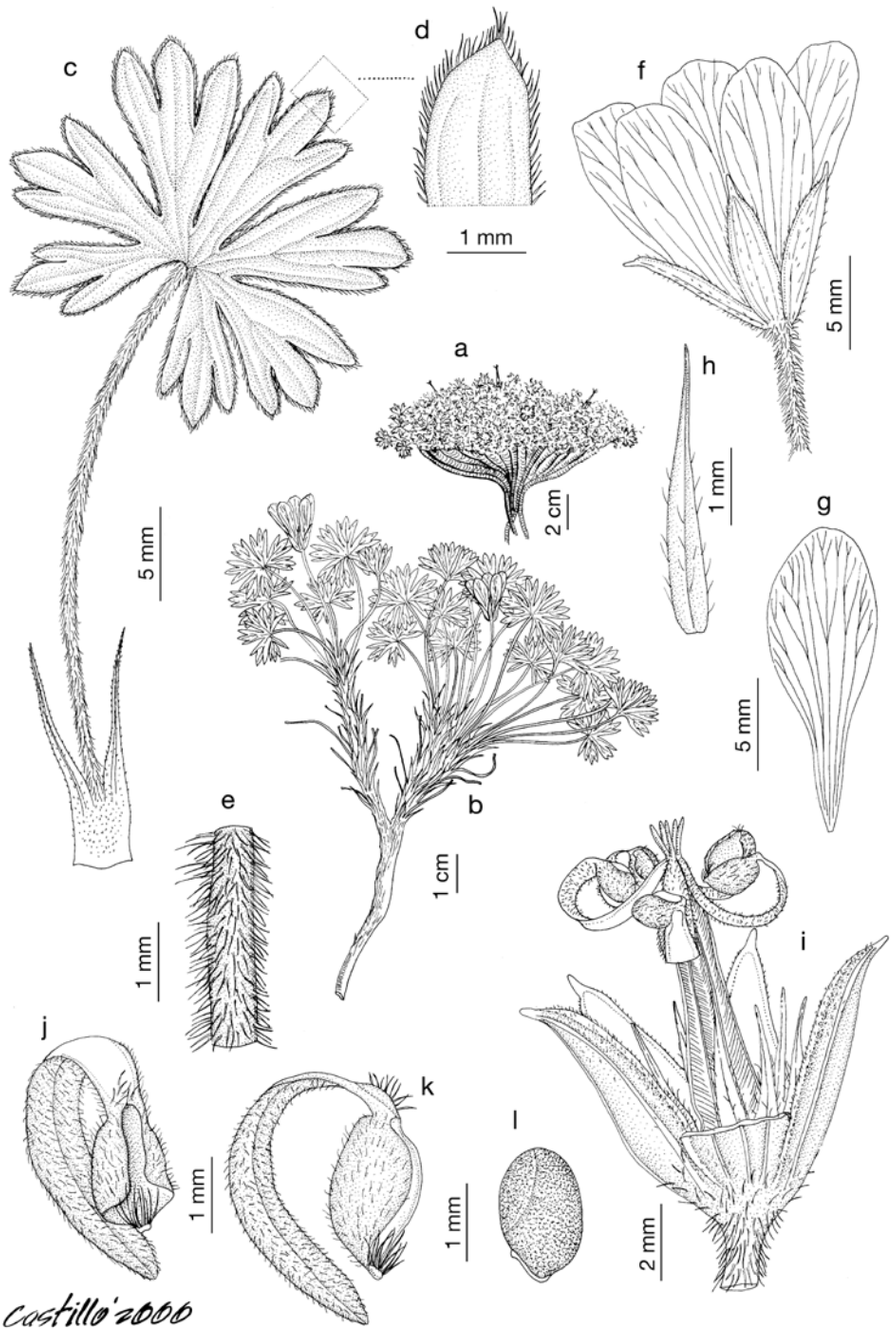


Fig. 438. *Geranium foreroi*. a. Habit. b. Flowering branch. c. Leaf. d. Leaf lobe. e. Peduncle. f. Flower. g. Petal. h. Staminal filament. i. Fruit. j, k. Mericarps. l. Seed. (Based on: *Forero & Kirkbride 635*, COL).

Fig. 439. Distribution of *Geranium foreroi*.

Flowers actinomorphic. *Sepals* 6.5-8.7 mm long, 2-2.8 mm wide, lanceolate, smooth, not accrescent, nerves 5, mucro 0.4-0.9 mm long [ratio mucro length/sepal length = 0.10-0.12], with erect-patent, eglandular hairs 0.2-0.7 mm long on the abaxial surface and margin, glabrous adaxially. *Petals* 15-18 mm long, 5.1-7 mm wide, erect-patent, rounded, without claw, white, hairy on the base of the adaxial surface and margin, with hairs 0.2-0.3 mm long. *Stamens* 10, both whorls bearing anthers; filaments 3.4-5.5 mm long, lanceolate, yellow, with eglandular hairs 0.2-0.3 mm long on the abaxial surface and margin; anthers 0.9-1.1 mm long, yellow. Nectaries 5, hemispheric, glabrous. *Gynoecium* 3.9-5 mm long, unknown color. *Fruit* 9-11 mm long, erect, discharge of seed-ejection type; mericarps ca. 2.3 mm long, 1 mm wide, without a strand of fibers, not compressed at the apex, smooth, without basal beak, with a basal callus, without a basal prong, brown, with antrorse, ± appressed, eglandular hairs 0.1-0.2 mm long; rostrum ca. 7 mm long, without a narrowed apex, not twisted, with erect-patent, eglandular hairs 0.1 mm long; stigmatic remnants 0.7-1 mm long, with 5 glabrous lobes. *Seeds* ca. 1.6 mm long, 0.9 mm wide, finely reticulate, uniformly colored, brown, glabrous. Cotyledons with entire margin. Fig. 438.

Pollen. *Geranium*-type (Aedo & al. 2002: 217).

Chromosome number. Unknown.

Phenology. Collected in flower in July.

Distribution. This species is endemic to northern Colombia (Fig. 439).

Habitat. Unknown, probably on *Espeletia* Mutis ex Bonpl. paramo; 3300-3400 m.

Additional specimens examined. **Colombia.** Magdalena: Sierra Nevada de Santa Marta, cabeceras del río Sevilla, 10º53'N, 73º57'W, 20 Jan. 1959, *Barclay & Juajibioy 6637* (COL, MO).

Discussion. Geranium foreroi has petioles and pedicels with patent, eglandular hairs 0.1-0.7 mm long and petals 15-18 mm long. This species could be confused with *G. paludosum*, which has retrorse short hairs (0.1-0.3 mm long) on the petioles and pedicels, and shorter petals (10.5-15.5 mm long). In both species the petals are adaxially hairy at the base and on the margin, an unusual feature among stemless species from the Andes. For differences between *G. foreroi* and *G. costaricense*, see that species. The only two collections of *G. foreroi* are from Sierra Nevada de Santa Marta, where *G. paludosum* also grows. The species are apparently allopatric; *G. foreroi* has been found in the northwestern part of this mountain range, and *G. paludosum* was collected on the central and eastern slopes.

173. Geranium paludosum R. Knuth, Repert. Spec. Nov. Regni Veg. 28: 2. 1930. Type locality: "Colombia: Sierra Nevada de Santa Marta, Siminchuená-Adurimeira, an moorigen Stellen (A. Schultze a. 1928 n. 1314 -- Typus in herb. Berol.!). -- Blühend Februar". Type: Colombia. Sierra Nevada de Santa Marta, Siminchuená-Adurimeira, 1928, *A. Schultze 1314* (holotype, B destroyed). Colombia. Magdalena, Sierra Nevada de Santa Marta, valley descending southwestern from Picos Reina and Ojeda, around laguna Naboba, Laguna Mamito and Laguna Mamo, 10°39'N, 73°37'W, 3 Oct. 1959, *J. Cuatrecasas & R. Romero 24578* (neotype, designated by Aedo & al. 2002: 261, COL-000001793!).

Perennial herbs, 2-7 cm tall. *Rootstock* 3-5 mm in diameter, ± vertical, not tuberculate, not turnip-shaped, without thickened roots. *Stem* scapiform, cushion-like, stolons absent, sometimes with short vegetative stems. *Basal leaves* in a persistent rosette; leaf laminas 0.8-1.3 cm long, 0.9-1.8 cm wide, not peltate, palmatifid [ratio main-sinus length/middle segment length = 0.70-0.81], polygonal in outline, base cordate, not coriaceous, with nerves not projected, glabrous on both surfaces, with antrorse, eglandular cilia 0.1-0.2 mm long on the margin; segments 5, in 1 plane, middle segment obtriangular (with linear-lanceolate lobes), 0.8-1.8 mm wide at the base [ratio segment width at the base/middle segment length = 0.16-0.18], 3-lobed at the apex [ratio secondary sinus length/middle segment length = 0.16-0.27]; petioles up to 5 cm long, without abscission zone, terete, not swollen, not deflexed in age, with retrorse, appressed, eglandular hairs 0.1-0.2 mm long; stipules 5-10.4 mm long, 1-2 mm wide, lanceolate, free, papery, brownish red, with eglandular hairs on abaxial surface and on the margin, glabrous adaxially (ending in 1-3 bristles 0.2-0.3 mm long). *Cymules* 1-flowered, solitary [ratio cymule length/leaf length = 0.7-1.1]; peduncles 8-40 mm long, with retrorse, appressed, eglandular hairs 0.1-0.3 mm long; bracteoles absent. Flowers actinomorphic. *Sepals* 5.5-7.9 mm long, 1.5-3.3 mm wide, lanceolate, smooth, not accrescent, nerves 3, mucro 0.3-0.7 mm long [ratio mucro length/sepal length = 0.08-0.09], with erect-patent, eglandular hairs 0.2-0.4 mm long on the abaxial surface and margin, glabrous adaxially. *Petals* 10.5-15.5 mm long, 3.3-7 mm wide, erect-patent, rounded, without claw, purple, hairy on both surfaces, mainly on the base of the adaxial surface, ciliate on the margin, with hairs 0.2-0.4 mm long. *Stamens* 10, both whorls bearing anthers; filaments 3.5-4.1 mm long, lanceolate, yellow, with eglandular hairs 0.1-0.3 mm long on the abaxial surface and margin; anthers 0.8-1 mm long, yellow. Nectaries 5, hemispheric, glabrous. *Gynoecium* 3.5-4 mm long, yellow. *Fruit* 10.1-12 mm long, erect, discharge of seed-ejection type; mericarps 1.9-2 mm long, 0.7-1 mm wide, without a strand of fibers, not compressed at the apex, smooth, without basal beak, with a basal callus, without a basal prong, brown, with antrorse, ± appressed, eglandular hairs ca. 0.1 mm

long; rostrum 7.4-9 mm long, without a narrowed apex, not twisted, with erect-patent, eglandular hairs 0.1 mm long; stigmatic remnants 0.9-1.1 mm long, with 5 glabrous lobes. *Seeds* 1.4-2 mm long, 0.9-1 mm wide, finely reticulate, uniformly colored, brown, glabrous. Cotyledons with entire margin. Fig. 440.

Pollen. *Geranium*-type (Aedo & al. 2002: 217).

Chromosome number. Unknown.

Phenology. Collected in flower from May to December.

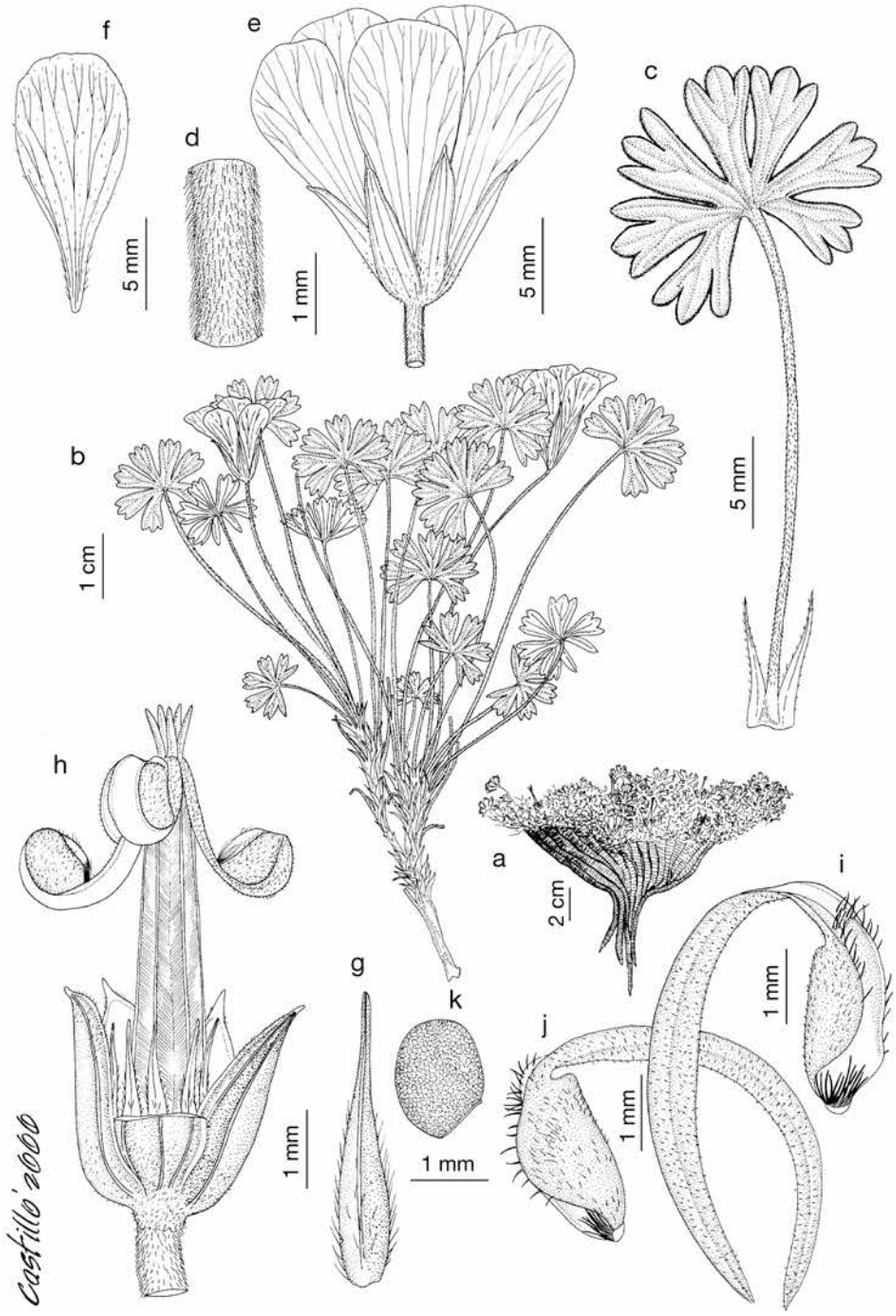


Fig. 440. *Geranium paludosum*. a. Habit. b. Flowering branch. c. Leaf. d. Peduncle. e. Flower. f. Petal. g. Staminal filament. h. Fruit. i, j. Mericarps. k. Seed. (Based on: a, d, g-k, *Cuatrecasas 24578*, COL; b, c, e, f, *Rangel 1881*, COL).

Distribution. This species is endemic to northern Colombia (Fig. 441).

Habitat. Paramo and upper montane forests; 3200-4500 m.

Additional specimens examined. **Colombia.** Magdalena: Sierra Nevada de Santa Marta, 1954, *College West Indies Exped. 22* (US); Sierra Nevada de Santa Marta, 1880, *Simons s.n.* (BM); Sierra Nevada de Santa Marta, caserío de San Sebastián-Bellavista, 10º36'N, 73º37'W, 7 Dec. 1980, *Rangel & al. 1881* (COL); Sierra Nevada de Santa Marta, valle del río Donachuy, camino Corisa-Naboba lake, 10º38'N, 73º30'W, 15 Oct. 1958, *Hammen 1179* (COL, MA); Sierra Nevada de Santa Marta, río Guiachinacopunameina, 10º44'N, 73º40'W, 28 May 1977, *White & Alverson 624* (COL, MO, NY); Sierra Nevada de Santa Marta, SE slopes, Hoya del río Donachuí, laguna de Calocribe, eastern of Meollaca, 10º46'N, 73º31'W, 30 Sep. 1959, *Cuatrecasas & Romero 24555* (COL); Sierra Nevada de Santa Marta, source of río Donachuy, 10º48'N, 73º39'W, 21 May 1977, *White & Alverson 532* (COL).

Discussion. Geranium paludosum, an endemic of Sierra Nevada de Santa Marta of northern Colombia, is readily recognized by its small and shallowly divided leaf laminas. It also has sepals with a short mucro and long petals that are basally hairy. In herbarium specimens the leaves are almost black. The lectotype proposed by Knuth (1930a: 2) is lost and no duplicates were found. Therefore, a neotype collected near the type locality and in agreement with the original description was designated.

Fig. 441. Distribution of *Geranium paludosum*.

174. Geranium stramineum Triana & Planch., Ann. Sci. Nat., Bot. ser. 5, 17: 112. 1873. Type locality: "Quebrada de los Venados, pic du Tolima (Goudot)". Type: Colombia. Tolima, pic Tolima, Quebrada de los Venados, 4°39'N, 75°22'W, 1844, *J. Goudot 3* (lectotype, designated by Aedo & al. 2002: 278, P-00136938!).

Geranium confertum Standl., Contr. U.S. Natl. Herb. 18: 111. 1916. Type locality: "Type in the U. S. National Herbarium, no. 531305, collected in the Páramo de Buena Vista, Huila Group, Central Cordillera, State of Cauca, Colombia, at an altitude of 3,000 to 3,600 meters, January, 1906, by H. Pittier (no. 1107)". Type: Colombia. Cauca, Páramo de Buena Vista, 2°48'N, 76°05'W, Jan. 1906, *H. Pittier 1107* (holotype, US-531305!).

Geranium angelense Halfd.-Niels., Nordic J. Bot. 16(3): 269, 270 fig. 2. 1996. Type locality: "Halfdan-Nielsen et al. 21, Ecuador, Prov. Carchi, Páramo del Angel, base de Volcán Chiles, Lagunas Verdes (77°55'W, 00°47'N), alt. 3890-3910 m, 16 Nov 1991 (C holotype, AAU, QCA, QCNE isotypes)". Type: Ecuador. Carchi, Páramo del Angel, base de Volcán Chiles, Lagunas Verdes, 0°47'N, 77°55'W, 16 Nov. 1991, *L.B. Halfdan-Nilesen & al. 21* (holotype, C-10012693!; isotypes, AAU!, QCA, QCNE).

Geranium guamanense Halfd.-Niels., Nordic J. Bot. 16(3): 271 fig. 3. 1996. Type locality: "Øllgaard & Balslev 10064, Ecuador, Prov. Napo, road Quito-Baeza, Páramo de Guamaní, 1 km along take-off road to telecommunication antenna in the pass, bunch grass páramo and boggy páramo, shrub in protected places (78°09'W, 0°17'S), alt. 4000-4100 m, 7-9 Oct 1976 (AAU holotype, NY isotype)". Type: Ecuador. Napo, road Quito-Baeza, Páramo de Guamaní, 0°17'S, 78°09'W, 7-9 Oct. 1976, *B. Øllgaard & H. Balslev 10064* (holotype, AAU!; isotypes, MO!, NY-00076862!).

Perennial herbs, 2-14 cm tall. *Rootstock* 1.3-6 mm in diameter, ± vertical, not tuberculate, not turnip-shaped, without thickened roots. *Stem* scapiform, cushion-like, stolons absent, sometimes with short vegetative stems. *Basal leaves* in a persistent rosette; leaf laminas 0.9-2.4 cm long, 1-2.7 cm wide, not peltate, palmatifid [ratio main-sinus length/middle segment length = 0.63-0.80], orbicular in outline, base cordate, ± coriaceous, nerves ± projected on the abaxial surface, sunken adaxially, glabrous to pilose with antrorse, appressed, eglandular hairs on both surfaces; segments 5, in 1 plane, middle segment obtriangular (with lanceolate lobes), 1.6-4 mm wide at the base [ratio segment width at the base/middle segment length = 0.21-0.31], 3-lobed in distal half [ratio secondary sinus length/middle segment length = 0.13-0.26]; petioles up to 10 cm long, without abscission zone, terete, not swollen, not deflexed in age, glabrous or with patent, eglandular hairs 0.2-1.3 mm long; stipules 8.8-60 mm long, 1.4-6 mm wide, lanceolate, obtuse (setaceous apex 1.3-6 mm long), free, scarious, stramineous, glabrous on both surfaces, ending in 1-3 bristles 0.3-0.9 mm long. *Cymules* 1-flowered, solitary [ratio cymule length/leaf length = 0.4-0.5(1)]; peduncles (4)8-20(40) mm long, glabrous or pilose, with patent, eglandular hairs 0.2-1 mm long; bracteoles absent. Flowers actinomorphic. *Sepals* (5.6)8-9 mm long, 1.5-3.5 mm wide, lanceolate, smooth, not accrescent, nerves 3, mucro 0.5-0.8 mm long [ratio mucro length/sepal length = 0.07-0.12], with erect-patent, eglandular hairs 0.5-1.1 mm long on the abaxial surface (sometimes glabrous) and margin, glabrous adaxially. *Petals* (8.3)9-14 mm long, 2.3-5 mm wide, erect-patent, rounded, without claw, purple, sometimes white, glabrous. *Stamens* 10, both whorls bearing anthers; filaments 2.8-5 mm long, lanceolate with an abruptly narrowed apex, white, glabrous, or with eglandular hairs 0.1-0.2 mm long on the abaxial surface and margin; anthers 0.6-0.8 mm long, purple. Nectaries 5, hemispheric, glabrous. *Gynoecium* 3-5.2 mm long, purple. *Fruit* 10-12.6 mm long, erect, discharge of seed-ejection type; mericarps 1.8-3.1 mm long, 1-1.4 mm wide, without a strand of fibers, not compressed at the apex, smooth, without basal beak, with a basal callus, without a basal prong, brown, with antrorse, ± appressed, eglandular hairs 0.1-0.5 mm long on the surface and eglandular hairs 0.5-0.7 mm long on the margin; rostrum 6-8 mm long, without a narrowed apex, not twisted, with erect-patent, eglandular hairs 0.1-0.4 mm long; stigmatic remnants 0.7-2 mm long, with 5 glabrous lobes. *Seeds* 1.5-1.8 mm long, 0.8-1.2 mm wide, finely reticulate, uniformly colored, brown, glabrous. Cotyledons with entire margin. Figs. 442, 443.

Pollen. *Geranium*-type (Aedo & al. 2002: 217).

Chromosome number. Unknown.

Phenology. Collected in flower from January to November.

Distribution. This species ranges from central Colombia to central Ecuador (Fig. 444).

Habitat. Grassy areas and boggy paramo among cushions and tuft of grasses; 1700-4300 m.

Representative specimens examined. **Colombia.** Boyacá: Páramo de Pisva, carretera Socha-La Punta, km 61, 6 km al E de Los Pinos, Alto de Granados, 5º59'N, 72º35'W, 10 June 1972, *Cleef 4370* (COL, U). Caldas: vertiente occidental, Páramo del Ruiz sobre La Laguna, 4º50'N, 75º33'W, 6 May 1940, *Cuatrecasas 9351* (COL); Páramo del Nevado del Ruiz, au-dessus de Termales, 4º50'N, 75º33'W, 31 Oct. 1952, *Humbert & al. 27068* (P); Cerro Tatama, 5º0'N, 76º5'W, 10 Sep. 1922, *Pennell 10563* (NY). Cauca: Soratá, antecima del volcan Soratá, 2º6'N, 76º35'W, 30 Nov. 2017, *Buira & Calvo 7597* (MA); Puracé, 2º21'N, 76º26'W, Feb. 1938, *Sneidern 1806* (S); Cordillera Central, vertiente occidental, cabeceras del río Palo, Alto de las Casitas, 2º59'N, 76º10'W, 3 Dec. 1944, *Cuatrecasas 18965* (BC, F, GH, MICH, MO, NY, US). Cundinamarca: Páramo de Sumapaz, Alto Caicedo entre Andabobos y Media Naranja, 4º8'N, 74º13'W, 6 July 1972, *Cleef & Huber 4824A* (COL, U); Páramo entre Cogua y San Cayetano, Laguna Seca, 5º3'N, 73º59'W, 17 Nov. 1972, *Cleef 6530* (COL, U). Meta: macizo de Sumapaz, paso El Boquerón Alto del Buque, Cerro Nevado, vertiente sur bajando hacia La Culebra, 4º11'N, 74º11'W, 4 July 1981, *Díaz Piedrahita & al. 2469* (COL). Nariño: Chiles, 0º49'N, 77º50'W, 30 Oct. 1955, *Fernández Pérez 2956* (COL); volcán Galeras, E slope, around La Torre, 1º12'N, 77º15'W, 7 Feb. 1965, *Cuatrecasas & Mora 26915* (COL); Pasto, volcán Galeras, 1º12'N, 77º15'W, 22 Oct. 1968, *Plowman 1957* (COL, GH, US). Risaralda: Santuario, vereda Las Colonias, 200 m arriba del campamento, 5º4'N, 75º58'W, 1 Feb. 1983, *Torres & al. 1617* (COL). Tol-

ima: Nevado del Ruiz, ESE of Manizales, 4º50'N, 75º33'W, 26 Jan. 1948, *Archibald 4048* (E). Valle: Páramo de Puracé, 2º15'N, 76º24'W, 31 Oct. 1977, *Ramírez 37* (HUA); Riofrío, Fenicia, Vereda El Roblal, Páramo del Duende, 4º7'N, 76º25'W, 12 Aug. 1997, *Vargas 3932* (COL, HUA); Riofrío-Darién, Páramo del Duende, 4º9'N, 76º17'W, 23 July 1998, *Vargas 4791* (HUA). **Ecuador.** Carchi: Páramo del Ángel, 0º41'N, 77º52'W, 5 Aug. 2006, *Aedo 13355* (MA); Páramo de Ángel, 0º48'N, 77º58'W, 23 Aug. 1957, *Barclay 5207* (COL). Chimborazo: El Altar, on the ridge below the Canonigo peak, 1º41'S, 78º24'W, 20 Aug. 1995, *Sklenář & Kosteckova 1091* (AAU). Imbabura: Lagunas de Mojanda, Laguna Negra, 0º8'N, 78º15'W, 22 Sep. 1990, Øllgaard *98192* (AAU, MO); Cerro Imbabura, 0º15'N, 78º10'W, 5 June 1995, *Sklenář & Kosteckova 33-6* (AAU); Nevado Cotacachi, 0º21'N, 78º21'W, 8 Sep. 1995, *Sklenář & Kosteckova 112-19* (AAU). Napo: road Quito-Baeza, 1 km along take-off road to telecomunication antenna in the pass, Páramo de Guamani, 0º17'S, 78º9'W, 7 Oct. 1976, Øllgaard *& Balslev 10063* (NY); Reserva Ecológica Antisana, carretera Pifo-Baeza, Páramo de la Virgen, 0º20'S, 78º12'W, 23 Nov. 1998, *Freire*

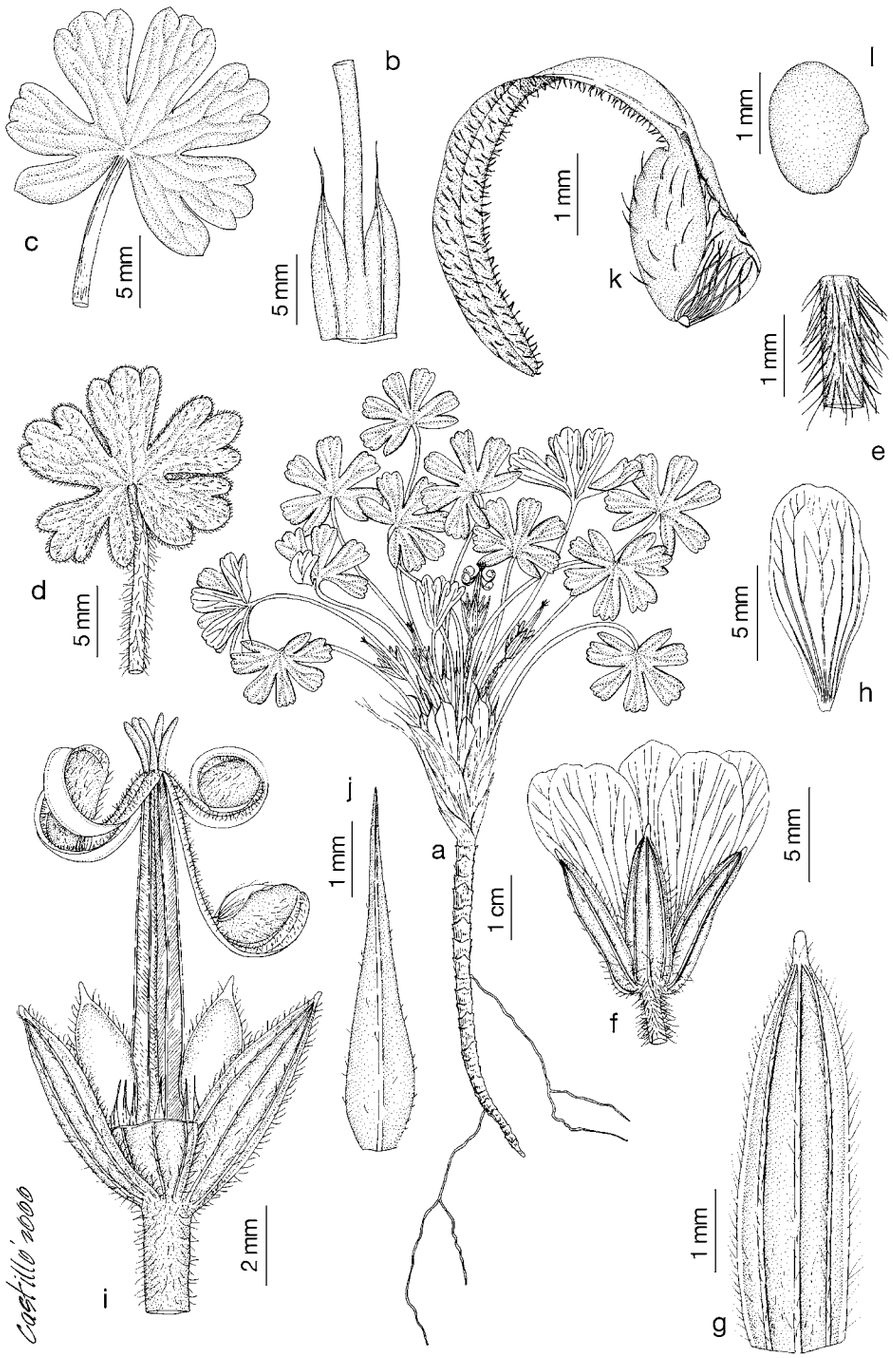


Fig. 442. *Geranium stramineum*. a. Habit. b. Stipules. c, d. Leaves. e. Peduncle. f. Flower. g. Sepal. h. Petal. i. Fruit. j. Staminal filament. k. Mericarp. l. Seed. (Based on: a-c, *MAF 61*, AAU; d, *Barclay 4057*, COL; e-h, *Idobro & al. 3181*, COL; i-l, *Archibald 4048*, E).

Fig. 443. *Geranium stramineum* (Based on: *Aedo & Ulloa 12930,* MA).

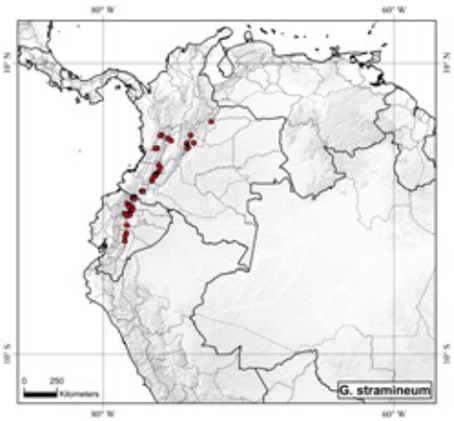


Fig. 444. Distribution of *Geranium stramineum*.

& al. 2854 (MO); NW slope of Antisana, N of Lago Mauca-Machay, 0°26'S, 78°9'W, 2 Nov. 1979, *Holm-Nielsen 20767* (AAU, MO). Pichincha: volcán Cayambe, 0°4'N, 77°59'W, 3 July 1980, *Holm-Nielsen &* Øllgaard *24276* (AAU). **Ecuador.** Pichincha: Páramo de Guamaní, E side of Laguna Boyero, 0°15'S, 78°10'W, 18 Mar. 1979, *Holm-Nielsen 16044* (AAU); reserva Cayambe-Coca, vía a Baeza, 0°19'S, 78°11'W, 14 July 2006, *Aedo & Ulloa 12930* (MA); NE slope of Sincholagua, 0°30'S, 78°22'W, 18 Aug. 1979, *Holm-Nielsen 19579A* (AAU). Tungurahua: Parque Nacional Llanganates, SW flank of Cerro Hermoso, 1°9'S, 78°21'W, 14 Nov. 1980, *Neil & al. 12065* (MA).

Discussion. Geranium stramineum can be distinguished from all other stemless species from the Andes by its stramineous and scarious stipules, which become frayed at the margin with time. These stipules are obtuse with a setaceous apex 3-6 mm long. In other stemless species, the stipules are usually papery, reddish, lanceolate, and sometimes have a setaceous apex (which usually ends in 1-3 bristles). *Geranium stramineum* can be glabrous or have more or less abundant hairs on the petiole and on the leaf lamina. Hairy forms have been described as *G. confertum*, *G. angelense*, and *G. guamanense*; however, many transitional specimens combine the glabrous to hairy forms, and I am reluctant to accord these forms specific recognition. For example, *Barclay 6399* (MO) has a glabrous petiole and hairs only on the leaf margin, and *Halfdan-Nielsen & León 74* (QCA) has a hairy petiole and hairs on the leaf margin and on the nerves of the abaxial surface. The collection *Lozano & al. 4591* (COL) includes glabrous specimens and some that are quite hairy on the petiole and on the lamina, whereas in a duplicate sheet at F all specimens are hairy. The sepal and petal length are variable, and do not show any correlation with the indumentum. Moreover, hairy and glabrous forms both occur over the entire range of this species. The collection *Macbride 4401* is labeled as collected in central Peru, but the two sheets at G and MA are *G. multipartitum*, and the one at NY includes a fragment of *G. stramineum*. The gathering was probably mislabeled, and the presence of *G. stramineum* in Peru remains to be confirmed.

175. Geranium ecuadoriense Hieron., Bot. Jahrb. Syst. 20, Beiblatt 49: 30. 1895. Type locality: "Ecuador: crescit locis arenosis montis Chimborazo, alt. s.m. 4000 m, ad limitem nivis aeternae, mense Junio florens (n. 6642)". Type: Ecuador. Chimborazo, Mt. Chimborazo, 1°28'S, 78°47'W, *F.C. Lehmann 6642* (lectotype, designated by Aedo & al. 2002: 245, K!; isolectotype, BH-418691-fragment!).

Perennial herbs, 1.3-5 cm tall. *Rootstock* 3-17 mm in diameter, vertical, not tuberculate, not turnip-shaped, without thickened roots. *Stem* scapiform, cushion-like, stolons absent, with short vegetative stems. *Basal leaves* in a persistent rosette; leaf laminas 0.4-0.8 cm long, 0.5-1.1 cm wide, not peltate, palmatisect, polygonal in outline, base cordate, not coriaceous, with nerves not projected, sericeous on both surfaces; segments 7, in more than 1 plane, middle segment obtriangular (with lanceolate lobes), 0.4-0.8 mm wide at the base [ratio segment width at the base/middle segment length = 0.08-0.18], 3-lobed in distal half [ratio secondary sinus length/middle segment length = 0.40-0.76]; petioles up to 3 cm long, without abscission zone, terete, not swollen, not deflexed in age, sericeous, with retrorse, ± appressed, eglandular hairs 0.2-1 mm long; stipules 4.5-12 mm long, 1-2.3 mm wide, lanceolate, free, papery, brownish red, with eglandular hairs on abaxial surface and on the margin, glabrous adaxially (ending in 1-3 bristles 0.3-0.6 mm long). Cymules 1-flowered, solitary [ratio cymule length/leaf length = 1-1.2]; peduncles 5.2-11 mm long, sericeous, with retrorse, ± appressed, eglandular hairs 0.2-0.6 mm long; bracteoles absent. Flowers actinomorphic. *Sepals* 4.1-8.2 mm long, 1.5-3.6 mm wide, lanceolate, smooth, not accrescent, nerves 3, mucro 0.4-0.9 mm long [ratio mucro length/sepal length = 0.10-0.13], sericeous with erect-patent, eglandular hairs 0.2-0.5 mm long on the abaxial surface and patent, eglandular hairs 0.6-1.5 mm long on the margin, hairy adaxially. *Petals* 6.7-10 mm long, 1.7-3.9 mm wide, erect-patent, rounded, without claw, white to pink, glabrous on the adaxial surface and margin, hairy on the base of the abaxial surface, with hairs 0.1-0.2 mm long. *Stamens* 10, both whorls bearing anthers; filaments 2.8-3.6 mm long, lanceolate, white, with eglandular hairs 0.2-0.4 mm long on the abaxial surface and margin; anthers 0.7-1.1 mm long, yellow. Nectaries 5, hemispheric, glabrous. *Gynoecium* 2.3-4.5 mm long, yellow. *Fruit* 10-14.4 mm long, erect, discharge of seed-ejection type; mericarps 2.2-3.8 mm long, 1-1.7 mm wide, without a strand of fibers, not compressed at the apex, smooth, without basal beak, with a basal callus, without a basal prong, brown, with antrorse, ± appressed, eglandular hairs 0.2-0.8 mm long; rostrum 6.3-8.2 mm long, without a narrowed apex, not twisted, sericeous, with erect-patent, eglandular hairs 0.1-0.4 mm long; stigmatic remnants 1-2 mm long, with 5 hairy lobes. *Seeds* 1.6-2.3 mm long, 0.8-1.4 mm wide, finely reticulate, uniformly colored, brown, glabrous. Cotyledons with entire margin. Figs. 445, 446.

Pollen. *Geranium*-type (Aedo & al. 2002: 217).

Chromosome number. Unknown.

Phenology. Collected in flower from June to January.

Distribution. This species is endemic to central Ecuador (Fig. 447).

Habitat. Sandy or gravelly paramo, with occasional cushion plants and scattered shrubs of *Loricaria* Wedd.; 3800-4600 m.

Additional specimens examined. **Ecuador.** Bolivar: road to Salinas, 1.8 km of Guaranda-Ambato, 1°25'S, 79°0'W, 25

June 1989, *Dorr & Valdespino 6480* (NY); W side of Chimborazo, on the left side of the road Guaranda-Ambato, 1°26'S, 78°55'W, 12 June 1999, *Sklenář & Laegaard 7214* (AAU, PRC); SW slope of Chimborazo, 1°28'S, 78°47'W, 1 Nov. 1952, *Fagerlind & Wibom 979* (S); SW slope of Chimborazo, 1°28'S, 78°47'W, 1 Nov. 1952, *Fagerlind & Wibom 980* (GH); Chimborazo, 1°28'S, 78°55'W, 4 Aug. 1979, *Holm-Nielsen 18734* (AAU, MO); W of volcán Chimborazo, 33 km N of Guaranda, 1°30'S, 78°56'W, 16 Jan. 1985, *Luteyn & Cotton 11079* (MA, NY, QCA, TEX); W of volcán Chimborazo, 33 km N of Guaranda, 1°30'S, 78°56'W, 29 Nov. 1989, *Luteyn 13396* (NY, QCA); W of volcán Chimborazo, 33 km N of Guaranda, 1°30'S, 78°56'W, 29 Nov. 1989, *Luteyn 13398* (NY). Chimborazo: prope Totonillas, 7 July 1876, *André 3950* (F, NY); prope Totonillas, 20 Sep., *Hirsch 335* (F); S slope of Mt. Chimborazo, 1°28'S, 78°47'W, 18 Aug. 1939, *Asplund 8378* (GH, NY, S, TEX); E slopes of volcán Chimborazo, 1°28'S, 78°47'W, 27 Nov. 1980, *Balslev 1013* (NY); Chimborazo, 1°28'S, 78°47'W, 13 June 1975, *Gilli 55* (W); base de volcán Chimborazo debajo del refugio, El Arenal, 1°28'S, 78°47'W, 22 Nov. 1991, *Halfdan-Nielsen & Huttel 53* (C); arenal du Chimborazo, 1°28'S, 78°47'W, 13 Sep. 1984, *Huttel 385* (MPU); arenal of Chimborazo, 1°28'S, 78°47'W, *Jameson s.n.* (K); from Chimborazo, 1°28'S, 78°47'W, 1880, *Jameson s.n.* (G); arenal of Chimborazo, 1°28'S, 78°47'W, Dec., *Lehmann 617* (K, US); Chimborazo, 1°28'S, 78°47'W, June, *Meyer 182* (JE); ex Chimborazo, Quito, 1°28'S, 78°47'W, *Née s.n.* (MA); slope of Chimborazo mountain, 1°28'S, 78°47'W, 10 May 1939, *Penland & Summers 695* (F, GH); Guaranda, W side of the volcano, below the road to Refugio, 1°28'S, 78°52'W, 5 July 1999, *Stancik 3197* (PRC); ladera S del volcán Chimborazo, 1°29'S, 78°51'W, 30 July 2006, *Aedo 13228* (MA). Pichincha: Pichincha, 0°10'S, 78°36'W, 1850, *Jameson s.n.* (G); Cordillera Oriental, entre Pifo y el boquerón de Cerro de Corrales, Páramo de Guamaní, 0°18'S, 78°15'W, 15 Aug. 1959, *Barclay & Juajibioy 8903* (MO). Tungurahua: El Arenal, on the via Whymper about 2 km from Cruce Arenal, 1°26'S, 78°54'W, 17 Apr. 1983, *Brandbyge 41142* (AAU, MO); El Arenal, on the road from Via Whymper to El Refugio, 1.5 km from Via Whymper, 1°26'S, 78°54'W, 3 Sep. 1983, *Brandbyge 42247* (AAU).

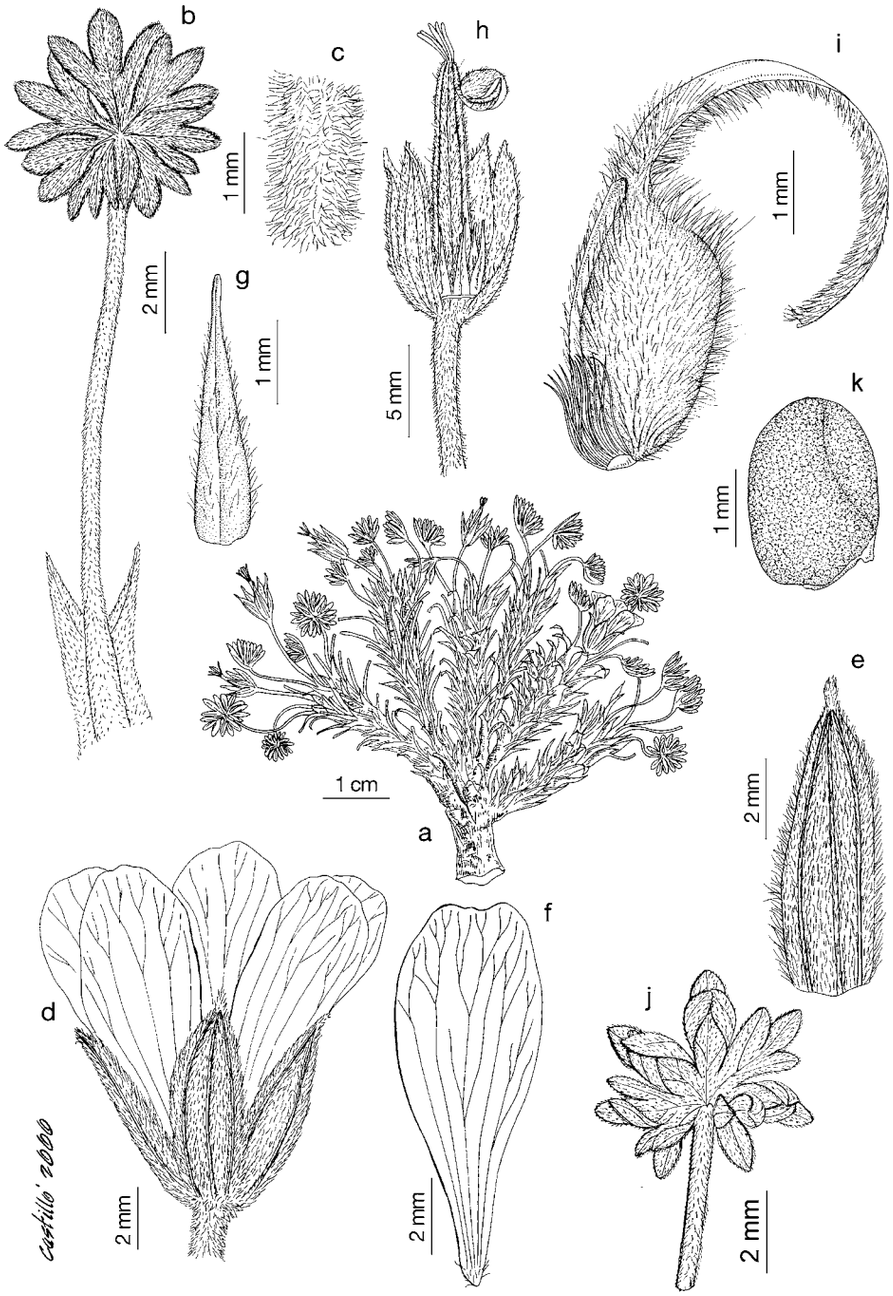


Fig. 445. *Geranium ecuadoriense*. a. Flowering and fruiting branch. b, j. Leaves. c. Peduncle. d. Flower. e. Sepal. f. Petal. g. Staminal filament. h. Fruit. i. Mericarp. k. Seed. (Based on: a, *Penland & Summers 695*, GH; b-k, *Asplund 8378*, S).

Discussion. Geranium ecuadoriense, an endemic of Ecuador, is known only from a small area near Volcán Chimborazo and localities near Quito. Among the stemless species from the Andes, *G. ecuadoriense* somewhat resembles *G. tovarii* and *G. weddellii* in its deeply divided, short, sericeous leaves. *Geranium ecuadoriense* has petioles and pedicels with retrorse hairs and petals abaxially basally hairy, whereas *G. tovarii* and *G. weddellii* have the petioles and pedicels with antrorse hairs and glabrous petals. In addition, *G. ecuadoriense* shares with *G. tovarii* sepals with long, patent, hairs on the margin and glabrous nectaries. *Geranium ecuadoriense* has been confused sometimes with depauperate forms of *G. diffusum*, which also grows in the Chimborazo area. Yet, leaves of

Fig. 446. *Geranium ecuadoriense* (Based on: *Aedo 13228,* MA).

Fig. 447. Distribution of *Geranium ecuadoriense*.

G. ecuadoriense differ in that the seven segments are held in two planes: the two basal segments are more or less perpendicular to the remaining ones. Additionally, *G. diffusum* is not sericeous, although it sometimes has a dense indumentum, and has prostrate to ascending (sometimes short) stems with internodes that are not covered by stipules.

176. Geranium multipartitum Benth., Pl. Hartw. 2: 166. 1845. Type locality: "Hacienda de Antisana". Type: Ecuador. Pichincha, near the hacienda de Antisana, 0°30'S, 78°10'W, *K. Hartweg s.n.* (lectotype, designated by Knuth 1912: 86, K!).

Geranium multipartitum var. *glabrescens* Hieron. ex R. Knuth, Bot. Jahrb. Syst. 37: 566. 1906. Type locality: "Ecuador: Antisana bei Estancia, 4056 m (Stuebel n. 185i.-Typus im Herb. Berl.!)". Type: Ecuador. Pichincha, Antisana, Estancia, 0°30'S, 78°10'W, *A. Stuebel 185i* (holotype, B destroyed).

Geranium multipartitum var. *velutinum* R. Knuth, Bot. Jahrb. Syst. 37: 566. 1906. Type locality: "Peru: Dep. Cajamarca am passe Coymolache oberhalb Hualgayoc auf hoher, dichter, fest geschlossener, sträucher- und kakteenloser Grasflur bei 4000-4100 m (Weberbauer n. 3990!)". Type: Peru. Cajamarca, am passe Coymolache oberhalb Hualgayoc, 6°46'S, 78°20'W, *A. Weberbauer 3990* (no original material located).

Geranium heinrichsae R. Knuth, Repert. Spec. Nov. Regni Veg. 40: 216. 1936. Type locality: "Ecuador: Páramo del Angel, bei der Hütte La Parada, 3400 bis 3600 m (E. Heinrichs a. 1934 sine n. - Typus in herb. Berol.!)". Type: Ecuador. Carchi, Páramo del Ángel, La Parada, 0°41'S, 77°53'W, 1934, *E. Heinrichs s.n.* (holotype, B destroyed).

Perennial herbs, 2-7(16) cm tall. *Rootstock* 4-8 mm in diameter, ± horizontal, not tuberculate, not turnip-shaped, without thickened roots. *Stem* scapiform, cushion-like, stolons absent, sometimes with short vegetative stems. *Basal leaves* in a persistent rosette; leaf laminas 0.7-1.7(2.7) cm long, 0.8-1.8(3) cm wide, not peltate, palmatisect, polygonal in outline, base cordate, not coriaceous, with nerves not projected, pilose, with ± scattered subpatent, eglandular hairs on both surfaces (rarely glabrous), each segment usually ending in 1-3 bristles 0.5-0.7 mm long; segments 9, in more than 1 plane, middle segment rhombic (with linear-lanceolate lobes), 0.4-1 mm wide at the base [ratio segment width at the base/ middle segment length = 0.03-0.06], 3-5(9)-lobed in distal half [ratio secondary sinus length/middle segment length = 0.57-0.68]; petioles up to 8 cm long, without abscission zone, ter-

ete, not swollen, not deflexed in age, with patent, eglandular hairs 0.2-1.1 mm long, sometimes glabrous; stipules 6.7-12.6 mm long, 1-2 mm wide, lanceolate, free, papery, brownish red, with eglandular hairs on abaxial surface and on the margin, glabrous adaxially (ending in 1-3 bristles 0.4-0.5 mm long). *Cymules* 1-flowered, solitary [ratio cymule length/leaf length = 0.6-1.8]; peduncles 5-14(31) mm long, with patent, eglandular hairs 0.2-1 mm long; bracteoles absent. Flowers actinomorphic. *Sepals* 5-8.3 mm long, 1.2-2.6 mm wide, lanceolate, smooth, not accrescent, nerves 3, mucro 0.5-1 mm long [ratio mucro length/sepal length = 0.12-0.16], with ± patent, eglandular hairs 0.2-1.6 mm long on both surfaces, sometimes patent, eglandular hairs 1-2.2 mm long on the margin, rarely ending in 1-1-2 bristles 0.3-0.4 mm long. *Petals* 5.2-7.4(10.2) mm long, 2.2-2.9 mm wide, erect-patent, rounded, without claw, purple, sometimes white, glabrous. *Stamens* 10, both whorls bearing anthers; filaments 2.5-4.4 mm long, lanceolate with an abruptly narrowed apex, white, glabrous on both surfaces, ciliate on the proximal half, with hairs 0.2-0.8 mm long; anthers 0.6-1 mm long, yellow. Nectaries 5, hemispheric, glabrous. *Gynoecium* 3-3.6 mm long, yellow. *Fruit* 9.7-13.5 mm long, erect, discharge of seed-ejection type; mericarps 2-3.4 mm long, 1-1.5 mm wide, without a strand of fibers, not compressed at the apex, smooth, without basal beak, with a basal callus, without a basal prong, brown, with ± patent, eglandular hairs 0.1-0.5 mm long on the surface and eglandular hairs 0.4-0.6 mm long on the margin; rostrum 5.6-8.1 mm long, without a narrowed apex, not twisted, with erect-patent, eglandular hairs 0.1-0.4 mm long; stigmatic remnants 1.3-2 mm long, with 5 glabrous lobes. *Seeds* 1.6-2.1 mm long, 1-1.3 mm wide, finely reticulate, uniformly colored, brown, glabrous. Cotyledons with entire margin. Figs. 448, 449.

Pollen. *Geranium*-type (Aedo & al. 2002: 217).

Chromosome number. Unknown.

Phenology. Collected in flower from January to December.

Distribution. This species ranges from Colombia, through Ecuador and Peru to western Bolivia (Fig. 450).

Habitat. Bogs, rocky slopes, among grass tussocks, paramo dominated by cushions of *Azorella* Lam. and *Plantago* L., and *Polylepis* Ruiz & Pav. forests; 1650-4700 m.

Representative specimens examined. **Bolivia.** La Paz: Larejaca, pr. Sorata, Cooco, 15°47'S, 68°26'W, Nov., *Mandon 786* (BM, G, P, W). **Colombia.** Boyacá: El Cocuy-Güicán, PNN El Cocuy, Alto de las Cuevas, 6°24'N, 72°27'W, 30 Dec. 1998, *Stancik & Carvajal 1881* (PRC). Cundinamarca: La

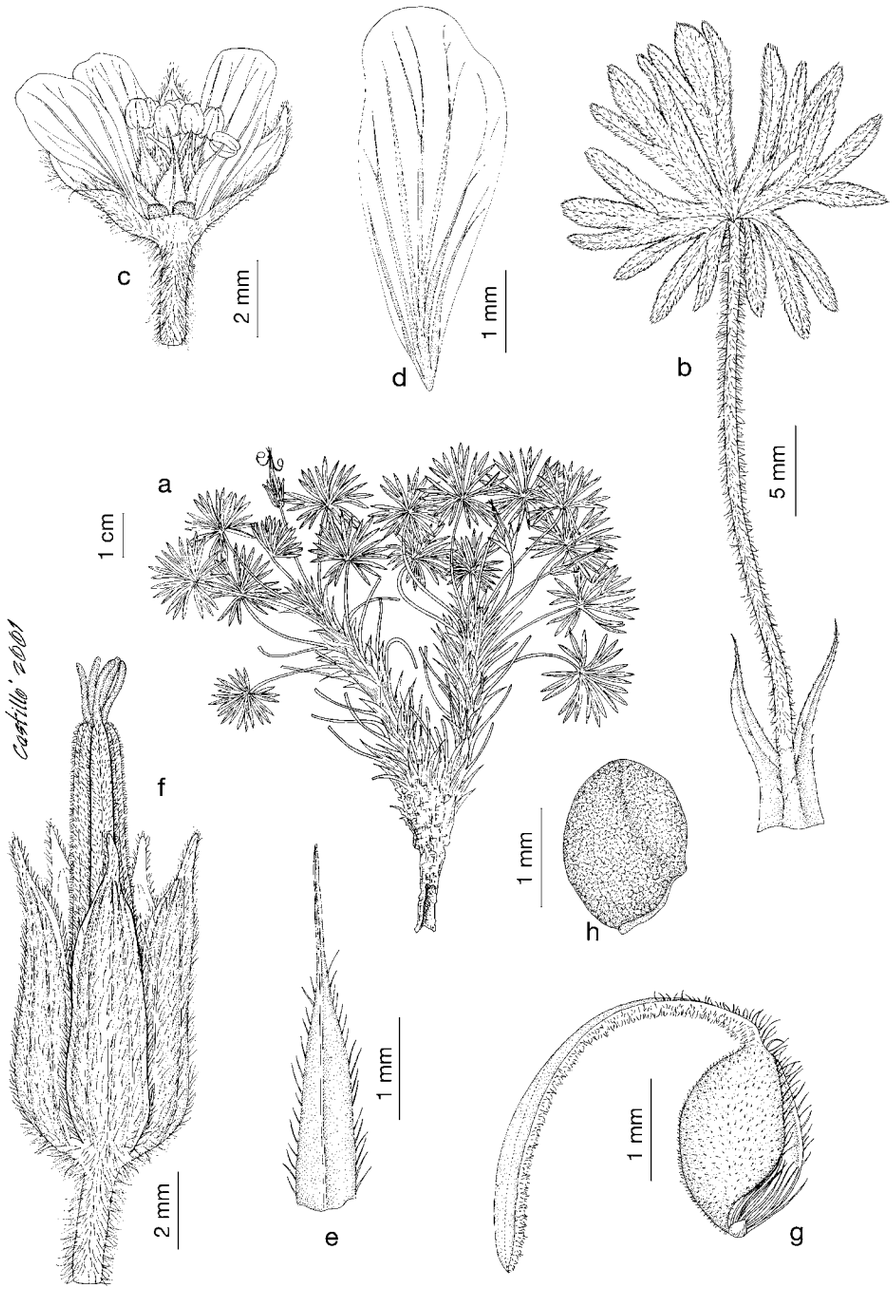


Fig. 448. *Geranium multipartitum*. a. Fruiting branch. b. Leaf. c. Flower. d. Petal. e. Staminal filament. f. Fruit. g. Mericarp. h. Seed. (Based on: a, b, *Øllgaard & al. 34087*, LD; c, d, *Holm-Nielsen & León 65*, C; e-h, *Barclay & Juajibioy 8008*, COL).

Fig. 449. *Geranium multipartitum* (Based on: a, *Aedo & al. 13032,* MA; b, *Aedo 13238,* MA; c, *Aedo 16539,* MA; d, e, *Calvo 7855*, LPB, photo: J. Calvo).

Calera, Parque Nacional de Chingaza, Laguna Seca, 4°41'N, 73°47'W, 5 Nov. 2000, *Díaz 148* (COL). Meta: Macizo de Sumapáz, Paso El Boquerón Alto del Buque, Cerro Nevado, vertiente S bajando hacia La Culebra, 3°59'N, 74°4'W, 4 July 1981, *Díaz Piedrahita & al. 2468* (COL, MO); Macizo de Sumapáz, Laguna La Media Naranja y la Balsa, 3°59'N, 74°4'W, 6 Dec. 1999, *Pedraza & al. 735* (COL). Risaralda: Parque de los Nevados, Laguna Otún, 4°49'N, 75°29'W, Jan. 1992, *Koops 123* (MA); Pereira, parque de los Nevados, 4°50'N, 75°45'W, 18 Jan. 1980, *Jaramillo & al. 5730* (COL, MA). Valle: Hoya del río Bugalagrande, Barragán, Páramo de Bavaya, 4°1'N, 75°52'W, 16 Mar. 1946, *Cuatrecasas 20083* (F, S); Tulúa, Barragán, 4°1'N, 75°52'W, 3 Dec. 1997, *Vargas 4135* (COL, HUA, S); márgenes del río Bugalagrande, Calamar, 4°10'N, 76°5'W, 6 Apr. 1946, *Cuatrecasas 20550* (F). **Ecuador.** Azuay: Laguna Toreadora, Las Cajas, 2°43'S, 79°12'W, 10 Sep. 1983, *Larsen & Eriksen 45013* (AAU); Páramo de Cajas, Chuspipuñuna, 2°48'S, 79°13'W, 20 July 2006, *Aedo & Ulloa 13098* (MA); Páramo de Tinajillas, 3°13'S, 79°4'W, 7 Mar. 1945, *Camp 2088* (BH, NY). Bolivar: W of volcán Chimborazo, 1°30'S, 78°56'W, 29 Nov. 1989, *Luteyn 13395* (NY). Cañar: Panamericana highway, between Cañar and Biblian, Fuganillas, 2°36'S, 78°54'W, 29 Aug. 1984, *Laegaard 52760* (AAU); Azogues-Pindilig road, km 21 from Azogues, 2°40'S, 78°46'W, 8 June 1979, *Løjtnant & Molau 14271* (AAU). Carchi: Nudo de Boliche, Voladero, 0°41'N, 77°54'W, 10 June 1939, *Penland & Summers 865* (F, GH); Páramo del Ángel, 0°43'N, 77°58'W, 21 June 1939, *Asplund s.n.* (S). Chimborazo: ladera N del volcán Cotopaxi, 0°39'S, 78°26'W, 1 Aug. 2006, *Aedo 13238* (MA). **Ecuador.** Chimborazo: ladera S del volcán Chimborazo, pr. Urbina, 1°27'S, 78°45'W, 31 Aug. 2006, *Aedo 13237* (MA); Riobamba, Sangay, 1°58'S,

Fig. 450. Distribution of *Geranium multipartitum*.

78°28'W (W). Cotopaxi: NW of Limpio Punga, 0°37'S, 78°27'W, 16 May 1984, *Laegaard 52117* (AAU); highway to Laguna Pisayambo, km 29, 1°5'S, 78°19'W, 21 Dec. 1976, *Boeke 582* (NY). El Oro: N Zaruma, Páramo Corredores, 3°45'S, 79°37'W, 9 Oct. 1947, *Espinosa 2187* (NY); N Zaruma, Páramo Corredores, 3°45'S, 79°37'W, 9 Oct. 1947, *Espinosa 2207* (NY). Imbabura: Cayambe, volcano Cayambe, 0°0'N, 78°1'W, 20 Oct. 2000, *Stancik 4167* (PRC); Cotacachi cantón, páramos entre Cotacachi y Yana Urcu, Ciénagas del Hospital, 0°27'N, 78°20'W, 16 Jan. 1991, *Palacios 6850* (AAU). Loja: de Jima a San Miguel, Páramo de Matanga, 3°13'S, 78°57'W, 18 July 2006, *Aedo, Minga & Ulloa 13032* (MA); Píntag, laguna de Mica, 0°32'S, 78°13'W, 3 Aug. 2006, *Aedo & León 13348* (MA). Pichincha: reserva Cayambe-Coca, vía a Baeza, 0°19'S, 78°11'W, 14 July 2006, *Aedo & Ulloa 12936* (MA); base del volcán Antisana, entrando por Pintag hacia la laguna de Micacocha, N de la laguna de Santa Lucía, 0°30'S, 78°10'W, 7 Oct. 1990, *Ulloa & al. 706* (AAU, QCA); Chaupi, ladera NE de los volcanes Ilinizas, 0°37'S, 78°41'W, 2 Aug. 2006, *Aedo 13346* (MA). Tungurahua: Reserva Faunística del Chimborazo, parroquia Pilahuin, unidad Mecha Huasca, sector Llama Guayuna junto a la quebrada Cunuyacu, 1°24'S, 78°49'W, 1 July 1992, *Cerón & al. 19173* (MO); 11 km S on Pan Am Highway from Mocha, on road to Riobamba, top saddle between Volcanoes Chimborazo and Igulata, 1°29'S, 78°43'W, 21 July 1977, *Iltis & Iltis 519* (MO). **Peru.** Cajamarca: alrededores de la laguna de San José, 6°50'S, 78°14'W, 19 Feb. 1994, *Sánchez Vega & Cabanillas 6763* (MA); pr. Cerro Yanahuanga, 6°51'S, 78°36'W, 17 June 2009, *Aedo 16539* (MA); prov. Cajamarca, Minas Conga, sector Huaylamachay, 6°51'S, 78°21'W, 1 Oct. 2005, *Granda 2477* (MA); Cuzco: Camino Inca, hacia Machu Pichu, Warmiwañusqua, 13°9'S, 72°29'W, July, *Aizpuru 3692CA* (MA); Urubamba, entre Huayllabamba y Warmihuañusca, Santuario histórico Machu Pichu, 13°9'S, 72°31'W, 22 Jan. 1989, *Núñez 10077* (MA). Huánuco: Tambo de Vaca, 9°50'S, 76°45'W, 10 June 1923, *Macbride 4401* (MA, G). La Libertad: Bolivar, Uchumarca, SW of Cerro Comulca, 7°4'S, 77°46'W, 9 Nov. 2013, *Bussmann & al. 18063* (MA); Uchumarca, SW cerro Comulca, 7°4'S, 77°46'W, 9 Nov. 2013, *Bussmann & al. 18063a* (MA); Bolivar, Uchuncha, SW side of Cerro Fila de Andosa, 7°7'S, 77°49'W, 14 Nov. 2013, *Bussmann & al. 18374* (MA).

Discussion. Geranium multipartitum can be distinguished from all other species treated here by its palmatisect leaves with nine segments and with ± scattered eglandular, subpatent hairs on both surfaces (but sometimes glabrous). It should be noted that the pair of basal segments is more or less perpendicular to the plane formed by the remaining segments of the leaf. *Geranium multipartitum* also has petioles and pedicels bearing patent, eglandular hairs. It has been frequently confused with *G. humboldtii*, a species characterized by its glabrous pedicels, and by its palmatisect leaves with seven segments, which are sericeous adaxially and glabrous abaxially. Two collections from Colombia (Depto. del Valle, *Cuatrecasas 20083, 20550*) have glabrous pedicels but otherwise are similar to other specimens of *G. multipartitum*. A specimen from Ecuador (Prov. Pichincha, *Barclay & Juajibioy 8894*) has leaves that are densely hairy adaxially, somewhat like *G. humboldtii*; however, the laminas have nine segments and agree with *G. multipartitum*. *Geranium heinrichsae* was based on *Heinrichs s.n.* (B), which was destroyed during the Second World War. Unfortunately, no duplicate of this collection has been found. Jørgensen & León (1999: 492) list the name as a synonym of *G. multipartitum*, an assignment that agrees with the original description (Knuth 1936: 216).

177. Geranium humboldtii Spreng., Syst. Veg. 3: 70. 1826, Type locality: "Amer. austr.? (G. potentilloides W. herb.)". Type: South America, *F.A. Humboldt & A. Bonpland s.n.* (lectotype, designated by Aedo & al. 2002: 249, B-W-12533-01-0 image!).

Geranium acaule Willd. ex Kunth in Humb., Bonpl. & Kunth, Nov. Gen. Sp. 5: 230. 1822, nom. illeg., non L., 1759. *Geranium sessiliflorum* var. *acaule* Kunth ex Reiche, Anales Univ. Chile 93: 573. 1895. Type locality: "Amer. austr.? (G. potentilloides W. herb.)". Type: Ecuador. Pichincha. Antisana, 0°30'S, 78°10'W, *F.A. Humboldt & A. Bonpland 2240* (lectotype, designated by Knuth 1912: 87, B-W-12530-01-0 image!; isolectotypes, BH-418693-fragment!, P-00136919!).

Geranium hypoleucum Benth., Pl. Hartw. 2: 166. 1845. Type locality: "Hacienda de Antisana". Type: Ecuador. Pichincha, Hacienda de Antisana, 0°30'S, 78°10'W, 1851, *K. Hartweg s.n.* (lectotype, designated by Aedo & al. 2002: 249, K!; isolectotype, BH-418694-fragment!).

Perennial herbs, 2-8 cm tall. *Rootstock* 2-12 mm in diameter, ± horizontal, not tuberculate, not turnip-shaped, without thickened roots. *Stem* scapiform, cushion-like, stolons absent, with short vegetative stems. *Basal leaves* in a persistent rosette; leaf laminas (0.6)1.1-1.5 cm long, 0.7-1.6 cm wide, not peltate, palmatisect, polygonal in outline, base cordate, not coriaceous, with nerves not projected, sericeous on the adaxial surface, with antrorse, appressed, eglandular hairs and glabrous abaxially; segments 7, in more than 1 plane, middle segment rhombic (with linear-lanceolate lobes), 0.4-1.1 mm wide at the base [ratio segment width at the base/middle segment length = 0.06-0.19], 3(4)-lobed in distal half [ratio secondary sinus length/middle segment length = 0.44-0.66]; petioles up to 7 cm long, without abscission zone, terete, not swollen, not deflexed in age, usually glabrous, sometimes with scattered, patent, eglandular hairs 0.8-1.2 mm long; stipules 5.1-14 mm long, 1.3-3 mm wide, lanceolate, free, papery, brownish red, glabrous on both surfaces, with patent, eglandular ciliae 0.2-0.3 mm long, ending in 1-2 bristles 0.3-0.8 mm long. *Cymules* 1-flowered, solitary [ratio cymule length/leaf length = 0.6-0.9]; peduncles 3.3-6 mm long, glabrous; bracteoles absent. Flowers actinomorphic. *Sepals* 5.7-7.5 mm long, 1.7-2.3 mm wide, lanceolate, smooth, not accrescent, nerves 3, mucro 0.5-0.6 mm long [ratio mucro length/sepal length = 0.09-0.12], glabrous or with scattered, eglandular hairs abaxially, erect-patent, eglandular hairs 0.2-1 mm long on the margin and adaxially. *Petals* (6.6)8.5-11 mm long, 1.6-4 mm wide, erect-patent, rounded, without claw, white to pink, usually glabrous, sometimes hairy on the basal 1/4 of their adaxial surface, gla-

brous abaxially, ciliate on the basal margin, with hairs 0.2-0.4 mm long. *Stamens* 10, both whorls bearing anthers; filaments 2.9-4 mm long, lanceolate or lanceolate with an abruptly narrowed apex, white, glabrous, or with eglandular hairs 0.2-0.4 mm long on the abaxial surface and margin; anthers 0.7-1 mm long, yellow. Nectaries 5, hemispheric, glabrous. *Gynoecium* 4-5 mm long, yellow. *Fruit* 10.8-12 mm long, erect, discharge of seed-ejection type; mericarps 2.2-3.1 mm long, 1.2-1.3 mm wide, without a strand of fibers, not compressed at the apex, smooth, without basal beak, with a basal callus, without a basal prong, brown, with antrorse, ± appressed, eglandular hairs 0.2-0.3 mm long; rostrum 5.6-7 mm long, without a narrowed apex, not twisted, with erect-patent, eglandular hairs 0.1-0.3 mm long; stigmatic remnants 1.1-1.9 mm long, with 5 hairy lobes. *Seeds* 1.6-1.9 mm long, 0.8-1.1 mm wide, finely reticulate, uniformly colored, brown, glabrous. Cotyledons with entire margin. Figs. 451, 452.

Pollen. *Geranium*-type (Aedo & al. 2002: 217).

Chromosome number. Unknown.

Phenology. Collected in flower from February to December.

Distribution. This species ranges from central and northern Ecuador to northern Peru (Fig. 453).

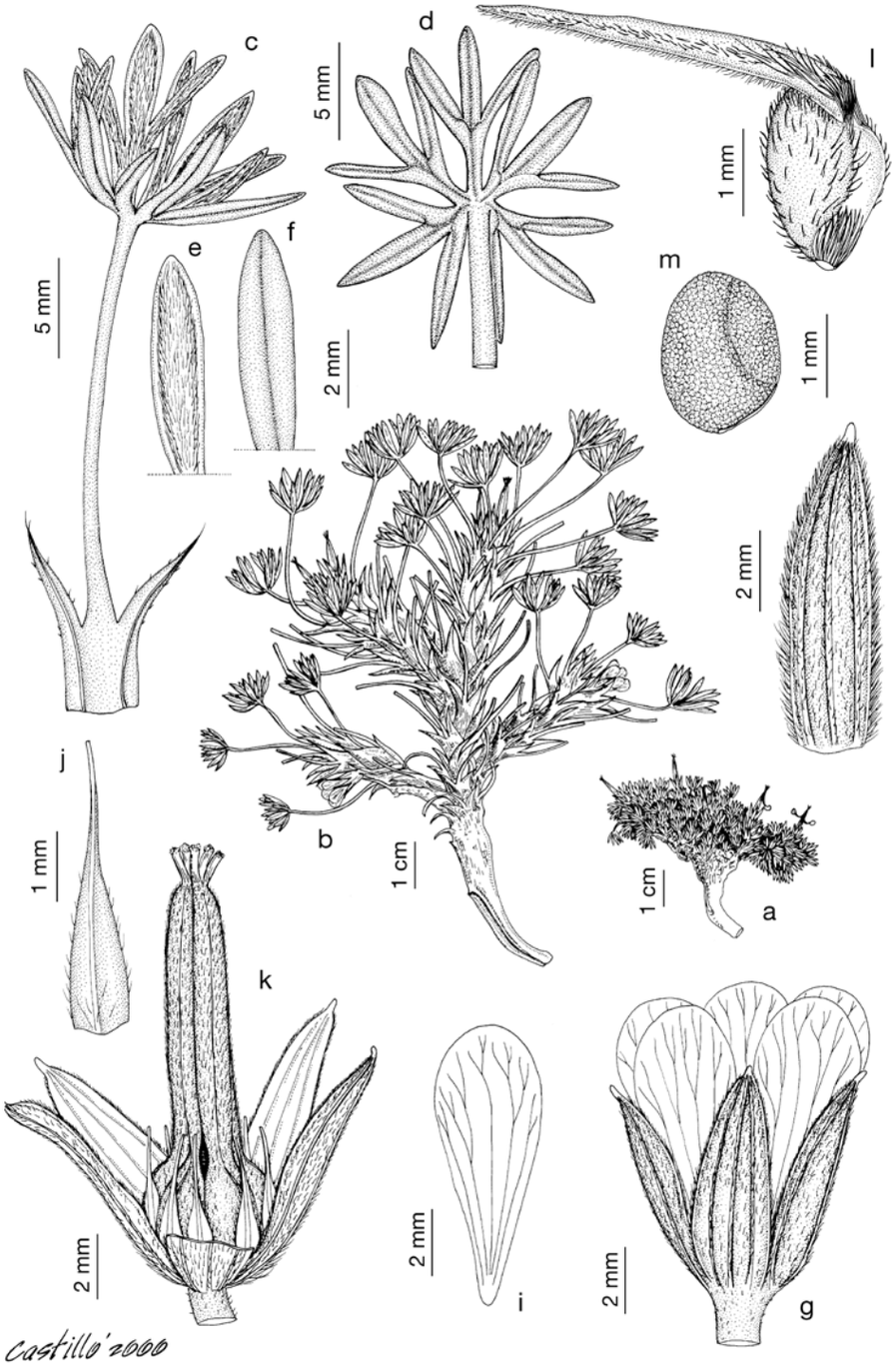


Fig. 451. *Geranium humboldtii*. a. Habit. b. Fruiting branch. c, d. Leaves. e. Leaf lobe, abaxial view. f. Leaf lobe, adaxial view. g. Flower. h. Sepal. i. Petal. j. Staminal filament. k. Fruit. l. Mericarp. m. Seed. (Based on: a, l, m, *Bonpland 2240*, P; b-k, *Cazalet & Pennigton 5758*, B).

Fig. 452. *Geranium humboldtii* (Based on: *Aedo 13230,* MA).

Habitat. Grassy and rocky slopes, on cushions of *Azorella* Lam. and *Plantago* L., and boggy depressions in paramos; 3500-5000 m.

Additional specimens examined. **Ecuador.** Chimborazo: ladera S del volcán Chimborazo, pr. Urbina, 1°27'S, 78°45'W, 31 Aug. 2006, *Aedo 13232* (MA); Cerro Chimborazo neben dem derrubio von Pucahuaico, 1°28'S, 78°48'W, 11 Aug. 1935, *Heinrichs 962b* (G); between Urbina and Mt. Chimborazo, 1°28'S, 78°48'W, 4 Oct. 1923, *Hitchcock 21939* (US); between Urbina and Mt. Chimborazo, 1°28'S, 78°48'W, 4 Oct. 1923, *Hitchcock 21988* (GH, NY); Chimborazo, 1°28'S, 78°48'W, 6 May 1927, *Rorud s.n.* (O); Páramo de Tililac, pr. San Juan, 1°38'S, 78°50'W, 31 Aug. 2006, *Aedo 13230* (MA). Cotopaxi: W side of Muro Urcu, 0°47'S, 78°24'W, 1 Apr. 1979, *Holm-Nielsen 16498* (AAU, LD, MO, NY); Pilalo-Latacunga road E, 0°54'S, 78°49'W, 4 July 1968, *Holm-Nielsen & Jeppesen 1333A* (AAU, NY); near origin of Río Langoa, E of Latacunga, Laguna Salayambo Cocha, 0°56'S, 78°25'W, 30 Sep. 1976, Øllgaard *& Balslev 9866B* (AAU, NY); road Salcedo-Napo km 27-29, 1°0'S, 78°30'W, 9 May 1967, *Sparre 18439b* (S). Napo: Antisano Volcano, 60 km due SE of Quito, border with Pichincha, 0°28'S, 78°5'W, 14 June 1991, *Gentry & Ortiz 74367* (MO); Páramo de Loma Gorda, along río Antisana, below Micacocha, 0°37'S, 78°10'W, 3 Nov. 1979, *Holm-Nielsen 20287* (MO); Páramo de Loma Gorda, along río Antisana, below Micacocha, 0°37'S, 78°10'W, 3 Sep. 1979, *Holm-Nielsen 20827* (AAU); valle Vicioso E of volcán Cotopaxi and N of Mt. Quilindaña, 0°45'S, 78°20'W, 22 May 1988, *Balslev & al. 69179A* (AAU); Quilindaña, 0°45'S, 78°19'W, June 1903, *Meyer 183* (JE); Quilindaña, 0°47'S, 78°21'W, June, *Bornmüller 183* (JE); Páramo de Quilindaña, Laguna Yurac Cocha, 0°47'S, 78°21'W, 31 Feb. 1979, *Kieft & al. 183* (U); around Laguna Yuragcocha, 3 km E peak Cerro Quilindaña, 0°47'S, 78°21'W, 31 Mar. 1979, *Løjtnant & Molau 11617A* (AAU). Napo-Pastaza: alrededores de La Cordillera de los Llanganati, Chihuila Sacha o Ainchilibí, 1°13'S, 78°15'W, 25 Aug. 1959, *Barclay & Juajibioy 8979* (MO).Napo-Pichincha: SW slopes of Vulcan Antisana, 0°30'S, 78°10'W, 4 Dec. 1982, *Barfod & Pennington 41258* (AAU). Pichincha: NE side of Cayambe Mountain, 0°1'N, 78°1'W, 12 Dec. 1961, *Cazalet & Pennington 5758* (B, NY, US); Nevado Cayambe, 0°1'N, 78°1'W, 1 July 1995, *Sklenář & Kosteckova 50-8* (C); in pascuis superior Paluguillo, 0°15'S, 78°18'W, *Mille s.n.* (QPLS); E slope of Iliniza Sur, 0°40'S, 78°42'W, 28 May 1995, *Sklenář & Kosteckova 16-11* (NY). Pichincha-Cotopaxi: E slope of Iliniza Sur, 0°40'S, 78°42'W, 28 May 1995, *Sklenář & Kosteckova 18-12* (QCA). Tungurahua: Páramo del Caryhuayrazo, lado SW, entrando por el arenal del Chimborazo, 1°24'S, 78°48'W, 1 Aug. 1988, *Cerón & al. 4396* (MO). Tungurahua-Napo-Pastaza: el Romo Páramo al E de San José de Poaló, very long crest of divide between Poaló and El Río Burro Portrero, 1°6'S, 78°28'W, 31 Aug. 1959, *Barclay & Juajibioy 9225* (MO). **Peru.** Cajamarca: Sexcemayo, siguiendo la ruta a Cumbe Mayo, 7°20'S, 78°25'W, 17 Nov. 1992, *Sánchez Vega & Castillo 6449* (MA).

Fig. 453. Distribution of *Geranium humboldtii*.

Discussion. Geranium humboldtii can be distinguished from all other species treated here by the palmatisect leaves, which are adaxially white-sericeous and abaxially glabrous. All other "sericeous" and stemless species from the Andes have leaves with a dense indumentum on both surfaces. *Geranium humboldtii* has sometimes been confused with *G. multipartitum*, because both share deeply divided leaves (with basal segments in a perpendicular plane); however, *G. multipartitum* differs for *G. humboldtii* in that its leaves have ± scattered, subpatent hairs on both surfaces (or are sometimes glabrous). A collection from Peru (Cajamarca, *Sánchez & Castillo 6449*) differs in its abaxially hairy instead of glabrous petals and lanceolate rather than subulate staminal filaments, but otherwise it matches other specimens of *G. humboldtii*.

178. Geranium macbridei Aedo, Anales Jard. Bot. Madrid 58: 358. 2001. Type locality: "Perú. Pasco, Chasqui, Macbride 3296 (F!); ISÓTIPOS: G! US! W!". Type: Peru. Pasco, Chasqui, 10°25'S, 76°27'W, 10 Apr. 1923, *J.F. Macbride 3296* (holotype, F-0041220F!; isotypes, G-00365888!, US-00610928!, W!).

Perennial herbs, 2.5-7 cm tall. *Rootstock* 5-8 mm in diameter, ± vertical, not tuberculate, not turnip-shaped, without thickened roots. *Stem* scapiform, cushion-like, stolons absent, with short vegetative stems. *Basal leaves* in a persistent rosette; leaf laminas 1-2.1 cm long, 1.1-2.1 cm wide, not peltate, palmatisect, polygonal in outline, base cordate, not coriaceous, with nerves not projected, pilose, with ± scattered antrorse, appressed eglandular hairs (on margin and nerves) on both surfaces; segments 7, in more than 1 plane, middle segment obtriangular (with linear-lanceolate lobes), 1-1.2 mm wide at the base [ratio segment width at the base/ middle segment length = 0.07-0.10], 3-lobed in distal half [ratio secondary sinus length/middle segment length = 0.54-0.65]; petioles up to 5 cm long, without abscission zone, terete, not swollen, not deflexed in age, with retrorse, appressed, eglandular hairs 0.2-0.4 mm long; stipules 9-12 mm long, 1-1.5 mm wide, lanceolate, free, papery, brownish red, glabrous or with scattered, eglandular hairs. *Cymules* 1-flowered, solitary [ratio cymule length/leaf length = 0.6-0.7]; peduncles 9-21 mm long, with retrorse, appressed, eglandular hairs 0.2-0.4 mm long; bracteoles absent. Flowers actinomorphic. *Sepals* 6.5-6.7 mm long, 2-2.2 mm wide, lanceolate, smooth, not accrescent, nerves 3, mucro 0.4-0.6 mm long [ratio mucro length/sepal length = 0.06-0.08], glabrous on the abaxial surface, with scattered, eglandular hairs 0.2-0.4 mm long on adaxial surface and erect-patent, eglandular hairs 0.4-0.6 mm long on the margin. *Petals* 9.5-13 mm long, ca. 4 mm wide, erect-pat-

ent, rounded, without claw, purple, sometimes white, glabrous. *Stamens* 10, both whorls bearing anthers; filaments ca. 4 mm long, lanceolate with an abruptly narrowed apex, yellow, with eglandular hairs 0.2-0.5 mm long on the abaxial surface and margin; anthers ca. 1 mm long, purple. Nectaries 5, hemispheric, with a tuft of hairs at the top, dorsally glabrous. *Gynoecium* 4-4.5 mm long, purple. *Fruit* 12-13 mm long, erect, discharge of seed-ejection type; mericarps ca. 2.4 mm long, 1.2 mm wide, without a strand of fibers, not compressed at the apex, smooth, without basal beak, with a basal callus, without a basal prong, brown, with scattered antrorse, eglandular hairs 0.2-0.5 mm long on margins and on the dorsal nerve; rostrum ca. 11 mm long, with a narrowed apex 1 mm long, not twisted, with erect-patent, eglandular hairs 0.1 mm long; stigmatic remnants 2-2.5 mm long, with 5 glabrous lobes. *Seeds* ca. 1.7 mm long, 1.3 mm wide, finely reticulate, uniformly colored, brown, glabrous. Cotyledons with entire margin. Fig. 454.

Pollen. *Geranium*-type (Aedo & al. 2002: 216).

Chromosome number. Unknown.

Phenology. Collected in flower in April.

Distribution. This species is endemic to central Peru (Fig. 455).

Habitat. Wet and grassy stream slopes; ca. 3000 m.

Discussion. Geranium macbridei is only known from the type, a flowering and fruiting collection from Pasco, Peru. It is most similar to *G. multipartitum*. These two differ from all other stemless species from the Andes by their palmatisect leaves without sericeous vesture. In *G. macbridei* the laminas have scattered antrorse, appressed hairs on the margin and on the nerves on both surfaces, whereas in *G. multipartitum* the leaves have scattered subpatent hairs on both surfaces (or rarely are glabrous). In *G. macbridei* the petioles and pedicels bear retrorse, appressed hairs 0.2-0.4 mm long, whereas those of *G. multipartitum* have patent hairs 0.2-1.1 mm long (or are rarely glabrous). *Geranium macbridei* is also easy to differentiate from *G. multipartitum* by its much longer petals, hairy nectaries, and fruits with a narrowed apex.

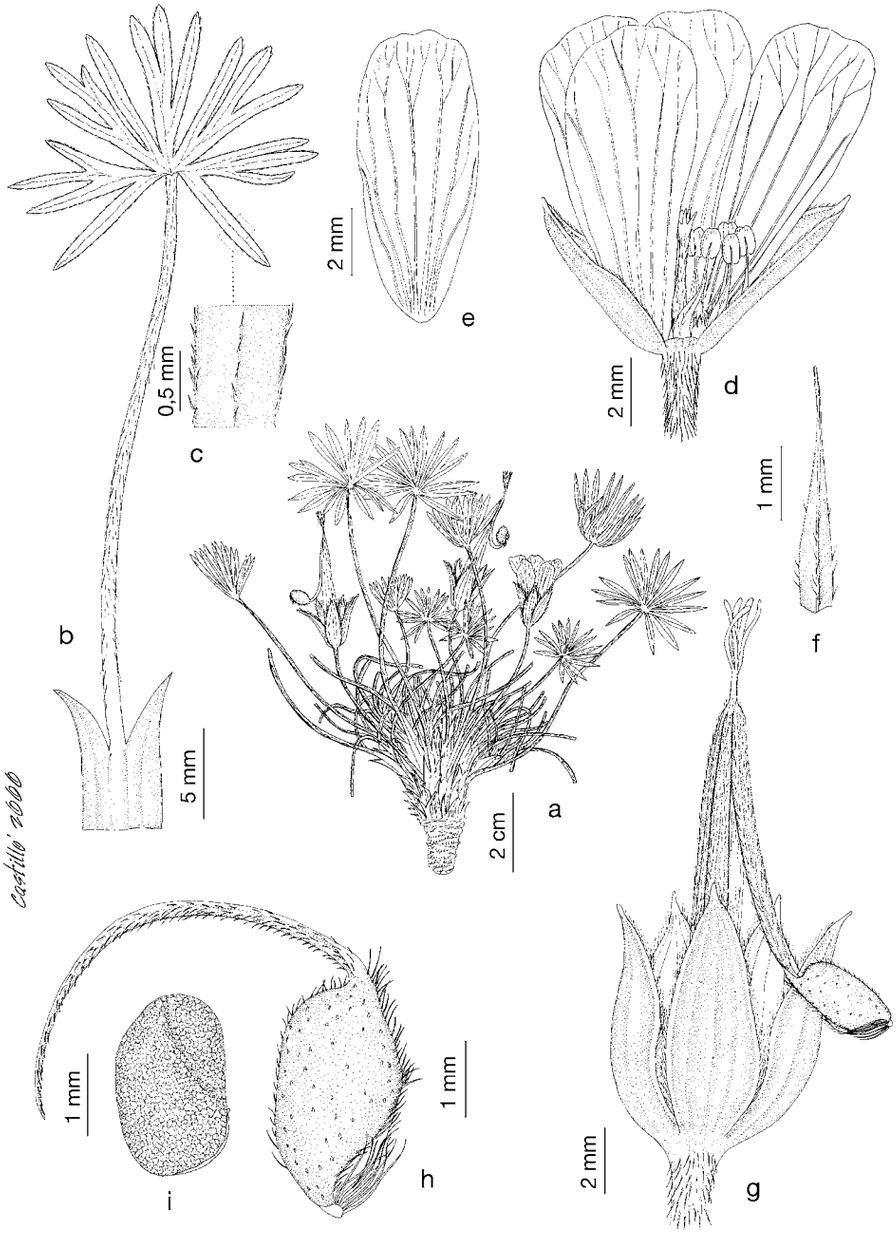


Fig. 454. *Geranium macbridei*. a. Fruiting branch. b. Leaf. c. Leaf detail. d. Flower. e. Petal. f. Staminal filament. g. Fruit. h. Mericarp. i. Seed. (Based on: a-c, *Macbride 3296*, F; d-f, *Macbride 3296*, US; g-i, *Macbride 3296*, W).

Fig. 455. Distribution of *Geranium macbridei*.

179. Geranium sagasteguii Aedo, Harvard Papers Bot. 9: 1, 2 fig. 1. 2004. Type locality: "Peru: La Libertad, Santiago de Chuco, Laguna Coipín, 7°46'0"S, 78°3'59" W, 11 June 2001, A. Sagastegui, S. Leiva & M. Zapata J 6702 (Holotype: MA [658508]; Isotype: F [n.v.])". TYPE: Peru. La Libertad, Santiago de Chuco, Laguna Coipín, 7°46'S, 78°03'W, 11 June 2001, *A. Sagástegui, S. Leiva & M. Zapata 16702* (holotype, MA-658508!; isotype, F-0076167F image!).

Perennial herbs, 3.5-6.2 cm tall. *Rootstock* 3.7-7.5 mm in diameter, ± vertical, not tuberculate, not turnip-shaped, without thickened roots. *Stem* scapiform, cushion-like, stolons absent, without vegetative stems. *Basal leaves* in a persistent rosette; leaf laminas 0.4-1.3 cm long, 0.3-1.5 cm wide, not peltate, palmatifid [ratio main-sinus length/middle segment length = 0.77-0.87], polygonal in outline, base cordate, not coriaceous, with nerves not projected, glabrous on both surfaces, with antrorse, appressed, eglandular hairs 0.1-0.2 mm long on the margin; segments 5, in 1 plane, middle segment obtriangular (with oval-lanceolate lobes), 0.86-2.57 mm wide at the base [ratio segment width at the base/middle segment length = 0.17-0.35], 3-lobed at the apex [ratio secondary sinus length/middle segment length = 0.31-0.49]; petioles up to 3 cm long, without abscission zone, terete, not swollen, not deflexed in age, with retrorse, appressed, eglandular hairs 0.2-0.5 mm long; stipules 7.1-10.2 mm long, 1-1.9 mm wide, lanceolate, free, papery, brownish red, glabrous except for some appressed, eglandular hairs on the margin, without apical bristles. *Cymules* 1-flowered, solitary [ratio cymule length/leaf length = 0.9-1.5]; peduncles 13-33 mm long, glabrous, rarely with retrorse, appressed, eglandular hairs 0.3-0.5 mm long; bracteoles absent. Flowers actinomorphic. *Sepals* (6.9)8.1-12 mm long, 2.1-3.9 mm wide, lanceolate, smooth, not accrescent, nerves 3, mucro 0.3-0.5 mm long [ratio mucro length/sepal length = 0.04-0.07], with antrorse, appressed, eglandular hairs 0.2-0.7 mm long on the abaxial surface (only a line near each margin), glabrous adaxially. *Petals* (12.7)15.3-21 mm long, 3-7.5 mm wide, erect-patent, rounded, without claw, white, glabrous. *Stamens* 10, both whorls bearing anthers; filaments 3.6-5.3 mm long, lanceolate, yellow, glabrous, rarely with some hairs 0.2-0.5 mm long on its margins; anthers 1-1.4 mm long, unknown color. Nectaries 5, hemispheric, with a tuft of hairs at the top,

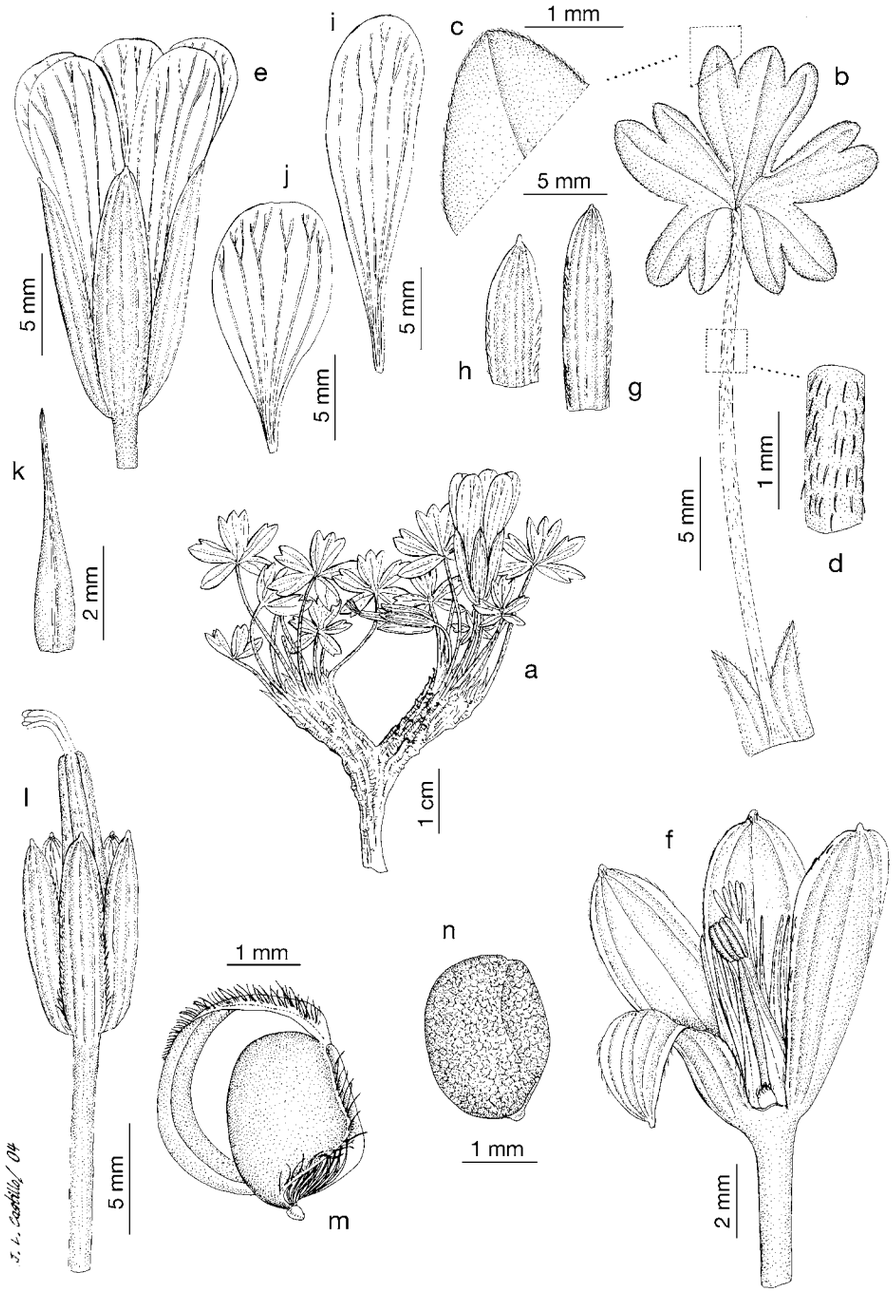


Fig. 456. *Geranium sagasteguii*. a. Habit. b. Leaf. c. Detail showing leaf lobe. d. Detail showing indumentum of petiole. e. Flower. f. Flower, petals removed. g, h. Sepals. i, j. Petals. k. Staminal filament. l. Fruit. m. Mericarp. n. Seed. (Based on: *Sagastegui & al. 16702*, MA).

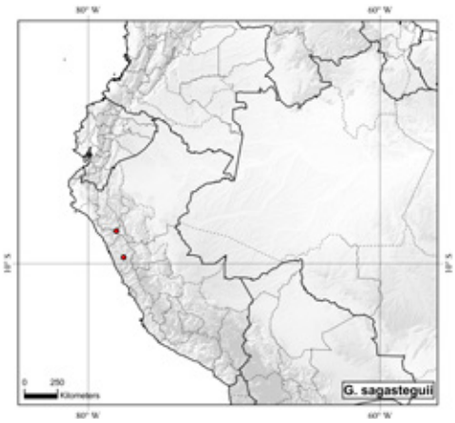


Fig. 457. Distribution of *Geranium sagasteguii*.

dorsally glabrous. *Gynoecium* 4.9-5.8 mm long, yellow. *Fruit* 11.7-14.6 mm long, erect, discharge of seed-ejection type; mericarps 2.6-2.7 mm long, 1.7-2 mm wide, without a strand of fibers, not compressed at the apex, smooth, without basal beak, with a basal callus, without a basal prong, brown, with antrorse, ± appressed, eglandular hairs ca. 0.5 mm long on the basal margin; rostrum 7.9-9.1 mm long, without a narrowed apex, not twisted, glabrous; stigmatic remnants 1-2.1 mm long, with 5 glabrous lobes. *Seeds* ca. 2.1 mm long, 1.5 mm wide, finely reticulate, uniformly colored, brown, glabrous. Cotyledons not studied. Fig. 456.

Pollen. *Geranium*-type (Aedo 2012: 10).

Chromosome number. Unknown.

Phenology. Collected in flower from June to November.

Distribution. This species is endemic to northern Peru (Fig. 457).

Habitat. Paramo-like zones called "jalca", in rocky or wet grassy places; 4000-4100 m.

Additional specimens examined. **Peru.** Ancash: Huari, Juprog, entre el caserío y la laguna, 9º34'S, 77º33'W, 24 Nov. 2006, *Cano & al. 17209* (MA). La Libertad: Santiago de Chuco, jalca de Coipín, 7º46'S, 78º3'W, 16 June 1984, *Sagástegui & al. 11975* (F, MO).

Discussion. Geranium sagasteguii is a rare endemic of Peru. Among the species of *Geranium* in South America, it resembles most closely *G. paludosum*, from which it is easy to differentiate by its usually glabrous pedicels, glabrous and longer petals, longer sepals that are hairy only on a line near each margin (not on the entire abaxial surface), nectaries with a tuft of hairs at the apex, and glabrous staminal filaments. The leaves are quite similar in both species, palmatifid and almost glabrous; yet, on closer inspection, differences become apparent: *G. paludosum* has narrow lobes and patent hairs on the margin, while *G. sagasteguii* has wide lobes and antrorse, appressed hairs. In addition, the geographical ranges of the two species do not overlap; *G. paludosum* is endemic to Sierra de Santa Marta of northern Colombia. *Geranium sagasteguii* could be confused with some specimens of *G. sessiliflorum* from northern Peru that have leaves not as deeply lobed and almost glabrous (hairs restricted to margins and nerves of the abaxial surface). These specimens, however, can easily be identified as *G. sessiliflorum* by the sepals, which bear long, patent hairs on the margins (more or less pectinate). In *G. sagasteguii* the hairs on the sepals are antrorse, appressed, and restricted to a narrow marginal line. One specimen of *G. sagasteguii* collected in Ancash (*A. Cano & al. 17209*) has sepals and petals a bit shorter than those collected at the type locality and pedicels with scattered retrorse hairs, but it otherwise matches the type of *G. sagasteguii.*

180. Geranium jaekelae J.F. Macbr., Candollea 6: 7. 1934, [-XII-1934]. *Geranium minimum* R. Knuth, Bot. Jahrb. Syst. 37: 567. 1906, nom. illeg., non Cav. 1787. Type locality: "Peru: Dep. Junin bei La Oroya auf ebenen Polster- und Rosettenpflanzenmatten bei 4300 m (Weberbauer n. 2623!).- Blühend und fruchtend im Februar". Type: Peru. Junín, La Oroya, 11°32'S, 75°54'W, *A. Weberbauer 2623* (lectotype, designated by Aedo & al. 2002: 250, G-00365890!; isolectotype, WRSL!).

Perennial herbs, 0.2-1.3 cm tall. *Rootstock* 4-11 mm in diameter, vertical, not tuberculate, not turnip-shaped, without thickened roots. *Stem* scapiform, cushion-like, stolons absent, without vegetative stems. *Basal leaves* in a persistent rosette; leaf laminas 0.3-1.3 cm long, 0.5-1.5 cm wide, not peltate, palmatifid [ratio main-sinus length/middle segment length = 0.52-0.71], polygonal in outline, base cordate, not coriaceous, with nerves not projected, glabrous or scattered hairy on both surfaces, with antrorse, eglandular cilia 0.2-0.3 mm long on the margin; segments 5, in 1 plane, middle segment obtriangular or broadly lanceolate, 0.9-2.8 mm wide at the base [ratio segment width at the base/middle segment length = 0.29-0.41], 1-3-lobed at the apex [ratio secondary sinus length/middle segment length = 0.11-0.19]; petioles up to 3 cm long, without abscission zone, terete, not swollen, not deflexed in age, with antrorse, appressed, eglandular hairs 0.2-0.4 mm long; stipules 3-6 mm long, 0.8-1 mm wide, lanceolate, free, papery, brownish red, with eglandular hairs on abaxial surface and on the margin, glabrous adaxially. *Cymules* 1-flowered, solitary [ratio cymule length/leaf length = 0.5-1]; peduncles 2-14.3 mm long, with antrorse, appressed, eglandular hairs 0.2-0.4 mm long; bracteoles absent. Flowers actinomorphic. *Sepals* 3.9-5.2 mm long, 1.3-2.1 mm wide, lanceolate, smooth, not accrescent, nerves 3, mucro 0.3-0.5 mm long [ratio mucro length/sepal length = 0.07-0.14], with erect-patent, eglandular hairs 0.2-0.4 mm long on the abaxial surface (patent hairs 0.8-1.2 mm long on the margin), glabrous adaxially. *Petals* 5-7.1 mm long, 1.5-2.8 mm wide, erect-patent, rounded, without claw, white, glabrous. *Stamens* 10, both whorls bearing anthers; filaments 2-2.7 mm long, lanceolate, white, glabrous, or with few eglan-

dular hairs 0.2-0.3 mm long on the abaxial surface and margin; anthers 0.5-0.8 mm long, yellow. Nectaries 5, hemispheric, glabrous. *Gynoecium* 2-3 mm long, white. *Fruit* 8.2-10 mm long, erect, discharge of seed-ejection type; mericarps 2-2.8 mm long, 0.8-1.3 mm wide, without a strand of fibers, not compressed at the apex, smooth, without basal beak, with a basal callus, without a basal prong, brown, with antrorse, ± appressed, eglandular hairs 0.2-0.8 mm long; rostrum 4.6-8 mm long, without a narrowed apex, not twisted, with erect-patent, eglandular hairs 0.1-0.2 mm long; stigmatic remnants 0.4-0.9 mm long, with 5 hairy lobes. *Seeds* 1.6-1.9 mm long, 1.1-1.2 mm wide, finely reticulate, uniformly colored, brown, glabrous. Cotyledons with entire margin. Figs. 458, 459.

Pollen. Ornamentation not studied.

Chromosome number. Unknown.

Phenology. Collected in flower from May to August.

Distribution. This species ranges through central Peru (Fig. 460).

Habitat. Meadows, rocky slopes and bogs; 3850-4800 m.

Additional specimens examined. **Peru.** Ancash: Cordillera Negra, cerca del tunel Kawish, 9°41'S, 77°15'W, 22 May 2013, *Aedo & Molina 20366* (MA). Huánuco: Lauricocha, San Miguel de Cauri, Laguna Lauricocha, 10°18'S, 76°41'W, 7 Aug. 2002, *Salvador & al. 524* (MA). Junín: Yauli, Ticlio, 11°36'S, 76°12'W, 13 June 1940, *Asplund 11643* (S). La Libertad: de Chugay a Molino Viejo, 7°47'S, 77°46'W, 28 June 2009, *Aedo & Zapata 16679* (MA). Lima: Cordillera Raura, base del pico Torre de Cristal, 10°29'S, 76°45'W, 30 May 2013, *Aedo & Molina 20558* (MA). Pasco: Abra Ucchuchacua, 10°36'S, 76°40'W, 31 May 2013, *Aedo & Molina 20572* (MA).

Discussion. Geranium jaekelae, a rare endemic from central Peru, differs from sympatric scapiform species by its small leaves with entire to three lobed segments and antrorsely hairy petioles and pedicels. It also has short cymules, reduced to a 1-flowered peduncle without bracteoles. The original material (*Weberbauer 2623*) has glabrous leaves, except for some antrorse cilia on the margin. The other known collections show sparse hairs on both surfaces. *Geranium jaekelae* approaches some forms of *G. sessiliflorum;* however, *G. jaekelae* differs for *G. sessiliflorum* in that its leaves are smaller, less deeply divided and usually with entire segments and that its petioles and pedicels are antrorsely hairy. Additionally, *G. jaekelae* lacks the characteristic turnip-shaped rootstock and sepals with pectinate margin of *G. sessiliflorum.*

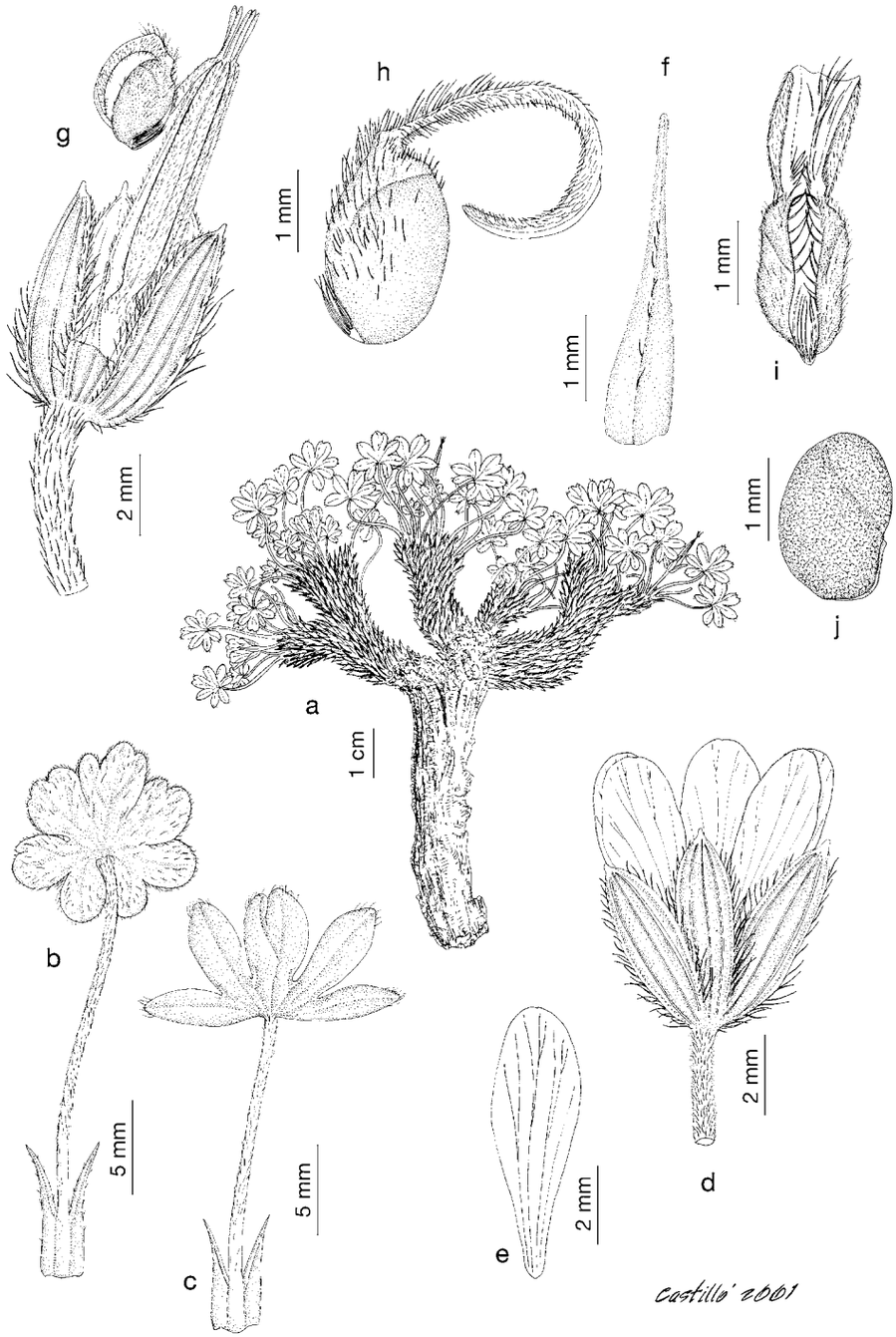


Fig. 458. *Geranium jaekelae*. a. Habit. b, c. Leaves. d. Flower. e. Petal. f. Staminal filament. g. Fruit. h, i. Mericarps. j. Seed. (Based on: a, c, *Weberbauer 2623*, G; b, d-j, *Asplund 11643*, S).

Fig. 459. *Geranium jaekelae* (Based on: a, b, *Aedo 16679,* MA; c, *Aedo & Molina 20558,* MA; d, *Aedo & Molina 20572,* MA).

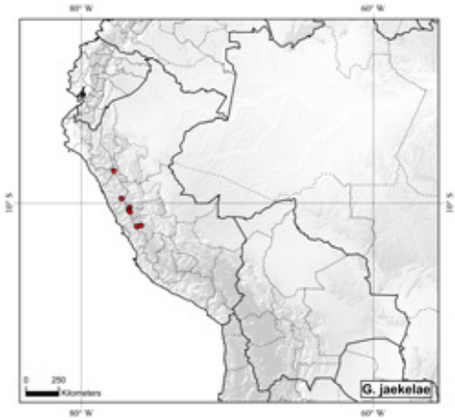


Fig. 460. Distribution of *Geranium jaekelae*.

181. Geranium pavonianum Briq., Annuaire Conserv. Jard. Bot. Genève 11-12: 183. 1908. Type locality: "Peruvia (verisim. ex Andibus editioribus, Pavon n. 110)". Type: Peru. without locality, *H. Ruiz & J. Pavón s.n.* ["110" in G specimen] (lectotype, designated by Knuth 1912: 83, G-00365897!; isolectotypes, CONC-43408!, MA!).

Perennial herbs, 1-4 cm tall. *Rootstock* 4-10 mm in diameter, vertical, not tuberculate, not turnip-shaped, without thickened roots. *Stem* scapiform, cushion-like, stolons absent, without vegetative stems. *Basal leaves* in a persistent rosette; leaf laminas 0.5-1.1 cm long, 0.6-1.2 cm wide, not peltate, palmatifid [ratio main-sinus length/middle segment length = 0.61-0.78], polygonal in outline, base cordate, not coriaceous, with nerves not projected, densely hairy on both surfaces; segments 5, in 1 plane, middle segment broadly obovate, 1.2-2.2 mm wide at the base [ratio segment width at the base/middle segment length = 0.31-0.33], 1(3)-lobed at the apex [ratio secondary sinus length/middle segment length = 0.15-0.21]; petioles up to 2 cm long, without abscission zone, terete, not swollen, not deflexed in age, with patent to retrorse, eglandular hairs 0.2-0.3 mm long; stipules 3-6.5 mm long, 0.9-1 mm wide, lanceolate, free, papery, brownish red, with eglandular hairs on abaxial surface and on the margin, glabrous adaxially (without bristles). Cymules 1-flowered, solitary [ratio cymule length/leaf length = 0.7-0.8]; peduncles 5-22 mm long, with patent to retrorse, eglandular hairs 0.2-0.3 mm long; bracteoles absent. Flowers actinomorphic. *Sepals* 3.5-6.6 mm long, 1.8-2 mm wide, lanceolate, smooth, not accrescent, nerves 3, mucro 0.5-0.8 mm long [ratio mucro length/sepal length = 0.10-0.12], densely hairy, with erect-patent, eglandular hairs 0.2-0.5 mm long on the abaxial surface and margin, glabrous adaxially. *Petals* ca. 9 mm long, 3.5 mm wide, erect-patent, rounded, without claw,

white, glabrous. *Stamens* 10, both whorls bearing anthers; filaments 2-3.2 mm long, lanceolate, yellow, with eglandular hairs 0.2-0.5 mm long on the abaxial surface and margin; anthers 0.5-0.7 mm long, yellow. Nectaries 5, hemispheric, glabrous. *Gynoecium* ca. 3 mm long, yellow. *Fruit* 11-13.4 mm long, erect, discharge of seed-ejection type; mericarps 2.2-3 mm long, 1.2-1.4 mm wide, without a strand of fibers, not compressed at the apex, smooth, without basal beak, with a basal callus, without a basal prong, brown, with patent, eglandular hairs 0.1-0.2 mm long; rostrum 8-8.7 mm long, without a narrowed apex, not twisted, with erect-patent, eglandular hairs 0.1-0.2 mm long; stigmatic remnants 1.2-1.5 mm long, with 5 glabrous lobes. *Seeds* 1.9-2 mm long, 1.1 mm wide, finely reticulate, uniformly colored, brown, glabrous. Cotyledons with entire margin. Fig. 461.

Pollen. *Geranium*-type (Aedo & al. 2002: 217).

Chromosome number. Unknown.

Phenology. Unknown.

Distribution. This species is endemic to central Peru (Fig. 462).

Habitat. Puna grassland dominated by *Calamagrostis* Adans. on granitic outcrops; 4200-4600 m.

Additional specimens examined. **Peru.** Ancash: Huaylas, Huascarán National Park, quebrada Alpamayo, at foot of Alpamayo and Quitaraju, 8º53'S, 77º41'W, 8 Mar. 1985, *Smith & al. 9749* (F, ISC, MO); Huari, Huascarán National Park, quebrada Rima Rima, a lateral valley of Quebrada Carhuazcancha, 9º28'S, 77º15'W, 7 May 1986, *Smith & al. 12332* (ISC, MO).

Discussion. Geranium pavonianum, a rare endemic of central Peru, is characterized by its densely hairy (but not sericeous) palmatifid leaves with five broadly obovate and usually entire segments. One collection (*Smith & al. 9749*, MO) has many leaves with segments that are 3-lobed at the apex but matches *G. pavonianum* otherwise. This species bears some resemblance to *G. sessiliflorum*, which differs in its characteristic turnip-shaped rootstock, sepals with pectinate mar-

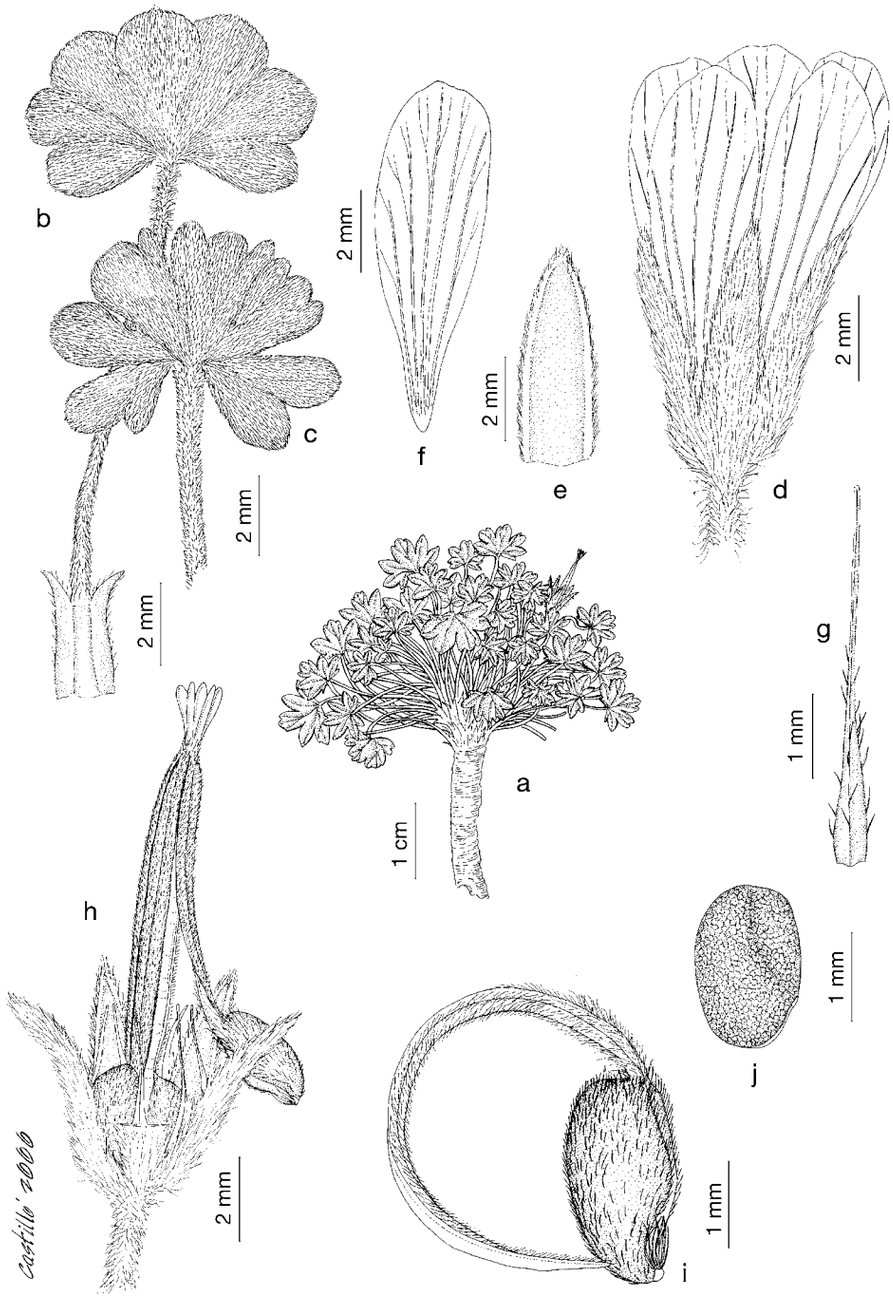


Fig. 461. *Geranium pavonianum*. a. Habit. b, c. Leaf. d. Flower. e. Sepal. f. Petal. g. Staminal filament. h. Fruit. i. Mericarp. j. Seed. (Based on: a, g-j, *H. Ruiz & Pavón 110*, G; b, *Smith & al. 9749*, F; c, *Smith & al. 9749*, MO; d-f, *Smith & al. 12332*, MO).

Fig. 462. Distribution of *Geranium pavonianum*.

gin, longer leaves with more lobed segments, and a longer sepal mucro. The paucity of collections of *G. pavonianum* does not permit a comprehensive evaluation of character variability. Additional collections of *G. pavonianum* may help to clarify the differences that separate it from *G. sessiliflorum*.

182. Geranium crassipes Hook. ex A. Gray, U.S. Expl. Exped., Phan. 1: 309. 1854. Type locality: "Hab. Obrajillo, Andes of Peru. (Cerro Pasco, Matthews, in herb. Hook.)". Type: Peru. Pasco, Cerro Pasco, 10°41'S, 76°16'W, *A. Matthews 683* (lectotype, designated by Aedo & al. 2002: 239, K-000531433!; isolectotype, W!).

Geranium sericeum var. *microphyllum* Wedd., Chlor. Andina 2: 285. 1861, ["microphylla"]. *Geranium lechleri* R. Knuth in Engl., Pflanzenr. IV.129 (Heft 53): 80. 1912. Type locality: "Hab. Équateur: sur l'Antisana ! (Humb. et Bonpl.).-- Pérou: dans les parties les plus élevées des Cordillères de Carabaya, au voisinage d'Ayapata ! (Lechler, exsicc., n. 1985).-- Bolivie: lieux arides, dans les parties élevées des Andes d'Ayopaya ! (Wedd.)". Type: Peru. Puno, Agapata, 13°50'S, 70°45'W, June 1854, *W. Lechler 1985* (lectotype, designated by Aedo & al. 2002: 239, G!; isolectotypes, GOET!, HAL-84323!, K!, P-00147020!, W!).

Geranium muscoideum R. Knuth, Bot. Jahrb. Syst. 37: 567. 1906. Type locality: "Peru: Dep. Junin bei La Oroya auf ebenen Polster- und Rosettenpflanzenmatten bei 4300 m (Weberbauer n. 2619!).- Blühend und fruchtend im Februar". Type: Peru. Junín, Tarma, La Oroya, 11°32'S, 75°54'W, *A. Weberbauer 2619* (lectotype, designated by Aedo & al. 2002: 239, G-00365886!; isolectotypes, WRSL!, F!).

Perennial herbs, 1-3 cm tall. *Rootstock* 6-16 mm in diameter, vertical, not tuberculate, not turnip-shaped, without thickened roots. *Stem* scapiform, cushion-like, stolons absent, without vegetative stems. *Basal leaves* in a persistent rosette; leaf laminas 0.4-0.9 cm long, 0.4-0.9 cm wide, not peltate, palmatifid [ratio main-sinus length/middle segment length = 0.67-0.78], polygonal in outline, base cordate, not coriaceous, with nerves not projected, sericeous on both surfaces; segments 5, in 1 plane, middle segment lanceolate, 0.5-1.5 mm wide at the base [ratio segment width at the base/middle segment length = 0.13-0.25], entire; petioles up to 1.7 cm long, without abscission zone, terete, not swollen, not deflexed in age, sericeous, with patent to retrorse (sometimes antrorse), eglandular hairs 0.2-0.9 mm long; stipules 2.3-8 mm long, 0.4-1.3 mm wide, lanceolate, free, papery, brownish red, with eglandular hairs on abaxial surface and on the margin, glabrous adaxially. *Cymules* 1-flowered, solitary [ratio cymule length/leaf length = (0.9)1.1-1.9]; peduncles 2-11.2 mm long, sericeous, with patent to retrorse, eglandular

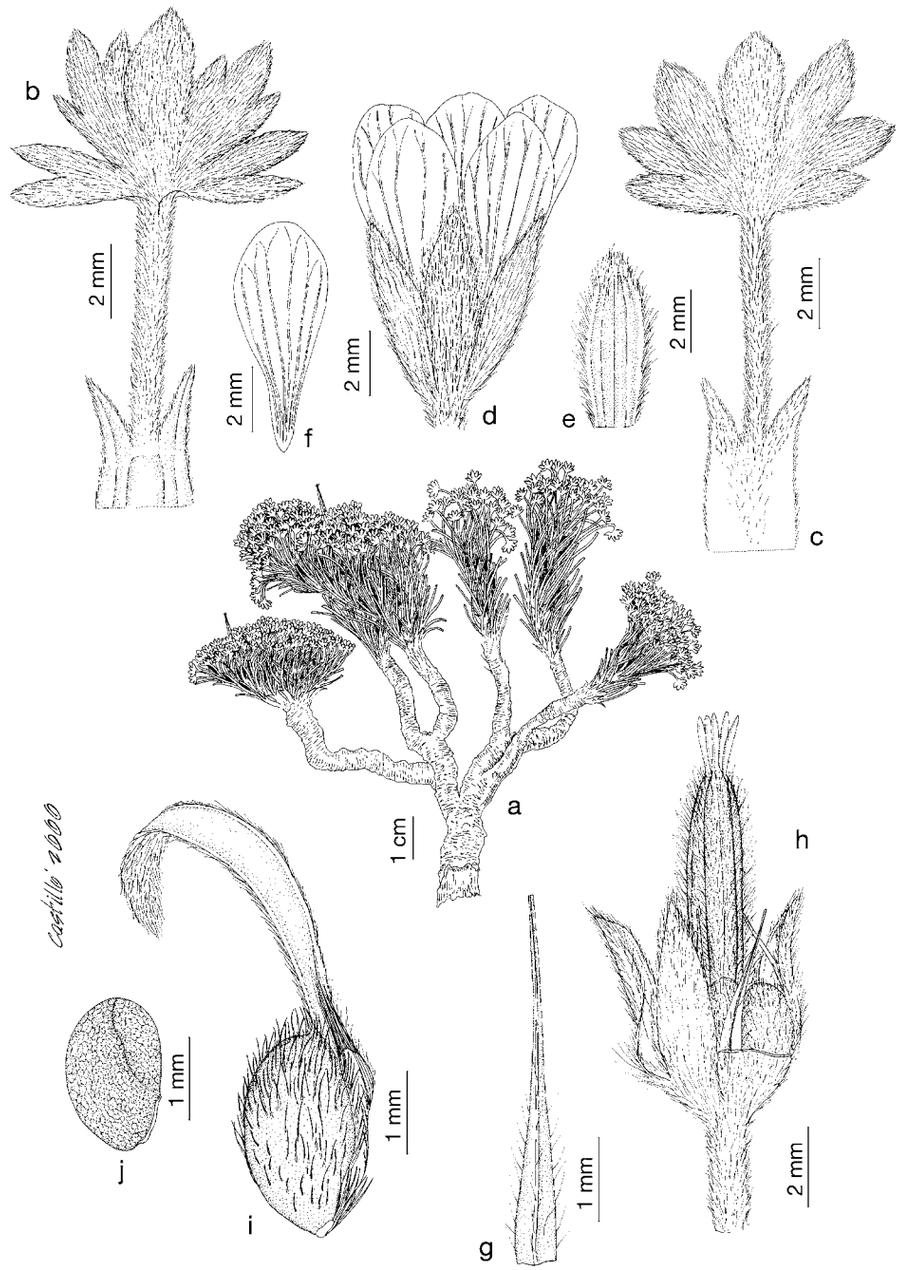


Fig. 463. *Geranium crassipes*. a. Habit. b. Leaf, adaxial side. c. Leaf, abaxial side. d. Flower. e. Sepal. f. Petal. g. Staminal filament. h. Fruit. i. Mericarp. j. Seed. (Based on: a, g-j, *Moore & al. 8319*, BH; b, *Humbert 30852*, P; c-f, *Killip & Smith 21968*, US).

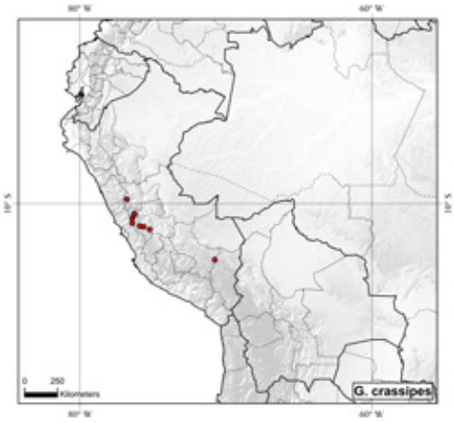


Fig. 464. Distribution of *Geranium crassipes*.

hairs 0.3-0.6 mm long; bracteoles absent. Flowers actinomorphic. *Sepals* 4.2-6.3 mm long, 1.3-2.3 mm wide, lanceolate, smooth, not accrescent, nerves 3, mucro 0.2-0.6 mm long [ratio mucro length/sepal length = 0.04-0.13], sericeous with erect-patent, eglandular hairs 0.2-0.5 mm long on the abaxial surface and patent, eglandular hairs 1-1.4 mm long on the margin, glabrous adaxially. *Petals* 5.2-10.5 mm long, 1.4-4.5 mm wide, erect-patent, rounded, without claw, white, glabrous. *Stamens* 10, both whorls bearing anthers; filaments 2.4-5 mm long, lanceolate, yellow, with eglandular hairs 0.2-0.6 mm long on the abaxial surface and margin; anthers 0.7-0.8 mm long, yellow. Nectaries 5, hemispheric, glabrous. *Gynoecium* 2.6-4.5 mm long, yellow. *Fruit* 6.5-10.5 mm long, erect, discharge of seed-ejection type; mericarps 2.3-3.7 mm long, 1.3-1.4 mm wide, without a strand of fibers, not compressed at the apex, smooth, without basal beak, with a basal callus, without a basal prong, brown, with antrorse, ± appressed, eglandular hairs 0.2-0.5 mm long; rostrum 4-7 mm long, without a narrowed apex, not twisted, sericeous, with antrorse, appressed, eglandular hairs 0.2-0.5 mm long; stigmatic remnants 0.5-1.4 mm long, with 5 hairy lobes. *Seeds* 1.4-2.1 mm long, 0.7-1.1 mm wide, finely reticulate, uniformly colored, brown, glabrous. Cotyledons with entire margin. Fig. 463.

Pollen. *Geranium*-type (Aedo & al. 2002: 217).

Chromosome number. Unknown.

Phenology. Collected in flower from March to April.

Distribution. This species ranges from central to eastern Peru (Fig. 464).

Habitat. Rocky outcrops in puna; 4000-4650 m.

Additional specimens examined. **Peru.** vallibus cordilleriis, 1790, *Haenke s.n.* (PR). Huánuco: Dos de Mayo, road from Pachas to Llata, 9º42'S, 76º47'W, 18 Mar. 2001, *Weigend & al. 5227* (F, M, MA, MO). Junín: Abra de la Viuda, 11º20'S, 76º25'W, 26 Mar. 2005, *Aedo & Galán de Mera 10881* (MA); between Tarma and Jauja, 11º35'S, 75º38'W, 24 Apr. 1929, *Killip & Smith 21968* (NY, US); Laguna Habascocha, en la carretera a las lomas, 11º46'S, 75º13'W, 29 Apr. 2000, *Flores 2416* (MA). Pasco: Cerro Pasco, 10º41'S, 76º16'W, Apr. (W); near km 312 on road to Huanuco just before Cerro de Pasco, 10º41'S, 76º16'W, 23 Apr. 1960, *Moore & al. 8319* (BH, MA); pr. Cerro de Pasco, 10º42'S, 76º14'W, 27 Mar. 2005, *Aedo & Galán de Mera 10898* (MA); Huaron, 11º0'S, 76º25'W, 8 June 1958, *Humbert 30846* (P); Huaron, 11º0'S, 76º25'W, 8 June 1958, *Humbert 30852* (P).

Discussion. Geranium crassipes is easily distinguished from most of the sericeous, stemless, Andean species by its palmatifid leaves, sericeous on both surfaces and with entire segments. It is quite similar to *G. planum*, from which it differs principally in its mucro-tipped sepals with long, patent hairs on the margin; the hairs on petioles and peduncles are also longer than in *G. planum*. *Geranium crassipes* might be mistaken at first glance for *G. nivale*, but it has fruit without a narrowed apex, and shorter leaf laminas and petals. Knuth (1912: 83) considered *G. crassipes* a synonym of *G. sessiliflorum*, although he did not see any type material. In my view, *G. sessiliflorum* is easy to differentiate from *G. crassipes* by its turnip-shaped rhizome with a constriction at the apex, its distally 3-12-lobed middle leaf-segment, and its non-sericeous vesture. *Geranium crassipes*, as here circumscribed, includes two taxa that Knuth (1912: 87) recognized: his novelty *G. muscoideum* and *G. lechleri*, Weddell's *G. sericeum* var. *microphyllum* elevated to species rank. Knuth (1912: 78) distinguished both taxa on the basis of the length of the leaf indumentum: "brevi subsericeo" in *G. muscoideum* and "satis longa argenteo-lanato-sericea" in *G. lechleri*. Macbride (1949: 513) considered *G. muscoideum* a synonym of *G. crassipes*, but distinguished *G. lechleri* by its "leaves often less deeply 5-parted". I have found a continuous variation in the length of the leaf indumentum, and that the number of leaf segments seems to be a constant five, even in the type material of *G. lechleri*. I therefore subsumed *G. muscoideum* and *G. lechleri* under *G. crassipes*.

183. Geranium planum Halloy, Brittonia 50: 467, 470 fig. 4. 1998. Type locality: "Argentina. Tucumán: Cumbres Calchaquíes, between Cerro Isabel and Cerro Adriana, 4600 m, 5 Mar 1979, S. Halloy 1722 (HOLOTYPE: LIL)". Type: Argentina. Tucumán, Cumbres Calchaquíes, between Cerro Isabel and Cerro Adriana, 26°36'S, 65°41'W, 5 Mar. 1979, *S. Halloy 1722* (holotype, LIL).

Perennial herbs, 1-5 cm tall. *Rootstock* 6.8-20 mm in diameter, vertical, not tuberculate, not turnip-shaped, without thickened roots. *Stem* scapiform, cushion-like, stolons absent, without vegetative stems. *Basal leaves* in a persistent rosette; leaf laminas 0.2-0.5(0.6) cm long, 0.3-0.5 cm wide, not peltate, palmatifid [ratio main-sinus length/middle segment length = 0.65-0.75], orbicular in outline, base cordate, not coriaceous, with nerves not projected, sericeous on both surfaces; segments 5, in 1 plane, middle segment broadly lanceolate, 0.4-1.2 mm wide at the base [ratio segment width at the base/middle segment length = 0.15-0.27], entire, rarely 2(3)-lobed in distal half; petioles up to 2.1 cm long, without abscission zone, terete, not swol-

len, not deflexed in age, sericeous, with antrorse, appressed, eglandular hairs 0.2-0.3 mm long; stipules 1.2-5 mm long, 0.3-2 mm wide, lanceolate, free, papery, brownish red, sericeous on both surfaces. *Cymules* 1-flowered, solitary [ratio cymule length/ leaf length = 0.9-1.5]; peduncles 2-6.8 mm long, sericeous, with antrorse, appressed, eglandular hairs 0.1-0.4 mm long; bracteoles absent. Flowers actinomorphic. *Sepals* 4-4.9 mm long, 1.7-2.1 mm wide, lanceolate, smooth, not accrescent, nerves 3, mucro absent, sericeous with erect-patent, eglandular hairs 0.2-0.3 mm long on the abaxial surface and margin, glabrous adaxially. *Petals* 6-7 mm long, 2.8-3.3 mm wide, erect-patent, rounded, white. *Stamens* 10, both whorls bearing anthers; filaments 2.9-3.5 mm long, lanceolate with an abruptly narrowed apex, yellow, with eglandular hairs 0.1-0.2 mm long on the abaxial

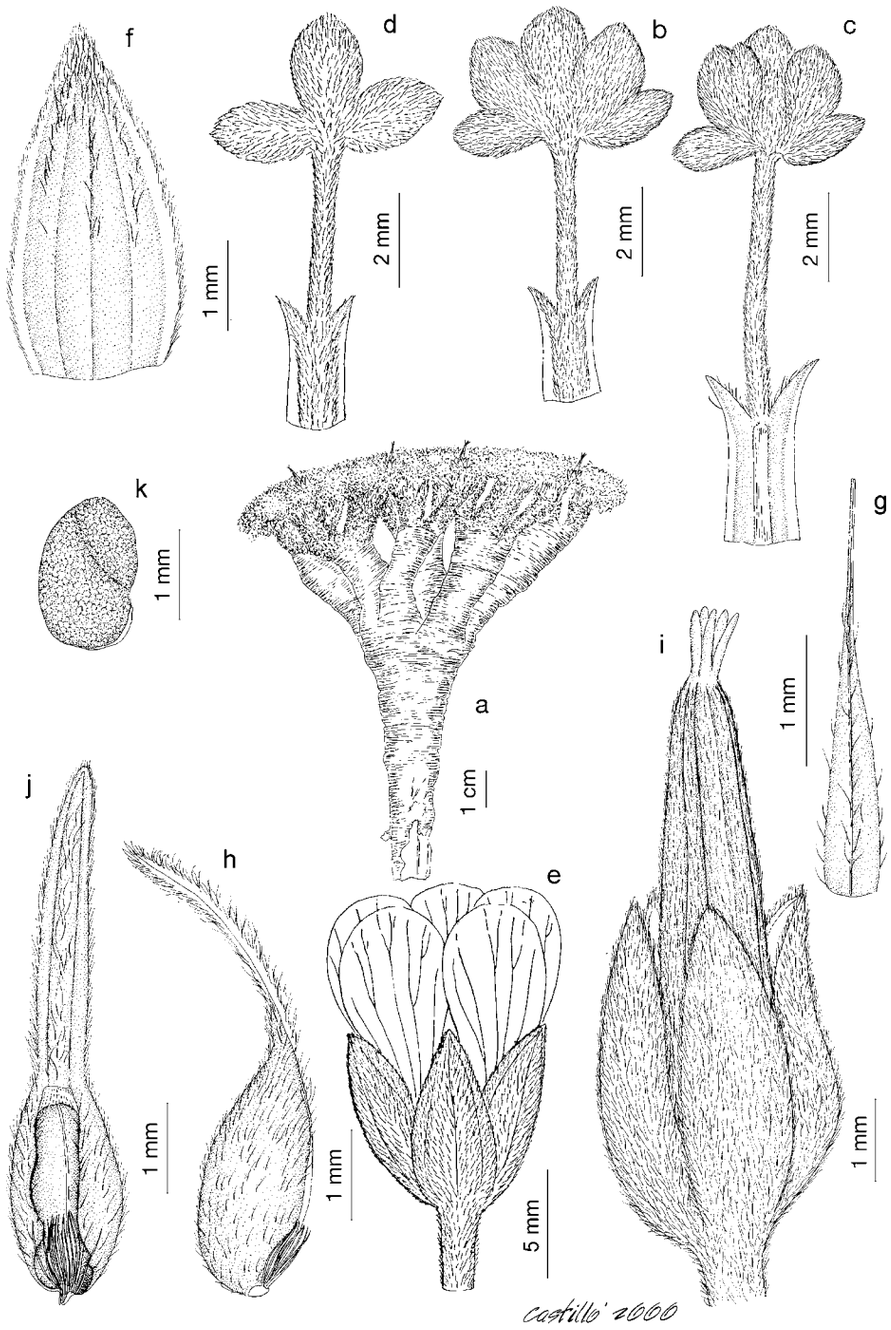


Fig. 465. *Geranium planum*. a. Habit. b-d. Leaves. e. Flower. f. Sepal. g. Staminal filament. i. Fruit. h, j. Mericarps. k. Seed. (Based on: a-c, f-k, *Halloy 3362*, Halloy herbarium; d, e, *Grau s.n.*, MA-765363).

Fig. 466. *Geranium planum* (without voucher, from Tucumán, Argentina, photo: A. Grau).

Fig. 467. Distribution of *Geranium planum*.

surface and margin; anthers ca. 0.5 mm long, yellow. Nectaries 5, hemispheric, glabrous. *Gynoecium* ca. 2.7 mm long, green. *Fruit* 8-8.8 mm long, erect, discharge of seed-ejection type; mericarps 2.2-2.8 mm long, 1-1.5 mm wide, without a strand of fibers, not compressed at the apex, smooth, without basal beak, with a basal callus, without a basal prong, brown, with antrorse, ± appressed, eglandular hairs 0.1-0.4 mm long; rostrum 3.8-6 mm long, without a narrowed apex, not twisted, sericeous, with antrorse, appressed, eglandular hairs 0.1-0.2 mm long; stigmatic remnants 0.8-0.9 mm long, with 5 glabrous lobes. *Seeds* 1.8-2 mm long, 0.8-1.1 mm wide, finely reticulate, uniformly colored, brown, glabrous. Cotyledons with entire margin. Figs. 465, 466.

Pollen. Ornamentation not studied.

Chromosome number. Unknown.

Phenology. Collected in flower in January.

Distribution. This species is endemic to northwestern Argentina (Fig. 467).

Habitat. Gently sloping or horizontal ground bordering schistose peaks; ca. 4500 m.

Additional specimens examined. **Argentina.** Tucumán: Huaca Huasi, Cerro Isabel, 26º36'S, 65º41'W, 3 Feb. 2008, *Grau s.n.* (MA); Tafí Viejo, Cumbres Calchaquíes, Abra de Piedras Paradas, 26º36'S, 65º41'W, *Halloy 3362* (herb. Halloy); Tafí Viejo, Cumbres Calchaquíes, Abra de Piedras Paradas, 26º36'S, 65º41'W, 9 Jan. 2001, *Halloy 4610* (LIL).

Discussion. Geranium planum, an endemic of northern Argentina, resembles most closely *G. crassipes* among the stemless species from the Andes in its palmatifid, short, sericeous leaves with usually entire segments, but its sepals lack a mucro and the marginal, long, patent hairs seen in *G. crassipes*. According to Halloy (1998), *G. planum* was found within a narrow elevational range bordering the peaks Cerro Adriana and Isabel and in five fragmented populations. I have searched for the holotype with the kind help of LIL's curator Dr. Slanis without success; however, I could examine a specimen from the private collection of Dr. Halloy and LIL-605921, both from the type locality. Additionally, Dr. Grau has provided me with a more recent collection from the same locality, which allowed me to emend the original description and drawing of this species, and add some data not indicated in Aedo & al. (2002: 265).

184. Geranium digitatum R. Knuth, Repert. Spec. Nov. Regni Veg. 28: 1. 1930. Type locality: "Peru: La Oroya, auf Kalkhängen, 3400 m. (Macbride et Featherstone in Exp. under the Capt. Marshall Field Fund a. 1922 n. 940 -- Typus in Herb. Field Museum n. 517468!)". Type: Peru. La Oroya, 11°32'S, 75°54'W, 27 May-7 June 1922, *J.F. Macbride & W. Featherstone 940* (holotype, F-517468!; isotypes, G-00365876!, US-00100880 image!, W!).

Perennial herbs, 1.5-7 cm tall. *Rootstock* 4-13.6 mm in diameter, vertical, not tuberculate, not turnip-shaped, without thickened roots. *Stem* scapiform, cushion-like, stolons absent, sometimes with short vegetative stems. *Basal leaves* in a persistent rosette; leaf laminas 0.5-1.5 cm long, 0.4-1.4 cm wide, not peltate, digitate (lateral segments upward) [ratio main-sinus length/middle segment length = 0.32-0.73], polygonal to obtriangular in outline, base cuneate, not coriaceous, with nerves not projected, sericeous on both surfaces; segments 3-5, in 1 plane, middle segment lanceolate, 1.4-3 mm wide at the base [ratio segment width at the base/middle segment length = 0.20-0.25], entire; petioles up to 6.5 cm long, without abscission zone, terete, not swollen, not deflexed in age, sericeous, with patent to retrorse, eglandular hairs 0.3-0.5 mm long; stipules 8.5-12 mm long, 1.5-2.2 mm wide, lanceolate, free, papery, brownish red, sericeous on abaxial surface and on the margin, glabrous adaxially. *Cymules* 1-flowered, solitary [ratio cymule length/leaf length = 0.7-0.8]; peduncles (4)10-67 mm long, sericeous, with patent to retrorse, eglandular hairs 0.3-0.5 mm long; bracteoles absent. Flowers actinomorphic. *Sepals* 6.5-9.8 mm long, 2.2-3.2 mm wide, lanceolate, smooth, not accrescent, nerves 3, mucro 0.1-0.4 mm long [ratio mucro length/sepal length = 0.01-0.07], sericeous with erect-patent, eglandular hairs 0.3-0.5 mm long on the abaxial surface and margin, glabrous adaxially. *Petals* 11.1-17 mm long, 5-8 mm wide, erect-patent, rounded, without claw, white, hairy on the base of the abaxial surface, ciliate on the basal margin, with hairs 0.2-0.5 mm long. *Stamens* 10, both whorls bearing anthers; filaments 4.5-5.2 mm long, lanceolate, yellow, with eglandular hairs 0.3-0.5 mm long on the abaxial surface and margin; anthers 1-1.2 mm long, yellow. Nectaries 5, hemispheric, with a tuft of hairs at the top, dorsally glabrous. *Gynoecium* 5.2-6 mm long, yellow. *Fruit* 14-18.5 mm long, erect, discharge of seed-ejection type; mericarps 3-3.2 mm long, 1.5-2 mm wide, without a strand of fibers, not compressed at the apex, smooth, without basal beak, with a basal callus, without a basal prong, brown, with antrorse, ± appressed, eglandular hairs 0.2-0.3 mm long; rostrum 10-12 mm long, with a narrowed apex 1.6-2 mm long, not twisted, sericeous, with erect-patent, eglandular hairs 0.2-0.4 mm long; stigmatic remnants 2.5-3 mm long, with 5 hairy lobes. *Seeds* 2.5-2.9 mm long, 1.4-1.7 mm wide, finely reticulate, uniformly colored, brown, glabrous. Cotyledons with entire margin. Fig. 468.

Pollen. *Geranium*-type (Aedo & al. 2002: 217).

Chromosome number. Unknown.

Phenology. Collected in flower from November to June.

Distribution. This species is endemic to central Peru (Fig. 469).

Habitat. Arid undisturbed and grazed grassland, in crevices on limestone; 3000-4500 m.

Additional specimens examined. **Peru.** Pérou, 1839-1840, *Gay 1208* (P). Junín: Tarma, slopes and bottom of draw of Quebrada Jajaluli, Hacienda Casa Blanca, ca. 18 km SSE of Tarma, 11°25'S, 75°44'W, 27 Nov. 1962, *Iltis & al. 107* (BH, MO, US, USM); Tarma, Incatacuna, entre Tarmatambo y Acolla, 11°26'S, 75°42'W, 29 June 1954, *Tovar 2332* (USM); Jauja, Tarma-Jauja road, 28 km from Tarma, 11°35'S, 75°38'W, 10 Jan. 1984, *Smith 5687* (MO, NY, TEX, USM); 3 km before highest point Tarma-Acolla-Jauja road, 11°40'S, 75°35'W, 31 Dec. 1961, *Saunders 710* (BH, K); Yauli, 11°42'S, 75°26'W, 25 May 1922, *Macbride & Featherstone 940b* (W).

Discussion. Geranium digitatum is easily separated from other sericeous and stemless species from the Andes by its digitate leaves with entire segments. In the type material leaves with five segments are predominant, while in other collections almost all leaves have three segments. Some variation is also evident in the indumentum of the nectaries: most of the specimens have a tuft of hairs at the apex of each nectary, but in *Smith 5687* (MO, NY, TEX) only scattered hairs are present. *Geranium digitatum* shares with *G. weddellii* hairy nectaries and a rostrum with a narrowed apex, but the deeply divided short leaves, antrorsely hairy petioles, and glabrous petals are consistently reliable characters that distinguish *G. weddellii* from *G. digitatum*.

Fig. 469. Distribution of *Geranium digitatum*.

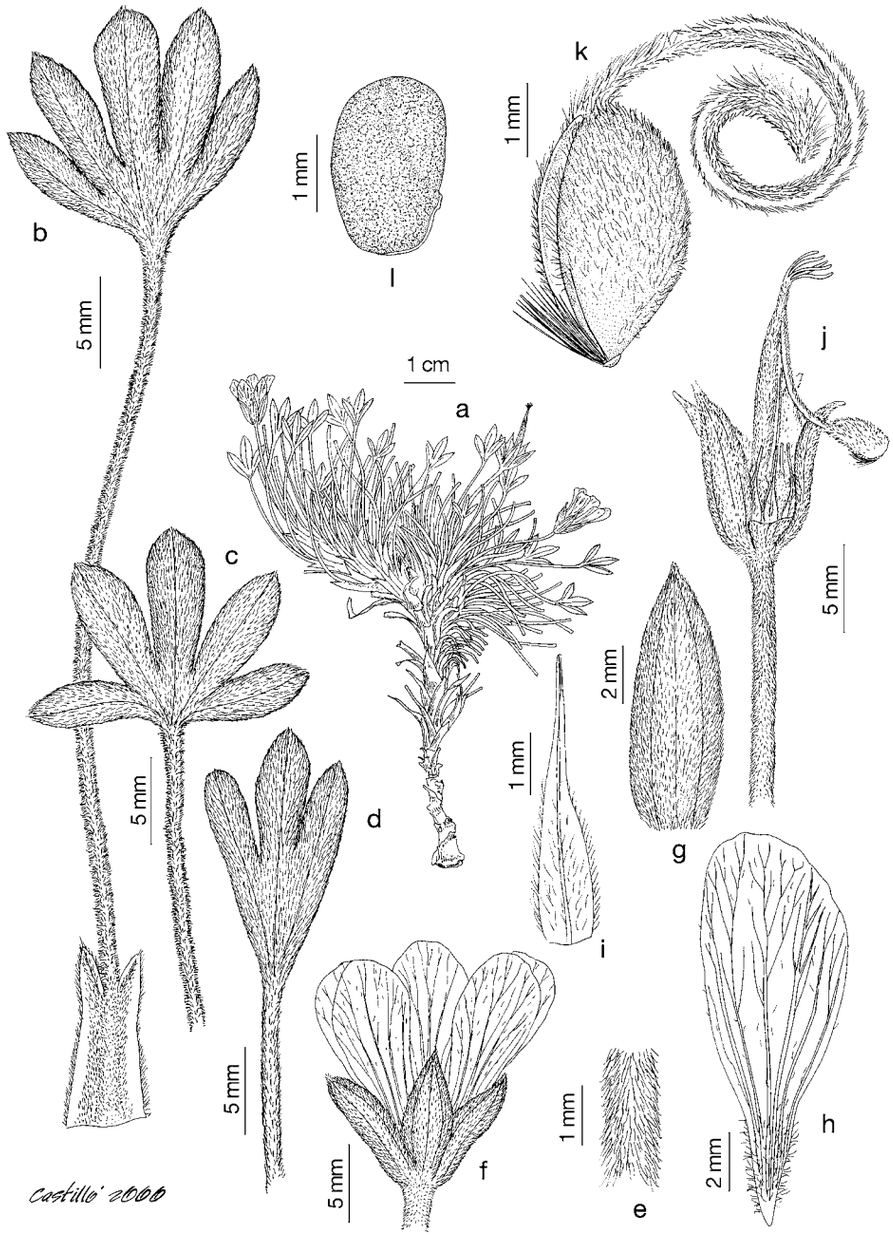


Fig. 468. *Geranium digitatum*. a. Fruiting branch. b-d. Leaves. e. Peduncle. f. Flower. g. Sepal. h. Petal, abaxial side. i. Staminal filament. j. Fruit. k. Mericarp. l. Seed. (Based on: a, d, g, i-l, *Iltis & al. 107*, MO; b, c, *Macbride & Featherstone 940*,W; e, f, h, *Saunders 710*, K).

185. Geranium trujillense Aedo, Candollea 66: 436. 2011. Type locality: "PERÚ. La Libertad: de Chugay a Molino Viejo, 7°47'S 77°46'W, 28.VI.2009, Aedo & Zapata 16682 (holo-: MA [788262]; iso-: USM)". Type: Peru. La Libertad, de Chugay a Molino Viejo, 7°47'S, 77°46'W, 28 June 2009, *C. Aedo & M. Zapata 16682* (holotype, MA-788262!; isotype, USM!).

Perennial herbs, 4.5-6.9 cm tall. *Rootstock* 7.7-13.3 mm in diameter, vertical, not tuberculate, not turnip-shaped, without thickened roots. *Stem* scapiform, cushion-like, stolons absent, without vegetative stems. *Basal leaves* in a persistent rosette; leaf laminas 1.2-1.7 cm long, 0.6-1.2 cm wide, not peltate, digitate (lateral segments upward) [ratio

main-sinus length/middle segment length = 0.53-0.70], rhombic in outline, base cuneate, not coriaceous, with nerves not projected, sericeous on both surfaces; segments 5, in 1 plane, middle segment linear-lanceolate, 0.8-1.3(1.5) mm wide at the base [ratio segment width at the base/middle segment length = 0.06-0.09], entire to 3-lobed at the apex [ratio secondary sinus length/ middle segment length = 0.07-0.12]; petioles up to 4 cm long, without abscission zone, terete, not swollen, not deflexed in age, sericeous, with antrorse, appressed, eglandular hairs 0.3-0.6 mm long; stipules 8.9-10 mm long, 1-1.6 mm wide, lanceolate, free, papery, brownish red, with eglandular hairs on abaxial surface and on the margin, glabrous adaxially. *Cymules* 1-flowered, solitary [ratio cymule length/leaf length = 0.5-0.8]; peduncles 10-34 mm long, sericeous, with antrorse, subappressed, eglandular hairs 0.3-0.8 mm long; bracteoles absent *Sepals* 6.2-7.3 mm long, 1.4-2.2 mm wide, lanceolate, smooth, not accrescent, nerves 3, mucro 0.6-1.2 mm long [ratio mucro length/sepal length = 0.10-0.17], sericeous with erect-patent, eglandular hairs 0.4-1.5 mm long on the abaxial surface and margin, glabrous adaxially. *Petals* unknown. *Stamens* 10, both whorls bearing anthers; filaments 2.9-4.4 mm long, lanceolate, unknown color, with eglandular hairs 0.2-0.6 mm long on the abaxial surface and margin; anthers unknown. Nectaries 5, hemispheric, glabrous. *Fruit* 10.2-14.3 mm long, erect, discharge of seed-ejection type; mericarps 2.2-3.1 mm long, 0.9-1.7 mm wide, without a strand of fibers, not compressed at the apex, smooth, without basal beak, with a basal callus, without a basal prong, brown, with antrorse, ± appressed, eglandular hairs 0.1-0.4 mm long; rostrum 5.1-7.9 mm long, without a narrowed apex, not twisted, sericeous, with erect-patent, eglandular hairs 0.1-0.3 mm long; stigmatic remnants 1.1-2.4 mm long, with 5 hairy lobes. *Seeds* 1.9-2.1 mm long, 1.2-1.4 mm wide, finely reticulate, uniformly colored, brown, glabrous. Cotyledons with entire margin. Figs. 470, 471.

Pollen. Ornamentation not studied.

Chromosome number. Unknown.

Phenology. Collected in flower in May.

Distribution. This species is endemic to La Libertad, in northern Peru (Fig. 472).

Habitat. Rocky slopes among grassy cushions and tufts of grass; 3800-4000 m.

Additional specimens examined. **Peru.** La Libertad: de Chugay a Molino Viejo, des-

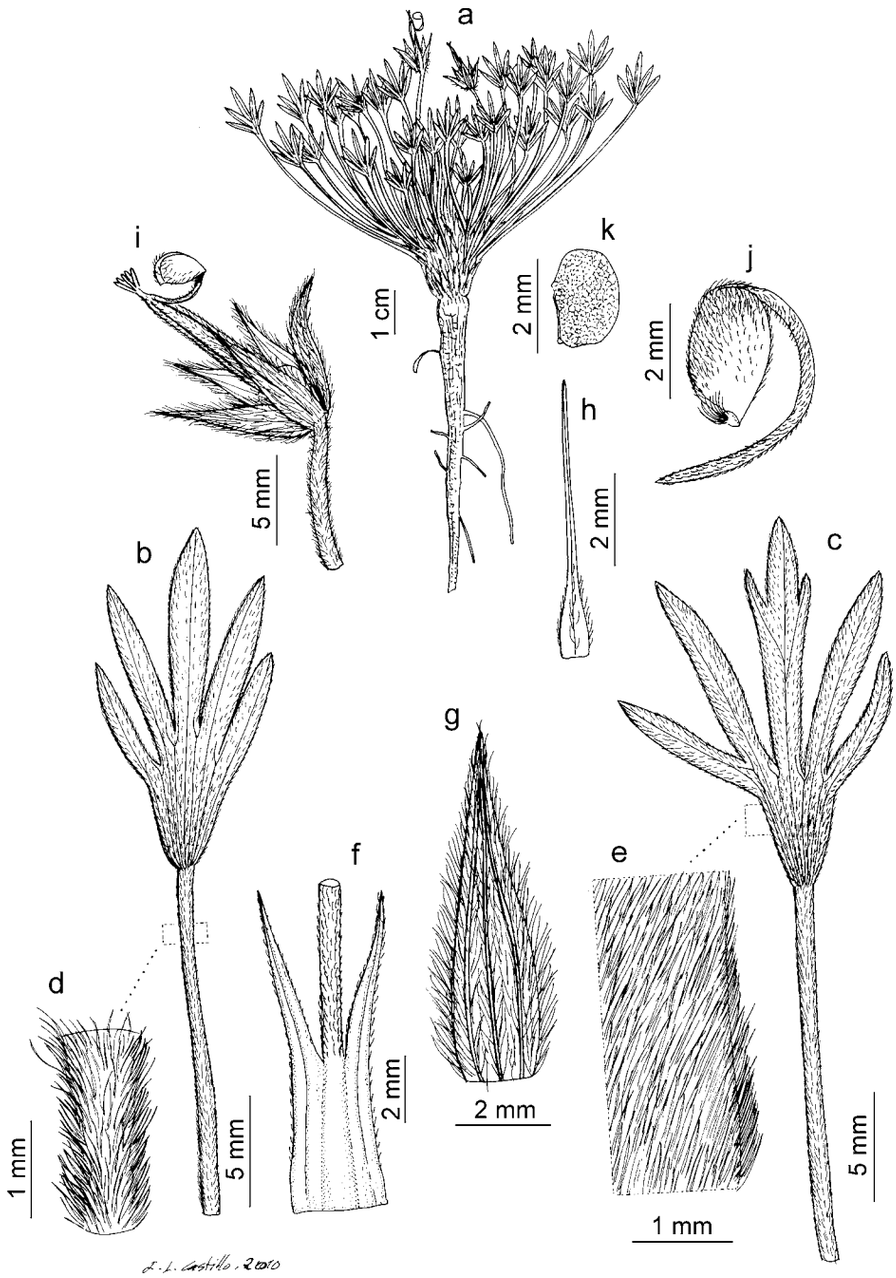


Fig. 470. *Geranium trujillense*. a. Habit. b, c. Leaves. d. Indumentum of petiole. e. Indumentum of leaf surface. f. Stipules. g. Sepal. h. Staminal filament. i. Fruit. j. Mericarp. k. Seed. (Based on: *Aedo & Zapata 16682*, MA).

Fig. 471. *Geranium trujillense* (Based on: *Aedo & Zapata 16682*, MA).

Fig. 472. Distribution of *Geranium trujillense*.

vio a Huagil, 7°47'S, 77°46'W, 4 May 2003, *Sagástegui & al. 17208* (HAO); Pataz, Piedra Grande, La Paccha-Chilia, 8°7.20'S, 77°25'W, 9 May 2003, *Sagástegui & al. 17337* (HAO).

Discussion. Geranium trujillense shares with *G. digitatum* digitate, sericeous leaves, but in *G. trujillense* the segments are narrower and more deeply divided. The apex of the middle segment may be entire or bear 1-2 lateral short lobelets. *Geranium trujillense* has antrorse hairs on the petioles and usually on the peduncles (such hairs are retrorse in *G. digitatum*), hairy stipules (sericeous in *G. digitatum*), a longer sepal mucro, shorter staminal filaments, glabrous nectaries, and also a shorter fruit with the rostrum lacking a narrowed apex and with shorter seeds than in *G. digitatum*. The two species are allopatric and separated by 300 km. *Geranium trujillense* was first discovered in the HAO herbarium, where two collections were kept: *Sagástegui & al. 17208* and *Sagástegui & al. 17337*. A visit to the locality of *Sagástegui & al. 17208* yielded additional fruiting material distributed to MA, HAO, and USM. Unfortunately, in 2010 the HAO herbarium was destroyed in a fire, and all specimens of the two Sagástegui collections (some of them with flowers) were lost. At the present the only available material is in fruit, and thus the description lacks information about petals, anthers, and the gynoecium.

186. Geranium nivale R. Knuth, Bot. Jahrb. Syst. 37: 563. 1906. Type locality: "Peru: zwischen Tarma und La Oroya im Dep. Junin auf Kalkfelsen bei 4000 m (Weberbauer n. 2533!). - Blühend und fruchtend im Februar". Type: Peru. Junín, Tarma, La Oroya, 11°32'S, 75°54'W, *A. Weberbauer 2533* (lectotype, designated by Aedo & al. 2002: 259, WRSL!).

Perennial herbs, 1-3 cm tall. *Rootstock* 5-7 mm in diameter, vertical, not tuberculate, not turnip-shaped, without thickened roots. *Stem* scapiform, cushion-like, stolons absent, without vegetative stems. *Basal leaves* in a persistent rosette; leaf laminas 0.9-1.2 cm long, 1.1-1.4 cm wide, not peltate, palmatifid [ratio main-sinus length/middle segment length = 0.80-0.86], polygonal in outline, base cordate, not coriaceous, with nerves not projected, sericeous on both surfaces; segments 5, in 1 plane, middle segment broadly obovate, 0.7-1.5 mm wide at the base [ratio segment width at the base/middle segment length = 0.13-0.15], entire; petioles up to 1.8 cm long, without abscission zone, terete, not swollen, not deflexed in age, sericeous, with patent to retrorse, eglandular hairs 0.2-0.7 mm long; stipules 8-12 mm long, 2 mm wide, lanceolate, free, papery, brownish red, sericeous on abaxial surface and on the margin, glabrous adaxially. Cymules 1-flowered, solitary [ratio cymule length/leaf length = 0.8-0.9]; peduncles 7-22 mm long, sericeous, with patent, eglandular hairs 0.4-0.7 mm long; bracteoles absent. Flowers actinomorphic. *Sepals* 6.7-8.2 mm long, 2-3 mm wide, lanceolate, smooth, not accrescent, nerves 3, mucro ca. 0.2 mm long [ratio mucro length/sepal length = 0.02-0.03], sericeous with erect-patent, eglandular hairs 0.3-0.7 mm long on the abaxial surface and margin, sparsely hairy adaxially. *Petals* 13-18 mm long, 5-5.5 mm wide, erect-patent, rounded, without claw, white, hairy on the base of the abaxial surface, ciliate on

the basal margin, with hairs 0.5-0.8 mm long. *Stamens* 10, both whorls bearing anthers; filaments 6-6.5 mm long, lanceolate, yellow, with eglandular hairs 0.2-0.5 mm long on the abaxial surface and margin; anthers ca. 1.1 mm long, yellow. Nectaries 5, hemispheric, glabrous. *Gynoecium* ca. 7 mm long, yellow. *Fruit* 12-13 mm long, erect, discharge of seed-ejection type; mericarps ca. 2.5 mm long, 1.5 mm wide, without a strand of fibers, not compressed at the apex, smooth, without basal beak, with a basal callus, without a basal prong, brown, sericeous, with erect-patent, eglandular hairs 0.4-0.6 mm long; rostrum 9.5-10 mm long, with a narrowed apex 1.2-1.5 mm long, not twisted, sericeous, with erect-patent, eglandular hairs 0.4-0.6 mm long; stigmatic remnants ca. 1 mm long, with 5 hairy lobes. *Seeds* unknown. Cotyledons not studied. Fig. 473.

Pollen. *Geranium*-type (Aedo & al. 2002: 217).

Chromosome number. Unknown.

Phenology. Collected in flower from February to October.

Distribution. This species ranges through central Peru (Fig. 474).

Habitat. On moist ground in puna; ca. 4000 m.

Additional specimens examined. **Peru.** Apurimac: Andahuaylas, 13º40'S, 73º25'W, Feb., *Pearce s.n.* (K). Junín: camino de la Oroya a Tarma, 11º14'S, 75º46'W, 12 Oct. 1863, *Isern 569* (F); bajada del Ricrican camino de la Oroya a Tarma, 11º14'S, 75º46'W, 29 Sep. 1863, *Isern 569b* (F); La Oroya, 11º32'S, 75º54'W, 1919, *Kalenborn & Kalenborn 88* (CAS, NY). Lima: puna antes de bajar a Pampas, 11º18'S, 76º45'W, Feb. 1863, *Raimondi 47* (P).

Discussion. Geranium nivale shares with *G. ruizii*, *G. planum*, and *G. crassipes* palmatifid sericeous leaves, but differs from them in the fruit rostrum with a narrowed apex and the longer petals. *Geranium nivale* has longer leaves than *G. ruizii*, with lanceolate entire segments, whereas the leaves of *G. ruizii* have obtriangular segments that are apically 3-lobed. *Geranium planum* and *G. crassipes* also have entire leaf segments [rarely 2(3)-lobed in *G. planum*], but they

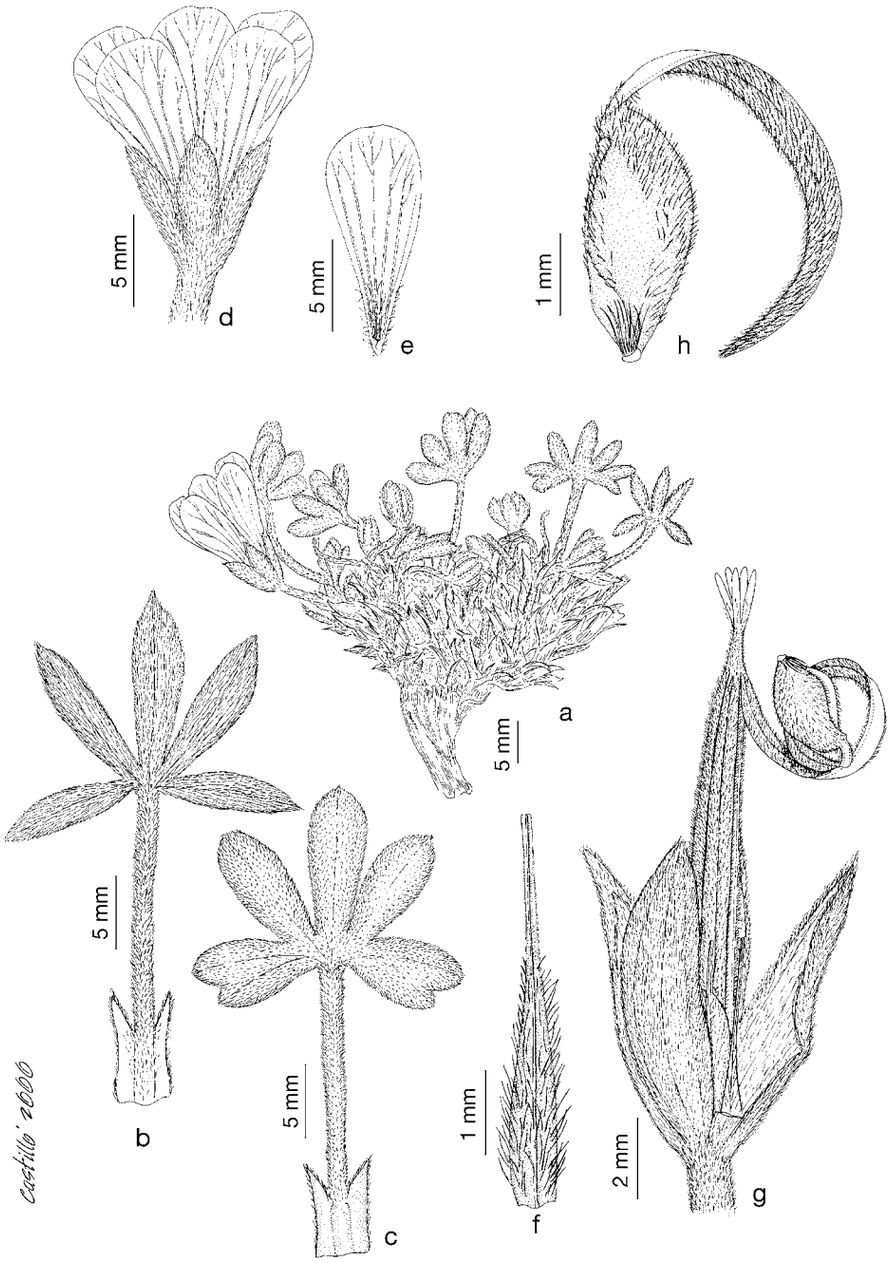


Fig. 473. *Geranium nivale*. a. Habit. b. Leaf, abaxial side. c. Leaf, adaxial side. d. Flower. e. Petal. f. Staminal filament. g. Fruit. h. Mericarp. (Based on: a, d-h, *Isern 569*, F; b, *Weberbauer 2533*, BRSL; c, *Kalenborn & Kalenborn 88*, CAS).

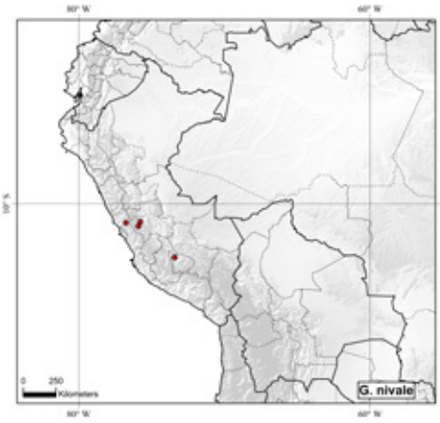


Fig. 474. Distribution of *Geranium nivale*.

have short leaf laminas (to 0.9 cm long) versus long leaf laminas of *G. nivale* (0.9-1.2 cm long). None of the scarce available material of *G. nivale* has mature seeds.

187. Geranium ruizii Hieron., Bot. Jahrb. Syst. 20, Beiblatt 49: 31. 1895. Type locality: "Peruvia: crescit in alpibus punas dictis, ubi legit cl. Ruiz". Type: Peru. Pasco, Cordillera del Diezmo, 11°01'S, 76°21'W, *H. Ruiz & J. Pavón s.n.* (lectotype, designated by Knuth 1912: 83, B destroyed; lectotype, here designated, MA-812559!; isolectotypes, BH-418700 fragment!, BM!, CONC!, FI!, G-00365891!, MPU!, P!).

Geranium dielsianum R. Knuth, Bot. Jahrb. Syst. 37: 563. 1906. Type locality: "Peru: Dep. Cajamarca am Passe Coymolache oberhalb Hualgayoc auf Felsen bei 4000-4100 m (Weberbauer n. 3959!). - Blühend im Mai". Type: Peru. Cajamarca, Pass Coymolache, 6°46'S, 78°20'W, *A. Weberbauer 3959* (lectotype, designated by Aedo & al. 2002: 269, G-00365894!; isolectotypes, WRSL!, MOL image!).

Perennial herbs, 2-6 cm tall. *Rootstock* 6-9.7 mm in diameter, vertical, not tuberculate, not turnip-shaped, without thickened roots. *Stem* scapiform, cushion-like, stolons absent, without vegetative stems. *Basal leaves* in a persistent rosette; leaf laminas 0.7-1.4 cm long, 0.8-1.7 cm wide, not peltate, palmatifid [ratio main-sinus length/middle segment length = 0.70-0.80], polygonal in outline, base cordate, not coriaceous, with nerves not projected, sericeous on both surfaces; segments 5, in 1 plane, middle segment obtriangular (with lanceolate lobes), 0.7-1.9 mm wide at the base [ratio segment width at the base/middle segment length = 0.11-0.21], 3-lobed at the apex [ratio secondary sinus length/middle segment length = 0.18-0.28]; petioles up to 3.5 cm long, without abscission zone, terete, not swollen, not deflexed in age, sericeous, with patent to antrorse, eglandular hairs 0.5-1.5 mm long; stipules 6-12.2 mm long, 0.7-2 mm wide, lanceolate, free, papery, brownish red, with eglandular hairs on abaxial surface and on the margin, glabrous adaxially. Cymules 1-flowered, solitary [ratio cymule length/leaf length = 0.7-0.8]; peduncles (3.3)7-45 mm long, with patent to antrorse, eglandular hairs 0.5-1.5 mm long; bracteoles absent. Flowers actinomorphic. *Sepals* 5.5-7 mm long, 1.7-2.2 mm wide, lanceolate, smooth, not accrescent, nerves 3, mucro 0.4-1 mm long [ratio mucro length/sepal length = 0.08-0.13], sericeous with erect-patent, eglandular hairs 0.6-1.5 mm long on the abaxial surface and margin, glabrous adaxially. *Petals* (8.7)10-14 mm long, 3.5-7 mm wide, erect-patent, rounded, without claw, white, glabrous.

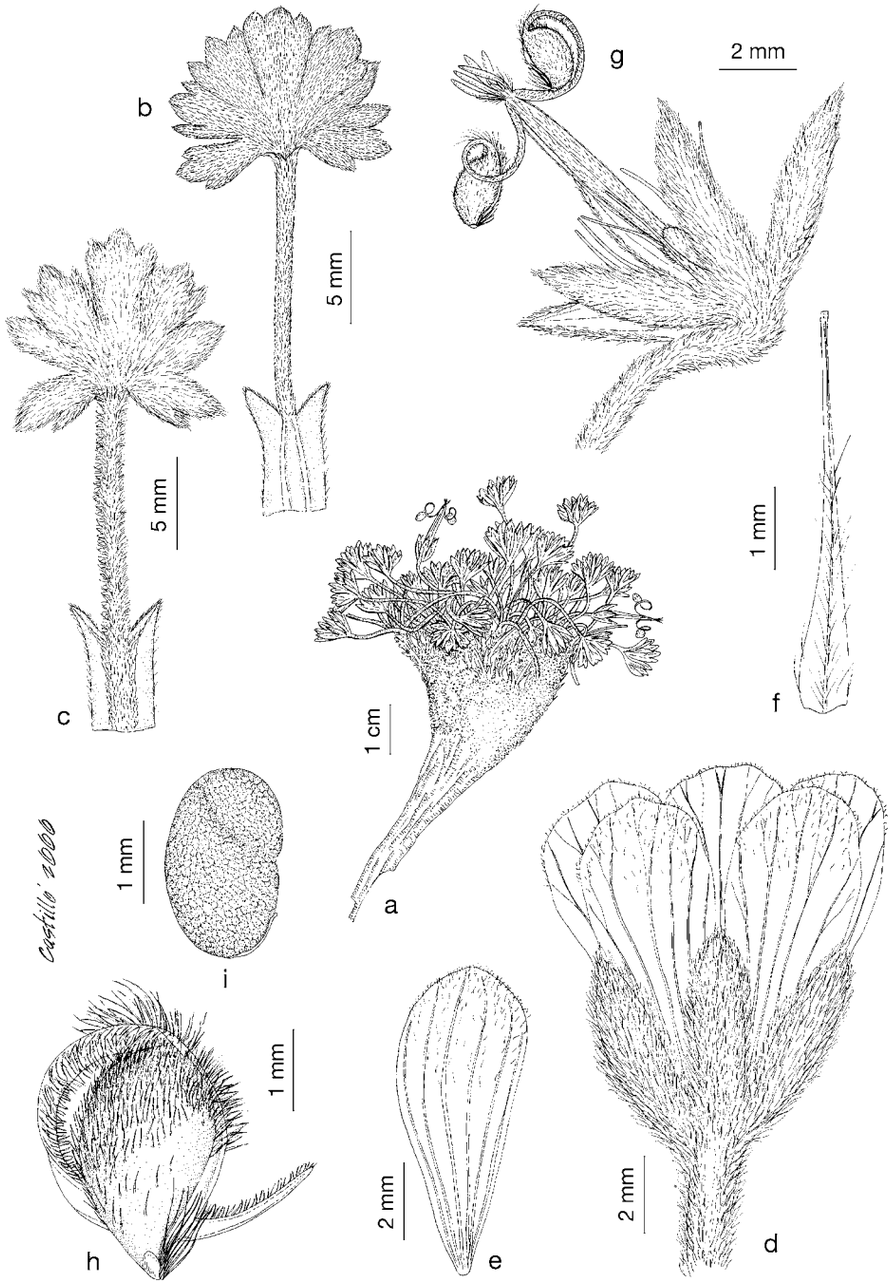


Fig. 475. *Geranium ruizii*. a. Habit. b. Leaf, adaxial side. c. Leaf, abaxial side. d. Flower. e. Petal. f. Staminal filament. g. Fruit. h. Mericarp. i. Seed. (Based on: a, c, f-i, *Sullivan & Sullivan 804*, MO; b, *Asplund 11655*, S; d, e, *Ruiz & Pavón s.n.*, *s.d.*, P).

Fig. 476. *Geranium ruizii* (Based on: a-c, *Aedo 16491,* MA; d-f, *Aedo & Molina 20368,* MA).

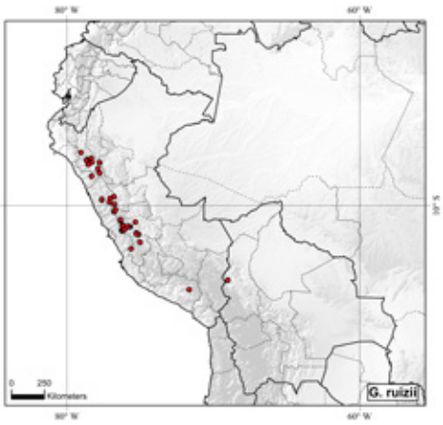


Fig. 477. Distribution of *Geranium ruizii*.

Stamens 10, both whorls bearing anthers; filaments 3.3-4.7 mm long, lanceolate, yellow, with eglandular hairs 0.2-0.8 mm long on the abaxial surface and margin; anthers 0.8-1 mm long, yellow. Nectaries 5, hemispheric, usually glabrous. *Gynoecium* 3.7-4.5 mm long, yellow. *Fruit* 10-12 mm long, erect, discharge of seed-ejection type; mericarps 2-2.9 mm long, 1-1.5 mm wide, without a strand of fibers, not compressed at the apex, smooth, without basal beak, with a basal callus, without a basal prong, brown, with erect-patent, eglandular hairs 0.3-0.6 mm long; rostrum 6-6.9 mm long, without a narrowed apex, not twisted, woolly-sericeous, with patent, eglandular hairs 0.4-1.6 mm long; stigmatic remnants 1-2.4 mm long, with 5 hairy lobes. *Seeds* 1.6-2.1 mm long, 1-1.2 mm wide, finely reticulate, uniformly colored, brown, glabrous. Cotyledons with entire margin. Figs. 475, 476.

Pollen. *Geranium*-type (Aedo & al. 2002: 217, Bortenschlager 1967: 425).

Chromosome number. Unknown.

Phenology. Collected in flower from January to June.

Distribution. This species ranges from northern and southern Peru to western Bolivia (Fig. 477).

Habitat. Among rocks, on exposed grassy slopes, among *Azorella* Lam. cushions in puna; 2700-5000 m.

Additional specimens examined. **Bolivia.** La Paz: Bautista Saavedra, paso a Curva (Medallani), 15°6'S, 69°0'W, 10 Jan. 1983, *Menhofer 1795* (LPB, MA). **Peru.** Ancash: San Marcos, mina Antamina, 9°30'S, 77°3'W, 23 May 2013, *Aedo & Molina 20368* (MA); Cordillera Negra, Abra Punta Callán, 9°34'S, 77°37'W, 17 May 2013, *Aedo & Molina 20187* (MA); Bolognesi, Aquia, comunidad de Tunacancha, 9°37'S, 77°37'W, 10 June 2002, *Cano & al. 12370* (USM); Huari, San Marcos, km 112 de la carretera al campamento de Antamina, 9°46'S, 77°6'W, 26 Mar. 2004, *Cano & al. 14143* (USM). Arequipa: Patapampa, 15°45'S, 71°39'W, 17 Feb. 1980, *Lilljekvist 20* (C). Cajamarca: pampa de Cerro Negro, km 29 de la carretera Cajamarca-Hualgayoc, 6°23'S, 79°3'W, 5 Feb. 1994, *Sánchez Vega & Cabanillas 6735* (MA, F); pr. Cerro Yanahuanga, 6°51'S, 78°36'W, 17 June 2009, *Aedo 16541* (MA); San Pablo, Tumbadén, alrededores de Ingatambo, 6°55'S, 78°40'W, 25 Feb. 2004, *Sánchez Vega & Díaz Miranda 12560* (MA); Quinuamayo, 7°3'S, 78°18'W, 7 Apr. 1948, *Pennell & Reichlin 15049* (USM); al W de Cajamarca, 7°11'S, 78°33'W, 15 June 2009, *Aedo 16491* (MA); pr. Huayllapampa, 7°12'S, 78°33'W, 15 June 2009, *Aedo 16495* (MA); Huacraruco, Cerro El Lorito, al E de Huacraruco-San Juan, 7°28'S, 77°53'W, 10 June 1976, *Sánchez 1887* (F). Huancavelica: 3 km SE de Conaica, Caniorccona, 12°31'S, 75°0'W, 10 Mar. 1951, *Tovar 112* (US); Hacienda Huari, Asnaj Puquío, 12°57'S, 75°37'W, 10 July 1976, *Lourteig 3139* (P). Huánuco: Huamalies, Puños, 9°24'S, 76°47'W, 22 Mar. 2004, *Cano & al. 14013* (MA); Dos de Mayo, Shirirragra, 9°55'S,

76°45'W, Apr. 1956, *Cardich 218* (USM); Lauricocha, San Miguel de Cauri, Laguna Lauricocha, 10°18'S, 76°41'W, 5 Aug. 2002, *Salvador & al. 346* (MA); quebrada Shiri-Ragra, a orillas de la Laguna Lauricocha, 10°19'S, 76°41'W, 20 Feb. 1955, *Cardich s.n.* (USM). Junín: camino s San Ramón, Montayaco, 11°8'S, 75°20'W, 27 June 1976, *Lourteig 3098* (USM); Corpacancha, S facing slope, 11°20'S, 76°12'W, 7 May 1981, *Sullivan & Sullivan 804* (MO, NY); Yauli, road to Corpacancha, 11°23'S, 76°11'W, 6 May 1981, *Sullivan & Sullivan 785* (MO); 20 km above Tarma, 11°25'S, 75°47'W, 18 Mar. 1973, *Richardson 2063* (NY, TEX); puna between La Oroya and Tarma, 11°27'S, 75°45'W, 29 Jan. 1983, *Gentry & al. 39757* (MO); Tarma, summit of Tarma-La Oroya highway, 11°27'S, 75°53'W, 8 Jan. 1983, *Smith 3028A* (MO); Paccha, cerca del lago, 11°27'S, 75°41'W, 12 Apr. 1943, *Zúñiga s.n.* (USM); near km 231 on road between La Oroya and Junín, 11°28'S, 75°54'W, 23 Apr. 1960, *Moore & al. 8309* (BH, US, USM); Morococha, 11°35'S, 76°8'W, 23 Mar. 1947, *Haapala s.n.* (H); Yauli, Ticlio, 11°39'S, 76°5'W, 13 June 1940, *Asplund 11655* (S); Concepción, Ingenio, 11°53'S, 75°15'W, 1948, *Soukup 3656* (F); Huancayo, San Gerónimo, 11°57'S, 75°15'W, *Hjertinger 656* (USM); Huancayo, Nevado Acopalca, 11°59'S, 75°6'W, Feb., *Soukup 3703* (F, US). La Libertad: Bolivar, Uchumarca, SW of Cerro Comulca, 7°4'S, 77°46'W, 27 Oct. 2012, *Bussmann & al. 17462* (MA); Bolivar, Uchumarca, SW of Cerro Comulca, 7°4'S, 77°46'W, 9 Nov. 2013, *Bussmann & al. 18102* (MA); de Chugay a Molino Viejo, 7°47'S, 77°46'W, 28 June 2009, *Aedo & Zapata 16680* (MA); Santiago de Chuco, Quiruvilca, 8°0'S, 78°19'W, 28 Apr. 2003, *Cano & al. 12985* (USM). Lima: Cord. Raura, 10°26'S, 76°47'W, 17 June 1954, *Rauh & Hirsch 1816* (F); Ticllo, 11°42'S, 76°8'W, 20 Feb. 1954, *Rauh & Hirsch 259* (F); Huarochiri, 1/2 mile before Chicla, 11°42'S, 76°16'W, 24 Feb. 1963, *Saunders 816* (K); Río Blanco, 11°44'S, 76°15'W, 19 May 1922, *Macbride 784* (F, G, W). Pasco: pr. Huayllay, 10°58'S, 76°20'W, 26 Mar. 2005, *Aedo & Galán de Mera 10890* (MA).

Discussion. Geranium ruizii can be distinguished from all other stemless Andean species by its palmatifid, sericeous leaves, with the middle and usually also the lateral segments 3-lobed. It also has sericeous petioles with patent to antrorse hairs. Knuth (1912: 78) differentiated *G. dielsianum* from *G. ruizii* on the basis of leaf size (longer in *G. dielsianum*) and Macbride (1949: 513) by the "lateral as middle leaf-divisions mostly or all 3-dentate" against "lateral leaf-divisions often entire or 1-dentate" in *G. ruizii*. I have found a continuous variation in leaf size, and that entire lateral segments occur sporadically, often among specimens with 3-lobed lateral segments, which indicate that there is no basis for recognizing *G. dielsianum* as distinct from *G. ruizii*. In a collection from Peru (*Sánchez & Cabanillas 6735*, F, MA) the nectaries have some hairs at the apex but otherwise match *G. ruizii*, which usually has glabrous nectaries. Most of the records of *G. ruizii* are from northern and central Peru. One isolated locality, in Bolivia near the Peruvian border (*Menhofer 1795*, MA), points up the insufficiency of collecting in the intervening region. More puzzling is a record of *G. ruizii* in Colombia. A specimen at K (*Lobb 285*) is labeled as "Columbia." According to Chaudhri & al. (1972: 454), William Lobb collected in southern Colombia (mainly in Nariño), an area in which the presence of *G. ruizii* is plausible; however, no other collection of *G. ruizii* from Colombia and Ecuador was found in any herbarium. According to the former curator of COL J.L. Fernández Alonso (*in litt.*) some other Lobb collections are similarly problematic.

188. Geranium sericeum Willd. ex Spreng., Syst. Veg. 3: 70. 1826. Type locality: "sericeum W. herb. ... Amer. austr.? Humb.". Type: Ecuador, Antisana, 0°30'S, 78°10'W, *A. Bonpland & F.A. Humboldt s.n.* (lectotype, designated by Aedo & al. 2002: 271, B-W-12529-01-0 image!; isolectotypes, BH-fragment!, HAL!, P-00136928!, PR-616138 fragment!).

Perennial herbs, 2-4.1 cm tall. *Rootstock* 6-14 mm in diameter, vertical, not tuberculate, not turnip-shaped, without thickened roots. *Stem* scapiform, cushion-like, stolons absent, without vegetative stems. *Basal leaves* in a persistent rosette; leaf laminas 0.9-1.7 cm long, 1.1-1.7 cm wide, not peltate, palmatisect, polygonal in outline, base cordate, not coriaceous, with nerves not projected, sericeous on both surfaces; segments 7, in more than 1 plane, middle segment obtriangular (with linear-lanceolate lobes), 0.3-0.8 mm wide at the base [ratio segment width at the base/middle segment length = 0.05-0.09], 3-lobed in distal half [ratio secondary sinus length/middle segment length = 0.51-0.89]; petioles up to 3 cm long, without abscission zone, terete, not swollen, not deflexed in age, woolly-sericeous, with patent to retrorse (not appressed), eglandular hairs 0.8-1.6 mm long; stipules 12-18 mm long, 1.1-3.9 mm wide, lanceolate, free, papery, brownish red, sericeous on abaxial surface and on the margin, glabrous adaxially. *Cymules* 1-flowered, solitary [ratio cymule length/leaf length = 0.4-0.9]; peduncles 1-8.1 mm long, woolly-sericeous, with patent, eglandular hairs 0.8-1 mm long; bracteoles absent. Flowers actinomorphic. *Sepals* 7-9 mm long, 1.8-2.3 mm wide, lanceolate, smooth, not accrescent, nerves 3, mucro 0.3-0.8 mm long [ratio mucro length/sepal length = 0.05-0.11], woolly-sericeous, with antrorse, eglandular hairs 1-2 mm long on the abaxial surface and margin, ± hairy adaxially. *Petals* 9-11.4 mm long, 3.7-6 mm wide, erect-patent, rounded, without claw, purple, hairy on both surfaces, mainly on the base of the adaxial surface, ciliate on the basal margin, with hairs 0.1-0.3 mm long. *Stamens* 10, both whorls bearing anthers; filaments 3.6-4.5 mm long, lanceolate, white, with eglandular hairs 0.5-0.8 mm long on the abaxial surface and margin; anthers 1-1.2 mm long, yellow. Nectaries 5, hemispheric, glabrous. *Gynoecium* 4-4.3 mm long, yellow. *Fruit* 10.9-14.5 mm long, erect, discharge of seed-ejection type; mericarps 2.5-3.5 mm long, 1.2-1.8 mm wide, without a strand of fibers, not compressed at the apex, smooth, without basal beak, with a basal callus, without a basal prong, brown, woolly-sericeous, with erect-patent, eglandular hairs 0.7-1.5

mm long; rostrum 6.8-10 mm long, without a narrowed apex, not twisted, woolly-sericeous, with patent, eglandular hairs 0.3-1.4 mm long; stigmatic remnants 0.8-2.3 mm long, with 5 usually glabrous lobes. *Seeds* 1.7-2.2 mm long, 1-1.3 mm wide, finely reticulate, uniformly colored, brown, glabrous. Cotyledons with entire margin. Figs. 478, 479.

Pollen. *Geranium*-type (Aedo & al. 2002: 217; Bortenschlager 1967: 425).

Chromosome number. Unknown.

Phenology. Collected in flower from January to December.

Distribution. This species is endemic to central Ecuador (Fig. 480).

Habitat. Grass tussocks in paramo, open sandy areas, ravines and rock outcrops; 3900-4900 m.

Additional specimens examined. **Ecuador.** Napo: NW slopes of Antisana, Lago Mauca-Machay, 0°27'S, 78°10'W, 2 Nov. 1979, *Holm-Nielsen 20734* (AAU, MO); falda W del Cerro Antisana, origen del río Antisana, 0°28'S, 78°12'W, 27 Jan. 1983, *Balslev & al. 3959* (COL, MA); Píntag, ladera SW del volcán Antisana, 0°29'S, 78°12'W, 3 Aug. 2006, *Aedo & León 13351* (MA); Píntag, ladera SW del volcán Antisana, 0°29'S, 78°10'W, 3 Aug. 2006, *Aedo & León 13352* (MA); SW slopes of volcán Antisana, 2-3 km N of Hacienda El Hato and 5-6 km of Laguna Micacocha, 0°29'S, 78°9'W, 1 July 1979, *Løjtnant & Molau 15325* (AAU); Antisana, 0°30'S, 78°10'W, Oct., *Anthony & Tate 293* (US); Cerro Antisana, 0°30'S, 78°10'W, 17 Sep. 1979, *Black 178* (AAU); 4 km N of Hacienda Antisana, 0°30'S, 78°10'W, 5 Aug. 196, *Grubb & al. 682* (K); Antisana, 0°30'S, 78°10'W, 1849, *Jameson 753* (G, E); SW slopes of Antisana, Laguna Micacocha, 0°30'S, 78°10'W, 5 Dec. 1982, *Laegaard 41263* (AAU); lake at origin of río Antisana on SW slope of volcán Antisana, Laguna Micacocha, 0°31'S, 78°11'W, 21 Aug. 1976, Øllgaard & *Balslev 8882* (AAU, MO). Pichincha: Andes of Quito, *Jameson 752* (G); declives SW Antisana, 0°30'S, 78°10'W, Apr., *Acosta Solís 1696* (M); in m. Antisana pag. super, 0°30'S, 78°10'W, *Sodiro s.n.* (P, W).

Discussion. Geranium sericeum, an endemic of Ecuador, is known only from a small area near the Volcán Antisana. It is easily distinguished from other palmatisect-leaved species within its range by the presence of a woolly-sericeous indumentum on the laminas, petioles, peduncles, sepals, and fruits. According to Fryxell (1991), *Sida radiciflora* C. Presl (Malvaceae) should be considered a synonym of *G. sericeum*. Fryxell stated that Presl (1831-1835) described his *Sida radiciflora* from Mt. Chimborazo, Ecuador, but no original specimen was kept at PR. Thus, Fryxell (1991) designated a collection by Née (MA-252584) as neotype of *S. radiciflora*, which is (in his view) *G. sericeum*; however, some recent information contradicts Fryxell's interpretation of *S. radiciflora*. Presl (1835: 106) described *S. radiciflora* from Guayaquil, not from Chimborazo, and, according to Halfdan-Nielsen (unpubl.),

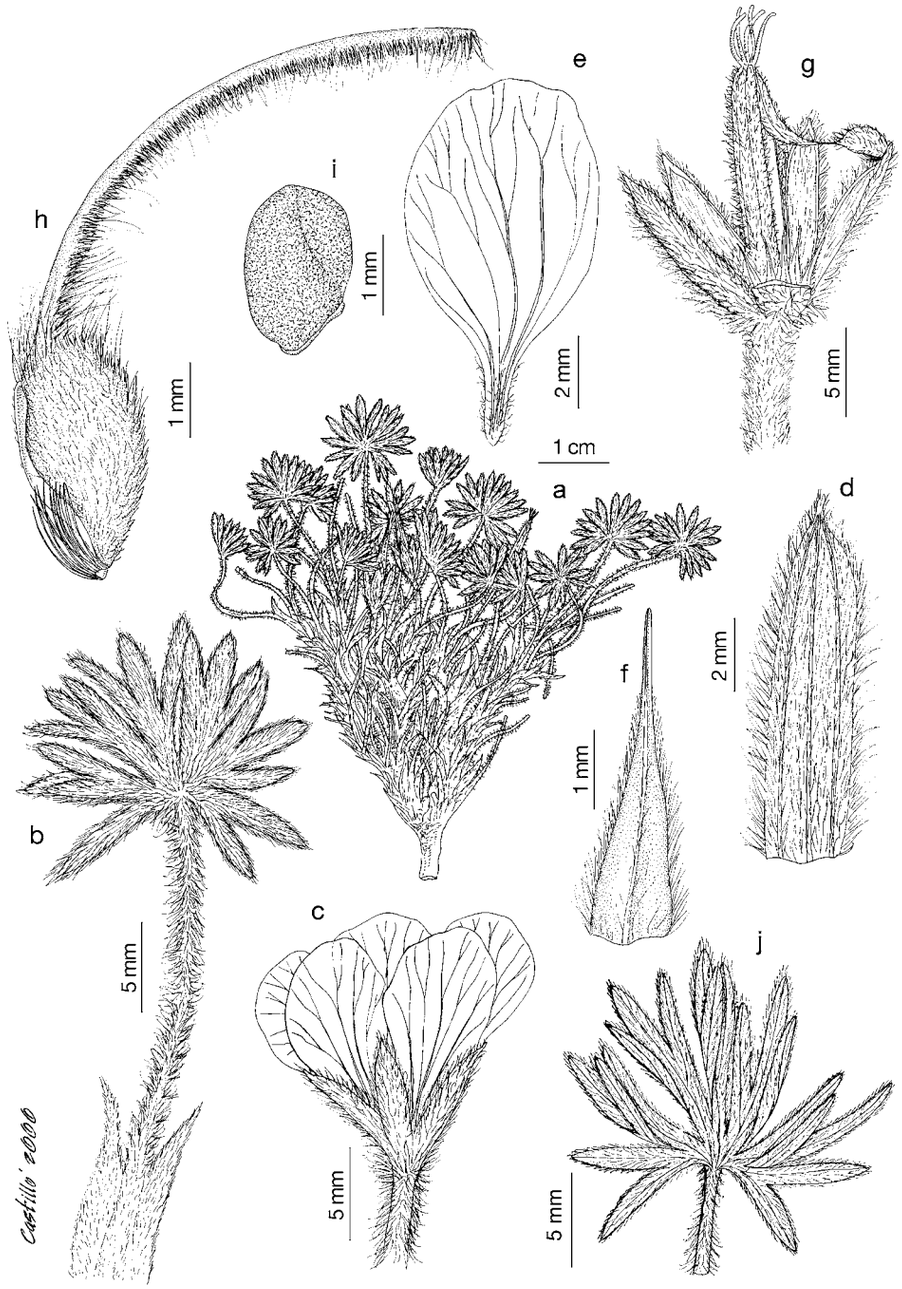


Fig. 478. *Geranium sericeum*. a. Fruiting branch. b, j. Leaves. c. Flower. d. Sepal. e. Petal. f. Staminal filament. g. Fruit. h. Mericarp. i. Seed. (Based on: a, c, *Black 178*, AAU; b, d-j, *Løjtnant & Molau 15325*, AAU).

Fig. 479. *Geranium sericeum* (Based on: a-d, *Aedo & León 13351,* MA; e, without voucher, from Cerro Antisana, Ecuador, photo: C. Ulloa).

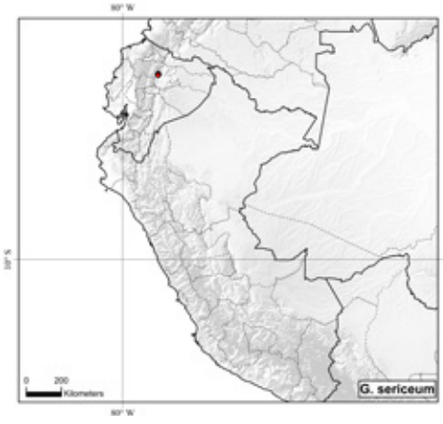


Fig. 480. Distribution of *Geranium sericeum*.

there exists a specimen collected by Haenke from Guayaquil, which is *Sida* and presumably the type of *S. radiciflora* (PR-185995-591). Also, examination of Née's collection (MA-252584) reveals that this is *Geranium ecuadoriense* rather than *G. sericeum* (Aedo & al. 2002: 271).

189. Geranium tovarii Aedo, Anales Jard. Bot. Madrid 58: 184. 2000. Type locality: "Perú. Lima, Huarochiri, lago Aguascocha, Mina Caprichosa, above Casapalca, 1-III-1964, Hutchison & Tovar 4258 (F!)". Type: Peru. Lima, Huarochiri, lago Aguascocha, Mina Caprichosa, above Casapalca, 11°01'S, 76°38'W, 1 Mar. 1964, *P.C. Hutchison & Ó. Tovar 4258* (holotype, F-0041223F!; isotypes, CAS!, E!, G!, GH-00105445!, LE-00002583!, M!, MO-176316!, NY-00468262!, P!, S-09-9939!, US-00731411 image!).

Perennial herbs, 0.7-5 cm tall. *Rootstock* 5-16 mm in diameter, vertical, not tuberculate, not turnip-shaped, without thickened roots. *Stem* scapiform, cushion-like, stolons absent, without vegetative stems. *Basal leaves* in a persistent rosette; leaf laminas 0.1-1.1 cm long, 0.2-1.1 cm wide, not peltate, palmatisect, polygonal in outline, base cordate, not coriaceous, with nerves not projected, sericeous on both surfaces; segments 7, in more than 1 plane, middle segment rhombic (with linear-lanceolate lobes), 0.3-0.7 mm wide at the base [ratio segment width at the base/middle segment length = 0.05-0.11], 5-6-lobed in distal half [ratio secondary sinus length/middle segment length = 0.33-0.63]; petioles up to 5 cm long, without abscission zone, terete, not swollen, not deflexed in age, sericeous, with antrorse, appressed, eglandular hairs 0.2-0.4 mm long; stipules 7-13 mm long, 1-2.8 mm wide, lanceolate, free, papery, brownish red, with eglandular hairs on abaxial surface and on the margin, glabrous adaxially. *Cymules* 1-flowered, solitary [ratio cymule length/leaf length = 0.5-0.7]; peduncles 1.8-6.4 mm long, glabrous (except for some glands) or with scattered, antrorse, appressed, eglandular hairs 0.2-0.3 mm long; bracteoles absent. Flowers actinomorphic. *Sepals* 4-6 mm long, 1.1-2.3 mm wide, lanceolate, smooth, not accrescent, nerves 3, mucro 0.1-0.4 mm long [ratio mucro length/sepal length = 0.04-0.08], with erect-patent, eglandular hairs 0.2-0.4 mm long on both surfaces and patent, eglandular hairs 1-1.2 mm long on the margin. *Petals* 4-7.4 mm long, 1.8-2.6 mm wide, erect-patent, rounded, without claw, purple, sometimes white, glabrous. *Stamens* 10, both whorls bearing anthers; filaments 2-3.3 mm long, lanceolate, yellow, glabrous; anthers 0.6-0.8 mm long, yellow. Nectaries 5, hemispheric, glabrous. *Gynoecium* 2-6-4.2 mm long, yellow. *Fruit* 6.5-9.4 mm long, erect, discharge of seed-ejection type; mericarps 1.9-2.5 mm long, 1-1.1 mm wide, without a strand of fibers, not compressed at

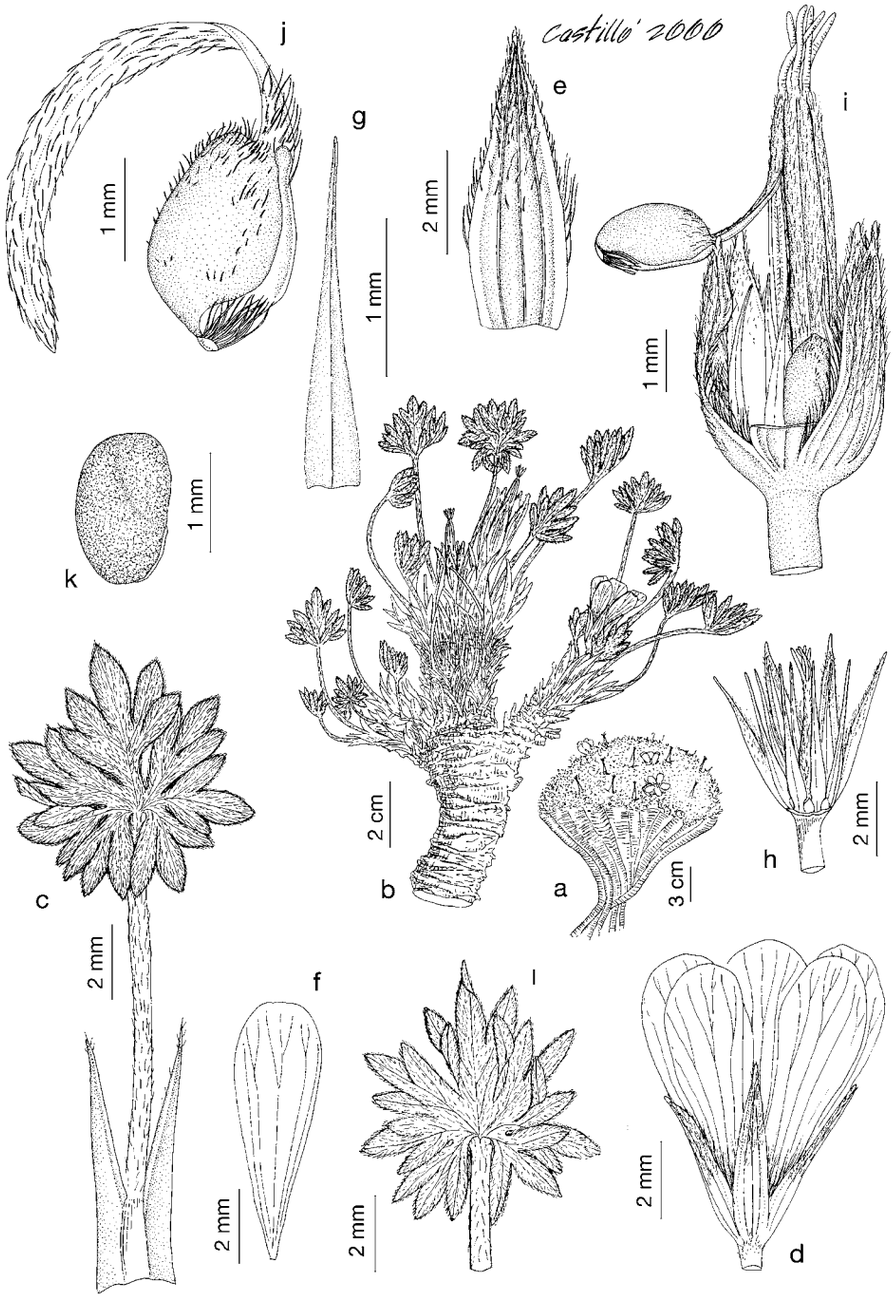


Fig. 481. *Geranium tovarii*. a. Habit. b. Fruiting and flowering branch. c, l. Leaves. d. Flower. e. Sepal. f. Petal. g. Staminal filament. h. Flower, sepals and petals removed. i. Fruit. j. Mericarp. k. Seed. (Based on: a-c, e, g, i, *Hutchison & Tovar 4258*, F; d, f, h, *Hutchison & Tovar 4258*, UC; j, k, *Hutchison & Tovar 4258*, M).

the apex, smooth, without basal beak, with a basal callus, without a basal prong, brown, with antrorse, ± appressed, eglandular hairs 0.2-0.3 mm long; rostrum 4-5.3 mm long, without a narrowed apex, not twisted, with antrorse, appressed, eglandular hairs 0.2-0.4 mm long; stigmatic remnants 0.7-1.8 mm long, with 5 glabrous lobes. *Seeds* 1.3-1.5 mm long, 0.7-1 mm wide, finely reticulate, uniformly colored, brown, glabrous. Cotyledons with entire margin. Fig. 481.

Pollen. *Geranium*-type (Aedo & al. 2002: 217).

Chromosome number. Unknown.

Phenology. Collected in flower from January to May.

Distribution. This species ranges through central Peru (Fig. 482).

Habitat. Rocky outcrops and dry grassland in puna; 4200-4800 m.

Additional specimens examined. **Peru.** Ancash: Recuay, carretera a Pachacoto, 9º52'S, 77º25'W, 28 May 2001, *Cano & al. 11428* (USM). Junín: Abra de la Viuda, 11º20'S, 76º25'W, 26 Mar. 2005, *Aedo & Galán de Mera 10889* (MA); Morococha, 11º35'S, 76º8'W, 14 Feb. 1949, *Haapala s.n.* (H). Pasco: near km 312 on road to Huanuco just before Cerro de Pasco, 10º41'S, 76º16'W, 23 Apr. 1960, *Moore & al. 8321* (BH); Huaron, 11º0'S, 76º25'W, 1958, *Humbert 30850* (P); Huayllay, Lago Huaron, 11º3'S, 76º25'W, 14 Jan. 1971, *Ellenberg 4052* (NY).

Discussion. Geranium tovarii, a rare endemic from central Peru, resembles most closely *G. weddellii*, from which it is easily differentiated by its much shorter petals, longer hairs on the margin of the sepals, glabrous nectaries, and a fruit without a narrowed apex. The ranges of *G. tovarii* and *G. weddellii* are completely allopatric.

Fig. 482. Distribution of *Geranium tovarii*.

190. Geranium weddellii Briq., Annuaire Conserv. Jard. Bot. Genève 11/12: 183. 1908. Type locality: "Bolivia: viciniis Sorata, Guatata, in graminosis (apacheta) reg. alpinae, 4200 m., dec. -- mart. 1858 (Mandon n. 785)". Type: Bolivia. La Paz, Sorata, Guatata, 15°46'S, 68°38'W, Mar. 1858, *G. Mandon 785* (lectotype, designated by Knuth 1912: 80, G-00365833!; isolectotypes, BM!, K-000531436 image!, MPU!, NY!, P-00147088!, W!).

Geranium palcaense R. Knuth, Meded. Rijks-Herb. 27: 68. 1915. Type locality: "Am Fuss der Cerros de Palca im oberen Llavetal, ca. 4400 m, auf kurzgrasigen, mageren Triften dichte Polster bildend (no. 2097, bl. im Mai 1911.-- Typus!)". Type: Bolivia. La Paz, Cerro de Palca, 16°35'S, 68°03'W, May 1911, *T. Herzog 2097* (holotype, L-0018351!; isotype, BH-418695-fragment!).

Perennial herbs, 0.6-3.5 cm tall. *Rootstock* 4.7-12 mm in diameter, vertical, not tuberculate, not turnip-shaped, without thickened roots. *Stem* scapiform, cushion-like, stolons absent, without vegetative stems. *Basal leaves* in a persistent rosette; leaf laminas 0.4-1.1 cm long, 0.5-1.1 cm wide, not peltate, palmatisect, polygonal in outline, base cordate, not coriaceous, with nerves not projected, sericeous on both surfaces; segments 7, in more than 1 plane, middle segment rhombic (with linear-lanceolate lobes), 0.2-0.5 mm wide at the base [ratio segment width at the base/middle segment length = 0.04-0.09], 3-10-lobed in distal half [ratio secondary sinus length/middle segment length = 0.36-0.48]; petioles up to 2.5 cm long, without abscission zone, terete, not swollen, not deflexed in age, sericeous, with antrorse, appressed, eglandular hairs 0.2-0.4 mm long; stipules 3-9.6 mm long, 0.5-4 mm wide, lanceolate, free, papery, brownish red, with eglandular hairs on abaxial surface and on the margin, glabrous adaxially. *Cymules* 1-flowered, solitary [ratio cymule length/leaf length = 0.6-0.9]; peduncles 3.6-15 mm long, sericeous, with antrorse, appressed, eglandular hairs 0.3-0.4 mm long; bracteoles absent. Flowers actinomorphic. *Sepals* 6-8.5 mm long, 1.6-3 mm wide, lanceolate, smooth, not accrescent, nerves 3, mucro 0.3-0.5 mm long [ratio mucro length/sepal length = 0.05-0.07], hairy to sericeous with erect-patent, eglandular hairs 0.2-0.5 mm long on the abaxial surface and ± hairy adaxially. *Petals* 10.6-15 mm long, 2.9-6 mm wide, erect-patent, rounded, without claw, purple, sometimes white, glabrous. *Stamens* 10, both whorls bearing anthers; filaments 5-6.4 mm long, lanceolate, yellow, with eglandular hairs 0.2-0.5 mm long on the abaxial surface and margin; anthers 1.1-1.3 mm long, yellow. Nectaries 5, hemispheric, with a tuft of hairs at the top, dorsally glabrous. *Gynoecium* 5.5-6.5 mm long, purple. *Fruit* 12.8-13.5 mm long, erect, discharge of seed-ejection type; mericarps 2.6-3 mm long, 1.3-1.7 mm wide, without a strand of fibers, not compressed at the apex, smooth, without basal beak, with a basal callus, without a basal prong, brown, with antrorse, ± appressed, eglandular hairs 0.2-0.7 mm long; rostrum 9-10 mm long, with a narrowed apex 1-1.7 mm long, not twisted, hairy to sericeous, with antrorse, appressed, eglandular hairs 0.2-0.4 mm long; stigmatic remnants 0.7-2 mm long, with 5 glabrous lobes. *Seeds* 2.1-2.2 mm long, 0.9-1.6 mm wide, finely reticulate, uniformly colored, brown, glabrous. Cotyledons with entire margin. Figs. 483, 484.

Pollen. *Geranium*-type (Aedo & al. 2002: 217).

Chromosome number. Unknown.

Phenology. Collected in flower from January to December.

Distribution. This species ranges from southeastern Peru to western Bolivia (Fig. 485).

Habitat. Bogs, wet places, and rocky or grassy slopes; 3100-4700 m.

Additional specimens examined. **Bolivia.** descent à Hylobayo, *Mandon s.n.* (P). Cochabamba: Arque, comunidad Huancani, 17°16'S, 66°43'W, 3 Jan. 1992, *Ibisch 765* (LPB); Abra de Tunari, 17°18'S, 66°22'W, 28 Feb. 1928, *Troll 1691* (B); Tapacarí, N-ladera del Cerro Quiguani, Japo, 17°37'S, 66°40'W, 23 Mar. 1995, *Pestalozzi 467* (MA); Arque, camino a Oruro entrando por el km 86, camino a Huancani, en Sayari, 17°42'S, 66°28'W, 1 Apr. 1992, *Rojas 1263* (BOLV). La Paz: Bautista Saavedra, camino de Cotabamba a Huanku China, 14 Nov. 1982, *Menhofer 1653* (MA, LPB, U); Bautista Saavedra, Abra Pumasani, 14°48'S, 69°10'W, 20 Apr. 1982, *Menhofer 1114* (MA, U); Bautista Saavedra, an der Strase von Pumazani nach Charazani, 2,5 km unerthalb der Abzweigung nach Ulla Ulla, 15°3'S, 69°16'W, 17 Dec. 1979, *Feuerer*

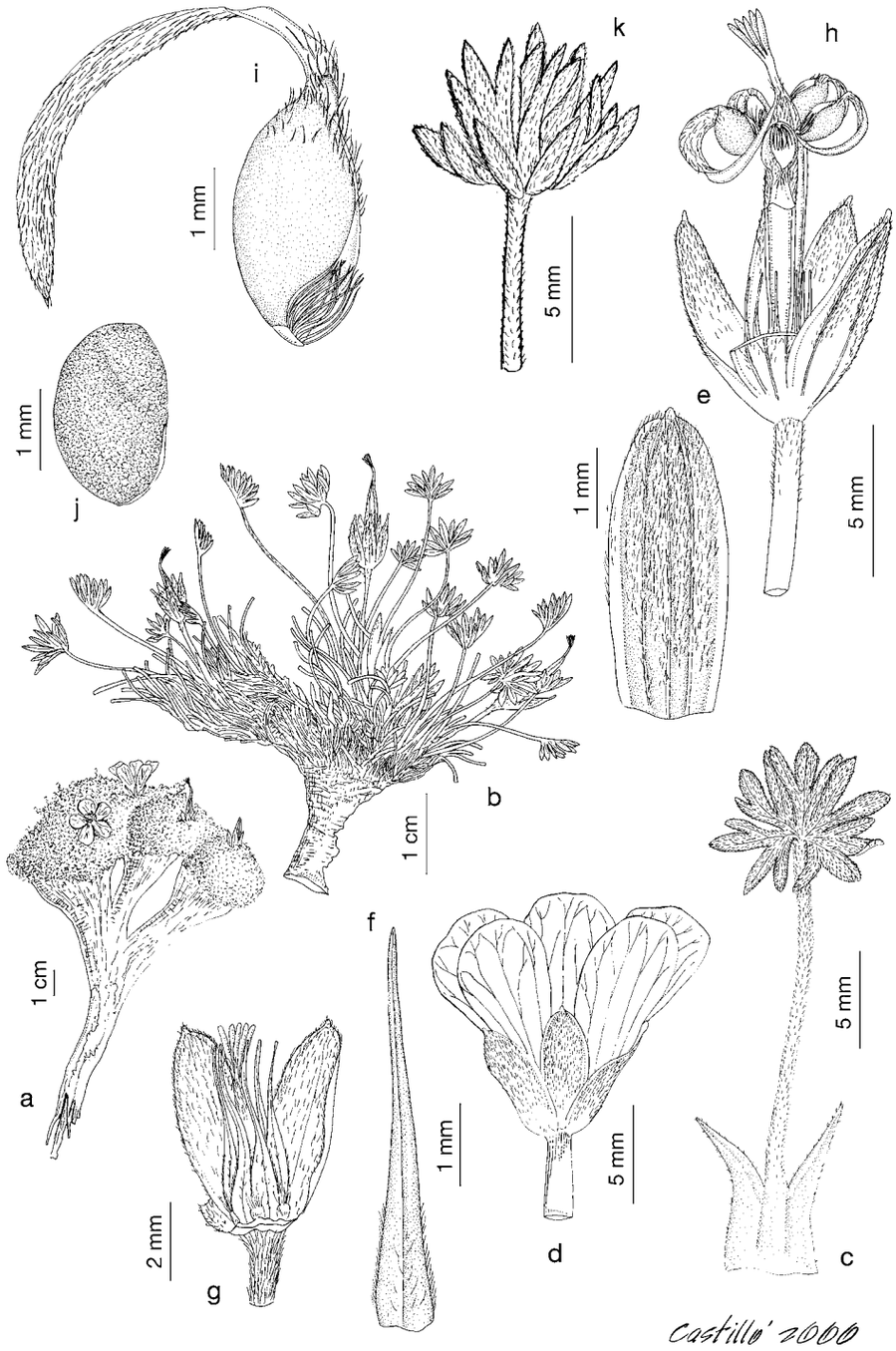


Fig. 483. *Geranium weddellii*. a. Habit. b. Fruiting branch. c, k. Leaves. d. Flower. e. Sepal. f. Staminal filament. g. Flower, petals and three sepals removed. h. Fruit. i. Mericarp. j. Seed. (Based on: a, *Solomon 11385*, MO; b, i, j, *Davis & al. 1569*, F; c, *Mandon 785*, G; d, f, g, *Vuilleumier 341*, LPB; e, h, *Davis & al. 1569*, GH).

Fig. 484. *Geranium weddellii* (Based on: *Aedo & Galán de Mera 11138,* MA).

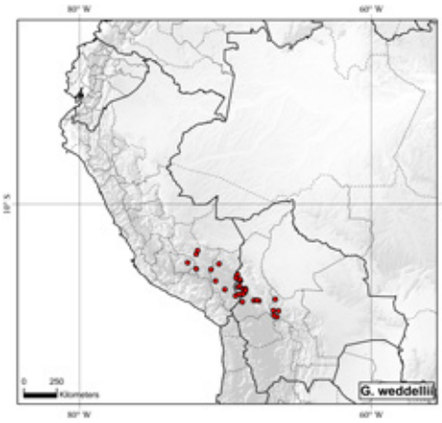


Fig. 485. Distribution of *Geranium weddellii*.

7275a (HBG, U); Bautista Saavedra, Khata, 15º9'S, 69º0'W, 6 Jan. 1983, *Menhofer 1826* (MA); Bautista Saavedra, Amarete, 15º14'S, 68º58'W, 27 Jan. 1980, *Feuerer 8188* (HBG); Camacho, near Huallpacayo, 15º35'S, 69º2'W, *Cárdenas 3879* (S); Camacho, entre Escoma y Huallpacayo, 15º40'S, 69º8'W, 28 Feb. 1979, *Ceballos & al. 661* (G); Omasuyos, on road from Achacachi to Sorata, 15º53'S, 68º37'W, 4 Apr. 1939, *Balls 6462* (CAS, E, K); camino de Achacachi a Sorata, 22 km de Achacachi, 16º2'S, 68º41'W, 17 Nov. 1981, *Zuloaga & Vázquez 1703* (LPB); Omasuyos, Achacachi 22 km hacia Sorata, 16º3'S, 68º41'W, 17 Nov. 1981, *Beck 7197* (CTES, LPB); Omasuyos, cerca de Tiquina, Lago Titicaca de Janckoama, pampa de Jipijipi, 16º8'S, 68º47'W, 23 Mar. 1997, *Beck 21989* (MA); Omasuyos, cerca de Tiquina, Lago Titicaca de Janckoama, pampa de Jipijipi, 16º8'S, 68º47'W, 23 Mar. 1997, *Beck 21990* (LPB); Manco Kapac, Copacabana 13 km hacia Tiquina, 16º10'S, 69º3'W, 28 Dec. 1995, *Beck 22493* (MA); Manco Kapac, Copacabana, península SW side l. Titicaca, 16º10'S, 69º3'W, 2 Feb. 1903, *Hill 88* (K); Murillo, 1 km W of pass between Mururata and Illimani, 16º34'S, 67º51'W, 11 Dec. 1983, *Solomon 11385* (MO, NY); Sud Yungas, 21 km ater Palca on the road to Iquico, 16º34'S, 67º50'W, 10 Nov. 1967, *Vuilleumier 341* (GH, LPB, NY, TEX, US); Murillo, La Paz-Calacoto 47 km hacia el E, sobre camino Via Lambate, 16º36'S, 67º42'W, 31 Dec. 1980, *Beck 3957* (LPB, NY); Ingavi, cantón Jesús de Machaca, comunidad Titicani-Tacaca, a 20 km de Guaqui, 16º41'S, 68º50'W, 13 Mar. 1989, *Villavicencio 48* (B); Ingavi, cantón Jesús de Machaca, comunidad Titicani-Tacaca, a 20 km de Guaqui, 16º41'S, 68º50'W, 13 Mar. 1989, *Villavicencio 49* (MA); Ingavi, cantón Jesús de Machaca, comunidad Titicani-Tacaca, a 20 km de Guaqui, 16º41'S, 68º50'W, 13 Mar. 1989, *Villavicencio 82* (B, MA). **Peru.** Apurimac: Cotabambas, distrito Progreso, 14º0'S, 72º35'W, 20 Oct. 2006, *Cano & al. 17059* (MA). Cuzco: Calca, Abra de Amparaes, 13º10'S, 71º54'W, 10 May 1975, *Chávez 3292* (MO); Urubamba, Chincheros, Taucca, 13º25'S, 72º0'W, 14 Jan. 1982, *Davis & al. 1569* (F, GH); Chumbivilcas, mina Katanga, cerca del pueblo Nelille, 14º25'S, 72º0'W, 21 Nov. 1984, *Carlier 240* (USM); La Raya, 14º28'S, 70º59'W, 4 Apr. 1954, *Rauh & Hirsch 675* (F). Puno: Macusani, 14º5'S, 70º26'W, Jan., *Soukup 537* (F, P); pr. Palca, 15º15'S, 70º40'W, 4 Apr. 2005, *Aedo & Galán de Mera 11138* (MA); Puno, 15º50'S, 70º2'W, 5 Mar. 1938, *Stafford 1256* (F); Juliaca, Pomata, 16º16'S, 69º18'W, *Shepard 27b* (GH).

Discussion. Geranium weddellii is easily recognized among other similar sympatric species by its small and palmatisect, sericeous leaves and its sericeous petioles with antrorse, appressed hairs. The differences between *G. weddellii* and *G. tovarii* are addressed under the latter species.

The Diffusum Group—This group is characterized by its prostrate or ascending habit, its opposite leaves and its 1-flowered cymules arranged in a monochasial inflorescence. The cymules usually lack pedicels. The leaves are usually palmatifid, polygonal in outline, and with few but deep lobes. The petals are of small size and the fruit rostrums usually lack a narrowed apex.

191. Geranium diffusum Kunth in Humb., Bonpl. & Kunth, Nov. Gen. Sp. 5: 230. 1822. Type locality: "Crescit in montibus Peruviae". Type: Colombia. Quindio, 4°38'N, 75°32'W, *A. Bonpland & F.A. Humboldt s.n.* (lectotype, designated by Knuth 1912: 214, B-W-12535-02-0 image!; isolectotype, P-136924!).

Geranium quinquelobum Wedd., Chlor. Andina 2: 286. 1861, nom. illeg., non Lam. 1788. *Geranium pichinchense* Aedo & Muñoz Garm., Kew Bull. 52(3): 726. 1997. Type locality: "Hab. Écuateur: sur le Pichincha !, h. 4250 m. (Jameson, exsicc, ann. 1856, n. 142)". Type: Ecuador. Pichincha, 0°10'S, 78°36'W, 21 Jan. 1856, *W. Jameson 142* (lectotype, designated by Aedo 2012: 268, G-00439764!; isolectotypes, BM-000603550!, FI!, GH-00338016!, P!).

Geranium diffusum var. *subsericeum* Hieron., Bot. Jahrb. Syst. 20, Beiblatt 49: 32. 1895. Type locality: "Columbia: crescit in dumetis regionis supremae silvaticae in montibus Altos de Chillanquer, prov. Tuquerres, alt. s. m. 3000-3400 m, mense Julio florens (n. 4811). -- Ecuador: crecit in monte Cotopaxi et Pichincha, alt. s. m. 3000 m, mense Novembri florens (n. 152)". Type: Colombia. Nariño. Tuquerres, Altos de Chillanquer, 1°01'N 77°40'W, July, *F.C. Lehmann 4811* (lectotype, designated by Aedo 2012: 268, F-0360133F!; isolectotype, K-000190057!).

Geranium sodiroanum R. Knuth, Bot. Jahrb. Syst. 37: 557. 1906. Type locality: "Ecuador: Prov. Riobamba auf Matten bei El Toldo (Sodiro, Spec. Fl. Ecuad. a. 1891, n. 213!).- Peru: Chicla an der Lima-Oroya-Bahn auf kurzwüchsigen, steinigen Matten, 3720 m (Weberbauer n. 255. - Blühend und fruchtend im Oktober-Dezember)". Syntypes: Ecuador. Chimborazo. Riobamba auf Matten bei El Toldo, 1°40'S, 78°38'W, 1891, *L. Sodiro 213* (no original material located); Peru. Lima, Lima-Oroya, Chicla, 11°45'S, 76°18'W, *A. Weberbauer 255* (no original material located).

? Geranium harmsii R. Knuth, Bot. Jahrb. Syst. 37: 559. 1906. Type locality: "Peru: Prov. Tarma im Dep. Junin auf den Bergen östlich von Palea auf Steppen mit eingestreuten Stäuchern und zahlreichen, aber niedrigen Gräsern bei 2700-3000 m (Weberbauer n. 2451. - Blühend im Februar)". Type: Peru. Junín, Tarma, 15°15'S, 70°32'W, *A. Weberbauer 2451* (lectotype, designated by Knuth 1912: 214, B destroyed; lectotype, designated by Aedo 2012: 268, G-00439765!).

Geranium diffusum var. *sprucei* Briq., Annuaire Conserv. Jard. Bot. Genève 11-12: 189. 1908. Type locality: "in Andibus ecuadorensibus (Spruce n. 5596)". Type: Ecuador. Pichincha. Andes Quitenses, Sananeajas, *R. Spruce 5596* (lectotype, designated by Aedo 2012: 268, G!; isolectotypes, LD-1507899!, W!).

Geranium chimborazense R. Knuth in Engl., Pflanzenr. IV.129 (Heft 53): 212. 1912. Type locality: "Ecuador: Quito, bei der Hacienda Pesillo und an der Camino de la Esperanza (Stübel, Fl. Aeq. a. 1871 n. 92b!). Chimborazo, auf der Nordwestseite bei 3800 m (H. Meyer, Pflz. Hochl. Ecuad. a. 1903 n. 181!).-- Herb. Berlin. Nota 1. Ad Hanc specim adnumerandum est speciminis fragmentum a cl. Knuth G. diffusum nominatum, quod conservatur in herb. Willd. sine loco natali. Sub hoc nomine itaque duae species asservantur". Type: Ecuador. Chimborazo, NW suite, 1°24'S, 78°52'W, June 1903, *H. Meyer 181* (lectotype, designated by Aedo 2012: 268, JE-00014434!).

Geranium columbianum R. Knuth in Engl., Pflanzenr. IV.129 (Heft 53): 212. 1912. Type locality: "Columbien: Paramo de Mucuchiez bei la Culata (Moritz n. 1245!, 1246! -- Typus in Herb. Berl.).-- Blühend und fruchtend Oktober" [the type locality is in Venezulea, according to Pittier 1929]. Type: Venezuela. Mérida. Páramo de Mucuchiez, la Culata, 8°45'N, 71°04'W, *J.W. Moritz 1246* (holotype, B destroyed; lectotype, designated by Aedo 2012: 268, BM-000835606!).

Geranium imbaburae R. Knuth in Engl., Pflanzenr. IV.129 (Heft 53): 211. 1912. Type locality: "G. diffusum var. grandiflorum Hieron. in sched. ... Ecuador: Prov. Imbabura,

auf dem Cerro Cotacachi (Cuicocha) (Stübel, Fl. Aeq. a. 1870 n. 52!, n. 67a -- Typus in Herb. Berol!).-- Blühend und fruchtend November bis März". Type: Ecuador. Imbabura. Cerro Cotacachi, 0°18'N, 78°22'W, *A. Stuebel 52* (holotype, B destroyed; photos, F!, GH!, MO!).

Geranium chamaense Pittier, J. Wash. Acad. Sci. 19: 179. 1929. Type locality: "Mérida: Páramos de los Apartaderos, upper Chama Valley, 3300 m.; flowers and fruits September 4, 1921 (Dr. A. Jahn 549, Type)". Type: Venezuela. Mérida, Páramos de los Apartaderos, upper Chama Valley, 8°48'N, 70°51'W, 4 Sep. 1921, *A. Jahn 549* (holotype, US-1120124!).

Geranium robustipes R. Knuth, Repert. Spec. Nov. Regni Veg. 45: 62. 1938. Type locality: "Venezuela: Paramo de Timotes (Farenholtz a. 1934 n. 1187 -- Typus in herb. Berol.!)". Type: Venezuela. Mérida. Páramo de Timotes, 8°52'N, 70°48'W, 1934, *H. Farenholtz 1187* (holotype, B destroyed; no original material located).

Geranium holm-nielsenii Halfd.-Niels., Nordic J. Bot. 16(3): 272, 273 fig. 4. 1996. Type locality: "Holm-Nielsen 18733, Ecuador, Prov. Bolívar, Mt. Chimborazo, windswept gravel páramo, with open cushion plant association (78°55'W, 1°28'S), alt. 4200 m, 4 Aug 1979 (AAU holotype)". Type: Ecuador. Bolívar, Mt. Chimborazo, 1°28'N, 78°55'W, 4 Aug. 1979, *L.B. Holm-Nielsen 18733* (holotype, AAU!).

Perennial herbs, 4-53 cm tall. *Rootstock* 2.4-11.9 mm in diameter, ± vertical, not tuberculate, turnip-shaped, without thickened roots. *Stem* prostrate to ascending, leafy, sometimes rooting at nodes, stolons absent, without vegetative stems, with ± retrorse, appressed, eglandular hairs 0.2-0.6 mm long. *Basal leaves* in a ± persistent rosette, cauline leaves opposite; leaf laminas 0.7-2.4 cm long, 0.6-2.6 cm wide, not peltate, palmatifid [ratio main-sinus length/middle segment length = (0.75)0.83-0.89(0.90)], polygonal in outline, base cordate, not coriaceous, with nerves not projected, pilose, with appressed, eglandular hairs on both surfaces; segments 5, in 1 plane, middle segment obtriangular (with lanceolate lateral lobes joined to the middle one), 0.5-2.3 mm wide at the base [ratio segment width at the base/middle segment length = 0.06-0.32], (1)3(5)-lobed at the apex [ratio secondary sinus length/middle segment length = 0.31-0.50]; petioles up to 11 cm long, without abscission zone, terete, not swollen, not deflexed in age, with retrorse (rarely antrorse), appressed, eglandular hairs 0.1-0.7 mm long; stipules 2.3-9.5 mm long, 0.7-1.8 mm wide, lanceolate, free, papery, brownish red, with eglandular hairs on abaxial surface and on the margin, minutely hairy adaxially. *Inflorescence* a monochasial cyme; cymules 1-flowered, solitary [ratio cymule length/leaf length = (0.6)1-2.1(3.3)]; peduncles 5.3-62 mm long, with retrorse (rarely antrorse), appressed, eglandular hairs 0.2-0.6 mm long; bracteoles. Flowers actinomorphic. *Sepals* 3.4-8 mm long, 1.3-3.4 mm wide, lanceolate, smooth, not accrescent, nerves 3, mucro 0.2-1.1 mm long [ratio mucro length/sepal length = 0.06-0.2], with erect-patent, eglandular hairs 0.3-1.5 mm long on the abaxial surface, minutely hairy adaxially. *Petals* (4.2)4.9-8.2(12.4) mm long, 1.7-5.7 mm wide, erect-patent, rounded, without claw, white or purple, glabrous or ciliate on the basal margin, with hairs 0.1-0.4 mm long. *Stamens* 10, both whorls bearing anthers; filaments 2.1-4.8 mm long, lanceolate, white or yellow, with eglandular hairs 0.1-0.5 mm long on the abaxial surface and margin; anthers 0.4-1.1 mm long, yellow. Nectaries 5, hemispheric, glabrous. *Gynoecium* 2.4-5.3 mm long, yellow. *Fruit* 8.3-16 mm long, erect, discharge of seed-ejection type; mericarps 1.8-3.8 mm long, 0.9-1.7 mm wide, without a strand of fibers, not compressed at the apex, smooth, without basal beak, with a basal callus, without a basal prong, brown, with erect-patent, eglandular hairs 0.1-0.6 mm long; rostrum 4.8-10.5 mm long, usually without a narrowed apex, not twisted, with erect-patent, eglandular hairs 0.1-0.7 mm long; stigmatic remnants 0.5-2 mm long, with 5 glabrous lobes. *Seeds* 1.4-2.9 mm long, 0.9-1.6 mm wide, finely reticulate, uniformly colored, brown, glabrous. Cotyledons with entire margin. Figs. 486, 487.

Pollen. *Geranium*-type (Bortenschlager 1967: 433 [sub *G. sodiroanum*]).

Chromosome number. Unknown.

Phenology. Collected in flower from January to December.

Distribution. This species ranges from Venezuela to Colombia, Ecuador, and northern Peru (Fig. 488).

Habitat. Roadsides, rocky or wet areas, grassy fields, grassy tussock paramos, disturbed and grazed shrublands; 1600-4600 m.

Representative specimens examined. **Colombia.** Antioquia: Urrao, Inspección Jaiperá, vereda el Chuscal, Páramo de Frontino, sitios Pico de Águila-La Laguna, 6°27'N, 76°46'W, 6 Apr. 1989, *Callejas & al. 7712* (HUA). Boyacá: Páramo de Pisva, carretera Socha-La Punta km 69, entre El Cardón y El Cadillal, 5°59'N, 72°43'W, 12 June 1972, *Cleef 4482* (COL, U); Sierra Nevada del Cocuy, valle Ritacuva, S-facing slope just N of finca Ritacuva, 6°30'N, 72°18'W, 4 Apr. 1959, *Barclay & Juajibioy 7209* (MO). Caldas: cabeceras del río Otún, hacia el Nevado de Santa Isabel, Bagas de la Laguna Negra, quebrada de la Leona, 4°47'N, 75°26'W, 24 Nov. 1946, *Cuatrecasas 23151* (F). Cauca: Macizo Colombiano, valle de las Papas, pr. Valencia, 1°54'N, 76°39'W, 11 Sep. 1958, *Idrobo & al. 3692* (COL, P). Cundinamarca: Subachoque, Vereda Tobal, finca El Cerro, 4°55'N, 74°10'W, 14 May 2003, *Hernández 1158* (COL); Subachoque, La Pradera, laguna del Salitre, 5°0'N, 74°7'W, 5 Dec. 2004, *Fernández Alonso & al. 22700* (MA). Nariño: Cumbal, alto de Machines, 0°54'N, 77°48'W, 7 Jan. 1952, *Fernández Pérez & al. 1081* (NY); Páramo del Tábano, alto de la Cordillera, entre Pasto y El Encano, vertiente occidental, 1°22'N, 77°48'W, 11 Jan. 1941, *Cuatrecasas 11935* (F, US). Putumayo: Páramo de San Antonio, road from Pasto to Sibundoy, 1°7'N, 77°1'W, 13 Mar. 1953, *Schultes & Cabrera 18862* (GH). Quindio: laguneta to Magaña, old Quindio trail, 4°36'N, 75°30'W, 1 Aug. 1922, *Killip & Hazen 9416* (NY); Salento, Laguneta, 4°38'N, 75°34'W, 1 Apr. 1942, *Sneidern 3091b* (MICH). Santander: Nevado del Cocuy, quebrada de San Paulino, El Morrón, 6°24'N, 72°27'W, 11 Sep. 1938, *Cuatrecasas 1386* (COL, F); W slope of Páramo de las Puentes, above La Baja, 7°22'N, 72°55'W, 25 Jan. 1927, *Killip & Smith 18733* (GH, NY). Tolima: laguna de Cumbal, 19 Sep. 1953, *Fernández Pérez 2638* (COL); municipio de Santa Isabel, Cordillera Central, 4°45'N, 75°10'W, 6 Feb. 1980, *Díaz Piedrahita & Jaramillo 1875* (COL, U). Valle: cordillera Central, vertiente occidental, Hoya del río Bugalagrande, loma de Barragán, desde la Parrilla a la Machuca, 4°4'N, 75°45'W,

13 Apr. 1946, *Cuatrecasas 20640* (F); Carthago, 4º44'N, 75º54'W, 1844, *Goudot s.n.* (P). **Ecuador.** Azuay: Páramo de Cajas, Chuspipuñuna, 2º48'S, 79º13'W, 20 July 2006, *Aedo & Ulloa 13100* (MA); de Jima a San Miguel, Páramo de Matanga, 3º13'S, 78º57'W, 18 July 2006, *Aedo & Ulloa 13026* (MA). Bolivar: Simiatug, Hacienda Talahua, 0º21'S, 79º4'W, 8 May 1939, *Penland & Summers 682* (F, GH); at the pass on the road Riobamba-Guaranda, 1º39'S, 78º50'W, 27 Nov. 1981, *Filskov & al. 37487* (AAU, MO). Cañar: between Biblián and Cañar, 2º42'S, 78º52'W, 21 Sep. 1955, *Asplund 17662* (S). Carchi: Tulcán-El Ángel road, 15 km S of Las Juntas, 0º40'N, 77º55'W, 20 Nov. 1980, *Balslev & Quintana 854* (NY); above Tufiño, 0º49'N, 77º51'W, 23 July 1955, *Asplund 17033* (S). Chimborazo: ladera SW del volcán Chimborazo, pr. Urbina, 1º27'S, 78º45'W, 31 July 2006, *Aedo 13235* (MA); ladera SW del volcán Chimborazo, 1º31'S, 78º50'W, 30 July 2006, *Aedo 13225* (MA). Cotopaxi: ladera N del volcán Cotopaxi, pr. Ingapirca, 0º35'S, 78º26'W, 1 Aug. 2006, *Aedo 13341* (MA); Pilalo-Quevedo road, c 12 km above Pilaló, 0º58'S, 78º58'W, 28 May 1979, *Løjtnant & Molau 13879* (AAU). Imbabura: Laguna Cuicocha, 0º18'N, 78º22'W, Nov. 1952, *Fagerlind & Wibom 1538* (S); between Chota and El Pun, 0º40'N, 77º37'W, Nov. 1952, *Fagerlind & Wibom 1362* (S). Loja: vía Loja-Chuquiribamba, 3º56'S, 79º16'W, 24 July 2006, *Aedo & Ulloa 13149* (MA); Jipiro, 5 km NE Loja, 3º57'S, 79º10'W, 6 Mar. 1947, *Espinosa 1343* (NY); km 67 de Saraguro, localidad entre Susudel y El Progreso, 4º25'S, 80º27'W, *Jaramillo & al. 8846* (AAU, NY). Morona-Santiago: Parque Nacional Sangay, between La Playa and Plazapampa, 2º0'S, 78º30'W, 23 Dec. 1995, *Clark & al. 1816* (MO); Napo: road Quito-Baeza, at Laguna Papallacta, 0º21'S, 78º6'W, 17 July 1976, Øllgaard & *Balslev 8028* (MO, NY); SW slopes of Antisana, 0º30'S, 78º10'W, 5 Dec. 1982, *Barfod & Pennington 41267* (AAU). Pichincha: reserva Pululahua, 0º1'S, 78º29'W, 13 July 2006, *Aedo & Ulloa 12916* (MA); Hacienda Yanacocha, 0º6'S, 78º34'W, 12 July 2006, *Aedo & Ulloa 12902* (MA).Tungurahua: entre Alajua y Quisapincha, 1º14'S, 78º41'W, 29 Oct. 1944, *Acosta Solís 8782* (F); camino de Guaranda al volcán Tunguragua, 1º30'S, 78º26'W, *Née s.n.* (MA). Zamora: road from loja to Zamora, km 45-51, 3º58'S, 79º7'W, 21 Nov. 1961, *Dodson & Thien 1466* (BH, MO, S). **Peru.** Cajamarca: pr. Hualgayoc, 6º48'S, 78º4'W, 17 June 2009, *Aedo 16548* (MA); pr. Celendín, 6º59'S, 78º11'W, 18 June 2009, *Aedo 16550* (MA). La Libertad: de Chugay a Molino Viejo, 7º47'S, 77º46'W, 28 June 2009, *Aedo & Zapata 16677* (MA); pr. Shore, pampa de la Julia, 7º59'S, 78º17'W, 12 June 2009, *Aedo & Leiva 16448* (MA). **Venezuela.** Mérida: Valle Grande ad ripam ad oram Paramo, 8º40'N, 71º7'W, 8 Nov. 1976, *Charpin & al. 13120* (G); Santo Domingo de Mucubají, alrededores de la laguna de Mucubají, 8º48'N, 70º50'W, 29 May 1985, *Stergios & al. 8383* (CAR, PORT); Páramo de Timotes, 8º52'N, 70º48'W, 2 Aug. 2010, *Grande & Aedo 2545* (MA); Trujillo: Páramo de Guirigay, Alto del Arenal, 9º1'N, 70º34'W, 1 Aug. 2010, *Grande & Aedo 2515* (MA); Páramo de Guirigay, Loma La Cava, 9º2'N, 70º30'W, 30 July 2010, *Grande & Aedo 2481* (MA).

Fig. 486. *Geranium diffusum*. a. Habit. b, c. Leaves, adaxial side. d. Leaf, abaxial side. e. Bracteoles. f. Pedicel. g. Flower, sepals and petals removed. h. Sepal. i. Petal. j. Staminal filament. k. Fruit. l. Mericarp. m. Seed. (Based on: a, d-m, *Aedo & Ulloa 12916*, MA; b, *Sparre 13761*, AAU; c, *Catalán & al. s.n.*, MA-709663; e, *Halfdan-Nielsen & León 60*, C).

Discussion. Geranium diffusum has a prostrate to ascending habit with small leaves and 1-flowered cymules. Well-developed plants sometimes root at the nodes. This species grows in a broad latitudinal range across

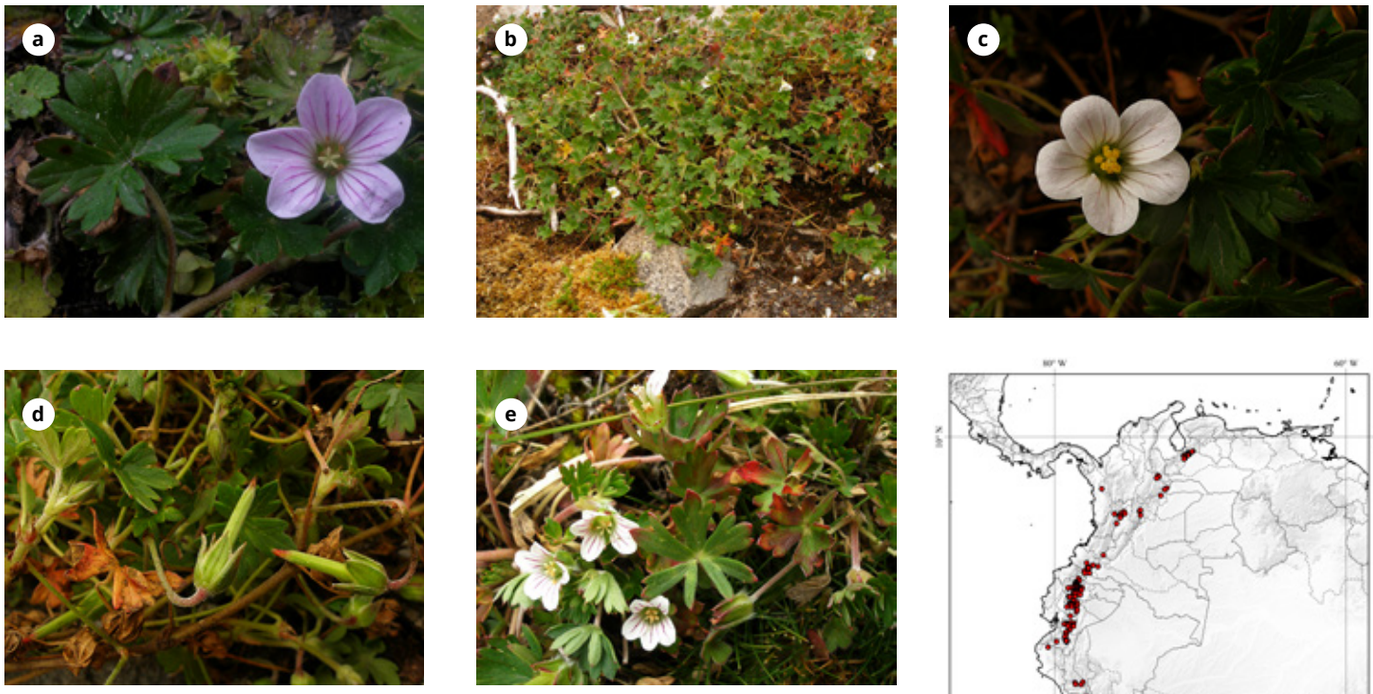


Fig. 487. *Geranium diffusum* (Based on: a, *Aedo & Ulloa 12902,* MA; b-d, *Aedo & Leiva 16448*, MA; e, *Grande & Aedo 2515,* MA).

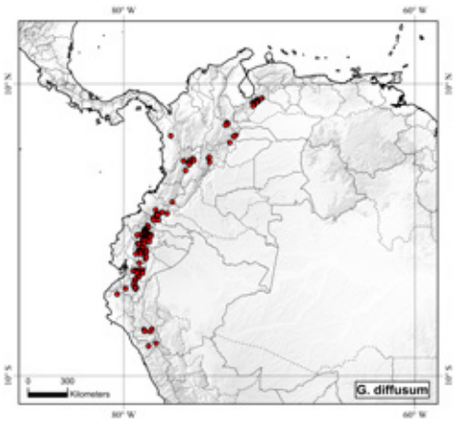


Fig. 488. Distribution of *Geranium diffusum*.

the northern Andes and shows some variability. The leaves usually have an obtriangular and 3-lobed middle segment, although leaves with 1-lobed segments rarely present. Such specimens resemble *G. sibbaldioides* subsp. *sibbaldioides*, but the leaves are covered with appressed hairs on both surfaces and lack a bristle at the tip of the lobes, and their young stems are not hidden by old stipules. *Geranium diffusum* usually has leaves with appressed eglandular hairs on both surfaces; the indumentum varies in density, and some unusual specimens are almost hoary-white. The cymules usually lack pedicels and bracteoles, although occasionally, cymules with a peduncle, two bracteoles, and a pedicel are present. In these rare cases, most of the cymules of the plant are without pedicel and bracteoles. The rostrum of the fruit usually ends abruptly without a narrowed apex, although some specimens have a rostrum with a short narrowed apex.

The type of *G. harmsii* agrees in most characters with *G. diffusum*, although it shows unusually long pedicels. Such long pedicels have also been found in plants from central Ecuador. The type lacks fruits and well-developed basal leaves; it is here assigned to *G. diffusum*. There is a surprising gap of ca. 400 km between the southern populations of *G. diffusum* in northern Peru and the type locality of *G. harmsii* in central Peru. Another species quite similar to *G. diffusum* is *G. smithianum*, which differs in the 5-lobed middle segment of the leaf and is known from scattered localities in central and southern Peru. Perhaps additional collections from the type locality of *G. harmsii* may reveal whether this variant indeed represents *G. diffusum* or only a form of *G. smithianum*. If the latter, then the name *G. harmsii* has priority over *G. smithianum*. In the protologue of *G. diffusum*, Kunth noted "Crescit in montibus Peruviae" (Humboldt & al. 1822: 230); however, in the Bonpland herbarium at P, "Perou (Quindiu)" is indicated on the label and later the word "Perou" was corrected by "Ne Grenade." The locality given in the protologue may be in error; Quindio (Colombia) is a well-known locality visited by Humboldt and Bonpland (Stearn 1968: 110). Yet, the collection for *G. diffusum* at B is heterogeneous and includes a sheet (B-W-12535-02-0) belonging to *G. diffusum* and another other sheet (B-W-12535-01-0) that is G. *reptans*. The same is true for the duplicates at P: one sheet (numbered as 136924) of *G. diffusum* and another specimen (numbered as 136923) with patent hairs on petioles and pedicels, which is *G. reptans*. Both sheets of *G. reptans* are to be excluded of the type gathering of *G. diffusum*.

Knuth (1912: 211) based *G. imbaburae* on two collections by *Stuebel* (*52* and *67a*); no specimens of these collections have been located. A photograph of *Stuebel 52* at F, GH, and MO shows a specimen that well matches *G. diffusum* in leaf shape, the 1-flowered cymules, and indumentum. *Geranium sodiroanum* is here listed as a synonym of *G. diffusum*, because the original description of *G. sodiroanum*,

especially noting 1-flowered cymules and pedicels with retrorse and appressed hairs, agrees with it. Both syntypes, *Sodiro 213* and *Weberbauer 255*, are lost, and no duplicates were found. A special search of Sodiro's specimen at QPLS and of Weberbauer's specimen at MOL and USM was conducted without success. Knuth (1912: 212) erroneously attributed the type locality of *G. columbianum* to Colombia; however, Moritz collected near Mérida in Venezuela. Knuth (1912: 212) listed two syntypes, of which I selected *Moritz 1246* as lectotype, because *Moritz 1245* is only a small fragment with some 2-flowered cymules. This character is exceptional in *G. diffusum*. *Geranium robustipes* was described by Knuth (1938: 62) also from a locality near Mérida. Unfortunately, the type was destroyed and no duplicate has been found. Yet, the original description provides details of indumentum, and inflorescence and leaf shape, which strongly indicate that *G. robustipes* is a synonym of *G. diffusum*. The names *G. chimborazense* and *G. holm-nielsenii* are also listed as synonyms of *G. diffusum*. The lectotype chosen for *G. chimborazense*, *Meyer 181* (JE), has antrorse hairs on the pedicels and petioles. This characteristic was also mentioned by Halfdan-Nielsen (1996: 272), when she described her *G. holm-nielsenii*; she also considered the congested habit as a defining character. I sampled several populations of *G. diffusum* (*Aedo 13224, 13225, 13235*) on the slopes of the Chimborazo volcano and found plants with different combinations of these characters. In exposed habitats plants of *G. diffusum* resemble small cushions, because they have very short branches. Yet, in the same area in sheltered places, such as under shrubs, plants of *G. diffusum* have long branches and assume the usual spreading habit. The type collection of *G. soratae*, *Rusby 763*, is a mixed gathering; the sheet at MO is *G. diffusum*. This specimen has not been mapped because it may be a labelling mistake.

192. Geranium pseudodiffusum Aedo, Syst. Bot. 35: 168, 169 fig. 1. 2010. Type locality: "Ecuador. Azuay, páramo de Cajas, Chuspipuñuna, 20 July 2006, Aedo & Ulloa 13101 (holotype, MA!; isotypes, MO!, QCNE!)". Type: Ecuador. Azuay, Páramo de Cajas, Chuspipuñuna, 2°48'N, 79°13'W, 20 July 2006, *C. Aedo & C. Ulloa 13101* (holotype, MA-745449!; isotypes, HA-211881!, JE-00012293!, MO-2071647!, QCNE-259!).

Perennial herbs, 3-17 cm tall. *Rootstock* 1-11 mm in diameter, ± vertical, not tuberculate, not turnip-shaped, without thickened roots. *Stem* prostrate, leafy, sometimes rooting at nodes, stolons absent, without vegetative stems, with retrorse, appressed, eglandular hairs 0.2-1.5 mm long and patent, glandular hairs 0.2-0.5 mm long. *Basal leaves* in a ± persistent rosette, cauline leaves opposite; leaf laminas 0.5-2.9 cm long, 0.7-2.7 cm wide, not peltate, palmatifid [ratio main-sinus length/middle segment length = (0.74)0.88-0.91(0.98)], polygonal in outline, base cordate, not coriaceous, with nerves not projected, pilose, with appressed, eglandular hairs and scattered, patent glandular hairs on margin and on nerves of the abaxial surface (sometimes also on adaxial nerves); segments 5, in 1 plane, middle segment obtriangular (with lanceolate lateral lobes joined to the middle one), 0.5-1.4 mm wide at the base [ratio segment width at the base/middle segment length = 0.07-0.20], 3(5)-lobed at the apex [ratio secondary sinus length/middle segment length = (0.31)0.44-0.52(0.61)]; petioles up to 17 cm long, without abscission zone, terete, not swollen, not deflexed in age, with retrorse, appressed, eglandular hairs 0.3-0.7 mm long and patent, glandular hairs 0.2-0.5 mm long; stipules 2.8-6.8 mm long, 1-1.8 mm wide, lanceolate, free, papery, brownish red, with scattered, eglandular hairs on abaxial surface and on the margin, glabrous adaxially. *Inflorescence* a monochasial cyme; cymules 1-flowered, solitary [ratio cymule length/leaf length = 0.2-0.8(1.1)]; peduncles 2.3-20.5 mm long, with retrorse, appressed, eglandular hairs 0.2-0.7 mm long and patent, glandular hairs 0.2-0.6 mm long; bracteoles absent. Flowers actinomorphic. *Sepals* 3.9-5.7 mm long, 1-2.1 mm wide, lanceolate, smooth, not accrescent, nerves 3, mucro 0.4-0.8 mm long [ratio mucro length/sepal length = 0.09-0.17], with erect-patent, eglandular hairs 0.2-0.7 mm long and glandular hairs 0.2-0.4 mm long on the abaxial surface, minutely hairy adaxially. *Petals* 4.8-7.1 mm long, 1.2-2.2 mm wide, erect-patent, rounded, without claw, white or pale pink, glabrous. *Stamens* 10, both whorls bearing anthers; filaments 2.1-3 mm long, lanceolate, yellow, with eglandular hairs 0.2-0.3 mm long on the abaxial surface and margin; anthers 0.4-0.7 mm long, yellow. Nectaries 5, hemispheric, glabrous. *Gynoecium* 2.4-3.2 mm long, yellow. *Fruit* 6.4-11.2 mm long, erect, discharge of seed-ejection type; mericarps 1.8-2.6 mm long, 0.8-1.3 mm wide, without a strand of fibers, not compressed at the apex, smooth, without basal beak, with a basal callus, without a basal prong, brown, with erect-patent, eglandular hairs 0.1-0.5 mm long and sometimes glandular hairs 0.1-0.4 mm long; rostrum 3.9-6.6 mm long, without a narrowed apex, not twisted, with erect-patent, eglandular hairs 0.1-0.3 mm long and, sometimes, glandular hairs 0.1-0.4 mm long; stigmatic remnants 0.8-1.2 mm long, with 5 glabrous lobes. *Seeds* 1.3-1.8 mm long, 0.7-1.2 mm wide, finely reticulate, uniformly colored, brown, glabrous. Cotyledons with entire margin. Figs. 489, 490.

Pollen. Ornamentation not studied.

Chromosome number. Unknown.

Phenology. Collected in flower from March to December.

Distribution. This species ranges from Ecuador to northern Peru (Fig. 491).

Habitat. Bogs and very humid habitats in *Polylepis* Ruiz & Pav. forests and open grassy areas; 3300-4150 m.

Additional specimens examined. **Ecuador.** Azuay: Páramo de Cajas, Laguna Toreadora, 2º46'S, 79º13'W, 20 July 2006, *Aedo & Ulloa 13105* (MA); Páramo de Cajas, Laguna Toreadora, 2º47'S, 79º13'W, 20 Nov. 1991, *Halfdan-Nielsen 51bis* (C); Páramo de Cajas, 20 km de Cuenca, 2º48'S, 79º9'W, 19 Nov. 1991, *Halfdan-Nielsen 45* (C); Páramo de Cajas, 18 km de Cuenca, 2º51'S, 79º8'W, 19 Nov. 1991, *Halfdan-Nielsen 43* (C). Chimborazo: Urbina, ladera SW del volcán Chimborazo, 1º27'S, 78º45'W, 31 July 2006, *Aedo 13236* (MA); Urbina, E volcán Chimborazo, 1º28'S, 78º46'W, 22 Nov. 1993, *Halfdan-Nielsen 57* (C); S slope of Mt. Chimborazo, 1º31'S, 78º49'W, Oct. 1952, *Fagerlind & Wibom 936* (S). Cotopaxi: ladera N del volcán Cotopaxi, 0º38'S, 78º26'W, 1 Aug. 2006, *Aedo 13340* (MA); Parque Nacional Cotopaxi, 0º38'S, 78º22'W, 15 Dec. 1989, *Cerón 7996* (MO). Napo: road Quito-Baeza, near the pass at Papallacta, 0º20'S, 78º12'W, 30 Oct. 1983, *Eriksen & Larsen 45446* (AAU); road Quito-Baeza, at Laguna Papallacta, 0º21'S, 78º6'W, 17 July 1976, Øllgaard *& Balslev 8029* (MO, NY). Pichincha: Andibus Ecuadoriensibus, 1857, *Spruce 5014* (E); flanc E du Pichincha, 0º9'S, 78º33'W, 23 Mar. 1930, *Benoist 2222* (P); E slopes of Cerro Pichincha, 0º9'S, 78º33'W, 30 Dec. 1919, *Holmgren & Heilborn 138b* (S); entre el refugio de Guagua Pichincha y Lloa, 0º10'S, 78º36'W, 29 Nov. 1991, *Halfdan-Nielsen 79* (C); San Ignacio, 0º12'S, 78º33'W, 14 Aug. 1923, *Anthony & Tate 142* (US); Chaupi, ladera NE de los volcanes Ilinizas, 0º37'S, 78º41'W, 2 Aug. 2006, *Aedo 13345* (MA). Tungurahua: valle río Colorado, 1º20'S, 78º51'W, 22 Nov. 1991, *Halfdan-Nielsen 54* (C); valle río Colorado, 1º20'S, 78º51'W, 22 Nov. 1991, *Halfdan-Nielsen 55* (C). **Peru.** Cajamarca: prov. Cajamarca, Minas Conga, sector Huaylamachay, 6º51'S, 78º21'W, 1 Oct. 2005, *Granda 2477* (MA); pr. Cerro Yanahuanga, 6º52'S, 78º37'W, 17 June 2009, *Aedo 16546* (MA); Huayllapampa, 7º12'S, 78º33'W, 15 June 2009, *Aedo 16494* (MA). La Libertad: Bolivar, Uchumarca, Chivane, subida a Conga de Yonan, 7º4'S, 77º43'W, 21 Nov. 2013, *Zambrana & al. 8831* (MA).

Discussion. Geranium pseudodiffusum, as the epithet implies, resembles *G. diffusum* in general appearance. The leaves of *G. diffusum* are ± densely covered with small and appressed hairs on both surfaces, whereas in *G. pseudodiffusum* the hairs are restricted to the margin and the nerves of the abaxial surface, and more rarely on the nerves of the adaxial surface. Additionally, *G. pseudodiffusum* has glandular hairs on stems, pedicels, sepals, petioles, and sometimes on the leaf lamina (especially towards the base). Glandular hairs are also often present on mericarps and the rostrum of the fruit. *Geranium antisanae* also has a glandular indumentum, but it is easily distinguished from *G. pseudodiffusum* by its less deeply divided leaves, which are densely covered by glandular and eglandular patent hairs (see that species). *Geranium pseudodiffusum* differs from *G. diffusum* also in some minor quantitative features, although with some overlap. The leaves of *G. pseudodiffusum* are more deeply divided, i.e., the segments as well as the apical lobes

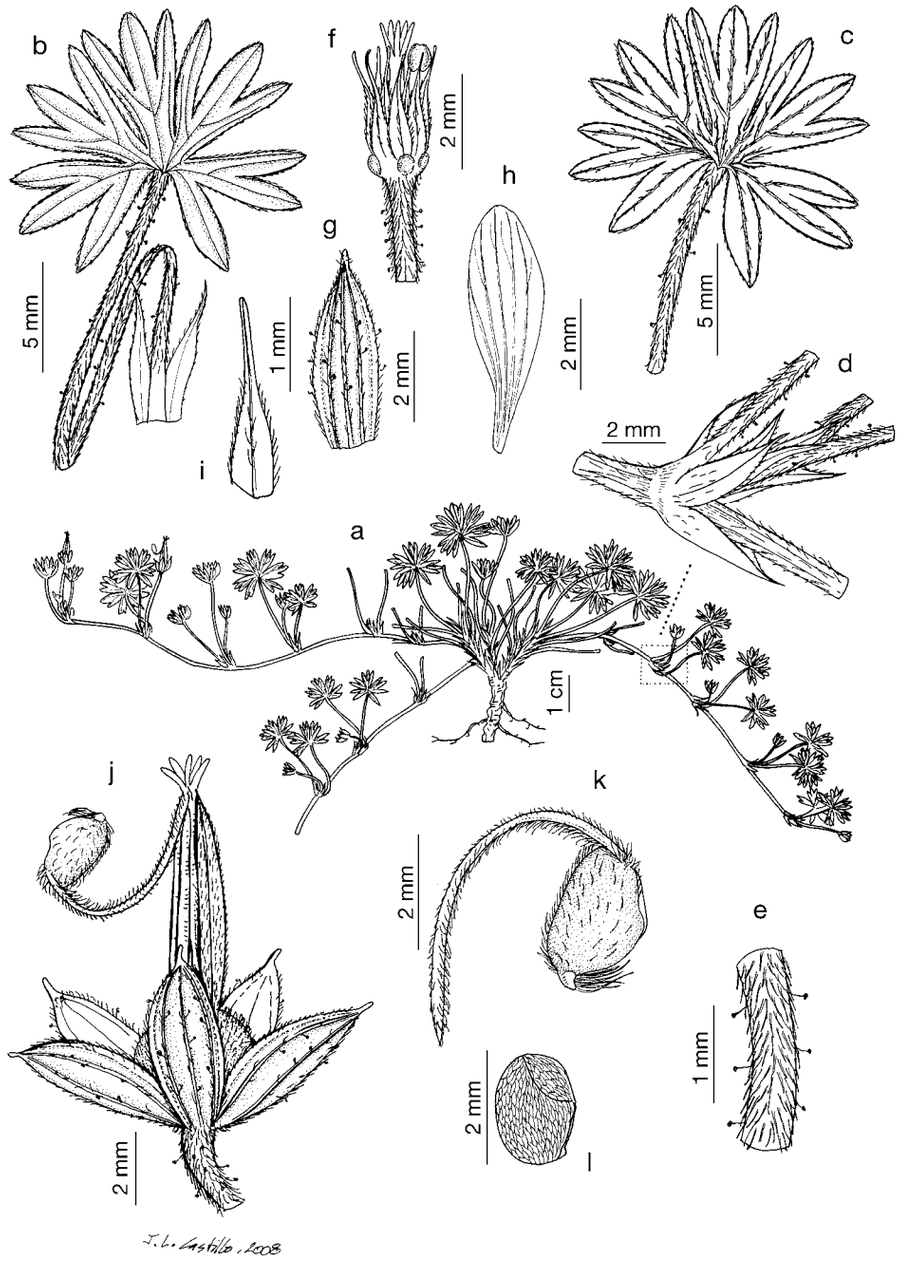


Fig. 489. *Geranium pseudodiffusum*. a. Habit. b. Leaf, adaxial side. c. Leaf, abaxial side. d. Bracteoles. e.Pedicel. f. Flower, sepals and petals removed. g. Sepal. h. Petal. i. Staminal filament. j. Fruit. k. Mericarp. l. Seed. (Based on: *Aedo & Ulloa 13101*, MA).

Fig. 490. *Geranium pseudodiffusum* (Based on: a, b, *Aedo & Ulloa 13101*, MA; c, d, *Aedo 16494*, MA).

are longer, than leaves of *G. diffusum*. The peduncles are shorter than in *G. diffusum*, and thus cymules appear shorter than the adjacent leaf. Petals are shorter and narrower than in *G. diffusum* and always glabrous, and staminal filaments and fruits are also shorter. *Geranium pseudodiffusum* is confined to paramos of central Ecuador and northern Peru, where *G. diffusum* is also found. I collected both species at several localities where they grew together; I found *G. diffusum* in disturbed areas, whereas *G. pseudodiffusum* occurs in peat bogs or very humid habitats. Rarely, *G. diffusum* may grow at the edges of peat bogs or even on tussocks of grasses, but *G. pseudodiffusum* is restricted to the swampy base of such tussocks.

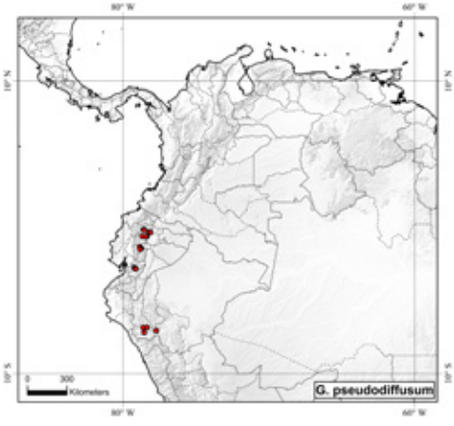


Fig. 491. Distribution of *Geranium pseudodiffusum*.

193. Geranium antisanae R. Knuth in Engl., Pflanzenr. IV.129 (Heft 53): 215. 1912. Type locality: "Ecuador: Antisana, 4056 m (Stuebel, Fl. Aequat. a. 1871 n. 185n -- Typus in Herb. Berlin!).-- Blühend Oktober". Type: Ecuador. Napo, Antisana, 0°28'S, 78°08'W, 1871, *A. Stuebel 185n* (holotype, B destroyed). Ecuador. Pichincha, Peñas Blancas, 0°18'S, 78°14'W, 14 July 2006, *C. Aedo & C. Ulloa 12946* (neotype, designated by Aedo 2012: 275, MA-744854!; isoneotypes, MO!, QCNE!).

Perennial herbs, 2.8-11 cm tall. *Rootstock* 3.3-7.1 mm in diameter, ± vertical, not tuberculate, not turnip-shaped, without thickened roots. *Stem* prostrate, leafy, sometimes rooting at nodes, stolons absent, without vegetative stems, with patent, eglandular hairs 0.2-0.5 mm long and patent, glandular hairs 0.3-0.5 mm long. *Basal leaves* in a ± persistent rosette, cauline leaves opposite; leaf laminas 0.8-1.3 cm long, 0.9-1.4 cm wide, not peltate, palmatifid [ratio main-sinus length/middle segment length = (0.64)0.68-0.77(0.81)], polygonal in outline, base cordate, not coriaceous, with nerves not projected, pilose, with ± patent, eglandular and glandular hairs on both surfaces; segments 5, in 1 plane, middle segment obtriangular (with lanceolate lateral lobes joined to the middle one), 1.5-2.1 mm wide at the base [ratio segment width at the base/middle segment length = 0.22-0.45], (1)3-lobed at the apex [ratio secondary sinus length/middle segment length = (0.20)0.25-0.31(0.36)]; petioles up to 4.8 cm long, without abscission zone, terete, not swollen, not deflexed in age, with patent, eglandular hairs 0.2-0.8 mm long and patent, glandular hairs 0.4-0.7 mm long; stipules 1.9-6 mm long, 1.2-1.8 mm wide, lanceolate to broadly lanceolate, free, papery, brownish red, with eglandular and glandular hairs on abaxial surface and on the margin, minutely hairy adaxially. *Inflorescence* a monochasial cyme; cymules 1-flowered, solitary [ratio cymule length/leaf length = 0.4-1.3]; peduncles 6.3-14.6 mm long, with patent, eglandular hairs 0.1-0.6 mm long and patent, glandular hairs 0.2-0.5 mm long; bracteoles absent. Flowers actinomorphic. *Sepals* 3.7-5 mm long, 1.7-2.2 mm wide, lanceolate, smooth, not accrescent, nerves 3, mucro 0.2-0.4 mm long [ratio mucro length/sepal length = 0.05-0.10], with erect-patent, eglandular hairs 0.5-1.2 mm long and patent, glandular hairs 0.2-0.4 mm long on the abaxial surface, minutely hairy adaxially. *Petals* 6.6-8.2 mm long, 1.7-3.1 mm wide, erect-patent, rounded, without claw, white, glabrous.

Stamens 10, both whorls bearing anthers; filaments 2.1-3.2 mm long, lanceolate, white, with eglandular hairs 0.2-0.3 mm long on the abaxial surface and margin; anthers 0.6-0.8 mm long, yellow. Nectaries 5, hemispheric, glabrous. *Gynoecium* 2.9-3.3 mm long, yellow. *Fruit* 9.4-10.9 mm long, erect, discharge of seed-ejection type; mericarps 1.9-2.5 mm long, 1.1-1.5 mm wide, without a strand of fibers, not compressed at the apex, smooth, without basal beak, with a basal callus, without a basal prong, brown, with erect-patent, eglandular hairs 0.2-0.4 mm long and sometimes, patent glandular hairs 0.3-0.4 mm long; rostrum 5.4-6.7 mm long, without a narrowed apex, not twisted, with erect-patent, eglandular hairs 0.1-0.6 mm long and patent, glandular hairs 0.2-0.5 mm long; stigmatic remnants 0.9-1.5 mm long, with 5 glabrous lobes. *Seeds* 1.4-1.9 mm long, 0.8-1.3 mm wide, finely reticulate, uniformly colored, brown, glabrous. Cotyledons with entire margin. Figs. 492, 493.

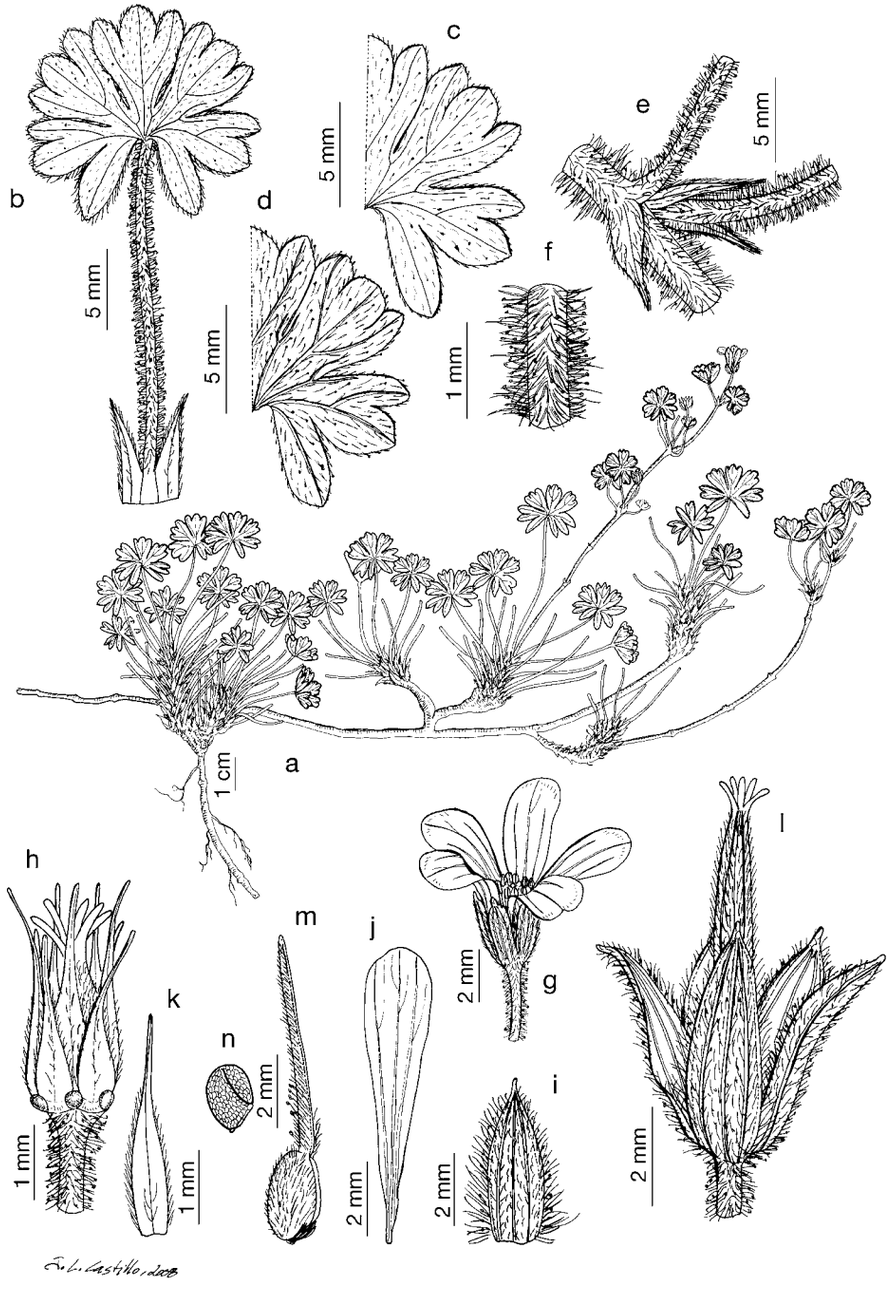


Fig. 492. *Geranium antisanae*. a. Habit. b. Leaf, adaxial side. c. Leaf detail, adaxial side. d. Leaf detail, abaxial side. e. Bracteoles. f. Pedicel. g. Flower. h. Flower, sepals and petals removed. i. Sepal. j. Petal. k. Staminal filament. l. Fruit. m. Mericarp. n. Seed. (Based on: *Aedo & Ulloa 12946*, MA).

Fig. 493. *Geranium antisanae* (Based on: *Aedo & Ulloa 12946,* MA).

Fig. 494. Distribution of *Geranium antisanae*.

Pollen. Ornamentation not studied.

Chromosome number. Unknown.

Phenology. Collected in flower from July to August.

Distribution. This species is endemic to northern Ecuador (Fig. 494).

Habitat. Among large grass tussocks or cushions of *Azorella* Lam., and at edge of *Polylepis* Ruiz & Pav. forests; 3750-4200 m.

Additional specimens examined. **Ecuador.** Cotopaxi: falda W del Cerro Antisana, origen del río Antisana, 0º28'S, 78º12'W, Jan. 1983, *Balslev & al. 3961* (QCA); besides road leading to Quito from Hacienda Antisana, 0º30'S, 78º12'W, 26 July 1960, *Grubb & al. 623* (NY); ladera N del volcán Cotopaxi, pr. Ingapirca, 0º35'S, 78º26'W, 1 Aug. 2006, *Aedo 13342* (MA); volcán Cotopaxi, N slope on the left side of the road to the refuge, 0º39'S, 78º26'W, 19 July 1995, *Sklenář & Kosteckova 85-5* (AAU). Napo: Píntag, ladera SW del volcán Antisana, 0º29'S, 78º12'W, 3 Aug. 2006, *Aedo 13350* (MA). Pichincha: Chaupi, ladera NE de los volcanes Ilinizas, 0º37'S, 78º41'W, 2 Aug. 2006, *Aedo 13347* (MA).

Discussion. Geranium antisanae shares a glandular indumentum with *G. pseudodiffusum* but differs greatly in leaf shape and leaf indumentum. The middle leaf segment of *G. antisanae* has a broader base and is shorter than in *G. pseudodiffusum.* The secondary divisions, i.e., the lobes of the middle segment, are also shallower in *G. antisanae* than in *G. pseudodiffusum*. The middle leaf segment is usually 3-lobed in *G. antisanae*, although some leaves with undivided segments can be found occasionally towards the base of the plant. Leaves of *G. antisanae* are covered with short, weak, dense, patent, glandular, and eglandular hairs on both surfaces. In *G. pseudodiffusum* the leaves bear appressed eglandular hairs restricted to margins and nerves (mainly abaxially); sometimes, some glandular patent hairs arise from the nerves towards the base of the leaf. *Geranium antisanae* differs also in some minor quantitative features with some overlap. The sepal mucro of *G. antisanae* is shorter than that of *G. pseudodiffusum*, and the petals are longer. Because the holotype *G. antisanae* is no longer extant, a neotype was designated (Aedo 2012: 275), which was collected about 20 km northwest of the Antisana massif, the original type locality of this species. The photograph of the lost holotype (at F, G, GH, NY) shows a fragment that well matches the neotype collection.

---

194. Geranium ayavacense Kunth in Humb., Bonpl. & Kunth, Nov. Gen. Sp. 5: 231. 1822, ["agavacense"]. Type locality: "Crescit prope Ayavaca Peruvianorum, alt. 1400 hex.". Type: Peru. Piura. Ayavaca, 4°37'S, 79°43'W, *A. Bonpland & F.A. Humboldt s.n.* (lectotype, designated by Knuth 1912: 213, B destroyed; lectotype, designated by Aedo 2012: 278, P-00136933!).

Geranium mathewsii Briq., Annuaire Conserv. Jard. Bot. Genève 11/12: 188. 1908. Type locality: "In Andibus peruvianis (Mathews ann. 1846, sine n.)". Type: Peru. Amazonas. Chachapoyas, 6°25'S, 77°20'W, 1846, *A. Mathews s.n.* (lectotype, designated by Knuth 1912: 213, Z; isolectotypes, G photo!, BM-000598368!).

Geranium piurense R. Knuth, Repert. Spec. Nov. Regni Veg. 18: 290. 1922, [31 Dec. 1922]. Type locality: "Peru, Dept. Piura, Prov. Ayavaca: Oberhalb Ayavaca, in der Grassteppe zwischen der herrschenden Gesträuchformation (Weberbauer, Fl. Peru a. 1912, no. 6374 - Typus in Herb. Berol.!)". Type: Peru. Piura, Ayavaca, Oberhalb Ayavaca, 4°37'S, 79°43'W, 1912, *A. Weberbauer 6374* (holotype, B destroyed).

Perennial herbs, 11-56 cm tall. *Rootstock* 2.6-9.3 mm in diameter, ± vertical, not tuberculate, turnip-shaped, without thickened roots. *Stem* ascending, leafy, sometimes rooting at nodes, stolons absent, without vegetative stems, with retrorse, appressed, eglandular hairs 0.1-0.6 mm long. *Basal leaves* in a ± persistent rosette, cauline leaves opposite; leaf laminas 1.4-2.7 cm long, 1.6-2.9 cm wide, not peltate, palmatisect, polygonal in outline, base cordate, not coriaceous, with nerves not projected, pilose, with appressed, eglandular hairs on both surfaces; segments 5, in 1 plane, middle segment rhombic (with linear lateral lobes clearly divergent to the middle one), 0.2-0.7 mm wide at the base [ratio segment width at the base/middle segment length = 0.01-0.05], (1)3(4)-lobed at the apex [ratio secondary sinus length/middle segment length = 0.37-0.54]; petioles up to 18 cm long, without abscission zone, terete, not swollen, not deflexed in age, with retrorse, appressed, eglandular hairs 0.2-0.4 mm long; stipules 2.7-5.4 mm long, 0.5-1.3 mm wide, lanceolate, free, papery, brownish red, with eglandular hairs on abaxial surface and on the margin, glabrous adaxially. *Inflorescence* a monochasial cyme; cymules 1-flowered, solitary [ratio cymule length/leaf length = (0.4)0.7-1.1(1.4)]; peduncles 10-51 mm long, with retrorse, appressed, eglandular hairs 0.2-0.5 mm long; bracteoles absent. Flowers actinomorphic. *Sepals* 3.8-6.1 mm long, 1.5-2.9 mm wide, lanceolate, smooth, not accrescent, nerves 3, mucro 0.4-0.9 mm long [ratio mucro length/sepal length = 0.07-0.23], with erect-patent, eglandular hairs 0.4-0.9 mm long on the abaxial surface, minutely hairy adaxially. *Petals* (4.7)5.4-6.6(7.2) mm long, 1.9-3.2 mm wide, erect-patent, rounded, without claw, white or purple, glabrous. *Stamens* 10, both whorls bearing anthers; filaments 2-2.8 mm long, lanceolate, yellow, with eglandular hairs 0.1-0.3 mm long on the abaxial surface and margin; anthers 0.5-0.7 mm long, yellow. Nectaries 5, hemispheric, glabrous. *Gynoecium* 2.2-3.5 mm long, yellow. *Fruit* 9.7-15.5 mm long, erect, discharge of seed-ejection type; mericarps 2.1-3.6 mm long, 1-1.5 mm wide, without a strand of fibers, not compressed at the apex, smooth, without basal beak, with a basal callus, without a basal prong, brown, with erect-patent, eglandular hairs 0.2-0.4 mm long; rostrum 5.8-10.2 mm long, usually without a narrowed apex, not twisted, with erect-patent, eglandular hairs 0.1-0.3 mm long; stigmatic remnants 0.6-1.4 mm long, with 5 hairy lobes. *Seeds* 1.6-2.2 mm long, 0.9-1.2

mm wide, finely reticulate, uniformly colored, brown, glabrous. Cotyledons with entire margin. Figs. 495, 496.

Pollen. *Geranium*-type (Bortenschlager 1967: 433).

Chromosome number. 2n = 52.

Phenology. Collected in flower from January to December.

Distribution. This species ranges from southern Ecuador to central Peru (Fig. 497).

Habitat. Mossy or boggy areas among patches of shrubs or small trees; 2300-4000 m.

Additional specimens examined. **Ecuador.** Azuay: road Gualaceo-Limón, km 21.9, 2º58'S, 78º40'W, 13 Jan. 2000, *Jørgensen & al. 1916* (MA); Gualaceo-Limón road, General Plaza Gutiérrez, km 21.9, 2º58'S, 78º40'W, 13 Jan. 2000, *Jørgensen & al. 1928* (MA); Gualaceo-Limón road, ca. 21 km E of Gualaceo, Páramo de Culebrillas, 3º1'S, 78º40'W, 12 Nov. 1990, *Luteyn & al. 14115* (NY, QCA); Cumbe, 3º5'S, 79º1'W, 22 Apr. 1968, *Harling & al. 8561* (QCA); de Jima a San Miguel, Páramo de Matanga, 3º13'S, 78º57'W, 18 July 2006, *Aedo & al. 13040* (MA). Loja: Catacocha, Hacienda La Hamaca, bosque de La Mira, 4º2'S, 79º38'W, 17 Apr. 1944, *Acosta Solís 7946* (F). Morona-Santiago: road Gualaceo-Limón, 0.6 km E of border with Azuay, 3º0'S, 78º42'W, 22 May 2003, *Croat & al. 89186* (MO). **Peru.** Amazonas: Luya, Tozan, cerca de Lamud, 6º9'S, 77º55'W, Nov. 1943, *Cevasco s.n.* (MA, USM); Chachapoyas prov., patron Samana, 6º13'S, 77º51'W, 23 Sep. 1987, *Sorensen & Holm 71* (C); Chachapoyas prov., upper slopes of Puma-urcu ESE of Chachapoyas, 6º14'S, 77º50'W, 1 June 1962, *Wurdack 659* (F, G, GH, NY, P, S, US); Leimebamba, 6º42'S, 77º48'W, 25 Dec. 1962, *Woytkowski 7816* (GH, MO, US). Ancash: prov. Yungay, Huascaran National Park, quebrada Ranincuray, 8º59'S, 77º34'W, 12 Jan. 1985, *Smith & al. 9112* (ISC, MO, USM); prov. Yungay, Huascaran National Park, quebrada Ranincuray, 9º0'S, 77º33'W, 17 Apr. 1985, *Smith & al. 10384* (ISC, MO); prov. Huaylas, Laguna Parón, 9º2'S, 77º40'W, 15 Oct. 1975, *Cano & al. 9975* (MO, USM); Huari, Huascarán National Park, quebrada Rurichinchay between boundary and quebrada Pachachaca, 9º27'S, 77º15'W, 11 June 1986, *Smith & al. 12463* (ISC, MA, MO); Huari, Huascarán National Park, S side of quebrada Carhuazcancha, 9º28'S, 77º15'W, 6 May 1986, *Smith & al. 12259* (ISC, MA, MO). Cajamarca: prov. Jaén, La Cocha, 5º40'S, 79º14'W, 17 June 1998, *Campos & al. 5019* (MA, USM); Cutervo, 6º22'S, 78º51'W, May 1879, *Jelski 249* (W); pr. Celendín, 6º59'S, 78º11'W, 18 June 2009, *Aedo 16551* (MA); Cendami Pass, 7º2'S, 78º14'W, 15 June 2009, *Bussmann & al. 15492* (MA); San Miguel, Cerro Quillón, Agua Blanca, 7º3'S, 78º59'W, 5 July 1986, *Mostacero & al. 1263* (MO, NY); Cerro Campanario, en la SAIS Atahualpa, 7º4'S, 78º38'W, 11 Apr. 1994, *Sánchez Vega & Bazán 6984* (F); entre Cajamarca y Cumbe Mayo, km 13, 7º10'S, 78º33'W, 11 June 1990, *Sánchez Vega 5319* (F); al W de Cajamarca, 7º11'S, 78º33'W, 15 June 2009, *Aedo 16492* (MA); pr. Cumbe Mayo, 7º11'S, 78º34'W, 15 June 2009, *Aedo 16496* (MA). Cuzco: Paucartambo, Tres Cruces, Parque Nacional Manu, 13º7'S, 71º35'W, 7 Mar. 1991, *Cano 4626* (USM); Urubamba, Machu Picchu, on the slopes of Altillero, a mountain near km 99 of the Urubamba railroad line, 13º15'S, 72º5'W, 10 June 1982, *Peyton & Peyton 503* (MO); prov. Paucartambo, Acjanaco, 13º18'S, 71º34'W, 9 May 1990, *Cano 3610* (USM). Huánuco: de Pillao en el Peru, 9º40'S, 75º58'W, *Ruiz & Pavón s.n.* (F, MA); Pillao,

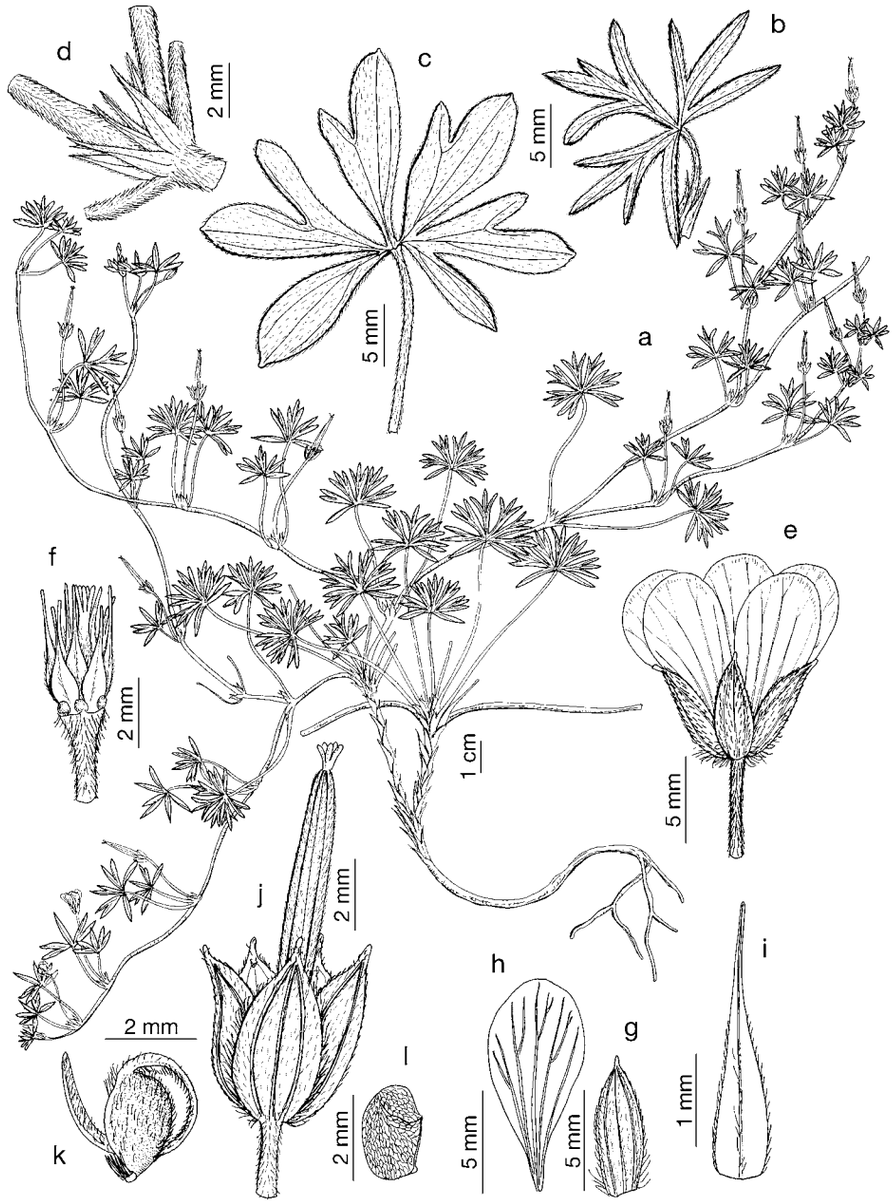


Fig. 495. *Geranium ayavacense*. a. Habit. b, c. Leaves. d. Bracteoles. e. Flower. f. Flower, sepals and petals removed. g. Sepal. h. Petal. i. Staminal filament. j. Fruit. k. Mericarp. l. Seed. (Based on: a, d, *Peyton & Peyton 503*, MO; b, c, *Campos & al. 5019*, MA; e-i, *Jørgensen & al. 1916*, MA; j-l, *Sánchez Vega 5319*, F).

Fig. 496. *Geranium ayavacense* (Based on: a, b, c, *Aedo 13040,* MA; d, *Aedo 16622*, MA).

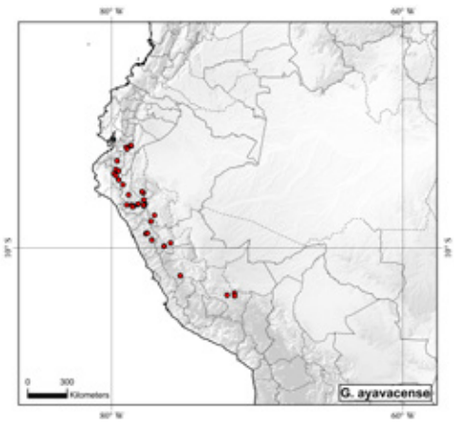


Fig. 497. Distribution of *Geranium ayavacense*.

9°40'S, 75°58'W, 13 Feb. 1946, *Woytkowski 34027* (G, MO, UC); Cani, 7 mi NE of Mito, 9°53'S, 76°24'W, 16 Apr. 1923, *Macbride 3476* (F, G); Mito, 9°54'S, 76°25'W, 8 July 1922, *Macbride & Featherstone 1740* (G). Junín: Concepción, Ingenio, 11°55'S, 75°18'W, Feb. 1948, *Soukup 3680* (F). La Libertad: Bolivar, Uchumarca, above laguna Huayabamba, 6°59'S, 77°44'W, 17 May 2011, *Bussmann & al. 16922* (MA); Bolivar, Uchumarca, Chivane, Pirca Pirca, 7°2'S, 77°45'W, 9 July 2010, *Bussmann & al. 16716* (MA); prov. Bolívar, entre el desvío a Uchumarca y Santa Luisa, 7°4'S, 77°49'W, 11 Nov. 2001, *Sánchez & al. 11208* (MA); Bolivar, Uchuncha, SW side of Cerro Fila de Andosa, 7°7'S, 77°49'W, 14 Nov. 2013, *Bussmann & al. 18350* (MA); prov. Pataz, alrededores de Minera La Estrella, Huaylillas, 8°10'S, 77°18'W, 23 Aug. 2002, *Sagástegui 17036* (MA); Piura: prov. Ayabaca, bosque de Huamba, 4°43'S, 79°32'W, 20 Sep. 1987, *Cano 1481* (MO); Ayavaca, alrededores de Arenales, Meseta Andina, 4°55'S, 79°51'W, 23 Apr. 2004, *Sagástegui & al. 17506* (MA); Morropón, Chalaco, Vista Alegre, 5°3'S, 79°43'W, 20 Aug. 2003, *Sánchez Vega & al. 12298* (MA); Abra Cruz Blanca, 5°20'S, 79°32'W, 23 June 2009, *Aedo 16622* (MA). San Martín: Mariscal Cáceres, Parque Nacional Río Abiseo, 7°46'S, 77°4'W, 29 June 1988, *León & Young 2059* (F).

Discussion. Geranium ayavacense is well characterized by its palmatisect leaves in which the segments are greatly narrowed at the base. The rhombic middle segments have narrow lateral lobes, separated by deep sinuses, that diverge from the central lobe. *Geranium ayavacense* shares retrorse appressed eglandular hairs on petioles and pedicels with *G. diffusum*. Some specimens of *G. diffusum* with deeply palmatifid leaves are difficult to differentiate from *G. ayavacense*; however, in *G. diffusum* lateral lobes of the middle segment are straight (not curved backwards and divergent) and less deeply divided than in *G. ayavacense*. The middle segment of a leaf of *G. ayavacense* usually has three lobes, although occasionally leaves with 4-lobed segments can be found. Some herbarium specimens have many leaves with undivided segments (e.g., Cajamarca, *Campos 5019*, USM; Piura, *Cano 1481*, USM); these are included in *G. ayavacense*, because the leaves are palmatisect and occasionally have some segments with 2-3 divergent lobes. I studied this variation in a population in Piura (*Aedo 16622*, MA) and found individuals with undivided segments intermingled with others that had 3-lobed segments. These observations indicate such variability is an occasional and local phenomenon, which does not merit taxonomic recognition.

In the protologue, the specific epithet was given as "agavacense" (Humboldt & al. 1822), which is probably a misprint. Steudel (1840) rightly corrected the specific epithet to "ayavacense" to indicate the type locality, Ayavaca. There is some controversy concerning orthography of the name for this village, which some authors write as "Ayabaca"; at least eight specific epithets have been proposed with "b." Apparently, Ayavaca is derived from Ayahuaca (a pre-Incan people in northern Peru). The Quechua diphthongs "ua" and "ui" preceded by an "h" should be transliterated to Latin or Spanish as "v." The holotype of *G. piurense* is lost, and no duplicates have been located. Knuth's (1922) detailed description agrees very well with *G. ayavacense*, and both names were based on col-

lections from the same locality. Macbride (1949: 514, 530) was the first author to cite *G. piurense* as a synonym of *G. ayavacense*. A specimen of *G. ayavacense* at BM, labeled as "Peruvia. 18.. Mathews", most likely is an isolectotype of *G. mathewsii*. *Geranium ayavacense* was reported from Venezuela by Knuth (1912: 213) based on *Linden 432* (G!, P!), which is *G. diffusum*.

195. Geranium smithianum R. Knuth, Repert. Spec. Nov. Regni Veg. 34: 146. 1933. Type locality: "Peru: Dept. Lima, Rio Blanco, 3000-3500 m, auf lichten Hügeln (Killip et Smith a. 1929 n. 21769 -- Typus in herb. Berol.); Dept. Ayacucho, Pampalca, zwischen Huanta und Rio Apurimac, 3000 m (Killip et Smith a. 1929 n. 22213, n. 23248!). -- Blühend und fruchtend April bis Mai". Type: Peru. Lima, Río Blanco, 11°44'S, 76°15'W, 15 Apr. 1929, *E.P. Killip & A.C. Smith 21769* (holotype, B destroyed; lectotype, designated by Aedo 2012: 282, US-00100943!; isolectotype, NY-00370262!).

Perennial herbs, 15-48 cm tall. *Rootstock* 7.7-11.6 mm in diameter, ± vertical, not tuberculate, turnip-shaped, without thickened roots. *Stem* ascending, leafy, not rooting at nodes, stolons absent, without vegetative stems, with retrorse, appressed, eglandular hairs 0.2-0.4 mm long. *Basal leaves* in a ± persistent rosette, cauline leaves opposite; leaf laminas 0.8-2.7 cm long, 1.1-3 cm wide, not peltate, palmatifid [ratio main-sinus length/middle segment length = (0.67)0.79-0.84(0.89)], polygonal in outline, base cordate, not coriaceous, with nerves not projected, pilose, with appressed, eglandular hairs on both surfaces; segments 5, in 1 plane, middle segment rhombic (with lanceolate lateral lobes ± joined to the middle one), 1-3.3 mm wide at the base [ratio segment width at the base/middle segment length = 0.12-0.22], 5(6)-lobed at the apex [ratio secondary sinus length/middle segment length = 0.29-0.35]; petioles up to 6.5 cm long, without abscission zone, terete, not swollen, not deflexed in age, with retrorse, appressed, eglandular hairs 0.2-0.5 mm long; stipules 2.8-6 mm long, 0.7-2.7 mm wide, lanceolate, free, papery, brownish red, with eglandular hairs on abaxial surface and on the margin, glabrous adaxially. *Inflorescence* a monochasial cyme; cymules 1-flowered, solitary [ratio cymule length/leaf length = 0.3-1.4(2.6)]; peduncles 5.9-28.8 mm long, with retrorse, appressed, eglandular hairs 0.2-0.4 mm

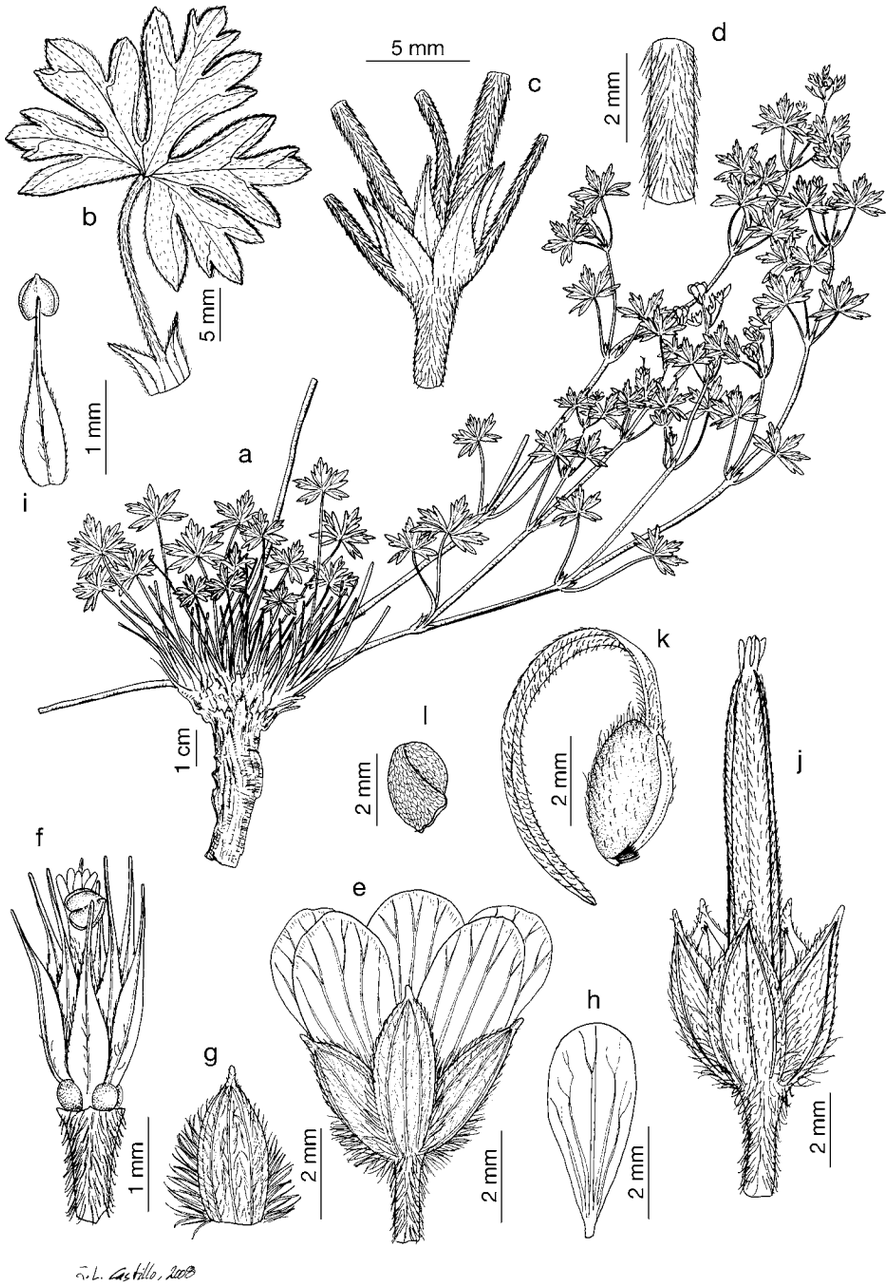


Fig. 498. *Geranium smithianum*. a. Habit. b. Leaf, adaxial side. c. Bracteoles. d. Pedicel. e. Flower. f. Flower, sepals and petals removed. g. Sepal. h. Petal. i. Stamen. j. Fruit. k. Mericarp. l. Seed. (Based on: a, c-i, *Herrera 2341*, F; b, j-l, *Killip & Smith 21769*, NY).

Fig. 499. *Geranium smithianum* (Based on: *Aedo & Molina 20235,* MA).

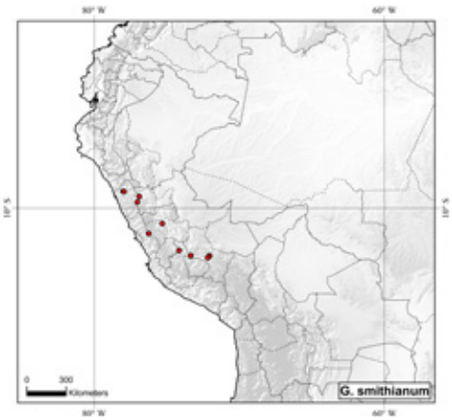


Fig. 500. Distribution of *Geranium smithianum*.

long; bracteoles absent. Flowers actinomorphic. *Sepals* 3.8-6.2 mm long, 1.8-2.6 mm wide, lanceolate, smooth, not accrescent, nerves 3, mucro 0.2-0.8 mm long [ratio mucro length/sepal length = 0.05-0.14], with erect-patent, eglandular hairs 0.2-0.9 mm long on the abaxial surface, minutely hairy adaxially. *Petals* (3.9)4.7-5.8(8.3) mm long, 1.5-2.9 mm wide, erect-patent, rounded, without claw, white or pale pink, glabrous or ciliate on the basal margin, with hairs 0.1-0.2 mm long. *Stamens* 10, both whorls bearing anthers; filaments 2.1-3.9 mm long, lanceolate, white, with eglandular hairs 0.1-0.2 mm long on the abaxial surface and margin; anthers 0.4-0.6 mm long, cream with purplish lines. Nectaries 5, hemispheric, glabrous. *Gynoecium* 2.3-4.9 mm long, white. *Fruit* 10.1-14.8 mm long, erect, discharge of seed-ejection type; mericarps 2.4-3.4 mm long, 1-1.7 mm wide, without a strand of fibers, not compressed at the apex, smooth, without basal beak, with a basal callus, without a basal prong, brown, with erect-patent, eglandular hairs 0.2-0.6 mm long; rostrum 6.1-9.7 mm long, usually without a narrowed apex, not twisted, with erect-patent, eglandular hairs 0.1-0.3 mm long; stigmatic remnants 0.9-1.9 mm long, with 5 hairy lobes. *Seeds* 2-2.8 mm long, 1.1-1.6 mm wide, finely reticulate, uniformly colored, brown, glabrous. Cotyledons with entire margin. Figs. 498, 499.

Pollen. Ornamentation not studied.

Chromosome number. Unknown.

Phenology. Collected in flower from February to October.

Distribution. This species ranges through central and southern Peru (Fig. 500).

Habitat. Rocky slopes, open shrubby hillsides, and edge of montane forests; 3000-4300 m.

Additional specimens examined. **Peru.** Ancash: prov. Huaylas, abajo del abra de Tres Cruces, 8°50'S, 78°0'W, 21 May 2000, *Cano & al. 10627* (USM); Cordillera Negra, Abra Tres Cruces, 8°51'S, 77°57'W, 21 May 2013, *Aedo & Molina 20352* (MA); prov. Huaylas, en la margen izquierda del río Puchca, 9°11'S, 76°54'W, 19 Apr. 2004, *Cano & al. 14269* (MA); prov. Huari, San Marcos, campamento Yanacancha (Antamina), 9°34'S, 77°2'W, 25 Mar. 2004, *La Torre & al. 3435a* (USM). Ayacucho: Pampalca, between Huanta and río Apurimac, 12°54'S, 74°9'W, 4 May 1929, *Killip & Smith 22213* (NY); Incahuasi, 13°15'S, 73°21'W, Mar. 1947, *Soukup 3211* (G); Huayoccari to Yanacocha, Urubamba, NW from Cusco, 13°16'S, 72°4'W, 14 Feb. 1987, *Núñez & al. 7052* (MO); Urubamba, distrito Huayllabamba, Yanacocha, 13°17'S, 72°3'W, 16 Feb. 2006, *Valenzuela & al. 5955* (MA, MO); colinas de Laxaihuamán, 13°24'S, 72°11'W, Mar. 1929, *Herrera 2341* (GH, F, G, S). Junín: Chanchamayo, 11°3'S, 75°19'W, 12 Oct. 1863, *Isern 2178* (F, MA).

Discussion. Geranium smithianum resembles *G. diffusum* in general appearance and shares with it an indumentum of appressed, retrorse eglandular hairs on stems, petioles, and pedicels. The most consistent difference is leaf shape. In *G. smithianum* the middle segment is rhombic and 5(6)-lobed, whereas in *G. diffusum* it is obtriangular and usually 3-lobed.

Some specimens of *G. smithianum* have leaves with 3-lobed middle segments towards the apex of the inflorescence, although most of the leaves are 5-lobed. The two species are also allopatric. *Geranium diffusum* is found from Venezuela to northern Peru, whereas *G. smithianum* is restricted to central and southern Peru. Some poorly prepared specimens of the sympatric *G. ayacuchense* may be confused with *G. smithianum*; however, *G. ayacuchense* is easily to distinguished by its longer petals with a well-differentiated claw and by its fruit with a rostrum narrowed at the apex. A collection from central Peru on which *G. harmsii* is based, may be a variant of *G. smithianum* or *G. diffusum*; see the discussion of *G. diffusum*.

196. Geranium reptans R. Knuth in Engl., Pflanzenr. IV.129 (Heft 53): 214. 1912. Type locality: "Ecuador: Pichincha, auf Felsen oberhalb 4000 m (Sodiro, Spec. Fl. Ecuad. a. 1886 n. 211 -- Typus in Herb. Berlin!).-- Fruchtend Juni". Type: Ecuador. Pichincha, 1886, *L. Sodiro 211* (holotype, B destroyed). Ecuador. Pichincha, Machachi, Pugyopamba, quebrada Malagche, 0°32'S, 78°31'W, 15 July 2006, *C. Aedo & C. Ulloa 12955* (neotype, designated by Aedo 2012: 284, MA-745676!; isoneotypes, MO!, QCNE!).

Geranium caucense R. Knuth, Repert. Spec. Nov. Regni Veg. 28: 9. 1930. Type locality: "Colombia: Dept. El Cauca, Mt. Puracé (Pennell a. 1922 n. 6508 -- Typus in herb. Berol.) -- fruchtend Juni". Type: Colombia. Cauca, Mt. Puracé, 2°15'N, 76°25'W, 11-13 July 1922, *F.W. Pennell & E.K. Killip 6508* (holotype, B destroyed; lectotype, designated by Aedo 2012: 284, US-1142115!; isotypes, GH-00055006!, NY!).

Perennial herbs, 15-85 cm tall. *Rootstock* 2.4-11.1 mm in diameter, ± vertical, not tuberculate, turnip-shaped, without thickened roots. *Stem* prostrate to ascending, leafy, sometimes rooting at nodes, stolons absent, without vegetative stems, with patent, eglandular hairs 0.2-1.2 mm long. *Basal leaves* in a ± persistent rosette, cauline leaves opposite; leaf laminas 0.9-4.5 cm long, 1.1-6 cm wide, not peltate, palmatifid [ratio main-sinus length/middle segment length = (0.72)0.79-0.84(0.86)], polygonal in outline, base cordate, not coriaceous, with nerves not projected, pilose, with appressed, eglandular hairs on both surfaces; segments 5, in 1 plane, middle segment obtriangular (with lanceolate lateral lobes joined to the middle one), 1.1-4.5 mm wide at the base [ratio segment width at the base/middle segment length = 0.12-0.25], 3(6)-lobed at the apex [ratio secondary sinus length/middle segment length = 0.17-0.36]; petioles up to 14 cm long, without abscission zone, terete, not swollen, not deflexed in age, with patent, eglandular hairs 0.2-1.3 mm long; stipules 3-7.6 mm long, 0.7-2.5 mm wide, lanceolate, free, papery, brownish red, with eglandular hairs on abaxial surface and on the margin, glabrous adaxially. *Inflorescence* a monochasial cyme; cymules 1-flowered, solitary [ratio cymule length/leaf length = (0.55)0.6-1.1(1.7)]; peduncles 8-40 mm long, with patent, eglandular hairs 0.2-1.6 mm long; bracteoles absent. Flowers actinomorphic. *Sepals* 3.4-6.9 mm long, 1.5-2.9 mm wide, lanceolate, smooth, not accrescent, nerves 3, mucro 0.3-1.2 mm long [ratio mucro length/sepal length = 0.08-0.20], with erect-patent, eglandular hairs 0.3-1.4 mm long on the abaxial surface, minutely hairy adaxially. *Petals* (4.7)6.5-7.5(8.6) mm long, 1.8-3.9 mm wide, erect-patent, rounded, without claw, purple or white, sometimes hairy on the base of the adaxial surface, glabrous or ciliate on the basal margin, with hairs 0.1-0.4 mm long. *Stamens* 10, both whorls bearing anthers; filaments 1.9-3.9 mm long, lanceolate, white, with eglandular hairs 0.1-0.7 mm long on the abaxial surface and margin; anthers 0.5-0.8 mm long, yellow. Nectaries 5, hemispheric, glabrous. *Gynoecium* 2.7-4 mm long, yellow. *Fruit* 11-15.1 mm long, erect, discharge of seed-ejection type; mericarps 2-3.2 mm long, 1.1-2.2 mm wide, without a strand of fibers, not compressed at the apex, smooth, without basal beak, with a basal callus, without a basal prong, brown, with erect-patent, eglandular hairs 0.2-0.7 mm long; rostrum 6.5-9.8 mm long, without a narrowed apex, not twisted, with erect-patent, eglandular hairs 0.1-1 mm long; stigmatic remnants 1.2-2.3 mm long, with 5 hairy lobes. *Seeds* 1.8-2.1 mm long, 1-1.4 mm wide, finely reticulate, uniformly colored, brown, glabrous. Cotyledons with entire margin. Figs. 501, 502.

Pollen. Ornamentation not studied.

Chromosome number. Unknown.

Phenology. Collected in flower from January to December.

Distribution. This species ranges through Colombia and Ecuador to northern Peru (Fig. 503).

Habitat. Disturbed areas, tussock grass in paramos, shrublands, and montane forests; 2200-4500 m.

Representative specimens examined. **Colombia.** Boyacá: Páramo de Guantiva, alto de Canutos, vertiente S, 6°7'N, 72°50'W, 17 July 1940, *Cuatrecasas & García Barriga 9737* (COL). Cauca: Almaguer, vereda El Jordán, entre la laguna y la Cuchilla, 1°54'N, 76°51'W, 28 July 2001, *Ramírez & Macías 14554* (COL); Páramo del Puracé, al sur del volcán en el filo de la Cordillera, San Francisco, 2°17'N, 76°23'W, 23 July 1943, *Cuatrecasas 14673* (F). Nariño: Tuquerres, a orillas del camino a Ospina, 1°5'N, 77°37'W, 3 Aug. 1959, *Mora 692* (COL); Páramo del Tábano, 1°22'N, 77°48'W, May 1935, *García Barriga 4530* (COL). Norte de Santander: Pamplona, SW de la ciudad, por el Piñuelal, 7°24'N, 72°38'W, 30 June 1945, *Garganta Fábrega 1038* (F). Putumayo: Páramo de San Antonio, road from Pasto to Sibundoy, 1°7'N, 77°1'W, 13 Mar. 1953, *Schultes & Cabrera 18874* (P); valle de Sibundoy, cerca de San Francisco, entrada de la carretera hacia Mocoa, 1°11'N, 76°50'W, 11 Aug. 1965, *Uribe 5395* (COL). Quindio: municipio Salento, Vereda Cocóra, below Nevado del Quindio, 4°40'N, 75°25'W, 22 May 1989, *Luteyn & al. 13046* (COL, NY). Tolima: Páramo de Ruiz, Rosalito, 4°50'N, 75°33'W, 15 Dec. 1917, *Pennell 2964* (GH, NY). Valle: cordillera Central, cabecera del río Tulúa, quebrada de las Vegas, 4°1'N, 75°52'W, 21 Mar. 1946, *Cuatrecasas 20395*

(F). **Ecuador.** Azuay: Páramo de Cajas, Laguna Toreadora, 2°46'S, 79°13'W, 20 July 2006, *Aedo & Ulloa 13106* (MA); de Jima a San Miguel, Páramo de Matanga, 3°13'S, 78°57'W, 18 July 2006, *Aedo, Minga & Ulloa 13028* (MA). Carchi: entre Cunquer y Cuesaca, 0°29'N, 77°53'W, 17 July 1945, *Acosta Solís 10462* (F); Tulcán, 500 m of the bus terminal, 0°48'N, 77°43'W, 25 Oct. 1981, *Madsen 36330* (AAU). Chimborazo: El Altar, 1°31'S, 78°30'W, July 1903, *Meyer 180* (JE); Guamote, 1°55'S, 78°42'W, 29 Oct. 1852, *Fagerlind & Wibom 824* (S). Cotopaxi: quebrada 7 km al S de Limpiopungo, 0°40'S, 78°30'W, 2 Oct. 1982, *Balslev & Steere 3285* (AAU, NY); Latacunga, 0°54'S, 78°49'W, Oct. 1858, *Wagner 784* (M). El Oro: Manu-Guanasan, km 17, 3°27'S, 79°27'W, 6 Nov. 1997, *Lewis & al. 3684* (AAU, MA). Imbabura: summit Cerro Colongal, above Laguna Mojanda, 0°7'N, 78°16'W, 6 Jan. 2007, *Keating 1204* (MA); Mojanda, 10 km SSW Otavalo, 0°10'N, 78°18'W, 12 Dec. 1966, *Sparre 13439* (MO). Loja: Saraguro, 3°37'S, 79°13'W, 9 Mar. 1947, *Espinosa 1382* (NY). Napo: Laguna San Marcos, NE of volcán Cayambe, extensive flat plain

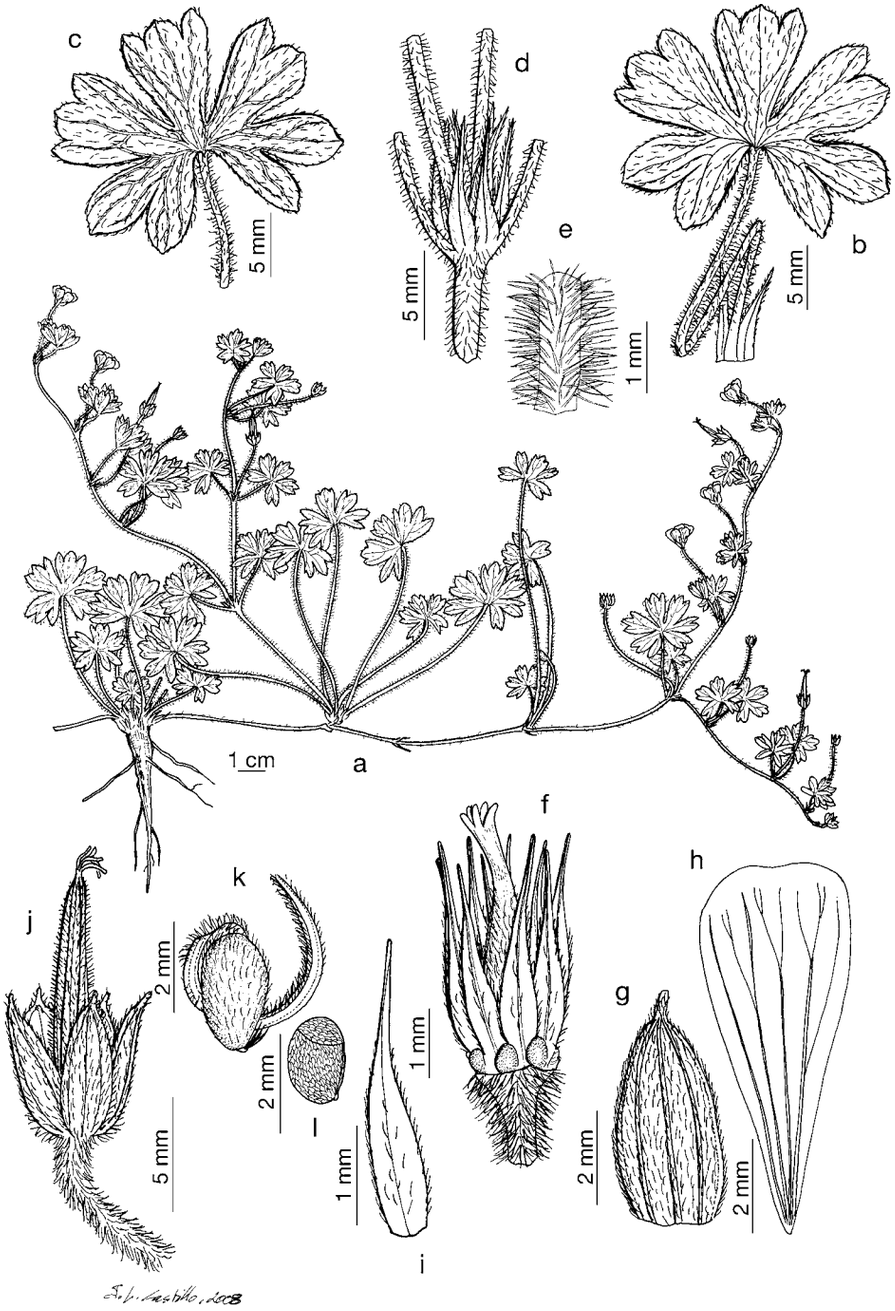


Fig. 501. *Geranium reptans*. a. Habit. b. Leaf, adaxial side. c. Leaf, abaxial side. d. Bracteoles. e. Pedicel. f. Flower, sepals and petals removed. g. Sepal. h. Petal. i. Staminal filament. j. Fruit. k. Mericarp. l. Seed. (Based on: *Porter 1043*, GH).

Fig. 502. *Geranium reptans* (Based on: a, *Aedo & Ulloa 12885,* MA; b, *Aedo & Ulloa 12955,* MA).

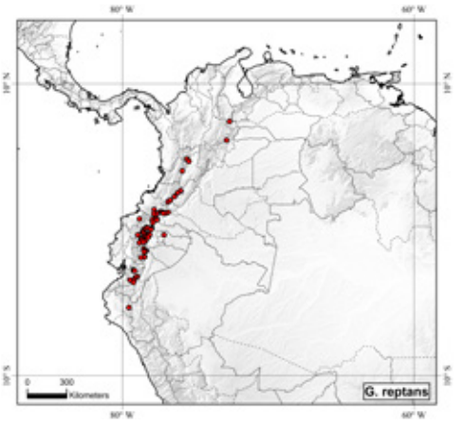


Fig. 503. Distribution of *Geranium reptans*.

S of the lake, 0º7'N, 77º58'W, 8 July 1980, Øllgaard *& al. 34010* (AAU, MO, UPS); Píntag, laguna de Mica, 0º32'S, 78º13'W, 3 Aug. 2006, *Aedo & León 13349* (MA). Pichincha: crater of Pululahua, 0º1'N, 78º29'W, 5 Apr. 1979, *Holm-Nielsen & al. 17030* (AAU); Hacienda Yanacocha, 0º6'S, 78º34'W, 12 July 2006, *Aedo & Ulloa 12897* (MA). Tungurahua: comunidad Rumipata, 0º22'S, 78º55'W, 16 Mar. 1984, *Brandbyge 42605* (AAU, F); N slopes of volcán Tungurahua, 1º29'S, 78º23'W, 30 Aug. 1987, *Ramsay & Merrow 299* (QCA). **Peru.** Piura: Abra Cruz Blanca, 5º20'S, 79º32'W, 23 June 2009, *Aedo 16622bis* (MA).

Discussion. Geranium reptans shares with *G. diffusum* a prostrate to ascending habit; well-developed plants sometimes root at the nodes. The leaves are also similar and usually have 3-lobed middle segments; however, in *G. reptans* the indumentum is denser, and the hairs are longer than in *G. diffusum*. The most consistent and diagnostic character for *G. reptans* is the presence of patent, eglandular hairs on pedicels and petioles. *Geranium reptans* occurs from central Colombia to Ecuador (one collection is recorded from northern Peru near the border with Ecuador) and is thus sympatric with *G. diffusum* in the central to southern part of its range. In this region, both species share the same disturbed habitats and sometimes are difficult to differentiate. Two specimens with glandular hairs on stem, petioles, and pedicels have been found in Nariño, Colombia: *Stancik 2615*, COL; *A. Fernández & L. E. Mora 1122*, COL, NY. They agree well with *G. reptans* otherwise, especially in leaf shape and indumentum, which avoids any confusion with *G. pseudodiffusum* or *G. antisanae*. Populations of *G. reptans* from southern Colombia need further study to assess the extent of variability. The holotype of *G. reptans* was destroyed, and no duplicates of *Sodiro 211* were found in major herbaria nor Sodiro's herbarium at QPLS. Consequently a neotype was designated (Aedo 2012: 284), which was collected in the same region as the holotype. It well matches with the photograph of the lost holotype (at F, G, GH, NY) and the original description.

The Renifolium Group—This group is characterized by its prostrate or ascending habit, its opposite leaves and its 1-flowered cymules arranged in a monochasial inflorescence. Except in *G. stuebelii*, the cymules lack pedicels. The leaves are palmatifid, usually orbicular in outline, and with few and shallow teeth towards the apex of the segments. The petals are of medium size.

197. Geranium renifolium Hieron., Bot. Jahrb. Syst. 21: 315. 1895. Type locality: "Peruvia: crescit supra Tambo Mayo inter Pacasmayo et Moyobamba, mense Aprili-Junio florens (coll. peruv. n. 43)". Type: Peru. Cajamarca, supra Tambo Mayo inter Pacasmayo et Moyobamba, 7°05'S, 78°18'W, *A. Stuebel 43* (lectotype, designated by Knuth, 1912: 159, B destroyed). Peru. La Libertad, Sánchez Carrión, Comumbamba, subiendo al nevado Huaylillas, 7°52'S, 78°01'W, 20 May 2001, *A. Sagástegui & M. Zapata 16461* (neotype, designated by Aedo 2012: 289, MA-658509!; isoneotype, F).

Perennial herbs, 9-27 cm tall. *Rootstock* 4.1-12.3 mm in diameter, ± vertical, not tuberculate, turnip-shaped, without thickened roots. *Stem* ascending, leafy, not rooting at nodes, stolons absent, without vegetative stems, with retrorse, appressed, eglandular hairs 0.2-0.4 mm long. *Basal leaves* in a ± persistent rosette, cauline leaves opposite; leaf laminas 0.8-1.9(3) cm long, 1.2-2(3.5) cm wide, not peltate, palmatifid [ratio main-sinus length/middle segment length = 0.53-0.67], orbicular in outline, base cordate, not coriaceous, with nerves not projected, glabrous except on margin and nerves of abaxial surface; segments 5, in 1 plane, middle segment obtriangular, 3.1-7.2 mm wide at the base [ratio segment width at the base/middle segment length = 0.29-0.51], (1)3-lobed at the apex [ratio secondary sinus length/middle segment length = 0.06-0.25]; petioles up to 13 cm long, without abscission zone, terete, not swollen, not deflexed in age, with retrorse, appressed, eglandular hairs 0.2-0.4 mm long; stipules 1.5-3.6 mm long, 0.5-1.8 mm wide, lanceolate, free, papery, brownish red, with eglandular hairs on abaxial surface and on the margin, glabrous adaxially. *Inflorescence* a monochasial cyme or dichasial with monochasial branches; cymules 1-flowered, solitary [ratio cymule length/leaf length = 2.3-4.2]; peduncles 15-40(45) mm long, with retrorse, appressed, eglandular hairs 0.2-0.5 mm long; bracteoles absent. Flowers actinomorphic. *Sepals* 5.7-7 mm long, 2.2-3.3 mm wide, lanceolate, smooth, not accrescent, nerves 3, mucro 0.4-0.9 mm long [ratio mucro length/sepal length = 0.07-0.13], with erect-patent, eglandular hairs 0.3-0.6 mm long on the abaxial surface, ± glabrous adaxially. *Petals* 9.9-14.4 mm long, 3.8-6.1 mm wide, erect-patent, slightly emarginate (notch 0.3-0.5 mm deep), with claw 1.2-2.3 mm long, purple, hairy on the base of the adaxial surface, ciliate on the basal margin, with hairs 0.2-0.3 mm long. *Stamens* 10, both whorls bearing anthers; filaments 3.6-5.2 mm long, lanceolate, yellow, with eglandular hairs 0.2-0.6 mm long on the abaxial surface and margin; anthers 1.2-1.4 mm long, yellow. Nectaries 5, hemispheric, glabrous. *Gynoecium* 3.8-6.6 mm long, yellow. *Fruit* 12.4-18.8 mm long, erect, discharge of seed-ejection type; mericarps 2.7-3.6 mm long, 1.5-1.8 mm wide, without a strand of fibers, not compressed at the apex, smooth, without basal beak, with a basal callus, without a basal prong, brown, with erect-patent, eglandular hairs 0.3-0.6 mm long; rostrum 8.2-12.4 mm long, with a narrowed apex 0.9-1.2 mm long, not twisted, with erect-patent, eglandular hairs 0.2-0.4 mm long; stigmatic remnants 1.8-2.1 mm

long, with 5 glabrous lobes. *Seeds* 1.9-2.3 mm long, 1.3-1.5 mm wide, finely reticulate, uniformly colored, brown, glabrous. Cotyledons with entire margin. Figs. 504, 505.

Pollen. Ornamentation not studied.

Chromosome number. Unknown.

Phenology. Collected in flower from May to June.

Distribution. This species is endemic to La Libertad, in northern Peru (Fig. 506).

Habitat. Grassy slopes and shrublands; 3000-3800 m.

Additional specimens examined. **Peru.** La Libertad: Sánchez Carrión prov., Huamachuco-Cajabamba, between Sausagocha and Cajabamba, 7º41'S, 78º1'W, 15 Feb. 1983, *Smith & Vásquez 3370* (F, NY, USM); Huamachuco, pr. La Conga, 7º44'S, 77º59'W, 30 June 2009, *Aedo & Zapata 16691* (MA); Sunchubamba, upper Chicama valley, 7º45'S, 78º38'W, 30 May 1957, *Ellenberg 1650* (U); Sunchubamba, 7º45'S, 78º38'W, 8 June 1957, *Ellenberg 1831* (U); provincia Huamachuco, cerca de Huamachuco, 7º48'S, 78º2'W, 17 Mar. 1948, *Ferreyra 3064* (USM).

Discussion. Geranium renifolium is well characterized by its 1-flowered cymules and its almost glabrous leaves, which are orbicular in outline, not deeply divided, with eglandular hairs restricted to the margins and nerves on the abaxial surface; rarely some sparse hairs are present between nerves. The leaves usually have the segments apically trilobulate; however, the segments are sometimes lanceolate and unlobed towards the apex of inflorescences. The hairs on stems, petioles, and pedicels are short, retrorse, appressed, and eglandular.

This species, described from southern Cajamarca, has also been found in a few localities in nearby La Libertad. The lectotype proposed by Knuth (1912: 159) is lost and no duplicates were found. Therefore, a neotype collected near the type locality and in agreement with the original description was designated.

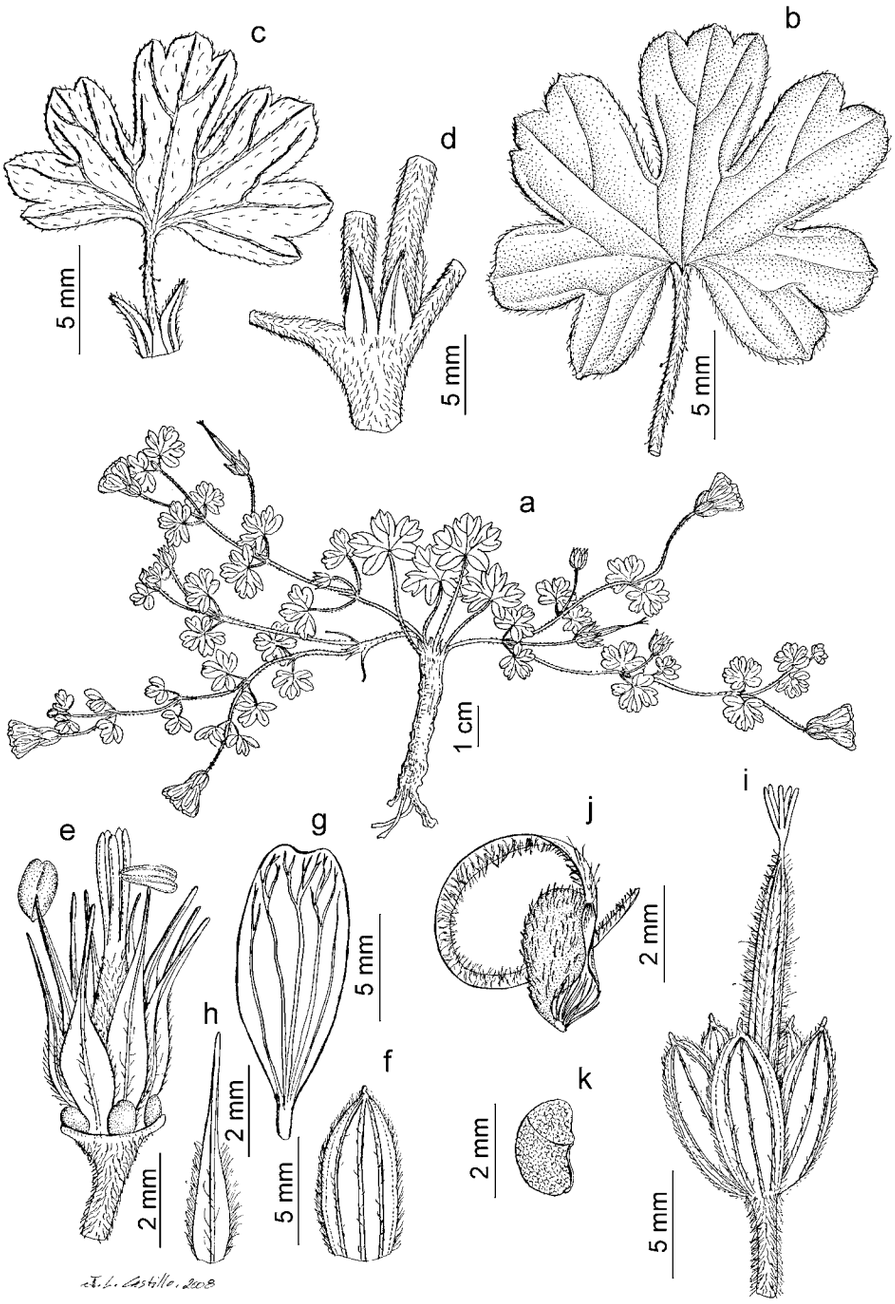


Fig. 504. *Geranium renifolium*. a. Habit. b. Leaf, adaxial side. c. Leaf, abaxial side. d. Stipules. e. Flower, sepals and petals removed. f. Sepal. g. Petal. h. Staminal filament. i. Fruit. j. Mericarp. k. Seed. (Based on: a, i-k, *Sagástegui & Zapata 16461*, MA; b, *Smith & Vásquez 3370*, USM; c-h, *Ellenberg 1650*, U).

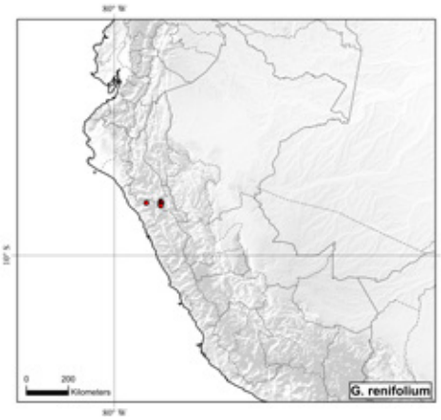


Fig. 506. Distribution of *Geranium renifolium*.

Fig. 505. *Geranium renifolium* (Based on: *Aedo & Zapata 16691,* MA).

198. Geranium stuebelii Hieron., Bot. Jahrb. Syst. 21: 316. 1895. Type locality: "Peruvia: crescit supra Tambo Mayo inter Pacasmayo et Moyobamba, mense Aprili-Junio florens (coll. peruv. n. 43 a)". Type: Peru. Cajamarca. Tambo Mayo inter Pacasmayo et Moyobamba, 7°05'S, 78°18'W, *A. Stuebel 43a* (no original material located). Peru. Cajamarca. pr. Cumbe Mayo, 7°11'S, 78°34'W, 15 June 2009, *C. Aedo 16497* (neotype, designated by Aedo 2012: 291, MA-788284!).

Perennial herbs, 26-59 cm tall. *Rootstock* 6.2-8.3 mm in diameter, ± vertical, not tuberculate, ± turnip-shaped, without thickened roots. *Stem* ascending, leafy, not rooting at nodes, stolons absent, without vegetative stems, with patent, eglandular hairs 0.3-1.2 mm long and, sometimes, patent, glandular hairs 0.3-1.3 mm long. *Basal leaves* in a ± persistent rosette, cauline leaves opposite; leaf laminas (1.7)1.8-3.1(3.4) cm long, 2-4.4 cm wide, not peltate, palmatifid [ratio main-sinus length/middle segment length = (0.49)0.56-0.64(0.69)], polygonal in outline, base cordate, not coriaceous, with nerves not projected, pilose, with appressed or patent, eglandular hairs and, usually, glandular hairs on both surfaces; segments 5, in 1 plane, middle segment obtriangular to rhombic, 5.3-9.9 mm wide at the base [ratio segment width at the base/middle segment length = 0.36-0.49], 3-5(7)-lobed at the apex [ratio secondary sinus length/middle segment length = 0.08-0.20]; petioles up to 10 cm long, without abscission zone, terete, not swollen, not deflexed in age, with patent, eglandular hairs 0.2-1 mm long and, usually, patent, glandular hairs 0.2-0.8 mm long; stipules 2.9-4.9 mm long, 0.9-1.6 mm wide, lanceolate, free, papery, brownish red, with eglandular hairs on both surfaces and on the margin. *Inflorescence* a monochasial cyme; cymules 1-flowered, solitary [ratio cymule length/leaf length = 1.6-3.8]; peduncles 22-41 mm long, with patent, eg-

landular hairs 0.2-1 mm long and patent, glandular hairs 0.3-0.6 mm long; bracteoles 3-4 mm long, 0.6-0.7 mm wide, lanceolate, opposite; pedicels absent or 16-68(71) mm long, with patent, eglandular hairs 0.2-0.8 mm long and patent, glandular hairs 0.2-0.9 mm long. Flowers actinomorphic. *Sepals* (4.9)5.7-6.5(8) mm long, 2-3.6 mm wide, lanceolate, smooth, not accrescent, nerves 3, mucro 0.2-0.9 mm long [ratio mucro length/sepal length = 0.04-0.14], with erect-patent, eglandular hairs 0.2-0.7 mm long and glandular hairs 0.3-1 mm long on the abaxial surface, glabrous adaxially. *Petals* (8.4)10.4-11.7 mm long, 4.4-7 mm wide, erect-patent, slightly emarginate (notch 0.3-0.4 mm deep), without claw, white or pale pink, glabrous or sparsely ciliate on the basal margin, with hairs 0.1-0.3 mm long. *Stamens* 10, both whorls bearing anthers; filaments 3.4-5.6 mm long, lanceolate, yellow, with eglandular hairs 0.1-0.5 mm long on the abaxial surface and margin; anthers 1-1.2 mm long, yellow. Nectaries 5, hemispheric, glabrous. *Gynoecium* 4.3-6.4 mm long, yellow. *Fruit* 19.7-23.4 mm long, erect, discharge of seed-ejection type; mericarps 2.6-3.5 mm long, 1.6-2 mm wide, without a strand of fibers, not compressed at the apex, smooth, without basal beak, with a basal callus, without a basal prong, brown, with erect-patent, eglandular hairs 0.1-0.9 mm long and patent, glandular hairs 0.3-1 mm long; rostrum 12.7-17 mm long, with a narrowed apex 1.4-2.8 mm long, not twisted, with patent, eglandular hairs 0.2-0.7 mm long and patent, glandular hairs 0.4-0.8 mm long; stigmatic remnants 1.7-2.8 mm long, with 5 glabrous lobes. *Seeds* 1.7-2.6 mm long, 1.3-1.8 mm wide, finely reticulate, uniformly colored, brown, glabrous. Cotyledons with entire margin. Figs. 507, 508.

Pollen. Ornamentation not studied.

Chromosome number. Unknown.

Phenology. Collected in flower from February to December.

Distribution. This species ranges through northern Peru (Fig. 509).

Habitat. Roadsides, rocky cliffs, open grassy areas, low shrublands, and forest remnants; 1800-3550 m.

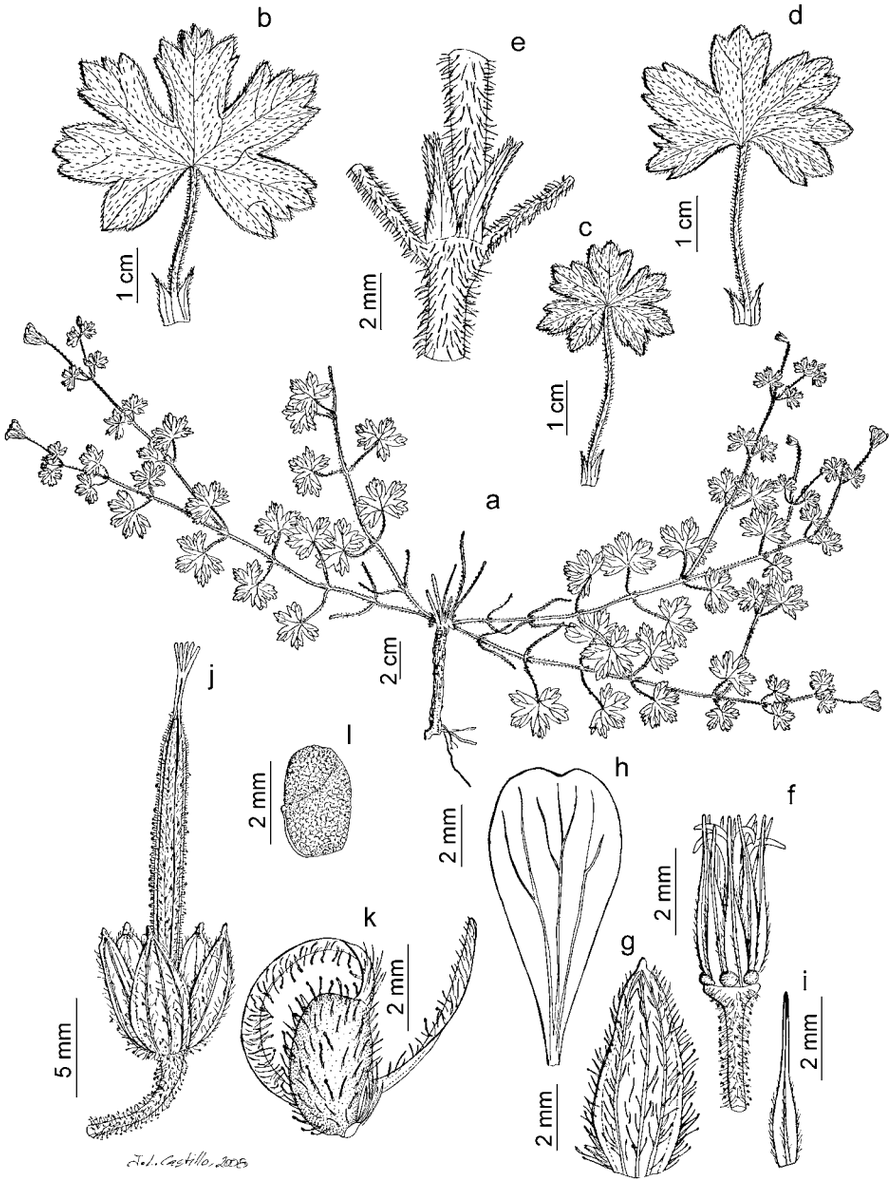


Fig. 507. *Geranium stuebelii*. a. Habit. b-d. Leaves, adaxial side. e. Stipules. f. Flower, sepals and petals removed. g. Sepal. h. Petal. i. Staminal filament. j. Fruit. k. Mericarp. l. Seed. (Based on: a, e-i, *Reichlen 9*, P; b, *Ferreyra 15607*, UC; c, j-l, *Ferreyra 15033*, UC; d, *Ferreyra 15607*, US).

Additional specimens examined. **Peru.** Amazonas: Pongará prov., distr. Yambrasbamba, 5º45'S, 77º54'W, 26 Mar. 1967, *Tillett 673-198* (GH); along road between Moyobamba and Chachapoyas, Bongara, Pomacocha, vicinity of km marker 339, E end of Lago Pomacocha, 5º47'S, 77º54'W, 13 Apr. 1984, *Croat 58246* (MO); 4-6 km of Pomacocha on road to Pedro Ruiz Gallo, 5º50'S, 77º50'W, 7 Feb. 1988, *Gentry & al. 61346* (MO); along road Jumbilla-Molinopampa, ca. 1 hour by car from Jumbilla, 5º57'S, 77º45'W, 6 Nov. 2012, *Werff & al. 25163* (MA); Chachapoyas, Leimebamba, on the río Utcubamba, 6º14'S, 77º55'W, 6 Apr. 1965, *Hutchison & Wright 4928* (F, MO, NY, US); Chachapoyas prov., 6º14'S, 77º52'W, *Mathews 2117* (E); Chachapoyas, Patron Samana, 6º14'S, 77º52'W, 23 Sep. 1987, *Sorensen & Holm 69* (C); middle and upper slopes of Puma-urcu SE of Chachapoyas, 6º16'S, 77º50'W, 25 May 1962, *Wurdack 531* (F, NY, US); along road

Fig. 508. *Geranium stuebelii* (Based on: a-c, *Aedo 16493,* MA; d, *Aedo 16497,* MA; e-g, *Aedo 16569,* MA).

Tingo-Kuelap, Choctamal, 6°23'S, 77°57'W, 12 Mar. 1998, *Werff & al. 14802* (MA, MO); Chachapoyas, cerros de Leimebamba, 6°42'S, 77°48'W, 20 Apr. 1964, *Ferreyra 15607* (MA, UC, US); Leimebamba, 6°42'S, 77°48'W, 7 Dec. 1962, *Woytkowski 7711* (MO); Chachapoyas prov., passim 20-17 km down E slope of Cerro Calla-Calla, 6°47'S, 77°53'W, 2 June 1966, *Edwin & Schunke 3671* (F, NY); Chachapoyas, Chuqibamba, 6°56'S, 77°50'W, 24 Nov. 2013, *Zambrana & al. 8912* (MA). Cajamarca: Jaén province, Sallique, 5°40'S, 79°15'W, 17 July 1998, *Campos & al. 5277* (MA); Chota, pass S of Conchan, 6°26'S, 78°38'W, 7 Dec. 1938, *Stork & Horton 10062* (F); Chota, arriba de Chota, 6°33'S, 78°39'W, 15 Aug. 1952, *Ferreyra 8481* (MA); Chota province, SE of Chota, 6°33'S, 78°39'W, 5 Dec. 1938, *Stork & Horton 10040* (F); Celendin, Marañón river valley, Chachapoyas-Cajamarca road, 6°51'S, 78°6'W, 28 May 1984, *Smith & Cabanillas 7284* (MA); al E de Celendín, 6°52'S, 78°6'W, 19 June 2009, *Aedo 16569* (MA); on road from Celendin to Balsas, passim down E slope of Cerro just W of Celendín, 6°52'S, 78°7'W, 29 May 1966, *Edwin & Schunke 3618* (BM, F, GH, NY, S); Celendín, 6°52'S, 78°9'W, 21 June 1963, *Ferreyra 15033* (UC); Celendín province, Sucre, Cerro Lonchepata, 6°56'S, 78°8'W, 6 Mar. 1969, *Chaman s.n.* (NY); pr. Celendín, 6°59'S, 78°11'W, 18 June 2009, *Aedo 16549* (MA); abajo de Sexcemayo, al W de Cajamarca, quebrada de Agua Minas, 7°3'S, 78°36'W, 9 Apr. 1992, *Sánchez Vega 6138* (F); pr. Quinuamayo, 7°8'S, 78°17'W, 16 June 2009, *Aedo 16515* (MA); al W de Cajamarca, 7°11'S, 78°33'W, 15 June 2009, *Aedo 16493* (MA). La Libertad: Uchumarca, Chibul, 6°58'S, 77°52'W, 12 July 2010, *Glenn & al. 617* (MA); Uchumarca, Maraypata, 6°58'S, 77°53'W, 27 June 2010, *Monigatti & al. 109* (MA); Bolivar, Uchumarca, from Las Quinas to Uchumarca, 7°1'S, 77°47'W, 17

Fig. 509. Distribution of *Geranium stuebelii*.

May 2011, *Bussmann & al. 16969* (MA); Cerro Cachorco, region de San Pablo, 7°7'S, 78°49'W, Dec. 1947, *Reichlen 9* (P); pr. Molino Viejo, 7°46'S, 77°46'W, 29 June 2009, *Aedo & Zapata 16683* (MA).

Discussion. Geranium stuebelli is a robust species with very characteristic leaves, polygonal in outline and with acute lobes. The middle segment varies from obtriangular to rhombic and usually is 3-5-lobed at the apex; in some specimens a few leaves have the middle segment apically 7-lobed. A glandular indumentum is always present in the inflorescence and often also on stems and leaves. Glandular forms of *G. peruvianum* have leaves orbicular in outline and with an obtriangular middle segment with obtuse lobes, but without glandular hairs on the fruits. The petals of *G. peruvianum* and *G. stuebelli* have a short notch; those of *G. peruvianum* have distinctive claw, which is absent in *G. stuebelli*. The cymules of *G. stuebelii* lack pedicels and bracteoles in most of the inflorescence, although rarely 1-2 bracteoles can be found at pedicels in the lower portion of the inflorescence.

Because the holotype for *G. stuebelli* is no longer extant, a specimen matching the original description and collected in the area of the type locality in southern Cajamarca was designated as neotype.

199. Geranium peruvianum Hieron., Bot. Jahrb. Syst. 21: 316. 1895. Type locality: "Peruvia: crescit inter Pacasmayo et Moyobamba mense Aprili-Junio florens (coll. peruv. n. 51 d)". Type: Peru. Cajamarca. Pacasmayo a Moyobamba, 7°05'S, 78°18'W, Apr-Jun 1875, *A. Stuebel 51d* (lectotype, designated by Knuth, 1912: 160, B destroyed, photo at F!). Peru. Cajamarca. pr. Quinuamayo, 7°08'S, 78°17'W, 16 June 2009, *C. Aedo 16514* (neotype, designated by Aedo 2012: 294, MA-788286!).

Perennial herbs, 8-35 cm tall. *Rootstock* 2.9-13.9 mm in diameter, ± vertical, not tuberculate, turnip-shaped, without thickened roots. *Stem* ascending, leafy, not rooting at nodes, stolons absent, without vegetative stems, with retrorse to patent, eglandular hairs 0.4-1.6 mm long. *Basal leaves* in a ± persistent rosette, cauline leaves opposite; leaf laminas (0.7)1.2-1.4(1.8) cm long, 0.8-2.3 cm wide, not peltate, palmatifid [ratio main-sinus length/middle segment length = (0.38)0.52-0.59(0.68)], orbicular in outline, base cordate, not coriaceous, with nerves not projected, pilose to velutinous on both surfaces, with patent, eglandular hairs; segments 5, in 1 plane, middle segment obtriangular, 1.9-5.5 mm wide

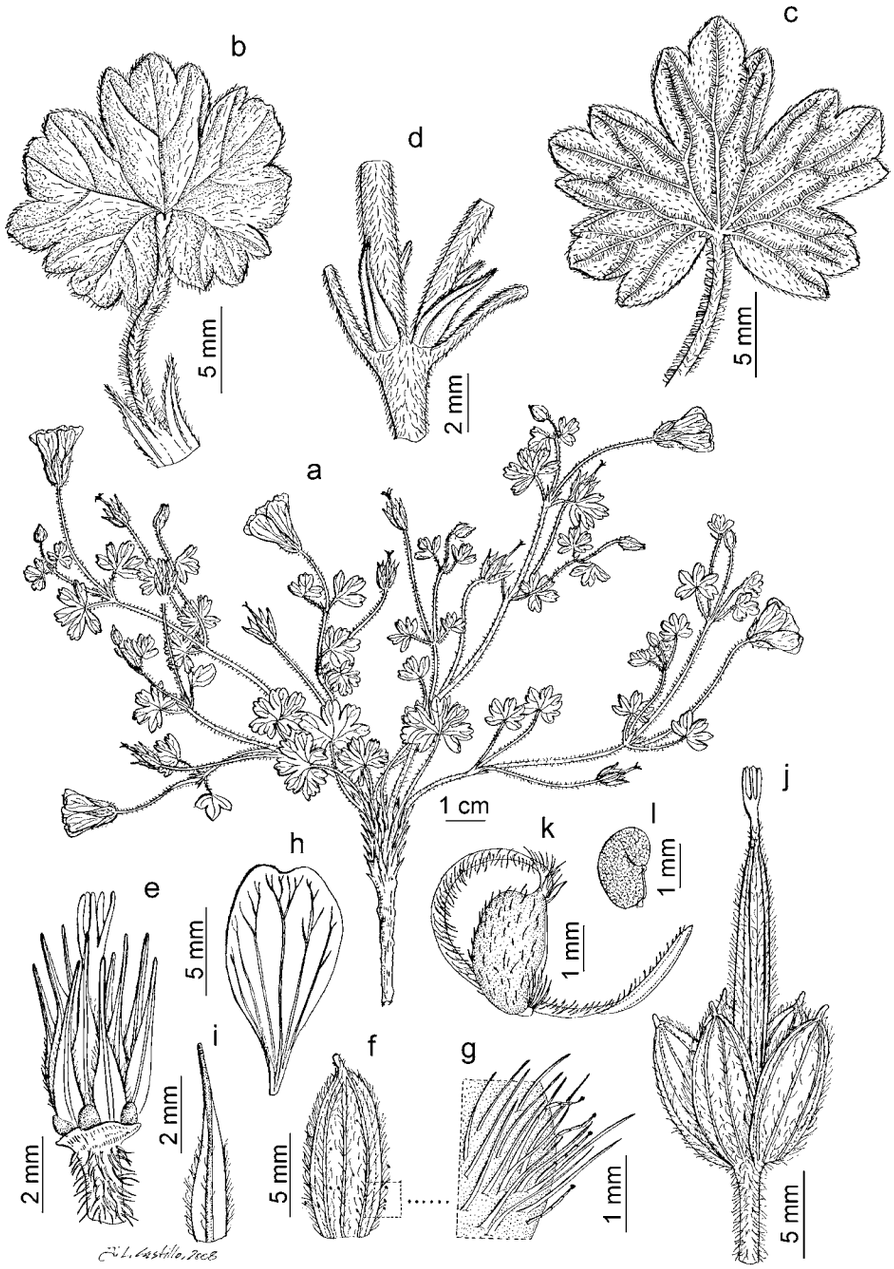


Fig. 510. *Geranium peruvianum*. a. Habit. b. Leaf, adaxial side. c. Leaf, abaxial side. d. Stipules. e. Flower, sepals and petals removed. f. Sepal. g. Detail showing sepal indumentum. h. Petal. i. Staminal filament. j. Fruit. k. Mericarp. l. Seed. (Based on: a, e-i, *Sánchez Vega & al. 10415*, MA; b, d, *Sánchez Vega & al. 6519*, F; c, *Sánchez Vega & al. 11210*, MA; j-l, *Sagástegui & al. 8400*, NY).

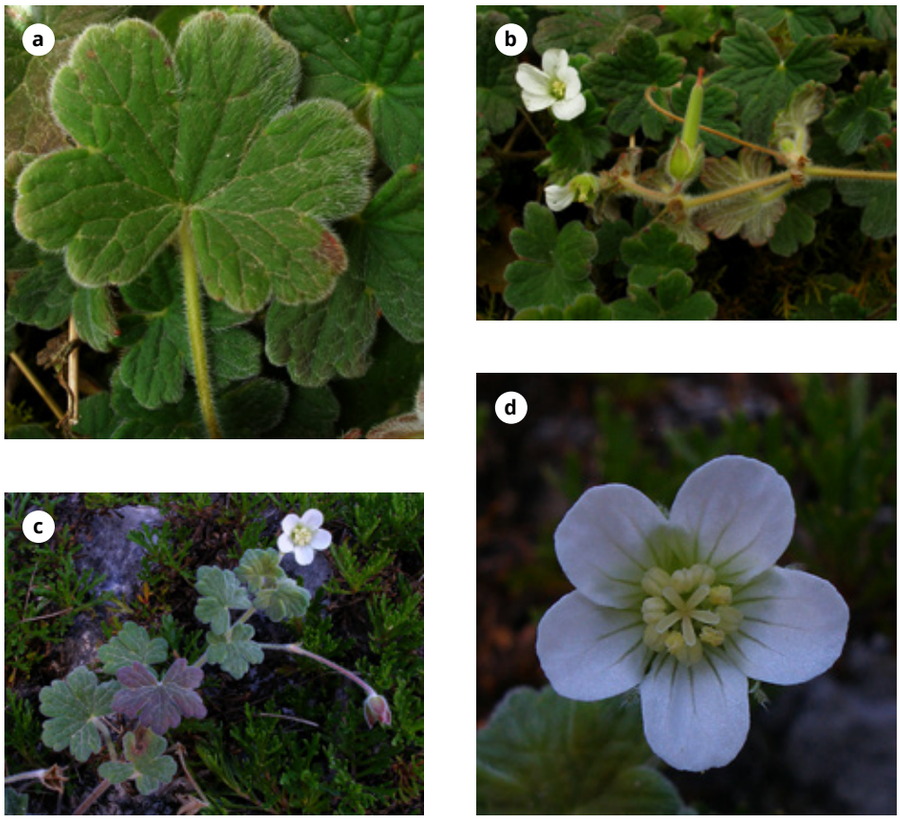


Fig. 511. *Geranium peruvianum* (Based on: a, b, *Aedo 16520,* MA; c, d, *Aedo 16678,* MA).

Fig. 512. Distribution of *Geranium peruvianum*.

at the base [ratio segment width at the base/middle segment length = 0.23-0.51], (1)3-lobed at the apex [ratio secondary sinus length/middle segment length = 0.11-0.23]; petioles up to 5 cm long, without abscission zone, terete, not swollen, not deflexed in age, with patent, eglandular hairs 0.2-1.3 mm long; stipules 1.8-5.3 mm long, 0.8-1.9 mm wide, lanceolate, free, papery, brownish red, with eglandular hairs on abaxial surface and on the margin, glabrous adaxially. *Inflorescence* a monochasial cyme; cymules 1-flowered, solitary [ratio cymule length/leaf length = 1.2-6.8]; peduncles 19-55(75) mm long, with patent, eglandular hairs 0.2-1.2 mm long and, rarely, patent, glandular hairs 0.5-0.6 mm long; bracteoles absent. Flowers actinomorphic. *Sepals* (4.3)5.7-7.4(8.2) mm long, 1.9-3.6 mm wide, lanceolate, smooth, not accrescent, nerves 3, mucro 0.3-1.1 mm long [ratio mucro length/sepal length = 0.05-0.16], with erect-patent, eglandular hairs 0.3-1.6 mm long and rarely sparse glandular hairs 0.7-0.8 mm long on the abaxial surface, ± glabrous adaxially. *Petals* (8.4)9.9-14.8 mm long, 3.7-7.5 mm wide, erect-patent, rounded, with claw 1.9-3.9 mm long, white or pale pink, glabrous or sparsely ciliate on the basal margin, with hairs 0.2-0.5 mm long. *Stamens* 10, both whorls bearing anthers; filaments 2.9-5.5 mm long, lanceolate, yellow, with eglandular hairs 0.2-0.8 mm long on the abaxial surface and margin; anthers 0.7-1.3 mm long, yellow. Nectaries 5, hemispheric, glabrous. *Gynoecium* 3.2-6 mm long, yellow. *Fruit* 11.8-21.6 mm long, erect, discharge of seed-ejection type; mericarps 2.6-3 mm long, 1.2-1.9 mm wide, without a strand of fibers, not compressed at the apex, smooth, without basal beak, with a basal callus, without a basal prong, brown, with erect-patent, eglandular hairs 0.3-0.5 mm long; rostrum 7.7-15.2 mm long, with a narrowed apex 0.5-1.6 mm long, not twisted, with erect-patent, eglandular hairs 0.1-0.5 mm long; stigmatic remnants 0.9-2.5 mm long, with 5 glabrous lobes. *Seeds* 1.8-2.4 mm long, 1.1-1.8 mm wide, finely reticulate, uniformly colored, brown, glabrous. Cotyledons with entire margin. Figs. 510, 511.

Pollen. Ornamentation not studied.

Chromosome number. Unknown.

Phenology. Collected in flower from January to November.

Distribution. This species ranges from Cajamarca to La Libertad, in northern Peru (Fig. 512).

Habitat. Edges of fields, limestone cliffs, open grassy areas, and low shrublands; 2700-3900 m.

Additional specimens examined. **Peru.** Cajamarca: ca. 57 km NE of Cajamarca on road to Celendín, near top of pass, 6°57'S, 78°10'W, 4 Jan. 1979, *Dillon & Turner 1617* (F); pr. Micuypampa, 7°2'S, 78°14'W, 16 June 2009, *Aedo 16520* (MA); jalca de Kumulca, ruta a Celendín, 7°2'S, 78°15'W, 17 June 1975, *Sagástegui & al. 8115* (MO, NY); arriba de la Encañada, ruta a Celendín, 7°5'S, 78°20'W, 18 May 1976, *Sagástegui & al. 8400* (NY); NW de Cajamarca, camino a Chamis, 7°7'S, 78°33'W, 7 Apr. 1993, *Sánchez Vega 6519* (F, MA); carretera a Celendín km 20, 7°8'S, 78°21'W, 12 Jan. 1979, *Gutte & Mueller 9177* (USM); km 17.1 on road from Cajamarca to Celendín, 7°8'S, 78°23'W, 3 Jan. 1983, *Stevens 22014* (USM); surronding of Cajamarca, 7°10'S, 78°31'W, 11 Mar. 1986, *Becker & Terrones*

623 (LPB); zona arqueológica de Cumbe Mayo, al W de Cajamarca, 7º11'S, 78º34'W, 6 Apr. 2001, *Sánchez Vega & al. 10415* (MA); pr centro turístico de Cumbe Mayo, al W de Cajamarca, 7º11'S, 78º34'W, 21 Apr. 2001, *Sánchez Vega & al. 10498* (MA); Cumbe Mayo, al W de Cajamarca, 7º11'S, 78º34'W, 4 June 1976, *Sánchez Vega & al. 1873* (MA, W); cumbre El Gavilán, entre Cajamarca y Chilete, 7º13'S, 78º41'W, 31 Mar. 1948, *Ferreyra 3323* (USM). La Libertad: Bolivar, Uchumarca, Chivane, 7º2'S, 77º45'W, 9 July 2010, *Bussmann & al. 16723* (MA); Bolivar prov., entre el desvío a Uchumarca y Santa Luisa, 7º4'S, 77º49'W, 11 Nov. 2001, *Sánchez Vega & al. 11210* (MA); Bolivar, Uchuncha, SW side of Cerro Fila de Andosa, 7º7'S, 77º49'W, 14 Nov. 2013, *Bussmann & al. 18325* (MA); de Chugay a Molino Viejo, 7º47'S, 77º46'W, 28 June 2009, *Aedo & Zapata 16678* (MA). San Martín: Huallaga prov., Saposoa distr., alrededores de Laguna La Artesa, 7º10'S, 77º40'W, 23 Aug. 2001, *Quipuscoa & al. 2599* (MA).

Discussion. Geranium peruvianum shares with *G. renifolium* 1-flowered cymules and leaves orbicular in outline and not deeply divided, which are densely covered with patent hairs on both surfaces. The leaves usually have apically 3-lobulate segments; however, towards the apex of inflorescence they are sometimes lanceolate and not lobulate. The indumentum of *G. peruvianum* is usually eglandular, although some specimens have scattered glandular hairs at the sepal base and the pedicel apex. The specimen *Gutte & Müller 9177* (USM) is an exception, and has glandular hairs spread on pedicels and stems, but aspects of the leaves and fruit place it with *G. peruvianum*. The cymules usually lack bracteoles, but the specimen *Sánchez 10498* (MA) has a pair of cymules with bracteoles near the base of the inflorescence.

Geranium peruvianum was described from a collection obtained in southern Cajamarca. The lectotype proposed by Knuth (1912: 160) is lost, and no duplicate was found. Therefore, a neotype collected near the type locality and in agreement with the original description was designated.

200. Geranium comarapense R. Knuth, Meded. Rijks-Herb. 27: 69. 1915. Type locality: "Auf Bergwiesen bei Comarapa, ca. 2600 m (no. 2015b, bl. im April 1911.-- Typus!)". Type: Bolivia. Santa Cruz, Comarapa, 17°54'S, 64°28'W, Apr. 1911, *T. Herzog 2015b* (holotype, L-0018339!).

Perennial herbs, ca. 13 cm tall. *Rootstock* 5.1 mm in diameter, unknown roots. *Stem* prostrate, leafy, not rooting at nodes, stolons absent, without vegetative stems, with patent, eglandular hairs 0.4-0.5 mm long and patent, glandular hairs 0.4-0.5 mm long. *Basal leaves* in a ± persistent rosette, cauline leaves opposite; leaf laminas 1.3-2.1 cm long, 1.5-2.7 cm wide, not peltate, palmatifid [ratio main-sinus length/ middle segment length = 0.61-0.64], orbicular in outline, base cordate, not coriaceous, with nerves not projected,

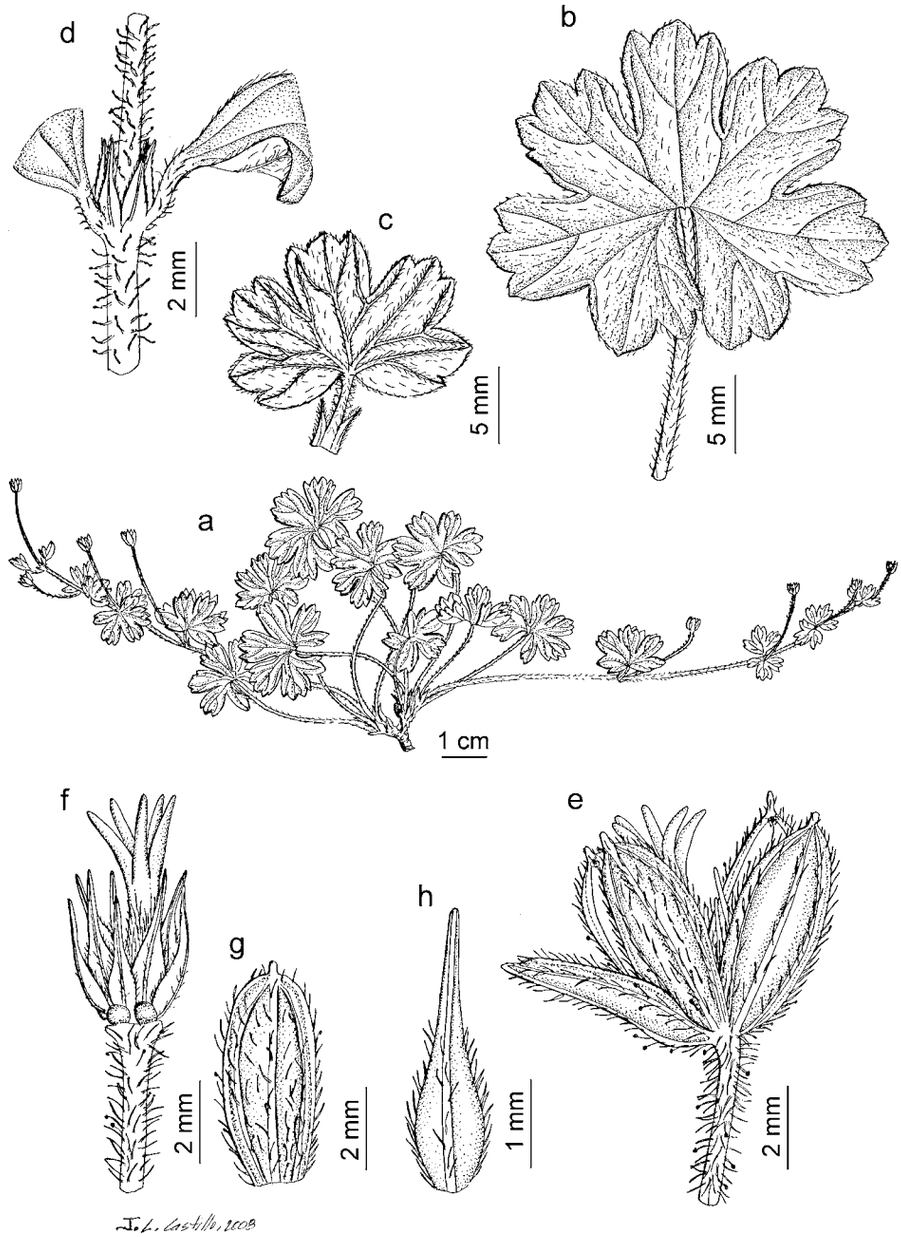


Fig. 513. *Geranium comarapense*. a. Habit. b. Leaf, adaxial side. c. Leaf, abaxial side. d. Stipules. e. Flower, petals removed. f. Flower, sepals and petals removed. g. Sepal. h. Staminal filament. (Based on: *Herzog 2015b*, L).

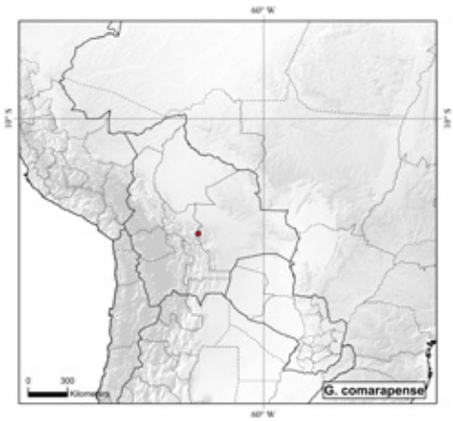


Fig. 514. Distribution of *Geranium comarapense*.

pilose, with patent, eglandular hairs on both surfaces; segments 5, in 1 plane, middle segment obtriangular, 4.2-7.4 mm wide at the base [ratio segment width at the base/middle segment length = 0.43-0.58], 3-5-lobed at the apex [ratio secondary sinus length/ middle segment length = 0.19-0.21]; petioles up to 5 cm long, without abscission zone, terete, not swollen, not deflexed in age, with patent, eglandular hairs 0.3-0.5 mm long and patent, glandular hairs 0.3-0.5 mm long; stipules 1.8-2.7 mm long, 0.6-0.7 mm wide, lanceolate, free, papery, brownish red, with eglandular hairs on abaxial surface and on the margin, glabrous adaxially. *Inflorescence* a monochasial cyme; cymules 1-flowered, solitary [ratio cymule length/leaf length = ca. 2.9]; peduncles 18-33 mm long, with patent, eglandular hairs 0.3-0.4 mm long and patent, glandular hairs 0.3-0.5 mm long; bracteoles absent. Flowers actinomorphic. *Sepals* 4.3-5 mm long, 1.8-2 mm wide, lanceolate, smooth, not accrescent, nerves 3, mucro 0.5-0.7 mm long [ratio mucro length/sepal length = 0.10-0.17], with erect-patent, eglandular hairs 0.3-0.7 mm long and patent, glandular hairs 0.3-0.4 mm long on the abaxial surface, almost glabrous adaxially. *Petals* unknown. *Stamens* 10, both whorls bearing anthers; filaments ca. 2.8 mm long, lanceolate, unknown color, with eglandular hairs 0.4 mm long on the abaxial surface and margin; anthers ca. 0.7 mm long, unknown color. Nectaries 5, hemispheric, glabrous. *Gynoecium* ca. 4.4 mm long, unknown color. *Fruit* unknown. *Seeds* unknown. Cotyledons not studied. Fig. 513.

Pollen. Ornamentation not studied.

Chromosome number. Unknown.

Phenology. Collected in flower in April.

Distribution. This species is endemic to western Santa Cruz, Bolivia (Fig. 514).

Habitat. Unknown; ca. 2600 m.

Discussion. Geranium comarapense is known only from the holotype, collected in western Santa Cruz, Bolivia. The specimen lacks the rootstock, petals, and fruits. A very immature fruit shows some glandular hairs, which differentiates this species from *G. peruvianum*. The leaves are resemble those of *G. peruvianum*, and the stems and inflorescence are covered with glandular hairs. A distance of 1700 km separates the type locality of *G. comarapense* from the nearest population of *G. peruvianum*.

The Rupicola Group—This group is characterized by its erect or ascending habit, its opposite, palmatifid leaves and its 1-flowered cymules arranged in monochasial or, more rarely, in dichasial inflorescence. Except in *G. laxicaule*, the cymules of all or some nodes lack pedicels. The petals are usually of medium size and without claw, and the fruit rostrums usually have a narrowed apex.

201. Geranium chilloense Kunth in Humb., Bonpl. & Kunth, Nov. Gen. Sp. 5: 231. 1822. *Geranium pubescens* Willd. ex Spreng., Syst. Veg. 3: 71. 1826, nom. illeg. Type locality: "Geranium pubescens Willd. herb... Crescit prope Chillo Quitensium, locis temperatis, alt. 1340 hex.". Type: Ecuador. Pichincha. Chillo, 0°21'S 78°26'W, *F.A. Humboldt & A. Bonpland s.n.* (lectotype, designated by Knuth 1912: 146, B-W-12536-01-0 image!; isolectotype, P-02088098!).

Geranium chinchense R. Knuth, Repert. Spec. Nov. Regni Veg. 28: 4. 1930. Type locality: "Peru: Chinche, Yanahuanca (Macbride et Featherstone a. 1922 n. 1263 in Exp. Capt. Marshall Field Fund - Typus in Herb. Field Mus.!) -- Mito (Macbride et Featherstone a. 1922 n. 1404 in Exp. Capt. Marshall Field Fund -- in Herb. Field Mus.!) --Fruchtend Juni bis Juli". Type: Peru. Pasco. Chinche, Yanahuanca, 10°31' S, 76°29'W, 21 June 1922, *J.F. Macbride & W. Featherstone 1263* (holotype, F!; isotype, G-00439766!).

Geranium choimacotense R. Knuth, Repert. Spec. Nov. Regni Veg. 28: 9. 1930. Type locality: "Peru: Dept. Ayacucho, prov. Huanta, Choimacota-Tal (Weberbauer a. 1926 n. 7579 in Exp. Cap. Marshall Field Fund - Typus in Herb. Field Museum n. 562497!). Dept. Lima, Chillon-Flub, oberhalb Obrajillo (Pennell a. 1925 n. 14417!). Tambo de Vaca (Macbride a. 1923 n. 4407 in Exp. Capt. Marshall Field Fund)". Type: Peru. Ayacucho, Huanta, Choimacota-Tal, 12°57'S, 74°14'W, Feb.-Mar. 1926, *A. Weberbauer 7579* (holotype, F!; isotypes, BM-000835593!, G-00439769!, K!, NY!, S-11-25190!, US image!).

Geranium huantense R. Knuth, Repert. Spec. Nov. Regni Veg. 28: 8. 1930. Type locality: "Peru: Dept. Ayacucho, Prov. Huanta, Choimacota-Tal (Weberbauer a. 1926 n. 7619 in Exp. Capt. Marshall Field Fund -- Typus in herb. Field Mus.!) -- Blühend Februar". Type: Peru. Ayacucho, Putis, Huanta, Choimacota-Tal, 12°57'S, 74°14'W, 27 Feb. 1926, *A. Weberbauer 7619* (holotype, F!; isotypes, G-00439770!, K!, US image!).

Geranium crassiusculum R. Knuth, Repert. Spec. Nov. Regni Veg. 40: 217. 1936. Type locality: "Ecuador: Cañar, unterhalb des Paramo (J.N. et G. Rose a. 1928 n. 22702 - Typus in U. St. Nat. Herb. n. 1022337!)". Type: Ecuador. Cañar, 2°33'S, 78°56'W, 15 Sep. 1918, *J.N. Rose & G. Rose 22702* (holotype, US-1022337!; isotype, NY!).

Geranium schimpffii R. Knuth, Repert. Spec. Nov. Regni Veg. 40: 219. 1936. Type locality: "Ecuador: Südöstlich von Riobamba, an der Grenze zwischen dem Wald- und dem Paramogebiet, 3200 m (Schimpff a. 1934 n. 879 - Typus in herb. Berol.)". Type: Ecuador. Chimborazo. Riobamba, 1°40'S, 78°38'W, 21 Mar. 1934, *H. Schimpff 879* (holotype, B destroyed; lectotype, designated by Aedo 2012: 299, G-00439771!; isolectotypes, M-0307401!, MO-288043 image!, Z!).

Perennial herbs, 26-100(200) cm tall. *Rootstock* 6.5-9.8 mm in diameter, ± vertical, not tuberculate, turnip-shaped, without thickened roots. *Stem* ascending or climbing, leafy,

not rooting at nodes, stolons absent, without vegetative stems, with patent, eglandular hairs 0.3-1.8 mm long and, sometimes, patent, glandular hairs 0.2-1.3 mm long. *Basal leaves* in a ± persistent rosette, cauline leaves opposite; leaf laminas (1.2)2.5-4.7(7.3) cm long, 2.1-7.8 cm wide, not peltate, palmatifid [ratio main-sinus length/middle segment length = 0.63-0.87], polygonal in outline, base cordate, not coriaceous, with nerves not projected, pilose, with appressed, eglandular hairs and, sometimes, glandular hairs on both surfaces; segments 5, in 1 plane, middle segment rhombic to obtriangular, 3.3-12.6 mm wide at the base [ratio segment width at the base/middle segment length = 0.16-0.41], 3-5(7)-lobed at the apex [ratio secondary sinus length/middle segment length = 0.11-0.29]; petioles up to 31 cm long, without abscission zone, terete, not swollen, not deflexed in age, with patent, eglandular hairs 0.2-1.4 mm long and, usually, patent, glandular hairs 0.3-1.4 mm long; stipules 1.8-7 mm long, 0.9-3.9 mm wide, broadly lanceolate, free, papery, brownish red, with eglandular hairs on abaxial surface and on the margin, minutely hairy adaxially. *Inflorescence* a monochasial cyme; cymules 1-flowered, solitary [ratio cymule length/leaf length = (0.3)0.6-1.3(1.8)]; peduncles 6.5-47 mm long, with patent, eglandular hairs 0.1-1 mm long and patent, glandular hairs 0.2-1 mm long; bracteoles absent. Flowers actinomorphic. *Sepals* 4.3-7 mm long, 1.7-3.1 mm wide, lanceolate, smooth, not accrescent, nerves 3, mucro 0.1-0.7 mm long [ratio mucro length/sepal length = 0.02-0.12], with erect-patent, eglandular hairs 0.1-0.9 mm long and glandular hairs 0.4-1 mm long on the abaxial surface, glabrous adaxially. *Petals* (4.4)6.5-7.9(9.4) mm long, 1.7-4.4 mm wide, erect-patent, rounded or slightly emarginate (notch 0.1-0.4 mm deep), without claw, purple, rarely white, glabrous or ciliate on the basal margin, with hairs 0.1-0.2 mm long. *Stamens* 10, both whorls bearing anthers; filaments 2.2-3.5 mm long, lanceolate, yellow, with eglandular hairs 0.1-0.3 mm long on the abaxial surface and margin; anthers 0.5-0.8 mm long, yellow. Nectaries 5, hemispheric, glabrous. *Gynoecium* 2.4-4.4 mm long, yellow. *Fruit* 17-21 mm long, erect, discharge of seed-ejection type; mericarps 2.3-3.8 mm long, 1.3-1.9 mm wide, without a strand of fibers, not compressed at the apex, smooth, without basal beak, with a basal callus, without a basal prong, brown, with erect-patent, eglandular hairs 0.2-0.6 mm long and patent, glandular hairs 0.2-0.7 mm long; rostrum 12.9-15.8 mm long, with a narrowed apex 1.1-2.1 mm long, not twisted, with patent, eglandular hairs 0.1-0.5 mm long and patent, glandular hairs 0.3-0.9 mm long; stigmatic remnants

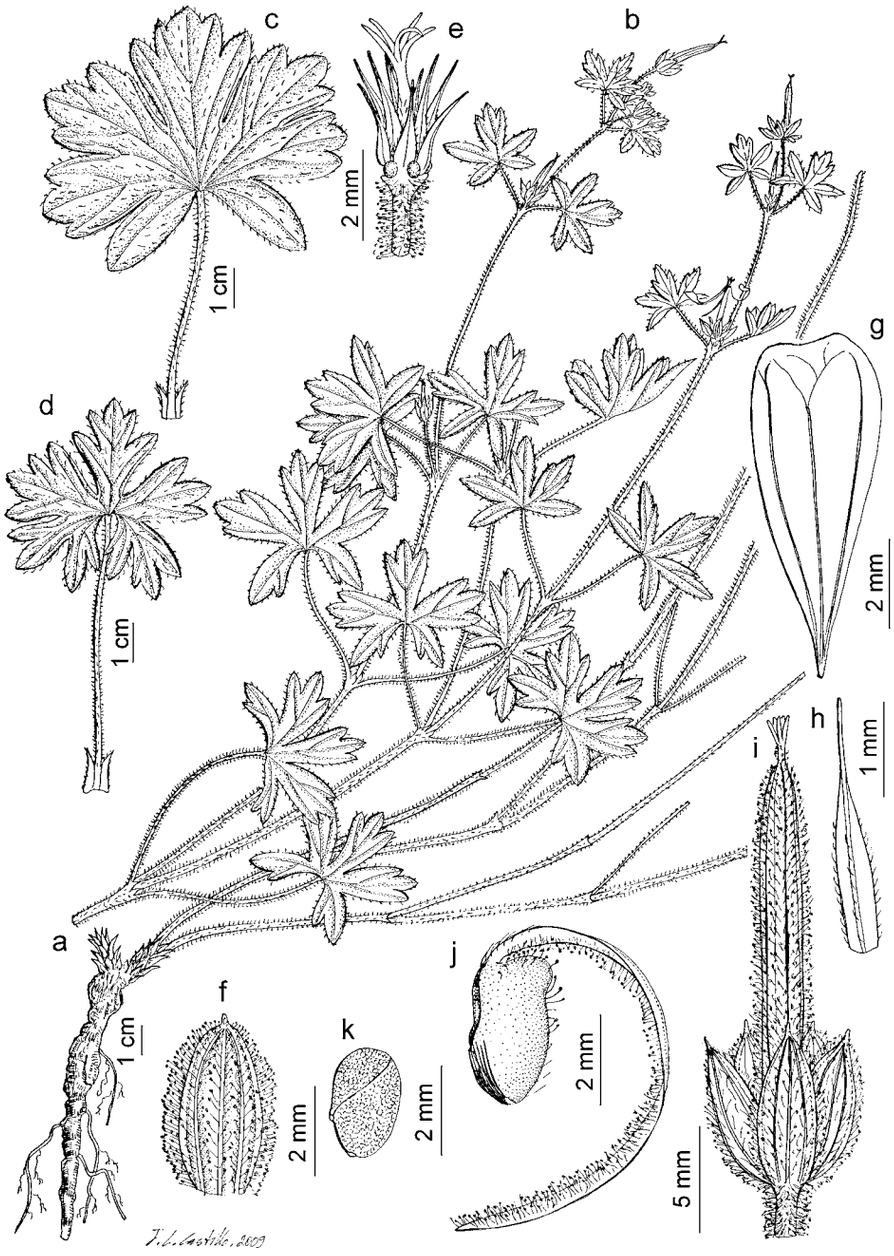


Fig. 515. *Geranium chilloense*. a, b. Habit. c, d. Leaves, adaxial side. e. Flower, sepals and petals removed. f. Sepal. g. Petal. h. Staminal filament. i. Fruit. j. Mericarp. k. Seed. (Based on: a, b, e-h, *Aedo & Ulloa 12958*, MA; c, i-k, *Asplund 16870*, S; d, *Smith & al. 11919*, MA).

Fig. 516. *Geranium chilloense* (Based on: a, *Aedo & Ulloa 12958*, MA; b-d, *Aedo 16525*, MA).

0.8-1.7 mm long, with 5 glabrous lobes. *Seeds* 2-2.9 mm long, 1-1.9 mm wide, finely reticulate, uniformly colored, brown, glabrous. Cotyledons with entire margin. Figs. 515, 516.

Pollen. Ornamentation not studied.

Chromosome number. Unknown.

Phenology. Collected in flower from January to December.

Distribution. This species ranges from southern Colombia to southern Peru (Fig. 517).

Habitat. Roadsides, among rocks, moist areas, meadows, shrub-covered slopes, and montane wet forests; 1900-4200 m.

Representative specimens examined. **Colombia.** Cauca: valle de las Papas, alrededores de Valencia, márgenes del río Sucubun, 1°54'N, 76°38'W, 11 Sep. 1958, *Idrobo & al. 3702* (COL, P); near río San Andrés, 2°23'N, 76°29'W, 14 June 1922, *Pennell 7147* (GH); Cordillera Central, vertiente occidental, cabeceras del río Palo, quebrada de Santo Domingo, vertiente derecha, 3°14'N, 76°25'W, 15 Dec. 1944, *Cuatrecasas 19355* (F, GH). Nariño: Tuquerres, Pasto, 1°5'N, 77°37'W, May 1853, *Triana 3750* (BM, E, G, W); municipio de Pasto, corregimiento del Encano, El Carrizo, 1°10'N, 77°10'W, 3 Jan. 1992, *Ramírez & Cuayal 4382* (COL); Pasto, between Pasto and Anganoy, 1°14'N, 77°17'W, 26 May 1946, *Schultes & Villarreal 7414* (GH). **Ecuador.** Azuay: road Cuenca-Sayausi-Molleturo, hostería Dos Chorreras, 2°46'S, 79°10'W, 6 Jan. 2000, *Jørgensen & al. 1638* (MA); along the río Matadero, W of Cuenca, 2°54'S, 78°59'W, 3 Mar. 1945, *Camp 1969* (BH, NY, UB); pr. Jima, 3°11'S, 78°57'W, 18 July 2006, *Aedo, Minga & Ulloa 13021* (MA). Bolivar: Hacienda Talahua, 1°21'S, 79°4'W, 28 Apr. 1939, *Penland & Summers 551* (F, GH); Hacienda Talahua, 1°21'S, 79°4'W, 2 May 1939, *Penland & Summers 609* (F, GH, LD); entre Guaranda y Vinuhoa, 1°36'S, 79°0'W, 29 Sep. 1943, *Acosta Solís 5931* (F). Cañar: Ingapirca Parish, Ingapirca, 2°32'S,

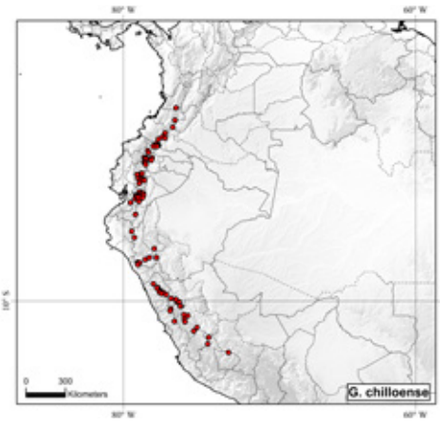


Fig. 517. Distribution of *Geranium chilloense*.

78º53'W, Nov., *Kohn 1398* (MO); between Biblian and Cañar, 2º42'S, 78º52'W, 21 Sep. 1955, *Asplund 17677* (S); 5 km NE of Azogues, near San Marcos, 2º44'S, 78º50'W, 1 Apr. 1945, *Camp 2469* (BH, US). Carchi: estación biológica Guandera, 0º35'N, 77º43'W, 12 July 2000, *Narváez 619* (MA); above El Pun towards Tulcán, 0º40'N, 77º37'W, 14 July 1955, *Asplund 16870* (S); Las Penas between La Rinconada and San Gabriel, 0º48'N, 77º43'W, 22 June 1939, *Asplund 7181* (S). Chimborazo: pr. San Juan, 1º37'S, 78º48'W, 31 July 2006, *Aedo 13231* (MA); Laguna Cocha, 1º43'S, 78º42'W, 4 May 1876, *André 3058* (F, NY); Chambo, 1º44'S, 78º35'W, 10 May 1939, *Asplund 5992* (AAU, MICH, F, MO, S). Cotopaxi: Parque Nacional Cotopaxi, cerca del límite SW, 0º40'S, 78º30'W, 1 Dec. 1982, *Balslev & al. 3536* (NY). Imbabura: Mojanda, 10 km SSW Otavalo, 0º10'N, 78º18'W, 12 Dec. 1966, *Sparre 13439* (S); Cuicocha, 0º18'N, 78º21'W, 10 Apr. 1956, *Asplund 20192* (S). Loja: La Argelia, Loja, 4 May 1946, *Espinosa 289* (NY, F); Cerro Pucará, Loja, 3º16'S, 79º32'W, 18 May 1946, *Espinosa 417* (NY); nudo de Cajanuma, 7 km S Loja, 4º5'S, 79º12'W, 9 July 1944, *Camp 113* (NY). Napo: entre Oya Cachi y Comenia, cord. Oriental, 0º12'S, 78º4'W, 27 Oct. 1945, *Acosta Solís 11184* (F); about 2 km E of Oyacachi, 0º12'S, 78º3'W, 25 Apr. 1996, *Stahl & Navarrete 2325* (QCA); road Quito-Baeza, at Laguna Papallacta, 0º21'S, 78º6'W, 17 July 1976, Øllgaard & *Balslev 8012* (AAU, NY). Pichincha: faldas del Pichincha, Quito, 0º10'S, 78º36'W, 30 July 1945, *Acosta Solís 10161* (F); carretera Quito al Páramo de Papallacta, 0º19'S, 78º12'W, 23 Nov. 1991, *Halfdan-Nielsen & León 62* (AAU, C); Machachi, Pugyopamba, quebrada Malagche, 0º32'S, 78º31'W, 15 July 2006, *Aedo & Ulloa 12958* (MA). Tungurahua: on the old Ambato-Guaranda road, about 3 km E of Llangahua, 1º15'S, 78º47'W, 30 Oct. 1983, *Brandbyge 42440* (AAU, MO); entre Pasa y San Fernando, 1º16'S, 78º44'W, 27 Oct. 1944, *Acosta Solís 8695* (F). **Peru.** Amazonas: Luya district, Tingo, Cuelap, 6º25'S, 77º54'W, 4 Sep. 1998, *Vázquez & al. 25482* (MA, USM). Ancash: Huaylas, Hauscarán National Park, Auquispuquio area of ruins, 8º50'S, 77º58'W, 7 Apr. 1986, *Smith & al. 11919* (ISC, MA, USM); Yacuyhuarmi, 9º7'S, 77º43'W, 23 Jan. 1877, *Martinet 716* (P); Huari, Juprog, 9º34'S, 77º5'W, 14 May 2003, *Cano & al. 13264* (USM). Apurimac: Abancay, Cerro Turronmocco, NW Nevado Ampay, 13º32'S, 72º49'W, 17 Mar. 1987, *Brandbyge 420* (AAU). Cajamarca: pr. Micuypampa, 7º2'S, 78º14'W, 16 June 2009, *Aedo 16525* (MA); Contumazá, Ventarrón, Trinidad-Totorillas, 7º21'S, 79º2'W, 6 July 1977, *Sagástegui & al. 8986* (MO, NY); Contumazá, Cruz del Huaco, 7º31'S, 79º2'W, 4 Apr. 1985, *Sagástegui & al. 12564* (MO, NY). Huánuco: Tambo de Vaca, 9º50'S, 76º45'W, 10 June 1923, *Macbride 4407* (F); Mito, 9º54'S, 76º25'W, 22 June 1922, *Macbride & Featherstone 1404* (F, G); Mitocucho, distr. Quichque, 10º22'S, 76º4'W, 13 Aug. 1977, *Cerrate & al. 6771* (GH, NY, USM). Junín: Junín prov., Ulcumayo, 2 km E of town along river, 10º57'S, 75º52'W, 30 June 1981, *Johns 81-29* (F); La Quinoa, 11º1'S, 75º36'W, 15 May 1975, *Pettersson s.n.* (S); Huancayo, Cerro Azul, 11º49'S, 74º58'W, 1948, *Soukup 3598* (US). La Libertad: Bolivar, Uchumarca, Chivane, 7º2'S, 77º45'W, 9 July 2010, *Bussmann & al. 16717* (MA). Lima: Cordillera Raura, entre mina Raura y Oyón, 10º33'S, 76º46'W, 30 May 2013, *Aedo & Molina 20571* (MA); pr. Viroc, 10º41'S, 76º49'W, 1 June 2013, *Aedo & Molina 20617* (MA); provincia Canta, Cullhuay, arriba del pueblo y siguiendo la carreteraa Yauli, 11º24'S, 76º31'W, 17 Aug. 1996, *Granda & Alegría 1915* (MA). Pasco: Daniel Carrión prov., Pumalion, bajando 16 km de La Quinua hacia Salccachupan, 10º22'S, 76º7'W, 1 Apr. 1948, *Ochoa 363* (F, GH, NY). Piura: Huancabamba, arriba de Mishia, hacia las Huaringas, 5º14'S, 79º27'W, 16 Sep. 1985, *Ferreyra & Chanco 20459* (USM).

Discussion. Geranium chilloense is characterized by its ascending or climbing habit, and its 1- flowered cymules that usually have short peduncles but lack pedicels and bracteoles. The peduncles are noticeably short towards the apex of inflorescence, where the flowers are sometimes almost sessile. A glandular indumentum is normally abundant on the inflorescence, although sometimes the glandular hairs are sparse and restricted to the apex of peduncles and sepals. In some specimens the glandular indumentum also extends to the base of the stems and petioles. Such variation can be found in the same specimen. The middle leaf segment is also variable, usually rhombic in outline but sometimes obtriangular. It usually has three to five lobes, although some specimens have seven lobes. Petal size is a useful feature for separating *G. chilloense* from *G. rupicola* and *G. laxicaule*, since *G. chilloense* has shorter petals (although with some overlap in a few specimens of *G. laxicaule*). The specimen *Aedo & al. 13021* (MA) is an exception; a single cymule near the inflorescence base has a short pedicel and a pair of bracteoles; the other cymules lack pedicels and bracteoles.

202. Geranium laxicaule R. Knuth in Engl., Pflanzenr. IV.129 (Heft 53): 209. 1912. Type locality: "Peru: An der Lima-Oroya-Bahn auf einem Bergstock südwestlich von Matucana im Hintergrunde des Thales von Huillacachi an einem kleinen Wasserfall, oberhalb 3000 m (Weberbauer a. 1901 n. 187 -- Typus in Herb. Berlin!).-- Blühend Dezember". Type: Peru. Lima. Lima-Oroya-Bahn, von Matucana im Hintergrunde des Thales von Huillacachi, 11°51'S, 76°24'W, 1901, *A. Weberbauer 187* (holotype, B destroyed). Peru. Lima. Huaros, 11°17'S, 76°31'W, 23 June 1925, *F.W. Pennell 14718* (neotype, designated by Aedo 2012: 303, NY-01364988!; isoneotypes, GH-00338015!, PH-00041314!, S-11-25163!).

Perennial herbs, 25-54 cm tall. *Rootstock* 5.5-9.6 mm in diameter, ± vertical, not tuberculate, turnip-shaped, without thickened roots. *Stem* ascending, leafy, rooting at nodes, stolons absent, without vegetative stems, with patent, eglandular hairs 0.3-1.2 mm long and, usually, patent, glandular hairs 0.2-0.8 mm long. *Basal leaves* in a ± persistent rosette, cauline leaves opposite; leaf laminas 1.5-4.1 cm long, 1.9-4.7 cm wide, not peltate, palmatifid [ratio main-sinus length/middle segment length = 0.63-0.83], polygonal in outline, base cordate, not coriaceous, with nerves not projected, pilose, with appressed, eglandular hairs on both surfaces; segments 5, in 1 plane, middle segment rhombic, 2.5-7.2 mm wide at the base [ratio segment width at the base/ middle segment length = 0.16-0.34], 3-5-lobed at the apex [ratio secondary sinus length/middle segment length = 0.11-0.27]; petioles up to 13 cm long, without abscission zone, terete, not swollen, not deflexed in age, with pat-

ent, eglandular hairs 0.2-1.4 mm long and, usually, patent, glandular hairs 0.3-0.4 mm long; stipules 3.1-6.6 mm long, 0.7-1.9 mm wide, lanceolate, free, papery, brownish red, with eglandular hairs on abaxial surface and on the margin, minutely hairy adaxially. *Inflorescence* a monochasial cyme; cymules 1-flowered, solitary [ratio cymule length/leaf length = (0.6)1.1-2.1(2.8)]; peduncles 14-74 mm long, with patent, eglandular hairs 0.2-1.1 mm long and, usually, patent, glandular hairs 0.2-0.9 mm long; bracteoles 1.8-4.3 mm long, 0.6-1.2 mm wide, linear-lanceolate, opposite; pedicels 12-39 mm long, with patent, eglandular hairs 0.4-1.2 mm long and, usually, patent, glandular hairs 0.3-0.7 mm long. Flowers actinomorphic. *Sepals* 4.5-7.9 mm long, 1.9-3.8 mm wide, lanceolate, smooth, not accrescent, nerves 3, mucro 0.3-0.7 mm long [ratio mucro length/sepal length = 0.06-0.14], with erect-patent, eglandular hairs 0.4-1 mm long and patent, glandular hairs 0.3-1.1 mm long on the abaxial surface, glabrous adaxially. *Petals* (6.2)7.8-11.3(16.3) mm long, 2.8-6 mm wide, erect-patent, rounded or slightly emarginate (notch 0.4-0.6 mm deep), without claw, white or pale pink, glabrous or ciliate on the basal margin, with hairs 0.2-0.4 mm long. *Stamens* 10, both whorls bearing anthers; filaments 1.8-5 mm long, lanceolate, white, with eglandular hairs 0.1-0.3 mm long on the abaxial surface and margin; anthers 0.5-1.2 mm long, yellow. Nectaries 5, hemispheric, glabrous. *Gynoecium* 2.9-6.5 mm long, white. *Fruit* 15.4-25.4 mm long, erect, discharge of seed-ejection type; mericarps 2.9-3.8 mm long, 1.4-2.4 mm wide, without a strand of fibers, not compressed at the apex, smooth, without basal beak, with a basal callus, without a basal prong, brown, with erect-patent, eglandular hairs 0.4-0.6 mm long; rostrum 10.5-18.2 mm long, with a narrowed apex 0.7-2.6 mm long, not twisted, with patent, eglandular hairs 0.2-0.5 mm long and, rarely, patent, glandular hairs 0.5-0.6 mm long; stigmatic remnants 0.9-1.8 mm long, with 5 glabrous lobes. *Seeds* 2.2-3 mm long, 1.3-1.9 mm wide, finely reticulate, uniformly colored, brown, glabrous. Cotyledons with entire margin. Figs. 518, 519.

Pollen. Ornamentation not studied.

Chromosome number. Unknown.

Phenology. Collected in flower from January to August.

Distribution. This species ranges through central Peru (Fig. 520).

Habitat. Open rocky slopes, cliffs, puna grassland and shrublands; 3000-4200 m.

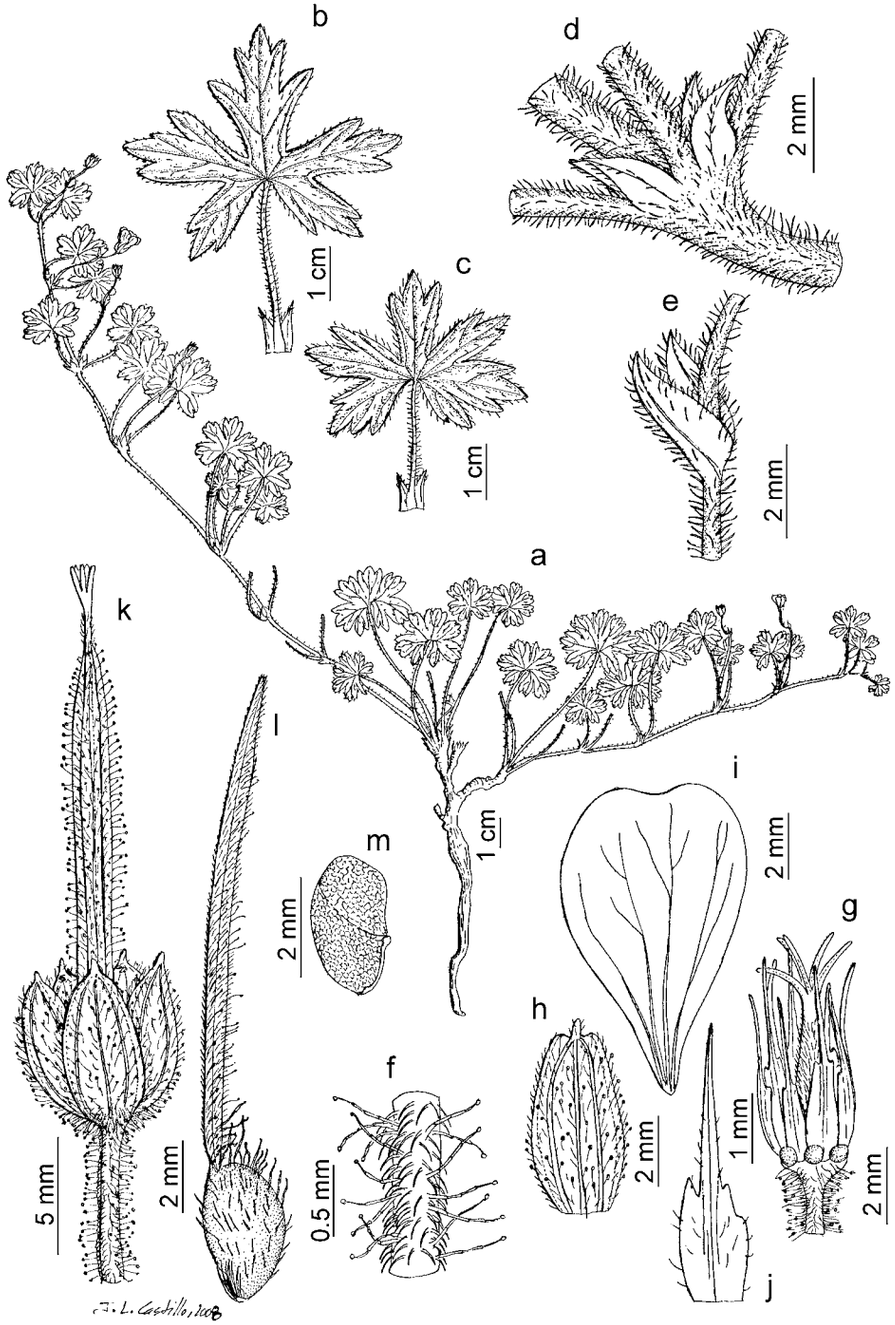


Fig. 518. *Geranium laxicaule*. a. Habit. b, c. Leaves, adaxial side. d. Stipules. e. Bracteoles. f. Peduncle indumentum. g. Flower, sepals and petals removed. h. Sepal. i. Petal. j. Staminal filament. k. Fruit. l. Mericarp. m. Seed. (Based on: a, *Smith & Goodwin 8922*, MA; b, *Ochoa 1455*, F; c, *Agurto 41*, MA; d-m, *Pennell 14718*, PH).

Fig. 519. *Geranium laxicaule* (Based on: *Aedo & Molina 20235,* MA).

Fig. 520. Distribution of *Geranium laxicaule*.

Additional specimens examined. **Peru.** Ancash: Pomabamba, 8°50'S, 77°28'W, *Agurto 41* (MA, USM); Huaylas, Huascaran National Park, quebrada Los Cedros, Alpamayo trail, 8°50'S, 77°44'W, 11 Mar. 1985, *Smith & al. 9881* (ISC, MA, MO, USM); Huaylas, Pueblo Libre, Huashta Cruz, 8°52'S, 77°53'W, 16 May 2000, *Roque & al. 1323* (MA); Huaylas, Hauscarán National Park, Quebrada Santa Cruz, 8°55'S, 77°38'W, 16 Jan. 1985, *Smith & al. 9288* (ISC, MA, MO); Huaylas, Huascarán National Park, Parón valley, at lake, 9°0'S, 77°41'W, 1 Jan. 1985, *Smith & Goodwin 8922* (ISC, MA, USM); Pueblo libre, Antircan, 9°6'S, 77°49'W, 9 Aug. 2001, *Cano & al. 11733* (USM); Huaylas, Pueblo libre, Antircan, 9°10'S, 77°48'W, 8 Aug. 2001, *Cano & al. 11699* (USM); Cordillera Negra, al S de Mina Santo Toribio, 9°31'S, 77°36'W, 18 May 2013, *Aedo & Molina 20235* (MA); Cordillera Negra, al S de Mina Santo Toribio, 9°31'S, 77°36'W, 18 May 2013, *Aedo & Molina 20241* (MA); Parque Nacional Huascarán, Huaraz, Cordillera Blanca, 9°32'S, 77°32'W, 13 Oct. 1976, *Bernardi & al. 16465* (C, G); pr. Huallanca, 9°52'S, 76°59'W, 25 May 2013, *Aedo & Molina 20449* (MA). La Libertad: Usquil, Cerro de Las Tres Suc., 7°48'S, 78°24'W, 11 May 1952, *Ochoa 1455* (F); Quiruvilca, campamento minero Cayacuyan, 8°0'S, 78°19'W, 27 Apr. 2003, *Cano & al. 12935* (MA). Lima: along río Chillón, above Obrajillo, 11°28'S, 76°41'W, 13 June 1925, *Pennell 14417* (F, PH).

Discussion. Geranium laxicaule, an endemic of central Peru, usually has glandular hairs at least on the inflorescence and 1-flowered cymules with a peduncle, bracteoles, and a pedicel. The glandular indumentum varies like that of *G. chilloense*; some specimens have a few glandular hairs (sparse and restricted to apex of peduncles and sepals) and others lack them. The middle leaf segment is usually rhombic in outline, with five lobes, although there may be three lobes. Specimens with short petals can be distinguished from the sympatric *G. chilloense* by the bracteolate cymules. Because the holotype of *G. laxicaule* (*Weberbauer 187*) was destroyed, and no duplicate was found at USM and MOL, a neotype was designated (Aedo 2012: 303), which was collected also in Lima Department and matches the original description and the photograph of the holotype (F, G, NY).

Some specimens from Ecuador identified in herbaria as *G. laxicaule* have 2-flowered cymules and should be assigned to *G. killipii*.

203. Geranium ayacuchense R. Knuth, Repert. Spec. Nov. Regni Veg. 18: 291. 1922, [31 Dec. 1922]. Type locality: "Peru, Dept. Ayacucho, Prov. Huanta: Weg von Tambo über Osno zum Flusse Apurimac; in der Grassteppe, die von kleineren Strauchbeständen unterbrochen wird (Weberbauer, Fl. Peru a. 1910, no. 5563.-Typus in Herb. Berol.!)". Type: Peru. Ayacucho, Huanta, von Tambo über Osno zum Flusse Apurimac, 12°56'S, 74°01'W, 31 May 1910, *A. Weberbauer 5563* (holotype, B destroyed; lectotype, designated by Aedo 2012: 306, F-0093172F!).

Geranium scissum R. Knuth, Repert. Spec. Nov. Regni Veg. 28: 4. 1930, R. Knuth. Type locality: "Peru: Paucartambo, Hacienda Churu (Herrera n. 1916 -- Typus in herb. Berol.!)". Type: Peru. Cuzco, Paucartambo, Hacienda Churú, 13°18'S, 71°35'W, *F. Herrera 1916* (holotype, B destroyed, no original material located).

Perennial herbs, 15-41 cm tall. *Rootstock* 4-7.9 mm in diameter, ± vertical, not tuberculate, turnip-shaped, without thickened roots. *Stem* ascending, leafy, not rooting at nodes, stolons absent, without vegetative stems, with retrorse to patent, eglandular hairs 0.2-1.2 mm long. *Basal leaves* in a ± persistent rosette, cauline

leaves opposite; leaf laminas (1.1)1.8-2.6(3.1) cm long, 1.3-4.1 cm wide, not peltate, palmatifid [ratio main-sinus length/middle segment length = (0.68)0.72-0.86], polygonal in outline, base cordate, not coriaceous, with nerves not projected, pilose, with appressed, eglandular hairs on both surfaces; segments 5, in 1 plane, middle segment obtriangular, 1.3-6 mm wide at the base [ratio segment width at the base/middle segment length = 0.10-0.38], 3-5(7)-lobed at the apex [ratio secondary sinus length/middle segment length = 0.18-0.34]; petioles up to 11 cm long, without abscission zone, terete, not swollen, not deflexed in age, with patent to retrorse, appressed, eglandular hairs 0.2-1.4 mm long; stipules 2-5.7 mm long, 0.6-1.7 mm wide, lanceolate, free, papery, brownish red, with eglandular hairs on both surfaces and on the margin. *Inflorescence* a monochasial cyme; cymules 1-flowered, solitary [ratio cymule length/leaf length = (1.3)1.7-3.8]; peduncles 7.9-73.5 mm long, with retrorse to patent, eglandular hairs 0.2-1 mm long; bracteoles absent. Flowers actinomorphic. *Sepals* (4.7)6.2-7.8(8.9) mm long, 2-4 mm wide, lanceolate, smooth, not accrescent, nerves 3, mucro (0.3)0.6-1(1.1) mm long [ratio mucro length/sepal length = 0.07-0.14(0.19)], with erect-patent, eglandular hairs 0.3-1.5 mm long on the abaxial surface, ± hairy adaxially. *Petals* (9.8)11.5-14.1(15.4) mm long, 4.7-9 mm wide, erect-patent, slightly emarginate (notch 0.3-1 mm deep), with claw 0.8-2.6 mm long, white, hairy on the base of the adaxial surface, ciliate on the basal margin, with hairs 0.2-0.6 mm long. *Stamens* 10, both whorls bearing anthers; filaments 3.7-6.6 mm long, lanceolate, yellow, with eglandular hairs 0.2-0.9 mm long on the abaxial surface and margin; anthers 0.7-1.3 mm long, yellow. Nectaries 5, hemispheric, usually hairy. *Gynoecium* 3.6-7.2 mm long, unknown color. *Fruit* 15.4-22.8(25) mm long, erect, discharge of seed-ejection type; mericarps 3-3.6 mm long, 1.2-2.3 mm wide, without a strand of fibers, not compressed at the apex, smooth, without basal beak, with a basal callus, without a basal prong, brown, with erect-patent, eglandular hairs 0.2-0.7 mm long; rostrum 9.2-18.5 mm long, with a narrowed apex (0)0.6-1.2(1.3) mm long, not twisted, with patent, eglandular hairs 0.1-0.6 mm long; stigmatic remnants 2.1-3.3 mm long, with 5 glabrous lobes. *Seeds* 2-2.7 mm long, 1-2.1 mm wide, finely reticulate, uniformly colored, brown, glabrous. Cotyledons with entire margin. Fig. 521.

Pollen. Ornamentation not studied.

Chromosome number. Unknown.

Phenology. Collected in flower from January to December.

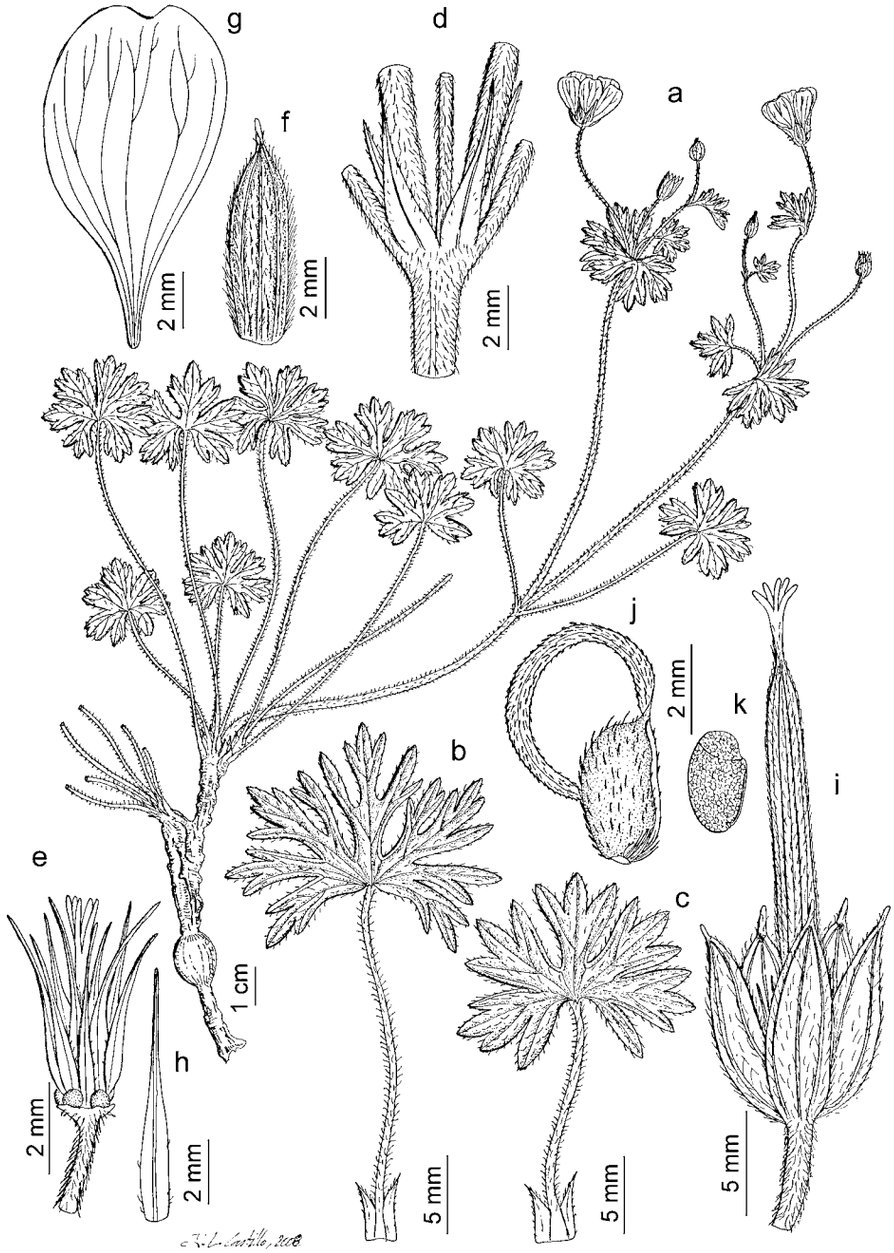


Fig. 521. *Geranium ayacuchense*. a. Habit. b, c. Leaves, adaxial side. d. Stipules. e. Flower, sepals and petals removed. f. Sepal. g. Petal. h. Staminal filament. i. Fruit. j. Mericarp. k. Seed. (Based on: a, d-f, h, *Vargas 155*, F; b, *Herrera 1027*, MO; c, *Stork & Horton 10777*, F; g, *Ellenberg 7105*, NY; i-k, *Dueñas 231*, MO).

Distribution. This species ranges through northern and central Peru (Fig. 522).

Habitat. Slopes, along roadsides, among herbs in shady, damp places and rocky hillsides; 2850-3800 m.

Additional specimens examined. **Peru.** Apurimac: Occupuro, 9 km via Abancay, 13º3'S, 71º9'W, 12 Mar. 1971, *Ellenberg 4783* (NY); Ampay, Tamburco, al N de Abancay, 13º30'S, 72º52'W, 22 Feb. 1987, *Núñez & Vargas 7216* (MO); Andahuaylas, 4 km S of Chincheros, 13º30'S, 73º42'W, 28 Feb. 1939, *Stork & Horton 10777* (F, K, UC); Abancay, 20 km hacia Cusco, 13º32'S, 72º47'W, 27 Mar. 1977, *Ellenberg 7105* (NY); 16 km E of Abancay on road to Cusco, 13º34'S, 72º49'W, 26 June 1978, *Gentry & al. 23377* (F, G); entre Urahuasi y Abancay, 13º38'S, 72º53'W, 20 Nov. 1947, *Ferreyra 2769* (USM); Abancai, Lambrama, quebrada de Quera, 13º52'S, 72º46'W, 22 July 1940, *Vargas 1963* (GH); Ayacucho: Pampalca, between Huanta and río Apurimac, 12º56'S, 74º15'W, 4 May 1929, *Killip & Smith 22214* (NY); Pampalca, between Huanta and río Apurimac, 12º56'S, 74º15'W, 4 May 1929, *Killip & Smith 23248* (NY, US). Cajamarca: Sais, José Carlos Mariátegui, km 20-40 on Sunchubamba-San Juan road, 7º29'S, 78º24'W, 5 June 1984, *Smith & Sánchez 7539* (MA). Cuzco: Calca, Hacienda Huándar, 13º0'S, 72º10'W, 29 Jan. 1947, *Vargas 6367* (MO); Paucartambo, Hacienda Churú, 13º18'S, 71º35'W, Jan. 1926, *Herrera 1027* (F, US); Calca, quebrada de Ccochacc, 13º18'S, 71º57'W, 9 Feb. 1943, *Vargas 3222* (MO); Yucay, 13º19'S, 72º4'W, 26 Dec. 1937, *Soukup 716* (F); laderas de la Hacienda Paucartica, 13º21'S, 71º55'W, 7 Jan. 1937, *Vargas 155* (F); Pisac, on río Urubamba, hillsides around ruins, 13º25'S, 71º51'W, 23 May 1977, *Solomon 3038* (F, MO, USM); Calca province, Huambutio, San Salvador, 13º29'S, 71º46'W, June 1986, *Dueñas 161* (MO); Calca province, Huambutio, San Salvador, 13º29'S, 71º46'W, June 1986, *Dueñas 231* (MO); Acomayo, Quenco Grande on the road to Acomayo to the right of the Apurimac river, 13º55'S, 71º40'W, 8 Jan. 1939, *Vargas 9747* (K, UC). Huancavelica: Tayacaja, quebrada S od Salcabamba, 12º12'S, 74º47'W, 8 Jan. 1939, *Stork & Horton 10290* (F). Junín: 19 km NE of Tarma on road to San Ramón, 11º19'S, 75º35'W, 17 Dec. 1978, *Dillon & Turner 1333* (F); Huasahuasi, 11º19'S, 75º37'W, Oct., *Ruiz & Pavón s.n.* (MA). La Libertad: mountain slopes above Yamobamba, 7º49'S, 78º6'W, 23 Feb. 1974, *Conrad 2725* (F, MO). Puno: cerca de Ollachea, 13º50'S, 70º30'W, 8 Jan. 2012, *Linares & Galán 2660* (MA).

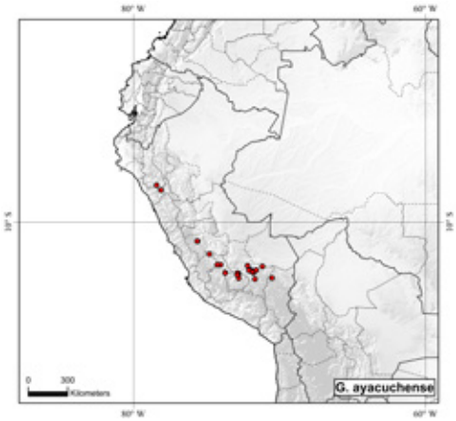


Fig. 522. Distribution of *Geranium ayacuchense*.

Discussion. Geranium ayacuchense is difficult to separate from *G. leucanthum* and from the eglandular forms of *G. rupicola*, because they have many quantitative characters that almost always overlap to some extent. The three species share cymules without pedicels and bracteoles for most part of the inflorescence, although sometimes 1-2 bracteoles can be found at the basal cymules. Specimens with some cymules that have peduncles, pedicels and bracteoles are exceptional in *G. ayacuchense* but more common in *G. leucanthum* and *G. rupicola*. The leaves of *G. ayacuchense* are shorter than in *G. leucanthum* and *G. rupicola*, and the middle segment is obtriangular, a useful distinguishing character that separates it from *G. leucanthum*. Additionally, in *G. ayacuchense* the lobes of the middle segment are fewer than in the other two species, but with some overlap. The inflorescence of *G. ayacuchense* is monochasial; it is dichasial in *G. leucanthum* and dichasial with monochasial branches in *G. rupicola*. The cymules are usually much longer than adjacent leaves in *G. ayacuchense*, unlike in *G. leucanthum*. Sepals of *G. ayacuchense* have a shorter mucro, and the petals are shorter than in *G. rupicola*; the petals are of similar length to those of *G. leucanthum* but with a distinct claw. Staminal filaments, anthers, fruits, and mericarps are shorter in *G. leucanthum* than in *G. ayacuchense* but with some overlap. The fruit rostrum has a narrowed apex in all three species, although it is longer in *G. leucanthum* and *G. rupicola* than in *G. ayacuchense*. The stigmatic remnants of *G. ayacuchense* are similar in length to those of *G. rupicola* and longer than those of *G. leucanthum*. Seeds are glabrous in both *G. ayacuchense* and *G. leucanthum*. The southernmost populations recorded for *G. ayacuchense* in southern Peru are more than 500 km distant from the nearest places where *G. rupicola* occurs, and more than 1000 km distant from the range of *G. leucanthum*. A collection from Cuzco (*Solomon 3038*) has the leaves deeply divided but matches *G. ayacuchense* otherwise. No original material of *G. scissum (Herrera 1916)* was located, but a collection from the type locality, *Herrera 1017* (F!, US!), aided in the interpretation of this name. These specimens have large petals, 1-flowered cymules without pedicels, and an eglandular indumentum, like those found in *G. ayacuchense*.

204. Geranium rupicola Wedd., Chlor. Andina 2: 285. 1861, ["rupicolum"]. *Geranium superbum* R. Knuth, Bot. Jahrb. Syst. 37: 561. 1906. Type locality: "Hab. Bolivie: rochers humides, dans les parties élevées des Cordillères de la province de Cinti ! (Wedd.)". Type: Bolivia. Chuquisaca, Cordillères de la province de Cinti, 20º35'S, 65º00'W, *H.A. Weddell s.n.* (lectotype, designated by Aedo 2012: 309, P-00493020!).

Geranium sepalo-roseum Rusby, Mem. Torrey Bot. Club 3(3): 12. 1893. Type locality: "Capi, March, 1890 (784)". Type: Bolivia. Oruro? Capi, Mar. 1890, *M. Bang 784* (lectotype, designated by Aedo 2012: 309, MO!; isolectotypes, BM-000835622!, E!, F!, GH-00338018!, NY!, US!).

Geranium album R. Knuth, Bot. Jahrb. Syst. 37: 557. 1906. Type locality: "Süd-Bolivia: Tucumilla bei Tarija in einer steilen Schlucht, 3000 m (Fiebrig, Pl. austro-boliv. a. 1903-04 n. 2638! mit weißer Korolle); bei Tarija auf einem steilen, mit Gras be-

wachsenem Hange, 2300 m (Fiebrig, Pl. austro-boliv. a. 1903-04 n. 3292! mit dunkelrosa beränderter Korolle). - Blühend und fruchtend im Dezember-Januar". Type: Bolivia. Tarija. Tucumilla, 21°27'S, 64°54'W, 15 Jan. 1904, *K. Fiebrig 2638* (lectotype, designated by Knuth 1912: 148, B destroyed; lectotype, designated by Aedo 2012: 309: W!; isolectotypes, BM-000603546!, E-00188173!, G!, GH!, GOET-007803!, HBG-518901!, K!, P!, PR-955525!, S!, UPS!, US image!).

Geranium herzogii R. Knuth, Meded. Rijks-Herb. 27: 69. 1915. Type locality: "Auf subalpinen Wiesen des Gipfels über Vallegrande, ca. 2550 m (no. 1865, bl. u. fr. im März 1911.-- Typus!)". Type: Bolivia. Santa Cruz, Vallegrande, 18°30'S, 64°10'W, Mar. 1911, *T. Herzog 1865* (lectotype, designated by Aedo 2012: 310, W!; isolectotype, L-0018343!).

Geranium chaparense R. Knuth, Repert. Spec. Nov. Regni Veg. 28: 4. 1930. Type locality: "Bolivia: Dept. Cochabamba, Prov. Chaparé, Colomi, auf Grashalden (Steinbach, herb. boliv. a. 1929 n. 8832 -- typus in herb. Berol.!) -- Blühend Januar". Type: Bolivia. Cochabamba, Chaparé, Colomi, 17°20'S, 65°52'W, 18 Jan. 1929, *J. Steinbach 8832* (holotype, B destroyed; lectotype, designated by Aedo 2012: 310, BM-000835598!; isolectotype, K!).

Geranium cuchillense R. Knuth, Repert. Spec. Nov. Regni Veg. 34: 144. 1933. Type locality: "Bolivia: Alto de Cuchilla, auf Matten, 2600 m (Troll a. 1927 n. 881 -- Typus in herb. Berol.!). -- Blühend und fruchtend Dezember". Type: Bolivia. Chuquisaca. Sucre, Tomina, Alto de Cuchilla, 19°10'S, 64°29'W, 1927, *C. Troll 881* (holotype, B destroyed; no original material located).

Geranium amoenum R. Knuth, Repert. Spec. Nov. Regni Veg. 40: 217. 1936. Type locality: "Bolivia: Zwischen Sailapata und Ayopaya, 2800 m, in grasiger Formation (Cárdenas a. 1935 n. 3102 - Typus in U. St. Nat. Herb. n. 1619318!)". Type: Bolivia. Cochabamba, Zwischen Sailapata und Ayopaya, 16°30'S, 66°35'W, Apr. 1935, *M. Cárdenas 3102* (holotype, US-1619318!).

Perennial herbs, 14-73 cm tall. *Rootstock* 3.5-10(21.5) mm in diameter, ± vertical, not tuberculate, turnip-shaped, without thickened roots. *Stem* erect, leafy, not rooting at nodes, stolons absent, without vegetative stems, with retrorse to patent, eglandular hairs 0.2-1.7 mm long and, sometimes, patent, glandular hairs 0.4-0.8 mm long. *Basal leaves* in a ± persistent rosette, cauline leaves opposite; leaf laminas (1.5)3-4.2(8) cm long, 2-8.2 cm wide, not peltate, palmatifid [ratio main-sinus length/middle segment length = 0.65-0.86(0.91)], polygonal in outline, base cordate, not coriaceous, with nerves not projected, pilose, with appressed, eglandular hairs on both surfaces; segments 5, in 1 plane, middle segment rhombic, 2.5-13.1 mm wide at the base [ratio segment width at the base/middle segment length = 0.08-0.41], (3)5-9(14)-lobed at the apex [ratio secondary sinus length/middle segment length = 0.16-0.41]; petioles up to 31 cm long, without abscission zone, terete, not swollen, not deflexed in age, with retrorse to patent, eglandular hairs 0.2-1.4 mm long and, sometimes, patent, glandular hairs 0.3-0.6 mm long; stipules 1.9-11 mm long, 0.5-3 mm wide, lanceolate, free, papery, brownish red, with eglandular hairs on both surfaces and on the margin. *Inflorescence* a dichasial cyme with monochasial branches; cymules 1-flowered, solitary [ratio cymule length/leaf length = 1-3]; peduncles 20-170 mm long, with retrorse to patent, eglandular hairs 0.2-1.3 mm long and, sometimes, patent, glandular hairs 0.2-1 mm long; bracteoles 3.2-9.1 mm long, 0.5-1.4 mm wide, linear-lanceolate, opposite; pedicels absent or 5.7-90 mm long, with retrorse to patent, eglandular hairs 0.2-1.5 mm long and, sometimes, patent, glandular hairs 0.2-1 mm long. Flowers actinomorphic. *Sepals* (5.6)7.7-9.9(12.3) mm long, 2.4-5.2 mm wide, lanceolate, smooth, not accrescent, nerves 3(5), mucro (0.6)1.1-2.8 mm long [ratio mucro length/sepal length = 0.08-0.26], with erect-patent, eglandular hairs 0.2-1.4 mm long and, sometimes, glandular hairs 0.2-1.1 mm long on the abaxial surface, ± glabrous adaxially. *Petals* (10.7)13.2-16.9(19.2) mm long, 4.2-14.4 mm wide, erect-patent, rounded or slightly emarginate (notch 0.3-0.9 mm deep), without claw, white, pink or dark purple, hairy on the base of the adaxial surface, ciliate on the basal margin, with hairs 0.2-1.1 mm long. *Stamens* 10, both whorls bearing anthers; filaments 4-7.8 mm long, lanceolate, yellow, with eglandular hairs 0.2-0.8 mm long on the abaxial surface and margin; anthers 1.1-2.3 mm long, yellow. Nectaries 5, hemispheric, with a tuft of hairs at the top, dorsally glabrous. *Gynoecium* 4.3-9.2 mm long, red. *Fruit* (14.2)21-34.6 mm long, erect, discharge of seed-ejection type; mericarps 2.7-5.5 mm long, 1.7-2.6 mm wide, without a strand of fibers, not compressed at the apex, smooth, without basal beak, with a basal callus, without a basal prong, brown, with erect-patent, eglandular hairs 0.3-1.2 mm long and, rarely, patent, glandular hairs 0.4-0.8 mm long; rostrum 8.5-24.8 mm long, with a narrowed apex (0.8)1.1-1.9(2.7) mm long, not twisted, with patent, eglandular hairs 0.2-1.1 mm long and, rarely, patent, glandular hairs 0.6-1 mm long; stigmatic remnants 1.8-4.7 mm long, with 5 glabrous lobes. *Seeds* 1.9-3.1 mm long, 1.2-2.3 mm wide, finely reticulate, slightly mottled, brown, hairy. Cotyledons with entire margin. Fig. 523.

Pollen. *Geranium*-type (Bortenschlager 1967: 429).

Chromosome number. Unknown.

Phenology. Collected in flower from October to March.

Distribution. This species ranges from central Bolivia to northwestern Argentina (Fig. 524).

Habitat. Wet crevices in shade places, grassy slopes, stony hillsides, slopes with ball cacti and shrubs and at edge of forests; 1750-4000 m.

Additional specimens examined. **Argentina.** Catamarca: Andalgalá, Río Vallecito, 27°17'S, 66°4'W, 3 Mar. 1942, *Rohmeder s.n.* (LIL); Andalgalá, estacion Yunka Suma, 27°18'S, 66°4'W, 21 Jan. 1949, *Hjerting & Petersen s.n.* (C). Jujuy: dep. Valle Grande, subida a Cerro Amarillo, 23°33'S, 64°52'W, 2 Jan. 1978, *Kiesling & al. 1589* (SI). Salta: departamento Santa Victoria, Cuesta de Mesón, 22°13'S, 64°49'W, 12 Feb. 1953, *Sleumer 3990* (LIL). Tucumán: Tafí Viejo, Cabrahorno, 26°37'S, 65°31'W, 12 Nov. 1944, *Olea 19* (GH, NY); Tafí Viejo, Sala Ch-

aquivil, 26°38'S, 65°35'W, 8 Jan. 1945, *Olea 195* (LIL, NY); Tafí Viejo, San José, 26°38'S, 65°35'W, 26 Jan. 1933, *Parodi 10687* (GH); Tafí Viejo, Cerro de Siambón, 26°42'S, 65°27'W, Nov. 1888 (PH); cumbre de Anfama, 26°45'S, 65°33'W, 28 Mar. 1922, *Schreiter s.n.* (LIL); Tafí Viejo, La Aguadita, la Ciénaga, 26°46'S, 65°39'W, Jan. 1943, *Borsini s.n.* (NY). **Bolivia.** Chuquisaca: Oropeza, on hilltop E of río Mam Wasi, 3 km NW of Punilla, 18°56'S, 65°23'W, 26 Dec. 1998, *Wood 14284* (LPB); Cerro Obispo, E facing gully below the summit, 19°8'S, 65°20'W, 30 Dec. 1993, *Wood 7796* (MA); 25 km E of Padilla, 19°26'S, 64°10'W, 8 Jan. 1938, *Carriker s.n.* (PH); provincia Hernando Siles, primera sección Monteagudo, cantón Fernández, comunidad Vallecito, Cerro Paja Blanca, 20°11'S, 64°18'W, 11 Oct. 2007, *Apaza & al. 49* (MA, MO). Cochabamba: Choro, above the Cocapata river, about 100 mi NW of Cochabamba, across the Tunari range, 16°55'S, 66°42'W, 21 Jan. 1950, *Brooke 6029* (BM, F, NY, U); Colomi, 17°0'S, 65°30'W, 9 Jan. 1949, *Brooke 5087* (BM); Ayopaya, 17°7'S, 66°52'W, 29 Mar. 1991, *Hensen 2116* (LPB); Liriuni, 17°18'S, 66°19'W, 27 Dec. 1961, (US); Tunari, 17°18'S, 66°22'W, Mar. 1953, *Cárdenas 5457* (US); about 20 km NW of Cochabamba, near Liriuni, 17°18'S, 66°19'W, 5 Feb. 1943, *Cutler 7695* (F, MO); Cercado, Pajcha, 17°18'S, 66°8'W, 7 Mar. 2004, *Gutiérrez & al. 648* (MA, MO); prov. Quillacollo, camino a Morochata, 17°19'S, 66°26'W, 29 Jan. 1995, *Fernández & Saravia 201* (LPB); Cercado, Cuenca Pintumayu, a 20 km desde la puerta del Parque Nacional Tunari, 17°19'S, 66°9'W, 18 Jan. 2006, *Vargas & al. 330* (MA, MO); prov. Quillacollo, Cuenca Taquiña, 17°20'S, 66°11'W, 27 Mar. 1993, *Alemán 2602* (BOLV); Colomi, 17°20'S, 65°52'W, Jan. 1949, *Cárdenas 4235* (GH); prov. Quillacollo, Palca pampa, 17°20'S, 66°30'W, 21 Apr. 1991, *Hensen 2171* (BOLV, LPB); prov. Quillacollo, valley above Taquiña Brewery, 2.5 km above the brewery, 17°20'S, 66°11'W, 7 Apr. 1994, *Ritter 756* (LPB); Quillacollo, sobre Laphia, Tiquipaya, 17°20'S, 66°26'W, 21 Jan. 1990, *Saravia & Guillén 356N* (BOLV); prov. Chapare, Melgar 2 km hacia Punata, 17°24'S, 65°48'W, 14 Jan. 1995, *Beck & al. 21715* (MA); prov. Quillacollo, camino Sipe-Sipe a Kami, cuanca del vale de Cochabamba, 17°27'S, 66°21'W, 23 Apr. 1989, *Beck & al. 18056* (LPB); prov. Tapacarí, comunidad Rodeo, 17°31'S, 66°36'W, 26 Feb. 1991, *Hensen 1133* (BOLV, LPB); Carrasco, 5 km E del puente sobre el río López Mendoza, camino Cochabamba a Santa Cruz, 19 km W Epizana, 17°32'S, 65°22'W, 11 Feb. 1987, *Solomon & Nee 16039* (LPB, MO); prov. Punata, camino Melga-Punata, abajo del

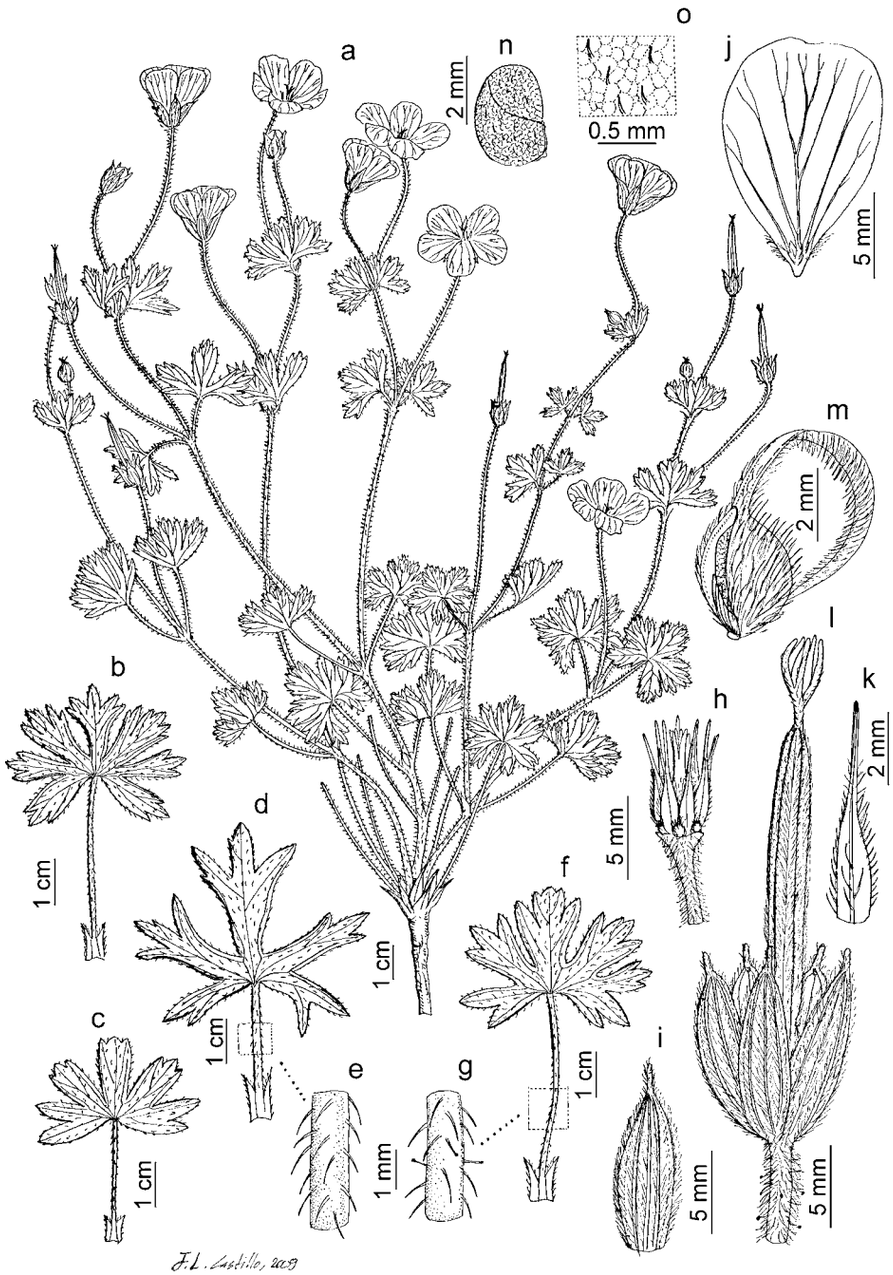


Fig. 523. *Geranium rupicola*. a. Habit. b-d, f. Leaves, adaxial side. e, g. Details showing petiole indumentum. h. Flower, sepals and petals removed. i. Sepal. j. Petal. k. Staminal filament. l. Fruit. m. Mericarp. n. Seed. o. Detail showing seed indumentum. (Based on: a, i-o, *Hawkes & al. 6515*, C; b, *Weddell 3942*, P; c, *Cárdenas 3102*, US; d, e, *Steinbach 8832*, BM; f-h, *Herzog 1865*, W).

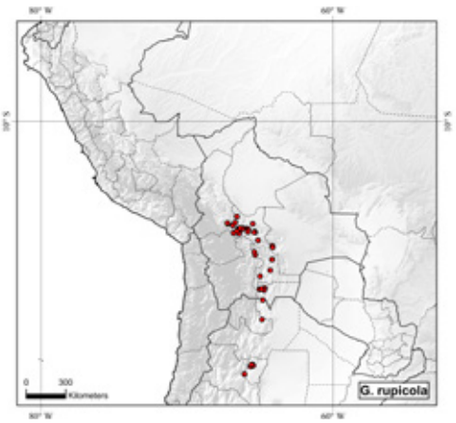


Fig. 524. Distribution of *Geranium rupicola*.

Cerro Toti, 17°33'S, 65°50'W, 10 Mar. 1991, *Hensen 1513* (LPB); prov. Quillacollo, localidad de Pucapuca, 17°35'S, 65°24'W, 16 Mar. 1990, *Alemán 318* (LPB); prov. Mizque, Khuchu, a 20 km al E de Vacas, 17°35'S, 65°20'W, 23 Mar. 1991, *Hensen 1929* (MA); 3-4 km S of Totoro, 17°38'S, 66°49'W, 16 Dec. 1994, *Wood 8967* (LPB); prov. Arque, camino a Oruro, km 77, Sihuaylla, 17°41'S, 66°26'W, 5 Jan. 1992, *Ibisch 810A* (LPB); prov. Cercado, slope above río Hura Hura, ca. 1.3 km beyond the junction with Quebrada Kulhu, 18°8'S, 65°8'W, 17 Mar. 1994, *Ritter 640* (LPB). La Paz: prov. Inquisivi, along trail between Cerro Cruz Pata & the mouth of the río Serenani, along the río Chichipata, 16°57'S, 67°14'W, 13 Dec. 1988, *Lewis 882043* (LPB, MA); prov. Inquisivi, 1 km upriver from Mina Chambillaya and ca. 3 km from Quime, 17°0'S, 67°13'W, 19 Nov. 1987, *Lewis 871050* (LPB, MA). Santa Cruz: prov. Valle Grande, 22 km from Valle Grande on road to Pucará, 18°37'S, 64°8'W, 1 Mar. 1980, *Hawkes & al. 6515* (C, LPB). Tarija: prov. Mendez, cerca de Choroma, 21°24'S, 64°41'W, 14 Mar. 1986, *Bastión 1111* (LPB, MA); prov. Cercado, cerca de Tucumilla, 21°28'S, 64°54'W, 25 Feb. 1986, *Bastión 848* (LPB); prov. Méndez, Sama, 21°29'S, 65°2'W, 15 Feb. 1986, *Ehrich 109* (MA); prov. Méndez, Cuesta de Sama, 21°29'S, 65°2'W, 10 Feb. 1983, *Gerold & al. 185* (MA, U); Tarija, 21°32'S, 64°44'W, 23 Jan. 1904, *Fiebrig 2644* (BM, E, G, GH, GOET, P, PR, U).

Discussion. Geranium rupicola is a species well characterized by its large petals, 1-flowered cymules, and hairy seeds, the last a unique condition in the entire genus. Petal color varies from white to deep purple. Some specimens from central and southern Bolivia have remarkably dark purple petals even in old herbarium material. The cymules at the apex of the inflorescence are always ebracteolate and lack a pedicel. Towards the base of inflorescence some cymules with a peduncle, bracteoles and pedicels can usually be found, but in some poorly prepared herbarium specimens these cymules are difficult to discern. Density of indumentum is variable. Young specimens usually have a dense indumentum, which mostly disappears in mature plants. Some specimens are eglandular, whereas others are densely covered with glandular hairs from the stem base to the sepals. Between these extremes are many transitional forms with a variable glandular indumentum. Variations in petal color, cymule structure, leaf shape, and indumentum are not correlated, and many different combinations can be found.

Knuth (1912: 149) characterized *G. rupicola* by its patent hairs and 1-flowered cymules and considered it very similar to *G. superbum*. Knuth (1912: 140) also stated that *G. superbum* may have 1-flowered cymules. These notes suggest that *G. superbum* was described from heterogeneous material. Two syntypes are listed in the protologue: "Bolivia: auf Felsen der höchsten Stellen der Provinz Cinti (Weddel).—Peru: an der Lima-Oroya-Bahn zwischen Puente di Arichi und Chicla auf einer kleinen Wiese am Ufer eines Baches bei 3450-3700 m (Weberbauer n. 259!)". The *Weberbauer 259* specimen is lost, and a duplicate at P of the Weddell collection was chosen as lectotype. Thus, *G. superbum* is a superfluous name for *G. rupicola*. *Geranium sepalo-roseum* was described from a collection obtained at "Capi", Bolivia; I found a small locality with this name in western Oruro (18°47'S, 68°11'W). Yet, it is doubtful that the type was collected in this area, since it is a region of dry puna, a habitat where this species has never been found. Most likely, the type collection was mislabeled. Knuth (1933) designated as holotype of *G. cuchillense* a sheet at B (Bolivia: Chuquisaca, Sucre, Tomina, Alto de Cuchilla, 1927, *Troll 881*). This specimen was destroyed, and no duplicate has been found. Yet, Knuth's original description (1933) fits well with *G. rupicola,* and the type locality falls within the range of *G. rupicola*. Therefore, *G. cuchillense* is here considered a synonym of *G. rupicola*.

205. Geranium soratae R. Knuth in Engl., Pflanzenr. IV.129 (Heft 53): 212. 1912. Type locality: "Bolivia: Sorata, 3300 m. (Rusby, Fl. South-America a. 1886 n. 763 -- Typus in Herb. Berol.!).-- Blühend Februar". Type: Bolivia. La Paz, Sorata,15°46'S, 68°38'W, Feb. 1886, *H.H. Rusby 763* (holotype, B destroyed; lectotype, designated by Aedo 2012: 313: G-00439772!; isolectotypes, BM-000603557!, E!, F-0093176F!, GH-00055016!, K-000190058!, LE!, NY-01364991!, P-00758022!, US-00100942 image!).

Perennial herbs, 18-59 cm tall. *Rootstock* 4.6-19.9 mm in diameter, ± vertical, not tuberculate, turnip-shaped, without thickened roots. *Stem* erect, leafy, not rooting at nodes, stolons absent, without vegetative stems, with retrorse, appressed, eglandular hairs 0.2-0.5 mm long. *Basal leaves* in a deciduous rosette, cauline leaves opposite; leaf laminas 1.9-3.3 cm long, 2-4.3 cm wide, not peltate, palmatifid [ratio main-sinus length/middle segment length = 0.77-0.85], polygonal in outline, base cordate, not coriaceous, with nerves not projected, pilose, with appressed, eglandular hairs on both surfaces; segments 5, in 1 plane, middle segment rhombic, 2.2-5.7 mm wide at the base [ratio segment width at the base/middle segment length = 0.13-0.21], 6-9-lobed at the apex [ratio secondary sinus length/ middle segment length = 0.23-0.40]; petioles up to 7.3 cm long, without abscission zone, terete, not swollen, not deflexed in age, with retrorse, appressed, eglandular hairs 0.2-0.5 mm long; stipules 2.7-9.5 mm long, 1.2-2.5 mm wide, lanceolate, free, papery, brownish red, with eglandular hairs on abaxial surface and on the margin, glabrous adaxially. *Inflorescence* a monochasial cyme; cymules 1-flowered, solitary [ratio cymule length/leaf length = (0.7)1-1.5(2.3)]; peduncles 15-25(70) mm long, with retrorse, appressed, eglandular hairs 0.2-0.6 mm long; bracteoles absent. Flowers actinomorphic. *Sepals* 4.2-5.6 mm long, 1.6-2.8 mm wide, lanceolate, smooth, not accrescent, nerves 3, mucro 0.4-0.9 mm long [ratio mucro length/sepal length = 0.09-0.16], with erect-patent, eglandular hairs

0.1-1.1 mm long on the abaxial surface, glabrous adaxially. *Petals* 7.1-9.9(10.2) mm long, 2.4-4 mm wide, erect-patent, rounded, without claw, white, glabrous or hairy on the base of the adaxial surface, ciliate on the basal margin, with hairs 0.1-0.3 mm long. *Stamens* 10, both whorls bearing anthers; filaments 3.5-4.6 mm long, lanceolate, yellow, with eglandular hairs 0.1-0.4 mm long on the abaxial surface and margin; anthers 0.7-1.2 mm long, unknown color. Nectaries 5, hemispheric, glabrous. *Gynoecium* 4-4.6 mm long, unknown color. *Fruit* 13.1-14.8 mm long, erect, discharge of seed-ejection type; mericarps 2.3-2.8 mm long, 1-1.3 mm wide, without a strand of fibers, not compressed at the apex, smooth, without basal beak, with a basal callus, without a basal prong, brown, with erect-patent, eglandular hairs 0.2-0.4 mm long; rostrum 8.8-11.2 mm long, without a narrowed apex, sometimes with a narrowed apex ca. 0.7 mm long, not twisted, with erect-patent, eglandular hairs 0.1-0.4 mm long; stigmatic remnants 0.8-1.3 mm long, with 5 glabrous lobes. *Seeds* 1.7-1.8 mm long, 1.1-1.2 mm wide, finely reticulate, uniformly colored, brown, glabrous. Cotyledons not studied. Fig. 525.

Pollen. Ornamentation not studied.

Chromosome number. Unknown.

Phenology. Collected in flower from December to February.

Distribution. This species is endemic to western Bolivia (Fig. 526).

Habitat. Rocky and shrublands, and edge of *Polylepis* Ruiz & Pav. forests; 2650-3650 m.

Additional specimens examined. **Bolivia.** La Paz: Larejaca, Sorata, 55 kms hacia Consata, sobre camino de altura, 15º26'S, 68º36'W, 16 Dec. 1981, *Beck 4981* (MA, U); Larejaca, Sorata, Cerro del Inimapi, 15º43'S, 68º38'W, Feb. 1859, *Mandon 778* (BM, G, NY, P, W); Sorata, 15º46'S, 68º38'W, Feb., *Rusby 760* (MO); Sorata, 15º46'S, 68º38'W, Feb., *Rusby 760* (W); Sorata, 15º46'S, 68º38'W, 1886, *Rusby 761* (NY).

Discussion. Geranium soratae, an endemic of northern Bolivia known from only few localities, is well char-

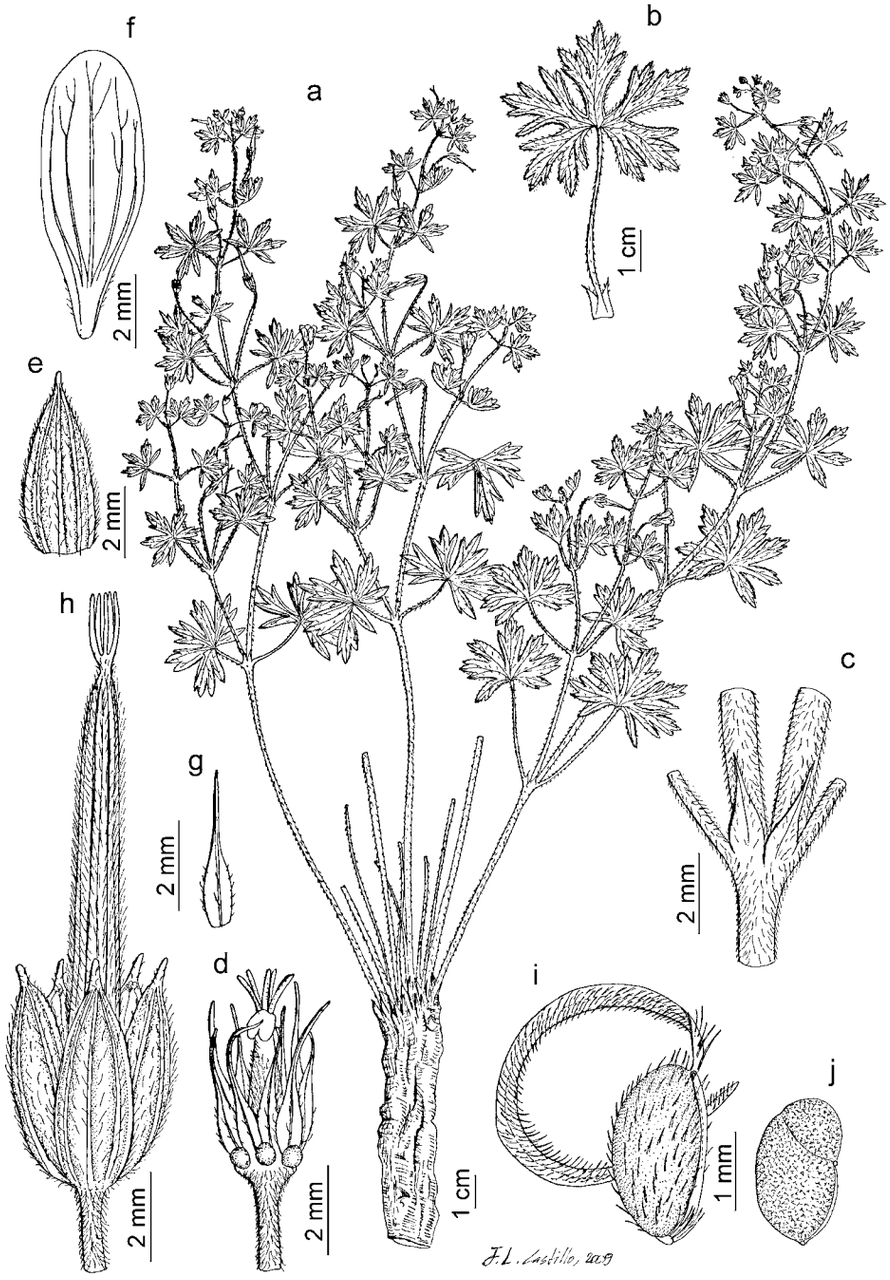


Fig. 525. *Geranium soratae*. a. Habit. b. Leaf, adaxial side. c. Stipules. d. Flower, sepals and petals removed. e. Sepal. f. Petal. g. Staminal filament. h. Fruit. i. Mericarp. j. Seed. (Based on: a, c-g, *Mandon 778*, P; b, *Rusby 763*, F; h-j, *Rusby 760*, MO).

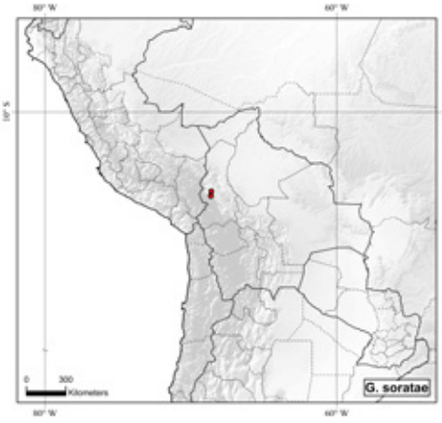


Fig. 526. Distribution of *Geranium soratae*.

acterized by its 1-flowered cymules without a pedicel and bracteoles, and by its short, narrow petals. Its indumentum is eglandular and, in young specimens, is usually dense and whitish. The leaves are deeply divided and have a rhombic middle segment, and the fruit rostrum usually ends abruptly (without a narrowed apex). The type collection of *G. soratae*, *Rusby 763*, is a mixed gathering; the sheet at MO is *G. diffusum*. Among the duplicates of *Rusby 760* are two sheets, at MO and W, that are *G. soratae*; the other specimens, at BM, F, GH, K, P, and US, constitute the type collection of *G. bolivianum*, a synonym of *G. fallax*.

206. Geranium leucanthum Griseb., Abh. Königl. Ges. Wiss. Göttingen 19: 103. 1874. Type locality: "Tucuman, in pascuis alpinis pr. Cienega". Type: Argentina. Tucumán, Ciénaga, 26º13'S, 65º34'W, 25 Mar. 1872, *P.G. Lorentz 763* (lectotype, designated by Knuth 1912: 147, B destroyed; lectotype, designated by Aedo 2012: 315, GOET-006298 image!; isolectotype, CORD-00005896!).

Geranium delphinifolium R. Knuth, Repert. Spec. Nov. Regni Veg. 45: 60. 1938, nom. illeg., non Poir. 1812. *Geranium tafiense* Aedo & Muñoz Garm., Kew Bull. 52(3): 726. 1997. Type locality: "Argentinien: Prov. Tucuman, Dept. Tafi, Cerro de San José, auf Wiesen, 2700 m (Venturi a. 1925 n. 3645 sub G. lanceolatum Griseb. -- Typus in U. St. Nat. Herb. n. 1549722!).-- Blühend Februar". Type: Argentina. Tucuman, Tafí, Cerro de San José, 26°38'S, 65°35'W, 10 Feb. 1925, *S. Venturi 3645* (holotype, US-1549722!; isotypes, GH image!, LIL!, MA!, SI-001752 image!).

Perennial herbs, 12-68 cm tall. *Rootstock* 3.6-16.4 mm in diameter, ± vertical, not tuberculate, turnip-shaped, without thickened roots. *Stem* erect, leafy, not rooting at nodes, stolons absent, without vegetative stems, with retrorse to patent, appressed, eglandular hairs 0.3-1.1 mm long. *Basal leaves* in a ± persistent rosette, cauline leaves opposite; leaf laminas (2.3)3.7-5.6(8.5) cm long, 2.8-10.4 cm wide, not peltate, palmatifid [ratio main-sinus length/middle segment length = 0.70-0.84(0.91)], polygonal in outline, base cordate, not coriaceous, with nerves not projected, pilose, with appressed, eglandular hairs on both surfaces; segments 5, in 1 plane, middle segment rhombic, 3-9.9 mm wide at the base [ratio segment width at the base/middle segment length = 0.12-0.34], (4)6-9(13)-lobed at the apex [ratio secondary sinus length/middle segment length = 0.18-0.42]; petioles up to 33 cm long, without abscission zone, terete, not swollen, not deflexed in age, with retrorse to patent, eglandular hairs 0.2-1 mm long; stipules 3.6-10.9 mm long, 0.8-2.9 mm wide, lanceolate, free, papery, brownish red, with eglandular hairs on both surfaces and on the margin. *Inflorescence* a dichasial cyme; cymules 1-flowered, solitary [ratio cymule length/leaf length = (0.8)1.2-1.8]; peduncles 6.8-57(136) mm long, with retrorse to patent, eglandular hairs 0.2-0.6 mm long; bracteoles 3.7-9.1 mm long, 0.5-1.3 mm wide, linear-lanceolate, opposite; pedicels absent or 9-26(75) mm long, with retrorse to patent, eglandular hairs 0.2-0.6 mm long. Flowers actinomorphic. *Sepals* (5.9)6.7-8.6(10.1) mm long, 1.3-3.8 mm wide, lanceolate, smooth, not accrescent, nerves 3, mucro (0.5)0.9-2.1 mm long [ratio mucro length/sepal length = 0.08-0.26], with erect-patent, eglandular hairs 0.3-1.2 mm long on the abaxial surface, ± glabrous adaxially. *Petals* (10.4)11.9-14.1(15.3) mm long, 4.1-8.8 mm wide, erect-patent, rounded or slightly emarginate (notch 0.3-1.3 mm deep), without claw, white or pale pink, hairy on the base of the adaxial surface, ciliate on the basal margin, with hairs 0.2-0.4 mm long. *Stamens* 10, both whorls bearing anthers; filaments 4-6.7 mm long, lanceolate, white to yellow, with eglandular hairs 0.2-0.7 mm long on the abaxial surface and margin; anthers 0.8-1.5 mm long, yellow. Nectaries 5, hemispheric, dorsally hairy. *Gynoecium* 4.6-7.2 mm long, white. *Fruit* (16.2)21-25.8 mm long, erect, discharge of seed-ejection type; mericarps 2.9-4.1 mm long, 1.4-2.3 mm wide, without a strand of fibers, not compressed at the apex, smooth, without basal beak, with a basal callus, without a basal prong, brown, with erect-patent, eglandular hairs 0.3-0.8 mm long; rostrum 9.5-17.9 mm long, with a narrowed apex (0.8)1.1-1.7(2.6) mm long, not twisted, with patent, eglandular hairs 0.3-1 mm long; stigmatic remnants 1.5-2.9 mm long, with 5 glabrous lobes. *Seeds* 2.2-3 mm long, 1.2-1.9 mm wide, finely reticulate, uniformly colored, brown, glabrous. Cotyledons with entire margin. Figs. 527, 528.

Pollen. Ornamentation not studied.

Chromosome number. Unknown.

Phenology. Collected in flower from November to March.

Distribution. This species ranges through northwestern Argentina (Fig. 529).

Habitat. Rocky and grassy areas, and meadows; 2200-4000 m.

Additional specimens examined. **Argentina.** Catamarca: Andalgalá, Los Quenoales, arriba de la Mesa de las Rosas, 27º35'S, 66º28'W, 15 Jan. 1952, *Sleumer 2230* (US). Jujuy: dep. Valle Grande, Serranía de Calilegua, Cerro Hermoso, 23º34'S, 64º53'W, 19 Feb. 1964, *Fabris & al. 5545* (SI); dep. Tumbaya, Volcán, Chilcayo, 23º54'S, 65º27'W, 6 Mar. 1965, *Cabrera & al. 16932* (SI); dep. Tumbaya, Volcán, Chilcayo, camino Abra Morada, 23º54'S, 65º27'W, 26 Feb. 1985, *Kiesling & al. 5794* (P, SI). Salta: dep. Santa Victoria, arroyo Peña Negra, ruta 5, 15 km al W de Santa Victoria, 22º11'S, 65º5'W, 14 Dec. 1988, *Novara 8293* (G, S); dep. Santa Victoria, entre Rodeo Pampa y Abra de Campanario, 22º34'S, 65º10'W, 11 Nov. 1991, *Charpin & Novara 23182* (G); dep. Cachi, Cuesta del Obispo, 25º10'S, 65º51'W, 21 Jan. 1947, *Romero s.n.* (NY). Tucumán: Tucumán, *Victor 3216* (MA); Trancas, pr. Hualinchay, camino hacia Tolombón, 26º20'S, 65º39'W, 16 Feb. 2008, *Aedo 15366* (MA); Tafí, cumbres Calchaquíes, la Queñoa, 26º27'S, 65º43'W, 17 Mar. 1974, *Zardini 298* (LP); Tafí Viejo, Peñas Azules a Campo de la Flora (San José), 26º38'S, 65º35'W, Dec. 1934, *Schreiter 7014* (F); Tafí Viejo, La Hoyada, 26º41'S, 65º31'W, 21 Mar. 1944, *Lourteig 573* (GH); Tafí del Valle, pr. El Infiernillo, 26º43'S, 65º47'W, 12 Feb. 2008, *Aedo 15302* (MA); Tafí del Valle, pr. El Infiernillo, 26º44'S, 65º43'W, 12 Feb. 2008, *Aedo*

15306 (MA); valle de Tafí, 26°44'S, 65°47'W, 1908, *Bruch s.n.* (LP, NY); Tafí del Valle, Infiernillo, quebrada del Alazán, 26°44'S, 65°45'W, 26 Mar. 1960, *Cristóbal 513* (UC); Tafí del Valle, Infiernillo, camino de Santa María a Tafí del Valle, 26°44'S, 65°45'W, 13 Feb. 1959, *Diers 81* (SI); Tafí del Valle, Infiernillo, Quebrada Honda, 26°44'S, 65°45'W, 12 Feb. 1952, *Hjerting & al. 9563* (C); Tafí del Valle, cerca de Infiernillo, 26°44'S, 65°47'W, 2 Mar. 1972, *Meyer s.n.* (LIL); Tafí del Valle, 26°44'S, 65°47'W, Jan. 1958, *Olrog s.n.* (S); Tafí del Valle, 26°44'S, 65°47'W, 13 Feb. 1949, *Sparre 5746* (W); Tafí del Valle, km 84 camino a Amaicha, 26°44'S, 65°45'W, Dec. 1969, *Vogel & al. 9559* (LIL); Tafí, Quebrada del Barón, Los Planebones, 26°51'S, 65°40'W, 7 Feb. 1958, *Fabris 1408* (M); Chicligasta, Quebrada del río Las Pavas, between Puesto La Cascada and Las Cuevas, 27°11'S, 65°58'W, 24 Feb. 1986, *Hawkes & al. 3604* (MO, S); Chicligasta, Estancia Las Pavas puente La Cueva, 27°11'S, 65°58'W, 11 Mar. 1924, *Venturi 3034* (LIL); Chicligasta, Estancia Las Pavas, 27°15'S, 65°52'W, 28 Nov. 1926, *Venturi 4619* (BR, CAS, GH).

Discussion. Geranium leucanthum is difficult to separate from the eglandular forms of *G. rupicola*. Both share long petals and 1-flowered cymules that are ebracteolate towards the apex of the inflorescence, although basal ones sometimes have pedicels and bracteoles. The range of *G. leucanthum* partially overlaps that of *G. rupicola*. The species differ in that the seeds of *G. leucanthum* are glabrous, its indumentum is always eglandular, and its petals are white or pale pink, but never dark purple, as in some specimens of *G. rupicola*. In general, the sepals, petals, and anthers are shorter in *G. leucanthum* than in *G. rupicola*. Barboza (1996) distinguished *G. leucanthum* as a species with palmatisect, discolorous leaves, a long calyx, and sometimes glandular vesture from *G. delphinifolium*, characterized as an eglandular and more robust species, with palmatipartite, concolorous leaves and a short calyx, and first collected in the vicinity of Tafí. Study of the many collections available from this region show *G. delphinifolium* to be a robust variant of *G. leucanthum*, and no character or suite of characters consistently supports

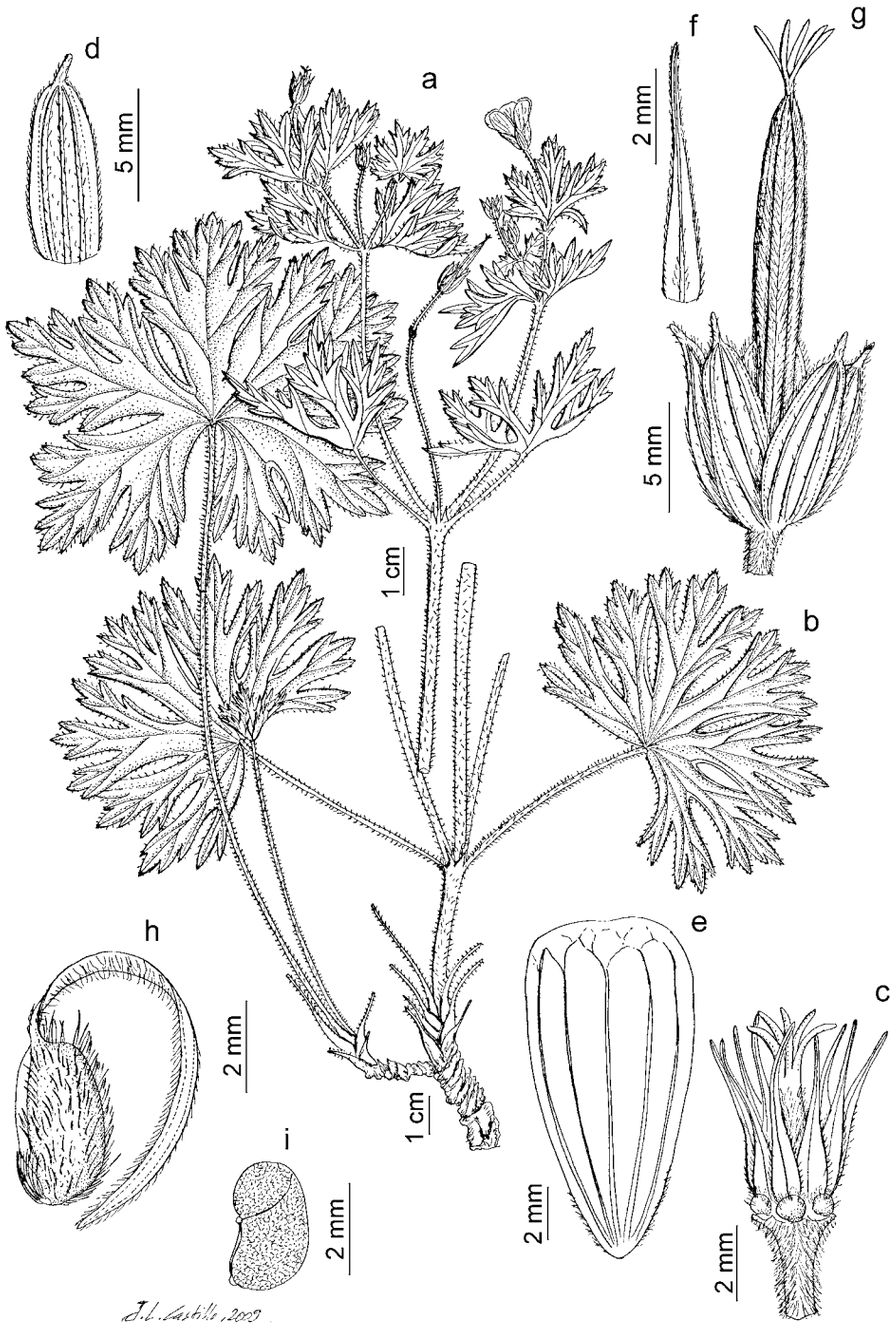


Fig. 527. *Geranium leucanthum*. a, b. Habit. c. Flower, sepals and petals removed. d. Sepal. e. Petal. f. Staminal filament. g. Fruit. h. Mericarp. i. Seed. (Based on: *Aedo 15302*, MA).

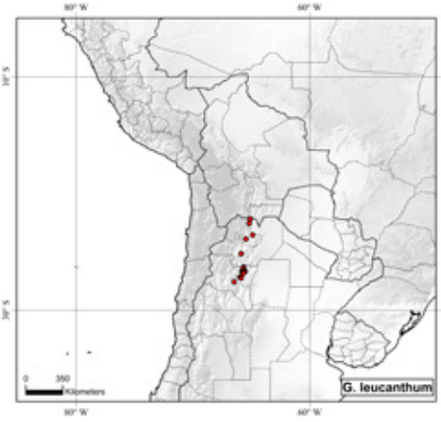


Fig. 529. Distribution of *Geranium leucanthum*.

Fig. 528. *Geranium leucanthum* (Based on: *Aedo 15302,* MA).

recognition of two species. In addition, Barboza's (1996) account of *G. leucanthum* suggests that specimens here identified as *G. rupicola* were included in her assessment.

The Multiceps Group—This group is characterized by its usually erect habit, its opposite leaves and its 2-flowered cymules arranged in a dichasial inflorescence. The first five species constitute a subgroup with thicker leaves (sometimes leathery), stem leaves cuneate to truncate at the base, and petals usually with a short claw.

207. Geranium multiceps Turcz., Bull. Soc. Imp. Naturalistes Moscou 31(2): 417. 1858. Type locality: "In prov. Meridensi Venezuelae prope Muchuchi, alt. 11,000 ped. Funck et Schlim n. 861". Type: Venezuela. Mérida, Páramo de Muchuchíes, 8°51'N, 70°48'W, 1846, *N. Funck & L.J. Schlim 861* (lectotype, designated by Aedo & al. 2003: 110, KW-001000001 image!; isolectotypes, BM-000543793!, G-00365898!, LD-1513012!, LE-00006839!, MPU-018503!, P-00758009!, W!).

Geranium tracyi Sandwith, Bull. Misc. Inform. 1941(3): 219. 1942. Type locality: "Venezuela. Merida: Paramo del Tambor, in open paramo among grasses, herbs and undershrubs, 2820 m., August 23rd, 1938, J. Hanbury-Tracy 50. 'Straggling, often prostrate on ground. Flowers mauve-pink, pink or white', Vernacular name, 'Aroma.'". Type: Venezuela. Mérida, Páramo del Tambor, 8°36'N, 71°24'W, 23 Aug. 1938, *N.J. Hanbury-Tracy 50* (lectotype, designated by Aedo 2012: 326, K-000531424!; isolectotype, US-00100934!).

Perennial herbs, 10-20(60) cm tall. *Rootstock* 3-8.3 mm in diameter, ± vertical, not tuberculate, not turnip-shaped, with ± thickened roots. *Stem* erect or ascending, leafy (rarely scapiform), not rooting at nodes, stolons absent, without vegetative stems, with usually retrorse, appressed, eglandular hairs 0.1-1.3 mm long. *Basal leaves* in a persistent rosette, cauline leaves opposite (cuneate to truncate, with usually 3(5) entire segments); leaf laminas (0.7)1.7-2.2(6.4) cm long, (0.9)2.4-3.1(8.3) cm wide, not peltate, palmatifid [ratio main-sinus length/middle segment length = 0.58-0.84], polygonal in outline, base cuneate to subtruncate, rarely cordate, not coriaceous, nerves ± projected on the abaxial surface, sunken adaxially, usually with short, patent, eglandular hairs restricted to margin, rarely scattered hairs on both surfaces; segments (3)5, curved, middle segment obtriangular, 2-5(16) mm wide at the base [ratio segment width at the base/middle segment length = 0.21-0.36], 3(5)-lobed at the apex [ratio secondary sinus length/middle segment length = 0.06-0.30]; petioles up to 5(30) cm long, without abscission zone, terete, not swollen, not deflexed in age, with retrorse, appressed (sometimes patent), eglandular hairs 0.1-0.8 mm long; stipules 1.9-8 mm long, 0.8-2.6 mm wide, subulate, free, papery, brownish red, subglabrous on abaxial surface, glabrous adaxially. *Inflorescence* a dichasial cyme; cymules 2-flowered, solitary [ratio cymule length/leaf length = 1.2-9.8]; peduncles 10-55 mm long, with usually retrorse, ± appressed, eglandular hairs 0.1-1.1 mm long; bracteoles 1.6-4 mm long, 0.5-2 mm wide, lanceolate, whorled; pedicels 8-30 mm long, with usually retrorse, ± appressed, eglandular hairs 0.1-0.9 mm long. Flowers actinomorphic. *Sepals* 5.1-8 mm long, 1.7-3.5 mm wide, lanceolate, smooth, not accrescent, nerves 3, mucro 0.3-0.7 mm long [ratio mucro length/sepal length = 0.05-0.14], with antrorse, appressed, eglandular hairs 0.2-0.9 mm long at

least on the nerves of abaxial surface and margin, glabrous adaxially. *Petals* 8.6-11(12) mm long, 3.4-5(7.5) mm wide, erect-patent, rounded or slightly emarginate (notch ca. 0.5 mm deep), with claw 1-3.8 mm long, purple, sometimes white with purplish veins, glabrous, rarely with scattered hairs on base of abaxial surface, with hairs 0.1-0.3 mm long. *Stamens* 10, both whorls bearing anthers; filaments 3-5 mm long, lanceolate, yellow, pilose on the abaxial surface, ciliate on the proximal half, with eglandular hairs 0.2-0.4 mm long; anthers 0.8-1.2 mm long, yellow. Nectaries 5, hemispheric, glabrous. *Gynoecium* 3.8-5.5 mm long, red. *Fruit* 13-17 mm long, erect, discharge of seed-ejection type; mericarps 2-3.5 mm long, 1.1-2 mm wide, without a strand of fibers, not compressed at the apex, smooth, without basal beak, with a basal callus, without a basal prong, brown, with abundant antrorse, appressed, eglandular hairs 0.1-0.6 mm long; rostrum 8.3-12 mm long, without a narrowed apex, not twisted, with abundant antrorse, appressed, eglandular hairs 0.1-0.7 mm long; stigmatic remnants 1.5-3 mm long, with 5 subglabrous lobes. *Seeds* 1.5-2 mm long, 0.9-1.2 mm wide, finely reticulate, uniformly colored, brownish red, glabrous. Cotyledons with entire margin. Figs. 530, 531.

Pollen. *Geranium*-type (Aedo & al. 2003: 99; Bortenschlager 1967: 427).

Chromosome number. Unknown.

Phenology. Collected in flower from February to October.

Distribution. This species ranges through western Venezuela (Fig. 532).

Habitat. Banks of pool and streams, bogs, grassy or rocky places, in open slopes dominated by *Espeletia* Mutis ex Bonpl.; 3000-4450 m.

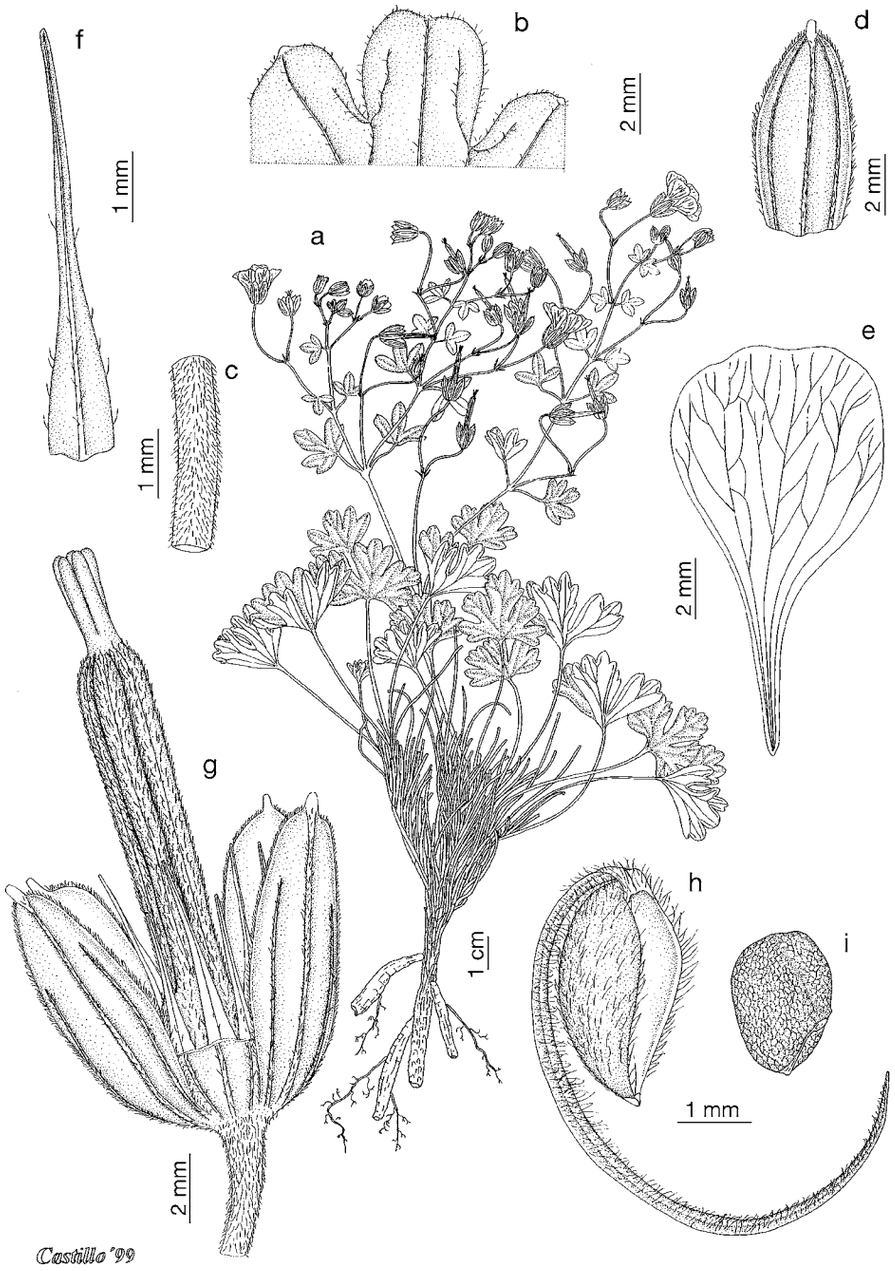


Fig. 530. *Geranium multiceps*. a. Habit. b. Detail of leaf, abaxial side. c. Peduncle. d. Sepal. e. Petal. f. Staminal filament. g. Fruit. h. Mericarp. i. Seed. (Based on: a-b, *Barreto 626*, MER; c-i, *Oberwinkler 12799*, M).

Representative specimens examined. **Venezuela.** Mérida: Mérida, 30 May 1952, *Vareschi 1416* (VEN); Páramo de los Monsalves, El Valle, Mucurí, 10 June 1952, *Vareschi & Pannier 1771* (VEN); trail leading from La Negrita to the Boquerón of the Quebrada de las Cañas, 8°4'N, 71°28'W, 31 Oct. 1978, *Luteyn & al. 6137* (MO, NY); Quebrada de Saisay, 8°11'N, 71°24'W, 10 Apr. 1930, *Gohriger 48* (VEN); Páramo de Don Pedro, camino a Aricagua, 8°18'N, 71°4'W, 18 July 1944, *Badillo 1002* (VEN); La Aguada, 8°24'N, 71°29'W, 22 Apr. 1994, *Schilling 82* (HBG); Pasa del Toro, Sierra Nevada above Mérida, 8°27'N, 71°7'W, Feb., *Chenery s.n.* (BM); Parque Nacional Sierra Nevada, Páramo Media Luna, 8°32'N, 71°4'W, 27 Oct. 1994, *Berg 186* (VEN); Sierra Nevada, de Loma Redonda a laguna de los Anteojos, 8°32'N, 71°5'W, 2 Nov. 1976, *Bernardi & al. 17036* (C, G, MA); departamento Libertador, Loma Redonda, laguna de los Anteojos, 8°32'N, 71°5'W, 25 Sep. 1983, *Fernández 473* (G, PORT); Sierra Nevada above Mérida, 8°33'N, 71°3'W, 3 Feb. 1939, *Alston 6845* (BM); Pico Bolivar, 8°33'N, 71°3'W, 1951, *Croizat 15* (VEN); Páramo de Santo Domingo, massiv des Pico Bolivar, von der Loma Redonda gegen den Pico Espejo, 8°33'N, 71°3'W, 13 Aug. 1967, *Merxmüller 22874* (M); Páramo de los Conejos, 8°40'N,

Fig. 531. *Geranium multiceps* (Based on: a-d, *Grande* & *Aedo 2483*, MA; e, *Grande* & *Aedo 2531,* MA; f, *Grande* & *Aedo 2532,* MA).

71°15'W, 24 June 1953, *Bernardi 690* (NY); Páramo de los Leones al W del Mucurubá, La Lagunita, La Cañada Grande, 8°41'N, 71°4'W, 31 May 1930, *Gehriger 139* (F); Páramo de Mucurubá, 8°43'N, 71°0'W, 21 May 1930, *Gehriger 114* (F, VEN); Libertador, P.N. Sierra de la Culata, 8°45'N, 71°3'W, 26 May 2008, *Fernández & al. 24977* (MA); Sierra de la Culata, Cuesta del Ciego, 8°46'N, 71°4'W, 7 Dec. 2003, *Catalán & al. s.n.* (MA); Páramo Laguna Negra, Mucubají, inter Laguna Grande et Laguna Negra, 8°47'N, 70°48'W, 5 Oct. 1965, *Bernardi 10787* (G, Z); distrito Rangel, cascada SE of laguna de Mucubají and below Pico Mucuñuque, 8°47'N, 70°49'W, 15 June 1988, *Dorr & Barnett 5536* (C, NY, PORT, VEN); highway 7.5 km E of Laguna Victoria, 8°47'N, 70°48'W, 21 Aug. 1972, *Hanselmann & Loveless 277* (MO); Sierra de Santo Domingo, Páramo de Mucubají, weg zur Laguna Negra, 8°47'N, 70°48'W, 27 Sep. 1968, *Oberwinkler 12799* (M); Rangel, alrededores de la laguna del Humo o del Bartolo, al pie del pico Bartolo, N Mucuchíes, 8°47'N, 70°56'W, 13 Oct. 1965, *Ruiz Terán 198* (MO); Laguna Negra, 8°47'N, 70°48'W, 18 May 1952, *Vareschi 979* (VEN); laguna de Mucubají, 8°48'N, 70°50'W, July, *Aristeguieta 2827* (VEN); Sierra de Santo Domingo, Páramo de Mucubají, alrededores de la Laguna Grande, 8°48'N, 70°50'W, 19 Sep. 1959, *Barclay & Juajibioy 9541* (COL, MO); along the río Santo Domingo, in the

Fig. 532. Distribution of *Geranium multiceps*.

valley above Laguna de Mucubají, 8°48'N, 70°50'W, 11 June 1972, *Hanselmann & Loveless 18* (MO); laguna de Mucubají, Páramo de Santo Domingo, 8°48'N, 70°50'W, Oct., *López 1627* (US); laguna de Mucubají, near Apartaderos and San Rafael, 35 km NE Mérida, 8°48'N, 70°50'W, 18 Oct. 1953, *Maguire 39418* (NY); de Santo Domingo, 8°48'N, 70°49'W, 19 Nov. 1939, *Mueller & Barras 1011* (VEN); Sierra Nevada de Santo Domingo, Páramo de Mucubají, cerca de la Laguna Grande, 8°48'N, 70°50'W, 7 Oct. 1965, *Schulz & al. 119* (U); Páramo de Mucuchíes, al SW de El Águila, 8°50'N, 70°50'W, 27 Sep. 1981, *Steyermark & Manara 125382* (US, VEN); distrito de Miranda, entre Chachopo y Pico el Águila, 8°51'N, 70°48'W, 17 Oct. 1972, *Badillo 5137* (F); Páramo de Mucuchíes, 8°51'N, 70°48'W, 29 Oct. 1943, *Badillo 530* (VEN); Sierra Nevada de Santo Domingo, between Apartaderos and Timotes, Páramo de Mucuchies, Pico Águila, 8°51'N, 70°48'W, 21 Nov. 1959, *Barclay & Juajibioy 9681* (MO); Águila pass, 80 km NE of Mérida, 8°51'N, 70°49'W, 8 Oct. 1966, *Bruijin 1146* (MO, VEN); Pico El Águilla, 8°51'N, 70°50'W, 16 Nov. 1980, *Maas & Tillett 5307* (U); Caserío Mifafí, camino quebrada río Chama-caserío Mucupís, Páramo Piedra Blanca, entrada road Apartaderos-Pico Águila, 8°51'N, 70°52'W, 14 Aug. 1980, *Stergios & Taphorn 2123* (MO, PORT); between Cachopo and Los Apartaderos, near El Águila, 8°51'N, 70°48'W, 15 Apr. 1944, *Steyermark 55912* (BH); Páramo de Mucuchíes, cerca la lagunilla, 8°51'N, 70°48'W, 28 Apr. 1951, *Vareschi 3048* (M); distrito Justo Briceño, Páramo de Piedras Blancas, 8°52'N, 70°57'W, 7 Nov. 1977, *Barreto 626* (MER); via Timotes-Mérida, 8°52'N, 70°48'W, 9 Aug. 1948, *Curran 283* (NY); Páramo de Timotes, 8°52'N, 70°48'W, 2 Aug. 2010, *Grande & Aedo 2546* (MA); Páramo de Mucusubicito, 8°54'N, 70°53'W, 18 Apr. 1976, *Echegarreta 93* (CAR); vertiente NW del Alto del Totumo, hoya del río Chirurí, a 19,5 km de El Águila por la carretera a Piñango, 8°56'N, 70°50'W, 16 Apr. 1983, *Berry & Calvo 4081* (VEN); de El Águila a Piñango, 8°56'N, 70°50'W, 3 Aug. 2010, *Grande & Aedo 2570* (MA); Páramo de la Sal, 9°1'N, 70°49'W, 2 Sep. 1921, *Jahn 591* (GH, US,VEN). Trujillo: Bocono, Laguna Larga, vía Laguna Las Parias to Laguna Eco, Páramo de Motumbo, Monumento Natural Teta de Niquitao-Guirigay, 8°58'N, 70°33'W, 15 Sep. 2003, *Stergios 20377* (MA); Páramo de Guirigay, Alto del Arenal, 9°1'N, 70°34'W, 1 Aug. 2010, *Grande & Aedo 2531* (MA); Bocono, Páramo de Guirigay, Monumento Natural Teta de Niquitao-Guirigay, sector Las Veguitas, 9°2'N, 70°35'W, 20 Aug. 2002, *Dorr & al. 9133* (MA); Páramo de Guirigay, Loma La Cava, 9°2'N, 70°30'W, 30 July 2010, *Grande & Aedo 2483* (MA).

Discussion. Geranium multiceps is easy to identify by its membranaceous, cuneate to subtruncate, funnel-shaped leaves, and the erect mature. *Geranium lainzii* is quite similar to *G. multiceps* but with coriaceous, subtruncate, flat leaves, usually with three segments, and reflexed mature fruits. *Geranium multiceps* is endemic to Venezuela; and records from Colombia in the literature should be corrected to *G. lainzii*. The unusual leaf of *G. multiceps* is best seen in living plants. The lamina is vertical and the lateral segments are recurved such that they almost touch one another, giving a funnel-like aspect to the leaf. In herbarium specimens the lateral leaf segments are usually folded over the middle one, and the cuneate shape of the leaf base is accentuated. In *G. multiceps* the leaves usually have very short eglandular hairs on the nerves, spreading patent hairs on the margins, and eglandular hairs restricted to the nerves of the abaxial surface. An unusual collection from Trujillo (*Grande & Aedo 2532*, MA, VEN) has leaves with only three segments and a more rigid posture, quite similar to leaves of *G. lainzii*; however, the fruits are erect (not reflexed, as in *G. lainzii*), and the leaves have curved segments as described above for *G. multiceps*. The variant plants grow in swampy areas, whereas populations with the usual morphology occur on the nearest dry slopes. At contact points intermediates are found, which indicate that the variants do not merit taxonomic recognition.

Sandwith (1942: 220) delimited *G. tracyi* on the basis of habit and a spreading indumentum on stems and inflorescence. Still, Sandwith suggested that *G. multiceps* is a variable species in these characters, and that field investigations would determine the status of *G. tracyi*. Study of the many herbarium specimens of *G. multiceps* showed that the type collection of *G. tracyi* falls within the variation found in *G. multiceps*.

208. Geranium cavanillesii Aedo, **sp. nov.** Type: Colombia? Columbia, paramo de Diacono, *Engels s.n.* (LE!, holotype).

Perennial herbs, 5-9 cm tall. *Rootstock* ca. 22 mm in diameter, ± vertical, not tuberculate, not turnip-shaped, without thickened roots. *Stem* erect, leafy, stolons absent, without vegetative stems, with retrorse, appressed, eglandular hairs 0.1-0.3 mm long. *Basal leaves* in a persistent rosette, cauline leaves opposite; leaf laminas 1.2-1.5 cm long, 0.8-1 cm wide, not peltate, digitate (lateral segments upward) [ratio main-sinus length/middle segment length = 0.46-0.63], obtriangular in outline, base cuneate, not coriaceous, with nerves not projected, usually with short, patent, eglandular hairs restricted to margin, rarely scattered hairs on both surfaces; segments 3, in 1 plane, middle segment obtriangular, 1.6-1.7 mm wide at the base [ratio segment width at the base/middle segment length = 0.10-0.14], 3-lobed at the apex [ratio secondary sinus length/middle segment length = 0.07-0.11]; petioles up to 2.4 cm long, without abscission zone, terete, not swollen, not deflexed in age, with retrorse, appressed, eglandular hairs 0.1-0.3 mm long; stipules 11-13 mm long, 1.2-1.8 mm wide, subulate, free, papery, brownish red, subglabrous on abaxial surface, glabrous adaxially. *Inflorescence* a dichasial cyme; cymules 2-flowered, solitary [ratio cymule length/leaf length = 2.5-4.3]; peduncles 27-32 mm long, with retrorse, appressed, eglandular hairs 0.1-0.2 mm long; bracteoles 1.1-3.1 mm long, 0.6-0.7 mm wide, lanceolate, whorled; pedicels 14-21 mm long, with retrorse, appressed, hairs eglandular 0.1-0.2 mm long. *Sepals* 6.4-6.7 mm long, 1.7-2.1 mm wide, lanceolate, smooth, not accrescent, nerves 3, mucro 0.5-0.6 mm long [ratio mucro length/sepal length = 0.08-0.10], with antrorse, appressed, eglandular hairs 0.2-0.3 mm long at least on the

nerves of abaxial surface and margin, glabrous adaxially. *Petals* unknown. *Stamens* 10, both whorls bearing anthers; filaments ca. 4 mm long, lanceolate, unknown color, with eglandular hairs ca. 0.2 mm long on the abaxial surface and margin; anthers unknown. Nectaries 5, hemispheric, glabrous. *Fruit* 14-15 mm long, erect, discharge of seed-ejection type; mericarps ca. 3 mm long, without a strand of fibers, not compressed at the apex, smooth, without basal beak, with a basal callus, without a basal prong, brown; rostrum ca. 9 mm long, with a narrowed apex ca. 1 mm long, not twisted, with abundant erect-patent, eglandular hairs 0.1-0.6 mm long; stigmatic remnants ca. 1.9 mm long, with 5 glabrous lobes. *Seeds* unknown. Cotyledons not studied. Fig. 533.

Pollen. Ornamentation not studied.

Chromosome number. Unknown.

Phenology. Unknown.

Distribution. This species ranges probably from Colombia or Venezuela.

Habitat. Unknown.

Discussion. Geranium cavanillesii is known only from the holotype. The sheet consists in three fragments that lack a well-developed rootstock, roots, petals, anthers and seeds. Thus, the description is incomplete and should be improved when more collections became available. *Geranium cavanillesii* seems close to *G. multiceps* in its general aspect, inflorescence structure, stipules, indumentum, and fruit position. However, it is easy to differentiate from *G. multiceps* by the shape of its leaves. The leaf lamina of *G. multiceps* is palmatifid, with five segments, polygonal in outline whereas those of *G. cavanillesii* is more narrow, digitate, with three segments and obtriangular in outline. In fact the leaf of *G. cavanillesii* resembles those of *G. cuneatum,* a species endemic to Hawaii. This is probably the reason for which it was originally identified as "Geranium cuneatum" in the field label. *Geranium cavanillesii* differs further in having a fruit rostrum with a narrowed apex not found neither *G. multiceps* nor close species.

According to the label of the type this plant was collected in "Columbia, paramo de Diacono". It has not been possible to locate this place either in Colombia or in Venezuela. The true identity of the collector also could not be fully resolved. The label reads *Engels*, who could be Theodor Franz Engel (1834-1920), a German with gardening studies who was in Venezuela in 1855-57 (Rodríguez 1999). Some other collections attributed to *Engels* have been found, such as that of *Centronia pulchra* Cogn. (BR-0000005628964), whose label reads: "Venezuela ad Merida: Engels in h. hort. Petr.", but this has not aided in

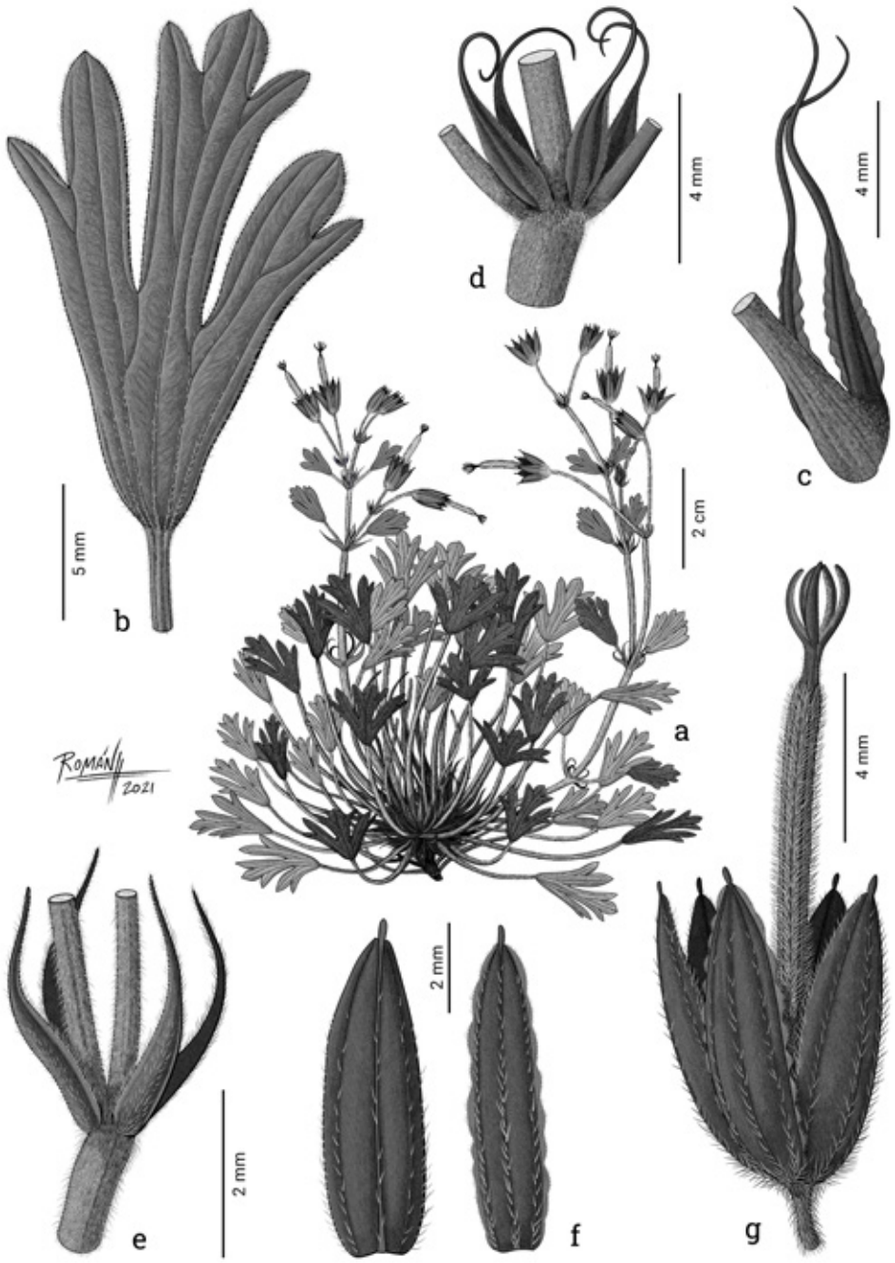


Fig. 533. *Geranium cavanillesii*. a. Habit. b. Leaf. c. Stipules. d, e. Bracteoles. f. Sepals. g. Fruit. (Based on: *Engels s.n.*, LE).

accurately determining the locality of *G. cavanillesii*, nor has it clarified the identity of the collector.

Both the scarcity of the material and the difficulties in locating its origin have resulted in an obstacle to describing this species which I had in my hands for many years. Finally, with a broader knowledge of the genus the importance of the above mentioned features become clear and support the decision to propose this new species.

209. Geranium lainzii Aedo, Anales Jard. Bot. Madrid 57: 162. 1999. Type locality: "Colombia. Cundinamarca, Páramo de Guasca en el cerrito del Santuario, Cuatrecasas 2273 (MA-252510!)". Type: Colombia. Cundinamarca, Páramo de Guasca en el cerrito del Santuario, 4°50'N, 73°50'W, 25 Apr. 1932, *J. Cuatrecasas 2273* (holotype, MA-252510!).

Perennial herbs, 7-50 cm tall. *Rootstock* 3-9.5 mm in diameter, ± vertical, not tuberculate, not turnip-shaped, with ± thickened roots. *Stem* ascending, leafy (rarely scapiform), not rooting at nodes, stolons absent, without vegetative stems, glabrous or with patent to retrorse, eglandular hairs 0.1-0.3(0.6) mm long (on a longitudinal line). *Basal leaves* in a persistent rosette, cauline leaves opposite (cuneate to truncate, with usually (1)3 entire segments); leaf laminas 0.9-3.2 cm long, 1-4.8 cm wide, not peltate, palmatifid [ratio main-sinus length/middle segment length = 0.50-0.80], polygonal in outline, base subtruncate, coriaceous, with nerves projected on the abaxial surface, sunken adaxially, with some eglandular hairs at the end of each segment and near the margin (sometimes with patent cilia), abaxially glabrous; segments 3(5), in 1 plane, middle segment obtriangular, 2.5-7(10.7) mm wide at the base [ratio segment width at the base/middle segment length = 0.26-0.46], 3-lobed at the apex [ratio secondary sinus length/middle segment length = 0.08-0.23]; petioles up to 10(20) cm long, without abscission zone, terete, not swollen, not deflexed in age, with patent, eglandular hairs 0.1-0.8 mm long; stipules 3-6(10) mm long, 1.1-2(4) mm wide, subulate, free, papery, brownish red, with eglandular hairs on the margin, subglabrous on abaxial surface and glabrous adaxially. *Inflorescence* a dichasial cyme; cymules 2-flowered, solitary [ratio cymule length/leaf length = 2.2-5.6]; peduncles 11-70(150) mm long, with retrorse to patent, eglandular hairs 0.2-0.9 mm long; bracteoles 2-7 mm long, 0.8-2 mm wide, subulate, whorled; pedicels 16-47 mm long, with retrorse to patent, eglandular hairs 0.1-0.5 mm long. Flowers actinomorphic. *Sepals* 6.1-9 mm long, 1.9-3.2 mm wide, lanceolate, smooth, not accrescent, nerves 3, mucro 0.2-1.3 mm long [ratio mucro length/sepal length = 0.08-0.18], with antrorse, ± appressed, eglandular hairs 0.15-0.9 mm long, at least on the nerves and margin on the abaxial surface, glabrous adaxially. *Petals* (10.5)12-14.5 mm long, 4-8 mm wide, erect-patent, rounded or slightly emarginate (notch 0.5-0.7 mm deep), with claw 1.3-2.8 mm long, purple, glabrous. *Stamens* 10, both whorls bearing anthers; filaments 3.6-6 mm long, lanceolate, yellow, glabrous on both surfaces, ciliate on the proximal half, with eglandular hairs 0.1-0.2 mm long; anthers 1-1.4 mm long, yellow. Nectaries 5, hemispheric, glabrous. *Gynoecium* 4-5.5 mm long, yellow. *Fruit* 14-21.4 mm long, reflexed, discharge of seed-ejection type; mericarps 2.7-3.5 mm long, 1.2-2 mm wide, without a strand of fibers, not compressed at the apex, smooth, without basal beak, with a basal callus, without a basal prong, brown, with abundant erect-patent, eglandular hairs 0.1-0.5 mm long; rostrum 7.8-12.8 mm long, without a narrowed apex, not twisted, with abundant erect-patent, eglandular hairs 0.1-0.5 mm long; stigmatic remnants 2-3 mm long, with 5 subglabrous lobes. *Seeds* 1.8-2.3 mm long, 0.9-1.6 mm wide, finely reticulate, uniformly colored, brownish red, glabrous. Cotyledons with entire margin. Fig. 534.

Pollen. *Geranium*-type (Aedo & al. 2003: 98).

Chromosome number. Unknown.

Phenology. Collected in flower from January to December.

Distribution. This species ranges through central Colombia (Fig. 535).

Habitat. Margins of pools, bogs, and other grassy, damp areas, among patches of *Espeletia* Mutis ex Bonpl. and *Puya* Molina; 2400-4000 m.

Representative specimens examined. **Colombia.** Antioquia: Urrao, Páramo de Frontino, Casa del Morro, 5°53'N, 75°40'W, 10 Jan. 1984, *Londoño & al. 229* (HUA); Urrao, Páramo of Morro Frontino, cascada de Llano Grande, 5°53'N, 75°40'W, 16 Sep. 1984, *Londoño & al. 526* (HUA); Urrao, Páramo de Frontino, 5°53'N, 75°40'W, 22 Sep. 1994, *Rentería 10573* (HUA); Urrao, sector El Quince-Páramo de Frontino, 6°29'N, 76°7'W, 18 May 1985, *Roldán 180* (HUA); Urrao, Páramo de Frontino, Puente Largo, lagunas cerca de la zona del camping, 6°30'N, 76°7'W, 18 July 1995, *Sánchez & al. 2224* (COL); Urrao, Páramo de Frontino, alto del Diablo, 6°30'N, 76°7'W, 29 Sep. 1995, *Sánchez & al. 2375* (COL); at summit of Morro Pelado, along Anocosca-Abriaqui camino, 6°39'N, 76°3'W, 15 Mar. 1944, *Core 460* (US). Boyacá: Arcabuco, santuario Iguaque, slopes above Laguna Iguaque to Ojo del Agua, 5°44'N, 73°25'W, 15 Oct. 1998, *Stancik & al. 936* (COL, PRC); Arcabuco, páramo vecino a la población, 5°45'N, 73°26'W, 6 June 1969, *Huertas & Camargo 6781* (COL). Cundinamarca: Páramo de Chisacá, 4°17'N, 74°12'W, 15 Oct. 1966, *Soderstrom 1345* (K, MO, NY); Fómeque, Parque Nacional Natural de Chingaza, Alto el Gorro, boquerón del Meta, 4°27'N, 73°48'W, 2 Dec. 1981, *Franco 851* (COL); Páramo de Sibaté, 4°29'N, 74°15'W, 1 Mar. 1981, *Iglesias 58* (COL); Páramo de la Cruz Verde, Alto de la Viga, flanco E, 4°30'N, 74°3'W, 11 Apr. 1972, *Cleef 2758* (COL); Páramo de la Cruz Verde, N Laguna El Verjón, 4°30'N, 74°3'W, 23 Apr. 1972, *Cleef & Jaramillo 3074* (COL, U); zona de Bogotá, Páramo de Cruz Verde, Choachí, 4°30'N, 74°3'W, 19 Feb. 1986, *Fernández Alonso & al. 5410* (MA, COL); Páramo de la Cruz Verde 8 km E of Bogotá, 4°30'N, 74°3'W, 15 Aug. 1960, *Hatheway & Idrobo 1083* (COL); Páramo de Chingaza, 4°31'N, 73°46'W, 20 Feb. 1987, *Rentería & al. 5355* (HUA); Páramo de Guadalupe, between

Bogotá and Choachí, 4º34'N, 74º0'W, 19 June 1957, *Barclay 4102* (MO); macizo de Bogotá, Alto de las Cruces-Guadalupe, 4º34'N, 74º3'W, 19 June 1939, *Cuatrecasas 5550* (BC, COL, F, US); Páramo, carretera Bogotá-Choachí, 4º34'N, 74º0'W, 11 May 1961, *Dumont 100* (G); Páramo Valle del río San Cristóbal, Alto de la Horqueta, 4º34'N, 74º5'W, 16 Nov. 1958, *García Barriga 16175* (COL); Guadalupe, 4º34'N, 74º3'W, 20 Apr. 1947, *Haught 5640* (COL, GH, US); Páramo de Choachí near Bogotá, 4º34'N, 74º0'W, 8 Aug. 1922, *Killip & Ariste-Joseph (brother) 11952* (US); Páramo de Montserrate, vereda El Verjón, Hacienda Santa Bárbara, El Granizo, 4º37'N, 74º2'W, 14 May 1986, *Garzón 511* (COL); Bogotá, 4º38'N, 74º5'W, *Ariste-Joseph (brother) 868* (MPU); Páramo de Palacio, al NW de la mina de cal, 4º40'N, 73º45'W, 13 May 1972, *Cleef 3737* (COL, U); Páramo de Palacio, Hacienda La Siberia, 4º40'N, 73º45'W, 11 Dec. 1959, *Cuatrecasas & al. 25614* (COL); La Calera, Páramo de Palacio, 4º40'N, 73º45'W, 4 June 1952, *Hammen 382* (COL); La Calera, Páramo de la Siberia, 4º40'N, 73º45'W, 25 Oct. 1952, *Humbert & al. 26889* (COL, P, S); La Calera, Páramo de Palacio, 4º40'N, 73º45'W, 25 Feb. 1953, *Schultes 18755* (GH); La Calera, Páramo de Chingaza, Piedras Gordas, 4º44'N, 73º50'W, 11 Mar. 2000, *Díaz 86* (COL); La Calera, Parque Nacional Natural de Chingaza, Quebradas de Piedras Gordas, 4º44'N, 73º50'W, 5 May 1990, *Kubocz & Schmitt 80* (COL); Páramo de Guasca, road from Guasca to Gacheta, cuchilla Pena Negra, 4º50'N, 73º48'W, 21 July 1998, *Stancik 489* (PRC); Páramo de Guasca, cumbre, 4º50'N, 73º50'W, 4 Oct. 1948, *Uribe 1810* (COL); Subachoque, Vereda Guamal, límites entre Subachoque y Pacho, 4º55'N, 74º10'W, 15 Dec. 2001, *Hernández 606* (MA); Bogotá, Alto de la Viga, on the road to Coachi, 5º12'N, 73º33'W, 1 Nov. 1999, *Stancik 3525* (COL, PRC); Villapinzón, Páramo La Calavera, 5º12'N, 73º33'W, 22 July 1998, *Stancik 453* (COL, F, PRC). Meta: Quebrada el Cariño, second main affluent of río Arroz on S side, 3º50'N, 74º16'W, 28 Aug. 1943, *Fosberg 20904* (NY, US).

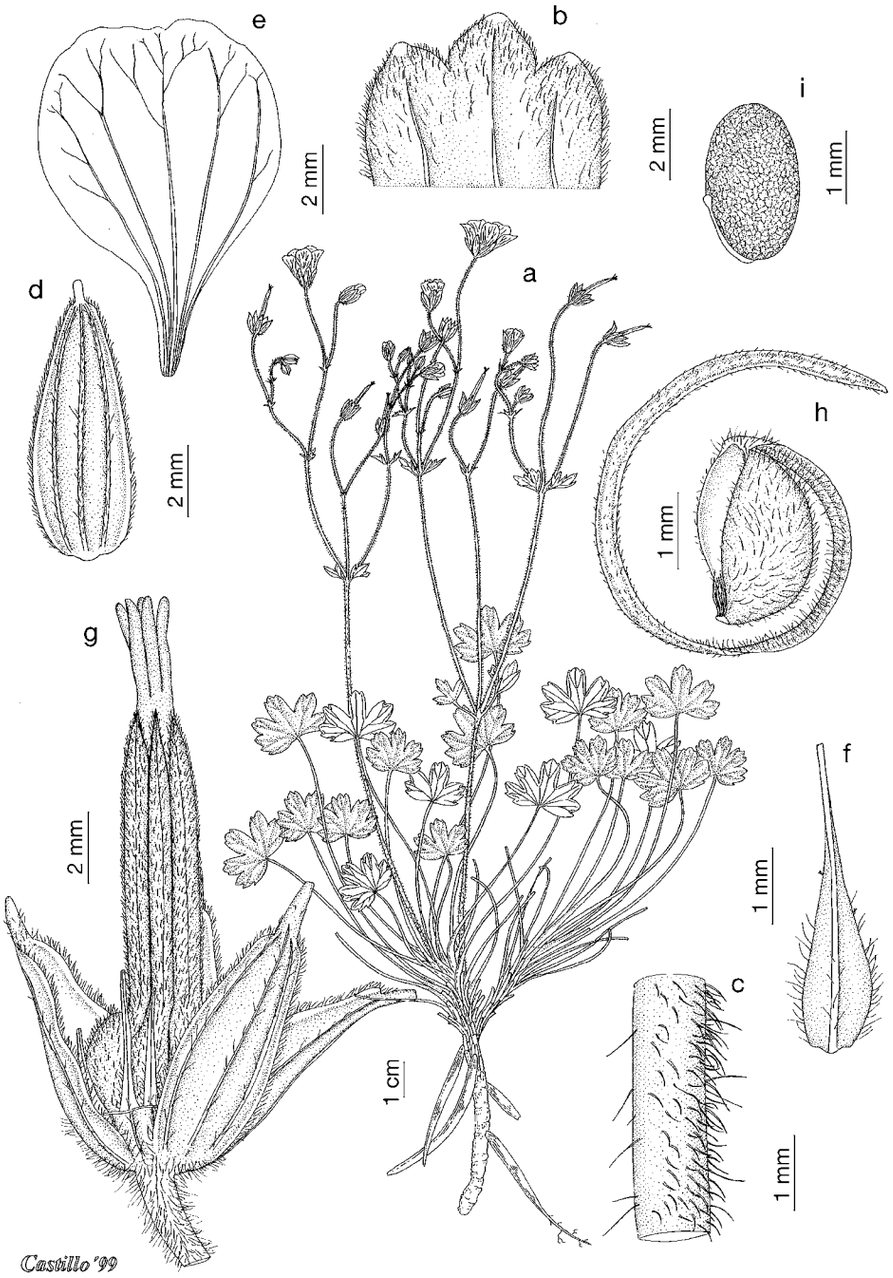


Fig. 534. *Geranium lainzii*. a. Habit. b. Detail of leaf, adaxial side. c. Peduncle. d. Sepal. e. Petal. f. Staminal filament. g. Fruit. h. Mericarp. i. Seed. (Based on: a, *Hatheway & Idobro 1083*, COL; b-g, *Cuatrecasas 5550*, US; h, i, *Langenheim & al. 3683*, US).

Discussion. Geranium lainzii is easily to separate from *G. multiceps* by its coriaceous, subtruncate, flat leaves with usually three segments, and by its reflexed mature fruits; in *G. multiceps* the membranaceous, cuneate to subtruncate, funnel-shaped leaves have five segments, and the mature fruits are erect. *Geranium lainzii* is restricted to Colombia. Some Colombian specimens were erroneously identified as *G. multiceps*, perhaps in agreement with Knuth's drawing

Fig. 535. Distribution of *Geranium lainzii*.

(1912: 105, fig. 18). Knuth's circumscription *G. multiceps* was based in part on collections of *G. lainzii*, but only the Venezuelan specimens he listed are *G. multiceps*. This confusion was already noted by Sandwith (1942: 220), who stated: "... the distinctive plant which is common around Bogotá in Colombia and has been identified with *G. multiceps* by all authors since Triana is certainly not the "typical" form of that species ..." *Geranium lainzii* superficially resembles *G. santanderiense*, which differs by its cordate leaves with five segments, antrorse appressed cilia on the margins, and eglandular hairs on the abaxial surface (vs. subtruncate leaves with three segments, glabrous abaxially and with scattered patent cilia). Some small specimens of *G. lainzii* have scapiform cymules; such reduced individuals always have 2-flowered cymules, which separate it from species with 1-flowered cymules allied with *G. sibbaldioides*.

210. Geranium santanderiense R. Knuth, Repert. Spec. Nov. Regni Veg. 18: 291. 1922, [31 Dec. 1922]. Type locality: "Columbien, Dept. Santander: Serra Pelada, an Bergabhängen zwischen Moosen, 3600 m (Kalbreyer a. 1878, no. 715.-Typus in Herb. Berol.!)". Type: Colombia. Ocaña to Pamplona, 7°50'N, 73°10'W, 30 Aug. 1878, *W. Kalbreyer 715* (holotype, B destroyed; lectotype, designated by Aedo & al. 2003: 112, K-000531426!).

Perennial herbs, (10)15-60 cm tall. *Rootstock* 4.4-12 mm in diameter, ± horizontal, not tuberculate, not turnip-shaped, with thickened roots along the rootstock. *Stem* ascending, leafy, not rooting at nodes, stolons absent, without vegetative stems, with retrorse, appressed, eglandular hairs 0.3-0.7 mm long. *Basal leaves* in a persistent rosette, cauline leaves opposite (cuneate to truncate, with usually 1(3) entire segments); leaf laminas 0.9-3.9(5.5) cm long, 1.5-4.9(6) cm wide, not peltate, palmatifid [ratio main-sinus length/middle segment length = 0.47-0.57], orbicular in outline, base cordate, coriaceous, with nerves projected on the abaxial surface, sunken adaxially, usually glabrous on the adaxial surface (sometimes hairy, mainly on nerve channels), densely ciliated (with antrorse, appressed, eglandular hairs) and with eglandular hairs on the nerves of abaxial surface; segments 5, in 1 plane, middle segment obtriangular, 4-9 mm wide at the base [ratio segment width at the base/middle segment length = 0.25-0.49], 3-lobed in distal half [ratio secondary sinus length/middle segment length = 0.07-0.20]; petioles up to 15(40) cm long, without abscission zone, terete, not swollen, not deflexed in age, with retrorse, appressed, eglandular hairs 0.1-0.5 mm long; stipules 2-4.9 mm long, 0.8-1.7 mm wide, lanceolate, free, papery, brownish red, with eglandular hairs on abaxial surface and on the margin, glabrous adaxially. *Inflorescence* a dichasial cyme; cymules 2-flowered, solitary [ratio cymule length/leaf length = 1.9-6.5]; peduncles 22-70(92) mm long, with retrorse, appressed, eglandular hairs 0.3-0.7 mm long; bracteoles 2-5.7 mm long, 0.6-1.5 mm wide, lanceolate, whorled; pedicels 14-50 mm long, with retrorse, appressed, eglandular hairs 0.2-0.5 mm long. Flowers actinomorphic. *Sepals* 5-6(9) mm long, 1.8-2.9 mm wide, lanceolate, smooth, not accrescent, nerves 3, mucro 0.2-0.8 mm long [ratio mucro length/sepal length = 0.05-0.12], with antrorse, appressed, eglandular hairs 0.15-1 mm long at least on nerves and margin on the abaxial surface, glabrous adaxially. *Petals* (9.3)12-16 mm long, 5.3-9 mm wide, erect-patent, rounded or slightly emarginate (notch ca. 0.5 mm deep), with claw 1-2 mm long, purple, hairy on the base of the adaxial surface, glabrous abaxially, ciliate on the basal margin, with hairs 0.3-0.5 mm long. *Stamens* 10, both whorls bearing anthers; filaments 2.7-5 mm long, lanceolate, yellow, pilose on the abaxial surface, ciliate on the proximal half, with eglandular hairs 0.2-0.6 mm long; anthers 0.8-1.2 mm long, yellow. Nectaries 5, hemispheric, glabrous. *Gynoecium* 4-6.4 mm long, purple. *Fruit* 14.6-21 mm long, reflexed, discharge of seed-ejection type; mericarps 2.1-3.5 mm long, 1.2-2 mm wide, without a strand of fibers, not compressed at the apex, smooth, without basal beak, with a basal callus, without a basal prong, brown, with abundant erect-patent, eglandular hairs 0.3-0.5 mm long; rostrum 8.7-17 mm long, without a narrowed apex, not twisted, with abundant erect-patent, eglandular hairs 0.1-0.5 mm long; stigmatic remnants 1.9-3 mm long, with 5 subglabrous lobes. *Seeds* 1.5-2.1 mm long, 1.1-1.2 mm wide, finely reticulate, uniformly colored, brownish red, glabrous. Cotyledons with entire margin. Fig. 536.

Pollen. *Geranium*-type (Aedo & al. 2003: 98).

Chromosome number. Unknown.

Phenology. Collected in flower from January to December.

Distribution. This species ranges from western Venezuela to central and southwestern Colombia (Fig. 537).

Habitat. Roadside banks, grassy areas, open rocky hillsides, brushy slopes, bogs, among patches of *Espeletia* Mutis ex Bonpl. and *Polylepis* Ruiz & Pav.; 2600-4000 m.

Representative specimens examined. **Colombia.** Antioquia: Páramo de Chaquiro, Cordillera Occidental, 6°13'N, 75°3'W, 23 Feb. 1918, *Pennell 4275* (GH, MO, NY, US); Belmira, vereda Los Patos, Alto de Santa Inés, sendero La Laguna, 6°35'N, 75°32'W, 13 Nov. 1999, *Benavides & al. 946* (HUA); Belmira, vereda El Yerbal, sitio Los Patos, margen izquierda río Chico, Alto de Sabanazos, 6°35'N, 75°32'W, 25 Mar. 1991, *Callejas & al. 10133* (HUA); Belmira, Páramo El Morro, 6°35'N, 75°32'W, 22 Apr. 1993, *Fonnegra & Tuberquia 4621* (HUA, MO); Belmira, Alto de Sabanas, margen izqda. río Chico, 6°40'N, 75°50'W, May 1996, *Alzate & al. 98* (HUA); San Andrés de Cuerquia, 6°50'N, 75°40'W, 31 July 1958, *Garganta Fábrega 2188* (US). Boyacá: Aquitania, Páramo Los Curies, El Guarne, 5°30'N, 72°52'W, 8 Feb. 1999, *Stancik & Medina 2196* (PRC); Tota, 5°33'N, 72°59'W, Dec., *Yepes Agredo 3299* (COL); 25 km S of

Socha, Las Mesas, headwaters of río Pauto, NE Quebrada Laja, 5º40'N, 72º43'W, 11 Nov. 1944, *Fosberg 22268* (US); in Páramo de la Rusia about 18 km from Duitama on road to Charalá, 5º40'N, 73º5'W, 11 Aug. 1953, *Langenheim 3409* (COL, F, GH); Páramo de Pisva, carretera Socha-La Punta, km 61, 6 km E Los Pinos, Alto de Granados, 5º55'N, 72º37'W, 12 June 1972, *Cleef 4458* (COL, U); Páramo al NW de Belén, cabeceras Quebrada Minas, Hoya Clla. Larga, 6º5'N, 72º55'W, 28 Feb. 1975, *Cleef 2011* (U); Güicán, quebrada Cóncavo, 6º24'N, 72º19'W, 26 Nov. 2014, *Buira 2422* (MA); Nevado del Cocuy, alto valle de Las Lagunillas, 6º24'N, 72º27'W, 12 Sep. 1938, *Cuatrecasas 1441a* (F); Sierra Nevada del Cocuy, valle de los Corralitos, 6º24'N, 72º27'W, 31 July 1957, *Grubb & al. 195* (COL, F, K, US). Cauca: Popayán, 2º27'N, 76º32'W, 21 July 1960, *Schultes 22501a* (COL, K). Cundinamarca: in pass along highway from Bogotá to Villavicencio, 4º25'N, 74º3'W, 7 Nov. 1943, *Core 30* (US); Chipaque, 4º25'N, 74º3'W, *Triana 3754* (BM); Páramo de Cruz Verde, W slopes, 4º30'N, 74º3'W, 7 Oct. 1938, *Cuatrecasas 372* (F); Zuqué near Bogotá, 4º31'N, 74º3'W, 4 Sep. 1948, *Regis s.n.* (US); Chapinero, Bogotá, 4º33'N, 74º4'W, 19 Mar. 1947, *Schneider 246* (COL); Bogotá-Choachí road, repetidora La Viga, 4º34'N, 74º0'W, 7 Jan. 1974, *Gentry & al. 8930* (MO); Guadalupe, Bogotá, 4º34'N, 74º3'W, 1844, *Goudot s.n.* (BM); Quebrada Chico, hills above Bogotá, 4º36'N, 74º5'W, 11 July 1943, *Allen 2990* (MO); supra Montserrat, versus Choachin, Peña Azul in regione bogotana, 4º37'N, 74º2'W, 24 Sep. 1965, *Bernardi 10725* (G); Páramo de Montserrate, Hacienda Santa Bárbara, El Granizo, 4º37'N, 74º2'W, 27 Feb. 1986, *Garzón & al. s.n.* (COL); Bogotá, S side of Canyon back of National Park, 4º37'N, 74º2'W, 25 Feb. 1945, *Schiefer 453* (GH); Subachoque, 4º55'N, 74º10'W, 7 June 2008, *Fernández Alonso 26613* (MA); Páramo de Zipaquirá and Pacho, 5º1'N, 74º0'W, 7 Sep. 1957, *Barclay 5318* (MO); Zipaquira, Pantano Redondo, 5º1'N, 74º0'W, 3 July 1952, *Hammen 402* (COL). Norte de Santander: de La Laguna a Nariz de Judio, Mutiscua, 7º20'N, 72º43'W, 19 June 1946, *Garganta Fábrega 1201* (F); Páramo de Tamá arriba de la Cueva, 7º24'N, 72º24'W, 27 Oct. 1941, *Cuatrecasas & al. 12611* (COL, F, GH); Páramo del Romeral, 7º50'N, 72º59'W, 29 Jan. 1927, *Killip & Smith 18538* (GH, NY, US); Cucutilla, Vereda Carrizal, Páramo del Romeral, 7º50'N, 72º59'W, 23 Oct. 2000, *Sánchez & al. 5118* (COL). Santander: Onzaga, vereda de Chaguacá, alto de la laguna de los Bobos, filo divisorio con Bocayá, 6º21'N, 72º50'W, 7 Aug. 1958, *Jaramillo & al. 926* (COL); Páramo del Almorzadero, extremo sur en Peralonso,

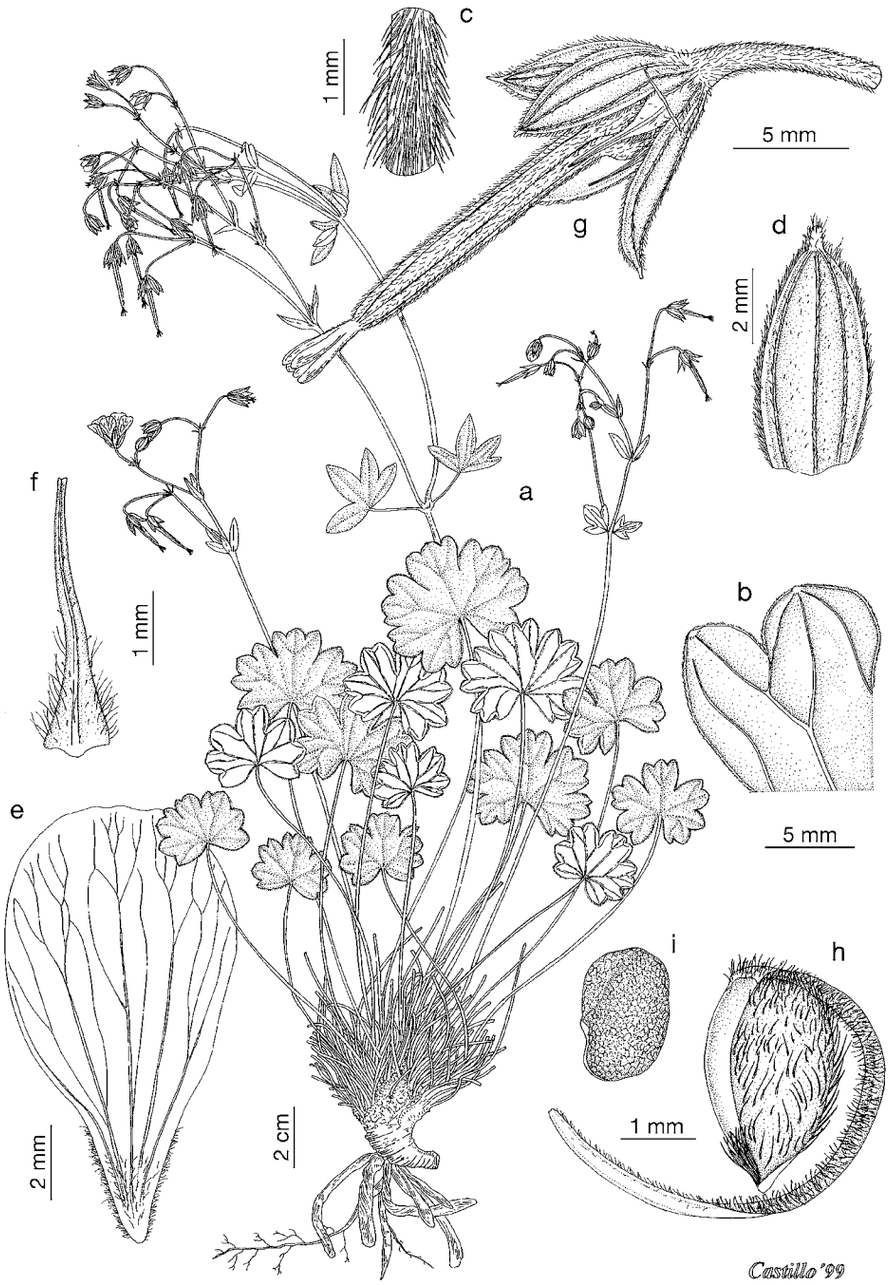


Fig. 536. *Geranium santanderiense*. a. Habit. b. Detail of leaf, adaxial side. c. Peduncle. d. Sepal. e. Petal. f. Staminal filament. g. Fruit. h. Mericarp. i. Seed. (Based on: a, *Fernández Alonso & al. 5156*, COL; b-h, *Fernández Alonso & al. 5156*, MA; i, *St. John 20754*, NY).

Fig. 537. Distribution of *Geranium santanderiense*.

6°59'N, 72°44'W, 28 Nov. 1941, *Cuatrecasas 13519* (COL, US); Páramo de las Vegas, 7°11'N, 73°0'W, 20 Dec. 1926, *Killip & Smith 15661* (F, GH, NY, US); edge of Páramo de las Vegas, 7°11'N, 73°0'W, 20 Dec. 1926, *Killip & Smith 15705* (GH, NY, US); a 2 km del paraje Berlín, 7°11'N, 72°53'W, 18 Dec. 1948, *Molina & Barkley 18S.407* (US); Bucaramanga, Berlín, 7°11'N, 72°53'W, 14 Aug. 1977, *Rentería & al. 568* (COL, MO); vicinity of Vetas, 7°12'N, 72°59'W, 16 Jan. 1927, *Killip & Smith 17275* (GH, US); Páramo de Mogotocoro, near Vetas, 7°12'N, 72°59'W, 18 Jan. 1927, *Killip & Smith 17597* (GH, NY); edge of Páramo de Santurbán, near Vetas, 7°12'N, 72°59'W, 17 Jan. 1927, *Killip & Smith 17946* (GH, US); Páramo Rico, 5 km S of California, 7°18'N, 72°57'W, 15 Sep. 1944, *Saint John 20754* (NY, US). **Venezuela.** Apure: Páramo de Pata de Judío, frontera Colombia-Venezuela, 30 km S San Vicente de la Revancha, al S Alquitrana, 7°25'N, 72°18'W, 19 Jan. 1968, *Steyermark & al. 101141* (NY, US, VEN); Táchira: Páramo de Tamá, 7°25'N, 72°25'W, 12 Nov. 1976, *Charpin & al. 13201* (C, G, MA); NE side of Páramo de Tamá from Cave to top, 7°25'N, 72°25'W, 18 Oct. 1978, *Luteyn & al. 5896* (NY, VEN).

Discussion. Geranium santanderiense is readily distinguished from other species allied with *G. multiceps* by its leaves, which bear antrorse, appressed cilia on the margin, giving a scarious appearance. *Geranium santanderiense* and *G. lainzii* share an eglandular indumentum on all parts of the plant and fruits that are reflexed at maturity. Both have small cauline leaves, sometimes reduced to a single lanceolate segment and are sympatric, although *G. santanderiense* has a wider range. See the discussion of *G. lainzii* for an account of the differences between the two species. Some specimens from the Sierra Nevada de Cocuy, Bocayá, Colombia (*Cuatrecasas 1441a*, *Grubb & al. 195*, *Cleef 10008*), and the Páramo de la Pata del Judío, Apure, Venezuela (*Steyermark & Dunsterville 101141*), show an unusual leaf indumentum: eglandular, appressed hairs 1.3 mm long on the adaxial surface, and eglandular hairs only on the nerves of the abaxial surface. Otherwise, they are similar to the other specimens of *G. santanderiense*.

211. Geranium jaramilloi Aedo, Feddes Repert. 120: 317, 318 fig. 1. 2009. Type locality: "Colombia. Santander, Onzaga, vereda de Chaguacá, alto de la laguna de Los Bobos, filo divisorio con Boyacá, 7 Aug. 1958, Jaramillo & al. 921 (holotype, COL-429670!; isotypes, COL-242185!, MA!)". Type: Colombia. Santander, Onzaga, vereda de Chaguacá, alto de la laguna de Los Bobos, filo divisorio con Boyacá, 6°19'N, 72°49'W, 7 Aug. 1958, *R. Jaramillo & al. 921* (holotype, COL-429670!; isotypes, COL-242185!, MA!).

Perennial herbs, 7-16 cm tall. *Rootstock* 5.1-9.2 mm in diameter, ± vertical, not tuberculate, not turnip-shaped, without thickened roots. *Stem* erect, leafy (rarely scapiform), not rooting at nodes, stolons absent, without vegetative stems, with patent, eglandular hairs 0.5-1.3 mm long. *Basal leaves* in a persistent rosette, cauline leaves opposite (cuneate to truncate, with usually 1(3) entire segments); leaf laminas 1-1.3 cm long, 1-1.5 cm wide, not peltate, palmatifid [ratio main-sinus length/middle segment length = 0.65-0.72], polygonal in outline, base cordate, coriaceous, with nerves projected on the abaxial surface, sunken adaxially, covered with abundant, long and stout, eglandular hairs on both surfaces, although restricted to nerves abaxially; segments 5, in 1 plane, middle segment broadly lanceolate, 2.1-2.5 mm wide at the base [ratio segment width at the base/middle segment length = 0.23-0.35], entire; petioles up to 4.8 cm long, without abscission zone, terete, not swollen, not deflexed in age, with patent, eglandular hairs 0.2-1.3 mm long; stipules 2.8-9.2 mm long, 0.8-2.5 mm wide, lanceolate to subulate, free, papery, brownish red, with eglandular hairs on abaxial surface and on the margin, glabrous adaxially. *Inflorescence* a dichasial cyme; cymules 2-flowered, solitary [ratio cymule length/leaf length = 6.4-10.5]; peduncles 15.9-27.6 mm long, with patent, eglandular hairs 0.2-1.3 mm long; bracteoles 2.5-4 mm long, 0.7-0.8 mm wide, lanceolate, whorled; pedicels 15-25 mm long, with patent, eglandular hairs 0.3-1.2 mm long. Flowers actinomorphic. *Sepals* 4.8-6.8 mm long, 1.6-2.6 mm wide, lanceolate, smooth, not accrescent, nerves 3, mucro 0.4-0.8 mm long [ratio mucro length/sepal length = 0.08-0.12], with erect-patent, eglandular hairs 0.15-0.9 mm long, mainly on the nerves and margin on the abaxial surface, glabrous adaxially. *Petals* 9.1-12.8 mm long, 4.7-7.4 mm wide, erect-patent, rounded, with claw 0.8-2 mm long, purple, glabrous, rarely with scattered hairs on base of abaxial surface, with hairs 0.2-0.3 mm long. *Stamens* 10, both whorls bearing anthers; filaments 3-4.7 mm long, lanceolate, yellow, pilose on the abaxial surface, ciliate on the proximal half, with eglandular hairs 0.2-0.5 mm long; anthers 0.8-1.1 mm long, yellow. Nectaries 5, hemispheric, glabrous. *Gynoecium* 4.4-5.9 mm long, purple. *Fruit* 14.1-19.8 mm long, reflexed, discharge of seed-ejection type; mericarps 2.3-2.8 mm long, 1.1-1.5 mm wide, without a strand of fibers, not compressed at the apex, smooth, without basal beak, with a basal callus, without a basal prong, brown, with abundant erect-patent, eglandular hairs 0.3-0.6 mm long; rostrum 8.9-12.4 mm long, with a narrowed apex 0.9-1.9 mm long, not twisted, with abundant erect-patent, eglandular hairs 0.6-0.7 mm long; stigmatic remnants 1.8-2.6 mm long, with 5 glabrous lobes. *Seeds* 1.8-2 mm long, 1-1.2 mm wide, finely reticulate, uniformly colored, brownish red, glabrous. Cotyledons with entire margin. Fig. 538.

Pollen. Ornamentation not studied.

Chromosome number. Unknown.

Phenology. Collected in flower in August.

Distribution. This species is endemic to central Colombia (Fig. 539).

Habitat. Paramo with *Espeletia* Mutis ex Bonpl.; ca. 3800 m.

Discussion. Geranium jaramilloi is known only from the type gathering, a

flowering and fruiting collection from northern Colombia. It is most similar to *G. santanderiense* and *G. lainzii*. The three species share an eglandular indumentum, coriaceous leaves, and reflexed fruits. The cauline leaves are small and with few segments, sometimes with only a single lanceolate segment. *Geranium jaramilloi* is sympatric with *G. santanderiense*, which also has cordate leaves. In *G. jaramilloi* the leaves have entire segments and abundant, patent, long, stout, eglandular hairs on both surfaces, although restricted to the nerves abaxially, whereas in *G. santanderiense* the leaf segments are 3-lobed, and the laminas are usually glabrous, except for a ciliate margin. The leaves of *G. lainzii* are subtruncate, and have 3-5-lobed segment and scattered hairs near the margin. The fruit rostrum with a narrowed apex also differentiates *G. jaramilloi* from the other two species, in which the rostrum terminates abruptly in the stigmatic remnants. Another notable difference found in herbarium specimens of *G. jaramilloi* is the revolute leaf margin; the basal stipules are usually subulate and adaxially shiny.

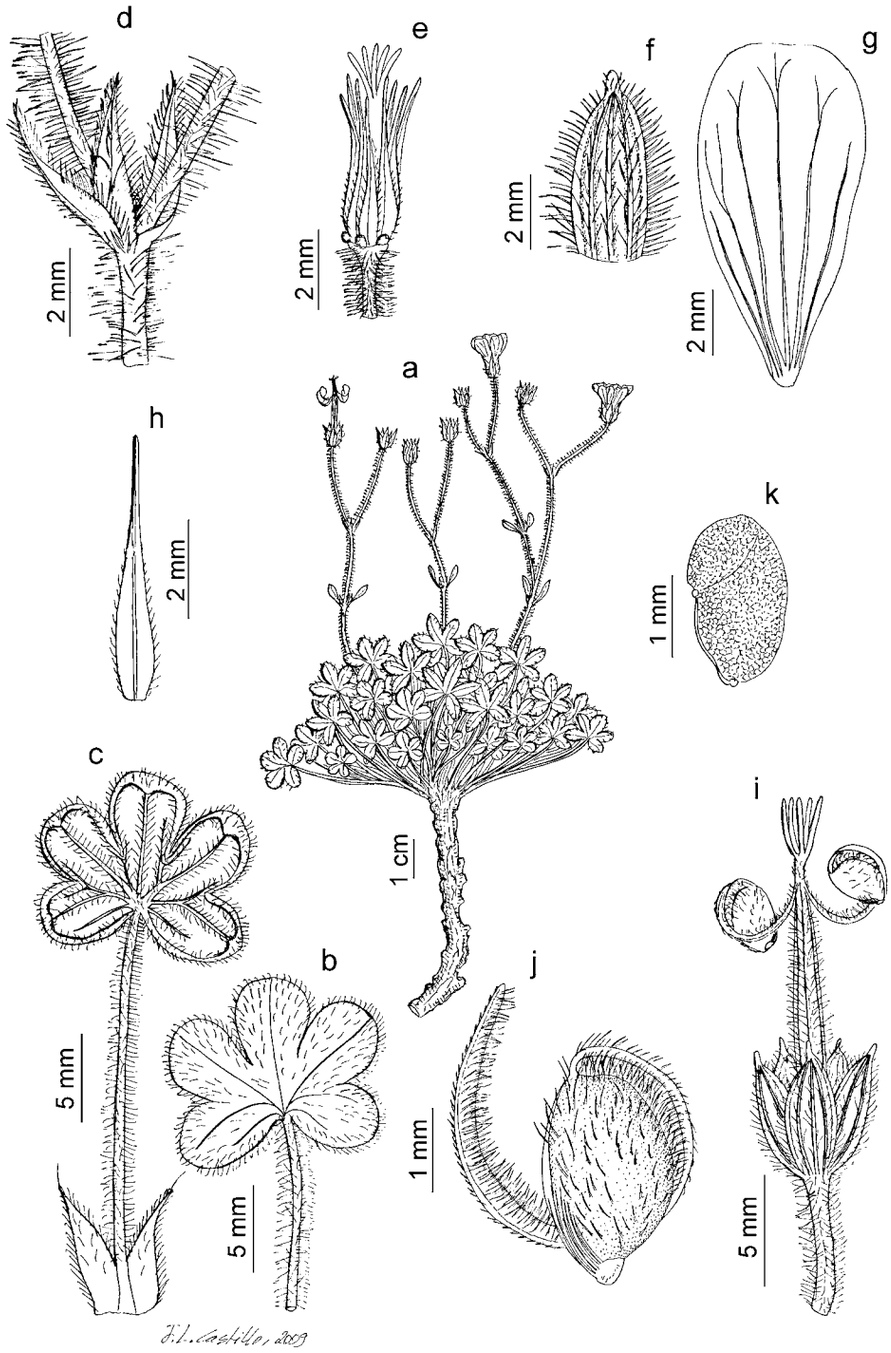


Fig. 538. *Geranium jaramilloi*. a. Habit. b. Leaf, adaxial side. c. Leaf, abaxial side. d. Bracteoles. e. Flower, sepals and petals removed. f. Sepal. g. Petal. h. Staminal filament. i. Fruit. j. Mericarp. k. Seed. (Based on: *Jaramillo & al. 921*, COL).

Fig. 539. Distribution of *Geranium jaramilloi*.

212. Geranium sebosum S.F. Blake, Contr. U.S. Natl. Herb. 20(13): 526. 1924. Type locality: "Type in the U. S. National Herbarium, no. 602198, collected on the Páramo de Timotes, Mérida, Venezuela, altitude 4,000 meters, March, 1910, by Alfred Jahn (no. 5)". Type: Venezuela. Mérida, Páramo de Timotes, 8°52'N, 70°48'W, Mar. 1910, *A. Jahn 5* (holotype, US-602198!).

Perennial herbs, 15-25 cm tall. *Rootstock* 5-8 mm in diameter, ± vertical, not tuberculate, not turnip-shaped, unknown roots. *Stem* erect, leafy, not rooting at nodes, stolons absent, without vegetative stems, with patent, eglandular hairs 0.5-2.3 mm long

and patent, glandular hairs 0.3-0.5 mm long. *Basal leaves* in a persistent rosette, cauline leaves opposite; leaf laminas 2.5-3.5 cm long, 3.4-4.1 cm wide, not peltate, palmatifid [ratio main-sinus length/middle segment length = 0.50-0.60], polygonal in outline, base cordate, not coriaceous, with nerves not projected, densely hairy, with appressed, eglandular and glandular hairs on both surfaces; segments 5, in 1 plane, middle segment obtriangular, 5-8 mm wide at the base [ratio segment width at the base/ middle segment length = 0.37-0.42], 3-5-lobed at the apex [ratio secondary sinus length/middle segment length = 0.15-0.20]; petioles up to 10 cm long, without abscission zone, terete, not swollen, not deflexed in age, with patent, eglandular hairs 0.5-2.5 mm long and patent, glandular hairs 0.3-0.5 mm long; stipules 5-6 mm long, 2 mm wide, lanceolate, free, papery, brownish red, with eglandular hairs on both surfaces and on the margin. *Inflorescence* a dichasial cyme; cymules 2-flowered, solitary [ratio cymule length/leaf length = 2-2.3]; peduncles 20-25 mm long, with ± patent, eglandular hairs 0.5-2 mm long and patent, glandular hairs 0.5-1 mm long; bracteoles 4-5 mm long, 1 mm wide, lanceolate, whorled; pedicels 10-20 mm long, with ± patent, eglandular hairs 0.5-2 mm long and patent, glandular hairs 0.5-1 mm long. Flowers actinomorphic. *Sepals* 4.5-5.5 mm long, ca. 2 mm wide, lanceolate, smooth, not accrescent, nerves 3, mucro 0.2-0.3 mm long [ratio mucro length/sepal length = 0.04-0.05], with ± patent, eglandular hairs 0.3-0.5 mm long and ± patent, glandular hairs 0.5-0.7 mm long on the abaxial surface, glabrous adaxially. *Petals* 6-7 mm long, ca. 5 mm wide, erect-patent, rounded or slightly emarginate (notch ca. 0.5 mm deep), without claw, purple, hairy on the base of the adaxial surface, glabrous abaxially, ciliate on the basal margin, with hairs 0.2-0.3 mm long. *Stamens* 10, both whorls bearing anthers; filaments 4-5 mm long, lanceolate, yellow, glabrous on both surfaces, ciliate on the proximal half, with eglandular hairs 0.3-0.8 mm long and some minute glandular hairs; anthers 0.9-1 mm long, unknown color. Nectaries 5, hemispheric, glabrous. *Gynoecium* 5-6 mm long, purple. *Fruit* 16-18 mm long, erect, discharge of seed-ejection type; mericarps 3-3.5 mm long, 1.5-2 mm wide, without a strand of fibers, not compressed at the apex, smooth, without basal beak, with a basal callus, without a basal prong, brown, with ± patent, eglandular hairs 0.3-0.5 mm long; rostrum 11-12 mm long, without a narrowed apex, not twisted, with patent, eglandular hairs 0.15-

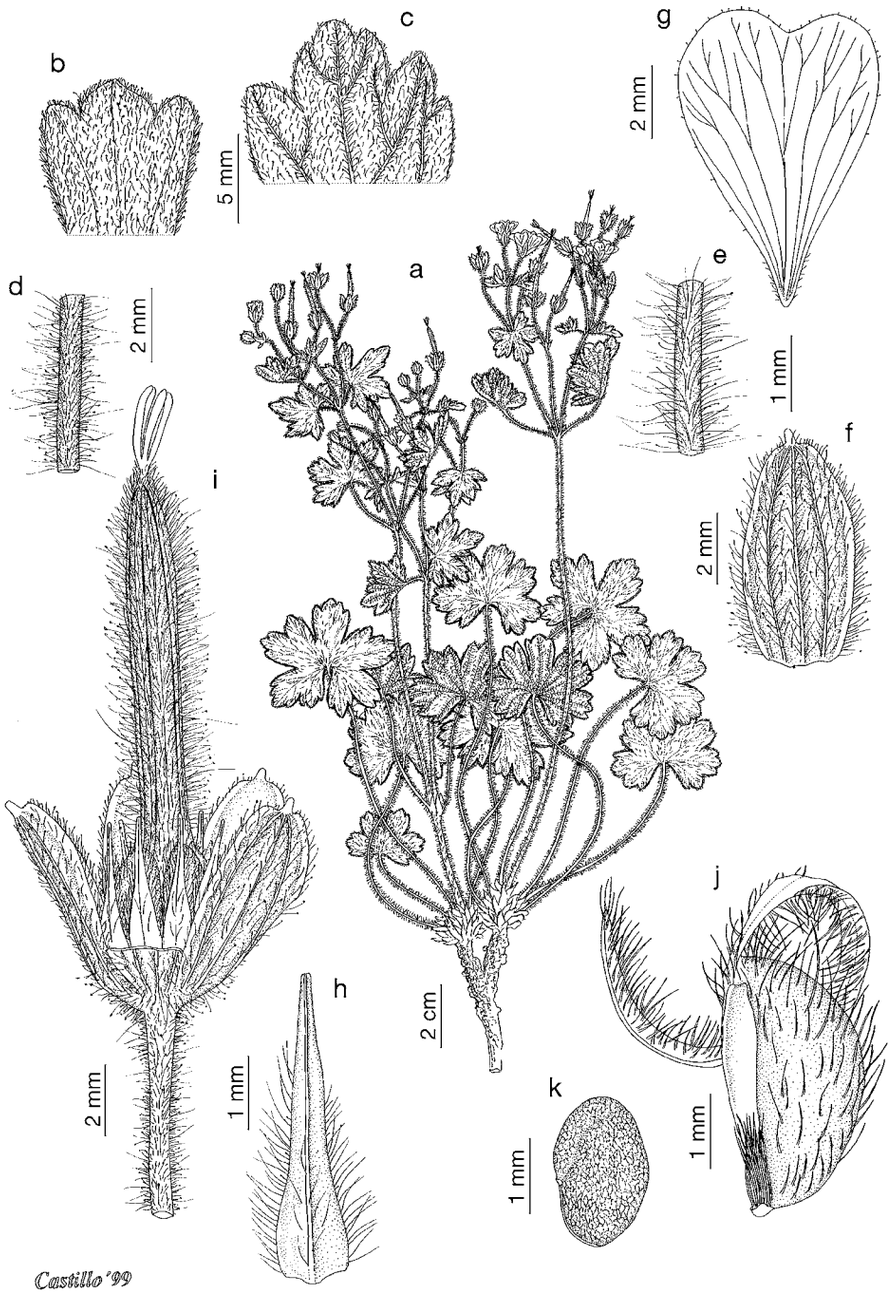


Fig. 540. *Geranium sebosum*. a. Habit. b. Detail of leaf, adaxial side. c. Detail of leaf, abaxial side. d. Petiole. e. Peduncle. f. Sepal. g. Petal. h. Staminal filament. i. Fruit. j. Mericarp. k. Seed. (Based on: a-h, *Farenholtz s.n., 4 July 1934,* B; i-k, *Jahn 5*, US).

Fig. 541. Distribution of *Geranium sebosum*.

0.6 mm long and patent, glandular hairs 0.5-0.7 mm long; stigmatic remnants ca. 2 mm long, with 5 glabrous lobes. *Seeds* ca. 2.2 mm long, 1.2 mm wide, finely reticulate, uniformly colored, brown, glabrous. Cotyledons not studied. Fig. 540.

Pollen. *Geranium*-type (Aedo & al. 2003: 98).

Chromosome number. Unknown.

Phenology. Collected in flower from March to July.

Distribution. This species is endemic to western Venezuela (Fig. 541).

Habitat. Unknown, probably in *Espeletia* Mutis ex Bonpl. paramo; 3000-4000 m.

Additional specimens examined. **Venezuela.** Mérida: Páramo de Timotes, 8°52'N, 70°48'W, 4 July 1934, *Farenholtz s.n.* (B).

Discussion. Geranium sebosum is characterized by a dense indumentum of long, glandular and eglandular hairs, and can be distinguished from the other species allied with *G. multiceps* by the presence of long glandular hairs on the petioles. Pittier (1929) reported this species from the Páramo de Mucuchíes, Mérida, but the voucher, *Gutzwiller 19* (NY), is *G. velutinum*.

213. Geranium stoloniferum Standl., Contr. U.S. Natl. Herb. 18: 110. 1916. Type locality: "Type in the U. S. National Herbarium, no. 602320, collected in the Páramo de la Cristalina, State of Trujillo, Venezuela, at an altitude of 2,900 meters, December 20, 1910, by Dr. Alfredo Jahn (no. 126)". Type: Venezuela. Trujillo, Páramo de la Cristalina, 9°17'N, 70°21'W, 20 Dec. 1910, *A. Jahn 126* (holotype, US-602320!; isotype, VEN-5321 image!).

Perennial herbs, 17-25(40) cm tall. *Rootstock* 2-6 mm in diameter, ± vertical, not tuberculate, not turnip-shaped, with thickened roots. *Stem* erect, leafy, rooting at nodes, stolons present (10-40 cm long), without vegetative stems, with patent, eglandular hairs 0.1-0.9 mm long and, rarely, patent, glandular hairs 0.3-0.5 mm long. *Basal leaves* in a persistent rosette, cauline leaves opposite (except in young stolons); leaf laminas 1.6-2.7 cm long, 1.8-3.3 cm wide, not peltate, palmatifid [ratio main-sinus length/middle segment length = 0.64-0.78], polygonal in outline, base cordate, coriaceous, with nerves projected on the abaxial surface, sunken adaxially, usually glabrous on the adaxial surface (sometimes with eglandular hairs on nerve channels, or even among them), densely ciliated (with patent, eglandular hairs), and with eglandular hairs on the nerves of abaxial surface; segments 5, in 1 plane, middle segment obtriangular, 3-6 mm wide at the base [ratio segment width at the base/middle segment length = 0.26-0.35], 3-lobed at the apex [ratio secondary sinus length/middle segment length = 0.11-0.17]; petioles up to 9 cm long, without abscission zone, terete, not swollen, not deflexed in age, with patent, eglandular hairs 0.1-0.9 mm long; stipules 7.1-17.9 mm long, 1.2-2.3 mm wide, subulate (with a setaceous apex 2-6 mm long), free, papery, brownish red, with eglandular hairs on abaxial surface and on the margin, glabrous adaxially. *Inflorescence* a dichasial cyme; cymules 2-flowered, solitary [ratio cymule length/leaf length = 2.4-6.3]; peduncles 12-25(45) mm long, with patent, eglandular hairs 0.1-0.8 mm long and patent, glandular hairs 0.3-1.1 mm long; bracteoles 3-6 mm long, 0.9-1.3 mm wide, subulate, whorled; pedicels 8-22 mm long, with ± patent, eglandular hairs 0.1-0.8 mm long and patent, glandular hairs 0.3-0.9 mm long. Flowers actinomorphic. *Sepals* 5-7 mm long, 2-2.5 mm wide, lanceolate, smooth, not accrescent, nerves 3, mucro 0.1-0.8 mm long [ratio mucro length/sepal length = 0.07-0.13], with appressed, eglandular hairs 0.1-0.5 mm long and patent, glandular hairs 0.3-0.9 mm long on the abaxial surface, glabrous adaxially. *Petals* 9.1-12 mm long, 4.5-7.4 mm wide, erect-patent, rounded or slightly emarginate (notch ca. 0.5 mm deep), without claw (rarely a claw ca. 2 mm long), purple, hairy on the base of the adaxial surface, glabrous abaxially, ciliate on the basal margin, with hairs 0.1-0.4 mm long. *Stamens* 10, both whorls bearing anthers; filaments 3.7-5 mm long, lanceolate to lanceolate with an abruptly narrowed apex, white, pilose on the abaxial surface, ciliate on the proximal half, with eglandular hairs 0.2-0.5 mm long; anthers 0.9-1.3 mm long, blue. Nectaries 5, hemispheric, glabrous. *Gynoecium* 4.4-6 mm long, pink. *Fruit* 15-17.5 mm long, reflexed, discharge of seed-ejection type; mericarps 2.6-3.5 mm long, 1.1-2 mm wide, without a strand of fibers, not compressed at the apex, smooth, without basal beak, with a basal callus, without a basal prong, brown, with ± patent, eglandular hairs 0.1-0.5 mm long; rostrum 10.9-13 mm long, with a narrowed apex 0.5-1.6 mm long, not twisted, with patent, eglandular hairs 0.1-0.4 mm long and, sometimes, patent, glandular hairs 0.3-0.5 mm long; stigmatic remnants 2-2.9 mm long, with 5 glabrous lobes. *Seeds* 1.9-2 mm long, 1-1.3 mm wide, finely reticulate, uniformly colored, brownish red, glabrous. Cotyledons with entire margin. Figs. 542, 543.

Pollen. *Geranium*-type (Aedo & al. 2003: 98).

Chromosome number. Unknown.

Phenology. Collected in flower from January to December.

Distribution. This species is endemic to western Venezuela (Fig. 544).

Habitat. Disturbed areas, boggy paramo, damp or rocky places, among dwarf shrubs; 2600-3100 m.

Additional specimens examined. **Venezuela.** Trujillo: Bocono, Páramo de Guaramacal, below television towers, 9°13'N, 70°11'W, 18 July 1990, *Dorr & al. 4955* (C, NY); Boconó, Páramo de Guaramacal, 9°13'N, 70°11'W, 29 July 2010, *Grande & Aedo 2440* (MA); Boconó, Páramo de Guaramacal, 9°13'N, 70°11'W, 29 July 2010, *Grande & Aedo 2448* (MA); Bocono, Parque Nacional de Guaramacal, NE slopes of Cerro Guacamaral between laguna de Los Cedros and the summit of the road to Guacamaral, 9°13'N, 70°11'W, 21 Sep. 2003, *Stergios 20641* (MA); entre Boconó y Guaramacal, cumbre del Páramo de Guaramacal, 9°13'N, 70°11'W, 25 Feb. 1971, *Steyermark 104856* (VEN); Páramo de Guaracamal, 9°13'N, 70°11'W, 3 Feb. 1987, *Werff & al. 8863* (MO); Bocono, Páramo de Guaramacal, SE Bocono, 9°14'N, 70°11'W, 18 July 1990, *Dorr & al. 7381* (C, NY); Bocono, Páramo de Guaramacal, from summit of Boconó, caserío de Guaramacal road to the television towers, 9°14'N, 70°11'W, 13 June 2001, *Dorr & al. 8944* (MA); Boconó, Páramo de Guaramacal, 9°14'N, 70°11'W, 29 July 2010, *Grande & Aedo 2460* (MA); Parque Nacional Guaramacal, Fila de Agua Fría, 9°16'N, 70°8'W, Jan. 1996, *Stergios & Zambrano 17694* (MA).

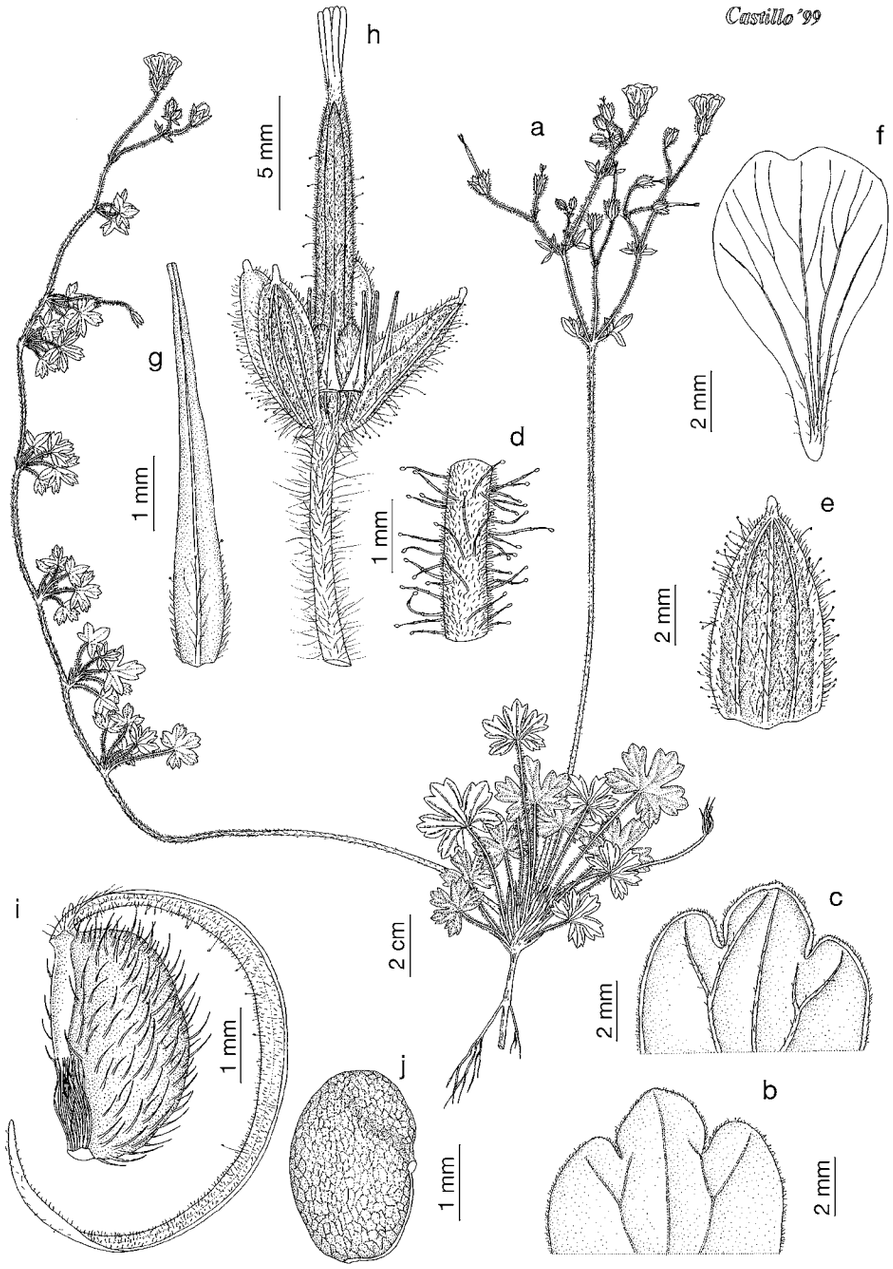


Fig. 542. *Geranium stoloniferum*. a. Habit. b. Detail of leaf, adaxial side. c. Detail of leaf, abaxial side. d. Peduncle. e. Sepal. f. Petal. g. Staminal filament. h. Fruit. i. Mericarp. j. Seed. (Based on: a, e-j, *Dorr & al. 4955*, NY; b-d, *Dorr & al. 7381*, NY).

Discussion. Geranium stoloniferum is known from only two small areas in the southeastern region of the state of Trujillo (Venezuela). It is well characterized by its peculiar habit; from a basal rosette of leaves arises one erect main stem, bearing a well-developed dichasial inflorescence, and one or two herbaceous procumbent stolons. These epigeal stolons arise from the inner part of the rosette and are up to 20 cm long; they have several pairs of opposite leaves (rarely alternate towards the apex) and terminate in a bud. The stolons apparently are produced during one growing season. *Geranium stoloniferum* also has some hypogeous lignified stolons. These arise from the external portion of the rosette, are ramified, and reach a length of 100 cm. They bear some secondary rosettes and terminate in a rosette as well. Such stolon formation may be an adaptive strategy for colonizing wide areas. In fact, individuals of *G. stoloniferum* form extensive patches in the paramo. The stolon formation *G. stoloniferum* is very rare in the genus and is quite unlike the vegetative stems found in *G. holosericeum*, which are entirely covered by stipules. Bono (1996: 554) recorded *G. stoloniferum* from the Páramo de Tamá (Táchira, Venezuela) on limestone (*Steyermark 57348*). Unfortunately, I have not located any specimen of this collection and could not verify the determination.

Fig. 543. *Geranium stoloniferum* (Based on: *Grande & Aedo 2440,* MA).

Fig. 544. Distribution of *Geranium stoloniferum*.

214. Geranium velutinum Turcz., Bull. Soc. Imp. Naturalistes Moscou 31(2): 417. 1858. Type locality: "Venezuela, in prov. Meridensi, Paramo de Portechuelo, alt. 8500 ped. Funk et Schlim n. 1251". Type: Venezuela. Mérida, Páramo de Portachuelo, 8°10'N, 71°54'W, *N. Funck & L.J. Schlim 1251* (lectotype, designated by Aedo & al. 2003: 121, KW-001001018 image!).

Perennial herbs, 20-40 cm tall. *Rootstock* 4.3-9 mm in diameter, ± vertical, not tuberculate, not turnip-shaped, with thickened roots. *Stem* erect, leafy, not rooting at nodes, stolons absent, without vegetative stems, with patent (sometimes retrorse, appressed), eglandular hairs 0.1-1.1 mm long. *Basal leaves* in a persistent rosette, cauline leaves opposite; leaf laminas (1.9)3.6-5.8 cm long, 2.3-7 cm wide, not peltate, palmatifid [ratio main-sinus length/middle segment length = 0.50-0.70(0.80)], polygonal in outline, base cordate, coriaceous or subcoriaceous, with nerves projected on the abaxial surface, sunken adaxially, pilose, with appressed, eglandular hairs on the adaxial surface and, usually, velutinous (with eglandular hairs, longer on the nerves) abaxially; segments 5(7), in 1 plane, middle segment obtriangular, 4.1-11.8 mm wide at the base [ratio segment width at the base/middle segment length = 0.26-0.45], 3-5(9)-lobed in distal half [ratio secondary sinus length/middle segment length = 0.09-0.24]; petioles up to 27 cm long, without abscission zone, terete, not swollen, not deflexed in age, with usually patent, eglandular hairs 0.1-0.7 mm long; stipules 3-14.7 mm long, 0.9-3.5 mm wide, lanceolate, free, papery, brownish red, with eglandular hairs on abaxial surface and on the margin, glabrous adaxially. *Inflorescence* a dichasial cyme; cymules 2-flowered, solitary [ratio cymule length/leaf length = 1.5-5.9]; peduncles (8.8)25-70 mm long, with patent, eglandular hairs 0.1-1 mm long and, usually, patent, glandular hairs 0.3-1 mm long; bracteoles 1.4-7 mm long, 0.6-1.5 mm wide, lanceolate, whorled; pedicels 10.7-31 mm long, with patent, eglandular hairs 0.1-1 mm long and, usually, patent, glandular hairs 0.3-1 mm long. Flowers actinomorphic. *Sepals* (4.5)6-8 mm long, (1.9)2.5-4 mm wide, lanceolate, smooth, not accrescent, nerves 3, mucro 0.2-1 mm long [ratio mucro length/sepal length = 0.06-0.14], with ± patent, eglandular hairs 0.2-1 mm long and, usually, erect-patent, glandular hairs 0.2-1 mm long and on the abaxial surface, glabrous adaxially. *Petals* (9.6)11-12.5 mm long, 5.6-8.6 mm wide, erect-patent, rounded or slightly emarginate (notch ca. 0.5 mm deep), without claw, purple, sometimes white, glabrous or hairy on the base of the adaxial surface, ciliate on the basal margin, with hairs 0.1-0.4 mm long. *Stamens* 10, both whorls bearing anthers; filaments 3.6-5.5 mm long, lanceolate, yellow, pilose on the abaxial surface, ciliate on the proximal half, with eglandular hairs 0.1-0.6 mm long; anthers 1.1-1.4 mm long, yellow. Nectaries 5, hemispheric, glabrous. *Gynoecium* 3.9-7 mm long, pink. *Fruit* 15.7-21.6 mm long, reflexed, discharge of seed-ejection type; mericarps 2.5-3.6 mm long, 1.1-3.4 mm wide, without a strand of fibers, not compressed at the apex, smooth, without basal beak, with a basal callus, without a basal prong, brown, with erect-patent, eglandular hairs 0.3-1.5 mm long; rostrum 9.7-17 mm long, with a narrowed apex 1-1.5 mm long, not twisted, with erect-patent, eglandular hairs 0.3-0.8 mm long and, sometimes, patent, glandular hairs 0.3-0.8 mm long; stigmatic remnants 2-3 mm long, with 5 glabrous lobes. *Seeds* 2.1-2.6 mm long, 1-1.4 mm wide, finely reticulate, uniformly colored, brownish red, glabrous. Cotyledons with entire margin. Figs. 545, 546.

Pollen. *Geranium*-type (Aedo & al. 2003: 98).

Chromosome number. Unknown.

Phenology. Collected in flower from February to December.

Distribution. This species ranges through western Venezuela (Fig. 547).

Habitat. Roadside banks, shrublands, damp places, *Espeletia* Mutis ex Bonpl. and edge of montane forests; 2550-3600 m.

Additional specimens examined. **Venezuela.** Lara: Parque Nacional Dinira, Páramo de Jabón, ladera NE, 9°33'N, 70°6'W, 13 Aug. 1999, *Riina & al. 523* (MA); Parque Nacional Dinira, Páramo de Jabón, vertiente hacia Tocuyo, sector Los Charquitos, 9°34'N, 70°6'W, 15 Aug. 1999, *Riina & al. 703* (MA); departamento Morán, trail from Humocaro to Buenos Aires (caserío) below Páramo Las Rosas, 9°36'N, 70°4'W, 25 June 1979, *Liesner & al. 8033* (VEN). Mérida: Páramo El Batallón, 8°10'N, 71°54'W, 18 Nov. 1976, *Charpin & al. 13532* (C, G, MA); pr. Bailadores, entre Río Arriba y el Portachuelo, 8°11'N, 71°54'W, 9 Aug. 2010, *Grande & Aedo 2618* (MA); Páramo de la Negra above Bailadores, 8°15'N, 71°52'W, 13 Feb. 1939, *Alston 7028* (BM, NY); Páramo La Negra between Tovar and La Grita, 8°15'N, 71°52'W, 7 Oct. 1965, *Breteler 4620* (K, MO, NY, S, US); Páramo de la Negra, pr. Bailadores, 8°15'N, 71°52'W, 8 Aug. 2010, *Grande & Aedo 2616* (MA); Páramo de la Negra, pr. Bailadores, 8°15'N, 71°52'W, 8 Aug. 2010, *Grande & Aedo 2617* (MA); Páramo La Negra, 8°15'N, 71°52'W, 23 Nov. 1976, *Stergios 763* (PORT); Páramo de Aricagua, 8°16'N, 71°13'W, 31 Mar. 1922, *Jahn 1004* (GH, VEN); Páramo de Mucuquí, sobre Pueblo Nuevo, 8°18'N, 71°22'W, 7 Dec. 1952, *Bernardi 90* (NY); Páramo Quirorá, 8°19'N, 71°26'W, 8 Oct. 1921, *Jahn 724* (GH); Sucre, Estanques, estribaciones del Páramo de Quirorá,

8°19'N, 71°26'W, 19 Feb. 1970, *Ruiz Terán & López Figueras 11* (MO, NY, VEN); Páramo de Pozo Negro, between San José and Beguilla, 8°20'N, 71°18'W, 3 May 1944, *Steyermark 56266* (F); Páramo de Mucuchíes, 8°51'N, 70°48'W, Dec., *Gutzwiller 19* (NY). TÁCHIRA: pr. El Cobre, Páramo del Zumbador, 7°55'N, 72°4'W, 10 Aug. 2010, *Grande & Aedo 2638* (MA); de civitate La Grita ad civitatem Pregonero, 8°6'N, 71°53'W, 9 Oct. 1965, *Bernardi 10969* (G, K); Páramo del Batallón, 8°8'N, 71°54'W, 9 Aug. 2010, *Grande & Aedo 2623* (MA); Uribante, faldas y quebradas afluentes a las cabeceras del río Uribante, 44 km SW de Pregonero, 8°9'N, 71°53'W, 28 Sep. 1981, *Steyermark & Manara 125442* (VEN); Jáuregui, entre el Portachuelo y la antena de CANTV, Páramo Batallón, 8°10'N, 71°54'W, 8 Aug. 1976, *Benítez 2044* (MO); base del Páramo de El Batallón, entre Portachuelo y la entrada al Páramo del Batallón, 8°10'N, 71°54'W, 13 Aug. 1974, *López Figueras 9155* (F, U); Páramo Portachuelo, 8°10'N, 71°55'W, 23 Oct. 1978, *Luteyn & Lebrón-Luteyn 6025* (F, U, VEN); Páramo Batallón, sector Portachuelo, entrando por Portachuelo y Las Porqueras, 8°10'N, 71°54'W, 27 Dec. 1976, *Stergios 772* (MO, NY); Páramo Batallón, sector de las Antenas, entrando por Portachuelo y las Porqueras, 8°10'N, 71°54'W, 27 Dec. 1976, *Stergios 773* (PORT); Páramo Batallón, sector Portachuelo, La Grita, 8°10'N, 71°54'W, 27 Dec. 1976, *Stergios 815* (PORT); Páramo Batallón, entrando por Portachuelo y las Porqueras, 8°10'N, 71°54'W, 27 Dec. 1976, *Stergios 863* (PORT); Páramo del Batallón, 8°10'N, 71°54'W, 3 Oct. 1956, *Vareschi 5544* (VEN); Páramo del Batallón, 8°10'N, 71°54'W, 3 Oct. 1956, *Vareschi 5565* (VEN); La Grita, Páramo La Negra, 8°14'N, 71°52'W, 10 Nov. 2000, *Stancik 4273* (PRC); Jáuregui, Páramo La Negra, 8°15'N, 71°53'W, 19 Aug. 1988, *Badillo & al. 7964* (F); Páramo de la Negra, between La Grita and Bailadores, 8°15'N, 71°52'W, 19 July 1944, *Steyermark 57472* (F, NY, VEN). TRUJILLO: municipio Carache, Parque Nacional Dinira, arriba de Mesa Arriba, debajo de pico Cendé, ladera SW, 9°33'N, 70°7'W, 1 Apr. 1999, *Duno & al. 744* (MA); Parque Nacional Dinira, Páramo de Jabón, cumbre pico Jabón, 9°34'N, 70°7'W, 14 Aug. 1999, *Riina & al. 582* (MA); Parque Nacional Dinira, Páramo de Jabón, cumbre pico Jabón, 9°34'N, 70°7'W, 14 Aug. 1999, *Riina & al. 590* (MA); La Quebrada Cortijo, by boundary line Lara-Trujillo, above Humocaro Bajo, 9°41'N, 70°0'W, 6 Feb. 1944, *Steyermark 55345* (F, NY, VEN).

Discussion. Pittier (1929: 180) considered *G. velutinum* to be conspecific with *G. multiceps*, but *G. velutinum* may be easily separated from that species by the glandular hairs on peduncles, pedicels, and sepals. Unusual specimens with sparse glandular hairs are recognized as *G. velutinum* by the coriaceous or subcoriaceous, flat leaves, velutinous abaxially, and by the reflexed fruits. In contrast, *G. multiceps* has membranaceous, funnel-shaped leaves with short, patent, eglandular hairs that are restricted to the margin (rarely scattered on both surfaces) and erect fruits. *Geranium velutinum* is also similar to *G. subnudicaule*, which has membranaceous leaves with eglandular hairs on the nerves of the abaxial surface and erect mature fruit. *Geranium velutinum* has a vertical rootstock that is more or less branched and stout,

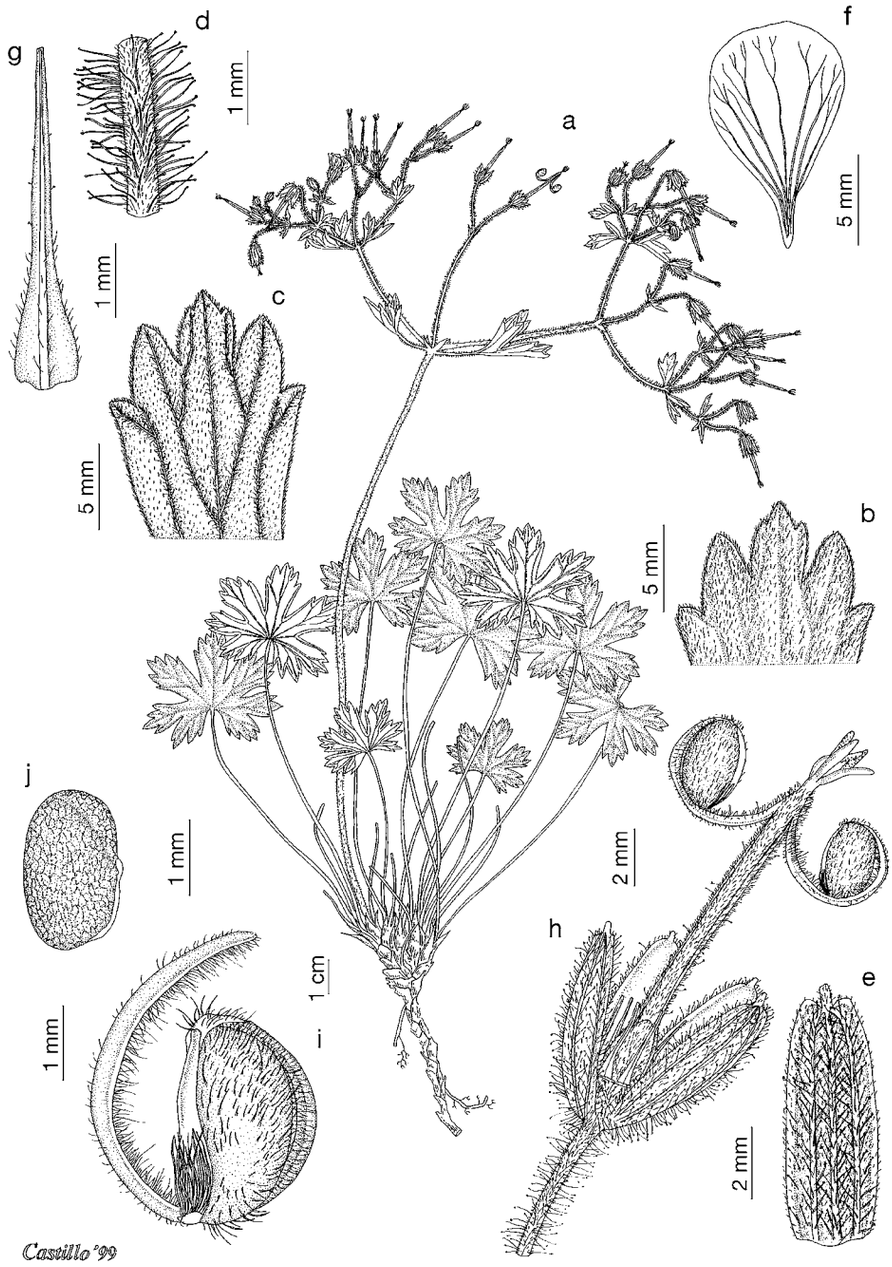


Fig. 545. *Geranium velutinum*. a. Habit. b. Detail of leaf, adaxial side. c. Detail of leaf, abaxial side. d. Peduncle. e. Sepal. f. Petal. g. Staminal filament. h. Fruit. i. Mericarp. j. Seed. (Based on: a-c, *Alston 7028*, BM; d, e, g-j, *Breteler 4620*, US; f, *Stergios 763*, PORT).

Fig. 546. *Geranium velutinum* (Based on: a-c, *Grande & Aedo 2616,* MA; d-e, *Grande & Aedo 2618,* MA; f-g, *Grande & Aedo 2638,* MA).

Fig. 547. Distribution of *Geranium velutinum*.

with fusiform roots, whereas in *G. subnudicaule* the vertical rootstock is unbranched and thin, with delicate roots. It is noteworthy that the fruits of *G. velutinum* are reflexed when young, but become erect at maturity. Some collections show variation in vesture. Usually, *G. velutinum* has patent, glandular hairs (to 1 mm long) on the distal part of stems, inflorescences (peduncles, pedicels, sepals), and the fruit rostrum; however, in some specimens glandular hairs are sparse or absent (e.g., *Ruiz Terán & López Figueiras 11*, NY). Some collections from Dinira National Park, located between Lara and Trujillo (e.g., *Riina & al. 703*, MA; *Duno & al. 744*, MA), have leaves covered abaxially by a sparser indumentum than found in most collections. The collection *Luteyn & al. 6025* is a mixed gathering; the sheets at F and U are *G. velutinum*, but the sheet at MO is *G. lindenianum*.

215. Geranium subnudicaule Turcz., Bull. Soc. Imp. Naturalistes Moscou 31(2): 418. 1858. Type locality: "Sierra Nevada prov. Meridensis Venezuelae, alt. 9000 ped. Funck et Schlim n. 1127". Type: Venezuela. Mérida, Sierra Nevada, 8°33'N, 71°03'W, *N. Funck & L.J. Schlim 1127* (lectotype, designated by Aedo & al. 2003: 119, KW-001001017 image!; isotypes, BM-000543794!, BR-0000005108978!, G-00365773!, LD-1512952!, LE-00002582!, MPU-018507!, P-00758023!, W!).

Perennial herbs, 24-83 cm tall. *Rootstock* 2.7-4 mm in diameter, ± vertical, not tuberculate, not turnip-shaped, without thickened roots. *Stem* erect, leafy, not rooting at nodes, stolons absent, without vegetative stems, with scattered patent, eglandular hairs 0.1-0.6 mm long. *Basal leaves* in a persistent rosette, cauline leaves opposite; leaf laminas 2-4.8 cm long, 2.4-5.5 cm wide, not peltate, palmatifid [ratio main-sinus length/middle segment length = 0.65-0.82], polygonal in outline, base cor-

date, not coriaceous, with nerves not projected, pilose, with ± appressed, mostly eglandular hairs on the adaxial surface, and with eglandular hairs on the nerves of the abaxial surface; segments 5, in 1 plane, middle segment obtriangular, 3.6-12.4 mm wide at the base [ratio segment width at the base/middle segment length = 0.24-0.46], 7-13-lobed in distal half [ratio secondary sinus length/middle segment length = 0.12-0.25]; petioles up to 30 cm long, without abscission zone, terete, not swollen, not deflexed in age, with scattered, patent, eglandular hairs 0.1-0.4 mm long; stipules 6.5-10.2 mm long, 1.8-3.8 mm wide, lanceolate, free, papery, brownish red, with eglandular hairs on abaxial surface and on the margin, glabrous adaxially. *Inflorescence* a dichasial cyme; cymules 2-flowered, solitary [ratio cymule length/leaf length = 2.3-5.8]; peduncles 20-50 mm long, with patent, eglandular hairs 0.15-1.1 mm long and patent, glandular hairs 0.3-0.9 mm long; bracteoles 2-3.5 mm long, 0.5-1.5 mm wide, lanceolate, whorled; pedicels 11-27 mm long, with patent, eglandular hairs 0.15-0.7 mm long and patent, glandular hairs 0.3-1.1 mm long. Flowers actinomorphic. *Sepals* 5.1-8 mm long, 2.1-3.5 mm wide, lanceolate, smooth, not accrescent, nerves 3, mucro 0.4-0.6 mm long [ratio mucro length/sepal length = 0.05-0.12], with ± patent, eglandular hairs 0.1-0.7 mm long and erect-patent, glandular hairs 0.3-1 mm long on the abaxial surface, glabrous adaxially. *Petals* 6.8-9 mm long, 2.8-5.5 mm wide, erect-patent, rounded or slightly emarginate (notch 0.3-0.9 mm deep), without claw, purple, glabrous. *Stamens* 10, both whorls bearing anthers; filaments 3-4.4 mm long, lanceolate, yellow, pilose on the abaxial surface, ciliate on the proximal half, with eglandular hairs 0.2-0.5 mm long; anthers 0.7-0.9 mm long, unknown color. Nectaries 5, hemispheric, glabrous. *Gynoecium* 3.1-6.3 mm long, unknown color. *Fruit* 17.9-21.3 mm long, erect, discharge of seed-ejection type; mericarps 3-3.5 mm long, 1.5-2 mm wide, without a strand of fibers, not compressed at the apex, smooth, without basal beak, with a basal callus, without a basal prong, brown, with scattered, erect-patent, eglandular hairs 0.2-1.2 mm long; rostrum 12-16 mm long, with a narrowed apex 1-2 mm long, not twisted, with erect-patent, eglandular hairs 0.15-1.2 mm long and, sometimes, patent, glandular hairs 0.5-1 mm long; stigmatic remnants 2-3 mm long, with 5 hairy lobes. *Seeds* 1.9-2.4 mm long, 0.9-1.5 mm wide, finely reticulate, uniformly colored, brownish red, glabrous. Cotyledons with entire margin. Fig. 548.

Pollen. *Geranium*-type (Aedo & al. 2003: 98).

Chromosome number. Unknown.

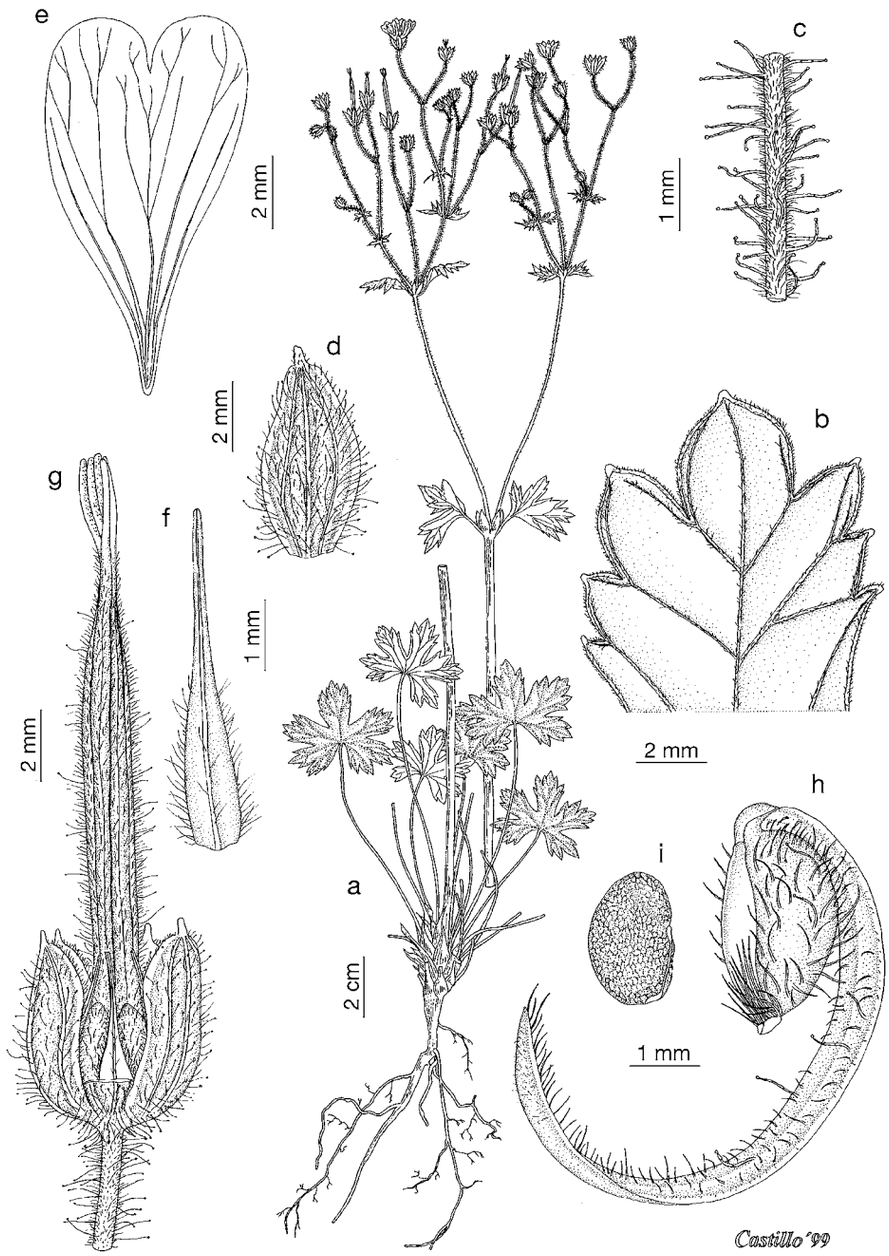


Fig. 548. *Geranium subnudicaule*. a. Habit. b. Detail of leaf, abaxial side. c. Peduncle. d. Sepal. e. Petal. f. Staminal filament. g. Fruit. h. Mericarp. i. Seed. (Based on: a, c, d-f, *Funck & Schlim 1127*, G; b, *Liden 413*, K; g-i, *Funck & Schlim 1128*, BM).

Fig. 549. Distribution of *Geranium subnudicaule*.

Phenology. Collected in flower in August.

Distribution. This species is endemic to western Venezuela (Fig. 549).

Habitat. Unknown; 2500-3000 m.

Additional specimens examined. **Venezuela.** Mérida: Sierra Nevada de Mérida, Aug., *Linden 413* (G, K, MPU, P, W).

Discussion. Geranium subnudicaule is similar to *G. velutinum*; see that species for a discussion of differences. Surprisingly, *G. subnudicaule* is known from only two old collections gathered near Mérida but without precise locality data (the label of Kew specimen, *Linden 413,* bear the questionable note "Caracas"). The area surrounding the city of Mérida has been frequently visited by botanical collectors; yet, the most recent record of *G. subnudicaule* dates from 1846. As noted in the discussion of *G. velutinum*, more field work is necessary to evaluate fully *G. subnudicaule* and its alliance with *G. velutinum*. The collection *Funck & Schlim 1128*, assigned by Aedo & al. (2003: 121) to *G. subnudicaule*, is *G. meridense*.

216. Geranium holosericeum Willd. ex Spreng., Syst. Veg. 3: 72. 1826. Type locality: "holosericeum W. herb. ... Amer. austr.? Humb.". Type: "Amer. austr.", *F.A. Humboldt & A. Bonpland s.n.* (lectotype, designated by Knuth 1912: 105, B-W-12568-01-0 image!).

Geranium gracilipes Triana & Planch., Ann. Sci. Nat., Bot. ser. 5, 17: 113. 1873. Type locality: "Quindio (Bonpland)". Type: Colombia. Quindío, 4°38'N, 75°32'W, *A. Bonpland s.n.* (lectotype, designated by Aedo & al. 2003: 102, P-00136935!).

Geranium holosericeum var. *stuebelii* R. Knuth in Engl., Pflanzenr. IV.129 (Heft 53): 105. 1912- Type locality: "Columbien: Cundinamarca, Páramo de Pasca 3700-3800 m (Stuebel, Fl. Col. a. 1868 n. 146 p.p.-Typ. in Herb. Berl.!)". Type: Colombia. Cundinamarca, Páramo de Pasca, 4°18'N, 74°18'W, *A. Stuebel 146 p.p.* (holotype, B destroyed; no original material located).

Perennial herbs, 19-60(100) cm tall. *Rootstock* 2.1-6.4 mm in diameter, ± vertical, not tuberculate, not turnip-shaped, unknown roots. *Stem* ascending or climbing, leafy, not rooting at nodes, stolons absent, with vegetative stems (5-10 cm long, ± horizontal, covered with imbricate stipules, usually without petiole remains), with patent, eglandular hairs 0.2-2.2 mm long and patent, glandular (only on the inflorescence) hairs 0.3-1 mm long. *Basal leaves* in a persistent rosette, cauline leaves opposite; leaf laminas 2.9-4.2(5) cm long, 3.2-5.2(6) cm wide, not peltate, palmatifid [ratio main-sinus length/middle segment length = (0.75)0.82-0.89], polygonal in outline, base cordate, not coriaceous, with nerves not projected, pilose, with eglandular, appressed hairs on both surfaces; segments 5, in 1 plane, middle segment rhombic, 3-9.5 mm wide at the base [ratio segment width at the base/middle segment length = 0.11-0.35], 5-10(15)-lobed in distal half [ratio secondary sinus length/middle segment length = 0.12-0.32]; petioles up to 25 cm long, without abscission zone, terete, not swollen, not deflexed in age, with patent, eglandular hairs 0.2-2.1 mm long and, rarely, patent, glandular hairs 0.2-0.3 mm long; stipules 7-17.7 mm long, 2.2-5.1 mm wide, lanceolate (with a setaceous apex 1-3.2 mm long), free, papery, brownish red, with eglandular hairs on abaxial surface and on the margin, glabrous adaxially. *Inflorescence* a dichasial cyme; cymules 2-flowered, solitary [ratio cymule length/leaf length = 2-6.2]; peduncles (18)30-100(130) mm long, with patent to retrorse, eglandular hairs 0.15-2.5 mm long and patent, glandular hairs 0.3-1.3 mm long; bracteoles 4-9 mm long, 0.8-1.5 mm wide, lanceolate to subulate, whorled; pedicels 9.5-36 mm long, with patent to retrorse, eglandular hairs 0.15-1.6 mm long and patent, glandular hairs 0.2-1.7 mm long. Flowers actinomorphic. *Sepals* 6-7.9(9) mm long, 2.8-4.5 mm wide, lanceolate, smooth, not accrescent, nerves 3-5, mucro 0.4-0.8 mm long [ratio mucro length/sepal length = 0.05-0.12], with ± patent, eglandular hairs 0.3-1.5 mm long and patent, glandular hairs 0.3-1.4 mm long on the abaxial surface, almost glabrous adaxially. *Petals* 10-13.3(14.6) mm long, 6.2-11.7 mm wide, erect-patent, rounded or slightly emarginate (notch ca. 1 mm deep), without claw, purple, glabrous on the adaxial surface, hairy on the base of the abaxial surface, ciliate on the basal margin, with hairs 0.2-0.8 mm long. *Stamens* 10, both whorls bearing anthers; filaments 4-6.3 mm long, lanceolate, yellow, pilose on the abaxial surface, ciliate on all of its length, with eglandular hairs 0.3-1 mm long; anthers 1-1.7 mm long, unknown color. Nectaries 5, hemispheric, glabrous. *Gynoecium* 4.7-8.2 mm long, yellow. *Fruit* 20-25.4 mm long, erect, discharge of seed-ejection type; mericarps 3.3-4.2 mm long, 1.6-2.1 mm wide, without a strand of fibers, not compressed at the apex, smooth, without basal beak, with a basal callus, without a basal prong, brown, with patent, eglandular hairs 0.15-1.4 mm long and ± patent, glandular hairs 0.3-1.3 mm long; rostrum 13-18.3 mm long, with a narrowed apex 1.2-2.2 mm long, not twisted, with patent, eglandular hairs 0.15-1 mm long and ± patent, glandular hairs 0.3-1 mm long; stigmatic remnants 2.8-3.6 mm long, with 5 glabrous lobes. *Seeds* 2.2-2.5 mm long, 1.2-1.6 mm wide, finely re-

ticulate, uniformly colored, brownish red, glabrous. Cotyledons with entire margin. Fig. 550.

Pollen. *Geranium*-type (Aedo & al. 2003: 98; Aedo & al. 2009: 228).

Chromosome number. Unknown.

Phenology. Collected in flower from February to November.

Distribution. This species ranges through central Colombia (Fig. 551).

Habitat. Pool margins, wet meadows, and bogs, among *Espeletia* Mutis ex Bonpl., *Polylepis* Ruiz & Pav., and *Weinmannia* L.; 2550-4000 m.

Representtive specimens examined. **Colombia.** Boyacá: Pesca, Páramo de la Cortadera, vereda La Peña, 5º33'N, 73º3'W, 14 Aug. 1982, *Bejarano 222* (COL); km 118 on road between Tunja and Bogotá, 5º33'N, 73º23'W, 31 Aug. 1953, *Langenheim 3661* (MICH, US); entre Arcabuco y Tunja, cruce carretera a Cómbita, 5º39'N, 72º26'W, 5 June 1989, *Castroviejo & al. 10686* (COL, MA, MO); Socha, Páramo de Pisba, Laguna Colorada, 5º43'N, 72º50'W, Aug. 1976, *Rangel & al. 527* (COL); Cordillera Oriental, Sierra Nevada del Cocuy, valle Ritacuva, 6º39'N, 72º18'W, 4 Apr. 1959, *Barclay & Juajibioy 7215* (MO). Caldas: carretera al Nevado del Ruiz, 4º54'N, 75º18'W, 30 Aug. 1966, *Panchón & al. 65* (COL). Cundinamarca: Chisaca, valley between Usme and Nazareth, 4º13'N, 74º11'W, 16 July 1998, *Stancik 289* (COL, PRC); Páramo de Sumapaz, Chisacá, cerca de la carcel destruida, 4º17'N, 74º12'W, 12 July 1972, *Cleef 4914* (COL, U); laguna de Verjón, above Bogotá, 4º30'N, 74º3'W, Oct., *Ariste-Joseph (brother) 755* (US); valle del río San Cristóbal, alto de la Horqueta, 4º34'N, 74º5'W, 16 Nov. 1958, *García Barriga 16140* (COL); Subachoque, 4º55'N, 74º10'W, 7 June 2007, *Fernández Alonso 26612* (COL, MA); Zipaquirá, en Pantano Redondo, 5º1'N, 74º0'W, 23 Oct. 1949, *Romero Castañeda 1831* (COL); Carupa, subida a Sumangá, 5º21'N, 73º54'W, July 1974, *Uribe 6817* (COL, MO). Meta: Macizo de Sumapaz, vertiente oriental de la cordillera, Hoya de la quebrada El Buque, 3º52'N, 74º25'W, 9 July 1981, *Díaz Piedrahita & al. 2733* (COL); Cubarral, laguna de la Guitarra, Páramo de Sumapaz, 4º5'N, 74º12'W, 10 July 1981, *Franco & Rangel 305* (COL). Norte de Santander: Pamplona SW de la ciudad, por el Piñuelal, 7º24'N, 72º38'W, 30 June 1945, *Garganta Fábrega 1039* (F); Nlle. Grenade, prov. de Ocaña, 8º15'N, 73º18'W, 1846-52, *Schlim 1129* (BM, G, P). Norte de Santander-Santander: Cordillera Oriental, Páramo cerca de la carretera Pamplona-Bucaramanga, 7º12'N, 72º50'W, 18 June 1966, *Schulz & al. 439* (U). Santander: near Mutisqua, N. Granada, 6º8'N, 73º29'W, 1848 (K).

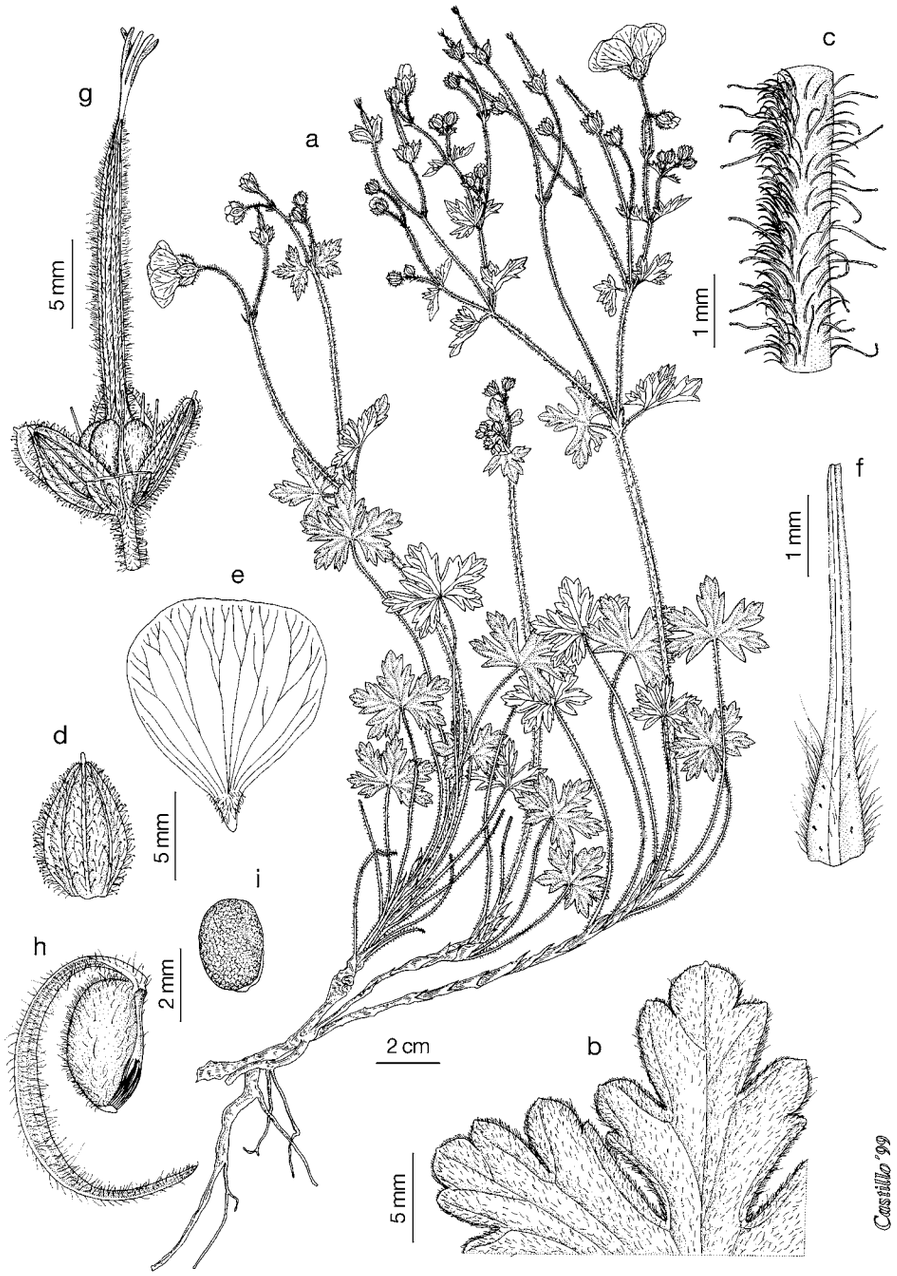


Fig. 550. *Geranium holosericeum*. a. Habit. b. Detail of leaf, adaxial side. c. Peduncle. d. Sepal. e. Petal. f. Staminal filament. g. Fruit. h. Mericarp. i. Seed. (Based on: *Uribe 6787*, COL).

Fig. 551. Distribution of *Geranium holosericeum*.

Discussion. Geranium holosericeum is characterized by the unusual "vegetative stems" and its dichotomously branched, lax inflorescence bearing 2-flowered, loose cymules, even towards the apex of the branches. The current circumscription follows the account of Aedo & al. (2009), a reassessment and elaboration of a previous study. Aedo & al. (2003) emphasized the presence of structures they termed "vegetative stems". *Geranium holosericeum* produces towards the apex of its branches a kind of bud, sometimes quite long, covered by stipules (usually without petiole remains), which bears a rosette of leaves and an inflorescence. Such structures may be the result of growth of each vegetative period and are also found in some stemless species from the Andes (Aedo & al. 2003). In the publication by Aedo & al. (2003) some collections now assigned to *G. lindenianum* and to *G. schultzei* were included in the circumscription of *G. holosericeum*, but study of newly available additional material allowed for more precise delimitation of species limits.

Geranium holosericeum can be distinguished from *G. lindenianum* by its sepals with a shorter mucro. Although with some overlap, additional discriminating characters include the length of sepals, petals, petal hairs, and fruits, which are all shorter in *G. holosericeum*. Field observations showed that both species differ in habit; *G. holosericeum* is an ascending, weak plant that usually leans on the surrounding vegetation, whereas *G. lindenianum* develops an erect and robust stem. Unfortunately, these aspects are difficult to appreciate in the fragments that constitute herbarium specimens. Both species are sympatric in the paramos dividing departments of Santander and Norte de Santander, Colombia. Southward only *G. holosericeum* has been found, but *G. lindenianum* occurs both in Venezuelan paramos and in Sierra de Perijá.

Geranium schultzei, for which only one collection (*Hanbury-Tracy 441*, K) had been seen by Aedo & al. (2003) in their earlier study, is now recognized as an endemic of the Sierra de Santa Marta (Magdalena, Colombia). It is an erect, robust species with an inflorescence similar to that of *G. lindenianum*, but it lacks vegetative stems, and its lanceolate stipules are without a setaceous apex.

Stipule shape also serves distinguish *G. holosericeum* from *G. killipii*, which has a monochasial inflorescence with cymules at each node, unlike the dichasially branched inflorescence of *G. holosericeum*. In some herbarium fragments the inflorescence structure is not apparent, and then the setaceous stipule apex of *G. holosericeum* permits correct identification.

---

217. Geranium schultzei R. Knuth, Repert. Spec. Nov. Regni Veg. 28: 2. 1930. Type locality: "Colombia: Sierra Nevada de Santa Marta, in Steingeröll der rechten Moräne des alten Aracataca-Gletschers, bei 3900 m. (A. Schultze a. 1928 n. 1328. -- Typus in herb. Berol.!) -- Fruchtend März". Type: Colombia. Magdalena. Sierra Nevada de Santa Marta, old Aracataca glacier, 10°35'N, 74°11'W, 1928, *A. Schultze 1328* (holotype, B destroyed). Colombia. Magdalena, Sierra Nevada de Santa Marta, 30 mi inland from Dibulla, 10°50'N, 73°28'W, July 1932, *W. Seifriz 462* (neotype, designated by Aedo & al. 2009: 233, US-1572282!).

Perennial herbs, 36-88(100) cm tall. *Rootstock* 5.5-9.7 mm in diameter, ± horizontal, not tuberculate, not turnip-shaped, unknown roots. *Stem* erect, leafy, not rooting at nodes, stolons absent, without vegetative stems, with patent, eglandular hairs 0.6-1.9 mm long and, usually, patent, glandular hairs 0.3-0.4 mm long. *Basal leaves* in a ± persistent rosette, cauline leaves opposite; leaf laminas 4.5-6.6 cm long, 6.3-9.9 cm wide, not peltate, palmatifid [ratio main-sinus length/middle segment length = 0.70-0.95], polygonal in outline, base cordate, not coriaceous, with nerves not projected, pilose, with ± erect, eglandular hairs and sometimes glandular hairs on both surfaces; segments 5, in 1 plane, middle segment rhombic, 3.1-9.6 mm wide at the base [ratio segment width at the base/middle segment length = 0.07-0.21], (9)14-22-lobed in distal half [ratio secondary sinus length/middle segment length = 0.17-0.36]; petioles up to 42 cm long, without abscission zone, terete, not swollen, not deflexed in age, with patent to retrorse, eglandular hairs 0.1-1 mm long and, usually, patent, glandular hairs 0.2-0.5 mm long; stipules 6.4-21.7 mm long, 2-6 mm wide, lanceolate, free, papery, dark reddish, usually with eglandular hairs on the margin and glabrous on both surfaces. *Inflorescence* a dichasial cyme; cymules 2-flowered, solitary or in aggregates at the top of each branch [ratio cymule length/leaf length = 1.1-3.2]; peduncles 21-57 mm long, with patent, eglandular hairs 0.6-2.1 mm long and patent, glandular hairs 0.3-1.2 mm long; bracteoles 3.3-9.1 mm long, 0.9-1.8 mm wide, lanceolate, whorled; pedicels 20-41 mm long, with patent, eglandular hairs 0.3-1.2 mm long and patent, glandular hairs 0.4-1.4 mm long. Flowers actinomorphic. *Sepals* (6.8)7.6-9.7 mm long, 2.9-7.6 mm wide, lanceolate, smooth, not accrescent, nerves 3-5, mucro (0.6)1-1.7 mm long [ratio mucro length/sepal length = 0.10-0.2], with ± patent, eglandular hairs 0.3-1.2 mm long and patent, glandular hairs 0.6-0.9 mm long on the abaxial surface, almost glabrous adaxially. *Petals* (12.8)14.8-18.8 mm long, 6.7-1.7 mm wide, erect-patent, rounded, without claw, purple, rarely white, hairy on both surfaces, mainly on the base of the adaxial surface, ciliate on the basal margin, with hairs 0.5-0.8 mm long. *Stamens* 10, both whorls bearing anthers; filaments 4.4-6.9 mm long, lanceolate, unknown color, pilose on the abaxial surface, ciliate on the proximal half, with eglandular hairs 0.5-0.8 mm long; anthers 1.1-1.7 mm long, unknown color. Nectaries

5, hemispheric, glabrous. *Gynoecium* 4.4-7.4 mm long, unknown color. *Fruit* 25-29.6 mm long, erect, discharge of seed-ejection type; mericarps 3.5-4.3 mm long, 1.8-2.7 mm wide, without a strand of fibers, not compressed at the apex, smooth, without basal beak, with a basal callus, without a basal prong, brown, with patent, eglandular hairs 0.5-1.6 mm long and ± patent, glandular hairs 0.4-0.9 mm long; rostrum 15.9-20.4 mm long, with a narrowed apex 1.8-2.7 mm long, not twisted, with patent, eglandular hairs 0.1-0.8 mm long and patent, glandular hairs 0.6-0.9 mm long; stigmatic remnants 2.8-4.2 mm long, with 5 glabrous lobes. *Seeds* 2.1-2.7 mm long, 1.1-2 mm wide, finely reticulate, uniformly colored, brownish red, glabrous. Cotyledons with entire margin. Fig. 552.

Pollen. *Geranium*-type (Aedo & al. 2009: 226).

Chromosome number. Unknown.

Phenology. Collected in flower from May to August.

Distribution. This species is endemic to northern Colombia (Fig. 553).

Habitat. Wet paramo with shrubs, among large outcrops; 2700-3900 m.

Additional specimens examined. **Colombia.** La Guajira: above Macotama, 10º55'N, 73º30'W, 16 May 1939, *Hanbury-Tracy 441* (K). Magdalena: in the vicinity of two small lakes near source of río Yebosimeina, 10º45'N, 73º38'W, 24 May 1977, *White & Alverson 553* (MO, NY); Sierra Nevada de Santa Marta, transecto del Buritaca, filo La Cumbre, 10º52'N, 73º48'W, 15 Aug. 1977, *Rangel & Cleef 944* (COL); Sierra Nevada de Santa Marta, alrededores de cabeceras del río Sevilla, 10º53'N, 73º54'W, 20 Jan. 1959, *Barclay & Juajibioy 6678* (COL, MO, US); Sierra Nevada de Santa Marta, 1 km al NW de la quebrada de la Laguna Río Frío, en dirección al Pico José Hilario, 10º55'N, 73º53'W, 31 July 1972, *Forero & Kirkbride 634* (COL, NY); Sierra Nevada de Santa Marta, alrededores de las cabeceras del río Ancho, Páramo de Macotama, 10º57'N, 73º33'W, 16 Feb. 1959, *Barclay & Juajibioy 7034* (COL, MO).

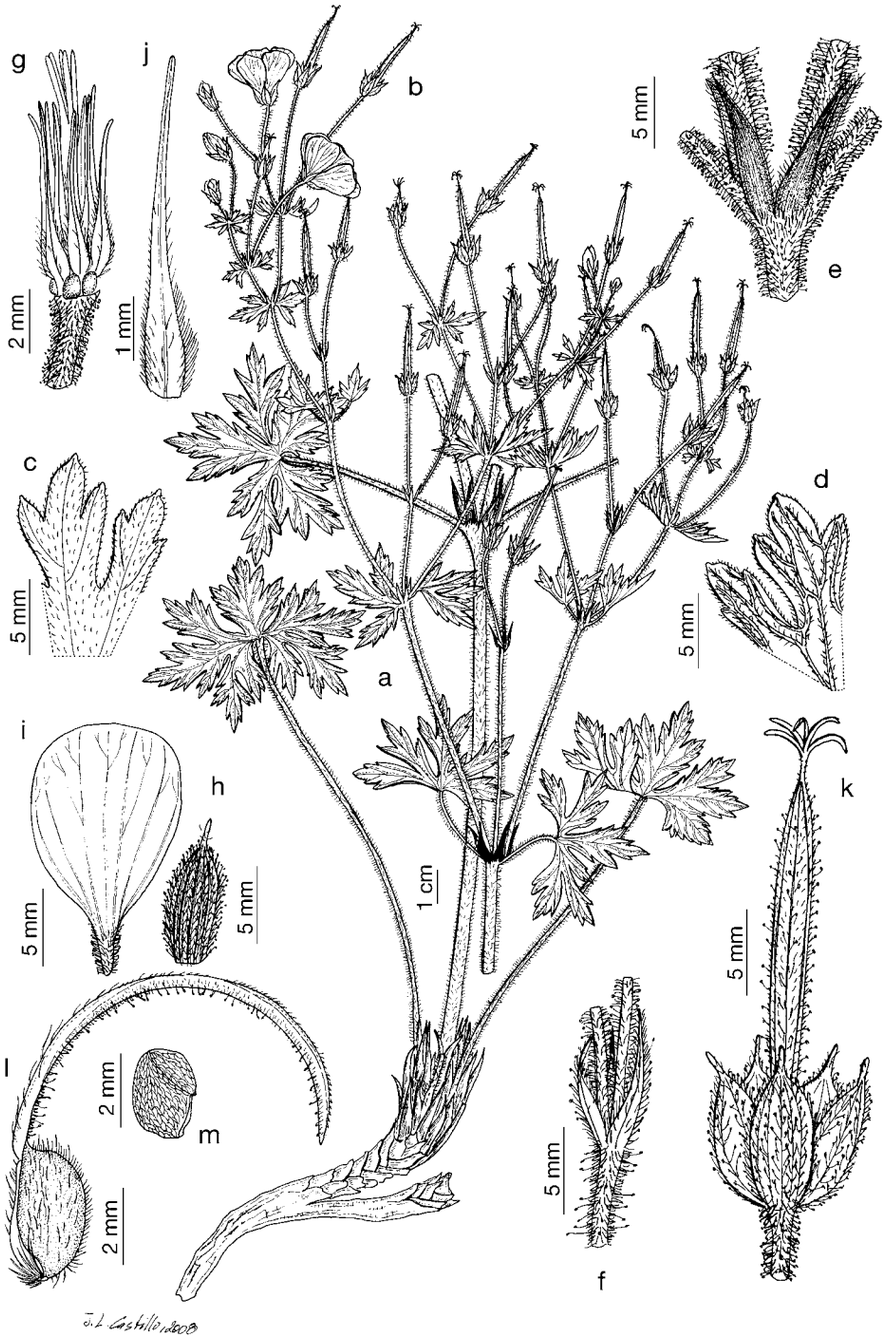


Fig. 552. *Geranium schultzei*. a, b. Habit. c. Detail of leaf, adaxial side. d. Detail of leaf, abaxial side. e. Stipules. f. Bracteoles. g. Flower, sepals and petals removed. h. Sepal. i. Petal. j. Staminal filament. k. Fruit. l. Mericarp. m. Seed. (Based on: *White & Alverson 553*, NY).

Fig. 553. Distribution of *Geranium schultzei*.

Discussion. Geranium schultzei was described by Knuth (1930a) as similar to *G. sylvaticum* in habit but up to 1.5 m high. Herbarium specimens of *G. schultzei* generally show robust plants with a strong rootstock from which a single, erect, thick, aerial stem arises that may reach 0.76 cm in diameter and ca. 1 m in length (according to the labels), yet it is herbaceous. *Geranium schultzei* is usually dichotomously branched and bears a large inflorescence with 2-flowered cymules at the first nodes and an aggregate of cymules (pseudoumbels) towards the apex of the branches. The stipules are usually long, glabrous on both surfaces, and remarkably dark reddish. The petals are (12.8)14.8-18.8 mm long. A glandular indumentum covers most of the plant but is only dense in the inflorescence. The leaf indumentum is composed of spreading, usually eglandular hairs that are longer than in *G. lignosum*. As noted above, *G. schultzei* was overlooked in the revision of section *Gracilia* by Aedo & al. (2003) and partially included in *G. holosericeum*, but it was recognized as an endemic of the Sierra Nevada de Santa Marta (Magdalena, Colombia) in the later study (Aedo & al. 2009). The collection *Forero 634* (COL, NY), without basal parts, has more deeply divided leaves than found in other specimens and hairy stipules, but it matches *G. schultzei* otherwise.

The holotype proposed by Knuth (1930a: 2) is lost, and no duplicate was found. Therefore, a neotype collected near the type locality and in agreement with the original description was designated.

218. Geranium lindenianum Turcz., Bull. Soc. Imp. Naturalistes Moscou 31(2): 418. 1858. Type locality: "Venezuela, Linden coll. u. 1394". Type: Venezuela. Páramo del Portachuelo, 8°10'N, 71°54'W, June 1843, *J. Linden 1394* (lectotype, designated by Aedo & al. 2003: 102, KW-001000002 imagen!; isotypes, FI-W!, K000531427!, LE!, MPU-018502!).

Perennial shrubby, 32-80(200) cm tall. *Rootstock* 7.2-10 mm in diameter, ± vertical, not tuberculate, not turnip-shaped, without thickened roots. *Stem* erect, leafy, not rooting at nodes, stolons absent, with vegetative stems (6-22 cm long, ± horizontal, covered with imbricate stipules, usually without petiole remains), with patent, eglandular hairs 0.5-2.3 mm long and, usually, patent, glandular hairs 0.1-1.2 mm long. *Basal leaves* deciduous, cauline leaves opposite; leaf laminas 4.3-10.4 cm long, 4.4-12 cm wide, not peltate, palmatifid [ratio main-sinus length/middle segment length = 0.80-0.90], polygonal in outline, base cordate, not coriaceous, with nerves not projected, pilose, with ± erect, eglandular hairs and sometimes glandular hairs on both surfaces; segments 5, in 1 plane, middle segment rhombic, 5-12.2 mm wide at the base [ratio segment width at the base/middle segment length = 0.10-0.23], 8-17-lobed in distal half [ratio secondary sinus length/middle segment length = 0.18-0.34]; petioles up to 15 cm long, without abscission zone, terete, not swollen, not deflexed in age, with patent to retrorse, eglandular hairs 0.4-2.6 mm long and, usually, patent, glandular hairs 0.2-0.6 mm long; stipules 9-25 mm long, 1.8-5.6 mm wide, lanceolate (with a setaceous apex 1.9-7.7 mm long), free, papery, brownish red, glabrous or with eglandular and, sometimes, glandular hairs on abaxial surface, ciliate on the margin, almost glabrous adaxially. *Inflorescence* a dichasial cyme; cymules 2-flowered, solitary or in aggregates at the top of each branch [ratio cymule length/leaf length = 1.1-3.4]; peduncles 14-85.2 mm long, with patent, eglandular hairs 0.2-2.1 mm long and patent, glandular hairs 0.3-1.6 mm long; bracteoles 6.9-14.5 mm long, 0.8-2.2 mm wide, lanceolate, whorled; pedicels 11-85 mm long, with patent, eglandular hairs 0.3-1.8 mm long and patent, glandular hairs 0.4-1.6 mm long. Flowers actinomorphic. *Sepals* (6.4)8-12.4 mm long, 3.7-5.3 mm wide, lanceolate, smooth, not accrescent, nerves 3-5, mucro (1.2)1.7-2.2 mm long [ratio mucro length/sepal length = 0.15-0.27], with ± patent, eglandular hairs 0.4-1.9 mm long and patent, glandular hairs 0.2-1.1 mm long on the abaxial surface, ± hairy adaxially. *Petals* (11.2)13.1-19.3 mm long, 6.5-11.5 mm wide, erect-patent, rounded, without claw, purple, hairy on both surfaces, mainly on the base of the adaxial surface, ciliate on the basal margin, with hairs 0.6-2.2 mm long. *Stamens* 10, both whorls bearing anthers; filaments 5.7-11.3 mm long, lanceolate, purple, pilose on the abaxial surface, ciliate on the proximal half, with eglandular hairs 0.5-1.3 mm long; anthers 1.6-2.8 mm long, blue. Nectaries 5, hemispheric, glabrous. *Gynoecium* 5.2-12.5 mm long, dark purple. *Fruit* 24.3-35.8 mm long, erect, discharge of seed-ejection type; mericarps 3.4-4.6 mm long, 1.7-2.4 mm wide, without a strand of fibers, not compressed at the apex, smooth, without basal beak, with a basal callus, without a basal prong, brown, with patent, eglandular hairs 0.8-1.3 mm long and, usually, ± patent, glandular hairs 0.6-0.9 mm long; rostrum 16-23.6 mm long, with a narrowed apex (1.7)2.2-6.6 mm long, not twisted, with patent, eglandular hairs 0.2-1.2 mm long and patent, glandular hairs 0.4-1.1 mm long; stigmatic remnants 2.7-5 mm long, with 5 glabrous lobes. *Seeds* 2.4-3.1 mm long, 1.4-1.9 mm wide, finely reticulate, uniformly colored, brownish red, glabrous. Cotyledons with entire margin. Figs. 554, 555.

Pollen. *Geranium*-type (Aedo & al. 2009: 228).

Chromosome number. Unknown.

Phenology. Collected in flower from February to November.

Distribution. This species ranges from western Venezuela to northern Colombia (Fig. 556).

Habitat. Roadside slopes, among rocks, in wet paramo, and among shrubs; 2700-3500 m.

Additional specimens examined. **Colombia.** César: Sierra de Perijá, 25 km E of Codazzi, on the Venezuelan border,

10º2'N, 72º58'W, 16 Feb. 1945, *Grant 10960* (COL, NY, US); Serranía de Perijá, Codazzi, 10º2'N, 72º58'W, 25 Feb. 2006, *Rivera & al. 3091* (COL); La Paz, San José de Oriente, Serranía de Perijá, Vereda Altos del Riecito-Altos de Perijá, finca Los Sauces, 10º15'N, 72º57'W, 26 Feb. 2006, *Rangel & al. 13667* (COL); E of Manaure, Sabana Rubia, 10º20'N, 72º54'W, 6 Nov. 1959, *Cuatrecasas & Romero 25045* (COL, MA, MO, US); Cerro El Avión, Manaure, 10º20'N, 72º54'W, 6 Nov. 1993, *Rangel 11196* (COL); Manaure, Cesar, Sabana Rubia, 10º23'N, 72º54'W, 22 July 1987, *Cuadros 3717* (MO); Serranía de Perijá, La Paz, 10º24'N, 72º58'W, 24 Feb. 2006, *Rangel 13644* (COL). La Guajira: Sierra Perijá, Cerro Pintado, 10º27'N, 72º53'W, 3 July 1942, *Carriker 26* (US). Santander: Páramo del Almorzadero, región media, 6º59'N, 72º44'W, 20 July 1940, *Cuatrecasas & García Barriga 9972* (COL); Páramo del Almorzadero, 6º59'N, 72º44'W, 20 July 1940, *Sánchez & al. 4662* (COL); Páramo del Almorzadero, municipio Cerrito, vereda Mortyño- La Cascada, 6º59'N, 72º44'W, 25 Feb. 1999, *Stancik & Medina 2517* (COL, PRC). **Venezuela.** Mérida: pr. Bailadores, entre Río Arriba y el Portachuelo, 8º11'N, 71º54'W, 9 Aug. 2010, *Grande & Aedo 2619* (MA). Táchira: Páramo del Zumbador, carretera Táriba-El Cobre, 7º35'N, 72º20'W, 25 July 1976, *Stergios 636* (MO, PORT); Uribante, faldas y quebradas afluentes del río Uribante, 48 km NW Pregonero, 8º9'N, 71º53'W, 28 Sep. 1981, *Steyermark 125435* (US, VEN); Páramo del Batallón, 8º10'N, 71º54'W, 9 Aug. 2010, *Grande & Aedo 2626* (MA); Páramo de Portachuelo, 8º10'N, 71º54'W, 23 Oct. 1978, *Luteyn & Lebrón-Luteyn 6025* (GH, MO).

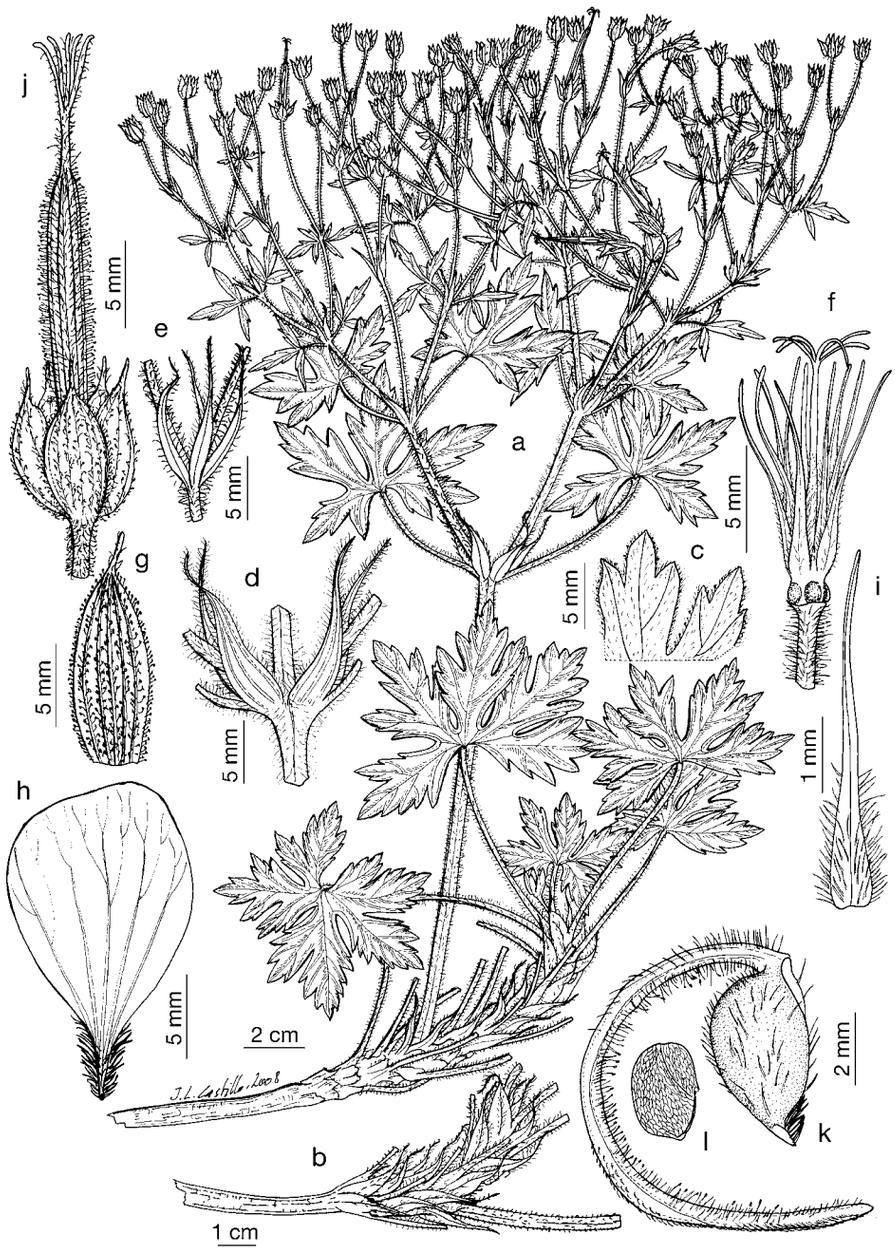


Fig. 554. *Geranium lindenianum*. a. Flowering branch. b. Vegetative stem. c. Detail of leaf, adaxial side. d. Stipules. e. Bracteoles. f. Flower, sepals and petals removed. g. Sepal. h. Petal. i. Staminal filament. j. Fruit. k. Mericarp. l. Seed. (Based on: a-e, i, *Cuatrecasas & Romero 25045*, US; f-h, *Carriker 26*, US; j-l, *Steyermark 125435*, US).

Discussion. Geranium lindenianum was considered conspecific with *G. holosericeum* by Aedo & al. (2003), but in a later study (Aedo & al. 2009) was recognized as a separate species of the Sierra Perijá and the Venezuelan paramos. The species is more robust than *G. holosericeum* and has an inflorescence like that of *G. schultzei*, but with longer sepals and a longer mucro, longer petals with longer hairs on the adaxial base, and longer fruits than those of *G. holosericeum*. The general appearance of *G. lindenianum* is like that of *G. schultzei*, with a robust, thick, erect stem and a similar inflorescence. Yet, *G. lindenianum* shares with *G. holosericeum* two features never observed in *G. schultzei*: a) vegetative stems, covered with imbricate stipules, usually without petiole remains, and b) lanceolate stipules with a notable setaceous apex. Herbarium specimens of *G. schultzei* are commonly fragments of the apical portion of plants and sometimes difficult to interpret. Field observations show that *G. lindenianum* has a lignified base that is more or less branched. These branches ("vegetative stems") become herbaceous towards the apex and terminate in a zone covered by stipules and a rosette of leaves. From each rosette arises an inflorescence. Well-developed plants lean on neighboring shrubs and may grow to 2 m high.

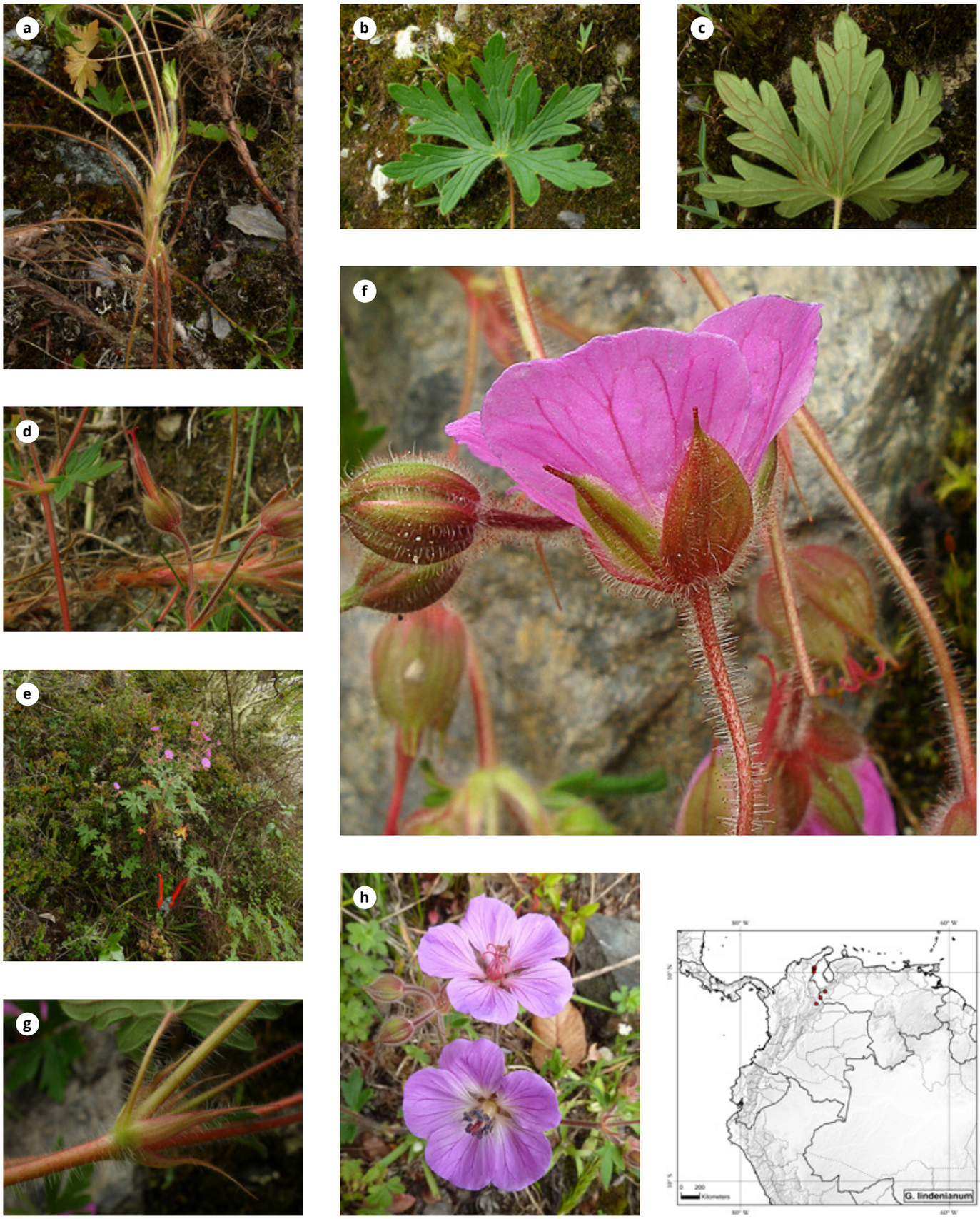


Fig. 555. *Geranium lindenianum* (Based on: a-g, *Grande* & *Aedo 2619,* MA; h, *Grande* & *Aedo 2626*, MA).

Fig. 556. Distribution of *Geranium lindenianum*.

The Killipii Group—This group is characterized by its prostrate to ascending habit, with long stems rooting at nodes, its opposite leaves and its 2-flowered cymules with a long peduncle, arranged in a monochasial inflorescence. It also has distinctive subtomentose buds containing the very young leaves and undeveloped cymules.

219. Geranium killipii R. Knuth, Repert. Spec. Nov. Regni Veg. 28: 8. 1930. Type locality: "Colombia: Dept. Norte de Santander, Mutiscua, 2900 m, auf lichten Hügeln (Killip et Smith a. 1927 n. 19649 -- Typus in herb. Berol.!) -- Blühend Februar". Type: Colombia. Norte de Santander, Mutiscua, 7°18'N, 72°45'W, 20-22 Feb. 1927, *E.P. Killip & A.C. Smith 19649* (holotype, B destroyed; lectotype, designated by Aedo 2012: 362: GH-00055013!; isotypes, COL-000001794!, NY-01364987!, US-00100912 image!).

Geranium elongatum R. Knuth in Engl., Pflanzenr. IV.129 (Heft 53): 209. 1912, nom. illeg., non Cav. 1787. *Geranium knuthianum* J.F. Macbr., Candollea 6: 7. 1934. Type locality: "Ecuador: An Zäunen bei Pomasqui (Sodiro, Specim. Fl. Ecuad. n. 214b -- Typus in Herb. Berol.!).-- Blühend Oktober". Type: Ecuador. Pichincha. Pomasqui, 0°03'S, 78°27'W, *L. Sodiro 214b* (holotype, B destroyed; photos: F!, GH!, NY!, P-00758002!).

Geranium subscandens R. Knuth, Biblioth. Bot. 29 (Heft 116): 98. 1937. Type locality: "Mittel-Ecuador: Interandines Hochland: Prov. Carchi: oberhalb El Angel, Hartlaub-Bergwald, 3200 m ü. M. Blühend und fruchtend Semptember 1933 (Diels 776.--Typus speciei!)". Type: Ecuador. Carchi, El Ángel, 0°41'N, 77°53'W, Sep. 1933, *F.L. Diels 776* (no original material located).

Geranium aequatoriale Halfd.-Niels., Nordic J. Bot. 16(3): 267, 268 fig. 1. 1996. Type locality: "Cazalet & Pennington 5473, Ecuador, Prov. Imbabura, Lago San Marcos, Mt. Cayambe, dwarf forest, damp open places, alt. 11 200 ft., 2 Dec 1961 (NY holotype, B, K, US isotypes)". Type: Ecuador. Pichincha, Lago San Marcos, Mt. Cayambe, 0°07'N, 77°58'W, 2 Dec. 1961, *P.C. Cazalet & D.T. Pennington 5473* (holotype, NY-00076887!; isotypes, B-100145013!, K-000190059!, US image!).

Geranium trianae Aedo & Muñoz Garm., Kew Bull. 52(3): 726. 1997. Type locality: "Colombia, cordillera de Bogota, Triana 3749". Type: Colombia. Cundinamarca, cordillera de Bogotá, 0°37'N, 74°02'W, 1851, *J. Triana 3749* (holotype, K!; isotypes, BM!, E!, G-00439763!, NY!, W!).

Perennial herbs, 50-100 cm tall. *Rootstock* 1.7-9.4 mm in diameter, ± vertical, not tuberculate, not turnip-shaped, without thickened roots. *Stem* prostrate to ascending, leafy, rooting at nodes, stolons absent, without vegetative stems, with patent to retrorse, eglandular hairs 0.3-1.4 mm long and, sometimes, patent, glandular hairs 0.7-1.1 mm long. *Basal leaves* in a ± deciduous rosette, cauline leaves opposite; leaf laminas (1.7)2.4-3.9(5.1) cm long, 2-6.1 cm wide, not peltate, palmatifid [ratio main-sinus length/middle segment length = (0.78)0.80-0.84(0.90)], polygonal in outline, base cordate, not coriaceous, with nerves not projected, pilose, with appressed, eglandular hairs and, rarely, with glandular hairs (subtomentose in bud) on both surfaces; segments 5, in 1 plane, middle segment rhombic, 2.4-7.7 mm wide at the base [ratio segment width at the base/middle segment length = (0.13)0.18-0.23(0.31)], (3)5-9(15)-lobed in distal half [ratio secondary sinus length/middle segment length = (0.17)0.21-0.25(0.28)]; petioles up to 19 cm long, without abscission zone, terete, not swollen, not deflexed in age, with patent to retrorse, eglandular hairs 0.2-1.5 mm long and, sometimes, patent, glandular hairs 0.4-0.6 mm long; stipules 2.9-8.9 mm long, 1.3-2.8 mm wide, lanceolate, free, papery, brownish red, with eglandular hairs on both surfaces and on the margin. *Inflorescence* a monochasial cyme; cymules 2-flowered, solitary [ratio cymule length/leaf length = 1.2-3.6]; peduncles (25)57-91(125) mm long, with patent to retrorse, eglandular hairs 0.2-1.3 mm long and, usually, patent, glandular hairs 0.5-1.2 mm long; bracteoles 1.9-6.2 mm long, 0.4-1.5 mm wide, linear-lanceolate, whorled; pedicels 11-39 mm long, with patent to retrorse, eglandular hairs 0.2-1 mm long and, usually, patent, glandular hairs 0.3-1.4 mm long. Flowers actinomorphic. *Sepals* (4.5)5.2-6.2(8.5) mm long, 1.6-3.4 mm wide, lanceolate, smooth, not accrescent, nerves 3, mucro (0.3)0.4-0.6(1.2) mm long [ratio mucro length/sepal length = 0.06-0.11(0.17)], with erect-patent, eglandular hairs 0.2-0.9 mm long and patent, glandular hairs 0.3-1.5 mm long on the abaxial surface, glabrous adaxially. *Petals* (7.5)9.1-10.4(11.4) mm long, 3.5-6.3 mm wide, erect-patent, rounded or slightly emarginate (notch 0.2-1 mm deep), without claw, white or pale pink, glabrous, sometimes ciliate on the basal margin, with hairs 0.1-0.6 mm long. *Stamens* 10, both whorls bearing anthers; filaments 2.2-5.3 mm long, lanceolate, white, with eglandular hairs 0.1-0.5 mm long on the abaxial surface and margin; anthers 0.6-1.1 mm long, blue. Nectaries 5, hemispheric, glabrous. *Gynoecium* 3.8-5.4 mm long, pink. *Fruit* 17.7-29.3 mm long, erect, discharge of seed-ejection type; mericarps 2.9-3.6 mm long, 1.3-1.9 mm wide, without a strand of fibers, not compressed at the apex, smooth, without basal beak, with a basal callus, without a basal prong, brown, with erect-patent, eglandular hairs 0.3-1.2 mm long and patent, glandular hairs 0.4-1.4 mm long; rostrum 12.4-20.8 mm long, with a narrowed apex 1.7-3.2 mm long, not twisted, with erect-patent, eglandular hairs 0.1-0.8 mm long and, sometimes, patent, glandular hairs 0.4-1.2 mm long; stigmatic remnants 1.4-2.6 mm long, with 5 usually glabrous lobes. *Seeds* 2.1-2.4 mm long, 1.1-1.5 mm wide, finely reticulate, uniformly colored, brown, glabrous. Cotyledons with entire margin. Figs. 557, 558.

Pollen. Ornamentation not studied.

Chromosome number. Unknown.

Phenology. Collected in flower from January to December.

Distribution. This species ranges from western Venezuela, through Colombia to central Ecuador (Fig. 559).

Habitat. Roadsides, grazed fields, rocky slopes, moist grassy paramo, among shrubs, and montane wet forests; 300-4000 m.

Representative specimens examined. **Colombia.** Boyacá: municipio de Aquitania, península de Suse, 5°27'N, 72°56'W, June 1976, *Rangel & Aguirre 437* (COL); Santuario de Iguaque, alrededores de El Carrizal, 5°40'N, 73°30'W, 9 June 2001, *Bello & al. 203* (COL); municipio de Duitama, vereda La Quinta, península de Suse, 5°49'N, 73°2'W, 11 Nov. 1981, *Camacho 62* (COL); valle de la Uvita, 6°18'N, 72°33'W, 7 Sep. 1938, *Cuatrecasas 1152* (BC, COL). Caldas: Páramo de Las Letras, 5°1'N, 75°22'W, 1 Nov. 1952, *Humbert & al. 27081* (COL, P); Manizales, vereda La Esperanza, reserva Torre Cuatro, 5°2'N, 75°22'W, 25 Feb. 2000, *Alvear & al. 784* (COL). Cauca: Macizo Colombiano, valle de las Papas, 5 km S of Valencia, Los Andes, 1°54'N, 76°39'W, 25 Sep. 1958, *Barclay & Juajibioy 5771* (COL, MO, TEX); valle de las Papas, alrededores de Valencia, márgenes del río Sucubun, 1°54'N, 76°39'W, 11 Sep. 1958, *Idrobo & al. 3704* (COL); near río San Andrés, 2°23'N, 76°29'W, 14 June 1922, *Pennell 7147* (NY, PH); around Huila, indian village in río Páez valley, Tierra Adentro, 2°48'N, 76°5'W, Jan. 1906, *Pittier 1302* (NY). Cundinamarca: Páramo de Chipaque, 4°26'N, 74°2'W, 25 Sep. 1941, *González Sicard 23* (COL); San Cristóbal, Bogotá, 4°34'N, 74°5'W, 16 Nov. 1958, *Pennell 2299* (GH); quebrada del Chicó, Bogotá, 4°36'N, 74°5'W, 25 Sep. 1946, *Jaramillo 456* (COL); Monserrate, valle del río San Francisco, 4°37'N, 74°2'W, 18 June 1948, *Hawkes & García Barriga 78* (COL); represa de Neusa, W side near vivero of Forest service, 5°8'N, 73°58'W, 21 June 1957, *Barclay 4116* (COL). Nariño: Cumbal, alto de Machines, 0°54'N, 77°48'W, 7 Jan. 1952, *Fernández Pérez & al. 1081* (COL); Pasto, Hacienda Obonuco, 1°13'N, 77°18'W, 28 Mar. 1950, *Espinosa 2774* (MA, NY); Pasto, near base of volcán Galeras, above town of Obonuco, 1°13'N, 77°18'W, 4 June 1946, *Schultes & Villarreal 8026* (BH, GH); Pasto, subida de Pasto al volcán Galeras, vereda San Cayetano, 1°13'N, 77°22'W, 16 Mar. 1999, *Stancik 2947* (COL, PRC). Norte de Santander: Mutiscua, márgenes del ramal que va del pueblo a la carretera Bucaramanga-Pamplona, 7°18'N, 72°45'W, 20 June 1946, *Garganta Fábrega 1233* (F). Putumayo: laguna de La Cocha, Ciudadela, above lake on road to Sibundoy, near Páramo de Bordoncillo, 1°10'N, 77°0'W, 27 May 1946, *Schultes & Villarreal 75221* (GH). Santander: Sucre, 5°54'N, 73°47'W, 1 Aug. 1952, *Uribe 2425* (COL); Páramo de Santurbán, entre Cuesta Boba y el extremo W, 7°15'N, 72°52'W, 27 July 1940, *Cuatrecasas 10309* (COL, GH, MO); vicinity of La Baja, 7°21'N, 72°55'W, 14 Jan. 1927, *Killip & Smith 18139* (GH); Pamplona, alto de las Coronadas, al S de la ciudad, 7°24'N, 72°38'W, 29 Nov. 1946, *Garganta Fábrega 1280bis* (F). Tolima: summit to La Ceja, old Quindio trail, 4°28'N, 75°30'W, 2 Aug. 1922, *Killip & Hazen 9504* (NY, PH); Páramo de Ruiz, Rosalito, 4°50'N, 75°33'W, 15 Dec. 1917, *Pennell 2981A* (NY). **Ecuador.** Carchi: 2 km de El Ángel hacia el Páramo del Ángel, 0°40'N, 77°55'W, 15 Nov. 1991, *Halfdan-Nielsen & al. 8* (AAU, C); Espejo, La Libertad, río Cariyacu, 0°40'N, 77°56'W, 27 Nov. 1993, *Palacios 11963* (MA); summit of Tulcán-El Carmelo road, 5-6 km E of Cruce Cordillera on de Panamerican highway, 0°44'N, 77°41'W, 7 Apr. 1979,

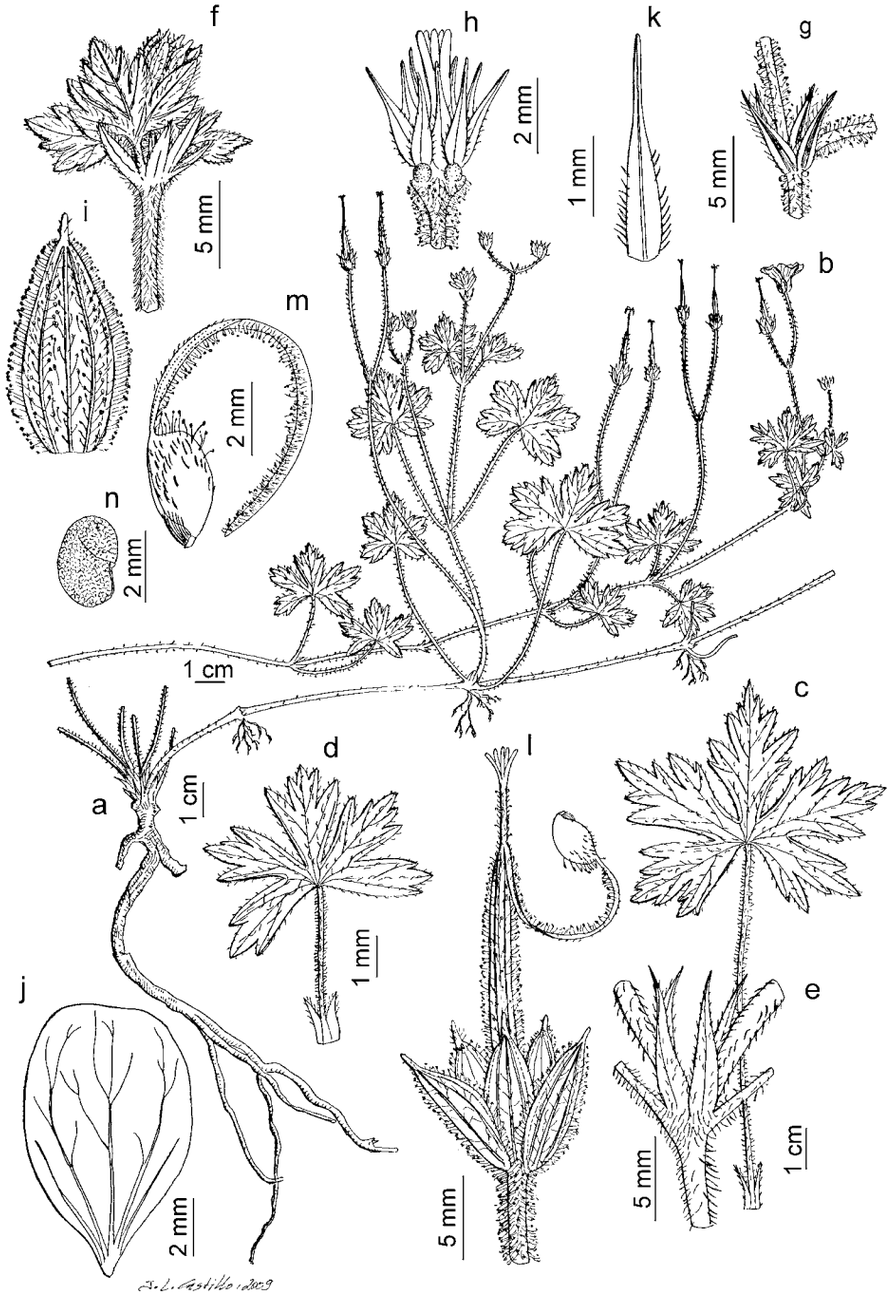


Fig. 557. *Geranium killipii*. a, b. Habit. c, d. Leaves. e. Stipules. f. Apical bud. g. Bracteoles. h. Flower, sepals and petals removed. i. Sepal. j. Petal. k. Staminal filament. l. Fruit. m. Mericarp. n. Seed. (Based on: a, b, e-n, *Aedo & Ulloa 12961*, MA; c, *Triana 3749*, G; d, *Asplund 16268*, S).

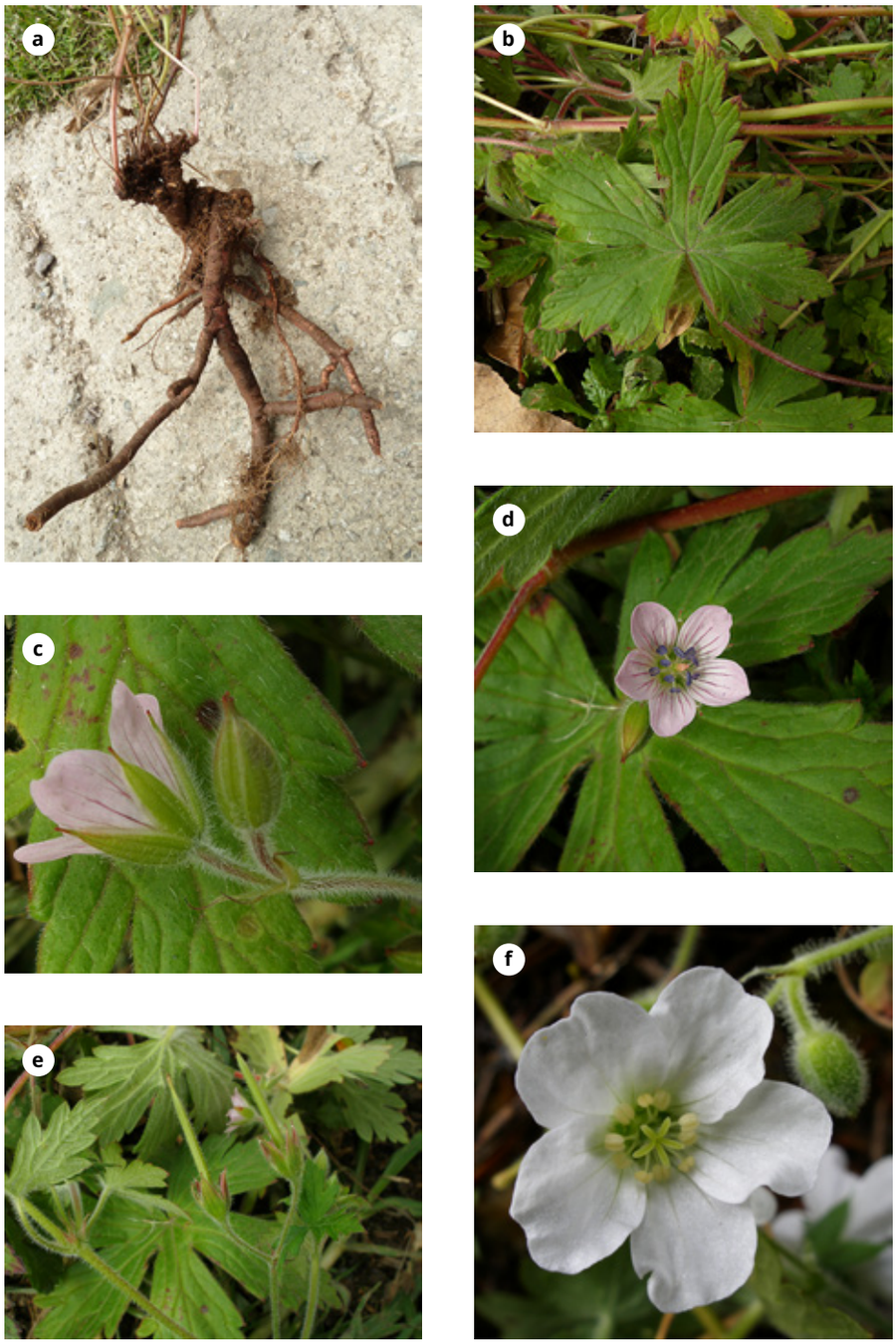


Fig. 558. *Geranium killipii* (Based on: a-e, *Grande* & *Aedo 2630,* MA; f, *Aedo & Ulloa 12961*, MA).

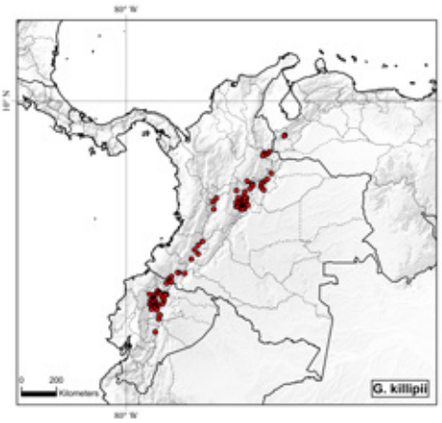


Fig. 559. Distribution of *Geranium killipii*.

Løjtnant & al. 11891 (AAU); 5 mi S of Tulcán, 0°48'N, 77°43'W, 10 Aug. 1923, *Hitchcock 21022* (GH, NY). Chimborazo: Parque Nacional Sangay, Changalay Chico, río Ramos Tambo, 1°50'S, 78°30'W, 18 July 1991, *Valencia & al. 518* (AAU). Cotopaxi: Iliniza, 0°39'S, 78°42'W, Oct. 1858, *Wagner s.n.* (M); Cotopaxi, 0°42'S, 78°25'W, Apr. 1952, *Acosta Solís 1697* (M); Parque Nacional Llanganates, along road E of Salcedo, valley río Anatenorio, km 56, 0°59'S, 78°17'W, 27 Aug. 1999, *Neil & al. 11904* (MA). Imbabura: 2 km N Hacienda Mojanda on road to Otavalo, 0°10'N, 78°18'W, 12 Dec. 1966, *Sparre 13508* (AAU, NY, S); 5 km along road from Otavalo to Laguna Mojanda, 0°12'N, 78°17'W, 22 Nov. 1981, *Filskov & al. 37523* (AAU, QCA); Laguna Cuicocha-Apuela road km 7, 0°18'N, 78°23'w, 4 Oct. 1984, *Jørgensen & Vive 56074* (AAU, MO, QCA, UPS). Napo: ENE of Cayambe mountain, 0°7'N, 77°58'W, 15 Dec. 1961, *Cazalet & Pennington 5592* (B, NY); about 2 km E of Oyacachi, 0°12'S, 78°3'W, 25 Apr. 1996, *Stahl & Navarrete 2325* (AAU); Papallacta, 0°21'S, 78°6'W, 15 June 1968, *Harling & al. 10307* (MO); Tena Cantón, Parque Nacional Llanganates, vía Salcedo-Tena, km 55-60, río Anatenorio, 0°58'S, 78°15'W, 17 Sep. 1998, *Vargas & al. 2529* (MA). Pichincha: Hacienda Yanacocha, 0°6'S, 78°34'W, 12 July 2006, *Aedo & Ulloa 12890* (MA); Cerro Pichincha, 0°9'S, 78°33'W, 7 Feb. 1920, *Holmgren & Heilborn 314* (S); Tandacota, 0°12'S, 78°45'W, 6 Jan. 1920, *Holmgren & Heilborn 498* (S); Machachi, Pugyopamba, quebrada Malagche, 0°32'S, 78°31'W, 15 July 2006, *Aedo & Ulloa 12961* (MA); Cerro Rumiñahui, 0°35'S, 78°32'W, 3 Apr. 1979, *Halfdan-Nielsen 16633* (AAU). Tungurahua: Río Verde, 1°11'S, 78°19'W, Jan. 1859, *Wagner s.n.* (M). **Venezuela.** Mérida: pr. Bailadores, 8°12'N, 71°53'W, 10 Aug. 2010, *Grande & Aedo 2630* (MA). Táchira: Páramo de la Negra above Bailadores, 8°15'N, 71°51'W, 13 Feb. 1939, *Alston 7018* (BM, NY).

Discussion. Geranium killipii is well characterized by its prostrate to ascending habit, with long stems rooting at nodes, and its 2-flowered cymules with a long peduncle, arranged in a monochasial inflorescence. It also has distinctive subtomentose buds containing the very young leaves and undeveloped cymules, which distinguish it from *G. holosericeum*. Towards the apex of branches young leaves retain

a dense indumentum, which is gradually lost in well-developed leaves. This feature most likely is the basis for Knuth's recognition of *G. hirtum* (1912: 147). *Geranium killipii* may be difficult to distinguish from *G. fallax*, especially when examining poorly prepared herbarium specimens. *Geranium fallax* is an ± erect herb that does not root at the nodes, unlike *G. killipii*; it also has longer peduncles, rostrum apex, and petals, although with some overlap. The southern localities of *G. killipii* in Ecuador are separated by more than 800 km from the nearest populations of *G. fallax* in central Peru. The middle leaf segment in specimens of *G. killipii* from central Colombia is usually more lobed (seven or more lobes) than in plants from central Ecuador (ca. five lobes); however, in both areas there are frequent exceptions, and no other consistent difference was found with which to delimit separate taxa. The glandular indumentum is sometimes restricted to the inflorescence and the distal part of the plant, but occasionally reaches the basal part. The inflorescence is composed of 2-flowered cymules with long peduncles (especially towards the base of the plant). Rarely, 1-flowered cymules can be found in some specimens with otherwise 2-flowered cymules.

The holotype of *G. elongatum* was destroyed, and no duplicates were found in other herbaria with holdings of Sodiro collections, but a photograph of the holotype (F, GH, NY) shows a plant that well matches *G. killipii*. *Geranium elongatum* has been considered a synonym of *G. laxicaule*, an endemic to central Peru; see that species for details. The holotype *G. subscandens* is also lost; however, both the type locality and description strongly indicate that this name is a synonym of *G. killipii*. The name *G. trianae*, now listed as a synonym of *G. killipii*, was proposed for an assemblage of Colombian plants determined by Knuth (1912: 147) as *G. hirtum* Willd. ex Spreng., a superfluous name for *G. mexicanum* Kunth, a Mexican species.

220. Geranium meridense Pittier, J. Wash. Acad. Sci. 19: 178. 1929. Type locality: "Mérida: Páramos de Sto. Domingo and Chachopo, 3100 m., flowers Sept. 14, 1922 (Dr. A. Jahn 1130a, Type)". Type: Venezuela. Mérida, Páramos de Santo Domingo and Chachopo, 8°50'N, 70°45'W, 14 Sep. 1922, *A. Jahn 1130a* (lectotype, designated by Aedo 2012: 368, US-1186730!; isolectotype, VEN with photocopy at MA!).

Perennial herbs, 11-70 cm tall. *Rootstock* 1.2-7 mm in diameter, ± vertical, not tuberculate, not turnip-shaped, without thickened roots. *Stem* prostrate to ascending, leafy, rooting at nodes, stolons absent, without vegetative stems, with patent to retrorse,

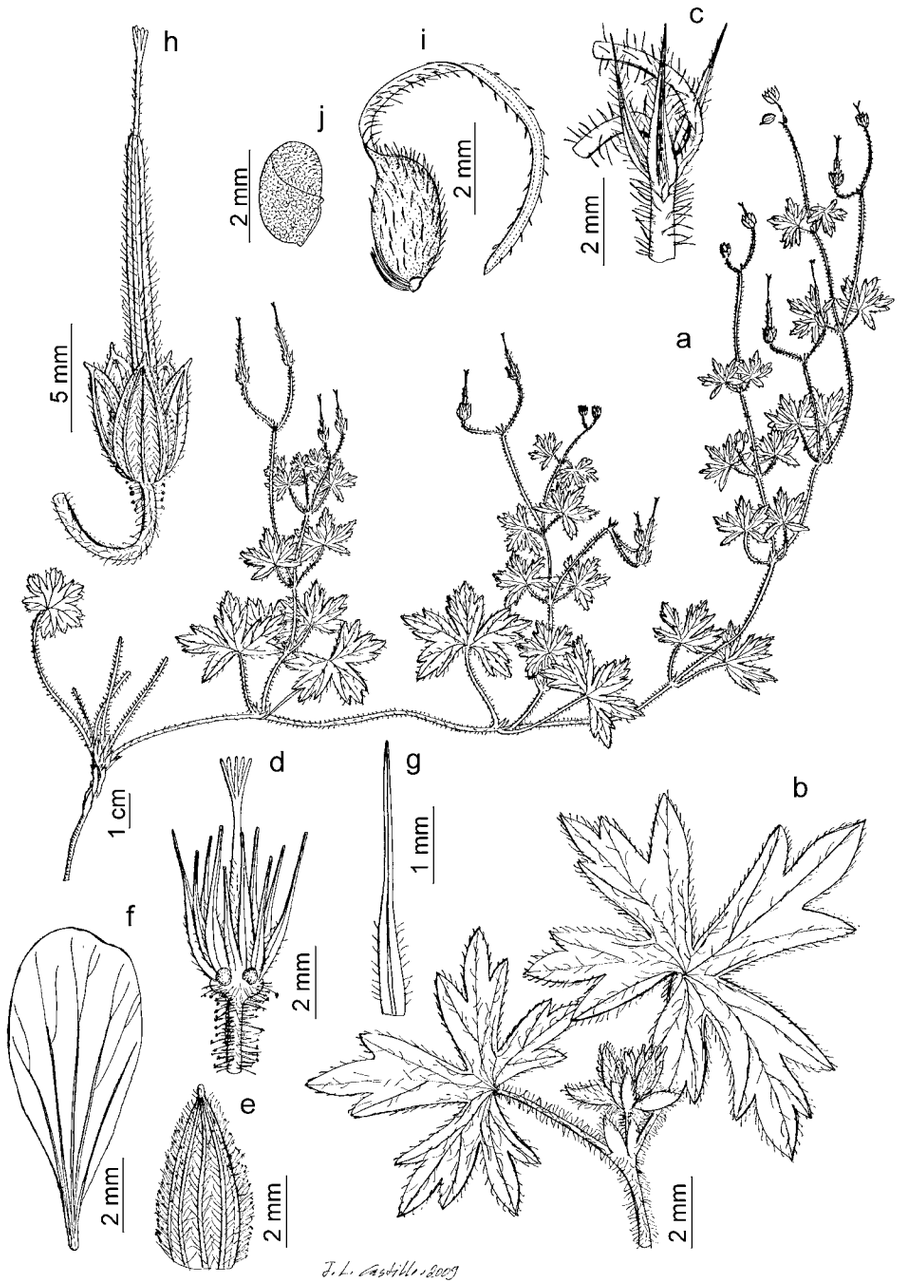


Fig. 560. *Geranium meridense*. a. Habit. b. Cauline leaves and bud. c. Bracteoles. d. Flower, sepals and petals removed. e. Sepal. f. Petal. g. Staminal filament. h. Fruit. i. Mericarp. j. Seed. (Based on: a, c-j, *Stergios 20512*, MA; b, *Barclay & Juajibioy 9957*, COL).

eglandular hairs 0.3-1.3 mm long. *Basal leaves* in a ± deciduous rosette, cauline leaves opposite; leaf laminas (1.7)1.8-2.2(3.5) cm long, 2.1-3.9 cm wide, not peltate, palmatifid [ratio main-sinus length/middle segment length = (0.66)0.74-0.86(0.91)], polygonal in outline, base cordate, not coriaceous, with nerves not projected, pilose, with ± appressed, eglandular hairs on both surfaces (subtomentose in bud); segments 5, in 1 plane, middle segment rhombic, 2.4-5.8 mm wide at the base [ratio segment width at the base/middle segment length = (0.19)0.21-0.33(0.36)], 3-5(7)-lobed in distal half [ratio secondary sinus length/middle segment length = (0.14)0.17-0.21(0.22)]; petioles up to 9.2 cm long, without abscission zone, terete, not swollen, not deflexed in age, with patent to retrorse, eglandular hairs 0.4-1.2 mm long; stipules 1.8-5 mm long, 1-2.1 mm wide, lanceolate, free, papery, brownish red, with eglandular hairs on both surfaces and on the margin. *Inflorescence* a monochasial cyme; cymules 2-flowered, solitary [ratio cymule length/leaf length = 1.4-5.4]; peduncles (16)37-59(92) mm long, with patent to retrorse, eglandular hairs 0.2-1.2 mm long and, rarely, patent, glandular hairs 0.5-0.6 mm long; bracteoles 1.5-3.9 mm long, 0.3-1.1 mm wide, lanceolate, whorled; pedicels 9.9-39 mm long, with patent to retrorse, eglandular hairs 0.1-1 mm long and, sometimes, eglandular hairs 0.2-0.7 mm long. Flowers actinomorphic. *Sepals* (4.6)5.3-5.8 mm long, 1.8-2.6 mm wide, lanceolate, smooth, not accrescent, nerves 3, mucro (0.2)0.3-0.5(0.6) mm long [ratio mucro length/sepal length = 0.04-0.12], with erect-patent, eglandular hairs 0.3-0.8 mm long and, usually, patent, glandular hairs 0.4-0.6 mm long on the abaxial surface, glabrous adaxially. *Petals* (5.6)6.3-8.5(9.3) mm long, 1.9-5.7 mm wide, erect-patent, rounded, without claw, white to pale pink, glabrous, rarely ciliate on the basal margin, with hairs 0.2-0.3 mm long. *Stamens* 10, both whorls bearing anthers; filaments 2.3-5 mm long, lanceolate, white, with eglandular hairs 0.1-0.6 mm long on the abaxial surface and margin; anthers 0.7-1.1 mm long, pale pink. Nectaries 5, hemispheric, usually glabrous. *Gynoecium* 3-5.9 mm long, pale pink. *Fruit* 16.8-21.9 mm long, erect, discharge of seed-ejection type; mericarps 2.4-3.6 mm long, 1.3-1.6 mm wide, without a strand of fibers, not compressed at the apex, smooth, without basal beak, with a basal callus, without a basal prong, brown, with erect-patent, eglandular hairs 0.4-1 mm long and, rarely, patent, glandular hairs 0.6-0.7 mm long; rostrum 12-14(16.1) mm long, with a narrowed apex 0.8-3.1 mm long, not twisted, with ± patent, eglandular hairs 0.2-0.8 mm long and, rarely, patent, glandular hairs 0.4-0.9 mm long; stigmatic remnants 1.5-2.3 mm long, with 5 glabrous lobes. *Seeds* 1.6-2.3 mm long, 1-1.4 mm wide, finely reticulate, uniformly colored, brown, glabrous. Cotyledons with entire margin. Figs. 560, 561.

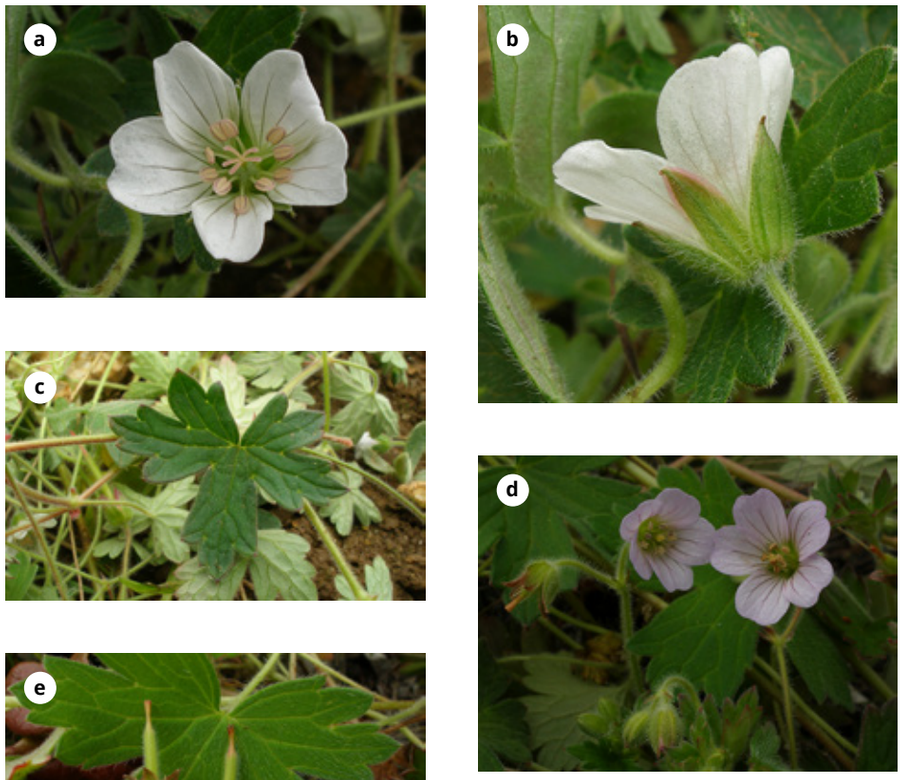


Fig. 561. *Geranium meridense* (Based on: a-c, *Grande* & *Aedo 2469*, MA; d, e, *Grande* & *Aedo 2547,* MA).

Fig. 562. Distribution of *Geranium meridense*.

Pollen. Ornamentation not studied.

Chromosome number. Unknown.

Phenology. Collected in flower from April to December.

Distribution. This species ranges from northwestern Venezuela to northern Colombia (Fig. 562).

Habitat. Margin of fields, stream banks, rocky slopes, moist grassy paramo, and shrublands; 1800-3750 m.

Additional specimens examined. **Colombia.** César: Serranía de Perijá, Agustín Codazzi, vereda Cara de Hombre, finca de Alcides San Juan, hacia el N de las playas, 10º5'N, 73º9'W, 24 May 1994, *Rangel & al. 12350* (COL). **Venezuela.** Mérida: Hautes Andes de Trujillo & Mérida, 1842, *Linden 466* (G, P); Sierra Nevada, 8º33'N, 71º3'W, 1846, *Funck & Schlim 1128* (BM, G, LD, MPU, P, W); Sierra Nevada, alrededores de la Laguna Coromoto, 8º37'N, 71º2'W, 3 Dec. 1959, *Barclay & Juajibioy 9957* (COL, MA, MO); La Culata, 8º45'N, 71º4'W, 4 Apr. 1994, *Schilling 48* (HBG); Sierra de Santo Domingo, Páramo de la Laguna Negra, slightly below Laguna Negra on trail to laguna de Mucubají, 8º47'N, 70º48'W, 24 Nov. 1959, *Barclay & Juajibioy 9806* (MO); distrito Rangel, cerca de Apartaderos, 8º48'N, 70º51'W, 21 Oct. 1984, *Fernández & Bracamonte 1106* (PORT); Andes de Mérida, unterhalb Mucubají, 8º48'N, 70º50'W, Sep. 1958, *Schwabe s.n.* (B); Páramo de Timotes, 8º52'N, 70º48'W, 2 Aug. 2010, *Grande & Aedo 2547* (MA). Trujillo: Bocono, Rangel, Páramo de Motumbo, SW of Laguna Larga, along border of divide to Laguna Las Parias, Monumento Natural Teta de Niquitao-Guirigay, 8º58'N, 70º33'W, 17 Sep. 2003, *Stergios 20512* (MA); Bocono, Páramo de Guirigay, Monumento Natural Teta de Niquitao-Guirigay, sector Las Veguitas, 9º2'N, 70º35'W, 22 Aug. 2002, *Dorr & al. 9232* (MA, US); La Morita, arriba de Jajó, 9º4'N, 70º39'W, Aug. 1958, *Aristeguieta & Medina 3477* (VEN); pr. Las Mesitas, 9º4'N, 70º29'W, 30 July 2010, *Grande & Aedo 2469* (MA).

Discussion. Geranium meridense is similar to *G. killipii* in its prostrate to ascending habit and subtomentose buds. The leaves of *G. meridense* are shorter than in *G. killipii*, and the middle segment has fewer lobes. *Geranium meridense* differs also in its shorter peduncles, sepals, and petals, although with some overlap. These characters and the allopatric distribution support recognition of *G. meridense* as separate from *G. killipii*. In *G. meridense* the glandular indumentum is restricted to the inflorescence and is usually present on sepals, sometimes on pedicels, and more rarely on peduncles. The fragmentary specimen *Fernández & Bracamonte 1106* (PORT) has the short petals and peduncles typical for *G. meridense*, but has leaves with 7-9 lobes. It is provisionally included in *G. meridense*.

Other species from South America

221. Geranium lignosum R. Knuth, Repert. Spec. Nov. Regni Veg. 28: 10. 1930. Type locality: "Colombia: Charakterpflanze der Paramos, Siminchuena, 3200 m (A. Schultze, Reise in die Sierra Nevada de Santa Marta a. 1928 n. 1232 -- Typus in herb. Berol.!). -- Fruchtend März". Type: Colombia. Magdalena, Sierra Nevada de Santa Marta, Siminchuena, 1928, *A. Schultze 1232* (holotype, B destroyed). Colombia. Magdalena, Sierra Nevada de Santa Marta, 10°45'N, 73°40'W, June 1844, *W. Purdie? s.n.* (neotype, designated by Aedo & al. 2003: 108, K!).

Perennial shrubby, ca. 50 cm tall. *Rootstock* and roots unknown. *Stem* erect, leafy, not rooting at nodes, stolons absent, with lateral branches having stipules groups and rosettes of leaves, with patent to retrorse, eglandular hairs 0.5-1.2 mm long. *Basal leaves* unknown, cauline leaves opposite; leaf laminas 2-3.5 cm long, 2.2-4 cm wide, not peltate, palmatifid [ratio main-sinus length/middle segment length = 0.70-0.90], polygonal in outline, base cordate, not coriaceous, with nerves not projected, pilose, with ± appressed, eglandular hairs on the adaxial surface and usually velutinous abaxially; segments 5, in 1 plane, middle segment rhombic, 2-4 mm wide at the base [ratio segment width at the base/middle segment length = 0.12-0.23], 6-13-lobed in distal half [ratio secondary sinus length/middle segment length = 0.16-0.43]; petioles up to 9 cm long, without abscission zone, terete, not swollen, not deflexed in age, with patent to retrorse, eglandular hairs 0.1-1 mm long; stipules 6-9 mm long, 1.5-2 mm wide, lanceolate, free, papery, brownish red, with eglandular hairs on abaxial surface and on the margin, almost glabrous adaxially. *Inflorescence* a monochasial cyme; cymules 2-flowered, solitary [ratio cymule length/leaf length = 2-2.2]; peduncles 27-90 mm long, with abundant retrorse to patent, eglandular hairs 0.1-1.2 mm long and scattered, patent, glandular hairs 0.3-0.6 mm long; bracteoles 3.3-7.9 mm long, 0.6-1.5 mm wide, lanceolate, whorled; pedicels 6-35 mm long, with some patent, eglandular hairs 0.1-0.8 mm long and abundant patent, glandular hairs 0.2-0.6 mm long. Flowers actinomorphic. *Sepals* 6.2-10 mm long, 2.2-4.2 mm wide, lanceolate, smooth, not accrescent, nerves 3-5, mucro 0.6-1.5 mm long [ratio mucro length/sepal length = 0.10-0.17], with ± patent, eglandular hairs 0.2-1.5 mm long and erect-patent, glandular hairs 0.2-0.7 mm long on the abaxial surface, hairy adaxially. *Petals* 10-14.2 mm long, 5.4-9 mm wide, erect-patent, rounded, with claw ca. 1 mm long, dark purple, hairy on both surfaces, mainly on the base of the adaxial surface, ciliate on the margin, with hairs 0.9-1 mm long. *Stamens* 10, both whorls bearing anthers; filaments 7-10 mm long, lanceolate, dark purple, pilose on the abaxial surface, ciliate on the proximal half, with eglandular hairs 0.8-1.4 mm long; anthers 1.3-2.3 mm long, unknown color. Nectaries 5, hemispheric, glabrous. *Gynoecium* 7.9-9.5 mm long, dark purple. *Fruit* 25-33 mm long, erect, discharge of seed-ejection type; mericarps 3-4.5 mm long, 2-2.1 mm wide, without a strand of fibers, not compressed at the apex, smooth, without basal beak, with a basal callus, without a basal prong, brown, with erect-patent, eglandular hairs 0.5-1.4 mm long; rostrum 21-24.5 mm long, with a narrowed apex 2.4-3 mm long, not twisted, with abundant patent, eglandular hairs 0.2-0.9 mm long and glandular hairs 0.3-0.5 mm long; stigmatic remnants 4-4.3 mm long, with 5 glabrous lobes. *Seeds* ca.

1.9 mm long, 1 mm wide, finely reticulate, uniformly colored, blackish, glabrous. Cotyledons with entire margin. Fig. 563.

Pollen. *Geranium*-type (Aedo & al. 2003: 99).

Chromosome number. Unknown.

Phenology. Collected in flower in May.

Distribution. This species is endemic to northern Colombia (Fig. 564).

Habitat. Montane rain forests; 3300-4000 m.

Additional specimens examined. **Colombia.** Magdalena: vicinity río Mamancanaca, 10º43'N, 73º39'W, 26 May 1977, *White & Alverson 600* (COL, MO, NY); valley of río Yebosimeina, 10º44'N, 73º39'W, 26 May 1977, *White & Alverson 601* (COL, HUA, NY); Santa Marta, 10º45'N, 73º40'W, 1845, *Purdie s.n.* (GH); Sierra Nevada, Santa Marta, 10º45'N, 73º40'W, 1880, *Simons s.n.* (BM).

Discussion. Geranium lignosum can be distinguished from all other species of *Geranium* from Colombia by its woody fertile shoots, its short lateral branches bearing stipules groups and persistent rosettes of leaves (usually velutinous abaxially), and its dark purplish petals and staminal filaments. Some herbarium specimens include only the lateral rosettes, which hinders proper identification, if the label does not indicate the shrubby habit. The leaves of *G. lignosum* have a short, close, and ± appressed indumentum of eglandular hairs. *Geranium lignosum* is a restricted endemic of the Sierra Nevada de Santa Marta (Magdalena, Colombia). Knuth (1930a: 10), who apparently had only a fragmentary specimen available, described this species as a shrub ca. 50 cm high, but more recently collected material has short branches about 35 cm long. A label accompanying *White & Alverson 600* (COL) indicates "Shrub sprawling over edge of streambank, ... forming a dense bush", which suggests that *G. lignosum* is a more robust plant than thought by Knuth. The description of *G. lignosum* presented here is emended in some details from that published by Aedo & al. (2003), but additional collections are need-

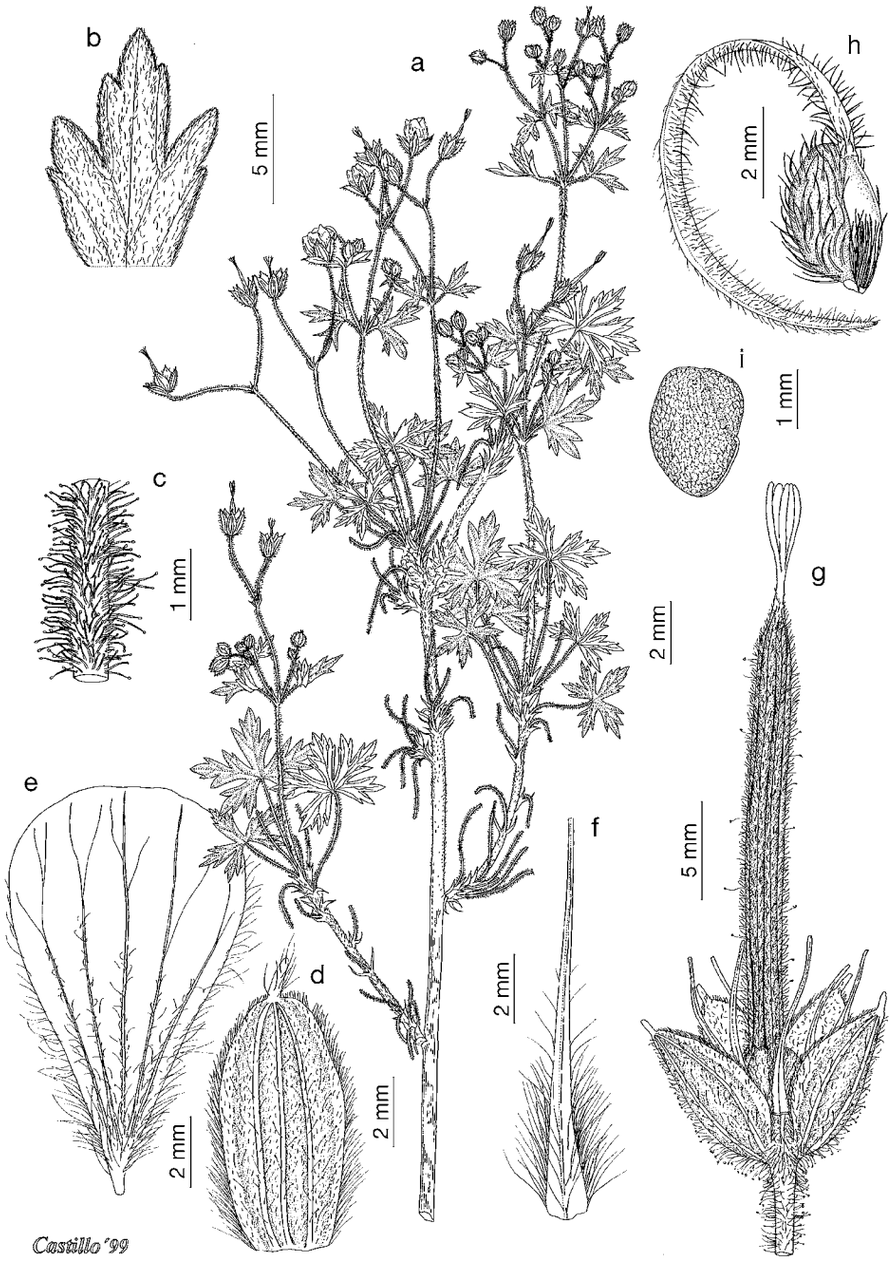


Fig. 563. *Geranium lignosum*. a. Flowering branch. b. Detail of leaf, adaxial side. c. Peduncle. d. Sepal. e. Petal. f. Staminal filament. g. Fruit. h. Mericarp. i. Seed. (Based on: a, *Purdie? s.n.*, *June 1844,* K; b-i, *Simons s.n., 1880,* BM).

Fig. 564. Distribution of *Geranium lignosum*.

ed to assess the morphology of this species. Among sympatric species, *G. schultzei* could be mistaken for *G. lignosum* because of its robust habit, but it has longer leaves with ± patent hairs and more lobes per segment, longer stipules, a sympodial inflorescence with an aggregate of cymules towards the apex of the branches, and longer petals than *G. schultzei.* Another species with a robust habit that grows in northern Colombia is *G. lindenianum,* which differs from *G. lignosum* by its longer leaves with ± patent hairs, longer stipules with a setaceous apex, a sympodial inflorescence with an aggregate of cymules towards the apex of the branches, longer sepals with a long mucro, and longer petals with long hairs.

The lectotype proposed by Knuth (1930a: 10) is lost, and no duplicate was found. Therefore, a neotype collected near the type locality and in agreement with the original description was designated.

222. Geranium matucanense R. Knuth, Repert. Spec. Nov. Regni Veg. 28: 5. 1930. Type locality: "Peru: Matucana, 2400 m. (Macbride et Featherstone a. 1922 n. 462 in Exp. Capt. Marshall Field Fund -- Typus in herb. Field Museum n. 516996!). --Blühend April bis Mai". Type: Peru. Lima. Matucana, 11°51'S, 76°24'W, 1922, *J.F. Macbride & W. Featherstone 462* (holotype, F-516996!; isotype, G-00439760!).

Perennial herbs, 22-46 cm tall. *Rootstock* 10-22 mm in diameter, ± vertical, unknown roots. *Stem* erect or ascending, leafy, not rooting at nodes, stolons absent, without vegetative stems, with retrorse, appressed, eglandular hairs 0.2-0.7 mm long. *Basal leaves* in a ± persistent rosette, cauline leaves opposite; leaf laminas 1.8-4.4 cm long, 2-5.1 cm wide, not peltate, palmatifid [ratio main-sinus length/middle segment length = 0.83-0.85], polygonal in outline, base cordate, not coriaceous, with nerves not projected, densely hairy, with ± appressed, eglandular hairs on the adaxial surface, and lanuginose abaxially; segments 5, in 1 plane, middle segment rhombic, 1.2-5.4 mm wide at the base [ratio segment width at the base/ middle segment length = 0.08-0.19], 3-7(9)-lobed in distal half [ratio secondary sinus length/middle segment length = 0.26.0.48]; petioles up to 19 cm long, without abscission zone, terete, not swollen, not deflexed in age, with retrorse, appressed, eglandular hairs 0.2-0.8 mm long; stipules 2.9-5.9 mm long, 1.4-4.8 mm wide,

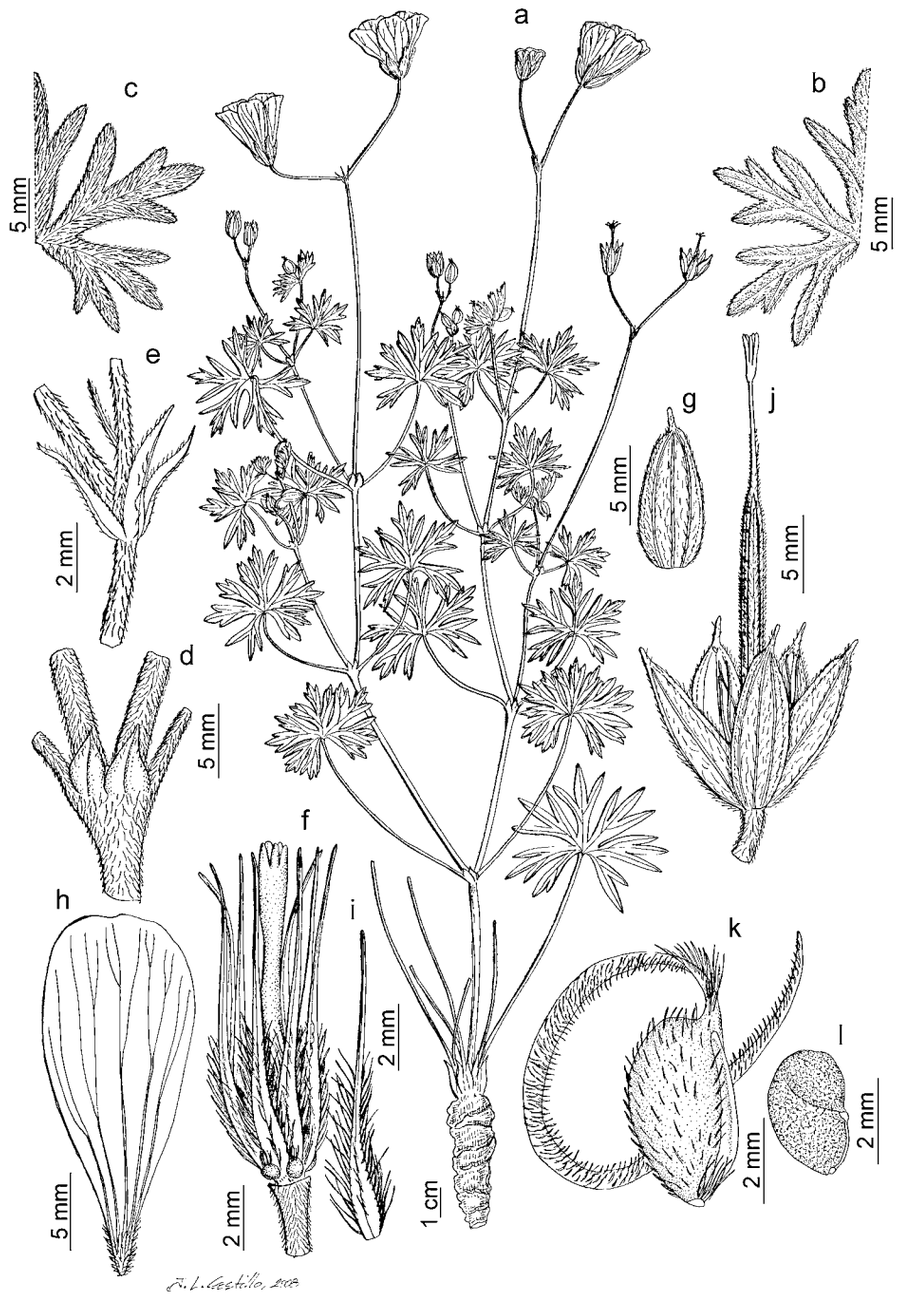


Fig. 565. *Geranium matucanense*. a. Habit. b. Portion of leaf, adaxial side. c. Portion of leaf, abaxial side. d. Stipules. e. Bracteoles. f. Flower, sepals and petals removed. g. Sepal. h. Petal. i. Staminal filament. j. Fruit. k. Mericarp. l. Seed. (Based on: a-e, *Macbride & Featherstone 462*, F; f-i, *Cano & al. 14970*, MA; j-l, *Saunders 262*, BM).

lanceolate, free, papery, brownish red, with eglandular hairs on abaxial surface and on the margin, almost glabrous adaxially. *Inflorescence* a dichasial cyme with monochasial branches; cymules 2-flowered, solitary [ratio cymule length/leaf length = 2.3-4]; peduncles 50-114(131) mm long, with retrorse, appressed, eglandular hairs 0.3-0.7 mm long; bracteoles 4.1-7.6 mm long, 0.5-1.3 mm wide, lanceolate, whorled; pedicels 17-58.9 mm long, with retrorse, appressed, eglandular hairs 0.3-0.7 mm long. Flowers actinomorphic. *Sepals* (8.1)9-10.3(10.8) mm long, 2.6-4.3 mm wide, lanceolate, smooth, not accrescent, nerves 3, mucro (1.1)1.3-2(2.9) mm long [ratio mucro length/sepal length = 0.12-0.33], with antrorse, ± appressed, eglandular hairs 0.4-0.9 mm long on the abaxial surface, glabrous adaxially. *Petals* (14.1)20-22(27.2) mm long, 7.5-12.8 mm wide, erect-patent, rounded or slightly emarginate (notch 0.4-1 mm deep), without claw, purple, hairy on both surfaces, mainly on the base of the adaxial surface, ciliate on the basal margin, with hairs 0.5-1.6 mm long. *Stamens* 10, both whorls bearing anthers; filaments 8.7-12.5 mm long, lanceolate, pink, pilose on the abaxial surface, ciliate on the proximal half, with eglandular hairs 1-1.6 mm long; anthers 2-2.8 mm long, dark purple. Nectaries 5, hemispheric, with a tuft of hairs at the top, dorsally glabrous. *Gynoecium* 9-16.1 mm long, dark purple. *Fruit* 31.3-33.6 mm long, erect, discharge of seed-ejection type; mericarps 4.2-5.6 mm long, 1.6-2.9 mm wide, without a strand of fibers, not compressed at the apex, smooth, without basal beak, with a basal callus, without a basal prong, brown, with ± antrorse, appressed, eglandular hairs 0.5-0.8 mm long; rostrum 23.2-25.7 mm long, with a narrowed apex 6.3-8.5 mm long, not twisted, with ± patent, eglandular hairs 0.3-0.4 mm long; stigmatic remnants 2.5-2.8 mm long, with 5 glabrous lobes. *Seeds* 2.6-3.4 mm long, 1.4-2.3 mm wide, finely reticulate, uniformly colored, brownish red, glabrous. Cotyledons not studied. Fig. 565.

Pollen. Ornamentation not studied.

Chromosome number. Unknown.

Phenology. Collected in flower from February to December.

Distribution. This species ranges through central Peru (Fig. 566).

Habitat. Rocky and shrubby slopes; 2650-3300 m.

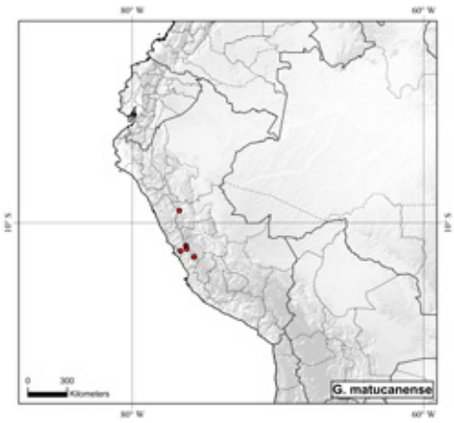


Fig. 566. Distribution of *Geranium matucanense*.

Additional specimens examined. **Peru.** Peru, *Dombey s.n.* (P). Ancash: Huarí, Yanas, distr. Huacchis, 9º9'S, 76º47'W, 18 Feb. 2005, *Cano & al. 14970* (MA). Lima: Canchis, 11º33'S, 76º20'W, 27 Dec. 1878, *Martinet 149* (P); Huarochiri cerca de Río Blanco, carretera central Lima-Huancayo, 11º43'S, 76º18'W, 9 Mar. 1953, *Ferreyra 8943* (USM); Huarochiri prov., distr. Matucana, km 94 carretera central, left side, 11º45'S, 76º18'W, 7 Mar. 1954, *Saunders 262* (BM); Huarochiri, cerca de San Mateo, entre Matucana y Casapalca, 11º47'S, 76º17'W, 25 Mar. 1950, *Ferreyra 6960* (MA, USM); Yauyos, Laraos, 12º20'S, 75º47'W, 6 Feb. 1989, *Beltrán 71* (USM).

Discussion. Geranium matucanense shares a similar inflorescence structure with *G. mutisii*, but the cymules are 2-flowered and have a long peduncle, which is a useful distinguishing character for *G. matucanense*. The indumentum of retrorse, appressed hairs on stems, petioles, and inflorescences is also similar in both species. No glandular hairs are present in *G. matucanense*, but *G. paramicola* and *G. mutisii* bear glandular hairs at least on sepals and pedicels. *Geranium matucanense* also differs from *G. mutisii* in its petiolate leaves and its longer sepals, petals, and fruits. The hairs of staminal filaments are noticeably longer in *G. matucanense* than in *G. paramicola* and *G. mutisii*.

223. Geranium mutisii Aedo, J. Torrey Bot. Soc. 136: 289, 290 fig. 1. 2009. Type locality: "Colombia. La Guajira, Sierra Nevada de Santa Marta, laguna Sabaca, nacimiento del río San Miguel, 10º40'N, 73º01'W, 3900 m, 16 Aug 1986, Cuadros & Gentry 2709 (holotype, MA-626646!; isotype, MO!)". Type: Colombia. La Guajira, Sierra Nevada de Santa Marta, laguna Sabaca, nacimiento del río San Miguel, 10°40'N, 73°00'W, 16 Aug. 1986, *H. Cuadros & A.H. Gentry 2709* (holotype, MA-626646!; isotype, MO-2235217!).

Perennial herbs, 30-61 cm tall. *Rootstock* and roots unknown. *Stem* erect, leafy, not rooting at nodes, stolons absent, without vegetative stems, with retrorse, appressed, eglandular hairs 0.2-0.5 mm long. *Basal leaves* unknown, cauline leaves opposite; leaf laminas 2.6-5.1 cm long, 2.4-7.7 cm wide, not peltate, palmatifid [ratio main-sinus length/middle segment length = 0.86-0.91], polygonal in outline, base cordate, not coriaceous, with nerves not projected, densely hairy, with ± appressed, eglandular hairs on the adaxial surface, and lanuginose abaxially; segments 5, in 1 plane, middle segment rhombic, 1.3-4.3 mm wide at the base [ratio segment width at the base/middle segment length = 0.04-0.09], 3-7-lobed in distal half [ratio secondary sinus length/middle segment length = 0.41-0.52]; petioles usually absent, rarely present, without abscission zone, with retrorse, appressed, eglandular hairs 0.3-0.4 mm long; stipules 3.5-6.6 mm long, 1.5-4.4 mm wide, lanceolate, free or connate (at least at the base), pa-

pery, brownish red, minute eglandular hairs on abaxial surface and margin, almost glabrous adaxially. *Inflorescence* a dichasial cyme with monochasial branches; cymules 2-flowered, solitary or in aggregates at the top of each branch [ratio cymule length/leaf length = 1.1-2.1]; peduncles 5.7-40 mm long, with retrorse, ± appressed, eglandular hairs 0.4-0.6 mm long and scattered, patent, glandular hairs 0.5-1.1 mm long; bracteoles 1.4-4.6 mm long, 0.3-1.1 mm wide, lanceolate, whorled; pedicels 8.7-15.4 mm long, with retrorse, ± appressed, eglandular hairs 0.2-0.5 mm long and scattered, patent, glandular hairs 0.7-1.1 mm long. Flowers actinomorphic. *Sepals* 6.1-8.5 mm long, 2.2-3.5 mm wide, lanceolate, smooth, not accrescent, nerves 3, mucro 0.7-1.3 mm long [ratio mucro length/sepal length = 0.12-0.18], with appressed, eglandular hairs 0.4-0.7 mm long and patent, glandular hairs 0.8-1.3 mm long on the abaxial surface, glabrous adaxially. *Petals* 11-12.9 mm long, 4.6-9.3 mm wide, erect-patent, rounded, without claw, purple, hairy on both surfaces, mainly on the base of the adaxial surface, ciliate on the basal margin, with hairs 0.4-0.5 mm long. *Stamens* 10, both whorls bearing anthers; filaments 4.6-5.1 mm long, lanceolate, unknown color, pilose on the abaxial surface, ciliate on the proximal half, with eglandular hairs 0.4-0.7 mm long; anthers 1.3-1.4 mm long, unknown color. Nectaries 5, hemispheric, with a tuft of hairs at the top, dorsally glabrous. *Gynoecium* 4.7-6.7 mm long, unknown color. *Fruit* 15-19.5 mm long, erect, discharge of seed-ejection type; mericarps 2.9-3.5 mm long, 1.3-1.4 mm wide, without a strand of fibers, not compressed at the apex, smooth, without basal beak, with a basal callus, without a basal prong, brown, with ± antrorse, appressed, eglandular hairs 0.4-0.8 mm long; rostrum 11-12.3 mm long, with a narrowed apex 1.3 mm long, not twisted, with ± antrorse, appressed, eglandular hairs 0.3-0.4 mm long; stigmatic remnants ca. 2.5 mm long, with 5 glabrous lobes. *Seeds* ca. 2.2 mm long, 1 mm wide, finely reticulate, uniformly colored, brownish red, glabrous. Cotyledons not studied. Fig. 567.

Pollen. Ornamentation not studied.

Chromosome number. Unknown.

Phenology. Collected in flower in August.

Distribution. This species is endemic to northern Colombia (Fig. 568).

Habitat. Paramos; 3700-3900 m.

Additional specimens examined. **Colombia.** La Guajira: Sierra Nevada de Santa Marta, Laguna Sabaca, nacimiento del río San Miguel, 10º40'N, 73º1'W, 16 Aug. 1986, *Cuadros & Gentry 2713* (MA, MO).

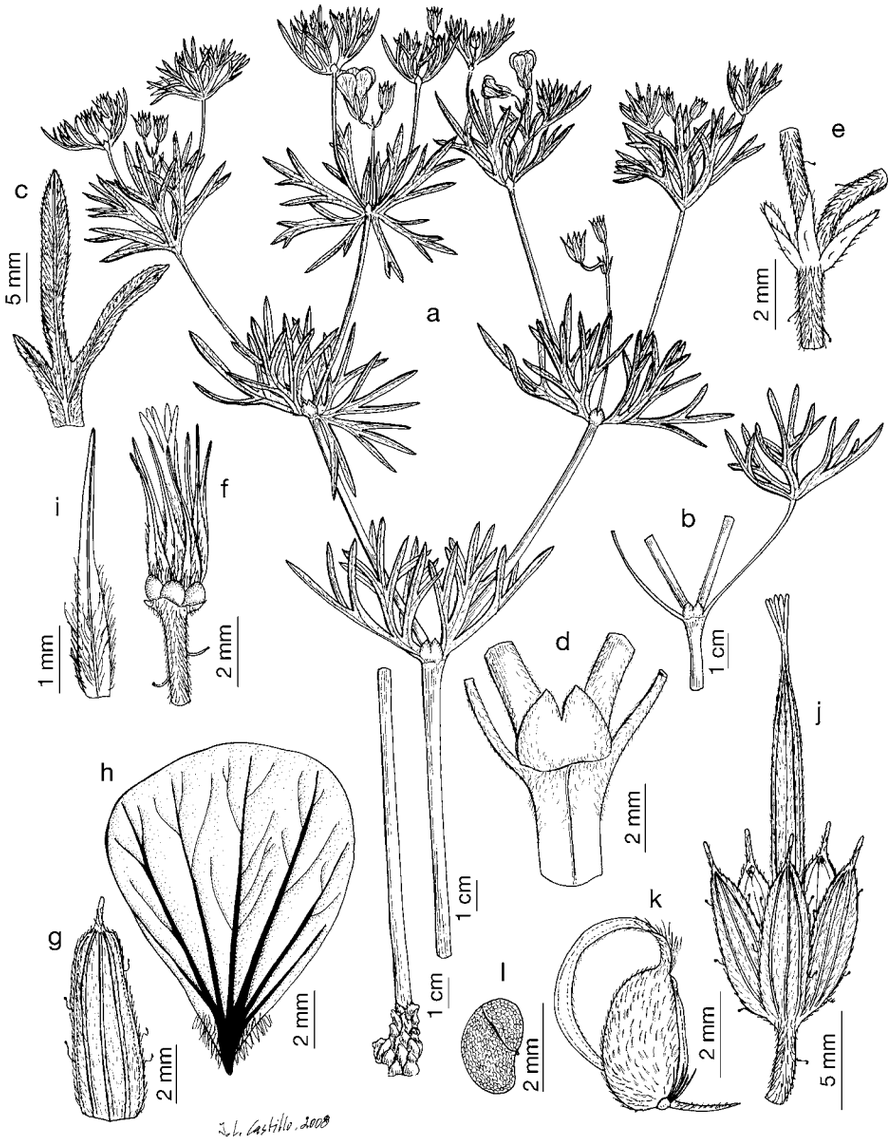


Fig. 567. *Geranium mutisii*. a. Habit. b. Basal node with a petiolate leaf. c. Portion of leaf detail, abaxial side. d. Stipules. e. Bracteoles. f. Flower, sepals and petals removed. g. Sepal. h. Petal. i. Staminal filament. j. Fruit. k. Mericarp. l. Seed. (Based on: a-d, *Cuadros & Gentry 2709*, MA; e-h, *Cuadros & Gentry 2709*, MO; i-l, *Cuadros & Gentry 2713*, MO).

Discussion. Geranium mutisii is quite similar to *G. paramicola* in leaf indumentum and is also endemic to Sierra Nevada de Santa Marta; how-

Fig. 568. Distribution of *Geranium mutisii*.

ever, it has an erect habit, retrorse appressed hairs on stems and the fruit rostrum, and a longer sepal mucro. Its leaves are more deeply divided; the segments are narrower than in *G. paramicola* and 3-lobed [segments are (5)6-11-lobed in *G. paramicola*]. The cauline leaves of *G. mutisii* are sessile, whereas in *G. paramicola* the petioles decrease in length towards the apex; no basal leaves of *G. mutisii* were seen. The inflorescence structure is also differs in these species. *Geranium mutisii* has a dichasial cyme with monochasial branches and 2-flowered cymules, borne solitary or in aggregates at the apex of each branch; the cymules are sometimes 1-flowered. In *G. paramicola* the inflorescence is a monochasial cyme with 2-flowered, solitary cymules. The nectaries of *G. mutisii* have a tuft of hairs at the apex, but are glabrous in *G. paramicola*. The stipules of *G. mutisii* are usually connate, at least at the first and second nodes. This feature is found otherwise only in some species from the Himalayas and Africa of subg. *Geranium*.

224. Geranium paramicola R. Knuth, Repert. Spec. Nov. Regni Veg. 40: 216. 1936. Type locality: "Colombia: Páramos der Sierra de Santa Marta, bei Dibulla, 3850 m (Seifriz a. 1932 n. 458 - Typus in U. St. Nat. Herb. n. 1572281!)". Type: Colombia. La Guajira, Páramos der Sierra de Santa Marta, bei Dibulla, 10°50'N, 73°28'W, July 1932, *W. Seifriz 458* (holotype, US-1572281!).

Perennial herbs, 9-41 cm tall. *Rootstock* ca. 7 mm in diameter, ± vertical, not tuberculate, not turnip-shaped, unknown roots. *Stem* ascending, leafy, not rooting at nodes, stolons absent, without vegetative stems, with patent, eglandular hairs 0.3-0.7 mm long. *Basal leaves* in a ± persistent rosette, cauline leaves opposite; leaf laminas 1.9-5 cm long, 2.9-6.2 cm wide, not peltate, palmatifid [ratio main-sinus length/middle segment length = 0.76-0.82], polygonal in outline, base cordate, not coriaceous, with nerves not projected, densely hairy, with ± erect, eglandular hairs on the adaxial surface, and lanuginose abaxially; segments 5, in 1 plane, middle segment rhombic, 2.1-5.6 mm wide at the base [ratio segment width at the base/middle segment length = 0.14-0.18], (5)6-11-lobed in distal half [ratio secondary sinus length/middle segment length = 0.36-0.51]; petioles up to 11.5 cm long, without abscission zone, terete, not swollen, not deflexed in age, with patent, eglandular hairs 0.5-0.8 mm long and, sometimes, scattered, patent, glandular hairs 0.3-0.5 mm long; stipules 3.1-5 mm long, 0.7-1.4 mm wide, lanceolate, free, papery, brownish red, with long eglandular hairs on both surfaces and on the margin. *Inflorescence* a monochasial cyme; cymules 2-flowered, solitary [ratio cymule length/leaf length = 1.1-5.8]; peduncles 19-145 mm long, with patent, eglandular hairs 0.2-0.7 mm long and, usually, patent, glandular hairs 0.3-0.6 mm long; bracteoles 1.9-3.8 mm long, 0.5-0.6 mm wide, lanceolate, whorled; pedicels 21-32 mm long, with patent, eglandular hairs 0.2-0.9 mm long and patent, glandular hairs 0.2-0.7 mm long. Flowers actinomorphic. *Sepals* 6.1-8.3 mm long, 2.3-3 mm wide, lanceolate, smooth, not accrescent, nerves 3, mucro 0.4-0.6 mm long [ratio mucro length/sepal length = 0.06-0.11], with ± patent, eglandular hairs 0.4-0.7 mm long and patent, glandular hairs 0.3-0.7 mm long on both surfaces. *Petals* 9.8-14.1 mm long, 5.9-9.2 mm wide, erect-patent, rounded, without claw, purple, with scattered hairs on the base of the adaxial surface, with hairs 0.1-0.2 mm long. *Stamens* 10, both whorls bearing anthers; filaments 4-5.1 mm long, lanceolate, unknown color, pilose on the abaxial surface, ciliate on the proximal half, with eglandular hairs 0.4-0.6 mm long; anthers 0.7-1.4 mm long, unknown color. Nectaries 5, hemispheric, glabrous. *Gynoecium* 3.8-5.7 mm long, unknown color. *Fruit* 20.1-23.4 mm long, erect, discharge of seed-ejection type; mericarps 3.3-3.8 mm long, 1.4-2.3 mm wide, without a strand of fibers, not compressed at the apex, smooth, without basal beak, with a basal callus, without a basal prong, brown, with ± patent, eglandular hairs 0.3-1 mm long; rostrum 13.4-17.1 mm long, with a narrowed apex 1.2-2 mm long, not twisted, with ± patent, eglandular hairs 0.2-0.8 mm long; stigmatic remnants 1.8-3.2 mm long, with 5 glabrous lobes. *Seeds* 2-2.9 mm long, 1.1-1.9 mm wide, finely reticulate, uniformly colored, brownish red, glabrous. Cotyledons not studied. Fig. 569.

Pollen. Ornamentation not studied.

Chromosome number. Unknown.

Phenology. Collected in flower from July to October.

Distribution. This species is endemic to northern Colombia (Fig. 570).

Habitat. Paramos; 3200-4500 m.

Additional specimens examined. **Colombia.** Magdalena: Sierra Nevada, 1829, *Simons s.n.* (BM); Sierra Nevada de Santa Marta, Duriameina, 10º31'N, 73º42'W, 18 Aug. 1946, *Foster & al. 1547* (COL, GH, MA); Sierra Nevada de Santa Marta, SE slopes, Hoya del río Donachui, below Dirincune Sabana, 10º43'N, 73º30'W, 29 Sep. 1959, *Cuatrecasas & Romero 24489* (COL); Sierra Nevada de Santa Marta, valle del río Donachuy, camino Corisa-Nabona lake, 10º44'N, 73º42'W, 15 Oct. 1958, *Hammen 1167* (COL).

Discussion. Geranium paramicola has an ascendant habit and is well characterized by its densely hairy leaves, which are lanuginose abaxially. Among South American species of *Geranium* such leaf vesture is also found in some stemless species from the Andes (all with 1-flowered cymules) and in other species allied with *G. paramicola*. Additionally, *G. paramicola* has patent, eglandular hairs on stems, stipules, and bracteoles. A dense glandular indumentum covers sepals and pedicels, and sometimes also peduncles. The fruit rostrum and the mericarps have ± patent, eglandular hairs in all specimens examined, including the type. Knuth's statement (1936: 216) "Rostrum dense glandulosum" is an error.

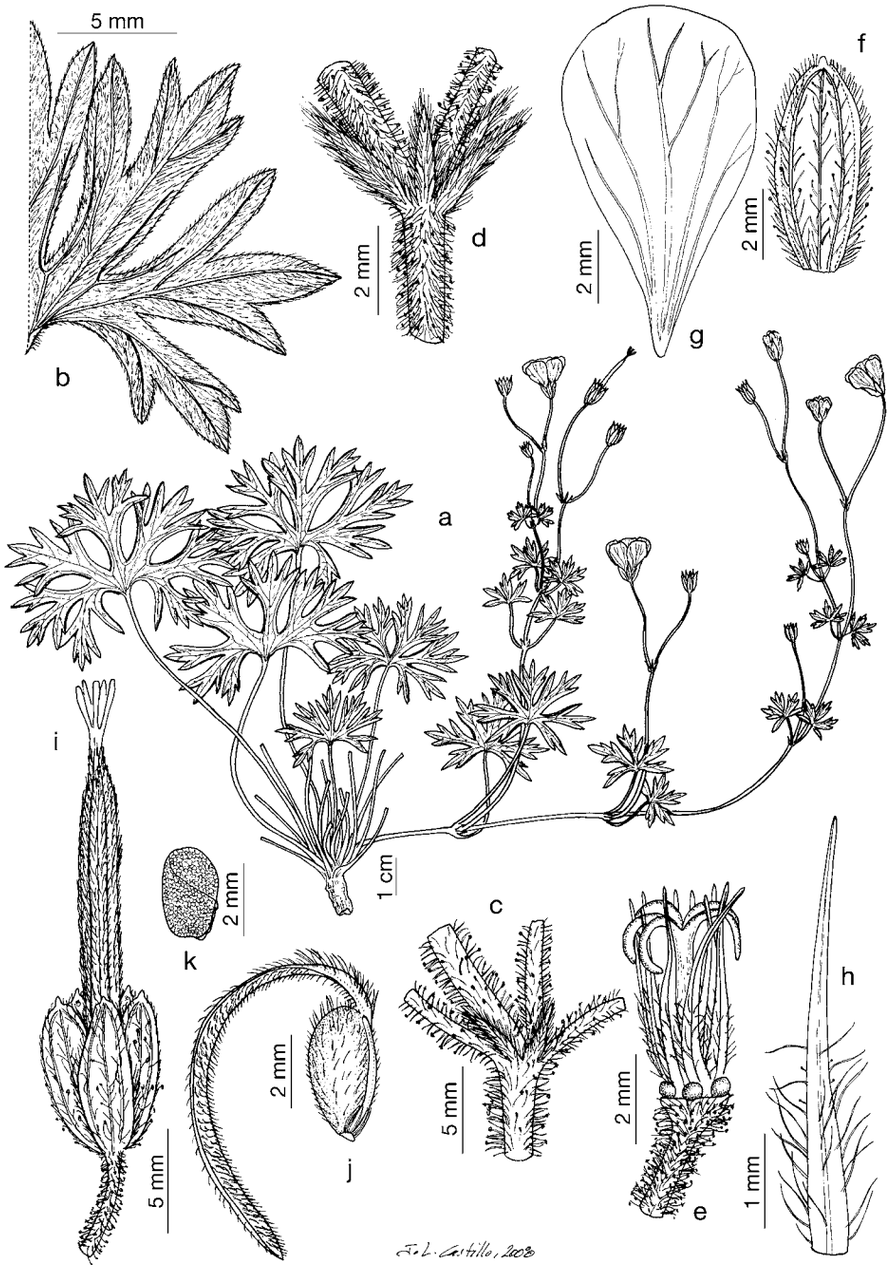


Fig. 569. *Geranium paramicola*. a. Habit. b. Portion of leaf, abaxial side. c. Stipules. d. Bracteoles. e. Flower, sepals and petals removed. f. Sepal. g. Petal. h. Staminal filament. i. Fruit. j. Mericarp. k. Seed. (Based on: a-h, *Cuatrecasas & Romero 24489*, COL; i-k, *Foster & al. 1547*, MA).

IIb. Geranium sect. **Paramensia** R. Knuth in Engl., Nat. Pflanzefam. ed. 2, 19a: 55. 1931. Type: *Geranium jahnii* (designated by Knuth 1931: 55).

Leaves with an abscission zone between lamina and petiole. *Stipules* ovate to lanceolate, entire, sometimes with a very short bifid apex. *Mericaps* with a basal callus.

Similarities between the sect. *Paramensia* and sect. *Neurophyllodes* (endemic to Hawaii) were already noted by (Standley 1915: 600). Both sections have a shrubby habit and unlobed, parallel-veined leaves rather than a herbaceous habit and palmate leaves typical of the genus. The most noteworthy feature shared by both groups is the presence of an abscission zone (at the apex of the petiole in the sect. *Paramensia* and at the base of the petiole in the sect. *Neurophyllodes*). This highly specialized feature, otherwise unknown in *Geranium*, suggests a common ancestry (Standley 1915: 600; Aedo & al. 2002: 213). The strong resemblance between the leaves of *G. jahnii* and *G. cuneatum* (of sect. *Neurophyllodes*) is also remarkable; they are obtriangular in outline and have teeth at the apex.

Fig. 570. Distribution of *Geranium paramicola*.

225. Geranium exallum H.E. Moore, Brittonia 13(2): 142, 143 fig. 1A. 1961. Type locality: "Ecuador: Prov. Azuay--'Oriente' Border: Eastern Cordillera, between Oña and the Río Yacuambi, 10,000-11,200 ft alt., 10-19 Sep 1945, F. Prieto 279 (Holotype, NY; isotype BH)". Type: Ecuador. Azuay, between Oña and the Río Yacuambi, 3°27›S, 79°06›W, 10-19 Sep. 1945, *F. Prieto 279* (holotype, NY-00468265!; isotypes, BH!, K!, U-0002233 image!, US-00100883 image!).

Perennial shrubby, 6-20 cm tall. *Rootstock* 2-4 mm in diameter, ± horizontal, not tuberculate, not turnip-shaped, without thickened roots. *Stem* erect, leafy, not rooting at nodes, stolons absent, without vegetative stems, glabrous, densely clothed with imbricate persistent stipules and petioles. *Basal leaves* deciduous, cauline leaves alternate; leaf laminas 0.8-1.1 cm long, 0.2-0.3 cm wide, not peltate, entire, lanceolate in outline, base cuneate, coriaceous, with nerves not projected, glabrous on both surfaces, with antrorse, eglandular cilia 0.1-0.3 mm long on the margin; segments 1; petioles up to 0.45 cm long, with an abscission zone between lamina and petiole, terete, not swollen, not deflexed in age, glabrous or with scattered, retrorse, eglandular hairs 0.1-0.2 mm long; stipules 2.1-4 mm long, 0.5-0.7 mm wide, lanceolate, free, papery, brownish red, glabrous on both surfaces, with antrorse, eglandular hairs 0.1-0.2 mm long on margin. *Cymules* 1-flowered, solitary at the end of each branch [ratio cymule length/leaf length = 1.4-3.4]; peduncles 7-13 mm long, with retrorse, appressed, eglandular hairs 0.2-0.4 mm long; bracteoles 5-7.5 mm long, 0.7-1 mm wide, linear-lanceolate, opposite; pedicels 3.4-19 mm long, with retrorse, appressed, eglandular hairs 0.2-0.6 mm long. Flowers actinomorphic. *Sepals* 7.5-10 mm long, 2.5-3.5 mm wide, lanceolate, smooth, not accrescent, nerves 3, mucro 0.8-1.4 mm long [ratio mucro length/sepal length = 0.13-0.17], with ± patent, eglandular hairs 0.2-0.7 mm long on both surfaces (mainly on nerves and margin). *Petals* 11-14.2 mm long, 6-7.8 mm wide, erect-patent, rounded, without claw, purple, glabrous. *Stamens* 10, both whorls bearing anthers; filaments 4-5.2 mm long, lanceolate, yellow, glabrous except for a few marginal hairs 0.2-0.4 mm long; anthers 1-1.5 mm long, yellow. Nectaries 5, hemispheric, glabrous. *Gynoecium* 4-5 mm long, yellow. *Fruit* ca. 17 mm long, erect, discharge of seed-ejection type; mericarps ca. 3.2 mm long, 1.5

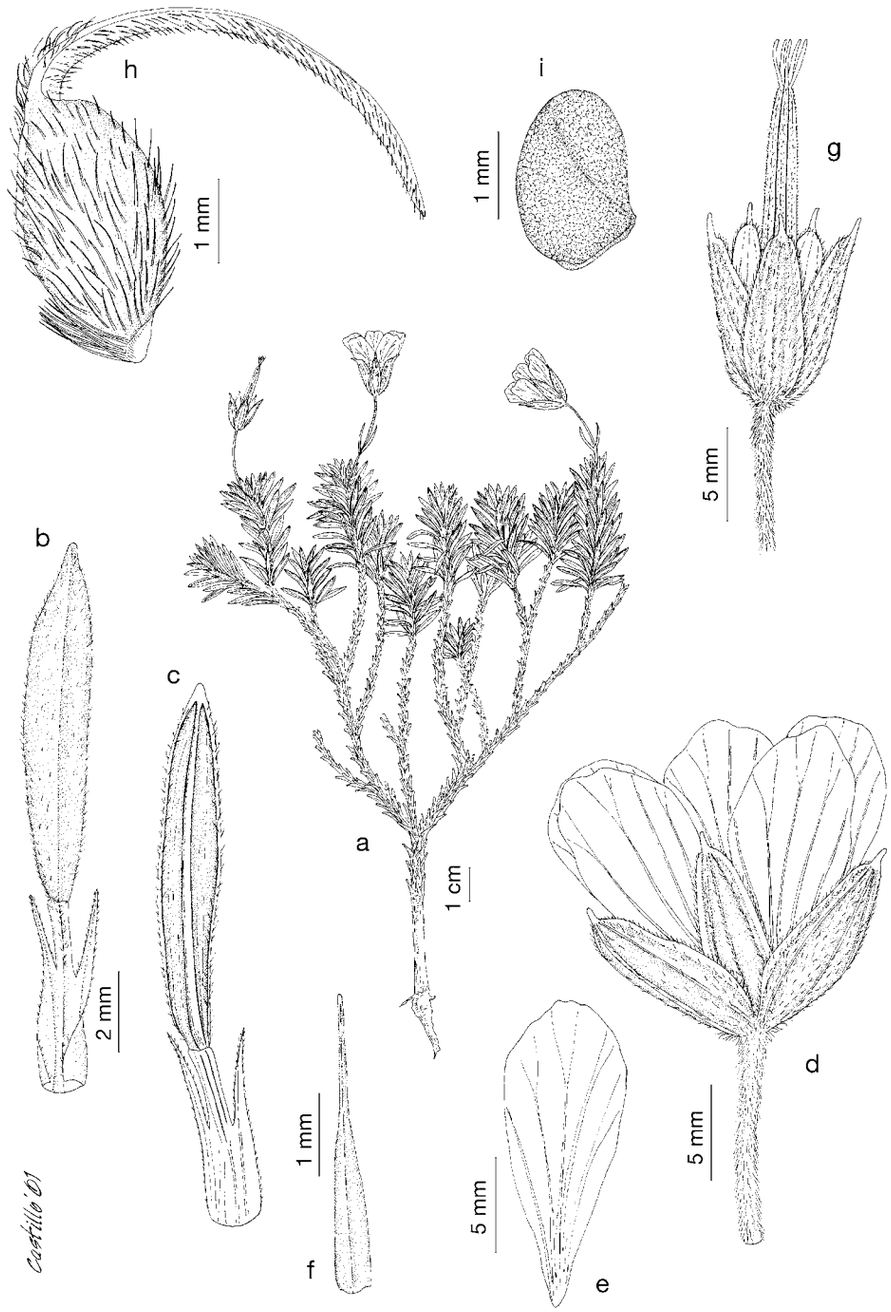


Fig. 571. *Geranium exallum*. a. Flowering branch. b. Leaf, adaxial side. c. Leaf, abaxial side. d. Flower. e. Petal. f. Staminal filament. g. Fruit. h. Mericarp. i. Seed. (Based on: a-f, *Prieto 279*, NY; g-i, *Prieto 279*, BH).

Fig. 572. *Geranium exallum* (Based on: a, b, *Sklenář 13027*, MA, photo: P. Sklenář; c, *Sklenář 15822,* MA, photo: P. Sklenář).

Fig. 573. Distribution of *Geranium exallum*.

mm wide, without a strand of fibers, not compressed at the apex, smooth, without basal beak, with a basal callus, without a basal prong, brown, with erect-patent, eglandular hairs 0.3-0.7 mm long; rostrum ca. 11 mm long, without a narrowed apex, not twisted, with erect-patent, eglandular hairs 0.1 mm long; stigmatic remnants ca. 3 mm long, with 5 glabrous lobes. *Seeds* ca. 2.2 mm long, 1.2 mm wide, finely reticulate, uniformly colored, brown, glabrous. Cotyledons with entire margin. Figs. 571, 572.

Pollen. *Geranium*-type (Aedo & al. 2002: 217).

Chromosome number. Unknown.

Phenology. Collected in flower from September to November.

Distribution. This species is endemic to southern Ecuador (Fig. 573).

Habitat. Rocky outcrops and marshy places in grass paramo with *Pinus* L. plantation, disturbed and burning; 2700-3100 m.

Additional specimens examined. **Ecuador.** Cañar: Cordillera Cordoncillo, El Quingueado (Saraguro), along road from Babes (ca 2 km E of Urdaneta) towards 28 de Mayo, 3º34'S, 79º6'W, 20 Nov. 2010, *Sklenář & al. 13027* (PRC). Loja: Cordillera Cordoncillo, along road from Babes, ca. 2 km E of Urdaneta, towards 28 de Mayo, 3º34'S, 79º6'W, 10 Nov. 2018, *Sklenář & al. 15822* (MA).

Discussion. Geranium exallum is easy to differentiate from other species of *Geranium* by its coriaceous, lanceolate, entire leaves, which, as also noted by Moore (1961: 141), is a unique condition in the genus. This species resembles most closely *G. jahnii* in its shrubby habit, its stems densely clothed with imbricate persistent stipules and petioles, and its leaves with an abscission zone between the lamina and the petiole. *Geranium jahnii* differs in its obtriangular glabrous leaves with a tridentate apex and pedicels with glandular hairs; *G. exallum* has lanceolate, entire leaves with marginal cilia and pedicels without glandular hairs. Additionally, the stipules have a setaceous apex in *G. jahnii*, which is not found in *G. exallum*. The two species constitute the sect. *Paramensia*, which appears to be a well-supported natural group (Aedo & al. 2002).

226. Geranium jahnii Standl., J. Wash. Acad. Sci. 5: 601. 1915. Type locality: "Type in the U.S. National Herbarium, no. 602229, collected on the Páramo del Jabón, State of Trujillo, Venezuela, altitude 3000 to 3200 meters, October 2, 1910, by Dr. Alfredo Jahn (no. 34)". Type: Venezuela. Trujillo, Páramo del Jabón, 9°53' N, 70°30' W,

2 Oct. 1910, *A. Jahn 34* (holotype, US-602229!; isotype, VEN-5308 image!).

Perennial shrubby, 8-13 cm tall. *Rootstock* 3-4 mm in diameter, ± horizontal, not tuberculate, not turnip-shaped, without thickened roots. *Stem* erect, leafy, not rooting at nodes, stolons absent, without vegetative stems, glabrous, densely clothed with imbricate persistent stipules and petioles. *Basal leaves* deciduous, cauline leaves alternate; leaf laminas 6.2-12.5 cm long, 2-4.3 cm wide, not peltate, entire with tridentate apex [ratio main-sinus length/middle segment length = 0.15-0.19], obtriangular in outline, base cuneate, coriaceous, with nerves projected on the abaxial surface, glabrous; segments 3, in 1 plane, middle segment lanceolate, entire; petioles up to 0.5 cm long, with an abscission zone between lamina and petiole, terete, not swollen, not deflexed in age, with retrorse, appressed, eglandular hairs 0.1-0.2 mm long; stipules 5.5-7.1 mm long, 0.7-1 mm wide, lanceolate (with a setaceous apex 1.3-2.5 mm long), free, papery, brownish red, with eglandular hairs on abaxial surface and on the margin, glabrous adaxially. *Cymules* 1-flowered, grouped at the end of each branch [ratio cymule length/leaf length = 1.4-2.8]; peduncles 3.8-9.7 mm long, with patent, eglandular hairs 0.1-0.3 mm long; bracteoles 3-4.6 mm long, 0.5-0.7 mm wide, linear-lanceolate, whorled; pedicels 3.4-25 mm long, with patent, eglandular hairs 0.1-0.6 mm long and, usually, patent, glandular hairs 0.4-0.6 mm long. Flowers actinomorphic. *Sepals* 6.3-7 mm long, 2-2.5 mm wide, lanceolate, smooth, not accrescent, nerves 3, mucro 0.7-1 mm long [ratio mucro length/sepal length = 0.12-0.16], with patent, eglandular hairs 0.3-0.7 mm long and patent, glandular hairs 0.4-0.7 mm long on the abaxial surface and margin, glabrous adaxially. *Petals* 10.3-13 mm long, 5-8 mm wide, erect-patent, rounded, with claw ca. 2 mm long, purple, hairy on the base of the abaxial surface, ciliate on the basal margin, with hairs 0.2-0.5 mm long. *Stamens* 10, both whorls bearing anthers; filaments 3.5-4.8 mm long, lanceolate, yellow, glabrous except for a few marginal hairs 0.2-0.7 mm long; anthers 0.8-1.1 mm long, unknown color. Nectaries 5, hemispheric, glabrous. *Gynoecium* 4-4.8 mm long, yellow. *Fruit* 14-17.2 mm long, erect, discharge of seed-ejection type; mericarps 3-3.1 mm long, 1.7-1.8 mm wide, without a strand of fibers, not compressed at the apex, smooth, without basal beak, with a basal callus, without a basal prong, brown, with antrorse,

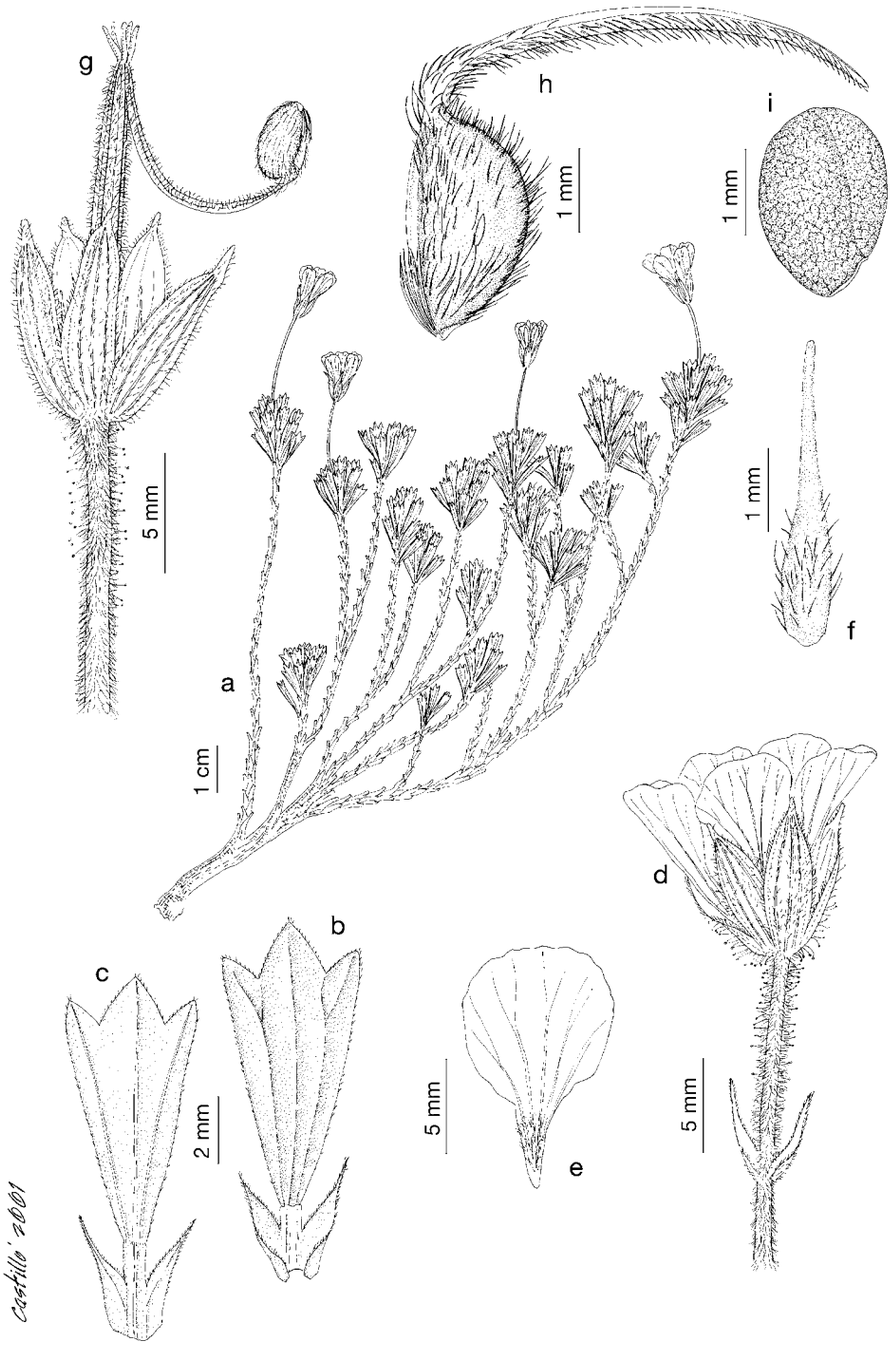


Fig. 574. *Geranium jahnii*. a. Habit. b. Leaf, adaxial side. c. Leaf, abaxial side. d. Flower. e. Petal. f. Staminal filament. g. Fruit. h. Mericarp. i. Seed. (Based on: a, d-f, *Duno & Riina 781*, MA; b, c, *Riina & al. 748*, MA; g-i, *Riina & al. 597*, MA).

Fig. 575. *Geranium jahnii* (Based on: *Riina & al. 748,* MA, photo: R. Riina).

Fig. 576. Distribution of *Geranium jahnii*.

± appressed, eglandular hairs 0.1-0.4 mm long; rostrum 10-11.7 mm long, without a narrowed apex, not twisted, with ± patent, eglandular hairs 0.1-0.3 mm long; stigmatic remnants 0.8-1 mm long, with 5 glabrous lobes. *Seeds* ca. 2.4 mm long, 1.5 mm wide, finely reticulate, uniformly colored, brown, glabrous. Cotyledons with entire margin. Figs. 574, 575.

Pollen. *Geranium*-type (Aedo & al. 2002: 217).

Chromosome number. Unknown.

Phenology. Collected in flower from April to August.

Distribution. This species is endemic to northwestern Venezuela (Fig. 576).

Habitat. Wet places among dwarf shrubs; 3000-3350 m.

Additional specimens examined. **Venezuela.** Trujillo: Parque Nacional Dinira, fila hacia el Pico Cendé, 9º31'N, 70º6'W, 15 Aug. 1999, *Riina & al. 748* (MA); Carache, Parque Nacional Dinira, arriba de Mesa Arriba, Pico Cendé, ladera NW, 9º32'N, 70º7'W, 2 Apr. 1999, *Duno & Riina 781* (MA); Parque Nacional Dinira, Páramo de Jabón, 9º34'N, 70º7'W, 14 Aug. 1999, *Riina & al. 597* (MA).

Discussion. Geranium jahnii differs from all other New World species by its distinctive obtriangular, tridentate leaves with an abscission zone between the lamina and the petiole. The differences and similarities between *G. jahnii* and *G. exallum* are addressed in the discussion under the latter species.

II.c Geranium sect. **Neurophyllodes** A. Gray, U.S. Expl. Exped., Phan. 1: 310. 1854. *Neurophyllodes* (A. Gray) O. Deg., Fl. Hawaiiensis: 171. 1937. Type: *Geranium arboreum* A. Gray (designated by Knuth 1912: 47).

Petiole with an abscission zone at base. *Stipules* ovate to lanceolate, entire, sometimes with a very short bifid apex. *Mericaps* with a basal callus.

227. Geranium arboreum A. Gray, U.S. Expl. Exped., Phan. 1: 315, tab. 31. 1854, 1856. *Neurophyllodes arborea* (A. Gray) O. Deg., Fl. Hawaiiensis, Fam. 171. 1937. Type locality: "Hab. Eastern part of the island of Maui, Sandwich Islands; near the upper border of the forest, at about the elevation of 6000 feet". Type: U.S.A. Hawaii. Maui Is., 20º43'N, 156º12'W, 1840, *W. Brackenridge & al. s.n.* (lectotype, designated by St. John 1985: 571, US!; isolectotypes, K!, NY!, P!, PH).

Shrub, 180-400 cm tall. *Rootstock* and roots unknown. *Stem* erect, leafy, not rooting at nodes, stolons absent, without vegetative stems, with patent, eglandular hairs 0.5-1 mm long (on young branches mainly). *Basal leaves* unknown, cauline leaves alternate; leaf laminas (2.6)2.8-5.4(6.5) cm long, 1.5-4.6 cm wide, not peltate, entire with serrate margin [with 5-21 teeth on each side, almost to the base], ovate in outline, base cordate to subcordate, coriaceous, with nerves not projected, pilose, with ± patent, eglandular hairs on both surfaces; segments 1; petioles up to 2.2 cm long, with an abscission zone between petiole and stipule, terete, not swollen, not deflexed in age, with patent, eglandular hairs 0.6-1.2 mm long; stipules 5.5-11.7 mm long, 1.5-2.3 mm wide, lanceolate (with a setaceous apex 2.1-5.8 mm long), sheathing, connate at the base, papery, brownish red, with eglandular hairs on abaxial surface and on the margin, glabrous adaxially. *Inflorescence* a monochasial cyme; cymules 1-flowered, grouped in 2-6-flowered cymes at the end of each brachyblast [ratio cymule length/leaf length = (0.8)1.1-1.4]; peduncles 7.8-12.4 mm long, with patent, eglandular hairs 0.6-1.2 mm long; bracteoles 3-5.1 mm long, 0.6-1.2 mm wide, linear-lanceolate, subopposite, overlapping at base on one side of the peduncle, exposing the opposite part. Flowers zygomorphic. *Sepals* (10.5)11-12.1(13.5) mm long, 2.7-3.9

mm wide, lanceolate, smooth, not accrescent, nerves 3-5, mucro 1.5-3.8 mm long [ratio mucro length/ sepal length = 0.14-0.32], with ± patent, eglandular hairs 0.3-1.1 mm long on the abaxial surface, glabrous adaxially. *Petals* (16.4)17-22.5 mm long, 3.8-7.5 mm wide, arcuate, the upper 3 erect (with revolute apex), the lower ones reflexed, rounded, without claw, reddish, hairy on the base of the abaxial surface, ciliate on the basal margin, with hairs 0.4-1.1 mm long. *Stamens* 10, both whorls bearing anthers; filaments (11.3)17-21 mm long, linear-lanceolate, with a dark purple apex, pilose on the abaxial surface, ciliate on the proximal half, with hairs 0.4-1.4 mm long; anthers 1.7-2.2 mm long, dark purple. Nectaries 5, ± hemispheric, with a tuft of hairs at the top, dorsally glabrous. *Gynoecium* 13.4-19.4 mm long, dark purple. *Fruit* 34.5-47.2 mm long, erect, discharge of seed-ejection type; mericarps 3.4-4.3 mm long, 1.6-2.3 mm wide, without a strand of fibers, not compressed at the apex, smooth (with 1-2 transverse veins at apex), without basal beak, with a basal callus, without a basal prong, brown, with erect-patent, eglandular hairs 0.6-1.4 mm long; rostrum 28.8-35.4 mm long, with a narrowed apex 12.8-16.1 mm long, not twisted, with ± patent, eglandular hairs 0.3-0.8 mm long; stigmatic remnants 2.4-3.8 mm long, with 5 glabrous lobes. *Seeds* 2.2-2.7 mm long, 1.3-1.5 mm wide, reticulate-sinuous, uniformly colored, brown, glabrous. Cotyledons with entire margin. Fig. 577.

Pollen. *Geranium*-type.

Chromosome number. 2*n* = c. 50.

Phenology. Collected in flower from April to October.

Distribution. This species is endemic to southeastern of Maui Is., Hawaii (Fig. 578).

Habitat. Steep sides of moist ravines with shrubby vegetation, sometimes on plantations of *Eucalyptus* L'Hér.; 600-2450 m.

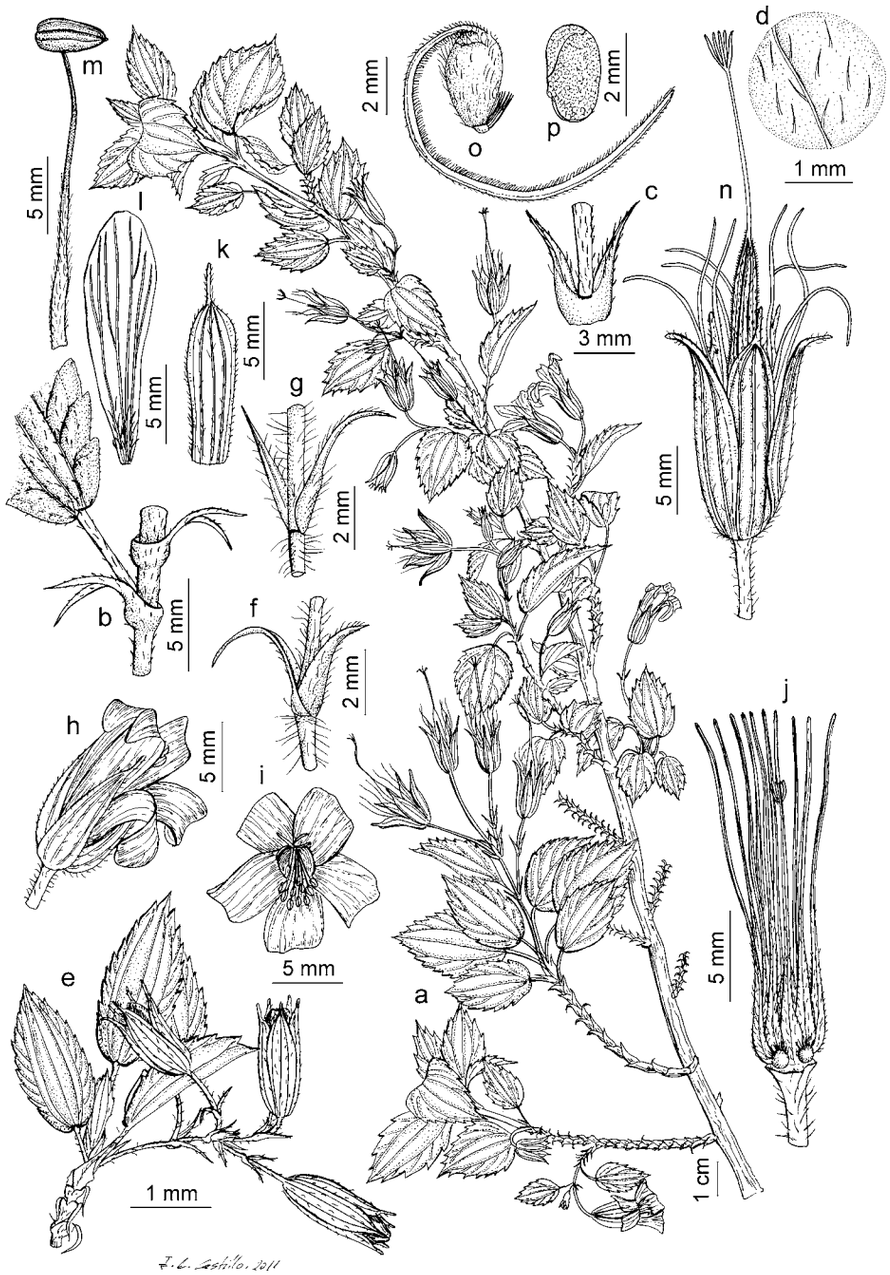


Fig. 577. *Geranium arboreum*. a. Branch with flowers and fruits. b. Stipules. c. Abaxial surface of a stipule. d. Detail of leaf indument, adaxial surface. e. Partial inflorescence. f, g. Bracteoles. h. Flower in lateral view. i. Flower in frontal view. j. Flower without petals and sepals. k. Sepal. l. Petal. m. Stamen. n. Fruit. o. Mericarp. p. Seed. (Based on: a-c, f, g, *Degener s.n.*, 27 July 1927, NY; e, *Wood & Perlman 6627*, NY; h-p, *Carlquist 2130*, S).

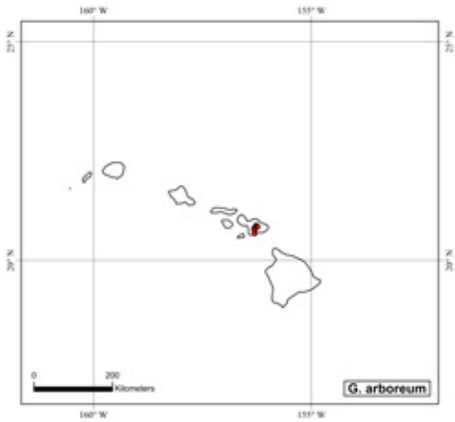


Fig. 578. Distribution of *Geranium arboreum*.

Additional specimens examined. **USA.** Hawaii: Maui Is., S slope of Haleakala, Lualailua, 20º37'N, 156º18'W, 14 Mar. 1920, *Forbes 1994* (NY); Maui Is., Polipoli Springs Park, 1.45 mi from park entrance gate on mauka side of road in adjoingin gulch, 20º42'N, 156º19'W, 21 June 1982, *Funk 18* (US); Maui Is., Kula Forest Reserve, 1 mi above Poli Poli Spring Road, along trail that begins approach of the Waihouli trail marker, 20º42'N, 156º19'W, 11 July 1982, *Funk & al. 204* (NY, US); Maui Is., Polipoli Springs Park, 1.45 mi from park entrance gate on mauka side of road in adjoingin gulch, 20º42'N, 156º19'W, 21 June 1982, *Funk 215* (US); Maui Is., Poli Poli Park, Waihouli area, Kula Forest Reserve, 20º42'N, 156º18'W, 3 Sep. 1997, *Wood & Perlman 6627* (AD, BR, K, MO, NY); Maui Is., road to Polipoli Park, Kula Forest Reserve, 20º43'N, 156º18'W, 14 Sep. 1971, *Herbst 2127* (F, GH, NY); Maui Is., NW slopes of Haleakala, Kula Forest Reserve, lower part, 20º43'N, 156º18'W, 17 Apr. 1964, *Stauffer & Gillett 5888* (GH, L, Z); Maui Is., on Polipoli road, 1 mi below Forest Service Cabin, Haleakala, 20º44'N, 156º19'W, 8 Aug. 1966, *Carlquist 2130* (AD, C, E, K, L, S, WU, Z); Maui Is., NE of Puu Nianiau, 20º46'N, 156º14'W, 12 Apr. 1952, *Degener 22315* (B, NY); Maui Is., paved road up W slope of mount Haleakala, on bulldozer road down SW rift, 20º46'N, 156º15'W, 17 Apr. 1964, *Gillet & Cheatham 1558* (L, US); Maui Is., Haleakala south, 20º46'N, 156º16'W, July 1865, *Hillebrand 437* (GH, K, US, WU); Maui Is., Haleakala, in gulch at roadside just below National Park boundary, 20º46'N, 156º16'W, 25 Jan. 1964, *Lamoreux 2554* (L); Maui Is., Haleakala, gulches near Puu Nianiau crater, 20º46'N, 156º14'W, Oct. 1910, *Rock 8522* (GH, NY, US); Maui Is., Haleakala, gulches near Puu Nianiau crater, 20º46'N, 156º14'W, Oct. 1910, *Rock s.n.* (L, NY); Maui Is., Haleakala, Puu Nianiau, W to radio realy station, 20º46'N, 156º14'W, 30 July 1975, *Smith s.n.* (H, LD, NY); Maui Is., Makawao district, Haleakala, just below Park headquarters at Homer's Grove, 20º46'N, 156º15'W, 17 May 1992, *Wood & Perlman 1928* (MO, US); Maui Is., E of Ukulele, Haleakala, 20º47'N, 156º15'W, 9 July 1919, *Forbes 696* (K, NY, US); Maui Is., hill Mauka of Olinda on way to Haleakala summit, 20º48'N, 156º16'W, 15 June 1927, *Degener 10486* (G, GH, NY, S, US, W); Maui Is., hill Mauka of Olinda on way to Haleakala summit, 20º48'N, 156º16'W, 15 June 1927, *Degener 18006* (B, CAS, GH, NY, US); Maui Is., hill NE of Olinda, 20º48'N, 156º16'W, 27 July 1927, *Degener 18007* (B, CAS, GH, NY, US); Maui Is., hill Mauka of Olinda on way to Haleakala, 20º48'N, 156º16'W, 15 June 1927, *Degener s.n.* (GH, NY); Maui Is., near hill NE of Olinda, 20º48'N, 156º16'W, 27 July 1927, *Degener s.n.* (B, GH, NY, Z).

Discussion. The endemic Hawaiian species of *Geranium* have sometimes been treated as belonging to a separate genus because of their singular features: shrubby habit, leaves with parallel veins, and petioles with an abscission line at the base. Among them, *G. arboreum* is unique in the genus because of its zygomorphic reddish corolla, which is probably an adaptation to bird pollination (Carlquist 1980: 135). It is also interesting to note that it is the most robust species of the genus. According to the original description, the trunk is up to 10 cm or more in diameter, and attains a height of 4 meters. On herbarium sheets only small fragments of flowering or fruiting branches are preserved. Thus, little information is available about the basal or underground parts or about the early stages of its development. The indument consists of short, spreading, eglandular hairs, scattered on young branches, leaves, and inflorescence. The hairs persist on woody branches but they progressively disappear with branch age. Each pair of stipules is fused at the base to form a sheath that surrounds the next portion of the branchlet. At the opposite extreme, each stipule ends in a narrow tip. The abscission line of the petiole is at its base, just at the junction of the petiole and the stipules. Thus, when the petioles (and consequently the leaf laminas) fall, the branchlets acquire a unique aspect because of the sheathing, persistent stipules. Along branches some floriferous branchlets can occur. These partial inflorescences are 2-6-flowered cymes in a complex structure. On the basal part of these inflorescences some axillary leaves occur. One single flowered cymule is usually borne on each node. It is interesting to note that on each peduncle there are two bracteoles. They are not sheathing but overlap at the base on one side of the peduncle to expose the opposite part. In other species of *Geranium* with 1-flowered cymules, the bracteoles are perfectly opposite. All nodes of the inflorescence, i.e., base of peduncle and partial branchlets, have abscission lines, which may contribute to seed dispersal as a complementary mechanism of autochory, superposed on the ballistic seed-ejection system of this *Geranium*. The shape of the nectaries is difficult to ascertain in dried material, but they seem to differ from the hemispherical ones in most species of the genus. The nectariferous area appears to be a slight depression with two lateral edges, usually with scattered hairs. The stamens are slightly curved and a bit shorter that the petals. They are exserted beyond the throat because the apex of the petals is more or less reflexed. The stamens appear to be accrescent in fruit. The fruit of *G. arboreum* is typical of *Geranium* subg. *Geranium*, presenting the seed-ejection type of discharge. The fruit rostrum has a very long, glabrous, narrowed apex not present in the remaining endemic species of Hawaii. It is curious to note that *G. palmatum*, an endemic from the island of Madeira in the Atlantic Ocean, also has very long stamens exserted far beyond the throat, a slightly zygomorphic corolla, and a fruit rostrum with a long narrowed apex. *Geranium palmatum*, however, belongs to subg. *Robertium*, characterized by the carpel-projection type of discharge.

228. Geranium multiflorum A. Gray, U.S. Expl. Exped., Phan. 1: 311, pl. 29 fig. A. 1854, 1856. *Neurophyllodes multiflora* (A. Gray) O. Deg. & Greenwell in O. Deg., Fl. Hawaiiensis, Fam. 171. 1952. Type locality: "Hab. District of Waimea, Hawaii, Sandwich Islands". Type: U.S.A. Hawaii. Maui Is., district of Waimea, 1840, *W. Brackenridge & al. s.n.* (lectotype, designated by St. John 1985: 571, US-00100900!).

Geranium ovatifolium A. Gray, U.S. Expl. Exped., Phan. 1: 314, pl. 30. 1854, 1856. *Geranium multiflorum* var. *ovatifolium* (A. Gray) Fosberg, Occas. Pap. Bernice Pauahi Bishop Mus. 16(15): 339. 1942. *Neurophyllodes ovatifolia* (A. Gray) O. Deg. & Greenwell in O. Deg., Fl. Hawaiiensis, Fam. 171.

1952. *Geranium multiflorum* subsp. *ovatifolium* (A. Gray) Carlquist & Bissing, Biotropica 8(4): 258. 1976. Type locality: "Hab. East division of Maui, Sandwich Islands, on the north bank of the crater Haleakala". Type: U.S.A. Hawaii. Maui Is., 20º46'N, 156º15'W, 1840, *W. Brackenridge & al. s.n.* (lectotype, designated by Fosberg 1942: 340, GH-00043683!; isolectotypes, K!, NY-00370271!, P-00758036!, US-00100893!).

Geranium multiflorum var. *canum* Hillebr., Fl. Hawaiian Isl.: 56. 1888. Type locality: "N. edge of the crater of Haleakala! Maui". Type: U.S.A. Hawaii. Maui Is., 20º46'N, 156º15'W, *W. Hillebrand s.n.* (no original material located).

Neurophyllodes ovatifolia var. *superbum* O. Deg., I. Deg. & Greenwell in O. Deg., Fl. Hawaiiensis, Fam. 171. 1952. *Geranium multiflorum* var. *superbum* (O. Deg. & I. Deg.) H. St. John, List & Summary Fl. Pl. Hawaiian Is.: 196. 1973. Type locality: "Within Koolau Gap, Haleakala, Maui, T.H. Aug. 11, 1927. Degener No. 18,421a". Type: U.S.A. Hawaii. Maui Is., Haleakala, Koolau Gap, 20º49'N, 156º10'W, 11 Aug. 1927, *O. Degener 18421a* (lectotype, designated by Aedo 2017a: 171, F!; isolectotypes, BISH-1009237 image!, CAS!).

Neurophyllodes ovatifolia var. *forbesii* O. Deg. & I. Deg. in O. Deg., Fl. Hawaiiensis, Fam. 171. 1967. *Geranium multiflorum* var. *forbesii* (O. Deg. & I. Deg.) H. St. John, List & Summary Fl. Pl. Hawaiian Is.: 196. 1973. Type locality: "E. of Ukulele. (Camp) Haleakala, July 17, 1919, by C.N. Forbes, the type specimen 809. M., being deposited in the Marie C. Neal Herbarium in Honolulu". Type: U.S.A. Hawaii. Maui Is., E of Ukulele, (Camp) Haleakala, 20º47'N, 156º15'W, 17 July 1919, *F. Forbes 809* (holotype, BISH!).

Shrub, 100-200(300) cm tall. *Rootstock* and roots unknown. *Stem* erect, leafy, not rooting at nodes, stolons absent, without vegetative stems, with antrorse, appressed, eglandular hairs 0.1-0.2 mm long (on young branches mainly). *Basal leaves* unknown, cauline leaves alternate; leaf laminas (2.2)3.1-5.5(6.3) cm long, 1.3-3.7 cm wide, not peltate, entire with serrate margin [with (1)4-14 teeth on each side, usually almost to the base but at least 1/3 from apex], ovate to elliptic, rarelly obovate in outline, base cuneate, ± coriaceous, with nerves not projected, usually glabrous except on the nerves of the adaxial surface (rarely with sparse hairs to moderately sericeous) and sericeous abaxially; segments 1; petioles up to 2.4 cm long, with an abscission zone between petiole and stipule, terete, not swollen, not deflexed in age, sericeous, with antrorse, appressed, eglandular hairs 0.2-1.2 mm long; stipules 5.7-10.7 mm long, 1.9-3.6 mm wide, lanceolate (with a setaceous apex 1-2.5 mm long), sheathing, connate at the base, papery, brownish red, sericeous, with eglandular hairs on abaxial surface and on the margin, glabrous adaxially. *Inflorescence* a monochasial cyme; cymules 1-flowered, grouped in 15-60-flowered cymes at the end of each brachyblast [ratio cymule length/leaf length = 1.4-2.1]; peduncles 3.8-8.6 mm long, ± sericeous, with erect-patent to appressed, eglandular hairs 0.2-1 mm long; bracteoles 1.4-2.9 mm long, 0.4-1.5 mm wide, lanceolate, opposite, overlapping at base to appear sheathing. Flowers actinomorphic. *Sepals* (5.8)6.1-6.9(8.4) mm long, 2.2-3.7 mm wide, lanceolate, smooth, not accrescent, nerves 3-5, mucro 0.3-1.1 mm long [ratio mucro length/sepal length = 0.06-0.18], sericeous, with antrorse, appressed, eglandular hairs 0.2-1.2 mm long on the abaxial surface, glabrous adaxially. *Petals* (8.5)9.1-11.1(13.9) mm long, 3.7-7.1 mm wide, erect-patent, rounded, without claw, usually white, sometimes pink, moderately hairy on the base of both adaxial and abaxial surface, with hairs 0.2-0.9 mm long. *Stamens* 10, both whorls bearing anthers; filaments 4.8-6.4 mm long, lanceolate with an abruptly narrowed apex, usually white, pilose on the abaxial surface, ciliate on the proximal half, with hairs 0.1-0.7 mm long; anthers 0.7-1.3 mm long, yellow. Nectaries 5, hemispheric, dorsally woolly. *Gynoecium* 4.7-7.4 mm long, dark purple. *Fruit* 15.8-24.2 mm long, erect, discharge of seed-ejection type; mericarps 2.6-4.6 mm long, 1.4-1.8 mm wide, without a strand of fibers, not compressed at the apex, smooth, without basal beak, with a basal callus, without a basal prong, brown, with erect-patent, eglandular hairs 0.3-0.7 mm long; rostrum 9.6-16.9 mm long, with a narrowed apex 0.6-1.1 mm long, not twisted, sericeous, with antrorse, appressed eglandular hairs 0.1-0.6 mm long; stigmatic remnants 2.2-3.5 mm long, with 5 glabrous lobes. *Seeds* 2.3-2.9 mm long, 1.1-1.6 mm wide, reticulate-sinuous, uniformly colored, brown, glabrous. Cotyledons with entire margin. Fig. 579.

Pollen. *Geranium*-type (Bortenschlager 1967: 456).

Chromosome number. Unknown.

Phenology. Collected in flower from May to October.

Distribution. This species is endemic to eastern of Maui Is., in Hawaii (Fig. 580).

Habitat. Montane grassland, forested gulches, rain-swept shrubby open forests, cinder cones, and fog-swept lava flows; 1580-2900 m.

Representative specimens examined. **USA.** Hawaii: Maui Is., Hana in the gulch on Haleakala side of Hana Q. site, 16 June 1982, *Funk 10A* (NY, US); Maui Is., near Kaupo Gap, Haleakala, 20º41'N, 156º9'W, 20 Aug. 1927, *Degener 12135* (GH, NY); Maui Is., between Rest House and Kaupo Gap, Haleakala, 20º41'N, 156º9'W, 20 Aug. 1927, *Degener 18424* (GH, NY); Maui Is., Haleakala, central crater near Kapalaoa cabin, 20º42'N, 156º11'W, 19 June 1982, *Crivellone 13* (US, H); Maui Is., N of Kuiki pist outside Haleakala section of Park boundary, 20º42'N, 156º8'W, 9 Aug. 1939, *Degener 17340* (GH, NY, US); Maui Is., Kapalaoa, Haleakala, 20º42'N, 156º11'W, 29 May 1959, *Degener 25291* (L, K, NY, US); Maui Is., 0.5 mi SW of Paliku, Haleakala, 20º43'N, 156º8'W, 11 Aug. 1939, *Degener 17385* (GH, NY); Maui Is., Paliku Gulch, on floor and side of this lush gulch, 20º43'N, 156º8'W, 6 June 1982, *Funk 203* (NY, US); Maui Is., Oili Puu off Halemauu trail, 20º43'N, 156º10'W, 24 Sep. 1997, *Wood & al. 6738* (NY); Maui Is., N of Holua cabin, Haleakala, 20º44'N, 156º13'W, 2 June 1959, *Degener 25290* (NY); Maui Is., Haleakala crater floor near Bubble Cave, ash bed, foot of Cinder cave, 20º44'N, 156º13'W, 22 Aug. 1933, *Fosberg 9925* (F, GH); Maui Is., Koolau Gap 10 minutes from the base of Halemaumau trail along the path to Waiau Camp site, 20º44'N, 156º13'W, 20 June 1982, *Funk 14A* (US); Maui Is., Puu Alaea, in the big gulch on the Hana side of Puu Alaea, 20º44'N, 156º7'W, 15 June 1982, *Funk 9* (NY, US);

Maui Is., N outer slope of Haleakala, 1.5 mi due N of Paliku Cabins, in heath scrub below Puu Alaea just above rain forest, 20°44'N, 156°8'W, 22 June 1969, *Henrickson & Vogl 3680* (E); Maui Is., Kipahulu valley, 20°44'N, 156°8'W, 28 Aug. 1967, *Kaiwi & al. s.n.* (AD); Maui Is., Haleakala crater, Koolau Gap close to the western pali, 20°44'N, 156°13'W, 12 Sep. 1966, *Mäkinen & Mäkinen 66-1709* (H); Maui Is., Wai Anapanapa, Haleakala, Kipahulu-Kuhiwa divide, 20°44'N, 156°8'W, 21 Aug. 1945, *Saint John & Mitchell 21099* (K); Maui Is., Haleakala, crater wall near Waineke spring, 20°45'N, 156°13'W, 4 Aug. 1938, *Cranwell & al. 2797* (H, K, S); Maui Is., W of Degener Lava Tube, Koolau Gap, Haleakala, 20°45'N, 156°13'W, 2 June 1959, *Degener 25289* (B, L, NY, US, W); Maui Is., Haleakala, inside of crater, 20°45'N, 156°13'W, 10 Oct. 1922, *Skottsberg 827* (S); Maui Is., Hanawi, E ridge from Frisbee Meadow, 20°45'N, 156°8'W, 23 June 1995, *Wood 4321* (F, MO, NY); Maui Is., NW side of Koolau Gap, Haleakala, 20°46'N, 156°13'W, 20 Aug. 1939, *Degener 17389* (B, CAS, NY, US).

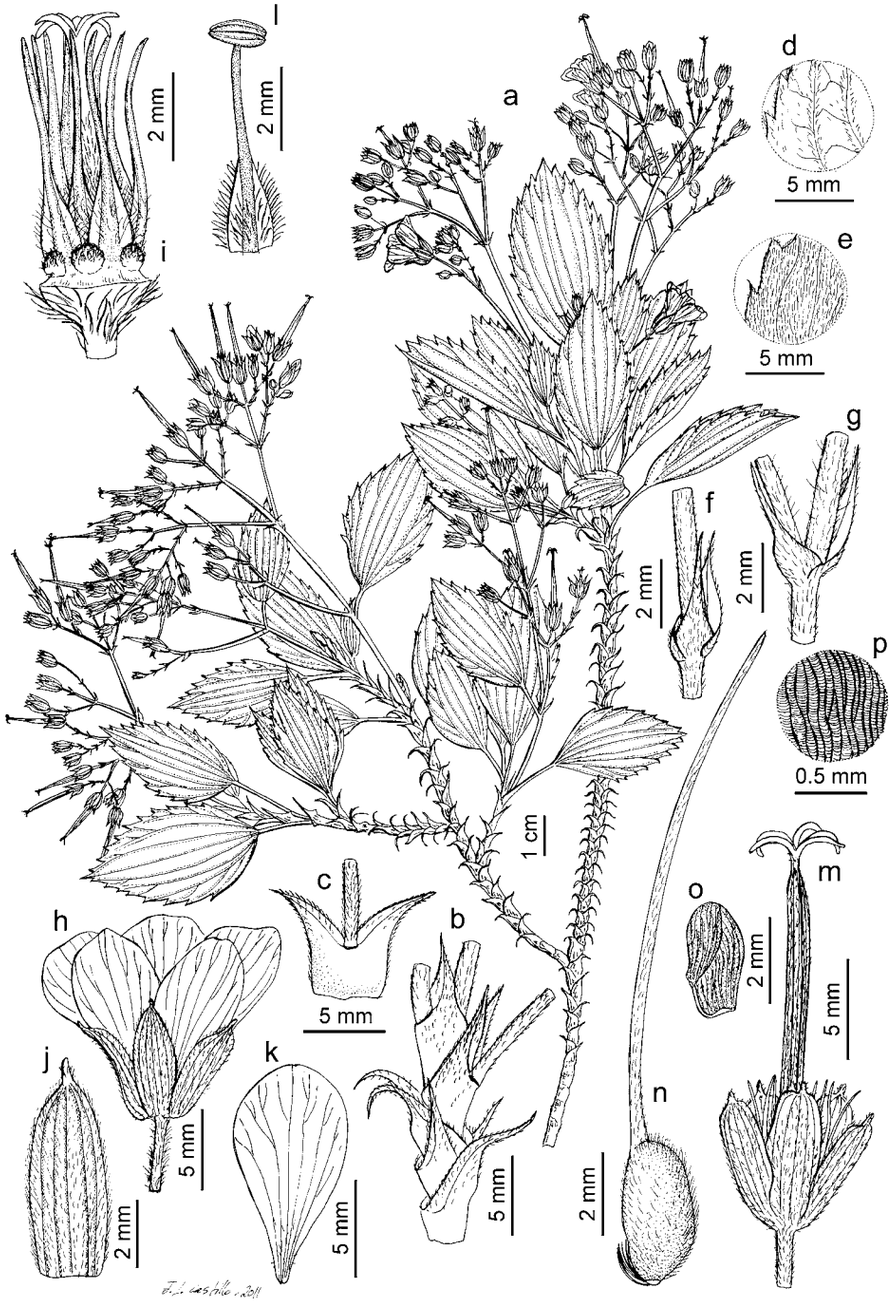


Fig. 579. *Geranium multiflorum*. a. Branch with flowers and fruits. b. Stipules. c. Abaxial surface of a stipule. d. Detail of leaf indument, adaxial surface. e. Detail of leaf indument, abaxial surface. f, g. Bracteoles. h. Flower. i. Flower without petals and sepals. j. Sepal. k. Petal. l. Stamen. m. Fruit. n. Mericarp. o. Seed. p. Detail of seed ornamentation (Based on: a-l, *Henrickson 3918*, GH; n-p, *Rock 8598*, GH).

Discussion. Geranium multiflorum is a shrub well characterized by the usually ovate leaves, which are serrate almost to the base, and by the many-flowered inflorescences with actinomorphic flowers. The leaves vary in shape and indument. Although most commonly the leaves are ovate, elliptic and obovate forms sometimes occur. The margin usually has 5-10 teeth on each side, from the apex to the petiole junction. In some cases the teeth are restricted to the apical third of the leaf, and forms with 3- or 4 apical teeth very rarely occur. In extreme cases nearly entire leaves and serrate leaves may occur on the same branch. The adaxial surface of the leaves is glabrous with lines of silky hairs on the nerves, but leaves with spreading hairs in the spaces between the nerves are also common. Exceptionally, some specimens have densely silky leaves adaxially. The abaxial surface of the leaves is consistently covered by a layer of flattened,

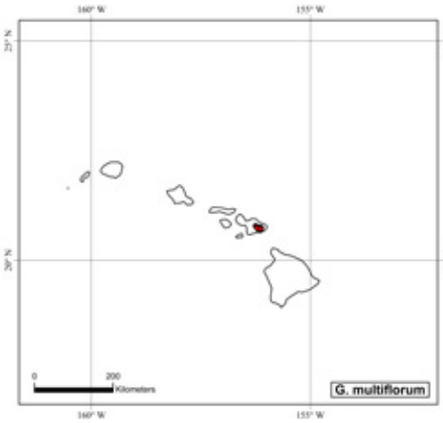


Fig. 580. Distribution of *Geranium multiflorum*.

appressed hairs and some spreading hairs on the nerves give a silky (rarely grayish) aspect to the abaxial surface. All this variability can be found intermingled in some populations, for instance in specimens from Koolau Gap (*Degener 18012, 18241, 18421, 18422, 18423*), suggesting that it does not deserve taxonomic recognition. Some of these forms with leaves silky on both surfaces and few teeth are reminiscent of *G. cuneatum* subsp. *tridens*, a taxon also present in this area. The ovate leaves and many-flowered inflorescences identify them, however, as *G. multiflorum*. The inflorescence structure of *G. multiflorum* is quite similar to that of *G. arboreum*, but more complex, with branches repeatedly trichotomous, and with many more flowers. As mentioned previously in *G. arboreum*, all nodes of the inflorescences have abscission lines. The bracteoles are opposite and not sheathing, but they overlap a base to give a sheathing appearance. The flowers of *G. multiflorum* are regular and the petals are white or with purple veins. Sometimes they have a purplish base, and exceptionally they can be purplish. *Geranium multiflorum* can be easily differentiated from *G. arboreum* by leaves not cordate at the base, by shorter, regular flowers, and by the shorter fruits lacking a long narrowed rostrum apex. Fosberg (1936: 4, 7-9) recognized two varieties of *G. multiflorum*: var. *multiflorum* from the island of Hawaii (with pilose leaves) and var. *canum* from Maui (with leaves densely silky or silvery abaxially). Fosberg (1936: 7) identified only two specimens as *G. multiflorum* var. *multiflorum*: the type and *Usinger 692* (BISH). According to Wagner & al. (1990: 734) *Usinger 692* (BISH) is *G. cuneatum* subsp. *cuneatum*, and the type was probably collected on Maui and incorrectly labeled as being from the island of Hawaii. Consequently, the presence of *G. multiflorum* on the island Hawaii remains to be confirmed. The type specimen (*Brackenridge & al. s.n.*, US) has ovate leaves 34-44 mm long with 5-8 teeth on each side, and spreading hairs on both surfaces, which is a bit deviant from the normal leaves found on plants from the island of Maui, which are glabrous adaxially (except for a few hairs on the nerves) and silky abaxially. Otherwise, the type matches the current concept of *G. multiflorum.* Thus, it would be rather premature to recognize infraspecific taxa in *G. multiflorum* as Carlquist & Bissing (1976) did. If new populations are found with leaves similar to the type, and if they have a distinct geographical range, it would be advisable to study this taxon further.

229. Geranium cuneatum Hook., Icon. Pl. 1(2): [98], tab. 198. 1837. *Geranium cuneatum* f. *menziesii* Fosberg, Occas. Pap. Bernice Pauahi Bishop Mus. 12(16): 11. 1936, nom. illeg. *Geranium cuneatum* var. *menziesii* A. Gray, U.S. Expl. Exped., Phan. 1: 312, pl. 29 fig. B. 1854, 1856. *Neurophyllodes cuneata* (Hook.) O. Deg. & Greenwell in O. Deg., Fl. Hawaiiensis, Fam. 171. 1952. Type locality: "Hab. Sandwich islands. A. Menzies, Esq.". Type: U.S.A. Hawaii. Hawaii Is., 1793, *A. Menzies s.n.* (lectotype, designated by Aedo 2017a: 175, BM-000797028!).

Shrub, 30-150 cm tall. *Rootstock* and roots unknown. *Stem* erect, leafy, not rooting at nodes, stolons absent, without vegetative stems, glabrous. *Basal leaves* unknown, cauline leaves alternate; leaf laminas 1-3.6 cm long, 0.4-1.6 cm wide, not peltate, entire with dentate apex [with 3-7 teeth], obtriangular-cuneiform in outline, base cuneate, ± coriaceous, with nerves not projected, glabrous (except on the nerves) to sericeous on both surfaces; segments 1; petioles up to 1.3 cm long, with an abscission zone between petiole and stipule, terete, not swollen, not deflexed in age, hairy to sericeous, with antrorse, appressed, eglandular hairs 0.1-0.7 mm long; stipules 3.1-12.2 mm long, 1.3-3.8 mm wide, lanceolate, sheathing, connate at the base, papery, brownish red, hairy to sericeous, with eglandular hairs on abaxial surface and on the margin, glabrous adaxially. *Inflorescence* a monochasial cyme; cymules 1-flowered, grouped in (3)7-12(25)-flowered cymes at the end of each brachyblast [ratio cymule length/leaf length = 1.3-3.6]; peduncles 2.8-12.5 mm long, hairy to ± sericeous, with erect-patent to appressed, eglandular hairs 0.1-0.9 mm long; bracteoles 1.3-4.6 mm long, 0.7-1.6 mm wide, lanceolate, opposite, overlapping at base to appear sheathing. Flowers actinomorphic. *Sepals* 4.7-7.7(11.8) mm long, 1.6-3.8 mm wide, lanceolate, smooth, not accrescent, nerves 3-5, mucro 0.2-0.8 mm long [ratio mucro length/sepal length = 0.03-0.12], hairy to ± sericeous, with antrorse, appressed eglandular hairs 0.2-0.6 mm long on the abaxial surface, glabrous adaxially. *Petals* (7)9.4-11.4(15.2) mm long, 2.2-7.5 mm wide, erect-patent, rounded, without claw, white, sometime with purple veins, glabrous to hairy on the base of both surfaces, with hairs 0.1-0.7 mm long. *Stamens* 10, both whorls bearing anthers; filaments 3.3-8.4 mm long, lanceolate, white, with scattered hairs 0.1-0.5 mm long on abaxial surface and margin; anthers 0.7-1.3 mm long, yellow. Nectaries 5, hemispheric, dorsally woolly. *Gynoecium* 4-7.8 mm long, purple. *Fruit* 14.4-32 mm long, erect, discharge of seed-ejection type; mericarps 2-4.9 mm long, 0.9-2.2 mm wide, without a strand of fibers, not compressed at the apex, smooth, without basal beak, with a basal callus, without a basal prong, brown, hairy to sericeous, with erect-patent, eglandular hairs 0.1-0.7 mm long; rostrum 9.8-20.1 mm long, with a narrowed apex 0.4-1.5 mm long, not twisted, hairy to sericeous, with antrorse, appressed eglandular hairs 0.1-0.6 mm long; stigmatic remnants 1.7-4.2 mm long, with 5 glabrous lobes. *Seeds* 1.6-3.2 mm long, 0.8-1.4 mm wide, reticulate-sinuous, uniformly colored, brown, glabrous. Cotyledons with entire margin.

Pollen. *Geranium*-type.

Chromosome number. Unknown.

Phenology. Collected in flower from January to October.

Distribution. This species is endemic to Hawaii (Hawaii Is. and Maui Is.).

Habitat. Shrubby slopes on volcanic rocks and open forests; 1500-3300 m.

Discussion. Geranium cuneatum is a shrub well characterized by the obtriangular-cuneiform leaves, which are dentate at the apex, and by many-flowered inflorescences with actinomorphic flowers. This species is similar in some aspects to *G. multiflorum*, although usually less robust. The most striking difference is in leaf shape, which is truncate and dentate at the apex in *G. cuneatum*, and ovate and serrate on most of the margin in *G. multiflorum*. In addition, *G. multiflorum* has longer and wider leaves. Some individuals with narrow leaves, sericeous on both surfaces, and few teeth (*Degener 18241, 18423*) would be intermediate forms between *G. multiflorum* and *G. cuneatum* subsp. *tridens*. However, their leaves with attenuate apices and 3 or 4 teeth on each side suggest that they should be identified as *G. multiflorum*. The stipules of *G. cuneatum* are sheathing and quite similar to those of *G. multiflorum*, although they lack the setaceous apex of *G. multiflorum*. The inflorescence of *G. cuneatum* is also quite similar to that of *G. multiflorum*, although with fewer flowers. In both species, the base of the peduncle and partial branchlets have abscission lines, and the bracteoles are also opposite and not sheathing.

Geranium cuneatum comprises variants that may be distinguished on the basis of leaf indument pattern and the number of leaf apical teeth. In *Geranium cuneatum* subsp. *tridens*, endemic to the island of Maui, the leaves are white-sericeous on both surfaces and usually have a tridentate apex. Some individuals have leaves with five apical teeth mixed with those with tridentate leaves. The sepals and petals in subsp. *tridens* are longer than those in the remaining subspecies, although with some overlap. The petals of subsp. *tridens* usually have scattered hairs at the base of adaxial the surface, while they are usually glabrous in subsp. *cuneatum*. Among the four subspecies in the Hawaiian Islands, the one most most similar to subsp. *tridens* is subsp. *hololeucum*, since both have leaves that are white-sericeous on both surfaces. In subsp. *hololeucum*, however, the leaves mostly have 5-7 teeth at the apex. In rare cases some tridentate leaves occur on plants with mostly five dentate leaves. Subsp. *cuneatum* is characterized by leaves nearly glabrous except for a line of silky, appressed hairs on the nerves on both surfaces, only rarely with some some scattered hairs between the nerves on some individuals. Subsp. *cuneatum* is similar to subsp. *hololeucum* in having 5-7 teeth (rarely only three) at the leaf apex. Finally, subsp. *hypoleucum* has the adaxial surface of the leaves almost glabrous except for a line of silky hairs on the nerves, and abaxially silky like subsp. *hololeucum*. The leaf apex of subsp. *hypoleucum* usually has 5-7 teeth, and with the same variability as that of subsp. *hololeucum* and subsp. *cuneatum*.

The four subspecies of *G. cuneatum* are weakly characterized, and only in the case of subsp. *tridens* clearly isolated geographically. The three subspecies present on the island of Hawaii appear to be partially allopatric. Subsp. *cuneatum* grows alone towards the west and subsp. *hypoleucum* is found mainly toward the south. Subsp. *hololeucum* grows only on the northeast-facing slopes of the volcano Mauna Kea. However, all three are found on the south and west slopes of Mauna Kea, and in the plateau between Mauna Kea and Mauna Loa. There is also an altitudinal trend, with subsp. *hololeucum* and subsp. *tridens* (both with the leaves silky on both surfaces) reaching higher altitudes, although with considerable overlap.

1. Leaves almost glabrous on both surfaces or sericeous on the abaxial surface.
    2. Leaves usually glabrous except for a line of silky, appressed hairs on the nerves on both surfaces, rarely with sparse hairs between nerves.
        229a. subsp. **cuneatum**
    2. Leaves sericeous on abaxial surface. **229c**. subsp. **hypoleucum**
1. Leaves sericeous on both surfaces.
    3. Leaves predominantly 5-7-toothed at apex.
        229b. subsp. **hololeucum**
    3. Leaves predominantly tridentate at apex. **229d**. subsp. **tridens**

229a. Geranium cuneatum Hook. subsp. **cuneatum**

Geranium cuneatum var. *rockii* Skottsb., Acta Horti Gothob. 6: 51. 1931. *Geranium cuneatum* f. *rockii* (Skottsb.) Fosberg, Occas. Pap. Bernice Pauahi Bishop Mus. 12(16): 11. 1936. *Neurophyllodes cuneata* var. *rockii* (Skottsb.) O. Deg. & Greenwell in O. Deg., Fl. Hawaiiensis, Fam. 171. 1952. Type locality: "Hawaii: Slopes of Mauna Kea, elevation between 9000-10,000 feet, above Kemole (Rock n. 8329, flowering June, 1910)" [cf. Rock in Bull. Coll. Hawai Publ. 1: 8, 1911]. Type: U.S.A. Hawaii. Hawaii Is., Mauna Kea, above Kemole, 19º52'N, 155º31'W, June 1910, *J.F. Rock 8329* (lectotype, designated by Aedo 2017a: 178, K!; isolectotypes, BISH-1009226 image!, GH-00368358!, NY!, P!, US-00429074!).

Leaf laminas (1.7)1.9-3.2(3.4) cm long, 0.7-1.4 cm wide, obtriangular-cuneiform [ratio lamina width/lamina length = (0.39)0.40-0.54(0.50)], apex dentate [(3)5-7 teeth], usually glabrous except on the nerves of both surfaces (which have a line of silky appressed hairs), rarely with sparse hairs between nerves. *Cymules* 1-flowered, grouped in (3)8-19-flowered cymes at the end of each brachyblast; peduncles 2.8-8.1 mm long, with sparse, erect-patent to ± appressed eglandular hairs 0.1-0.4 mm long.

Sepals 5.4-6.6(7.7) long, 1.6-3.2 mm wide, with mucro (0.2)0.3-0.4(0.5) mm long, glabrous adaxially. with sparse, antrorse, appressed eglandular hairs 0.2-0.4 mm long on abaxial surface. *Petals* (7)8.1-10.8(11.4) mm long. *Fruit* 17.8-21.2 mm long; mericarps 2.6-3.5 mm long, smooth, with erect, patent eglandular hairs 0.1-0.3 mm long; rostrum 10.3-14.7 mm long, with a narrowed apex 0.4-0.7 mm long. Fig. 581 a-c, j-p.

Pollen. Geranium-type (Bortenschlager 1967: 433).

Chromosome number. Unknown.

Phenology. Collected in flower from June to September.

Distribution. This subspecies is endemic to northern and western of Hawaii Is. (Fig. 582).

Habitat. Dry volcanic cinder slopes, foggy lava flows, and *Metrosideros* Gaertn. forests; 1700-3050 m.

Additional specimens examined. **USA.** Hawaii: Sandwich Is., 1840, *Brackenridge s.n.* (NY); Hawaii Is., Kona, Kauehaka, 24 June 1911, *Forbes 252H* (L, NY); Hawaii, in lehua forest, *Hosaka 1518* (US); Hawaii Is., central plateau of Hawaii, 1867, *Mann & Brigham 307* (G); Iles Sandwich, 1851, *Remy 628* (MA, L, NY, P); Hawaii Is., near Papaloa, Captain Cook, Kona, 19º30'N, 155º47'W, Aug. 1949, *Degener 20248* (B); Hawaii Is., N of Papaloa, Captain Cook Kona, 19º30'N, 155º47'W, 14 Aug. 1949, *Degener 20379* (B, C, G, GH, MA, NY, US, W); Hawaii Is., Kealakekua, S Kona, near Papae Clarke, 19º31'N, 155º46'W, 13 Nov. 1950, *Greenwell 11* (NY); Hawaii Is., slopes of Hualalai, 19º41'N, 155º50'W, 15 June 1911, *Forbes 161H* (GH, L, NY, US); Hawaii Is., E of summit of Hualalai, 19º41'N, 155º50'W, 9 Sep. 1961, *Fosberg 42112* (US); Hawaii Is., Hualalai, between summit and 6000 ft, 19º41'N, 155º53'W, 27 Sep. 1950, *Richards 20974* (B); Hawaii Is., Hualalai, slope of crater, 19º41'N, 155º53'W, 25 Sep. 1922, *Skottsberg 647* (H, S); Hawaii Is., Puu Hualalai, 19º42'N, 155º52'W, 30 July 1966, *Carlquist 2098* (AD, L, Z); Hawaii Is., Hualalai, 19º42'N, 155º53'W, 11 June 1909, *Rock s.n.* (NY); Hawaii Is., NW slope of Hualalai, 19º43'N, 155º54'W, 9 July 1967, *Degener & al. 31268* (B, E, NY, Z); Hawaii Is., Mauna Kea, 19º47'N, 155º28'W, June 1910, *Rock s.n.* (NY); Hawaii Is., Mauna Kea, central plateau, 19º52'N, 155º25'W, 1865, *Hillebrand & al. 438* (K); Hawaii Is., Mauna Kea, Kemole crater, 19º52'N, 155º31'W, June 1910, *Rock s.n.* (GH).

229b. Geranium cuneatum subsp. **hololeucum** (A. Gray) Carlquist & Bissing, Biotropica 8(4): 258. 1976. *Geranium cuneatum* var. *hololeucum* A. Gray, U.S. Expl. Exped., Phan. 1: 312, pl. 29 fig. D. 1854, 1856. *Neurophyllodes hololeuca* (A. Gray) O. Deg. & Greenwell in O. Deg., Fl. Hawaiiensis, Fam. 171. 1952. Type locality: "Hab. Hawaii, Maui, and Kauai, Sandwich Islands: on the mountains... [y]. Mouna Kea; also Mouna Loa, with the preceding form; abundant through the region of Edwardsia. East". Type: U.S.A. Hawaii. Hawaii Is., Mauna Kea, 19º49'N, 155º28'W, 1840, *W. Brackenridge & al. s.n.* (lectotype, designated by St. John 1985: 571, US-00100875!; isolectotypes, NY-00370269!, P!).

Geranium cuneatum var. *pauciflorum* Hillebr., Fl. Hawaiian Isl.: 55. 1888. Type locality: "Mauna Kea, at an elevation of 11000 ft., where it grows with Argyroxiphium. Gray, l.c. pl. 29, C". Type: U.S.A. Hawaii. Hawaii Is., Mauna Kea, 19º49'N, 155º28'W, *W. Hillebrand 441* (lectotype, designated by Aedo 2017a: 180, K-001089665!).

Geranium cuneatum var. *polyphyllum* Hillebr. ex Skottsb., Acta Horti Gothob. 2: 241. 1926. Type locality: "Hawaii: Mauna Kea, w. side c. 3000 m, fl.-fr. 28/9 (n. 702)". Type: U.S.A. Hawaii. Hawaii Is., Mauna Kea, 19º49'N, 155º28'W, 28 Sep. 1922, *C. Skottsberg 702* (lectotype, designated by Aedo 2017a: 180, S!; isolectotype, H!).

Leaf laminas (1.1)1.6-2.6(3.6) cm long, 0.5-1.6 cm wide, obtriangular-cuneiform [ratio lamina width/ lamina length = (0.37)0.45-0.53(0.54)], apex dentate [(3)5-7 teeth], sericeous on both surfaces. *Cymules* 1-flowered, grouped in (5)9-25-flowered cymes at the end of each brachyblast; peduncles (3.3)4-7(9.4) mm long, ± sericeous, with erect-patent to appressed eglandular hairs 0.3-0.8 mm long. *Sepals* 5.3-7.8 long, 2.1-3.7 mm wide, with mucro 0.3-0.6 mm long, glabrous adaxially, ± sericeous, with antrorse, appressed eglandular hairs 0.2-0.4 mm long on abaxial surface. *Petals* (7)9.7-11.5(13.6) mm long. *Fruit* 16.4-26.8 mm long; mericarps 2.4-3.9 mm long, sericeous, with erect-patent eglandular hairs 0.3-0.6 mm long; rostrum 11.2-19.9 mm long, with a narrowed apex 0.4-1.5 mm long. Fig. 581 h, i.

Pollen. Ornamentation not studied.

Chromosome number. Unknown.

Phenology. Collected in flower from January to September.

Distribution. This subspecies is endemic to northeastern of Hawaii Is. (Fig. 583).

Habitat. Fog-swept lava flows, scrubby woodlands, and *Sophora* L. and *Metrosideros* Gaertn. forests; 1650-3300 m.

Additional specimens examined. **USA.** Hawaii: Hawaii Is., Mauka of Kulani Prison, 19º36'N, 155º23'W, 15 Feb. 1952, *Degener 21862* (B); Hawaii Is., Kulani road 8 mi above Prison camp, 19º36'N, 155º23'W, 5 Jan. 1958, *Fosberg 39309* (US); Hawaii Is., Kulani road 8 mi above Prison camp, 19º36'N, 155º23'W, 5 Jan. 1958, *Fosberg 39310* (MO); Hawaii Is., North Hilo district, Hilo Forest Reserve, Saddle road at 35.4 km, 19º40'N, 155º22'W, 14 Jan. 1998, *Annable & Palmer 3750* (NY); Hawaii Is., Aina Hou, 19º40'N, 155º25'W, 12 June 1915, *Forbes 831H* (K, NY); Hawaii Is., Saddle road, kipuka across road from Kipuka Aina Hou, 28.8 mi SSE of juntion with highway 190, 19º40'N, 155º25'W, 7 Aug. 1987, *Lorence & Flynn 5516* (MO); Hawaii Is., along saddle road near Puu Huluhulu, 19º41'N, 155º28'W, 20 Aug. 1949, *Degener 19979* (B, G, GH, MA, NY, W); Hawaii Is., 21 mi W of Hilo on Saddle road, 19º41'N, 155º20'W, 5 Aug. 1992, *Miller & Merello 7927* (MO); Hawaii Is., Mauna Kea, NE of Halepohaku, 19º45'N, 155º27'W, 9 Sep. 1949, *Degener 19962* (B, G, K, NY, US, W); Hawaii Is., Mauka of Hale Pohaku, Mauna Kea, 19º45'N, 155º27'W, 20 July 1967, *Degener & Degener 35314* (B, C, E, GH, K, L, NY); Hawaii Is., Humuula trail to summit of Mauna Kea, 19º45'N, 155º28'W, 14 June 1915, *Forbes 843H* (NY); Hawaii Is., Hamakua district, Hale Pohaku area, slopes of Mauna Kea, 5 mi N of the junction with Saddle road, 19º45'N, 155º27'W, 13 July 1978, *Gustafson 1095* (CAS, NY); Hawaii Is., 0.2 mi up gravel road from turnoff to Hale Pohaku, ca. 28 mi up saddle road from Hilo, then 6.4 mi N toward Mauna Kea, 19º45'N, 155º27'W, 30 May 1982, *Stuessy 6151* (L); Hawaii Is., source of Wailuku River, Mauna Kea, 19º49'N, 155º26'W, 18 June 1915, *Forbes 883H* (K, NY); Hawaii Is., source of Wailuku River, Mauna Kea, 19º49'N, 155º26'W, 18 June 1915, *Forbes 885H* (GH, US); Hawaii Is., slopes of Mauna Kea, Waiki, 19º50'N, 155º35'W, Aug. 1911, *Forbes 466H* (GH, L, NY); Hawaii

Is., slopes of Mauna Kea, Waiki, 19º50'N, 155º35'W, Aug. 1911, *Forbes 471H* (US); Hawaii Is., slopes of Mauna Kea, above Waikii, 19º50'N, 155º35'W, Aug. 1910, *Rock 8700* (GH); Hawaii Is., Mauna Kea, 19º52'N, 155º24'W, May 1875, *[illegible] s.n.* (LD); Hawaii Is., Mauna Kea, 19º52'N, 155º24'W, July 1909, *Faurie 852* (KYO, G, GH); Hawaii Is., Mauna Kea, N side, 19º52'N, 155º25'W, 22 Aug. 1916, *Hitchcock 14206* (US); Hawaii Is., Mauna Kea, 19º52'N, 155º24'W, 5 Dec. 1936, *Hosmer s.n.* (NY, US); Hawaii Is., Mauna Kea, 19º52'N, 155º24'W, 1910, *Hosmer s.n.* (NY); Hawaii Is., border of Hamakua and North Hilo district, Puu Kanakaleonui area, Mauna Kea, 19º52'N, 155º23'W, 3 June 1993, *Wood & Perlman 2605* (NY).

229c. Geranium cuneatum subsp. **hypoleucum** (A. Gray) Carlquist & Bissing, Biotropica 8(4): 258. 1976. *Geranium cuneatum* var. *hypoleucum* A. Gray, U.S. Expl. Exped., Phan. 1: 312, pl. 29 figs. 7-9. 1854, 1856. *Neurophyllodes hypoleuca* (A. Gray) O. Deg. & Greenwell in O. Deg., Fl. Hawaiiensis, Fam. 171. 1952. Type locality: "Hab. Hawaii, Maui, and Kauai, Sandwich Islands: on the mountains... ß. Mouna Loa; a common shrub from the crater of Lua Pele to the elevation of 8,000 feet. Mountains of Kauai; a very small form, without flowers...". Type: U.S.A. Hawaii. Hawaii Is., 19º28'N, 155º36'W, 1840, *W. Brackenridge & al. s.n.* (lectotype, designated by St. John 1985: 571, US-00100876!; isolectotypes, NY!, P-00758034!).

Leaf laminas (1)1.6-2.4(3) cm long, 0.4-1.2 cm wide, obtriangular-cuneiform [ratio lamina width/lamina length = (0.38) 0.40-0.51(0.55)], apex dentate [(3)5-7 teeth], usually glabrous except for a line of silky appressed eglandular hairs on the nerves of the adaxial surface (rarely with sparse hairs between nerves) and sericeous on the abaxial surface. *Cymules* 1-flowered, grouped in (3)7-15-flowered cymes at the end of each brachyblast; peduncles 3.1-11.6 mm long, ± sericeous, with erect-patent to appressed eglandular hairs 0.2-0.5 mm long. *Sepals* 4.7-6.7(9) long, 2.1-3.6 mm wide, with mucro 0.3-0.5(0.6) mmlong, glabrous adaxially, ± sericeous, with antrorse, appressed eglandular hairs 0.2-0.5 mm long on abaxial surface. *Petals* (7.7)9-10(11.7) mm long. *Fruit* 14.4-20.9 mm long; mericarps 2-3.1 mm long, sericeous, with erect-patent eglandular hairs 0.2-0.5 mm long; rostrum 9.8-13.8 mm long, with a narrowed apex 0.4-0.9 mm long. Fig. 581 f, g.

Pollen. Ornamentation not studied.

Chromosome number. Unknown.

Phenology. Collected in flower from January to September.

Distribution. This subspecies is endemic to central and southeastern of Hawaii Is. (Fig. 582).

Habitat. Crevices of open basalt gravel, sandy pockets, scrubby woodlands on lava flows, and *Metrosideros* Gaertn. forests; 1500-2300 m.

Additional specimens examined. **USA.** Hawaii: Hawaii Is., Kahuku Ranch road to Nene Cabin, 19º10'N, 155º41'W, 26 June 1971, *Saint John 26825* (L); Hawaii Is., SW rift zone Mauna Loa, 19º12'N, 155º45'W, 1 Mar. 1964, *Hansen & English s.n.* (US); Hawaii Is., Naalehu Kau forest, Puuolokuana, 19º13'N, 155º38'W, 13 Jan. 1912, *Rock 10009* (GH, NY, US); Hawaii Is., southern slopes of Mauna Loa above Naiohinu, 19º13'N, 155º38'W, Jan. 1912, *Rock 10009b* (GH, L); Hawaii Is., Kahuku Ranch road, Kau, 19º14'N, 155º37'W, 1 Mar. 1968, *Degener & Degener 35312* (L, NY, S); Hawaii Is., Kipuka ahui, 19º15'N, 155º39'W, 21 June 1915, *Forbes 898H* (GH, K, NY, US); Hawaii Is., along saddle road 23.5 mi from Hilo, 19º34'N, 155º27'W, 26 Aug. 1949, *Degener & al. 20008* (NY, B); Hawaii Is., Mauna Loa Boys' school, Mauka of Kulani Prison, 19º35'N, 155º20'W, 10 Aug. 1968, *Degener & Degener 31660* (B, C, E, GH, NY); Hawaii Is., Kulani road 8 mi above Prison camp, 19º35'N, 155º24'W, 5 Jan. 1958, *Fosberg 39310* (NY, P, US); Hawaii Is., Mauna Loa trail, 19º35'N, 155º25'W, 26 Mar. 1985, *Krajina 660624008* (NY); Hawaii Is., Mauna Loa E slope of crater, 19º35'N, 155º23'W, 15 Sep. 1922, *Skottsberg 519* (S); Hawaii Is., Mauna Loa trail, 19º35'N, 155º26'W, 28 July 1989, *Thorne & Black 6748* (NY); Hawaii Is., border of North Hilo & South district, Kulani Correctional Facility, near boy school, alon jeep road, 19º35'N, 155º20'W, 25 June 1991, *Wood & al. 968* (AD, MO); Hawaii Is., Mauna Loa at the end of truck road from Kilauea, 19º36'N, 155º24'W, 14 Sep. 1938, *Cranwell & al. 3267* (H, K, NY, S); Hawaii Is., Mauka of Kulani Prison, 19º36'N, 155º22'W, 8 July 1961, *Degener & Degener 27800* (B, C, CAS, G, L, NY); Hawaii Is., slopes of Mauna Loa above Ropopola, 19º36'N, 155º23'W, July 1911, *Forbes 435H* (NY); Hawaii Is., NE slope of Mauna Loa, 19º36'N, 155º23'W, 1 Nov. 1969, *Wentworth 20* (US); Hawaii Is., S Hilo district, edge of Ohia forest, 13.5 mi SE of Pohakuloa, 19º39'N, 155º22'W, 28 June 1968, *Webster & al. 13965* (GH); Hawaii Is., Aina Hou, 19º40'N, 155º25'W, 12 June 1915, *Forbes 827H* (GH); Hawaii Is., along Saddle road 23.5 mi from Hilo, 19º41'N, 155º21'W, 26 Aug. 1949, *Degener & al. 20208* (B).

229d. Geranium cuneatum subsp. **tridens** (Hillebr.) Carlquist & Bissing, Biotropica 8(4): 259. 1976. *Geranium tridens* Hillebr., Fl. Hawaiian Isl.: 55. 1888. *Geranium cuneatum* var. *tridens* (Hillebr.) Fosberg, Occas. Pap. Bernice Pauahi Bishop Mus. 12(16): 14. 1936. *Neurophyllodes tridens* (Hillebr.) O. Deg. & Greenwell in O. Deg., Fl. Hawaiiensis, Fam. 171. 1952. Type locality: "Maui! Haleakala, from 4000-8000 ft., common on the north and east slope". Type: U.S.A. Hawaii. Maui Is., Haleakala, 20º49'N, 156º10'W, *W. Hillebrand s.n.* (lectotype, designated by Aedo 2017a: 182, BM!; isolectotypes, GH-00368360!, US!).

Leaf laminas (1.2)1.7-2.7(3.4) cm long, 0.4-1.6 cm wide, obtriangular-cuneiform [ratio lamina width/lamina length = (0.32)0.38-0.47(0.59)], apex dentate [3(5) teeth], sericeous on both surfaces. *Cymules* 1-flowered, grouped in (4)6-16-flowered cymes at the end of each brachyblast; peduncles 3.7-12.5 mm long, ± sericeous, with erect-patent to appressed eglandular hairs 0.2-0.9 mm long. *Sepals* 6.8-8.9(11.8) long, 2.4-3.8 mm wide, with mucro (0.3)0.4-0.5(0.8) mm long, glabrous adaxially, ± sericeous, with antrorse, appressed eglandular hairs 0.2-0.6 mm long on abaxial surface. *Petals* (9.6)10.5-12.4(15.2) mm long. *Fruit* 17.1-32 mm long; mericarps 2.7-4.9 mm long, sericeous, with erect-patent eglandular hairs 0.3-0.7 mm long; rostrum 10.7-

20.1 mm long, with a narrowed apex 0.5-1.3 mm long. Fig. 581 d, e.

Pollen. *Geranium*-type (Bortenschlager 1967: 433).

Chromosome number. Unknown.

Phenology. Collected in flower from April to October.

Distribution. This subspecies is endemic to southeastern of Maui Is. (Fig. 583).

Habitat. Exposed, often cloud covered, shrubby slopes, scrubland on lava rock slopes and dry *Sophora* L. shrublands; 1900-3250 m.

Representative specimens examined. **USA.** Hawaii: Maui Is., hill Mauka of Olinda on way to Haleakala, 15 June 1927, *Degener 18009* (GH, NY); Maui Is., Haleakala, crater rim along the Halemauu Trail, 20º42'N, 156º12'W, 5 July 1948, *Wilbur & Webster 1019* (US); Maui Is., Makawao district, Haleakala, just below Park headquarters at Homer's Grove, in small gulch aove highway, 20º42'N, 156º16'W, 17 May 1992, *Wood & Perlman 1930* (MO, US); Maui Is., Haleakala crater, western slopes near the crater, 20º43'N, 156º15'W, 10 Sep. 1975, *Sparre 102* (S); Maui Is., outer Haleakala

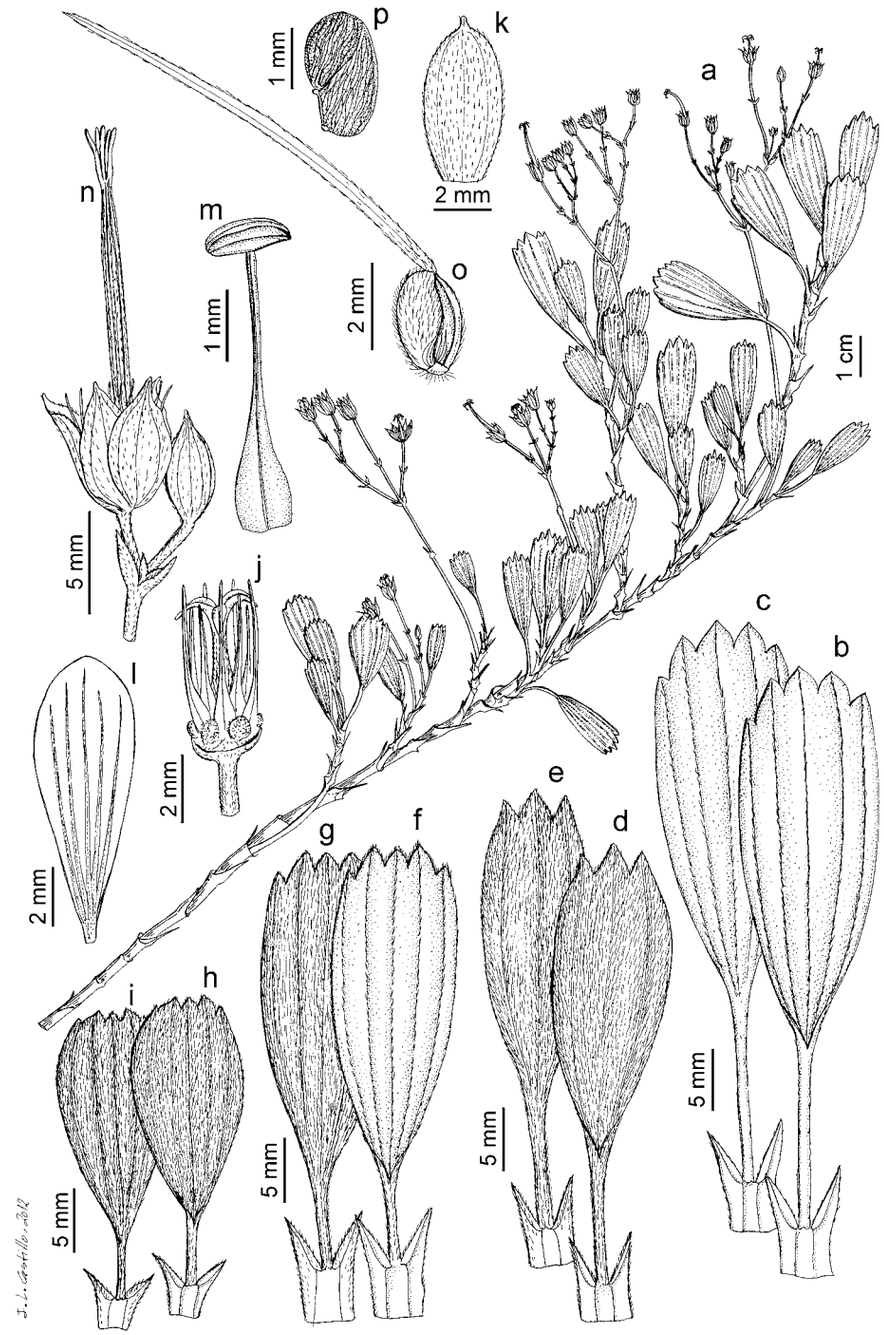


Fig. 581. *Geranium cuneatum* subsp. *cuneatum*. a. Branch with flowers and fruits. b. Leaf adaxial surface. c. Leaf abaxial surface. j. Flower without petals and sepals. k. Sepal. l. Petal. m. Stamen. n. Fruit. o. Mericarp. p. Seed. (Based on: *Skottsberg 647*, S). *Geranium cuneatum* subsp. *tridens*. d. Leaf adaxial surface. e. Leaf abaxial surface (Based on: *Rock 8562*, K). *Geranium cuneatum* subsp. *hypoleucum*. f. Leaf adaxial surface. g. Leaf abaxial surface. (Based on: *Cranwell & al. 3267*, K). *Geranium cuneatum* subsp. *hololeucum*. h. Leaf adaxial surface. i. Leaf abaxial surface (Based on: *Fosberg 39310*, MO).

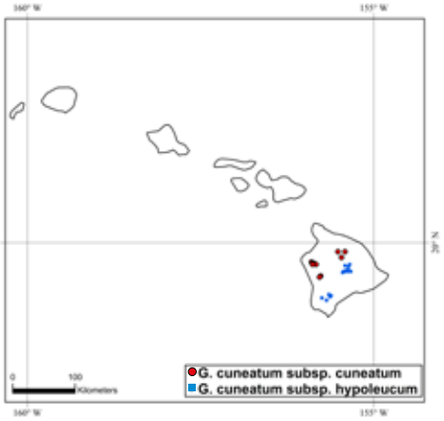


Fig. 582. Distribution of *Geranium cuneatum* subsp. *cuneatum* and *G. cuneatum* subsp. *hypoleucum*.

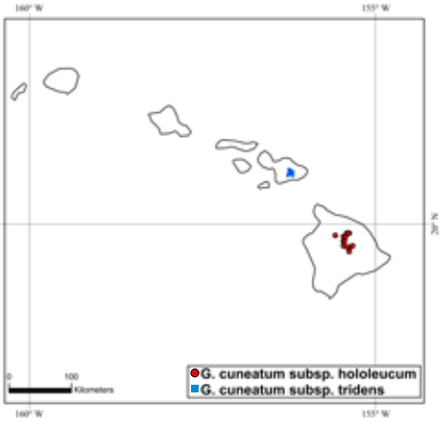


Fig. 583. Distribution of *Geranium cuneatum* subsp. *tridens* and *G. cuneatum* subsp. *hololeucum*.

rim between Koolau Gap and Olod Rest House, 20º44'N, 156º14'W, 26 July 1939, *Degener 17341* (CAS, GH, NY, US); Maui Is., highway 378 about 4 mi beyond the Haleakala Park Headquarters, 20º44'N, 156º15'W, 20 Aug. 1975, *Gustafson & Briel s.n.* (US); Maui Is., on highway below Kalahaku Overlook western outer side of Haleakala crater, 20º44'N, 156º14'W, 7 Aug. 1967, *Iltis & Iltis 547-a* (US); Maui Is., Haleakala crater, above Park Headquarters, 20º45'N, 156º15'W, 2 Mar. 1962, *Carlson 3809* (BR, F); Maui Is., Koolau Gap, Haleakala, 20º45'N, 156º12'W, 11 Aug. 1927, *Degener 12130* (NY); Maui Is., Haleakala, end of Halemauu trail above Park Headquarters, 20º45'N, 156º14'W, 24 June 1969, *Henrickson & Vogl 3720b* (US); Maui Is., NW outer slopes of Haleakala, near the end of Halemauu trail at Park road, 20º45'N, 156º14'W, 13 July 1969, *Henrickson 3848b* (E, NY, US); Maui Is., Haleakala, S of head of Halemauu trail, 20º45'N, 156º14'W, 13 June 1975, *Higashino 685* (US); Maui Is., Haleakala crater, Halemauu trail o.2 mi E of Haleakala highway, 20º45'N, 156º14'W, 13 Sep. 1966, *Mäkinen & Mäkinen 66-1647* (H); Maui Is., Puu Nianiau, Haleakala, 20º46'N, 156º14'W, 15 June 1927, *Degener 12129* (G, GH, L, NY, S); Maui Is., slopes of Haleakala, between top of Halemauu trail end of road at Puu Nianiau, 20º46'N, 156º14'W, 23 Aug. 1933, *Fosberg 9974* (CAS, F, NY); Maui Is., E of Hosmer's Grove, near Haleakala National Park fence, 20º46'N, 156º15'W, 20 June 1982, *Funk 12A* (NY, US); Maui Is., Haleakala, narrow ravine 50 m E of Hosmer's Grove, 20º46'N, 156º15'W, 12 June 1975, *Higashino 627* (US); Maui Is., Puu Nianiau, N slope of Haleakala, 20º46'N, 156º14'W, 14 Dec. 1935, *Judd s.n.* (L); Maui Is., slopes of Haleakala above Ukulele, 20º47'N, 156º15'W, July 1910, *Forbes 181* (CAS, F, GH, K, NY, US); Maui Is., E of Ukulele camp, Haleakala, 20º47'N, 156º15'W, 19 July 1919, *Forbes 848* (NY, US).

230. Geranium hanaense A.C. Medeiros & H. St. John, Brittonia 40(2): 214, 215 fig. 1. 1988. Type locality: "Hawaii. Maui Island: East Maui, big boggy area in Hana rainforest, NE upper Haleakala, Haleakala National Park, Mid-Camp Bog, 1670 m, 13 Jun 1982, E. Funk 207 (holoype: BISH)". Type: U.S.A. Hawaii. Maui Is., Hana rainforest, Haleakala National Park, Mid-Camp Bog, 20º44'N, 156º06'W, 13 June 1982, *E. Funk 207* (holoype, BISH).

Perennial shrubby, 19-40 cm tall. *Rootstock* 2-3 mm in diameter, horizontal, not tuberculate, not turnip-shaped, without thickened roots. *Stem* ascending, leafy, often rooting at nodes, stolons absent, without vegetative stems, glabrous. *Basal leaves* unknown, cauline leaves alternate; leaf laminas (2.3)2.5-4(4.6) cm long, 1-2.2 cm wide, not peltate, entire with dentate apex [with (3)5-7 teeth], obovate to elliptic in outline, base cuneate, ± coriaceous, with nerves not projected, sericeous on

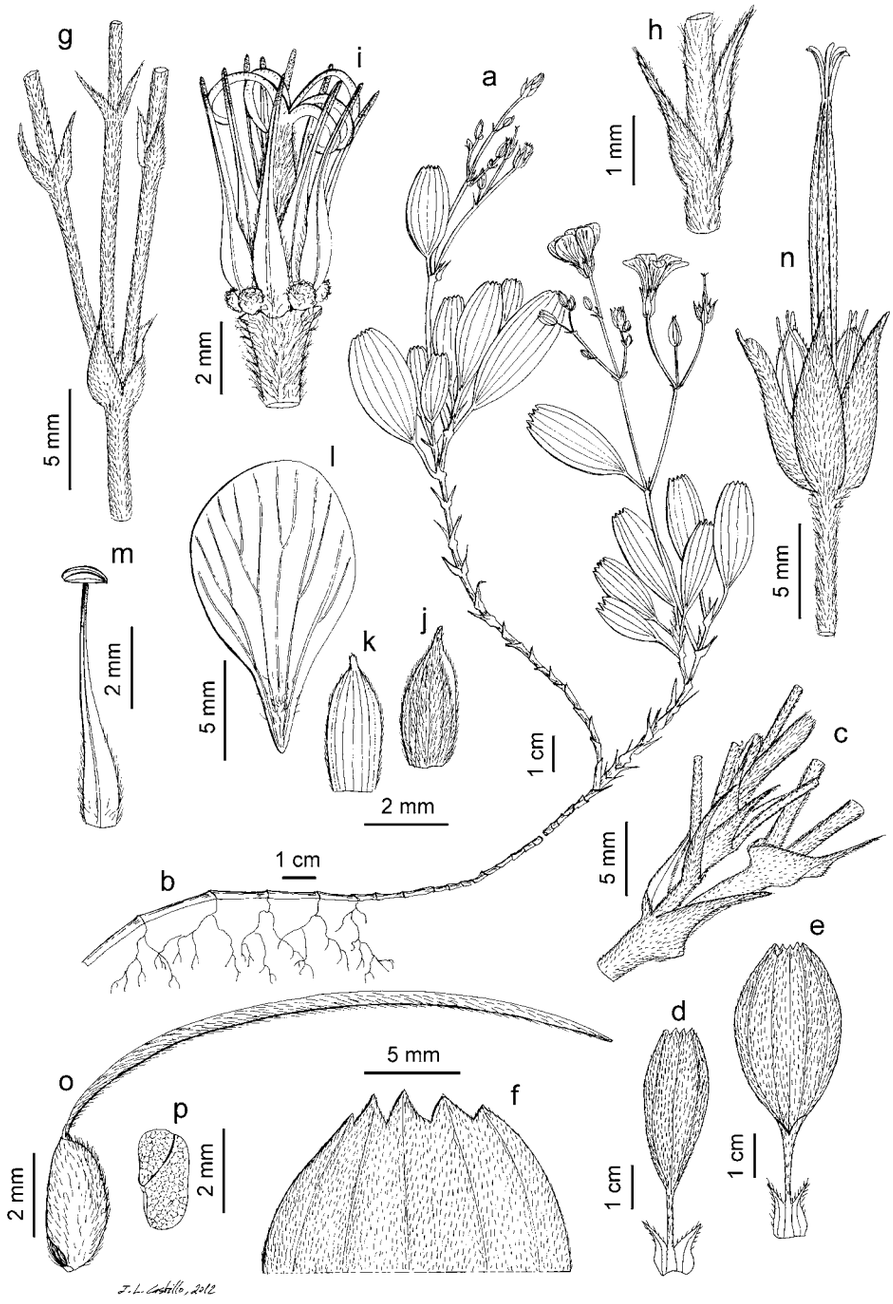


Fig. 584. *Geranium hanaense*. a. Branch with flowers and fruits. b. Rootstock fragment. c. Stipules. d, e. Leaves. f. Indument of the leaf apex. g. Detail of inflorescence showing bracteoles. h. Bracteoles. i. Flower without petals and sepals. j. Sepal, abaxial surface. k. Sepal, adaxial surface. l. Petal, adaxial surface. m. Stamen. n. Fruit. o. Mericarp. p. Seed. (Based on: a, c-m, *Harrison 243*, BISH; b, redrawn from *Brittonia* 40(2): 215, fig. 1. 1988; n-p, *Wood 6820*, BISH).

Fig. 585. Distribution of *Geranium hanaense*.

both surfaces; segments 1; petioles up to 1.8 cm long, with an abscission zone between petiole and stipule, terete, not swollen, not deflexed in age, sericeous, with antrorse, appressed, eglandular hairs 0.2-0.7 mm long; stipules 4.9-9.8 mm long, 2.2-3.5 mm wide, lanceolate, sheathing, connate at the base, papery, brownish red, sericeous, with eglandular hairs on abaxial surface and on the margin, glabrous adaxially. *Inflorescence* a monochasial cyme; cymules 1-flowered, grouped in 2-11(13)-flowered cymes at the end of each brachyblast [ratio cymule length/leaf length = 1.6-2.9]; peduncles (11)17.7-20.6(25.9) mm long, ± sericeous, with erect-patent to appressed, eglandular hairs 0.5-1.1 mm long; bracteoles 2-4.3 mm long, 0.9-1.7 mm wide, lanceolate, opposite, overlapping at base to appear sheathing. Flowers actinomorphic. *Sepals* (6.8)7.2-8 mm long, 2.3-3.6 mm wide, lanceolate, smooth, not accrescent, nerves 3-5, mucro 0.7-1.2 mm long [ratio mucro length/sepal length = 0.09-0.18], sericeous, with antrorse, appressed, eglandular hairs 0.3-0.6 mm long on the abaxial surface, glabrous adaxially. *Petals* 14.7-15.9 mm long, 5.6-8.6 mm wide, erect-patent, rounded, without claw, white, sometime with purple veins, hairy on the base of both surfaces, with hairs 0.4-0.6 mm long. *Stamens* 10, both whorls bearing anthers; filaments 5-7.6 mm long, lanceolate, with a purple apex, with scattered hairs 0.3-0.5 mm long on abaxial surface and margin; anthers 1.1-1.4 mm long, purple. Nectaries 5, hemispheric, dorsally woolly. *Gynoecium* 6.3-8.5 mm long, purple. *Fruit* 23-25 mm long, erect, discharge of seed-ejection type; mericarps 3.2-3.5 mm long, 1.4-1.7 mm wide, without a strand of fibers, not compressed at the apex, smooth, without basal beak, with a basal callus, without a basal prong, brown, hairy to sericeous, with erect-patent, eglandular hairs 0.4-1 mm long; rostrum 15.8-17.4 mm long, with a narrowed apex 1-1.7 mm long, not twisted, sericeous, with antrorse, appressed eglandular hairs 0.4-0.5 mm long; stigmatic remnants 2.3-3.1 mm long, with 5 glabrous lobes. *Seeds* 2.1-2.8 mm long, 1-1.2 mm wide, reticulate-sinuous, uniformly colored, brown, glabrous. Cotyledons not studied. Fig. 584.

Pollen. Ornamentation not studied.

Chromosome number. Unknown.

Phenology. Collected in flower from June to October.

Distribution. This species is endemic to eastern of Maui Is., Hawaii (Fig. 585).

Habitat. Boggy areas in rainforests; 1650-1750 m.

Additional specimens examined. **USA.** Hawaii: Maui Is., Hana side, in bog closest to trail below Greensword Bog, 20°44'N, 156°6'W, 13 June 1982, *Funk 206* (BISH); Maui Is., Hana Rain Forest, 20°44'N, 156°6'W, 13 June 1982, *Funk 8A* (BISH); Maui Is., Hana Rain Forest, near N rim of Kipahulu, 20°44'N, 156°6'W, 29 June 1973, *Harrison 243* (BISH); Maui Is., Hanawi, above State Camp, esat fence, 20°44'N, 156°6'W, 5 Oct. 1997, *Wood 6820* (BISH).

Discussion. Geranium hanaense is a dwarf, decumbent shrub that roots at the nodes. It is easy to distinguish by its leaves, which are obovate to elliptic, sericeous on both surfaces and mostly 5-7-toothed at the apex, and by its long partial inflorescences with long internodes and peduncles. The partial inflorescences of 2-6-flowered cymes in a complex structure are quite similar to those of *G. arboreum*. *Geranium hanaense* might be mistaken at first for *G. cuneatum* subsp. *tridens* (both growing on Maui) or *G. cuneatum* subsp. *hololeucum* (from the island of Hawaii) because of the sericeous leaves. However, these taxa are erect shrubs not rooting at the nodes. According to Medeiros & St. John (1988: 218), plants of *G. hanaense*, raised at Haleakala National Park headquarters, retained their trailing decumbent branches, large flowers, and leaves with more than 3 teeth at the apex after four years in cultivation. In addition, *Geranium hanaense* generally has longer petioles, longer partial inflorescences (with longer internodes and peduncles), a longer sepal mucro, and longer petals than are found in either of the two *G. cuneatum* subspecies, although there is some overlap in all of these quantitative features. No original material of *Geranium hanaense* could be located for this study. The material seen, however, closely matches the protologue and was all collected from the vicinity of the type locality.

231. Geranium hillebrandii Aedo & Muñoz Garm., Kew Bull. 52(3): 725. 1997. *Geranium humile* Hillebr., Fl. Hawaiian Isl. 56. 1888, nom. illeg., non Cav. 1787. *Geranium humile* var. *mauiense* Fosberg, Occas. Pap. Bernice Pauahi Bishop Mus. 12(16): 18. 1936. *Neurophyllodes humilis* Hillebr. ex O. Deg. & Greenwell in O. Deg., Fl. Hawaiiensis, Fam. 171. 1952. Type locality: "Summit of Eeka! Maui; and a similar plant in the swamps of Lehua makanui, Kauai: Mrs. Sinclair, pl. 35 (leaves toothed, cymes single-flowered)". Type: U.S.A. Hawaii. Maui Is., summit of Mt. Eeka, 20°55'N, 156°34'W, *W. Hillebrand s.n.* (lectotype, designated by Fosberg 1936: 18, BISH-509374!; isolectotype, GH-00351563!).

Perennial shrubby, 12-26 cm tall. *Rootstock* 2-2.4 mm in diameter,

horizontal, not tuberculate, not turnip-shaped, without thickened roots. *Stem* ascending, leafy, often rooting at nodes, stolons absent, without vegetative stems, glabrous. *Basal leaves* unknown, cauline leaves alternate; leaf laminas (1.3)1.6-1.8(2.5) cm long, 0.6-1.4 cm wide, not peltate, entire with dentate apex [with 5-7 teeth], elliptic to obtriangular-cuneiform in outline, base cuneate, ± coriaceous, with nerves not projected, usually glabrous except for a line of silky, appressed, eglandular hairs on the nerves of the adaxial surface (rarely with sparse hairs among nerves) and sericeous abaxially; segments 1; petioles up to 0.4 cm long, with an abscission zone between petiole and stipule, terete, not swollen, not deflexed in age, sericeous, with antrorse, appressed, eglandular hairs 0.3-0.6 mm long; stipules 5.6-12.9 mm long, 1.7-3.4 mm wide, lanceolate, sheathing, connate at the base, papery, brownish red, glabrous or sparsely hairy on abaxial surface, hairy on the margin, glabrous adaxially. *Inflorescence* a monochasial cyme; cymules 1-flowered, grouped in 2-5-flowered cymes at the end of each brachyblast [ratio cymule length/leaf length = 1.7-2.6]; peduncles 3.9-11(13.3) mm long, ± sericeous, with erect-patent to appressed, eglandular hairs 0.6-1 mm long; bracteoles 1.2-4.7 mm long, 0.8-1.5 mm wide, lanceolate, opposite, overlapping at base to appear sheathing. Flowers actinomorphic. *Sepals* (5.1)6.5-7.2(8.3) mm long, 2.3-4.4 mm wide, lanceolate, smooth, not accrescent, nerves 3-5, mucro 0.4-0.9 mm long [ratio mucro length/sepal length = 0.06-0.13], ± sericeous, with antrorse, appressed, eglandular hairs 0.4-0.9 mm long on the abaxial surface, glabrous adaxially. *Petals* (9.5)12-15.5(17.6) mm long, 4.1-10.4 mm wide, erect-patent, rounded, without claw, white, with purple veins, hairy on the base of the adaxial surface and on the basal half of the abaxial surface, with hairs 0.5-0.8 mm long. *Stamens* 10, both whorls bearing

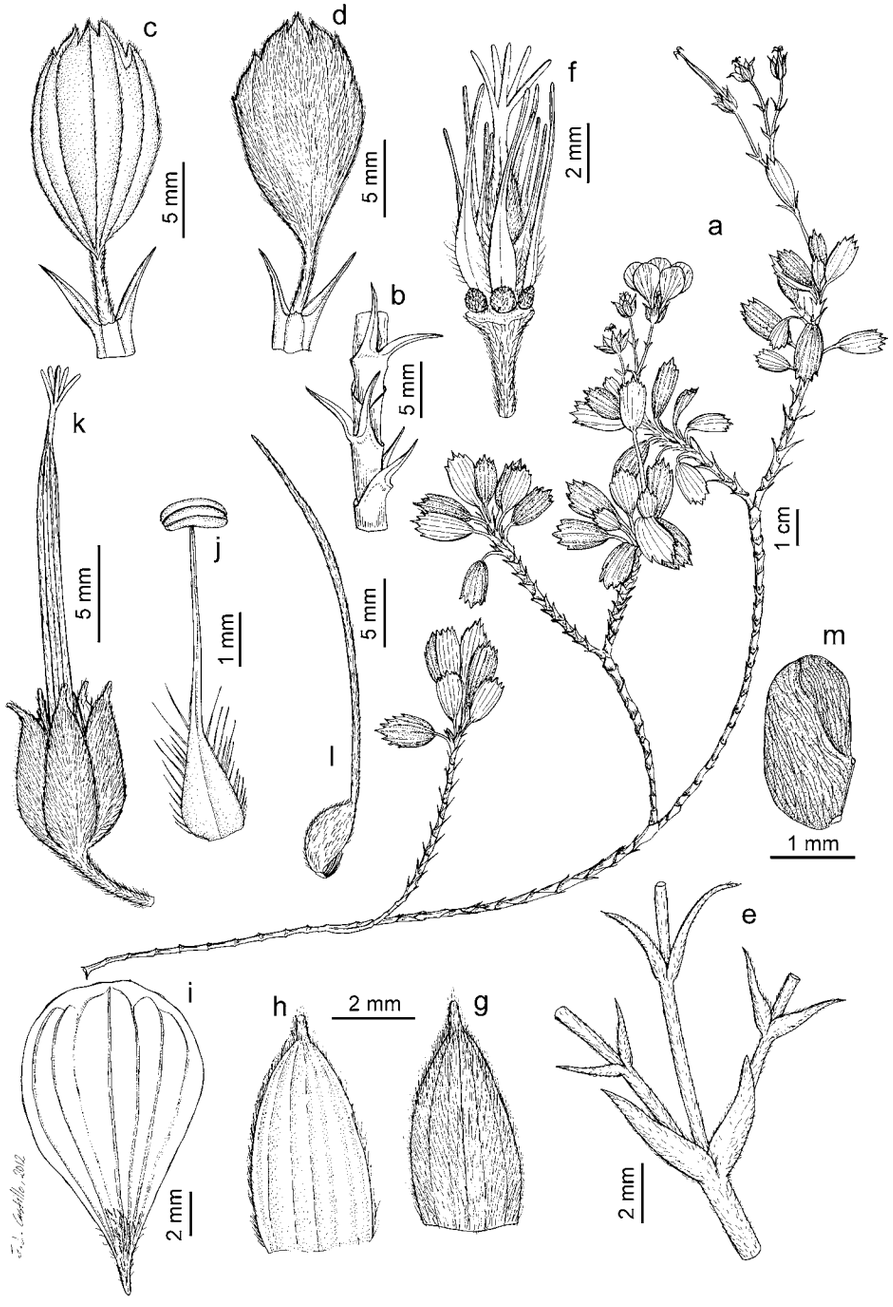


Fig. 586. *Geranium hillebrandii*. a. Branch with flowers and fruits. b. Stipules. c. Leaf adaxial surface. d. Leaf abaxial surface. e. Detail of inflorescence showing bracteoles. f. Flower without petals and sepals. g. Sepal, abaxial surface. h. Sepal, adaxial surface. i. Petal. j. Stamen. k. Fruit. l. Mericarp. m. Seed. (Based on: *Rock 8147*, GH).

Fig. 587. Distribution of *Geranium hillebrandii*.

anthers; filaments 4.2-7.9 mm long, lanceolate, white, with scattered hairs 0.3-0.7 mm long on abaxial surface and margin; anthers 1.2-1.5 mm long, yellow. Nectaries 5, hemispheric, dorsally woolly. *Gynoecium* 4.3-8.7 mm long, purple. *Fruit* 19.1-26.9 mm long, erect, discharge of seed-ejection type; mericarps 2.9-3.5 mm long, 1.5-1.7 mm wide, without a strand of fibers, not compressed at the apex, smooth, without basal beak, with a basal callus, without a basal prong, brown, hairy to sericeous, with erect-patent, eglandular hairs 0.4-0.5 mm long; rostrum 17.7-20.9 mm long, with a narrowed apex 2.3-2.9 mm long, not twisted, hairy to sericeous, with antrorse, appressed eglandular hairs 0.3-0.4 mm long; stigmatic remnants 2-2.3 mm long, with 5 glabrous lobes. *Seeds* 2.2-2.3 mm long, 1.2-1.4 mm wide, reticulate-sinuous, uniformly colored, brown, glabrous. Cotyledons not studied. Fig. 586.

Pollen. *Geranium*-type (Bortenschlager 1967: 433 [sub *G. humile*]).

Chromosome number. Unknown.

Phenology. Collected in flower from April to December.

Distribution. This species is endemic to northwestern of Maui Is., Hawaii (Fig. 587).

Habitat. Open foggy bogs, and *Metrosideros* Gaertn. montane wet shrublands; 1250-1850 m.

Additional specimens examined. **USA.** Hawaii: Maui Is., Hana side, in bog closest to trail below Greensword Bog, 20º44'N, 156º6'W, 13 June 1982, *Funk 206* (BISH); Maui Is., Hana Rain Forest, 20º44'N, 156º6'W, 13 June 1982, *Funk 8A* (BISH); Maui Is., Hana Rain Forest, near N rim of Kipahulu, 20º44'N, 156º6'W, 29 June 1973, *Harrison 243* (BISH); Maui Is., Hanawi, above State Camp, esat fence, 20º44'N, 156º6'W, 5 Oct. 1997, *Wood 6820* (BISH).

Discussion. Geranium hillebrandii is a decumbent dwarf shrub that roots at the nodes. Its leaves are sericeous only on the abaxial surface, as is found in *G. cuneatum* subsp. *hypoleucum* and in *G. kauaiense*. The inflorescence of *G. hillebrandii* is quite similar to that of *G. arboreum* and *G. hanaense* in having partial inflorescences of 2-6-flowered cymes in a complex structure. *Geranium hillebrandii* is easily recognized by the lines of sericeous hairs along the nerves of the adaxial surface of the leaves. Such lines are evident without magnification in *G. hillebrandii*, while they are only visible with a microscope in *G. cuneatum* subsp. *hypoleucum* and in *G. kauaiense*. *Geranium cuneatum* subsp. *hypoleucum* resembles *G. hillebrandii* in some features, among which it can be noted that it is an erect shrub with relatively narrow, apically truncate leaves. In *G. hillebrandii* the leaf apex is usually ± attenuate, and most frequently with seven teeth. In addition, the stipules of *G. hillebrandii* are longer, the petiole shorter, and the inflorescence fewer flowered, the hairs of the petioles and peduncles are longer, as are the petals, the anthers and the narrowed apex of the rostrum. Most of these quantitative features show some overlap. The petals of *G. hillebrandii* are usually hairy at base on the adaxial surface and on the basal half of the abaxial surface, while those of *G. cuneatum* subsp. *hypoleucum* have only scattered hairs at the base on the adaxial surface (rarely glabrous). *Geranium kauaiense* is close to *G. hillebrandii*. Both are dwarf, decumbent shrubs that root at the nodes and grow in bogs. The first may be distinguished by its narrower leaves, truncate and 5-toothed apex, shorter stipules and longer petiole. Partial inflorescences of *G. kauaiense* are significantly longer because of longer internodes and peduncles. In both species, however, the flowers are fewer, which is a useful feature for separating these species from *G. cuneatum* subsp. *hypoleucum*. Additionally, the sepals, petals, anthers and narrowed apex of the rostrum are shorter in *G. kauaiense* than in *G. hillebrandii*, and the stigmatic remnants are longer. Most of these quantitative features show some overlap. Hillebrand (1888) described *G. humile* (here *G. hillebrandii*) including plants from Maui and Kaua'i. Rock (1911: 9) segregated the plants from Kaua'i as a different variety, which was also recognized by Fosberg (1936: 18). St. John (1984: 481) subsequently recognized the plants from Kaua'i as *G. kauaiense*. Consequently, *G. humile* should be typified by the Maui specimen cited by Hillebrand and *G. kauaiense* on those from Kaua'i cited by Rock (1911: 9).

232. Geranium kauaiense (Rock) H. St. John, Bull. Torrey Bot. Club 111(4): 481. 1984. *Geranium humile* var. *kauaiense* Rock, Bull. Coll. Hawaii Publ. 1: 9. 1911. *Neurophyllodes kauaiensis* (Rock) O. Deg. & Greenwell in O. Deg., Fl. Hawaiiensis, Fam. 171. 1952. *Geranium humile* subsp. *kauaiense* (Rock) Carlquist & Bissing, Biotropica 8(4): 259. 1976. Type locality: "Kauai: Summit of Waialeale, elevation 5000 feet, on moss-covered rocks (Rock n. 4931, flowering Sept. 24, 1909, Oct. 20, 1911)". Type: U.S.A. Hawaii. Kauai Is., summit of Waialeale, 22º04'N, 159º29'W, 24 Sep. 1909, *J.F. Rock 4926* (lectotype, designated by Fosberg 1936: 19, BISH!; isolectotype, NY!).

Perennial shrubby, 10-30 cm tall. *Rootstock* 2-2.2 mm in diameter, horizontal, not tuberculate, not turnip-shaped, without thickened roots. *Stem* ascending, leafy, often rooting at nodes, stolons absent, without vegetative stems, glabrous. *Basal leaves* unknown, cauline leaves alternate; leaf laminas (1.2)1.3-1.9(2.6) cm long, 0.4-1.1 cm wide, not peltate, entire with dentate apex [with (3)-5 teeth], elliptic to obtriangular-cuneiform in outline, base cuneate, ± coriaceous, with nerves not projected, usually glabrous except for scattered, appressed, eglandular hairs on the nerves of the adaxial surface and sericeous abaxially; segments 1; petioles up to 0.9 cm long, with an abscission zone between petiole and stipule, terete, not swollen, not deflexed in age, hairy to sericeous,

with antrorse, appressed, eglandular hairs 0.2-0.3 mm long; stipules 3.7-6.2 mm long, 1.5-2.9 mm wide, lanceolate, sheathing, connate at the base, papery, brownish red, hairy to sericeous, with eglandular hairs on abaxial surface and on the margin, glabrous adaxially. *Inflorescence* a monochasial cyme; cymules 1-flowered, grouped in 1-5-flowered cymes at the end of each brachyblast [ratio cymule length/leaf length = 2.3-6.6]; peduncles (14.1)21-28(33.4) mm long, hairy to ± sericeous, with erect-patent to appressed, eglandular hairs 0.1-0.4 mm long; bracteoles 1.2-2.4 mm long, 0.5-1.2 mm wide, lanceolate, opposite, overlapping at base to appear sheathing. Flowers actinomorphic. *Sepals* (5.2)5.4-6.8(7.4) mm long, 2-2.8 mm wide, lanceolate, smooth, not accrescent, nerves 3-5, mucro 0.3-0.6 mm long [ratio mucro length/sepal length = 0.07-0.12], sericeous, with antrorse, appressed, eglandular hairs 0.3-0.4 mm long on the abaxial surface, glabrous adaxially. *Petals* (8.5)9.3-13.9(15.7) mm long, 3.4-7.7 mm wide, erect-patent, rounded, without claw, white, with purple veins, moderately hairy on the base of both adaxial and abaxial surface (rarely glabrous on the abaxial surface), with hairs 0.2-0.5 mm long. *Stamens* 10, both whorls bearing anthers; filaments 3.8-5.8 mm long, lanceolate, white, with scattered hairs 0.3-0.4 mm long on abaxial surface and margin; anthers 1-1.3 mm long, yellow to dark purple. Nectaries 5, hemispheric, dorsally woolly. *Gynoecium* 4.9-6.4 mm long, purple. *Fruit* 19.4-21.3 mm long, erect, discharge of seed-ejection type; mericarps 2.3-3.6 mm long, 1.4-1.6 mm wide, without a strand of fibers, not compressed at the apex, smooth, without basal beak, with a basal callus, without a basal prong, brown, hairy to sericeous, with erect-patent, eglandular hairs 0.2-0.4 mm long; rostrum 12.8-14.6 mm long, with a narrowed apex 0.7-0.8 mm long, not twisted, sericeous, with antrorse, appressed eglandular hairs 0.2-0.4 mm long; stigmatic remnants 2.6-3.5 mm long, with 5 glabrous lobes. *Seeds* 1.7-2.1 mm long, 1.1-1.3 mm wide, reticulate-sinuous, uniformly colored, brown, glabrous. Cotyledons not studied. Fig. 588.

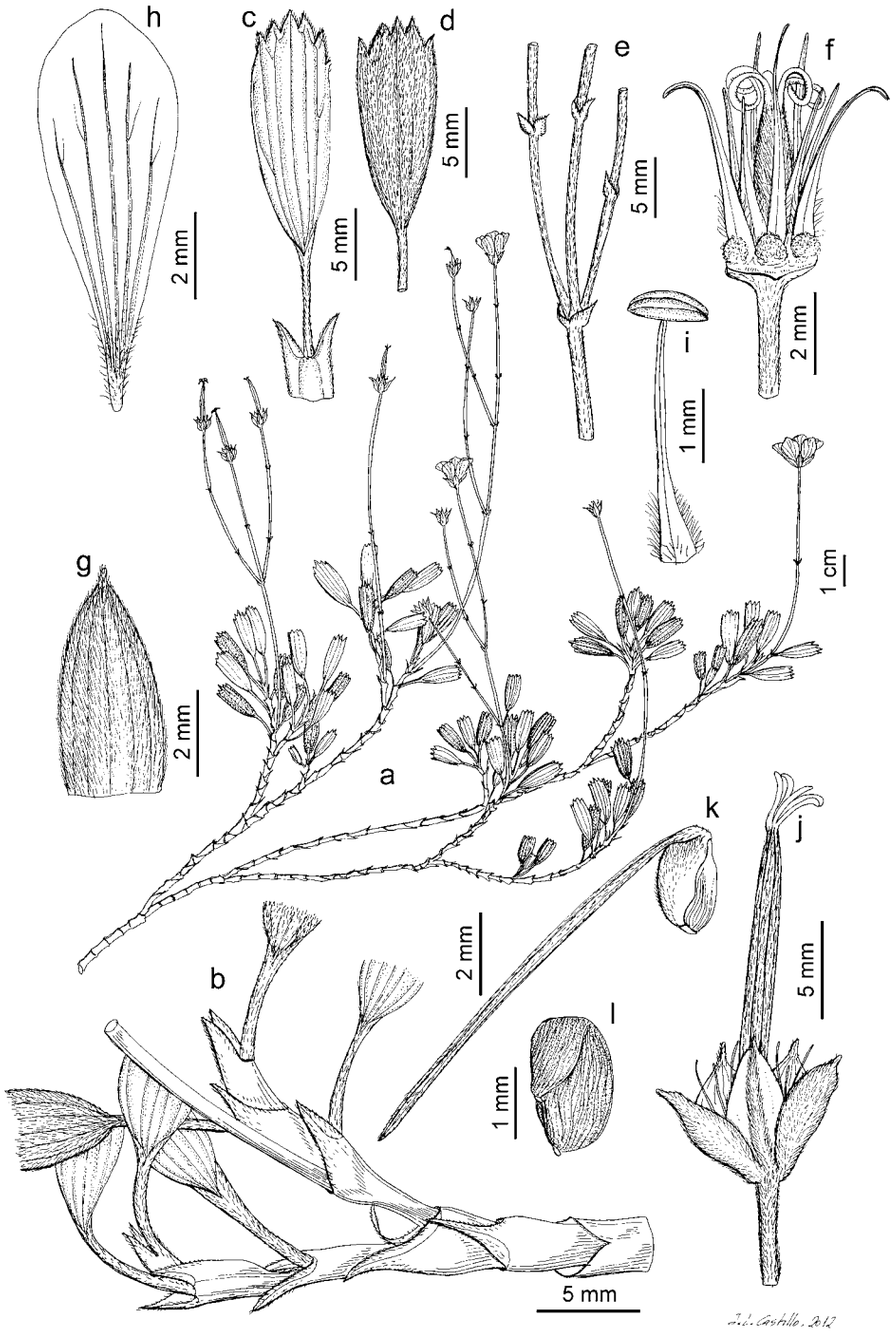


Fig. 588. *Geranium kauaiense*. a. Branch with flowers and fruits. b. Stipules and petioles. c. Leaf adaxial surface. d. Leaf abaxial surface. e. Detail of inflorescence showing bracteoles. f. Flower without petals and sepals. g. Sepal. h. Petal. i. Stamen. j. Fruit. k. Mericarp. l. Seed. (Based on: *Wood & Perlman 3399*, MO).

Pollen. Ornamentation not studied.

Chromosome number. Unknown.

Phenology. Collected in flower from July to September.

Distribution. This species is endemic to Kauai Is., Hawaii (Fig. 589).

Habitat. Open bogs and at the edges of *Metrosideros* Gaertn. clumps; 1200-1600 m.

Fig. 589. Distribution of *Geranium kauaiense*.

Additional specimens examined. **USA.** Hawaii: Sandwich Is., Mts. Kauai, 1840, *Brackenridge & al. s.n.* (GH); Kauai Is., Oct. 1916, *Rock s.n.* (BISH); Kauai Is., Kauluwehi Bog, Kokee plateau, 22°4'N, 159°29'W, 1 Sep. 1983, *Medeiros & Miranda 499* (BISH); Kauai Is., Alakai Swamp, border of Hanalei and Waimea districts in open bog 2 mi W of Mt. Waialeale and 0.5 mi S of Wainiha Pali, 22°4'N, 159°29'W, 29 July 1987, *Wood 28* (BISH, F); Kauai Is., Alakai Swamp, 22°5'N, 159°33'W, 1 Mar. 1936, *Fosberg 12757* (BISH, CAS, F, GH); Kauai Is., Alakai Swamp, Kauai Forest Bird Survey, transect Bog 2, 22°5'N, 159°32'W, 16 Feb. 1989, *Perlman & al. 10624* (MO); Kauai Is., Alakai Swamp, branch of Mohihi-Waialae trail 2nd bog, 22°5'N, 159°35'W, 31 Aug. 1977, *Royen & al. 11696* (US); Kauai Is., Waimea district, Sincock Bog, near distric border, Halehaha area, 22°5'N, 159°33'W, 12 Aug. 1994, *Wood & Perlman 3396* (NY); Kauai Is., Waimea district, Sincock Bog, near distric border, Halehaha area, 22°5'N, 159°33'W, 12 Aug. 1994, *Wood & Perlman 3399* (MO, NY, WU).

Discussion. Geranium kauaiense is a decumbent dwarf shrub that roots at the nodes. It is easy to distinguish by its narrow leaves that are five-toothed across the truncate apex and have a nearly glabrous adaxial surface and sericeous abaxial surface, and by its long partial inflorescences with long internodes and peduncles and few flowers. The inflorescence of *G. kauaiense* is quite similar to that of *G. hillebrandii* with partial inflorescences of 2-6-flowered cymes in a complex structure. *Geranium kauaiense* appears to be close to *G. hillebrandii* and in some aspects is similar to *G. cuneatum* subsp. *hypoleucum* (see discussion under *G. hillebrandii*). Sinclair (1885, tab. 35) illustrated *G. kauaiense* under the name *G. cuneatum*. Rock (1911: 9) and Knuth (1912: 216) recorded the name as "*Geranium cuneatum var. Sinclair*" in synonymy under *G. humile* var. *kauaiense* and *G. humile*, respectively. It seems, however, that no epithet was ever proposed by either of these authors. The type collection of *Geranium humile* var. *kauaiense* has been somewhat confusing. Rock (1911: 9), in describing *G. humile* var. *kauaiense*, stated: "Kauai: Summit of Waialeale, elevation 5000 feet, on moss-covered rocks (Rock n. 4931, flowering Sept. 24, 1909, Oct. 20, 1911)". I have examined a collection by Rock numbered 4926 (BISH). This specimen is considered to be, in a handwritten note on the sheet, "part of Rock 4931 collection". Fosberg (1936: 19) stated "September 24, 1909, J. F. Rock 4931 (type) and 4926 (probably same collection)." At NY is another collection by Rock with the same locality and date, but unnumbered, which also seems to be original material.

II.d Geranium sect. **Incana** Reiche in Engl. & Prantl, Nat. Pflanzefam. 3(4): 8. 1890. Type: *Geranium incanum* Burm. f. (art. 10.8).

Leaves and petiole without any abscission zone. *Stipules* (2)3-5(11)-fid, with linear to lanceolate and deep lobes. *Mericaps* with a basal callus.

233. Geranium incanum Burm. f., Spec. Bot. Geran.: 28, tab. 1 fig. 26. 1759 [17 July 1759]. *Geranium incanum* J. Printz ex L., Pl. Rar. Afr.: 13. 1760, nom. illeg. *Geranium elongatum* Salisb., Prodr. Stirp. Chap. Allerton: 310. 1796, nom. illeg., non Cav. 1787. Type locality: "Habitat in Africa". Type: Africa. *H.B. Oldenland s.n.* (lectotype, first-step, designated by Kokwaro 1971: 134, G-PREL!, here in second-step, see discussion).

Perennial herbs, 14-80 cm tall. *Rootstock* 2.7-9.8 mm in diameter, ± vertical, not tuberculate, not turnip-shaped, without thickened roots. *Stem* procumbent to ascending, leafy, not rooting at nodes, stolons absent, without vegetative stems, with retrorse, usually appressed, eglandular hairs 0.3-0.9 mm long and, rarely, patent, glandular hairs 0.5-0.6 mm long. *Basal leaves* usually not present, cauline leaves alternate and upper opposite; leaf laminas (1)2.5-3.8(7.8) cm long, 1.3-9.7 cm wide, not peltate, palmatisect, polygonal in outline, base cordate, not coriaceous, with nerves not projected, with appressed, eglandular hairs, rarely glabrous, on the adaxial surface and sericeous abaxially; segments 5, in 1 plane, middle segment rhombic (with narrow linear lobes 0.5-2.3(2.7) mm wide), (0.4)0.6-0.8(1.4) mm wide at the base [ratio segment width at the base/ middle segment length = (0.02)0.03-0.05(0.07)], 5-34(47)-lobed in distal half [ratio secondary sinus length/ middle segment length = (0.27)0.43-0.56(0.60)]; petioles up to 13 cm long, without abscission zone, terete, not swollen, not deflexed in age, with retrorse, usually appressed, eglandular hairs 0.2-0.6 mm long; stipules 3.2-12 mm long, 1-8 mm wide, 2-5-fid, with linear lobes 2.2-9.7 mm deep, 0.2-1 mm wide, free, papery, brown, with eglandular hairs on abaxial surface, ± glabrous adaxially. *Inflorescence* a monochasial cyme; cymules 2-flowered, solitary [ratio cymule length/ leaf length = (1.5)2.4-3.9(6.8)]; peduncles (18)30-77(133) mm long, with retrorse, ± appressed, eglandular hairs 0.2-0.7 mm long and, sometimes, patent, glandular hairs 0.3-0.7 mm long; bracteoles 1.8-8.2 mm long, 0.2-1.3 mm wide, linear-lanceolate, whorled; pedicels (7.9)18.7-32.5(44.1) mm long, with retrorse, ± appressed, eglandular hairs 0.1-0.7 mm long and, sometimes, patent, glandular hairs 0.2-0.7 mm long. Flowers actinomorphic.

Sepals (4.2)6.1-7.4(8.3) mm long, 1.6-3.5 mm wide, lanceolate, smooth, not accrescent, nerves 3, mucro (0.4)0.8-1.3(1.6) mm long [ratio mucro length/ sepal length = (0.07)0.12-0.19(0.24)], sericeous, with appressed, eglandular hairs 0.1-0.8 mm long and, sometimes, patent, glandular hairs 0.2-0.9 mm long on the abaxial surface, glabrous adaxially. *Petals* (5.2)8.5-13.6(17.5) mm long, (3.1)4.9-9.6(13.3) mm wide, erect-patent, rounded or emarginate (notch 0.4-2.2 mm deep), without claw, white, pink or purple, hairy on the base of the adaxial surface, glabrous abaxially, ciliate on the basal margin, with hairs 0.2-0.7 mm long. *Stamens* 10, both whorls bearing anthers; filaments (2)4.3-6.1(8.5) mm long, lanceolate, yellow, with scattered eglandular hairs 0.1-0.4 mm long on the abaxial surface and margin; anthers (1)1.3-1.9(2.3) mm long, yellow. Nectaries 5, hemispheric, with a tuft of hairs at the top, dorsally glabrous. *Gynoecium* 2.1-7.6 mm long, yellow to pink. *Fruit* (11.1)18-28(35) mm long, erect, discharge of seed-ejection type; mericarps 2.6-4.6 mm long, 1.4-2.5 mm wide, without a strand of fibers, not compressed at the apex, smooth, without basal beak, with a basal callus, without a basal prong, brown, with erect-patent, eglandular hairs 0.4-0.9 mm long and, sometimes, patent, glandular hairs 0.4-0.8 mm long; rostrum 10-26.6 mm long, with a narrowed apex 0.4-4.4 mm long, not twisted, with erect-patent, eglandular hairs 0.1-0.8 mm long and, sometimes, patent, glandular hairs 0.4-0.8 mm long; stigmatic remnants 0.8-5.7 mm long, with 5 glabrous lobes. *Seeds* 1.7-2.9 mm long, 1.1-2 mm wide, finely reticulate, uniformly colored, brown, glabrous. Cotyledons with entire margin.

Pollen. *Geranium*-type (Bortenschlager 1967: 431; Verhoeven & Venter 1992: 441, 442).

Chromosome number. Unknown.

Phenology. Collected in flower from January to December.

Distribution. This species ranges from southern Tanzania to southwestern South Africa and it is introduced in Australia and U.S.A.

Habitat. Coastal dunes, disturbed areas, grassland and forest edges; 0-3200 m.

Discussion. The group, comprising *G. incanum* and related species (*G. magniflorum*, *G. nyassense*, *G. multisectum* and *G. vagans*), is characterized by their palmatisect leaves with narrow lobes. It is the most complex group of the sect. *Incana.* Essentially, the entities proposed by Hilliard & Burtt (1985) have been accepted with some modification. The variability of the characters of these entities that is related to their range makes it advisable to group them, at least partially, as Laundon (1961, 1963) did. For this reason *G. magniflorum* and *G. nyassense* have been subordinated to *G. incanum* as subspecies. Although to a lesser extent *G. multisectum* and *G. vagans* are sometimes also difficult to separate from *G. incanum* s.l. The result is an unsatisfactory taxonomy, similar to that which occurs in those groups that are still in the process of speciation. An analysis of the variation of the populations in the field would probably help to better understand the variability of these taxa and, if necessary, to propose a more operative delimitation.

The typification proposed by Kokwaro (1971) for *G. incanum* needs some clarification, because he only stated: "Type: South Africa, Cape of Good Hope, *Oldenland* (Herb. Oldenland, G, holo.)". The most important part of Oldenland's herbarium came into the hands of the Burman family and is now in G, into the prelinnean collection, sometimes called the Burman collection (G-PREL). In Burman's herbarium there are seven sheets that could be related to this species, but only four of them fit the current concept of *G. incanum.* One of the latter shows a 2-flowered cymule with two additional flowers at the base, very similar to the one that appears in the drawing of the protologue. The label of this sheet reads "Geranium incanum foliis tenuissimis multifidis quinquepartitus, laciniis linearibus pedunculis subbifloris", and it is written in Burman's hand according to N. Fumeaux (*in litt.*). Burman attributes this polynomial to Oldenland in the protologue (part underlined). Consequently this specimen is here designated as lectotype in second step.

1. Leaves with linear-lanceolate, plane lobes; pedicels and sepals usually with glandular hairs
233c. subsp. **nyassense**

1. Leaves with narrow, linear, revolute lobes; pedicels and sepals with or without glandular hairs

2. Lower leaves lacking or distributed along the stem; pedicels and sepals without glandular hairs; sepal mucro (0.7)1-1.5(1.6) mm long
233a. subsp. **incanum**

2. Lower leaves in a ± persistent rosette; pedicels and sepals usually with glandular hairs; sepal mucro (0.4)0.7-0.9(1.4) mm long
233b. subsp. **magniflorum**

233a. Geranium incanum Burm. f. subsp. **incanum**

Geranium multifidum Sweet, Geraniaceae 3, tab. 245. 1825, nom. illeg., non Andrews, 1805. *Geranium incanum* var. *multifidum* Sweet ex Hillard & B.L. Burtt, Notes Roy. Bot. Gard. Edinburgh 42(2): 197. 1985. Type locality: "We first observed this curious species of Geranium, in the summer of 1819, in the garden of Mr. Burchell, at Fulham; where we saw several plants of it in bloom. It is a native of the Cape of Good Hope, and was raised from seed, brought from that country, by Mr. W.J. Burchell; and from a plant given by him to Robert Henry Jenkinson, Esq. our drawing and description were taken last summer". Type: Sweet, Geraniaceae 3, tab. 245, 1825 (lectotype, designated by Hilliard & Burtt 1985: 197).

Stem procumbent, with retrorse, usually appressed, eglandular hairs 0.3-0.9 mm long. *Basal leaves* not present (no rosette); middle leaf segment rhombic (with narrow linear lobes 0.7-0.8(1.5) mm wide), (0.4)0.6-

0.7(0.9) mm wide at the base. *Peduncles* (28)30-97(133) mm long, with retrorse, ± appressed, eglandular hairs 0.3-0.7 mm long; pedicels (7.9)16.7-35.6(44.1) mm long, with retrorse, ± appressed, eglandular hairs 0.3-0.7 mm long. *Sepals* (4.6)6.5-7.6(8.2) mm long, 2.2-3.4 mm wide, with mucro (0.7)1-1.5(1.6) mm long, sericeous, with appressed, eglandular hairs 0.2-0.4 mm long on the abaxial surface. *Petals* (5.6)10-15.6(17.5) mm long, (3.2)5.4-11(13.3) mm wide, rounded or emarginate (notch 0.5-2.2 mm deep), white to pink. Fig. 590.

Pollen. *Geranium*-type (Verhoeven & Venter 1992: 441, 442).

Chromosome number. Unknown.

Phenology. Collected in flower from January to December.

Distribution. This subspecies ranges through Western Cape and Eastern Cape, in South Africa and it is introduced in Australia and U.S.A. (Fig. 591).

Habitat. Coastal dunes, disturbed areas, grassland, among scrub, or in open places on forested mountain slopes; 0-1500 m.

Representative specimens examined. **Australia.** South Australia: Kangaroo Is., Penneshaw, 35°43'S, 137°56'E, 29 Sep. 1997, *Bates 48112* (MA). **South Africa.** Eastern Cape: Albany district, Riebeek East, 33°12'S, 26°8'E, 29 Nov. 1973, *Bayliss 6220* (A, MO, NY, Z); Humansdorp, Hofmans Bosch, 33°22'S, 25°33'E, 9 Jan. 1919, *Britten 1214* (PRE); Port Alfred, 33°35'S, 26°53'E, Sep. 1895, *Hulton 2743* (PRE); Alexandria district, Alexandria forest, 33°42'S, 26°21'E, 26 Mar. 1954, *Johnson 887* (PRE); Richmond district, Leopards Vley, 33°43'S, 26°34'E, Dec. 1917, *Bolus 88* (MO); Humansdorp, Rietvlei, 33°55'S, 24°34'E, 11 Nov. 1941, *Esterhuysen s.n.* (BOL); Humansdorp, ad viam inter Gamtoos et pagum Assegaai Bosch, 33°56'S, 24°19'E, 19 Sep. 1930, *Fries & al. 1272* (LD, K, MO); between Port Elizabeth and Humansdorp, 33°57'S, 25°3'E, 8 Feb. 1936, *Cullelt 1383* (K); Port Elizabeth, Sea View, 34°0'S, 25°21'E, 15 Dec. 1981, *Hilliard & Burtt 14831* (K, NU); Clarkson, 34°0'S, 24°20'E, Aug. 1926, *Thode A751* (GH, K); 2 mi from Humansdorp on Port Elizabeth, 34°0'S, 24°46'E, 8 Dec. 1964, *Wells 2956* (K); Humansdorp district, Saint Francis Bay, 34°2'S, 25°7'E, 16 Dec. 1981, *Hilliard & Burtt 14836* (NU); Humansdorp, Oubosch Strand, 34°4'S, 24°13'E, 4 Oct. 1963, *Rechinger 2827* (W); Zitzikamma, 34°10'S, 24°29'E, Sep. 1920, *Fourcade 870* (K). West-

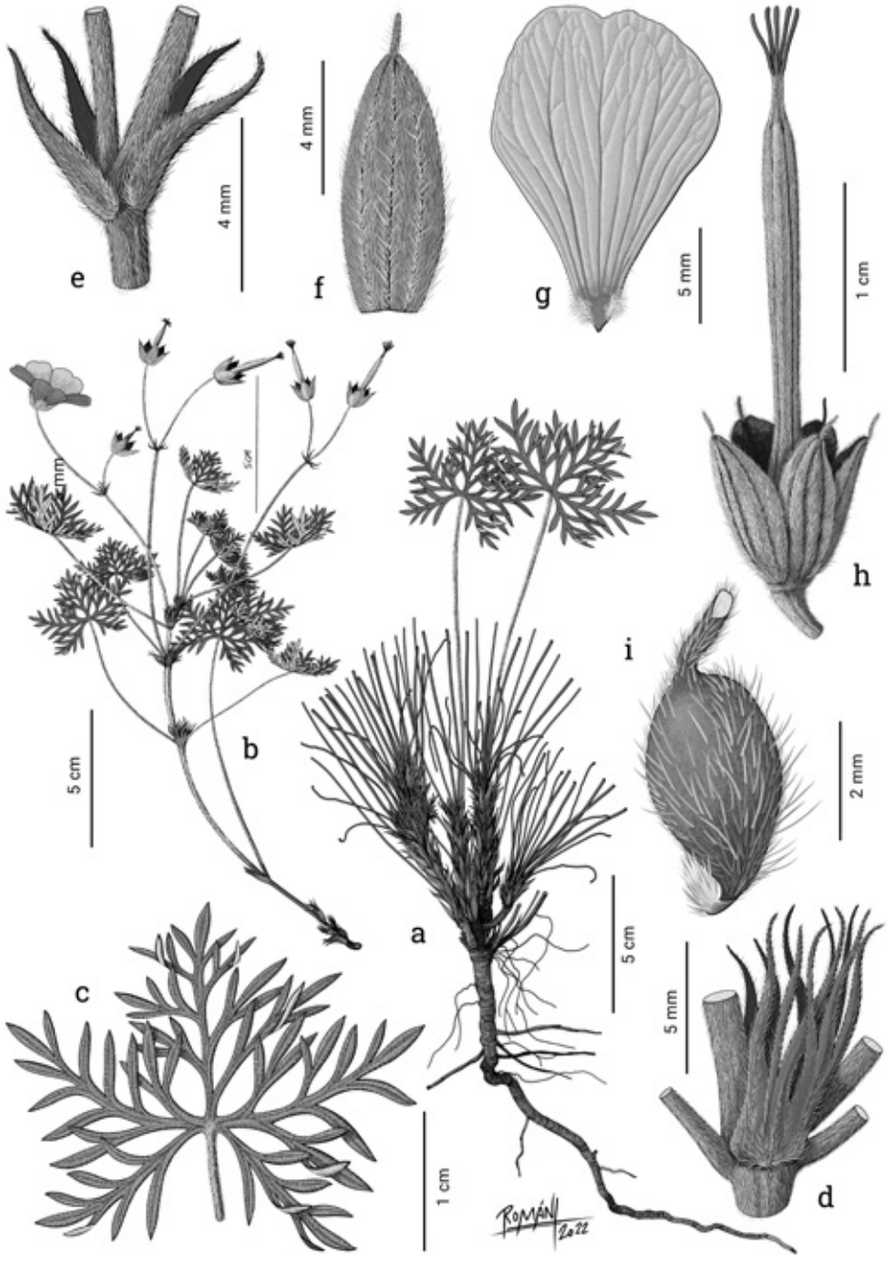


Fig. 590. *Geranium incanum* subsp. *incanum*. a, b. Habit. c. Leaf. d. Stipules. e. Bracteoles. f. Sepal. g. Petal. h. Fruit. i. Mericarp. (Based on: *Hilliard & Burtt 14836*, NU).

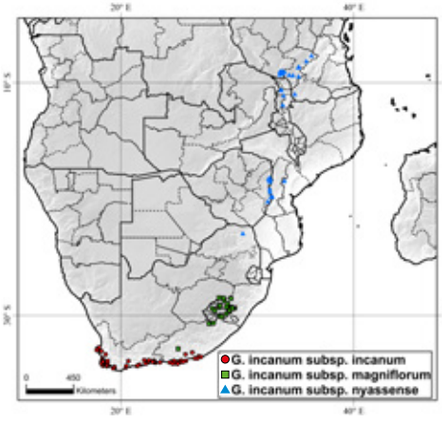


Fig. 591. Distribution of *Geranium incanum*.

ERN CAPE: Klippiea Baai, 32°46'S, 18°8'E, 11 Nov. 1979, *Williams 12* (MO); Ceres, 33°22'S, 19°18'E, May 1918, *Mitchell s.n.* (MO); Melkbosch Strand, cape Peninsular, 33°43'S, 18°26'E, 12 Dec. 1965, *Bayliss 3056* (NY, GH); Melkbosstrand, 33°43'S, 18°26'E, 24 Sep. 1966, *Dahlstrand 1059* (C, GB, MO); Milnerton, 33°52'S, 18°29'E, 30 Aug. 1936, *Lindeberg s.n.* (GH, LD); Robinson Pass, N of Mossel Bay on the way to Oudtshoorn, 33°52'S, 22°1'E, 25 Sep. 1987, *Meyer 1365* (PRE); George, 33°57'S, 22°27'E, 1 Nov. 1894, *Penther 2211* (W); Rondebosch, 33°58'S, 18°28'E, 5 Sep. 1895, *Wolley-Dod 60* (K); Knysna, Wilderness, 33°59'S, 22°34'E, Sep. 1960, *Horn s.n.* (PRE); Wynberg Hill, 33°59'S, 18°27'E, Nov. 1950, *Pillans 10253* (Wny, MO); pr. Wynberg, 33°59'S, 18°24'E, 31 Mar. 1892, *Schlechter 615* (WU); Sedgefield, 34°1'S, 22°48'E, 20 Oct. 1966, *Bayliss 3649* (MO); edge of Rondevlei, near Sedgefield, 34°1'S, 22°48'E, 18 Oct. 1974, *Bayliss 6835* (Z); Mossel Bay, Sedgefield, 34°1'S, 22°48'E, 2 Oct. 1990, *Gibby & Barret 376* (BM, GB); Constantia Nek, 34°3'S, 18°23'E, 27 Nov. 1938, *Wall 1343* (LD); pr. Muizenberg, 34°4'S, 18°38'E, 24 Jan. 2008, *Aedo & al. 15228* (MA); Mossel Bay, 34°10'S, 22°8'E, 14 Sep. 1951, *Van Niekerk 36* (BOL); Witsands Bay, 34°10'S, 18°20'E, 2 Nov. 1958, *Werdermann & Oberdieck 814* (B); Simonstown, 34°11'S, 18°26'E, Oct. 1890, *Marloth s.n.* (PRE); 6 km from turn-off Albertinia-Ystervarkfotein, 34°15'S, 21°36'E, 22 Oct. 1999, *Jordaan 3512* (PRE); Pringle Bay, 34°20'S, 18°49'E, 30 Sep. 1989, *Greuter 21507* (B); Stillbay, 34°21'S, 21°25'E, 6 Oct. 1978, *Botnen 4412* (MO, PRE); De Hoop-Potberg Nature Reaserve, Potberg farm, 34°21'S, 20°29'E, 17 Oct. 1978, *Burgers 1417* (MO); Betty's Bay, 34°21'S, 18°54'E, 1 Oct. 1980, *Hilliard & Burtt 13091* (K, MO, PRE); Riversdale district, Still Bay, 34°22'S, 21°24'E, July 1909, *Muir 418* (PRE); Caledon, Hangklip, 34°23'S, 18°49'E, 23 Oct. 1949, *Steyn 685* (BOL); De Hoop Nature reserve, 34°30'S, 20°26'E, 12 Dec. 1996, *Bremer & Bremer 3712* (UPS); Caledon division, Strandskloof, 34°34'S, 19°26'E, 4 Sep. 1943, *Hoekste 8573* (BOL); Gansbaai, 9.9 km W of road to Elim, 34°34'S, 19°21'E, 14 Oct. 1973, *Vorster 2382* (PRE). **USA.** CALIFORNIA: Dana Point, Harbor Drive at Island Way, 33°27'N, 117°41'W, 16 June 2012, *Riefner 12-404* (MA); Laguna Beach, South Crescent Bay, 33°32'N, 117°48'W, 1 Aug. 2011, *Riefner 11-78* (MA); Newport Beach, Newport Bay, 33°38'N, 117°58'W, 28 Apr. 2007, *Riefner 07-189* (MA).

Discussion. *Geranium incanum* subsp. *incanum* is a procumbent herb with a thin vertical rootstock branching from the base into multiple aerial stems, and with thin roots. The lower leaves are generally arranged along the stem base. Sometimes at the base of the branches they are very close together but do not form basal rosettes. The leaves are palmatisect with five segments divided in linear and revolute lobes which vary from entire to pinnate, and are arranged in a single plane. They are covered by ± scattered, appressed, eglandular hairs on the adaxial surface and are sericeous, with appressed, eglandular hairs, abaxially. On the stem, the inflorescence and other parts of the plant the indumentum is also eglandular. The sepals are sericeous, with antrorse, appressed hairs. The petals are long although they vary in size and color and are usually emarginate.

According to Hilliard & Burtt (1985: 197) the var. *multifidum* is distinguished from the var. *incanum* by its pink and larger petals. The length of the petals shows a considerable overlap and the color also seems highly variable, which discourages the taxonomic recognition of these entities.

233b. Geranium incanum subsp. **magniflorum** (R. Knuth) Aedo, **comb. nov.** *Geranium magniflorum* R. Knuth, Bot. Jahrb. Syst. 40: 68. 1908. TYPE LOCALITY: "Natal: Drakenberg, 2700-3000 m, an grasigen Stellen (Thode n. 13! -- Blühend im Februar). -- Typus in herb. Berol.". TYPE: South Africa. KwaZulu-Natal, Drakensberg, 29°00'S, 29°00'E, Feb., *H.J. Thode 13* (holotype, B destroyed). South Africa. KwaZulu-Natal, Lions River district, Kamberg, 29°22'S, 29°46'E, 14 Dec. 1974, *J.B. Wright 2012* (neotype, here designated, NU-89144!).

Stem ascending, with retrorse, usually appressed, eglandular hairs 0.4-0.6 mm long and, rarely, patent, glandular hairs 0.5-0.6 mm long. *Basal leaves* in a ± persistent rosette; middle leaf segment rhombic (with narrow linear lobes 0.5-1.2(1.7) mm wide), (0.4)0.6-0.8(1.4) mm wide at the base. *Peduncles* (27)36-71(81) mm long, with retrorse, ± appressed, eglandular hairs 0.3-0.7 mm long and, usually, patent, glandular hairs 0.4-0.7 mm long; pedicels (15)23-34(38.3) mm long, with retrorse, ± appressed, eglandular hairs 0.3-0.6 mm long and usually, patent, glandular hairs 0.4-0.7 mm long. *Sepals* (5.7)6.7-7.5(7.9) mm long, 2.4-3.5 mm wide, with mucro (0.4)0.7-0.9(1.4) mm long, sericeous, with appressed, eglandular hairs 0.2-0.8 mm long and, usually, patent, glandular hairs 0.3-0.9 mm long on the abaxial surface. *Petals* (8)11.1-13.3(15.1) mm long, (4.8)5.9-10.1(12.6) mm wide, rounded or emarginate (notch 0.4-2 mm deep), pink to purple, rarely white. Fig. 592.

Pollen. *Geranium*-type (Verhoeven & Venter 1992: 445).

Chromosome number. Unknown.

Phenology. Collected in flower from September to May.

Distribution. This subspecies ranges through Lesotho, Free State, KwaZulu-Natal and Eastern Cape, in South Africa (Fig. 591).

Habitat. Damp and grassy or rocky slopes; 1350-3200 m.

Additional specimens examined. **Lesotho.** LERIBE: Ha Mohab, Jan. 1996, *Edwards 1370* (NU); Malibamatso, Ha Poli N bank of Malibamatso River, S of LHDA guest house, 29°9'S, 28°29'E, 27 Apr. 1995, *Braun 2080* (PRE); Bokong, Katse, E of Katse village, E of Maliba-Matso river, 29°19'S, 28°29'E, 11 Dec. 1995, *Braun 2182* (PRE); Bokong, Katse, E of Katse village, E of Maliba-Matso river, 29°19'S, 28°29'E, 11 Dec. 1995, *Braun 2200* (PRE); Bokong, Katse, E katse village and SE of Katse lodge, 29°20'S, 28°29'E, 6 Dec. 1995, *Braun 2115* (MO, PRE); Maliba-Matso, SE side of Thabana-li-mele, 29°9'S, 28°29'E, 7 Dec. 1995, *Braun 2130* (MO, PRE); Leribe district, upper waters of Mokhoulane River, 29°9'S, 28°25'E, 13 Jan. 1996, *Phillipson & al. 4570* (K, MO). MOKHOTLONG: between Oxbow and Mokhotlong, 29°17'S, 29°3'E, 15 Jan. 1973, *Werger 1637* (PRE); Basutoland, between Indumeni Dome and Castle Buttress, 29°0'S, 29°10'E, 5 Dec. 1952, *Killick 1844* (K, PRE); MASERU: 100 m below Blue Mountain Pass, 29°25'S, 27°51'E, 24 Dec. 1980, *Schmitz 9162* (MO, NU); 32 km E of Thaba Putsoa, 29°35'S, 28°3'E, 20 Mar.

1983, *Halliwell 5057* (PRE). Qacha's Nek: Sehlabathebe, slopes of Thaba Ntso below Tsenola, just outside of the National Park fence, 29°51'S, 29°4'E, 22 Feb. 1979, *Hoener 2183* (MO, PRE); Fikalemotho, 30°3'S, 28°28'E, Feb. 1914, *Jacottet s.n.* (Z); near Qacha's Nek, Rapase, 30°8'S, 28°40'E, 10 Mar. 1936, *Galpin 14087* (BOL, PRE). Thaba-Tseka: top of Sany Pass, 29°35'S, 29°17'E, 11 Dec. 1983, *Brophy 19* (NU). **South Africa.** Eastern Cape: Barkly East district, old lady Grey road, above Kraai River, 29°35'S, 29°20'E, 29 Nov. 1981, *Hilliard & Burtt 14570* (K, NU, PRE); Barkly East district, Ben Mcdhui, 30°40'S, 27°57'E, 5 Feb. 1983, *Hilliard & Burtt 16448* (K, NU); Barkly East district, Beddgelert, lower slopes Avoca, 30°43'S, 27°34'E, 5 Dec. 1981, *Hilliard & Burtt 14714* (PRE); Graaf Reinet district, Oudeberg, 32°53'S, 24°55'E, Dec. 1867, *Bolus 148* (K). Free State: WSW od Clarens, SE of Drie Susters peaks, farm Dunblane, 28°30'S, 28°25'E, 14 Mar. 1972, *Scheepers 1867* (K, MO, PRE); Witzieshoek, footpath to Sentinel, 28°31'S, 28°48'E, 27 Dec. 1975, *Hilliard & Burtt 8649* (MO, NU); Witzieshoek, footpath to Sentinel, 28°31'S, 28°48'E, 2 Feb. 1982, *Stewart & Maning 2243* (K). KwaZulu-Natal: Underberg district, 5-7 mi NNW of Castle View farm, headwaters Mlahlangubo River, 28°33'S, 29°27'E, 23 Jan. 1983, *Hilliard & Burtt 15340* (K); Drakensberg Royal Natal National Park, above Sentinel Car Park, 28°43'S, 28°53'E, May 2014, *Brochmann CB64* (NU); Mont-aux-Sources, 28°44'S, 28°53'E, Apr. 1920, *Allsop 32* (PRE); Drakensberg range, Tugela valley & Mont-aux-Sources, 28°44'S, 28°53'E, 3 Apr. 1934, *Humbert 15122* (MA); Bergville, Royal Natal National park, Mont-aux-Sources, 28°44'S, 28°53'E, 20 Feb. 1964, *Trauseld 196* (PRE); Drakensberg, Giant's Castle, Bushmans Pass, 29°17'S, 29°26'E, 28 Dec. 1914, *Symons 241* (PRE); Estcourt district, Giant's Castle, 29°20'S, 29°28'E, 11 Dec. 1973, *Wrigth 1617* (K, MO, NU); Kamberg area, farm Game Pass, 29°22'S, 29°39'E, 7 Nov. 1982, *Hilliard 8203* (NU, PRE); Underberg, Highmoor Forest Station, on Little Berg, 29°23'S, 29°35'E, 14 Jan. 1966, *Killick & al. 3591* (K); Mpendhle district, Kamberg, Storm Heights, 29°25'S, 29°39'E, 14 Dec. 1978, *Hilliard & Burtt 11748* (K, MO, NU); Underberg district, Sani Pass, valley N of Police Post, 29°35'S, 29°20'E, 15 Dec. 1984, *Hilliard & Burtt 18000* (K, MO, PRE); Underberg district, Sani Pass, valley N of Police Post, 29°35'S, 29°20'E, 15 Dec. 1984, *Hilliard & Burtt 18001* (NU); Underberg district, Sani Pass, 29°35'S, 29°20'E, 17 Jan. 1976, *Hilliard & Burtt 8853* (MO); Underberg district, Sani Pass, near top, 29°35'S, 29°17'E, 19 Jan. 1976, *Hilliard & Burtt 8880* (NU); Underberg district, Cobham Forest reserve, Lakes cave area, 29°40'S, 29°20'E, 15 Dec. 1987, *Manning & al. 16065* (NU).

Discussion. Geranium incanum subsp. *magniflorum* differs from subsp. *incanum* in its somewhat thicker rhizome and its ascending habit. The basal leaves of subsp. *magniflorum* remain grouped at the base of the stem forming a rosette-like which gives it a very characteristic appearance. The leaf is very similar to that of the subsp. *incanum*, palmatisect, with very narrow, revolute, linear lobes and discolorous. Leaf lobes are most often entire but can also be pinnate. The subsp. *magniflorum* frequently has glandular hairs on the inflorescence while subsp. *incanum* is always eglandular. The sepal mucro of subsp. *magniflorum* is somewhat shorter than that of subsp. *incanum* but with some overlap.

In *Hilliard & Burtt 18000* (K, PRE) collection, the basal leaves are almost palmatisect, while the stem leaves are like those of other more typical specimens of subsp. *magniflorum;* otherwise, it fit very well with the current concept of subsp. *magniflorum*. The specimen *Bolus 148* (K) lacks the basal part of the plant and shows leaves which are not clearly sericeous abaxially but, in accordance with Hilliart & Burtt (1985: 195), it is provisionally included here under subsp. *magniflorum*.

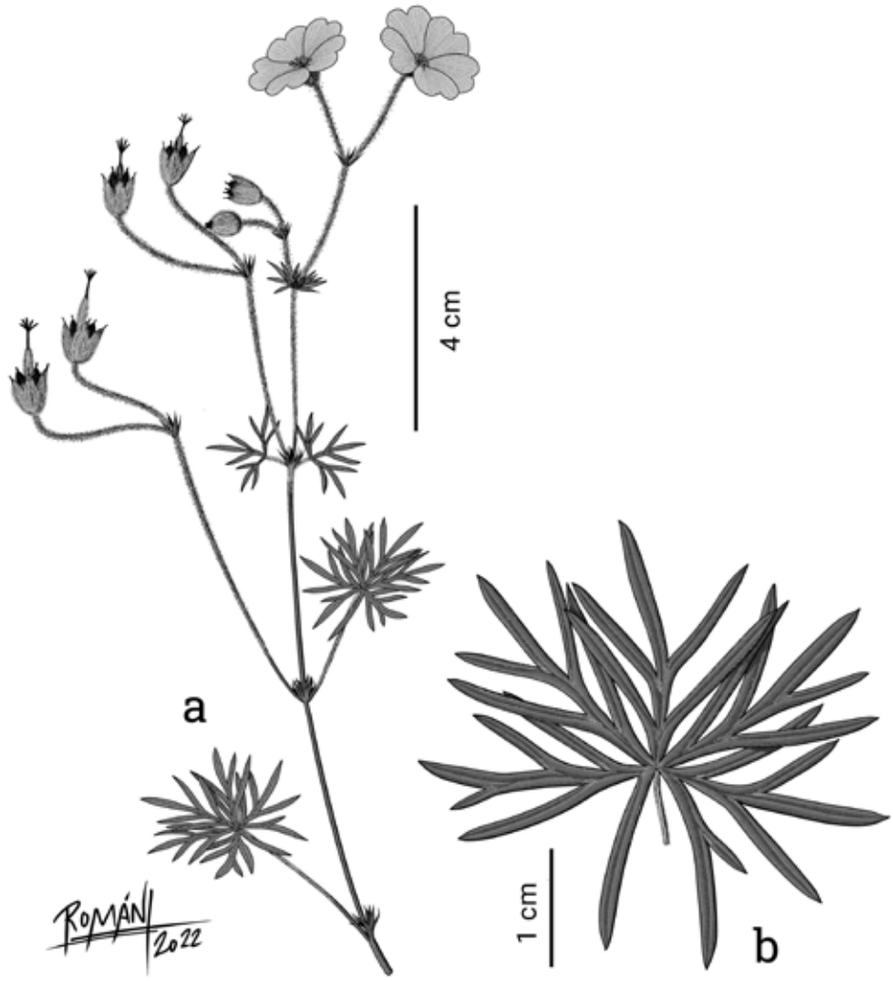


Fig. 592. *Geranium incanum* subsp. *magniflorum*. a. Fragment of the habit. b. Leaf. (Based on: *Wrigth 2012*, NU).

Because the holotype *G. magniflorum* is no longer extant, a neotype is designated. The neotype here chosen matches the original description, and was collected in the same region as indicated in the protologue.

233c. Geranium incanum subsp. **nyassense** (R. Knuth) J.R. Laundon, Bol. Soc. Brot. ser. 2, 35: 63. 1961. *Geranium nyassense* R. Knuth, Repert. Spec. Nov. Regni Veg. 18: 289. 1922, [31 Dec. 1922]. Type locality: "Nyassa-Hochland: Station Kyimbila, 1800 m (Stolz a. 1912, no. 1389 - Typus in herb. Berol.!)". Type: Tanzania. Nyassa-Hochland, Station Kyimbila, 09°16'S, 33°39'E, 26 June 1912, *A.F. Stolz 1389* (holotype, B destroyed; lectotype, here designated, B-101043895!; isotypes, C!, G-412280!, JE!, K-000417215!, M-0108610, NU-0015560-0, S-05-9468, W!, Z-181323!).

Geranium ukingense R. Knuth, Repert. Spec. Nov. Regni Veg. 18: 292. 1922. Type locality: "Südlichstes Deutsch-Ostafrika: Ukingaberge, 2400 m, Mwakalilaland, auf Bergwiesen (Stolz a. 1913, no. 2060.-Typus in Herb. Berol.!)". Type: Tanzania. Ukingaberge, Mwakalilaland, 7°38›S, 36°21›E, *A.F. Stolz 2060* (holotype, B destroyed; lectotype, here designated, MO-891470!; isotypes, B-101068542!, C!, BM-000796987!, G-412284!, PR-9977!, PRE-0594448-0 image!).

Stem procumbent to ascending, with retrorse, usually appressed, eglandular hairs 0.3-0.6 mm long. Basal leaves not present (no rosette); middle leaf segment rhombic (with narrow linear lobes 0.7-2.3(2.7) mm wide), (0.4)0.5-0.8(0.9) mm wide at the base. *Peduncles* (18)21-78(79) mm long, with retrorse, ± appressed, eglandular hairs 0.2-0.4 mm long and, usually, patent, glandular hairs 0.3-0.5 mm long; pedicels (13.7)18.7-32(42.2) mm long, with retrorse, ± appressed, eglandular hairs 0.1-0.5 mm long and, usually, patent, glandular hairs 0.2-0.6 mm long. *Sepals* (4.4)4.6-6.6(8.3) mm long, 1.6-2.7 mm wide, with mucro (0.7)0.9-1.2(1.4) mm long, sericeous, with appressed, eglandular hairs 0.1-0.5 mm long and, usually, patent, glandular hairs 0.2-0.8 mm long on the abaxial surface. *Petals* (5.2)7.4-10(13.6) mm long, (3.1)3.4-5.8(7.5) mm wide, rounded or, rarely, emarginate (notch 1.4-2.2 mm deep), white to lilac. Fig. 593.

Pollen. *Geranium*-type (Verhoeven & Venter 1992: 441, 442).

Chromosome number. Unknown.

Phenology. Collected in flower from January to December.

Distribution. This subspecies ranges from southern Tanzania to Zimbabwe and northern South Africa (Figure 591).

Habitat. Grassland near streams and on damp forest edges; 900-2700 m.

Additional specimens examined. **Malawi.** Northern: Nyika Plateau, 10°34'S, 33°44'E, 31 Aug. 1969, *Fitzpatrick 91* (BM); Nyika Plateau, near Government Rest House, 10°34'S, 33°44'E, 17 Aug. 1962, *Ingles 37* (BM); North Nyasa district, Nyika Plateau, 10°37'S, 33°48'E, 12 Aug. 1946, *Brass 17189* (BM, GH, NY); Northern Region, Nkhata Bay district, S Vipya Plateau, 58 km SW of Mzuzu on road to Chikangawa, 11°5'S, 33°58'E, 9 May 1970, *Brummitt 10537* (PRE); Nkhata Bay district, 12.5 mi NE of Chikangawa, 11°53'S, 33°54'E, 20 Aug. 1978, *Phillips 3803* (Z). **Mozambique.** Manica: Manica e Sofala, Tsetserra, 19°22'S, 32°48'E, 7 Feb. 1955, *Exell & al. 248* (BM). Sofala: Gorongoza, Gogogo mountains, 18°25'S, 34°2'E, 5 July 1955, *Schelpe 485* (BOL); Gorongosa National Park, Gogogo summit area, 18°25'S, 34°2'E, July 1970, *Tinley 1962* (M). **South Africa.** Limpopo: Sibasa, 22°56'S, 30°28'E, 25 Dec. 1935, *Smuts & Gillett 3282* (PRE). **Tanzania.** Iringa: Iringa district, Kibengu,

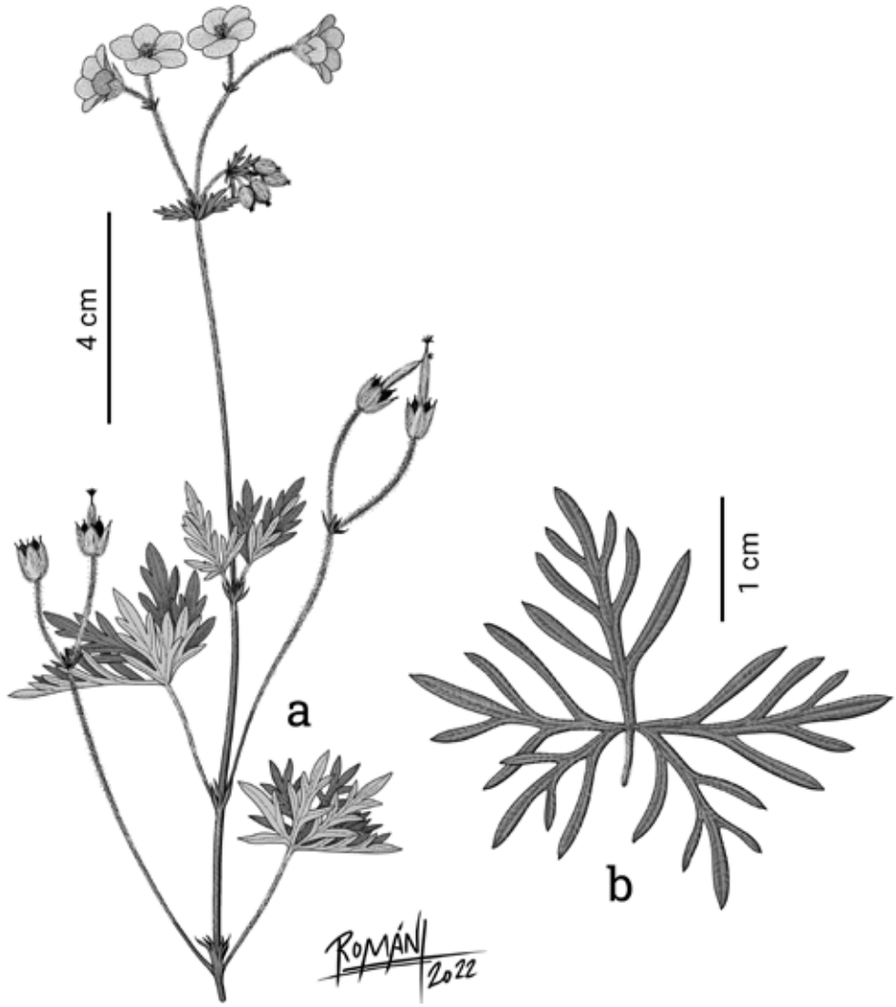


Fig. 593. *Geranium incanum* subsp. *nyassense*. a. Fragment of the habit. b. Leaf. (Based on: a, *Zerny 73,* W; b, *Polhill & Paulo 1500,* B).

18 mi S of Dabaga, Dabaga Highlands, 8º7'S, 35º55'E, 16 Feb. 1962, *Polhill & Paulo 1500* (B); Mufindi district, Livalonge Tea Estate, 8º36'S, 35º17'E, 25 Aug. 1921, *Perdue 11244* (M); Iringa district, Kiban, Kigogo, 8º39'S, 35º13'E, 4 May 1968, *Renvoize & Abdallah 1894* (B). Mbeya: Rungwe district, Sawago Forest, 2 km W of Igoma on top of Mporoto Ridge, 9º0'S, 33º39'E, 4 June 1992, *Gereau & Kayombo 4577* (UPS); Rungwe district, Ngozi Poroto Mountains, 9º0'S, 33º45'E, 17 Oct. 1956, *Richards 6552* (B); Rukwa, N slopes of Rungwe Mt., 9º7'S, 33º41'E, 9 Nov. 1966, *Gillett 17668* (UPS); Rukwa, Rungwe Mt., 9º7'S, 33º41'E, 25 May 1971, *Mhoro 1412b* (UPS). Njombe: Iringa province, Makete distr., Kitulo plateau, 18 km S of Matamba village, 9º0'S, 33º54'E, 27 Feb. 2001, *Wiland & Mboya 139* (MO); Southern Highlands Province, Ndumbi Forest Reserve, 9º2'S, 34º2'E, Mar. 1954, *Semsei 1645* (B); Njombe district, Elton Plateau, 9º4'S, 33º54'E, 7 Jan. 1957, *Richards 7563* (B); Rungwe district, top ridge of Livingstone Mountains on trail from Bumbigi to Kitulo, 9º10'S, 33º54'E, 27 Feb. 1991, *Gereau & Kayombo 4082* (UPS); Njombe district, Kipengere, 9º17'S, 34º26'E, 12 Jan. 1957, *Richards 7706* (B); Njombe district, Mdapo, 9º20'S, 34º46'E, Mar. 1954, *Semsei 1658* (B); Njombe district, Njombe-Songea road, 9º26'S, 35º15'E, 28 Feb. 1963, *Richards 14664* (B). Ruvuma: Songea district, Matengo Hills, 1 km NW of Miyau, 10º57'S, 34º56'E, 28 May 1956, *Milne-Redhead & Taylor 10471* (B); Matengo-Hochland von Songea, 10º57'S, 34º56'E, 26 Nov. 1935, *Zerny 73* (W). **Zambia.** Muchinga: Nyika plateau, Government Rest House, 10º34'S, 33º44'E, 17 Aug. 1962, *Ingles 36* (BM). **Zimbabwe.** Manicaland: Inyanga distric, heat above Troutbeck Inn, 18º11'S, 32º49'E, 25 Mar. 1968, *Dahlstrand 82* (GB, H); Inyanga, 18º12'S, 32º44'E, Jan. 1919, *Eyles 1440* (BM); Inyanga, 18º12'S, 32º44'E, 3 Mar. 1960, *Head 276* (BM); Inyanga, 18º12'S, 32º44'E, 19 Oct. 1946, *Rattray 892* (NY); Inyanga, 18º12'S, 32º44'E, 19 Oct. 1946, *Wild 1384* (LD); Inyanga, 3 km W versus montis Inyangani, 18º14'S, 32º40'E, 6 Dec. 1930, *Fries & al. 3477* (LD, NY); Inyanga, montis Inyangani, 18º14'S, 32º40'E, 7 Dec. 1930, *Fries & al. 3573* (LD, M); Inyanga, Inyangani mt., 18º14'S, 32º40'E, 24 May 1998, *Poilecot 8054* (G); Inyanga, pr. collem Kuhera, 3 km S pago Inyanga, 18º17'S, 32º50'E, 20 Nov. 1930, *Fries & al. 3092* (LD); Inyanga, Inyangani mt., 18º17'S, 32º50'E, 25 Oct. 1946, *Sturgeon 16967* (NY); Inyanga, Nyangani, 18º22'S, 32º46'E, 26 Nov. 1949, *Chase 1831* (NY); Inyanga, pr. fluminis Pungwe, 18º24'S, 32º46'E, 6 Nov. 1930, *Fries & al. 2686* (MO); Inyanga, pr. fluminis Pungwe, 18º24'S, 32º46'E, 6 Nov. 1930, *Fries & al. 2740* (LD); Inyanga, Mtarazi falls, 18º28'S, 32º47'E, 1 Apr. 1949, *Chase 1284* (BM, NY); Umtali, below Elephant Forest, Vumba Mts., 19º7'S, 32º46'E, 13 Dec. 1955, *Drummond 5093* (BM); Manicaland, Chimanimani mountains, Bundi River, 19º47'S, 33º1'E, 6 May 2013, *Buira 1852* (MA); Melsetter district, near Residency shrubbery, 19º48'S, 32º52'E, 3 Sep. 1950, *Brook M119* (NY); Melsetter district, Bundi Valley, Chimanimani, 19º48'S, 32º52'E, 15 Nov. 1959, *Goodier 634* (BM); Chipinga-Mutare, 20º11'S, 32º37'E, 14 Jan. 1993, *Prässl 317* (WU).

Discussion. *Geranium incanum* subsp. *nyassense* differs from subsp. *incanum* in its leaf shape and its indumentum. The leaf is very similar to that of the subsp. *incanum*, being palmatisect, and discolorous, but their leaf lobes are usually linear-lanceolate, not revolute and not as narrow as in subsp. *incanum*. However, scattered throughout the *nyassense* area there are specimens with very narrow and revolute lobes [e.g.: *Gereau & Kayombo 4082* (UPS), *Polhill & Paulo 1500* (B), *Richards 7563, 7706* (B), *Semsei 1658* (B), *Soltz 2599* (NY), *Slotz 2060* (B, C, G, PR)] or, sometimes, with a part of the leaves of linear-lanceolate and not revolute lobes. These samples are difficult to separate from subsp. *incanum*, which reinforces the hypothesis that they are not independent species in spite of the geographical separation. The subsp. *nyassense* frequently has glandular hairs on the inflorescence while subsp. *incanum* is always eglandular. The petals of subsp. *nyassense* are somewhat shorter than those of subsp. *incanum* but with some overlap, and frequently, not emarginate.

Geranium incanum subsp. *nyassense* shares with subsp. *magniflorum* the indumentum of the inflorescence, frequently glandular, but differs from it in the leaf shape and in the arrangement of lower leaves. In subsp. *magniflorum* the leaf lobes are similar to subsp. *incanum*, but the lower leaves remain grouped at the base of the stem forming a rosette-like. The subsp. *magniflorum* has petals somewhat longer than in subsp. *nyassense*, and more often emarginate.

The type label of *G. ukingense* shows some inconsistency with the protologue, especially in the locality. The label reads "Geranium ukingense Knuth / Nr. 2060 / Nyassa Hochland – Station Kyimbila / Seehöhe 16-1800 Meter / 1912 / leg. A. Stolz" [the handwritten part of the label has been underlined]. I have assumed that the handwritten part is the correct and that the typewritten part was from a previous label that was reused. The specimens *Stolz 1389, 2060* (B) are from the herbarium of Rudolf Gross, acquired in 1946, after Berlin herbarium fire that destroyed the corresponding holotypes. In both *G. nyassense* and *G. ukingense* a lectotype has been chosen among the available isotypes, in accordance with art. 9.12 of the Shenzhen Code.

234. Geranium multisectum N.E. Br., Bull. Misc. Inform. 1901(175/177): 120. 1901. Type locality: "South Africa. Basutoland: Machacha Mountain, alt. 9000 ft., Right Hon. J. Bryce". Type: Lesotho. Basutoland, Machache Mountain, 29°21'S, 27°53'E, May 1896, *J. Bryce s.n.* (lectotype, designated by Hilliard & Butt 1985: 191, K-000417228!).

Geranium incanum var. *glabrius* R. Knuth in Engl., Pflanzenr. IV.129 (Heft 53): 164. 1912. Type locality: "Transvaal: Haageveld bei Heidelberg (Wilms, Fl. Afr. austr. n. 180!).-Herb. Berol.". Type: South Africa. Gauteng, Transvaal, Haageveld bei Heidelberg, 26°30'S, 28°21'E, *F. Wilms 180* (holotype, B destroyed; no original material located).

Geranium incanum var. *grandicalyculatum* R. Knuth in Engl., Pflanzenr. IV.129 (Heft 53): 164. 1912. Type locality: "Transvaal: Pretoria (Wilms, Fl. Afr. austr. n. 179!). Zwischen Middelburg und dem Krokodilfluss (Wilms, Fl. Afr. austr. n. 181!).-Herb. Berol.". Type: South Africa. Gauteng, Transvaal, farm von Rensburg bei Pretoria, 26°31'S, 28°22'E, Dec. 1883, *F. Wilms 179* (holotype, B destroyed; isotypes, BM-000796981!, K-000417230!).

Geranium incanum var. *purpureum* Burtt Davy, Man. Pl. Transvaal 1: 191. 1926. Type locality: "Vleis and (moist?) grassy hillsides, E. Mts. and Highveld 4, 5: Pm! Pa! Btl! Er! Ca! Ly, Machadodorp! (Nat! O.F.S! Bas! E. Cape!) Atherstone! Pott

3592! Williams H6314! type; Rademacher H7303! Wilms 179! Zey. 160!". Type: South Africa. Mpumalanga, Transvaal, Machadodorp, 25°40'S, 30°14'E, Feb. 1909, *S. Williams 6314* (lectotype, designated by Hilliard & Burtt 1985: 191, K-000417229!; isolectotype, PRE-0762329-0).

Perennial herbs, 13-45 cm tall. *Rootstock* 2-6 mm in diameter, ± vertical, not tuberculate, not turnip-shaped, without thickened roots. *Stem* procumbent to ascending, leafy, rarely rooting on nodes, stolons absent, without vegetative stems, with retrorse, usually appressed, eglandular hairs 0.2-0.6 mm long. *Basal leaves* sometimes in a ± persistent rosette, cauline leaves alternate and upper opposite; leaf laminas (0.9)1.5-2.2(2.9) cm long, 0.9-3.3 cm wide, not peltate, palmatisect, polygonal in outline, base cordate, not coriaceous, with nerves not projected, with appressed, eglandular hairs on the adaxial surface and sericeous (rarely also with patent, glandular hairs) abaxially; segments 5, in more than 1 plane, middle segment rhombic (with narrow linear lobes (0.3)0.4-0.7(0.8) mm wide), 0.3-0.5(0.6) mm wide at the base [ratio segment width at the base/middle segment length = (0.02)0.03-0.04(0.05)], 33-65-lobed in distal half [ratio secondary sinus length/middle segment length = (0.34)0.38-0.51(0.59)]; petioles up to 13 cm long, without abscission zone, terete, not swollen, not deflexed in age, with usually retrorse, appressed, eglandular hairs 0.2-0.5 mm long; stipules 3.5-7.9 mm long, 1.4-5.8 mm wide, 2-4(5)-fid, with linear lobes 2.2-5.6 mm deep, 0.2-1 mm wide, free, papery, brown, with eglandular hairs on abaxial surface, ± glabrous adaxially. *Inflorescence* a monochasial cyme; cymules 2-flowered, solitary [ratio cymule length/leaf length = 1.5-8.8]; peduncles (23)34-63(92) mm long, with patent to retrorse, uncinate, eglandular hairs 0.2-0.7 mm long and, usually, patent, glandular hairs 0.3-0.7 mm long; bracteoles 3.8-6.1 mm long, 0.6-1.6 mm wide, linear-lanceolate, whorled; pedicels (15)23-36(38) mm long, with patent to retrorse, uncinate, eglandular hairs 0.2-0.4 mm long and, usually, patent, glandular hairs 0.3-0.8 mm long. Flowers actinomorphic. *Sepals* (5.8)6.4-7.6(7.8) mm long, 1.8-3.5 mm wide, lanceolate, smooth, not accrescent, nerves 3, mucro (0.2)0.4-0.6(0.9) mm long [ratio mucro length/sepal length = (0.04)0.06-0.10(0.13)], sericeous, with ± appressed, eglandular hairs 0.2-0.4 mm long and, usually, patent, glandular hairs 0.3-0.8 mm long on the abaxial surface, glabrous adaxially. *Petals* (10.7)12.2-14.8(16.6) mm long, (6)7.5-10.6(15.9) mm wide, erect-patent, emarginate (notch 0.6-1.7 mm deep), without claw, purple, hairy on the base of the adaxial surface, glabrous abaxially, ciliate on the basal margin, with hairs 0.3-0.6 mm long. *Stamens* 10, both whorls bearing anthers; filaments (3.2)3.9-5(6.1) mm long, lanceolate, pink, with scattered eglandular hairs 0.2-0.3 mm long on the abaxial surface and margin; anthers 1.4-1.8 mm long, purple. Nectaries 5, hemispheric, usually with a tuft of hairs at the top, dorsally glabrous. *Gynoecium* 4,5-7.7 mm long, purple. *Fruit* (22)23-26(28.9) mm long, erect, discharge of seed-ejection type; mericarps 3.4-4 mm long, 1.7-2.2 mm wide, without a strand of fibers, not compressed at the apex, smooth, without basal beak, with a basal callus, without a basal prong, brown, with erect-patent, eglandular hairs 0.3-0.8 mm long and usually, patent, glandular hairs 0.7-0.8 mm long; rostrum 14-20 mm long, with a narrowed apex 1.2-4.3 mm long, not twisted, with ± patent, eglandular hairs 0.2-0.4 mm long and usually, patent, glandular hairs 0.4-0.8 mm long; stigmatic remnants 2.4-4.2 mm long, with 5 glabrous lobes. *Seeds* 2.2-2.7 mm long, 1.5-2 mm wide, finely reticulate, uniformly colored, brown, glabrous. Cotyledons with entire margin. Figs. 594, 595.

Pollen. *Geranium*-type (Verhoeven & Marais 1990: 167; Verhoeven & Venter 1992: 445).

Chromosome number. Unknown.

Phenology. Collected in flower from October to July.

Distribution. This species ranges from Eastern Cape, through Lesotho, KwaZulu-Natal and Free State to Gauteng and Mpumalanga, in South Africa (Fig. 596).

Habitat. Grassland, marshy places and along streamlines; 1250-3100 m.

Representative specimens examined. **Lesotho.** Berea: Mamalapi, 29°15'S, 29°50'E, 19 Jan. 1957, *Marais 1290* (K). Butha-Buthe: Khatibe Camp, 1.5 mi from Ox Bow, above Tschlanyane river, 28°43'S, 28°30'E, 19 Jan. 1962, *Lubke 229* (Z, K, M); 5 km from New Oxbow Inn on road to S, 28°46'S, 28°38'E, 5 Feb. 1987, *Killick 4492* (MO); on Butha-Buthe to Lenberg road, 6 km before Mothae mine turn-off, 28°46'S, 28°14'E, 24 Jan. 1984, *Richardson 232* (NU). Leribe: Makika Lisiu Pass, 29°3'S, 28°24'E, 10 Jan. 1996, *Phillipson & al. 4397* (MO). Maseru: 4 km beyond Blue Mountain Pass, 29°25'S, 27°51'E, 23 Jan. 1987, *Backéus 2075* (UPS); Basutoland, Morija, 29°37'S, 27°30'E, Oct. 1914, *Jacottet 44* (Z); Bushman's Pass, 29°43'S, 27°56'E, 25 Nov. 1982, *Richardson 203* (NU); Bushman's River Valley, 29°43'S, 27°56'E, 21 Oct. 1907, *Wood 10564* (MO). Qacha's Nek: Sehlabathebe, Cave Sandstone, 29°52'S, 29°3'E, 4 Jan. 1973, *Guillarmod & al. 269a* (K, MO). Thaba-Tseka, Sani Top, 29°35'S, 29°17'E, 10 Feb. 2013, *Buira 1768* (MA); Sani Top, 29°35'S, 29°17'E, 1 Jan. 1974, *Hilliard 5427* (K, MO, NU); escarpment S of Sani Pass, 29°35'S, 29°17'E, 18 Jan. 1976, *Hilliard & Burtt 8866* (K, MO). **South Africa.** Eastern Cape: Barkely East district, Ben McDhui, 30°40'S, 27°57'E, 3 Feb. 1983, *Hilliard & Burtt 16377* (K, NU); estacion de sky de Tiffindell, 30°41'S, 27°58'E, 17 Jan. 2008, *Aedo & al. 15171* (MA); Naude's Nek, 30°43'S, 28°8'E, 13 Feb. 1983, *Hilliard & Burtt 16591* (NU); Drakensberg's, near Barkly East, 2 km E of Cairntoul, near Naudes Nek, 30°43'S, 28°8'E, 19 Dec. 1982, *Phillipson 689* (MO); Naude's Nek Pass, 30°43'S, 28°8'E, 28 Jan. 1986, *Steiner 1146* (MO); Maclear district, Naude's Nek, 30°43'S, 28°8'E, 13 Dec. 1926, *Stewart 1902* (K); Saalboom Nek, 13.4 mo SSE of Clifford, 30°57'S, 27°27'E, 15 Jan. 1959, *Acocks 20181* (M, K); Barkely East-Elliot district, Saalboom Nek, 30°57'S, 27°27'E, 21 Jan. 1979, *Hilliard & Burtt 12307* (K, NU); pr. Barkly Pass, 31°12'S, 27°50'E, 17 Jan. 2008, *Aedo & al. 15092b* (MA); Elliot, farm Radobil, Otto du Plessis Pass, 16 km N of Ida, 31°14'S, 27°31'E, 16 Dec. 1993, *Bester 2117* (K); Elandsberg, 32°26'S, 26°27'E, 17 Jan. 1986, *Norris 3218* (NU); Amatole Moun-

tains, Elandsberg, 32°31'S, 26°54'E, 1 Jan. 1984, *Phillipson 799* (MO, UPS); in summit montis Boschberg, 32°41'S, 25°32'E, Nov., *MacOwan 1071* (WU). Free State: Drakensberg Botanise Tuin, 6 Dec. 1979, *Jacobsz 2263* (PRE); Harrismith district, Platberg, escarpment above Zig-Zag path, 28°13'S, 30°12'E, 14 Dec. 1976, *Hilliard & Burtt 9535* (NU, K, MO); Witzieshoek, 28°31'S, 28°48'E, Mar. 1917, *Junod s.n.* (G); Smaldeel, Glen Agricultural College, N of Bloemfontein, 30°12'S, 26°21'E, Nov. 1906, *Rogers s.n.* (PRE). Gauteng: Johanesburg district, Comaro street where it meets junction of Denington road, 26°18'S, 28°4'E, July 2009, *Burgoyne 10895* (PRE); Vereeniging district, between Walkerville and Kliprivier, 26°25'S, 28°1'E, 23 Nov. 2007, *Bester 8262* (K, MO); Johanesburg, Suikerbosrand, 26°30'S, 28°13'E, 20 Nov. 1971, *Bredenkamp 314* (PRE). KwaZulu-Natal: Bergville division, Drakensberg, 1 mi S of Beacon Buttress, 28°44'S, 28°53'E, 2 Dec. 1951, *Schelpe 3056* (BM); Mpendle district, 2 mi along Runnymead Road, 29°8'S, 29°42'E, 26 Feb. 1964, *Moll 656* (K, M, NU); Lions River district, Nottingham Road, 29°21'S, 29°59'E, Nov. 1963, *Hilliard 1981* (NU); Mpendhle district, Highmoor forest reserve Ridge SE of Giant's Castle, headwaters of Elandshoek river, 29°23'S, 29°35'E, 6 Jan. 1983, *Hilliard & Burtt 12261* (NU, K); Sani Pass, 29°35'S, 29°17'E, 14 Jan. 2008, *Aedo & al. 14987* (MA). Mpumalanga: Wemmershoek, Lydenburg-Dullstroom road, 25°5'S, 30°27'E, 11 Jan. 1960, *Strey 3144* (M, UPS); Belfast district, 10 m NE of Machadodorp on road to Lydenburg, 25°40'S, 30°14'E, 14 Nov. 1947, *Codd & de Winter 3359* (PRE); Belfast, 25°41'S, 30°2'E, 31 Jan. 1929, *Hutchinson 2731* (K); Belfast district, 5 mi NW of Belfast, 25°41'S, 30°2'E, 12 Dec. 1955, *Leistner 523* (K, UPS); Carolina, 26°4'S, 30°6'E, Feb. 2006, *Edwards 3403* (NU); Middelburg, 3 mi from Hendrina to Ermelo, 26°9'S, 29°42'E, 9 Nov. 1966, *Marsh 112* (PRE); Clarence, 26°15'S, 30°40'E, Nov. 1917, *Van Hoepen 10171* (PRE); Kriel area, 2.5 km SE of Matla Power Statiom, 26°17'S, 29°8'E, 9 Nov. 2007, *Gotze 31* (PRE); Bethal, 26°25'S, 29°27'E, 14 Dec. 1910, *Leendertz 9390* (PRE); Ermelo Spitskop, 26°28'S, 29°55'E, Dec. 1915, *Pott s.n.* (PRE); Middelburg district, farm Welverdiend, 27°18'S, 29°41'E, 18 Mar. 1981, *Hilliard & Burtt 14412* (K, PRE); Wakkerstroom, Town lands, 27°21'S, 30°8'E, 17 Nov. 1916, *Beeton 41* (PRE).

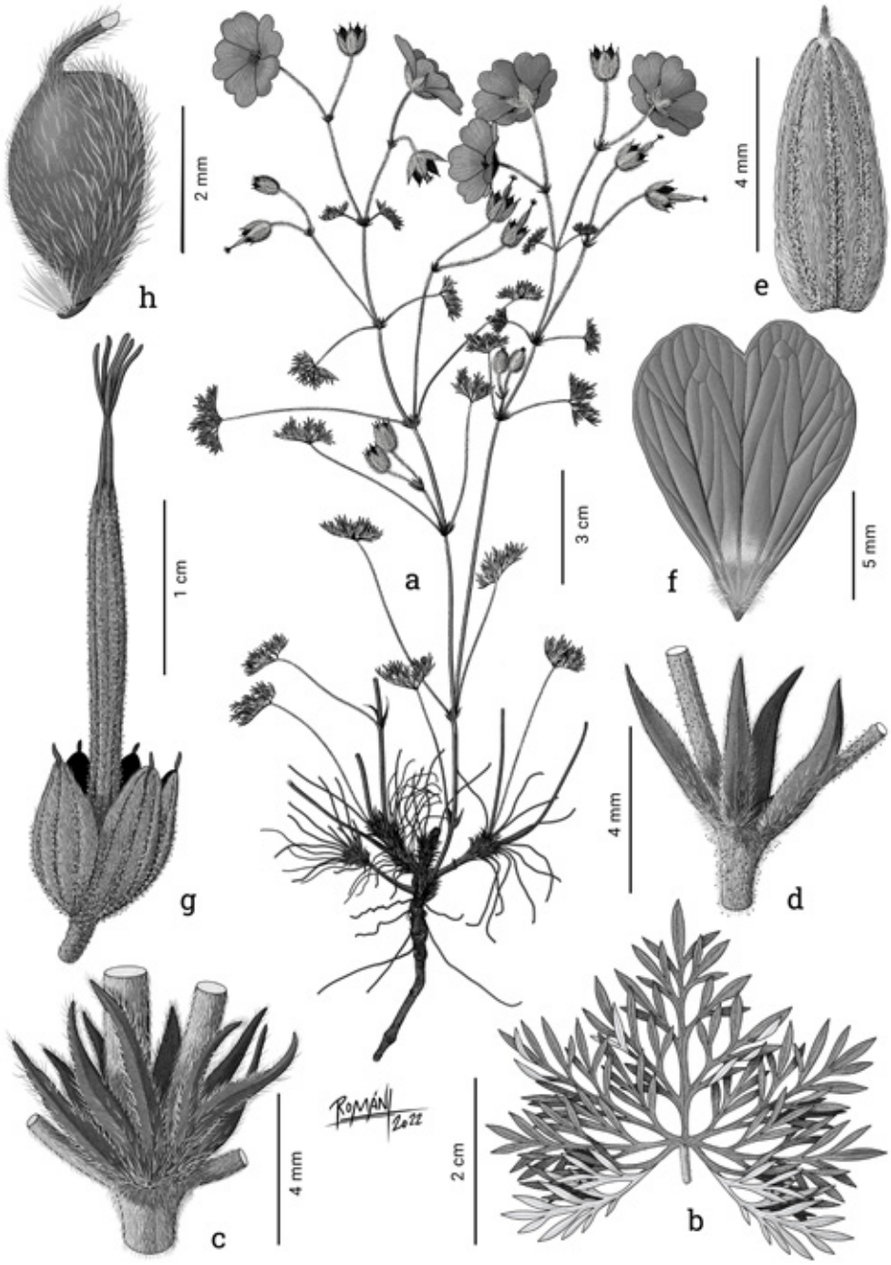


Fig. 594. *Geranium multisectum*. a. Habit. b. Leaf. c. Stipules. d. Bracteoles. e. Sepal. f. Petal. g. Fruit. h. Mericarp. (Based on: a, c-e, *Aedo & al. 14987,* MA; b, g, *Hilliard & Burtt 16261*, PRE; f, h, *Aedo & al. 15092bis*, MA).

Discussion. Geranium multisectum is a procumbent to ascending herb with a thin vertical rootstock branching from the base into multiple aerial stems, and with thin roots. According to Hilliard & Burtt (1985: 191) stems sometimes root when in contact with the ground which has been verified in some herbarium specimens. Hilliard & Burtt (1985: 191) indicated that basal leaves are tufted like in *G. incanum* subsp. *magniflorum*. However, in the specimens studied only occasionally are leaves gathered in a basal rosette. The palmatisect leaves of *G. multisectum* have segments divided in short, narrow and revolute lobes that are pinnate. *Geranium multisectum* is quite similar to *G. incanum*, with which it has sometimes been confused. In *G. incanum* the leaves are arranged in a single plane while in *G. multisectum* the lateral lobes of the middle seg-

Fig. 595. *Geranium multisectum* (Based on: *Aedo & al. 15092b,* MA).

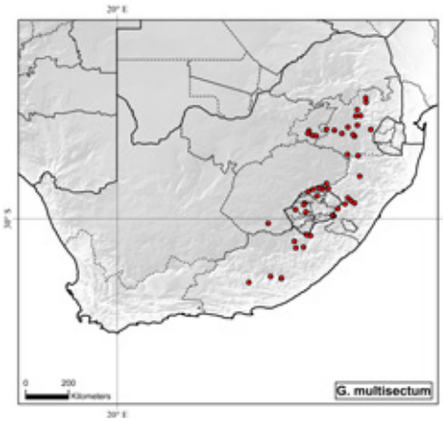


Fig. 596. Distribution of *Geranium multisectum*.

ment are pinnate and ± perpendicular to the plane formed by the segments, which gives the leaf a much entangled appearance when it dries. The leaves of *G. multisectum* are covered by ± scattered, appressed, eglandular hairs on the adaxial surface and are sericeous, with appressed, eglandular hairs, abaxially. Occasionally, glandular, patent hairs are found on both surfaces. The indumentum of stem, petioles and inflorescence usually comprises retrorse, eglandular hairs. On the inflorescence the presence of patent, glandular hairs is also frequent. The sepals are sericeous and usually have glandular hairs. The sepal mucro is very short. The petals are long and usually emarginate.

Some specimens of *G. multisectum* from Mpumalanga (northern South Africa) have leaves with narrow lobes that are not sericeous abaxially [e.g.: *Codd & de Winter 3359* (PRE), *Edwards 3403* (NU), *Hutchinson 2731* (K), *Leistner 523* (K, UPS), *Pott s.n.* (PRE-662446)]. In some this sericeous indumentum could have been lost, since there are areas covered with more or less scattered appressed hairs. In others the appressed hairs are reduced to the nerves. However, these specimens have the lateral lobes of the middle segment, ± perpendicular to the plane formed by the segments and longer petals, which distinguishes them easily from *G. vagans*.

235. Geranium vagans Baker, Bull. Misc. Inform. 1897: 246. 1897. Type locality: "British Central Africa. Nyika plateau, alt. 6000-7000 ft., Whyte". Type: Malawi. Nyika plateau, 10°40'S, 33°49'E, *A. Whyte s.n.* (lectotype, designated by Kokwaro 1971: 4, K-417217!).

Geranium whytei Baker, Bull. Misc. Inform. 1898: 302. 1898. *Geranium vagans* subsp. *whytei* (Baker) J.R. Laundon, Bol. Soc. Brot. ser. 2, 35: 71. 1961. Type locality: "British Central Africa. Mount Malosa and Mount Zomba, alt. 4000-6000 ft., Whyte". Type: Malawi. Mount Malosa, 15°15S, 35°18'E, *A. Whyte s.n.* (lectotype, here designated, K-000285638!, isolectotype, G-00412304!).

Geranium linearilobum R. Knuth, Jahresber. Schles. Ges. Vaterl. Cult. 81, II. Abt. Nat. b: 17. 1904, nom. illeg., non DC. 1815. Type locality: "Ostafrika: Uluguru, 2500 m. zwischen Pteris (Stuhlmann a. 1894!); Nyassaland, Plateau des Mt. Zomba, 15-1800 m (Whyte!)". Type: Malawi, Mt. Zomba, 15°16'S, 35°16'E, *A. Whyte s.n.* (lectotype, first-step, designated by Laudon 1961: 71, K, second-step, here designated, K-000285637 image!).

Geranium angustisectum Engl. ex R. Knuth in Engl., Pflanzenr. IV.129 (Heft 53): 207. 1912. Type locality: "Kilimandscharo: Am Fuße des Kifinika-Vulkans in einem Bestande von Erica arborea oberhalb des Gürtelwaldes (Volkens n. 1305!). In einer feuchten Schlucht oberhalb des Kiboscho-Waldes 3100 m bei Yumba ya Mbassa (Volkens n. 1534 -Typus!). Nyika Plateau (Mc Clounie a. 1903 n. 122!)". Type: Tanzania. Kilimanjaro, Kiboscho-Waldes, Yumba ya Mbassa, 3°*50›S, 37°32›E, Jan. 1894, G.L. Volkens 1534* (holotype, B destroyed; isotype, BM-000797000!, G-412293!).

Geranium schliebenii R. Knuth, Notizbl. Bot. Gart. Berlin-Dahlem 11: 1067. 1934. Type locality: "Uluguru-Gebirge: Lukwangule-Plateau, 2400 m, in der Grassavanne an sumpfigen Stellen (Blühend und fruchtend 29. Februar 1933- H.J. Schlieben n. 3486". Type: Tanzania. Morogoro, Uluguru-Gebirge, Lukwangule-Plateau, 7°*07›S, 37°37›E, 29 Feb. 1933, H.J. Schlieben 3486* (holotype?, B-101043942!; isotypes, BM-000796999!, BR-0000006245627 image!, G-00365967 image!, HBG-517282 image!, LE-00014590 image!, LISC-000726!, M-108608!, MA-383491!, P!, S-G-2852 image!).

Perennial herbs, 17-57 cm tall. *Rootstock* 5-7 mm in diameter, ± vertical, not tuberculate, not turnip-shaped, with thickened roots along the rootstock. *Stem* ascending to suberect, leafy, not rooting at nodes, stolons absent, without vegetative stems, with patent to retrorse, eglandular hairs 0.2-1 mm long and, usually, patent, glandular hairs 0.3-0.9 mm long. *Basal leaves* in a ± persistent rosette, cauline leaves alternate and upper opposite; leaf laminas (3)3.3-6(7) cm long, 3.8-8.3 cm wide, not peltate, palmatisect, polygonal in outline, base cordate, not coriaceous, with nerves not projected, with appressed, eglandular hairs and, sometimes, patent, glandular hairs on the adaxial surface and with appressed, eglandular hairs and, sometimes, patent, glandular hairs usually restricted to the nerves abaxially; segments 5, in 1 plane, middle segment rhombic (with narrow linear to linear-lanceolate lobes, 1.1-2(3.4) mm wide), (0.5)0.8-1.1(1.5) mm wide at the base [ratio segment width at the base/middle segment length = (0.02)0.03-0.04(0.06)], 6-12-lobed in distal half [ratio secondary sinus length/middle segment length = (0.31)0.37-0.45(0.65)]; petioles up to 21 cm long, without abscission zone, terete, not swollen, not deflexed in age, with patent to retrorse, eglandular hairs 0.3-1 mm long and, usually, patent, glandular hairs 0.3-0.9 mm long; stipules 5.4-11.3 mm long, 1.9-3.6 mm wide, 2-fid, with lanceolate lobes 3.8-9.4 mm deep, 0.7-1.5 mm wide, free, papery, brown, with eglandular and glandular hairs on abaxial surface, glabrous adaxially. *Inflorescence* a monochasial cyme; cymules 2-flowered, solitary [ratio cymule length/leaf length = (1.1)1.7-5.3(8.4)]; peduncles (13)35-68(80) mm long, with retrorse, uncinate, eglandular hairs 0.2-0.5 mm long and patent, glandular hairs 0.4-1.1 mm long; bracteoles 2-6.4 mm long, 0.4-1 mm wide, linear-lanceolate, whorled; pedicels (9)16-32(44) mm long, with retrorse, uncinate, eglandular hairs 0.2-0.5 mm long and patent, glandular hairs 0.4-1 mm long. Flowers actinomorphic. *Sepals* (4.7)4.8-6(6.4) mm long, 1.6-2.6 mm wide, lanceolate, smooth, not accrescent, nerves 3, mucro (0.3)0.6-1.1(1.3) mm long [ratio mucro length/sepal length = 0.08)0.13-0.20(0.23)], with appressed, eglandular hairs 0.2-0.5 mm long and patent, glandular hairs 0.5-1.2 mm long on the abaxial surface, glabrous adaxially. *Petals* (5.7)7.1-10.6(11.7) mm long, (3.5)3.9-5.5(6.3) mm wide, erect-patent, rounded, without claw, pink, rarely white, hairy on the base of the adaxial surface, glabrous abaxially, ciliate on the basal margin, with hairs 0.2-0.4 mm long. *Stamens* 10, both whorls bearing anthers; filaments (2.3)3.7-5(5.4) mm long, lanceolate, yellow, with eglandular hairs 0.2-0.3 mm long on the abaxial surface and margin; anthers 0.9-1.6(1.7) mm long, blue. Nectaries 5, hemispheric, usually with a tuft of hairs at the top, dorsally glabrous. *Gynoecium* 3.3-5.7 mm long, pink. *Fruit* (16)18-20.4 mm long, erect, discharge of seed-ejection type; mericarps 2.7-3.4 mm long, 1.3-1.7 mm wide, without a strand of fibers, not compressed at the apex, smooth, without basal beak, with a basal callus, without a basal prong, black, with ± patent, eglandular hairs 0.4-0.8 mm long and patent, glandular hairs 0.4-0.8 mm long; rostrum 12-17.3 mm long, with a narrowed apex 1-2.3 mm long, not twisted, with ± patent, eglandular hairs 0.1-0.5 mm long and, usually, patent, glandular hairs 0.4-0.7 mm long; stigmatic remnants 1.4-3.2 mm long, with 5 glabrous lobes. *Seeds* 1.9-2 mm long, 1.2-1.4 mm wide, finely reticulate, uniformly colored, brown, glabrous. Cotyledons with entire margin. Fig. 597.

Pollen. Ornamentation not studied.

Chromosome number. Unknown.

Phenology. Collected in flower from January to December.

Distribution. This species ranges from Kenya to southern Malawi (Fig. 598).

Habitat. Roadsides, grassland, along streams or in marshy places; 1800-3600 m.

Representative specimens examined. **Kenya.** Bungoma: Mount Elgon, 1º8'N, 34º33'E, May 1948, *Adamson 496* (G);

Bungoma, Mount Elgon, E slopes above Tweedie's saw-mill, 1°8'N, 34°33'E, 9 May 1948, *Hedberg 844* (UPS). Meru: Marania river, Mt. Kenia, N sector, 0°0'S, 37°23'E, 2 Aug. 1949, *Schelpe 2527* (GB); Tharaka-Nithi, Mt. Kenya, Gorges valley, along Nithi river and associated streams, 0°8'S, 37°24'E, 11 Jan. 1958, *Coe & Karika 379* (UPS). Nakuru: Naivasha district, Aberdare mountains, Naivasha-Nyeri track, 0°42'S, 36°25'E, 28 Oct. 1934, *Taylor 1395* (G, GB). Nyandarua: Mt. Aberdare, pr. Sattima oriental, 0°21'S, 36°37'E, 13 Mar. 1922, *Fries & Fries 2374* (UPS). Nyeri: Aberdare National Park, Wanderers track, Elephant Bridge, 0°23'S, 36°42'E, 19 Feb. 1979, *Jonsell & Moberg 4791* (UPS); Nyeri district, Aberdare Mountains, Chania Wasserfálle, 0°26'S, 37°0'E, 19 Sep. 1986, *Hagemann & Classen 3091* (B). West Pokot: Sekerr Mt., 1°39'N, 35°23'E, 4 Aug. 1968, *Agnew & al. 10569* (MO). **Malawi.** Northern: Nyika, lake Kaulime, 10°30'S, 33°43'E, 1 July 1986, *La Croix 3933* (MO); Chelinda, Nyika national park, Mpopoti Peak, 10°32'S, 33°52'E, 31 Mar. 2000, *Willis & Luhanga 73* (PRE); near Chelinda Camp, Nyika National Park, 10°34'S, 33°48'E, 14 Feb. 1987, *La Croix 4319* (MO); Nyika Plateau, Chelinda bridge, 10°34'S, 33°48'E, 7 Jan. 1974, *Pawek 7821* (MO); Nyika Plateau, Dembo road, 10°34'S, 33°56'E, 17 Apr. 1975, *Pawek 9300* (MO); Nyika Plateau, valley road to Chelinda, bottom of valley, 10°34'S, 33°48'E, 15 Feb. 1967, *Richards 22567* (MO, UPS); Northern region, Rumpi district, Nyika plateau, S of Kasaramba view point, 10°39'S, 33°58'E, 8 July 1970, *Brummitt 11891* (PRE); North Nyasa district, Nyika plateau, Nchena-chena Spur, 10°45'S, 33°58'E, 10 Aug. 1946, *Brass 17148* (MO, NY, US). Southern: Zomba, Zomba Plateau, Mlumbe Peak, 15°2'S, 35°16'E, 14 Apr. 1989, *Iversen & Martinsson 89238* (UPS); Zomba district, Zomba Plateau, 15°19'S, 35°16'E, 25 May 1976, *Banda 1240* (M, MO); Zomba district, Zomba Plateau, by Chingwe's Hole, 15°19'S, 35°16'E, 11 Feb. 1970, *Brummitt & Banda 8499* (PRE); Zomba plateau, Chiradzulu peak, 15°41'S, 35°10'E, 12 July 1985, *Kaunda & Salubeni 243* (NY, NY). **Rwanda.** Southern: forêt de Nyungwe, environs du Muwasenkoko, au km 67, 2°31'S, 29°20'E, 17 Feb. 1971, *Bouxin 289* (MO); Astrida, 2°36'S, 29°44'E, Mar. 1956, *Christisensen 1577* (MO). Western: au km 67 de la route Butare-Cyangugu, 2°30'S, 29°15'E, 9 Mar. 1972, *Auquier 2788* (MO). **Tanzania.** Kilimanjaro: Kilimanjaro Shura Plateau, 3°2'S, 37°14'E, 26 Jan. 1974, *Richards 28793* (M, MO); Kilimanjaro, S slope above Mweka Wildlife College, 3°8'S, 37°20'E, 19 Nov. 1967, *Hedberg 4387* (UPS). Mbeya: 17 km from Mbeya on the Chunya road, 8°54'S, 33°27'E, 2 Dec. 1974, *Aleljung 17* (UPS); Mbeya, Rungwe district, 9.3 km from Mbeya-Kyela highway on road betwwen Igoma and Kitulo, S slope of Mporoto Mountains, 9°0'S, 33°42'E, 27 Jan. 1991, *Gereau & al. 3739* (UPS); Mbeya

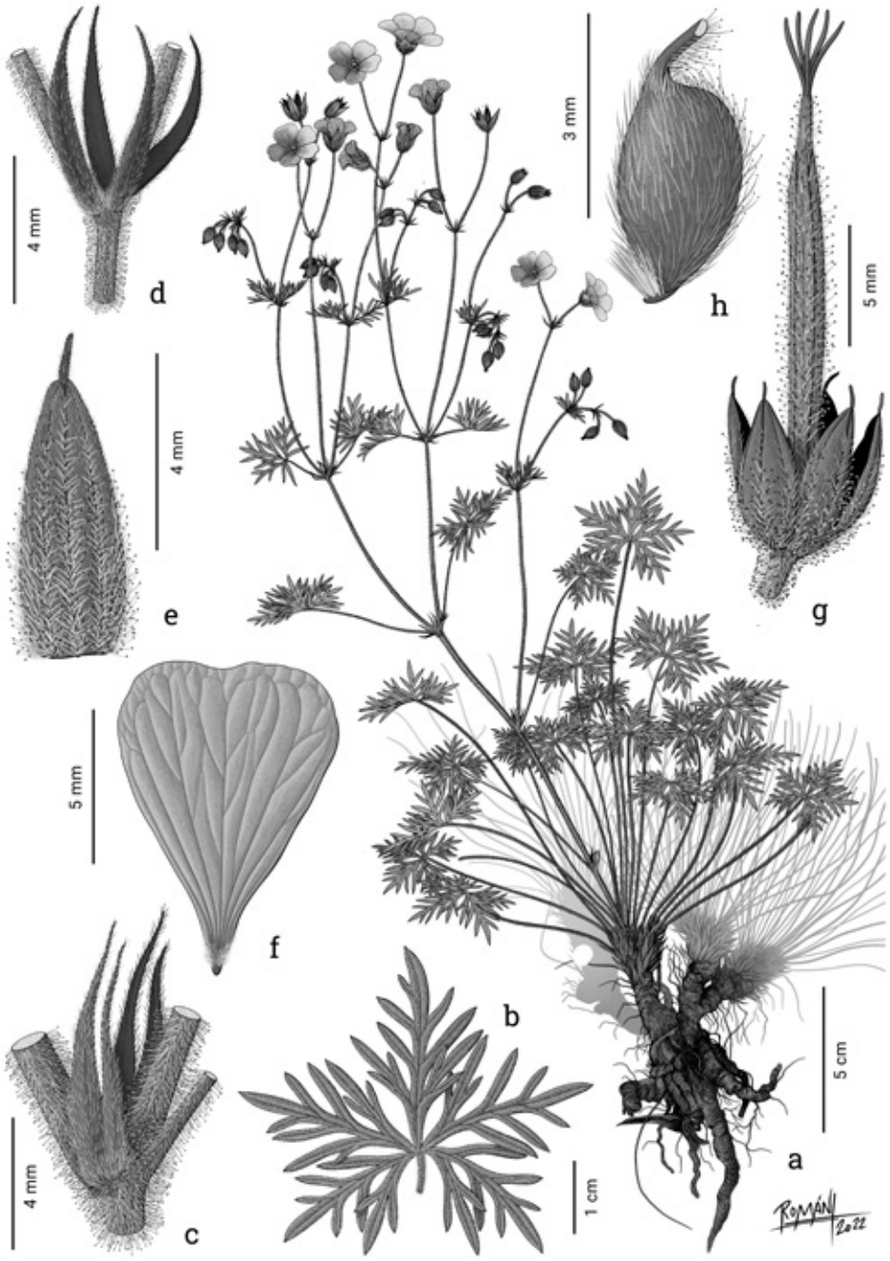


Fig. 597. *Geranium vagans*.a. Habit. b. Leaf. c. Stipules. d. Bracteoles. e. Sepal. f. Petal. g. Fruit. h. Mericarp. (Based on: a, b, d-f, *Gereau & al. 3739*, MO; c, *Brummitt 11891*, PRE; g, h, *Mhoro 1412a*, UPS).

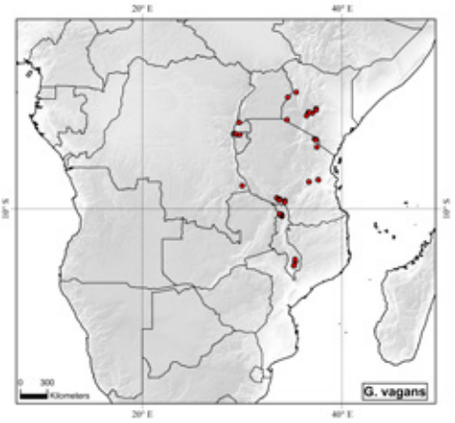


Fig. 598. Distribution of *Geranium vagans*.

region, Ntumbi area Usafwa, on road to Kiwira forest camp, 9º5'S, 33º39'E, 21 Mar. 1985, *Hedrén & al. 223* (UPS); Mbeya, Rungwe district, Mt. Rungwe, 9º6'S, 33º40'E, 25 May 1971, *Mhoro 1412a* (UPS). Morogoro: Lukwangulu Plateau, 7º6'S, 37º36'E, 9 Feb. 2001, *Mboya & Wiland 160* (MO); Uluguru mts., Lukwangule plateau, above Chenzema mission, 7º7'S, 37º37'E, 13 Mar. 1953, *Drummond & Hemsley 1509* (B); Nsogiroberg, SW Ussagara, 7º18'S, 36º40'E, 20 Nov. 1911, *Houy 40* (JE). Njombe:, Kipengere Mts., 9º10'S, 34º15'E, 9 Jan. 1957, *Richards 7615* (B); Njombe district, Mwakete near Boma, 9º21'S, 34º14'E, 17 Jan. 1957, *Richards 7863* (B). **Uganda.** Eastern: Bugishu district, Mt. Elgon, W slope above Butadiri along the track via Mudani through the Caldera, 1º7'S, 34º28'E, 8 Dec. 1967, *Hedberg 4537* (UPS). Western: volcan Muhavura, 1º22'S, 29º40'E, June 1929, *Humbert 8506* (B, MO); Virunga mountains, Muhavura, 1º22'S, 29º40'E, 17 Nov. 1934, *Taylor 1763* (BM, G, GB). **Zaire.** Tanganyika: Musipi, Marungo, 7º42'S, 30º0'E, Apr. 1945, *Dubois 1375* (B, NY).

Discussion. Geranium vagans is an ascending herb that climbs on the surrounding vegetation. It has a vertical rootstock branching from the base into multiple aerial stems, with thickened roots. The leaves are palmatisect, with lobes that vary in shape and width. In some herbarium specimens the lobes are long, linear and with revolute margins. In other specimens the lobes are linear-lanceolate, somewhat wider, and not revolute. In *Schlieben 3486* (M) outer basal leaves with wider lobes and the inner basal and the cauline leaves with narrower and more linear lobes can be seen, suggesting that this variability lacks taxonomic importance.

The indumentum of *G. vagans* includes eglandular and glandular hairs, although in some specimens the latter are partially or totally missing. Laundon (1963: 135) recognizes the subsp. *whytei* (from Mt. Zomba, Malawi) for its fruit which lacks glandular hairs. In this study, specimens with abundant glandular hairs on the fruit have been found in this area, along with others with few or none, which does not support Laundon's proposal. The leaves of *G. vagans* have appressed, eglandular hairs all over the adaxial surface and usually restricted to the veins and margins on the abaxial surface. Occasionally, eglandular hairs are also found between the nerves on the abaxial surface and glandular hairs on both surfaces.

In an initial observation, some specimens of *G. caffrum* are quite similar to *G. vagans* in leaf shape. However, in *G. caffrum* the base of the middle segment is wider and the width of the lobes is also greater, although some overlap. Furthermore, the indumentum of *G. caffrum* rarely includes glandular hairs. Both species are allopatric and are separated by about 1000 km.

Some specimens of *G. multisectum* from Mpumalanga (northern South Africa) are similar to *G. vagans* by their narrow lobes non-sericeous abaxially. However, these specimens have the lateral lobes of the middle segment, ± perpendicular to the plane formed by the segments and much longer petals than *G. vagans*.

---

236. Geranium pulchrum N.E. Br., Bull. Misc. Inform. 1895: 143. 1895. Type locality: "Habitat.--Natal: on the Drakensberg, in swamps, 6000-7000 feet, January, Evans, 378". Type: South Africa. KwaZulu-Natal, on the Drakensberg, 29°00'S, 29°00'E, Jan., *M.S. Evans 378* (lectotype, designated by Hilliard & Burtt 1985: 182, K-000417220!; isolectotype, NH-0121687-0).

Geranium lanuginosum R. Knuth, Bot. Jahrb. Syst. 40: 67. 1908, nom. illeg., non Lam. 1788. Type locality: "Natal: Auf Sandbänken eines kleinen Baches in Weenen County, 1200-1500 m (Medley Wood, Nat. Gov. Herb. n. 916!-Blühend im Dezember); an grasigen Stellen des Umdedelele-Gebirges auf dem Cathkin Peak in der Nähe von Bächen, 2000-2500 m (Thode n. 11!).-Herb. Berol.". Type: South Africa. KwaZulu-Natal, Weenen County, South Downs, 29°10'S, 29°50'E, *J.M. Wood 916* (lectotype, designated by Hilliard & Burtt 1985: 182, E; isolectotypes, GRA-0001544-0, MO-1891029!, US-3291584!, Z-000181339!).

Perennial shrubby, 50-100(300) cm tall. *Rootstock* 18-21 mm in diameter, ± vertical, not tuberculate, not turnip-shaped, without thickened roots. *Stem* erect and trailing, leafy, not rooting at nodes, stolons absent, without vegetative stems, with retrorse, ± appressed, eglandular hairs 0.4-1 mm long. *Basal leaves* unknown, cauline leaves alternate and upper opposite; leaf laminas (4.7)6-7.9(10.1) cm long, 5.5-12.1 cm wide, not peltate, palmatifid [ratio main-sinus length/middle segment length = (0.76)0.85-0.87(0.89)], polygonal in outline, base cordate, not coriaceous, with nerves not projected, with ± appressed, eglandular hairs on the adaxial surface and sericeous, with ± appressed, eglandular hairs, abaxially; segments 5, in 1 plane, middle segment rhombic, (4.5)5.4-7.9(11.6) mm wide at the base [ratio segment width at the base/middle segment length = 0.11-0.16(0.25)], 21-33-lobed in distal half [ratio secondary sinus length/middle segment length = (0.11)0.15-0.21(0.26)]; petioles up to 20 cm long, without abscission zone, terete, not swollen, not deflexed in age, with retrorse, appressed, eglandular hairs 0.4-0.7 mm long; stipules 8.3-20.8 mm long, 2.3-19.6 mm wide, (2)4-5(6)-fid, with linear lobes 6-17 mm deep, 0.5-0.9 mm wide, free, papery, brown, with eglandular hairs on abaxial surface, glabrous adaxially. *Inflorescence* a monochasial cyme; cymules 2-flowered, solitary [ratio cymule length/leaf length = 3-11.8]; peduncles (19)28-64(108) mm long, with patent, eglandular hairs 0.3-0.8 mm long and patent, glandular hairs 0.3-0.9 mm long; bracteoles (5.9)6.3-9.8(11.3) mm long, 0.4-1.1 mm wide, linear-lanceolate, whorled; pedicels (8)20-32(47) mm long, with patent, eglandular hairs 0.2-0.7 mm long and patent, glandular 0.4-0.8 mm long. Flowers actinomorphic. *Sepals* (6.8)8.7-10-1(10.6) mm long, 2.5-4.4 mm wide, lanceolate, smooth, not accrescent, nerves 3, mucro (0.8)1.1-1.6(2) mm long [ratio mucro length/sepal length = 0.11-0.21], sericeous, with erect-patent, eglandular hairs

0.2-0.8 mm long and patent, glandular hairs 0.4-0.8 mm long on the abaxial surface, glabrous adaxially. *Petals* (11)15.4-18.9(20.5) mm long, (5.4)8.4-13.2(13.7) mm wide, erect-patent, emarginate (notch 0.5-1.2 mm deep), without claw, light purple to pink, hairy on the base of the adaxial surface, glabrous abaxially, ciliate on the basal margin, with hairs 0.5-1 mm long. *Stamens* 10, both whorls bearing anthers; filaments (3.8)6.5-8.3(8.6) mm long, lanceolate, yellow, pilose on the abaxial surface, ciliate on the proximal half, with hairs 0.3-0.7 mm long; anthers (1.4)2.1-2.5(2.8) mm long, purple. Nectaries 5, hemispheric, with a tuft of hairs at the top, dorsally glabrous. *Gynoecium* 7.7-11.8 mm long, pale pink. *Fruit* (27)28-36 mm long, erect, discharge of seed-ejection type; mericarps 4.4-5.5 mm long, 1.9-2.7 mm wide, without a strand of fibers, not compressed at the apex, smooth (with 1 transverse vein at apex), without basal beak, with a basal callus,

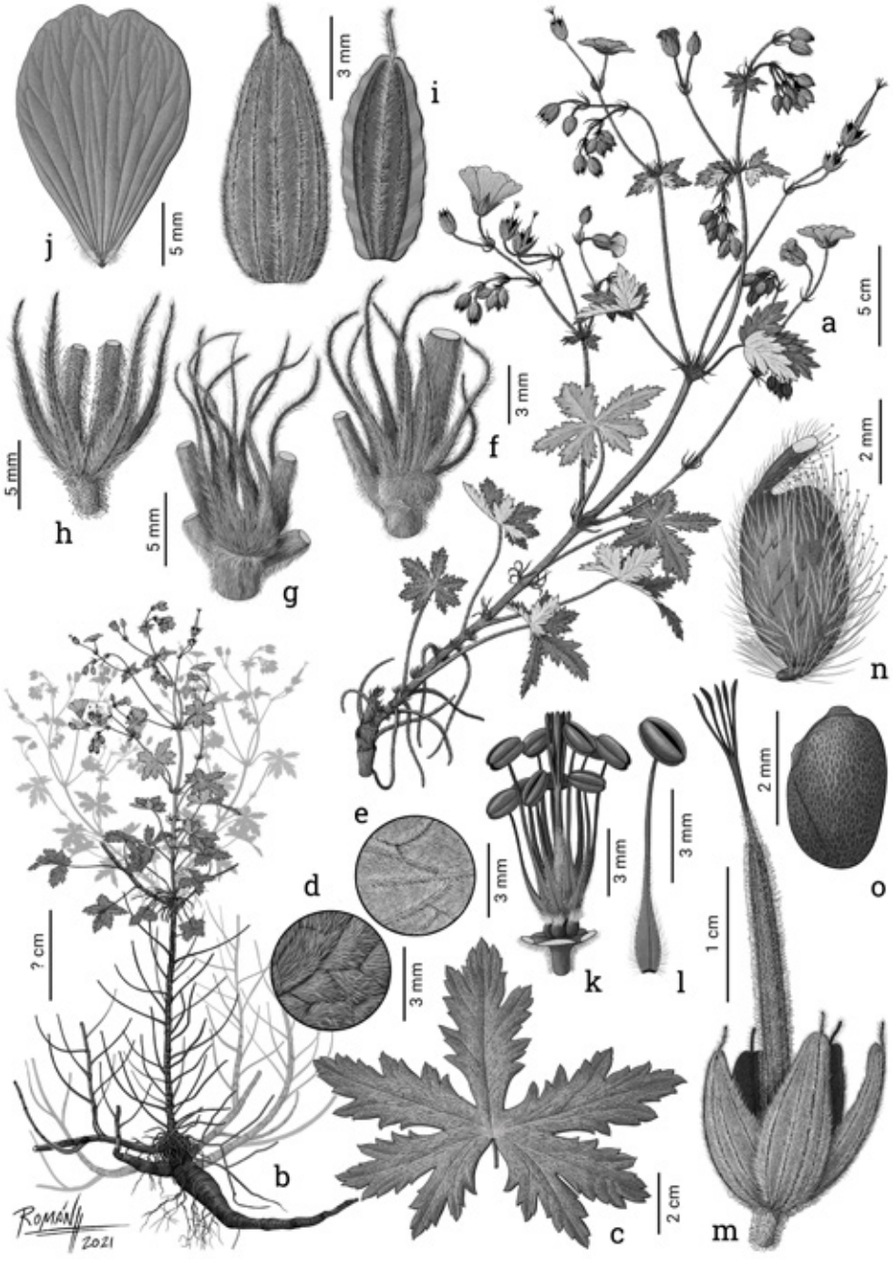


Fig. 599. *Geranium pulchrum*. a, b. Habit. c. Leaf. d. Detail of the adaxial surface of the leaf. e. Detail of the abaxial surface of the leaf. f, g. Stipules. h. Bracteoles. i. Sepals. j. Petal. k. Flower without sepals and petals. l. Stamen. m. Fruit. n. Mericarp. o. Seed. (Based on: a, b, h-l, *Aedo & al. 15016*, MA; c-g, m-o, *Aedo & al. 14978*, MA).

Fig. 600. *Geranium pulchrum* (Based on: *Aedo & al. 14978, 15016,* MA).

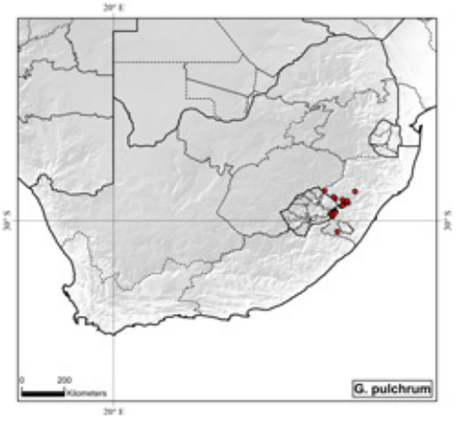


Fig. 601. Distribution of *Geranium pulchrum*.

without a basal prong, brown, with ± patent, eglandular hairs 0.9-1.4 mm long and patent, glandular hairs 0.4-0.7 mm long; rostrum 20-26 mm long, with a narrowed apex 4.6-5.6 mm long, not twisted, with ± patent, eglandular hairs 0.2-0.3 mm long and patent, glandular hairs 0.6-0.8 mm long; stigmatic remnants 3.6-5.5 mm long, with 5 glabrous lobes. *Seeds* 2.9-3.1 mm long, 1.7-1.9 mm wide, finely reticulate, uniformly colored, brown, glabrous. Cotyledons with entire margin. Figs. 599, 600.

Pollen. *Geranium*-type (Verhoeven & Marais 1990: 167; Verhoeven & Venter 1992: 441).

Chromosome number. Unknown.

Phenology. Collected in flower from January to December.

Distribution. This species ranges through southwestern KwaZulu-Natal, in South Africa (Fig. 601).

Habitat. Mountain meadows, amongst scrub, and damp or marshy places along streams; 1500-4000 m.

Additional specimens examined. **South Africa.** KwaZulu-Natal: cultivated Royal Natal park, Witsieshoek, 11 Dec. 1969, *McMurtry 3446* (PRE); Natal National Park, Mont-aux-Sources, 28º44'S, 28º53'E, Jan. 1964, *Trauseld 7* (NU); Bushman's River Valley, 28º46'S, 30º10'E, 19 Oct. 1907, *Rogers 10404* (Z); Bushman's River Valley, 28º46'S, 30º10'E, 19 Oct. 1907, *Wood 10604* (G); Weenen, Cathedral Peak area, 29º0'S, 29º16'E, July 1949, *Esterhuysen 15497* (BOL); Mont Cowl Forest reserve, Cowl Fork Valley, 29º4'S, 29º20'E, 8 Dec. 1983, *Balkwill & al. 1102* (K); Estcourt district, Tabamhlope Mountain, 29º7'S, 29º38'E, 31 Mar. 1963, *Hilliard 1488* (NU); Tabamhlope Mountain, 29º7'S, 29º38'E, 20 Apr. 1937, *West 177* (PRE); Dartington Farm 3906, on the Hlatikulu River, 29º15'S, 29º52'E, 22 Jan. 1998, *Jacobsen 5658* (PRE); Kamberg, Game Pass Farm, 29º22'S, 29º39'E, 11 Jan. 1990, *Williams 772* (PRE); Highmoor Forest reserve, Giants Castle, Drakensberg, 29º23'S, 29º35'E, 1 Jan. 1964, *Bos 1003* (M); pr. Sani Pass, 29º35'S, 29º17'E, 14 Jan. 2008, *Aedo & al. 15016* (MA); pr. Sani Pass along Twin Stream, 29º35'S, 29º18'E, May 2014, *Brochmann CB4* (NU); pr. Sani Pass, 29º36'S, 29º20'E, 14 Jan. 2008, *Aedo & al. 14978* (MA); Sani Pass, 29º36'S, 29º20'E, 20 Oct. 1922, *Weigend 2770* (M); Southern Drakensberg, near Gxalingenwa Cave, 29º38'S, 29º21'E, 7 Feb. 2013, *Buira 1755* (MA); Underberg, Cobham Forest Reserve, Upper Polela Cave area, 29º40'S, 29º20'E, 14 Feb. 1979, *Hilliard & Burtt 12571* (NU); Underberg distr., Garden Castle, path to Mashai Pass, 29º42'S, 29º8'E, 6 Feb. 1986, *Steiner 1163* (MO); Underberg district, Garden Castle Nature, W of forest house, 29º45'S, 29º14'E, 28 Jan. 1975, *Hilliard & Burtt 7769* (NU, PRE); Underberg district, Garden Castle Forest reserve, ravine of Sleeping Beauty, 29º45'S, 29º14'E, 10 Feb. 1982, *Kukkonen & Lassig 11915* (H); Mount Currie Nature Reserve, Mount Currie, 30º28'S, 29º25'E, 5 Feb. 1998, *Steiner 3275* (PRE).

Discussion. Geranium pulchrum is a subshrub with a strong and ± vertical rootstock. Its stem is ligneous towards the base and can reach 12 mm in diameter. The main stem has usually about 1 m tall, but the herbaceous branches spread over other plants and reach up to 3 m in length. Basal leaves are absent, but on the tip of the branches some leaves are grouped in a rosette-like structure. Along the branches the leaves are alternately arranged, while towards the inflorescence they are shorter and opposite.

Geranium pulchrum shares with *G. brycei* its general aspect, and deeply palmatifid and discolor leaves. The inflorescence is also quite similar, with peduncles opposite to the upper leaves along the branches, but in well grown specimens, forming large compound cymes, lacking leaves on the upper nodes and with ultimate peduncles mostly 2-flowered. The indumentum comprises both glandular and eglandular hairs on the inflorescence, and only appressed eglandular hairs on petioles and stem. In contrast, *G. pulchrum* is a more robust plant, that has leaves a bit less divided with the sericeous indumentum of the abaxial surface covering the nerves, longer anthers, fruits with longer stigmatic remnants, and rostrum with longer narrowed apex.

According to Hilliard & Burtt (1985: 183) *G. robustum* has a more restricted and allopatric distribution in relation to *G. brycei*.

237. Geranium brycei N.E. Br., Bull. Misc. Inform. 1901(175/177): 120. 1901. Type locality: "South Africa. Basutoland, on Machacha Mountain, in a moistkloof, alt. 9500 ft., Right Hon. J. Bryce". Type: Lesotho. Basutoland, on Machache Mountain, 29°21'S, 27°53'E, May 1896, *J. Bryce s.n.* (lectotype, designated by Hilliard & Burtt 1985: 183, K-000417225!).

Geranium thodei Schltr. ex R. Knuth, Bot. Jahrb. Syst. 40: 70. 1908. Type locality: "Natal: Mont aux Sources, an grasigen, steinigen Stellen des Gipfelplateaus um 2900-3000 m (Thode a. 1896-Typus in herb. Schlecht.!)". Type: South Africa. KwaZulu-Natal, Mont aux Sources, 28°46'S, 28°52'E, Jan. 1896, *H.J. Thode s.n.* (lectotype, designated by Hilliard & Burtt 1985: 183, BOL-136333 image!; isolectotypes, NBG-0199118-0 image!, NH-0017089, STE).

Perennial herbs or subshrubs, 24-56(100) cm tall. *Rootstock* and roots unknown. *Stem* ascending to erect, leafy, not rooting at nodes, stolons absent, without vegetative stems, with patent, eglandular hairs 0.7-1.4 mm long. *Basal leaves* unknown, cauline leaves alternate and upper opposite; leaf laminas (2.8)3.3-7.1(16) cm long, 3.1-18 cm wide, not peltate, palmatifid [ratio main-sinus length/middle segment length = (0.77)0.82-0.89(0.94)], polygonal in outline, base cordate, not coriaceous, with nerves not projected, with ± appressed, eglandular hairs on the adaxial surface and sericeous, except on the nerves, with appressed, eglandular hairs abaxially; segments 5, in 1 plane, middle segment rhombic, 2.2-21.4 mm wide at the base [ratio segment width at the base/middle segment length = (0.08)0.11-0.20(0.25)], 14-52-lobed in distal half [ratio secondary sinus length/middle segment length = (0.18)0.20-0.28(0.30)]; petioles up to 24 cm long, without abscission zone, terete, not swollen, not deflexed in age, with ± patent, eglandular hairs 0.5-1.5 mm long and, rarely, patent, glandular hairs 1-1.2 mm long; stipules 5.9-14.9 mm long, 2-9.7 mm

wide, (2)3-5(11)-fid, with linear lobes 4-9 mm deep, 0.6-1.1 mm wide, free, papery, brown, with eglandular hairs on both surfaces and on the margin. *Inflorescence* a monochasial cyme; cymules 2-flowered, solitary [ratio cymule length/leaf length = (1.9)3-4.9(6.9)]; peduncles (19)25-66(100) mm long, with patent, eglandular hairs 0.3-1.3 mm long and patent, glandular 0.3-1.8 mm long; bracteoles 4-7.3 mm long, 0.6-1.5 mm wide, linear-lanceolate, whorled; pedicels 14.8-67.7 mm long, with patent, eglandular hairs 0.3-0.9 mm long and patent, glandular 0.7-1.3 mm long. Flowers actinomorphic. *Sepals* (5.7)7-8.1(10.5) mm long, 2.3-4.2 mm wide, lanceolate, smooth, not accrescent, nerves 3, mucro (0.4)0.7-0.9(1.3) mm long [ratio mucro length/sepal length = (0.06)0.10-0.13(0.16)], with erect-patent, eglandular hairs 0.3-1.2 mm long and patent, glandular hairs 0.5-1.1 mm long on the abaxial surface, glabrous adaxially. *Petals* (10.7)14.1-17.8(18.8) mm long, (8.7)10.2-12.6(13.3) mm wide, erect-patent, emarginate (notch 0.7-1.1 mm deep), without claw, pale to deep purple, sometimes with a whitish base, hairy on the base of the adaxial surface, glabrous abaxially, ciliate on the basal margin, with hairs 0.5-1.1 mm long. *Stamens* 10, both whorls bearing anthers; filaments (4.3)5.2-6(6.8) mm long, lanceolate, yellow, with eglandular hairs 0.2-0.6 mm long on the abaxial surface and margin; anthers (1.2)1.4-1.9(2) mm long, yellow. Nectaries 5, hemispheric, with a tuft of hairs at the top, dorsally glabrous. *Gynoecium* 5.5-8 mm long, purple. *Fruit* (20)23.8-31.7(32.2) mm long, erect, discharge of seed-ejection type; mericarps 3.4-4.4 mm long, 1.8-2.5 mm wide, without a strand of fibers, not compressed at the apex, smooth (with 1-2 transverse veins at apex), without basal beak, with a basal callus, without a basal prong, brown, with ± patent, eglandular hairs 0.7-1.1 mm long and some pat-

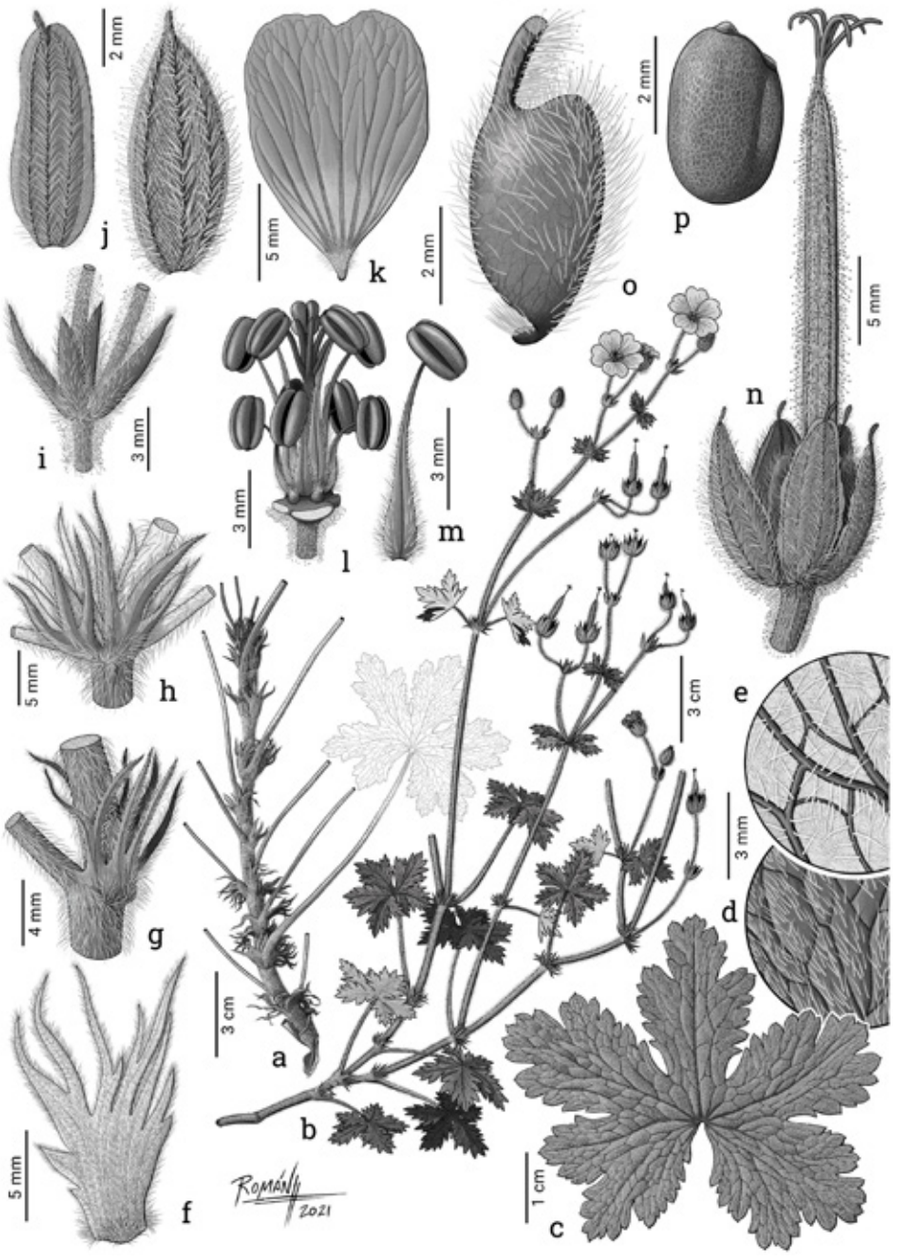


Fig. 602. *Geranium brycei*. a, b. Habit. c. Leaf. d. Detail of the adaxial surface of the leaf. e. Detail of the abaxial surface of the leaf. f-h. Stipules. i. Bracteoles. j. Sepals. k. Petal. l. Flower without sepals and petals. m. Stamen. n. Fruit. o. Mericarp. p. Seed. (Based on: a, c, g, j, *Hilliard & Burtt 18683*, K; b, h, i, *Hilliard & Burtt 16365*, PRE; d, e, k-m, *Hilliard & Burtt 16701*, M; f, n-p, *Hoener 1461*, PRE).

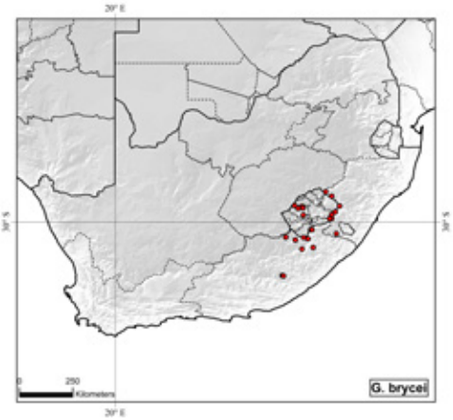


Fig. 603. Distribution of *Geranium brycei*.

ent, glandular hairs 0.5-1.2 mm long at the apex; rostrum 13-23 mm long, with a narrowed apex 1.8-2.9 mm long, not twisted, with patent, eglandular hairs 0.2-0.5 mm long and patent, glandular hairs 0.6-1 mm long; stigmatic remnants (2.6)2.8-3.7(3.8) mm long, with 5 glabrous lobes. *Seeds* 2.4-3 mm long, 1.4-1.8 mm wide, finely reticulate, uniformly colored, brown, glabrous. Cotyledons with entire margin. Fig. 602.

Pollen. *Geranium*-type (Verhoeven & Marais 1990: 166; Verhoeven & Venter 1992: 446).

Chromosome number. Unknown.

Phenology. Collected in flower from October to May.

Distribution. This species ranges from central Eastern Cape to Lesotho and southern KwaZulu-Natal, in South Africa (Fig. 603).

Habitat. Damp and often rocky places, along streambanks and down drainage lines, and open mountain sides; 1000-2900 m.

Additional specimens examined. **Lesotho.** Berea: Basutoland, Phutha, 29°19'S, 27°34'E, 28 Feb. 1949, *Compton 21619* (PRE). Maseru: Molimo Nthuse Pass, 29°25'S, 27°55'E, 12 Jan. 1979, *Hilliard & Burtt 12082* (K, NU); Roma, 29°26'S, 27°43'E, Nov. 1914, *Jacottet 43a* (Z); Bushmen's pass, 29°43'S, 27°56'E, 2 Dec. 1978, *Schmitz 8522* (PRE). Qacha's Nek: Sehlabathebe, Cave Sandstone, 29°52'S, 29°3'E, 4 Jan. 1973, *Guillarmod & al. 269* (MO, PRE); Sehlabathebe National Park, between Admin.-Research Centre and high point on lodge to rest hut road, 29°52'S, 29°3'E, 7 Apr. 1976, *Hoener 1461* (PRE); Sehlabathebe National Park, ravine E of the Research Centre, 29°52'S, 29°3'E, 8 Jan. 1977, *Hoener 1746* (PRE); Blue Mountain Pass, 29°52'S, 29°8'E, 20 Jan. 1981, *Schmitz 9192* (NU); Basutoland, near top of Bushmen's Nek, 29°52'S, 29°8'E, 12 Dec. 1957, *Whellam 1457* (PRE). **South Africa.** Eastern Cape: Transkei, Ongeluks Nek, 30°20'S, 28°15'E, 5 Dec. 1985, *Hilliard & Burtt 18683* (K, MO, NU); Thaba Chitja, Ongeluk's Neck, Killarney, 30°20'S, 28°18'E, 31 Jan. 1985, *Hutchings & Hutchings 1459* (PRE); Ongeluks Nek, between border post, 4 km from Lesotho post, 30°20'S, 28°15'E, 14 Jan. 1983, *Matthews 913* (MO, PRE); Ongeluks Nek, 30°20'S, 28°15'E, 14 Jan. 1983, *Roux 1371* (PRE); Barkly East district, Ben McDhui, 30°40'S, 27°57'E, 3 Feb. 1983, *Hilliard & Burtt 16365* (K, MO, NU, PRE); Naude's Nek, 30°43'S, 28°8'E, 13 Feb. 1983, *Hilliard & Burtt 16600* (MO, NU); Maclear district, Naude's Nek, 30°43'S, 28°8'E, 9 Apr. 1966, *Hilliard 3936* (NU); Three Drifts stream below farm 'Pitlochrie', 30°46'S, 27°36'E, 6 Dec. 1981, *Hilliard & Burtt 14733* (K, NU); Maclear, 20 km W of Ugie, 31°5'S, 28°21'E, 11 May 1993, *Bester 563* (M); Elliot district, Bastervoetpad, 31°9'S, 27°53'E, 15 Feb. 1983, *Hilliard & Burtt 16698* (MO, NU, PRE, Z); Elliot district, Bastervoetpad, 31°9'S, 27°53'E, 15 Feb. 1983, *Hilliard & Burtt 16701* (M, MO); Goshen, 32°16'S, 27°3'E, Oct., *Baur s.n.* (B); Windvogelsberg, 32°17'S, 27°6'E, Oct., *Baur 831* (GRA). KwaZulu-Natal: Basutoland, summit of Mount aux Sources, 28°44'S, 28°53'E, 1894, *Flanagan 2017* (PRE); Mount aux Sources, 28°44'S, 28°53'E, 22 Feb. 1926, *McClean & Bayer 251* (MO); near Hut, Mount aux Sources, 28°44'S, 28°53'E, 19 Mar. 1946, *Schelpe 1339* (NU); Bergville, Upper Tsanatalana valley, Cathedral Peak area, 28°55'S, 29°8'E, 14 Jan. 1983, *Matthews 913b* (BOL); Giant's Castle, 29°20'S, 29°28'E, 17 Jan. 1949, *Bruyns-Haylett 17* (MO, NU); Sani Pass, 29°35'S, 29°17'E, Jan. 2000, *Edwards 1747* (K, NU); Underberg distr., Sani Pass, 29°35'S, 29°17'E, 17 Feb. 1982, *Hilliard & Burtt 15518* (K, PRE); S of Sani Pass, 29°35'S, 29°17'E, 18 Jan. 1976, *Hilliard & Burtt 8865* (K, MO, NU); Underberg distr., Garden Castle Forest Reserve, Mlarnbonja valley, path to Mashai Pass, 29°42'S, 29°8'E, 8 Jan. 1982, *Hilliard & Burtt 15014* (K, M, MO, NU); Zuurbergen, 30°30'S, 29°20'E, 1 Feb. 1895, *Schlechter s.n.* (Z).

Discussion. Among herbarium sheets of *G. brycei* only fragments without underground parts are available. However, Hilliard & Burtt (1985: 183), who collected this species many times, stated that is a "... perennial herb or subshrub up to l m tall, though often much shorter, stems one or several from the base, eventually bare and woody there, up to c. 10 mm diam., erect or decumbent...". The basal leaves are unknown as well, but on the tip of the branches some leaves are grouped in a rosette-like structure, as in *G. pulchrum*. Along of the branches the leaves are alternately arranged, while towards the inflorescence they are shorter and opposite.

Geranium brycei is easily recognized by its deeply palmatifid and discolor leaves. The sericeous indumentum of the abaxially surface is distinctive because it is dense except on the nerves, which are clothed with long spreading hairs. In fact, the nerves are visible, but the surface between nerves is completely covered by a tangle of white hairs.

The peduncles are opposite to the upper leaves along the branches. However well grown specimens form large compound cymes, lacking leaves on the upper nodes and with ultimate peduncles mostly 2-flowered. The inflorescence usually has an indumentum of both glandular and eglandular hairs, although in some specimens glandular hairs are scarce.

Geranium brycei is close to *G. pulchrum*. The latter has petioles with appressed hairs and leaves uniformly sericeous on the abaxial side and acute and less deeply divided segments.

238. Geranium robustum Kuntze, Revis. Gen. Pl. 3(3): 32. 1898. Type locality: "Natal: Charlestown". Type: South Africa. KwaZulu-Natal, Charlestown, 27°24'S, 29°52'E, 22 Mar. 1894, *O. Kuntze s.n.* (lectotype, designated by Hilliard & Burtt 1985: 180, K-000417226!; isolectotype, NY-426165!).

Geranium incanum var. *pottiae* Burtt Davy, Man. Pl. Transvaal 1: 191. 1926. Type locality: "E. Highveld 4: Er, Goede Hoop! (End.) Pott 4971! type". Type: South Africa. Mpumalanga, Ermelo distr., farm Goedehoop, 26°49'S, 30°10'E, Dec. 1915, *R. Pott 4971* (holotype, PRE-662957 image!; isotype, BOL-136334 image!).

Perennial shrubby, 26-100 cm tall. *Rootstock* 6.8-9.9 mm in diameter, ± vertical, not tuberculate, not turnip-shaped, without thickened roots. *Stem* erect, leafy, not rooting at nodes, stolons absent, without vegetative stems, sericeous, with retrorse, ± appressed, eglandular hairs 0.1-0.5 mm long. *Basal leaves* not present (no rosette), cauline leaves alternate and upper opposite; leaf laminas (2.1)3.7-5.2(5.9) cm long, 2.1-7.2 cm

wide, not peltate, palmatisect, polygonal in outline, base cordate, not coriaceous, with nerves not projected, densely covered with greyish-white, appressed, eglandular hairs on the adaxial surface and sericeous, with ± appressed, eglandular hairs, abaxially; segments 5, in 1 plane, middle segment rhombic, (0.4)0.6-0.9(1.2) mm wide at the base [ratio segment width at the base/middle segment length = (0.01)0.02-0.04(0.05)], 19-47-lobed in distal half [ratio secondary sinus length/middle segment length = (0.22)0.31-0.36(0.39)]; petioles up to 14 cm long, without abscission zone, terete, not swollen, not deflexed in age, with retrorse, appressed, eglandular hairs 0.2-0.4 mm long; stipules 6.4-16.1 mm long, 1.8-9.2 mm wide, 3-5-fid, with lanceolate lobes 4.1-9.4 mm deep, 0.3-0.7 mm wide, free, papery, brown, with eglandular hairs on abaxial surface, glabrous adaxially. *Inflorescence* a monochasial cyme; cymules 2(3)-flowered, solitary [ratio cymule length/leaf length = 2.2-5.5]; peduncles (43)51-101(160) mm long, with retrorse, ± appressed, eglandular hairs 0.3-0.4 mm long and, usually, patent, glandular hairs 0.3-0.8 mm long; bracteoles 2.7-9.3 mm long, 0.5-1.4 mm wide, linear-lanceolate, whorled; pedicels (19)30-60(69) mm long, with retrorse, ± appressed, eglandular hairs 0.3-0.7 mm long and, usually, patent, glandular hairs 0.4-1.2 mm long. Flowers actinomorphic. *Sepals* (6.7)7.2-8.8(9.1) mm long, 2.7-3.7 mm wide, lanceolate, smooth, not accrescent, nerves 3, mucro (0.9)1-1.5(1.9) mm long [ratio mucro length/sepal length = (0.13)0.14-0.20(0.22)], sericeous, with appressed, eglandular hairs 0.2-0.5 mm long and, usually, patent, glandular hairs 0.7-1.3 mm long on the abaxial surface, glabrous adaxially. *Petals* (11.4)12.5-19(20.7) mm long, (6.8)8.1-13.2(14.5) mm wide, erect-patent, emarginate (notch 0.5-1.3 mm deep), without claw, purple, hairy on the base of the adaxial surface, glabrous abaxially, ciliate on the basal margin, with hairs 0.4-0.5 mm long. *Stamens* 10, both whorls bearing anthers; filaments (5.9)7.6-8.2(9.1) mm long, lanceolate, white, pilose on the abaxial surface, ciliate on the proximal half, with hairs 0.3-0.5 mm long; anthers (1.6)1.8-2(2.1) mm long, purple. Nectaries 5, hemispheric, with a tuft of hairs at the top, dorsally glabrous. *Gynoecium* 6.4-10.4 mm long, purple. *Fruit* (28)29-34(36) mm long, erect, discharge of seed-ejection type; mericarps 3.8-4.7 mm long, 1.9-2.5 mm wide, without a strand of fibers, not compressed at the apex, smooth, without basal beak, with a basal callus, without a basal prong, brown, with ± patent, eglandular hairs 0.8-1.4 mm long and patent, glandular hairs 0.8-1.6 mm long; rostrum 19-27 mm long, with a narrowed apex 4.1-6.8 mm long, not twisted, with ± patent, eglandular hairs 0.2-0.4 mm long and patent, glandular hairs 0.7-1.6 mm

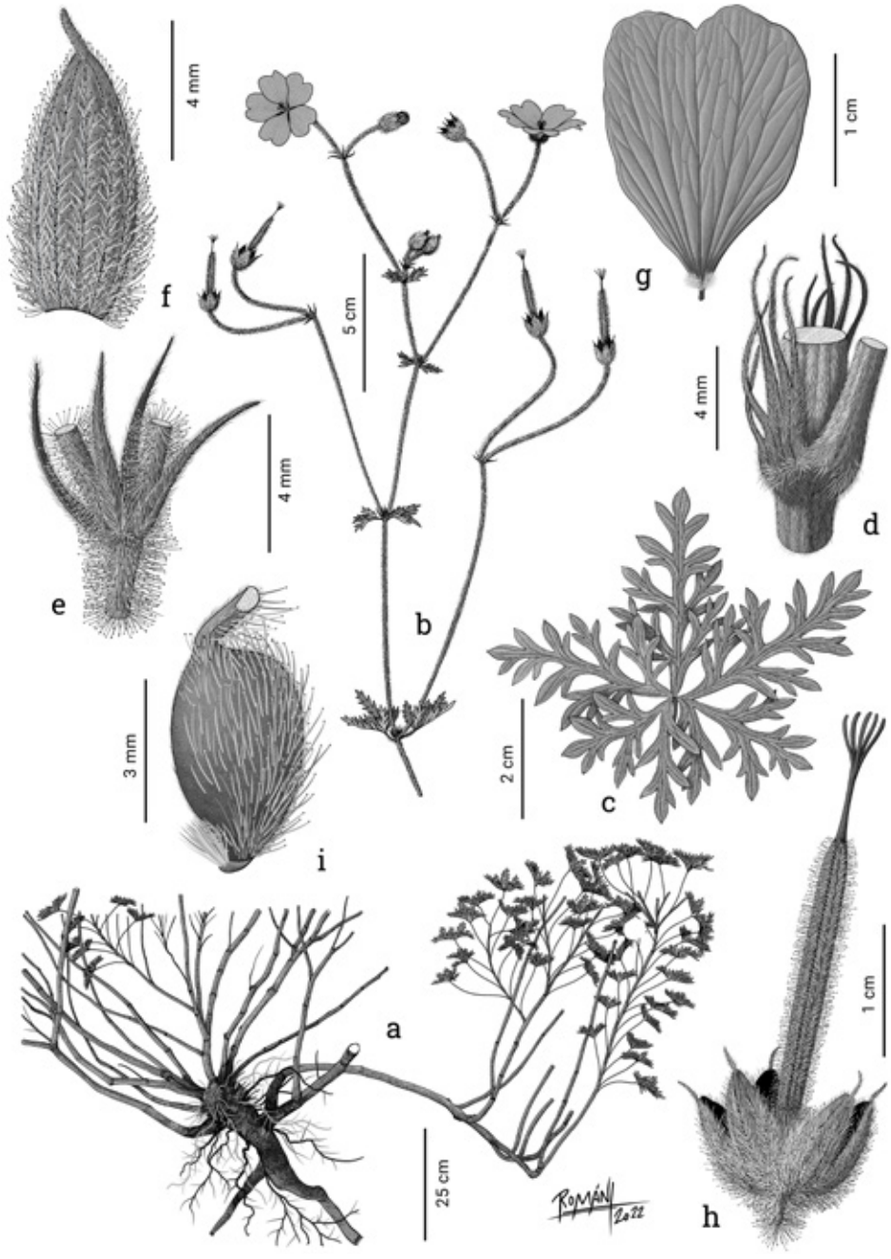


Fig. 604. *Geranium robustum*. a, b. Habit. c. Leaf. d. Stipules. e. Bracteoles. f. Sepal. g. Petal. h. Fruit. i. Mericarp. (Based on: *Aedo & al. 15110*, MA).

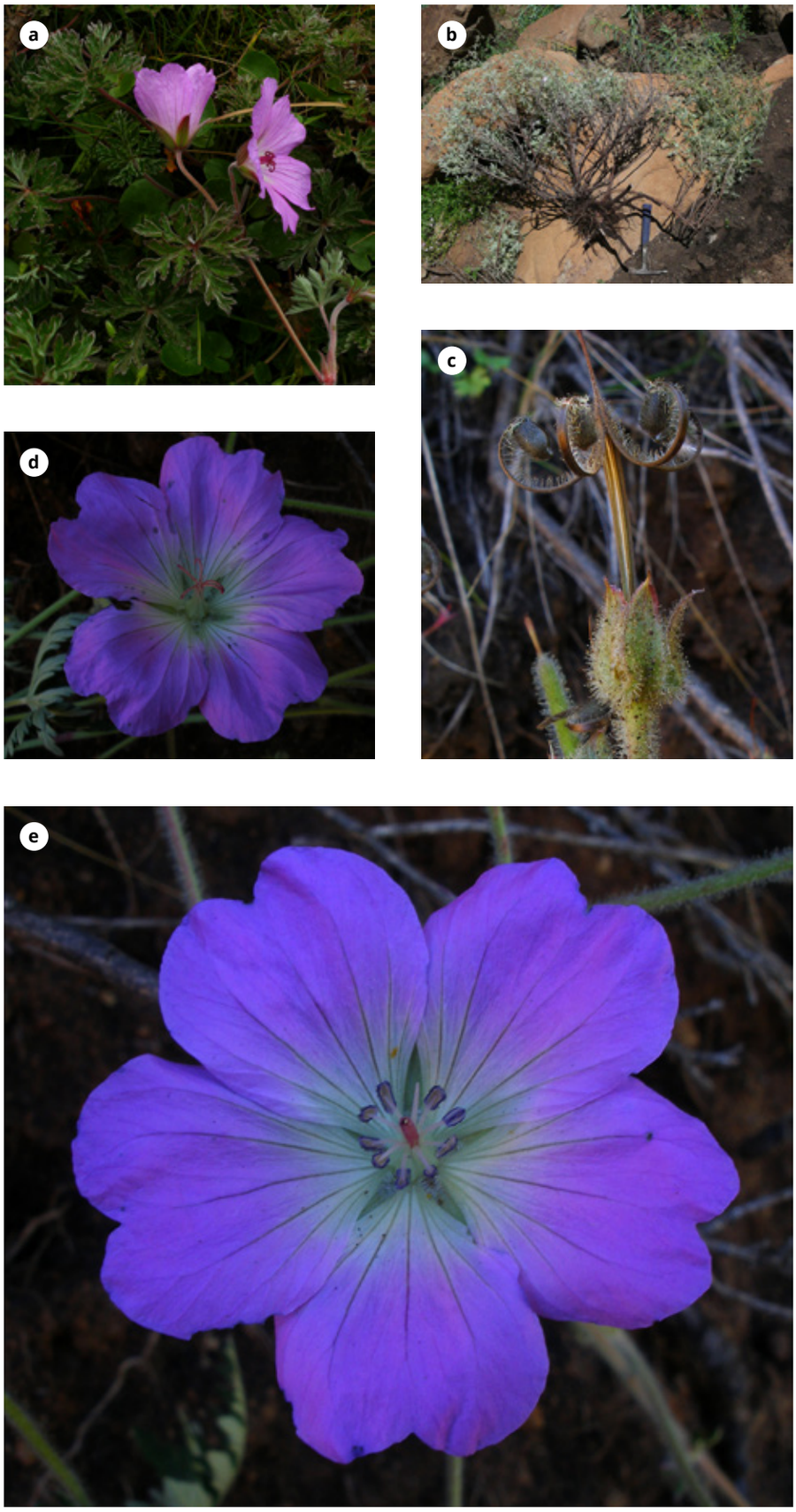


Fig. 605. *Geranium robustum* (Based on: a, *Aedo & al. 15110*; b-e, *Aedo, 15113,* MA).

long; stigmatic remnants (2.7)3.2-4.1(4.2) mm long, with 5 glabrous lobes. *Seeds* 2.4-2.6 mm long, 1.6-2 mm wide, finely reticulate, uniformly colored, brown, glabrous. Cotyledons with entire margin. Figs. 604, 605.

Pollen. *Geranium*-type (Verhoeven & Marais 1990: 167; Verhoeven & Venter 1992: 445).

Chromosome number. Unknown.

Phenology. Collected in flower from January to December.

Distribution. This species ranges from northern Eastern Cape, through Lesotho, Free State and KwaZulu-Natal to Mpumalanga, in South Africa (Fig. 606).

Habitat. Streamsides and moist, shrub-covered mountain slopes; 1650-2800 m.

Additional specimens examined. **Lesotho.** Basutoland, 27 Mar. 1950, *Ruch 1641* (PRE). Berea: Mamalapi, 29°7'S, 28°13'E, 29 Dec. 1948, *Compton 21362* (PRE); Berea, Mamathes, 29°7'S, 27°50'E, 7 Feb. 1955, *Marais 1082* (PRE, K, M); Berea, Mamalapi, 29°7'S, 28°13'E, 19 Jan. 1957, *Marais 1291* (PRE); Botsabelo area, Berea plateau, 29°17'S, 27°37'E, 30 Oct. 1970, *Williamson 802* (K). Butha-Buthe: middle of Moteng Pass, 28°45'S, 28°35'E, 29 Jan. 1982, *Killick 4441* (PRE). Maseru: Molimo Nthuse pass, 29°25'S, 27°54'E, 12 Jan. 1979, *Hilliard & Burtt 12091* (K, NU); Thaba Bosiu, 29°20'S, 27°40'E, Jan. 1903, *Junod 1870* (Z); Roma, 29°26'S, 27°43'E, Nov. 1914, *Jacottet 43* (Z). **South Africa.** Eastern Cape: Barkly East district, old Lady Grey road, above Kraai River, 29°35'S, 29°20'E, 30 Nov. 1981, *Hilliard & Burtt 14568* (MO, NU); NE of Rhodes, Klop-

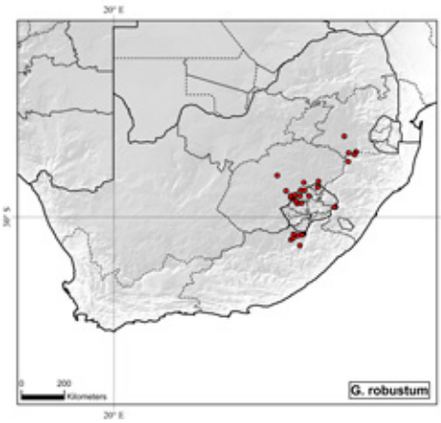


Fig. 606. Distribution of *Geranium robustum*.

pershoekspruit Valley, Mavis Bank farm, 30º42'S, 28º0'E, 7 Dec. 1999, *Smook 10206* (PRE); pr. Rhodes, 30º43'S, 27º57'E, 17 Jan. 2008, *Aedo & al. 15110* (MA); Barkly East district, Witteberg, Beddgelert, 30º43'S, 27º34'E, 1 Dec. 1981, *Hilliard & Burtt 14623* (K); Rhodes, Carlisle Hoek, 30º45'S, 27º56'E, 10 May 1985, *Hutchings 1689* (MO); Drakensberg's near Barkly East, along road S of Lundean's nek, 30º47'S, 27º45'E, 18 Dec. 1982, *Phillipson 617* (MO, PRE, UPS); Barkly East district, 33 km from Lady Grey on road to Barkly East, 30º53'S, 27º33'E, 22 Nov. 2004, *Burgoyne 9923* (PRE); Barkely East-Elliot district, Saalboom Nek, S of Clifford, 30º57'S, 27º27'E, 21 Jan. 1979, *Hilliard & Burtt 12312* (K, MO); pr. Barkly Pass, 31º12'S, 27º50'E, 29 Nov. 1981, *Hilliard & Burtt 14555* (K, NU, PRE). Free State: Thaba Nchu Mountain, 28º15'S, 26º53'E, 13 Dec. 1977, *Peeters & al. 380* (PRE); Golden Gate Highland Park, 28º30'S, 28º37'E, 18 Aug. 2014, *Jaca 475* (PRE); Bethelehem, Golden Gate Highland Park, 28º30'S, 28º37'E, 25 Oct. 1963, *Liebenberg 7287* (K, M); Bethelehem, Golden Gate Highland Park, Glen Reenen house, 28º30'S, 28º37'E, 18 Jan. 1966, *Liebenberg 7549* (K); Ficksburg, farm Westbury, 28º52'S, 27º52'E, 14 Oct. 1934, *Galpin 32252* (BOL); Excelsior, Korannaberg mountain, Hollow cave, 28º54'S, 27º15'E, 18 Oct. 2005, *Stevens 458* (MO, NY); Ladybrand, Tandjiesberg, 29º4'S, 27º37'E, 8 Nov. 1991, *Peyper 1033* (PRE); Ladybrand, Modderpoort, 29º6'S, 27º27'E, 27 Nov. 1991, *de Lange 38* (PRE); Ladybrand, 29º11'S, 27º27'E, 16 Oct. 1982, *Richardson 155* (NU); Ladybrand, 29º11'S, 27º27'E, Feb. 1906, *Rogers 5144* (PRE). KwaZulu-Natal: Charlestown, valley of Buffalo river, 27º40'S, 29º52'E, 27 Feb. 1895, *Wood 5708* (BM, K, MO); Sani Pass, 29º35'S, 29º17'E, 14 Jan. 2008, *Aedo & al. 15013* (MA). Mpumalanga: Wakkerstroom district, farm Oshoek, 26º36'S, 29º42'E, 3 Feb. 1960, *Devenish 221* (PRE); 10 km NE of Wakkerstroom on Jantjieshoek Pass, 27º15'S, 30º12'E, 5 Feb. 2000, *Burrows 7086* (PRE); Volkrust district, Verkykkop, 27º18'S, 29º53'E, 1 Dec. 1999, *Jordaan 3614* (PRE); Wakkerstroom, 27º21'S, 30º8'E, Jan. 1922, *Van Dam 24329* (PRE); Wakkerstroom, Honey Moon Kloof, 27º22'S, 30º8'E, 20 Feb. 1916, *Beeton 65* (Z).

Discussion. Geranium robustum is a subshrub with a strong and ± vertical rootstock and a woody stem with multiple ligneous branches from the base. The plant can reach about 1 m in height. The basal leaves are unknown, but the lack of rosette should be confirmed in young plants. The ligneous part of the branches is naked and ends in an herbaceous part with alternate leaves which are replaced by opposite leaves towards the apex.

Geranium robustum shares with *G. pulchrum* and *G. brycei* their general aspect, discolorous leaves, long and emarginate petals and long fruits, but differs from both by its palmatisect leaves. The inflorescence is also quite similar, with peduncles opposite to the upper leaves along the branches. However in well grown specimens forming large compound cymes, leaves are lacking on the upper nodes and ultimate peduncles are mostly 2-flowered. The indumentum comprises both glandular and eglandular hairs on the inflorescence, and only appressed, eglandular hairs on petioles and stem.

---

239. Geranium discolor Hilliard & B.L. Burtt, Notes Roy. Bot. Gard. Edinburgh 42(2): 186, 173 fig. 1 F. 1985. Type locality: "E Cape, Stutterheim distr., 3227 CB, Kabusie Forest, 20 x 1980, Hilliard & Burtt 13194 (NU holo., E iso.)". Type: South Africa. Eastern Cape, Stutterheim distr., Kabusie Forest, 32°34'S, 27°25'E, 20 Oct. 1980, *O.M. Hilliard & B.L. Burtt 13194* (holotype, NU-0015563-0; isotypes, E-00200449, K-000417234! PRE-0685405-0, S-G-10314 image!).

Perennial herbs, 22-60 cm tall. *Rootstock* and roots unknown. *Stem* procumbent to ascending, leafy, not rooting at nodes, stolons absent, without vegetative stems, with ± patent, eglandular hairs 0.4-1 mm long. *Basal leaves* not present (no rosette), cauline leaves alternate and upper opposite; leaf laminas (2.1)2.8-3.1(3.2) cm long, 2.2-3.9 cm wide, not peltate, palmatifid [ratio main-sinus length/middle segment length = (0.54)0.62-0.68(0.76)], polygonal in outline, base cordate, ± coriaceous, with nerves not projected, with ± appressed, eglandular hairs on the adaxial surface (sometimes nearly glabrous), sericeous abaxially; segments 5, in 1 plane, middle segment obtriangular, (4.4)6.5-7.9(9.9) mm wide at the base [ratio segment width at the base/middle segment length = (0.34)0.37-0.43(0.47)], 5-7-lobed in distal half [ratio secondary sinus length/middle segment length = (0.14)0.19-0.25(0.28)]; petioles up to 18 cm long, without abscission zone, terete, not swollen, not deflexed in age, with patent, eglandular hairs 0.2-1 mm long; stipules (7.7)8.4-10.9(13.6) mm long, 1.2-5.5 mm wide, (2)3-fid, with linear lobes 3.8-9.7 mm deep, 0.3-0.9 mm wide, free, papery, brown, with eglandular hairs on both surfaces and on the margin. *Inflorescence* a monochasial cyme; cymules 2-flowered, solitary [ratio cymule length/leaf length = (2.1)3.2-5.1(6)]; peduncles (50)69-81(130) mm long, with patent to retrorse, ± appressed, eglandular hairs 0.2-1.1 mm long; bracteoles 7.3-10.9 mm long, 0.8-1.9 mm wide, linear-lanceolate, whorled; pedicels (17)26-46(58) mm long, with patent to retrorse, ± appressed, eglandular hairs 0.3-1.2 mm long. Flowers actinomorphic. *Sepals* (7.6)8.4-9.8(10.9) mm long, 2.9-4.4 mm wide, lanceolate, smooth, not accrescent, nerves 5(7), mucro (1.1)2-2.3(2.8) mm long [ratio mucro length/sepal length = (0.13)0.22-0.29], sericeous, with ± appressed, eglandular hairs 0.2-1.4 mm long and, rarely, patent, glandular hairs 0.5-0.6 mm long on the abaxial surface, glabrous adaxially. *Petals* (13.2)17.1-19.6(20.7) mm long, (9.7)10.2-12.8 mm wide, erect-patent, slightly emarginate (notch 0.6-1.3 mm deep), without claw, pale to dark purple, white towards the base, hairy on the base of the adaxial surface, glabrous abaxially, ciliate on the basal margin, with hairs 0.6-0.7 mm long. *Stamens* 10, both whorls bearing anthers; filaments (7.5)8.8-10.4(10.7) mm long, lanceolate, yellow, pilose on the abaxial surface, ciliate on the proximal half, with hairs 0.2-0.4 mm long; anthers 2-2.7 mm long, yellow. Nectaries 5, hemispheric, with a tuft of hairs at the top, dorsally glabrous. *Gynoecium* 8.6-11

mm long, purple. *Fruit* 28.5-31.9 mm long, erect, discharge of seed-ejection type; mericarps 4.3-5.1 mm long, 1.7-2.1 mm wide, without a strand of fibers, not compressed at the apex, smooth, without basal beak, with a basal callus, without a basal prong, brown, with ± appressed, eglandular hairs 1.1-1.9 mm long; rostrum 18.2-20.9 mm long, with a narrowed apex 3.8-5.1 mm long, not twisted, with ± patent, eglandular hairs 0.4-1.2 mm long; stigmatic remnants 4.3-5.5 mm long, with 5 glabrous lobes. *Seeds* 3.3-3.4 mm long, 1.5-1.5 mm wide, finely reticulate, uniformly colored, brown, glabrous. Cotyledons not studied. Fig. 607.

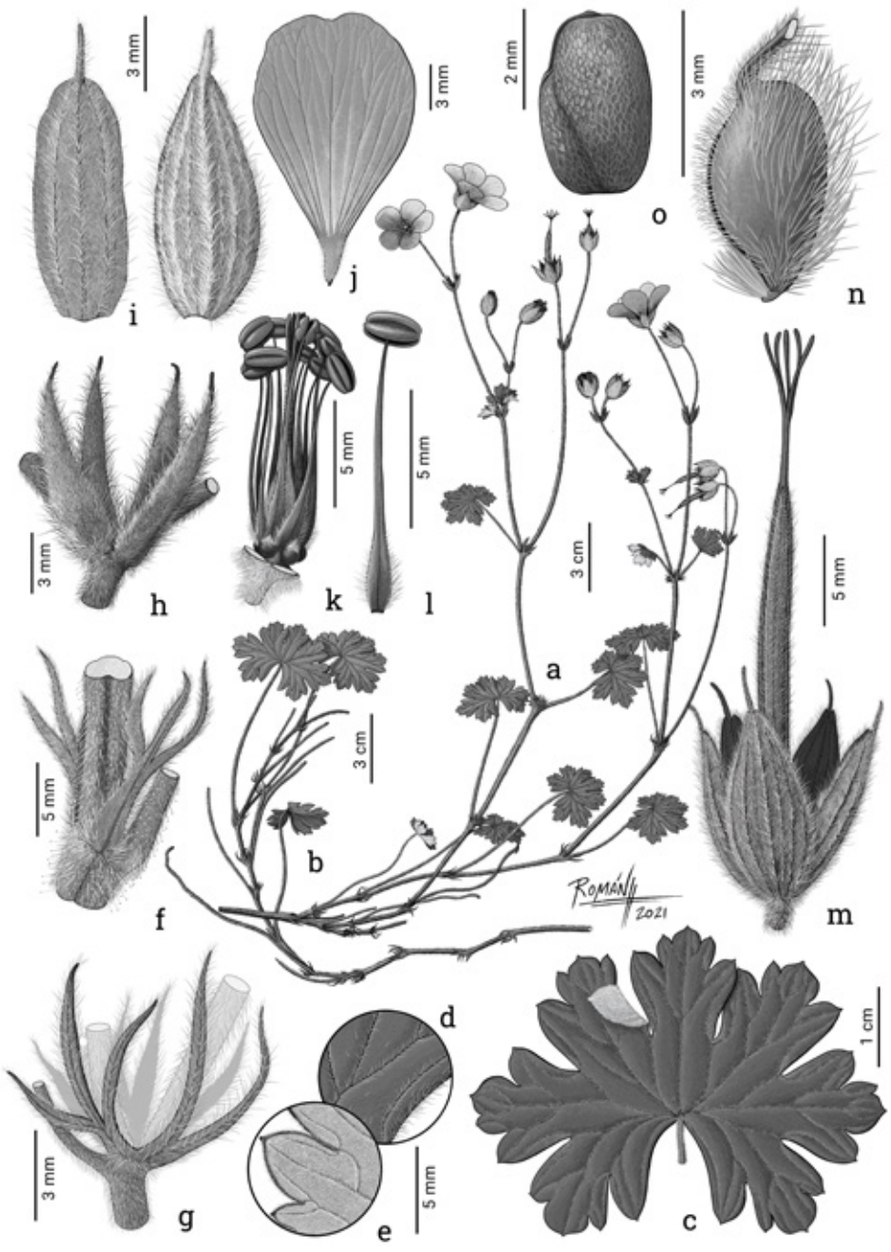


Fig. 607. *Geranium discolor*. a, b. Habit. c. Leaf. d. Detail of the adaxial surface of the leaf. e. Detail of the abaxial surface of the leaf. f, g. Stipules. h. Bracteoles. i. Sepals. j. Petal. k. Flower without sepals and petals. l. Stamen. m. Fruit. n. Mericarp. o. Seed. (Based on: a-e, *Phillipson 976*, UPS; f, g, i, k, l, *Flanagan 2161*, PRE; h, j, *Hilliard & Burtt 14787*, M; m-o, *Leighton 2740*, BOL).

Pollen. *Geranium*-type (Verhoeven & Marais 1990: 166; Verhoeven & Venter 1992: 441).

Chromosome number. Unknown.

Phenology. Collected in flower from October to January.

Distribution. This species is endemic to central Eastern Cape, in South Africa (Fig. 608).

Habitat. Moist places on forest edges, and among rocks on open mountain slopes; 1200-1800 m.

Additional specimens examined. **South Africa.** Eastern Cape: Amatole Mountains, near Cata, 32°33'S, 27°7'E, 11 Feb. 1983, *Furness & Phillipson 228* (MO); Amatole Mountains, below Gaikas Kop, 32°33'S, 26°56'E, 3 Dec. 1982, *Furness & Phillipson 54* (PRE); Amatole Mountains, below Gaikas Kop, 32°33'S, 26°56'E, 3 Dec. 1982, *Phillipson 54* (MO); Amatole Mountains, below Gaikas Kop, 32°33'S, 26°56'E, 17 Dec. 1984, *Phillipson 976* (K, MO, PRE, UPS); Stutterheim district, Thomas Mountain, 32°34'S, 27°14'E, 9 Dec. 1981, *Hilliard & Burtt 14787* (K, M, MO); Hogsback Forest Reserve, Fort Beaufort, 60 mi NNE Grahamstown, 32°35'S, 26°56'E, 25 Nov. 1969, *Dahlstrand 1843* (GB); Hogsback F.R. above Kettespont Falls, 32°35'S, 27°1'E, 9 Dec. 1977, *Hilliard & Burtt 10950* (MO, NU); Stutterheim district, Mt Kemp, near radio mast, 32°40'S, 27°15'E, 14 Dec. 1977, *Hilliard & Burtt 11047* (B, NU, PRE); King Williams Town Division, Mt Kemp, 32°40'S, 27°15'E, 13 Jan. 1947, *Leighton 2740* (BOL); at foot of Pirie, 32°43'S, 27°16'E, 1893, *Flanagan 2161* (MO, PRE).

Discussion. Geranium discolor is a perennial herb prostrate to ascend-

Fig. 608. Distribution of *Geranium discolor*.

ing. The stem is branched from the base, somewhat lignified in the lower part and naked or with the remains of stipules, apparently without rosette. Nevertheless, the lack of rosette should be confirmed in young plants. Its underground parts are not well known owing to the scarce amount of herbarium material available. The indumentum is predominantly eglandular but, according to Hilliard & Burtt (1985: 187), some specimens can have glandular hairs on peduncles or sepals. *Geranium discolor* is easily recognized by its subcoriaceous leaves, not deeply palmatifid and sericeous on the abaxial surface, and its long and wide petals shallowly notched. Its stipules are usually trifid with narrow and deep lobes. Sometimes bifid stipules appear in some nodes.

Hilliard & Burtt (1985: 187) reported a possible hybrid between *G. discolor* and *G. amatolicum*, collected among the parents (*Hilliard & Burtt 14796a*, E, NU). *Geranium discolor* has sometimes been confused with *G. ornithopodon*, from which it is easily separated by its less deeply divided leaves and sericeous abaxially.

240. Geranium harveyi Briq., Annuaire Conserv. Jard. Bot. Genève 11/12: 183. 1908. *Geranium sericeum* Harv. in Harv. & Sond., Fl. Cap. 1: 257. 1860, nom. illeg., non Willd. ex Spreng. 1826. Type locality: "Hab. Wildschutsberg and Compasberg, 5-6000 f., Drege! Zeyher! (Herb. T.C.D., Hook., Sond.)". Type: South Africa. Eastern Cape, Wildschutsberg, 31°48'S, 26°29'E, Dec., *J.F. Drège s.n.* (lectotype, designated by Hilliard & Burtt 1985: 187, K-000417221!; isolectotypes, BM-000796978 image!, E-00200430 image!, HBG-517304 image!, K-000417224!, P!, S-G-2849 image!, W!) [locality from the protologue, not from the herbarium sheets].

Perennial herbs, 17-33 cm tall. *Rootstock* 3.2-3.8 mm in diameter, ± vertical, not tuberculate, not turnip-shaped, without thickened roots. *Stem* ascending to suberect, leafy, not rooting at nodes, stolons absent, without vegetative stems, with retrorse, appressed, eglandular hairs 0.2-0.5 mm long. *Basal leaves* unknown, cauline leaves alternate and upper opposite; leaf laminas (0.8)1-1.5(2.3) cm long, 0.9-2.6 cm wide, not peltate, deeply palmatifid [ratio main-sinus length/middle segment length = (0.80)0.84-0.88(0.93)], polygonal in outline, base cordate, not coriaceous, with nerves not projected, sericeous, with appressed, eglandular hairs on both surfaces, more densely on the abaxial surface; segments 5, in 1 plane, middle segment rhombic, (0.9)1.2-1.3(2.8) mm wide at the base [ratio segment width at the base/middle segment length = 0.12-0.20(0.249], 5-11-lobed in distal half [ratio secondary sinus length/ middle segment length = (0.31)0.35-0.42(0.47)]; petioles up to 14 cm long, without abscission zone, terete, not swollen, not deflexed in age, with retrorse, appressed, eglandular hairs 0.3-0.5 mm long; stipules 3.4-8.1 mm long, 0.6-4.7 mm wide, 2-4-fid, with linear lobes 1.9-5.4 mm deep, 0.3-0.7 mm wide, free, papery, brown, with eglandular hairs on abaxial surface, ± glabrous adaxially. *Inflorescence* a monochasial cyme; cymules 2-flowered, solitary [ratio cymule length/ leaf length = 1.3-5]; peduncles (48)61-96(119) mm long, with retrorse, appressed, eglandular hairs 0.2-0.4 mm long; bracteoles 1.7-5.5 mm long, 0.4-0.7 mm wide, linear-lanceolate, whorled; pedicels (21)30-44(53) mm long, with retrorse, appressed, eglandular hairs 0.2-0.4 mm long. Flowers actinomorphic. *Sepals* (5.1)5.3-6(6.4) mm long, 2.2-3.7 mm wide, lanceolate, smooth, not accrescent, nerves 3, mucro (0.5)0.6-0.8(0.9) mm long [ratio mucro length/sepal length = 0.10-0.18], sericeous, with antrorse, appressed, eglandular hairs 0.1-0.5 mm long on the abaxial surface, glabrous adaxially. *Petals* (9.4)10.5-12.9(13.7) mm long, (6.3)6.7-7.7(7.8) mm wide, erect-patent, emarginate (notch 0.5-1 mm deep), without claw, purple, hairy on the base of the adaxial surface, glabrous abaxially, ciliate on the basal margin, with hairs 0.3-0.5 mm long. *Stamens* 10, both whorls bearing anthers; filaments (4.8)5.2-7.2(7.5) mm long, lanceolate, yellow, with eglandular hairs 0.3-0.4 mm long on the abaxial surface and margin; anthers (1.3)1.4-1.7(1.9) mm long, yellow. Nectaries 5, hemispheric, with a tuft of hairs at the top, dorsally glabrous. *Gynoecium* 4.9-8.2 mm long, yellow. *Fruit* (20.4)21-23.2(31.6) mm long, erect, discharge of seed-ejection type; mericarps 3.4-3.8 mm long, 1.9-2.2 mm wide, without a strand of fibers, not compressed at the apex, smooth, without basal beak, with a basal callus, without a basal prong, brown, with erect-patent, eglandular hairs 0.6-1.1 mm long; rostrum 12-23 mm long, with a narrowed apex 1.2-3.4 mm long, not twisted, with erect-patent, eglandular hairs 0.2-0.5 mm long; stigmatic remnants 2.2-3.2 mm long, with 5 glabrous lobes. *Seeds* 2.4-2.9 mm long, 1.5-1.8 mm wide, finely reticulate, uniformly colored, brown, glabrous. Cotyledons with entire margin. Fig. 609.

Pollen. *Geranium*-type (Verhoeven & Marais 1990: 168; Verhoeven & Venter 1992: 442).

Chromosome number. Unknown.

Phenology. Collected in flower from October to February.

Distribution. This species ranges from Western Cape to Eastern Cape, in South Africa (Fig. 610).

Habitat. Among outcropping rocks or among bushes on grassy slopes and on roadsides; 1200-2200 m.

Additional specimens examined. **South Africa.** Eastern Cape: R398 Middelburg to Richmond, after 29 turn left, 28 km to Compassberg, 31°43'S, 24°36'E, 3 Aug. 1999, *Nienaber 529* (PRE); Middelburg, Gordonville, 31°44'S, 24°41'E, 14 Feb. 1952, *Acocks 16578* (K); Middelburg, Lootsberg pass, 31°47'S, 24°48'E, 17 Jan. 1957, *Theron 2165* (M); Queenstown, 31°53'S, 26°52'E, Nov. 1893, *Galpin 1631* (PRE); S extreme of Renosterberg above Lootsberg railway, farm Blaauwater, 31°53'S, 24°52'E, 25 Nov. 1977, *Hilliard & Burtt 10648* (K, MO,

PRE); Queenstown, 31°53'S, 26°52'E, 31 Dec. 1962, *Roberts 2013b* (PRE); Goshen, 32°16'S, 27°3'E, Oct., *Baur 830* (B, K); Cathcart, Windvogelberg, 32°17'S, 27°6'E, 8 Dec. 1981, *Hilliard & Burtt 14780* (NU); Tarkastad district, De Beers Pass, S of Tarkastad, 32°18'S, 26°11'E, 3 Jan. 1981, *Moffett 2892* (NU); Cradock district, mountain of Welterrede, Bankberg, 32°19'S, 25°20'E, 24 Jan. 1966, *Liebenberg 7619* (PRE); Cathcart, 32°27'S, 27°8'E, Jan. 1901, *Sim 2782* (PRE); Amatole mountains, Hogsback-Cathcart road, near Kliplaat river crossing, 32°29'S, 26°56'E, 15 Oct. 1985, *Phillipson 1144* (K, MO, UPS); Banders Kop, Katberg mountains, 32°31'S, 26°38'E, 8 Jan. 1927, *Grant 3126* (MO). Western Cape: Beaufort West, Karoo National Park, on upper mountain plateau at Bulthoudersbank, below FM tower, 32°15'S, 22°30'E, 31 Oct. 1984, *Bengis 388* (PRE); Beaufort West, Mountain View Farm, 32°15'S, 22°55'E, 31 Dec. 1962, *Roberts 2013* (PRE); Beaufort West, Mountain View Farm, Karroid Merxmuellera Mt. Veld, 32°15'S, 22°55'E, 14 Feb. 1978, *Russell & al. 135* (BM).

Discussion. Geranium harveyi is a perennial herb with a spreading stem suberect to ascending. The stem is branched from the base, somewhat lignified in the lower part and naked or with the remains of stipules, apparently without rosette. Nevertheless, the lack of rosette should be confirmed in young plants. Its underground parts are poorly known owing to the scarce availability herbarium material, but in some specimens a thin vertical rootstock appears. *Geranium harveyi* is easily recognized by its leaves, which are deeply palmatifid and sericeous on both surfaces. The indumentum of the adaxial surface is dense and white on young leaves, but in some herbarium specimens mature leaves show a less dense and grey indumentum. Its stipules are usually trifid with narrow and deep lobes but, sometimes bifid or 4-fid stipules appear in some nodes. *Geranium harveyi* is sometimes confused with *G. canescens*. The two species are allopatric. *Geranium canescens* is easily distinguished from *G. harveyi* by its longer sepals, white and shorter petals, glandular indumentum and discolorous leaves.

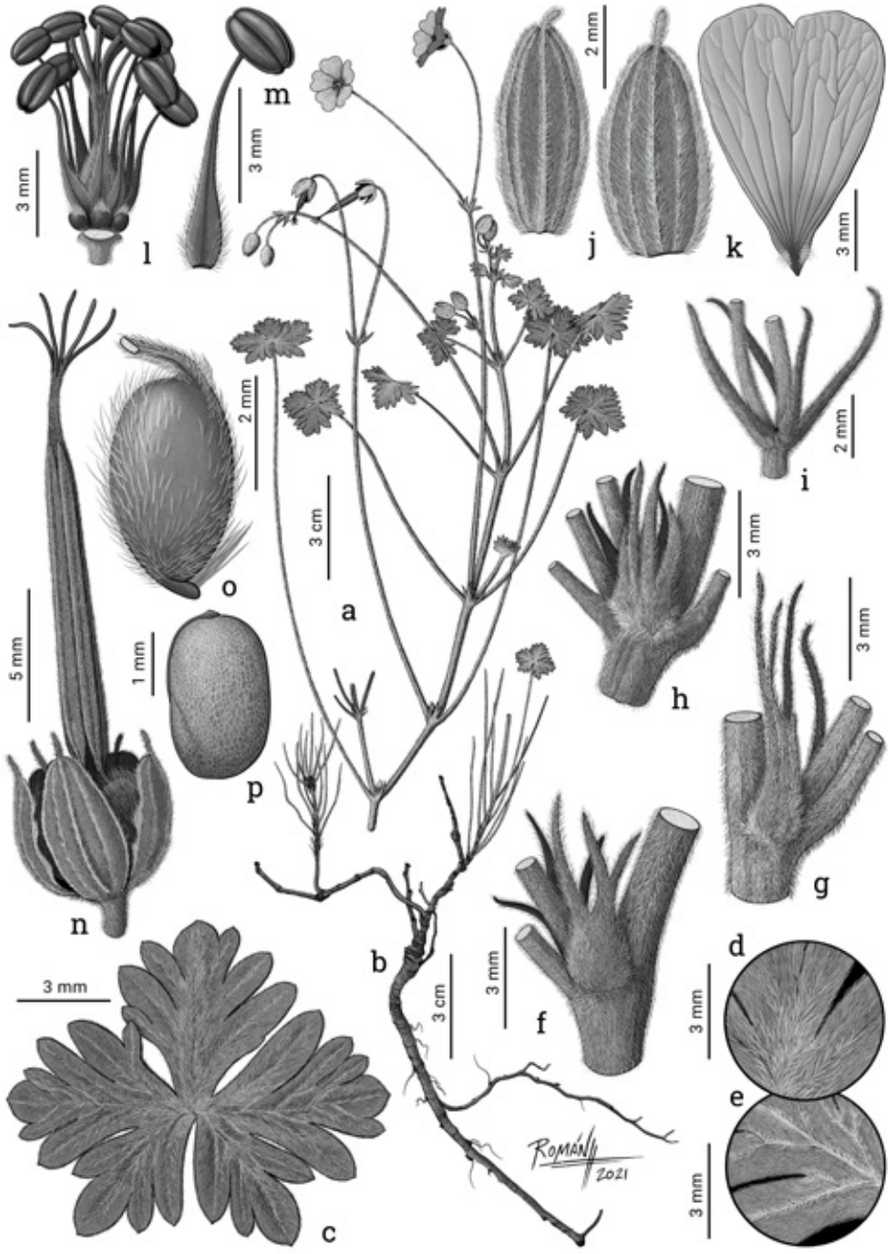


Fig. 609. *Geranium harveyi*. a, b. Habit. c. Leaf. d. Detail of the adaxial surface of the leaf. e. Detail of the abaxial surface of the leaf. f-h. Stipules. i. Bracteoles. j. Sepals. k. Petal. l. Flower without sepals and petals. m. Stamen. n. Fruit. o. Mericarp. p. Seed. (Based on: a-c, f, h, j, k, *Bengis 388*, PRE; d, e, g, i, l, m, *Hilliard & Burtt 14780*, NU; n-p, *Moffett 2892*, NU).

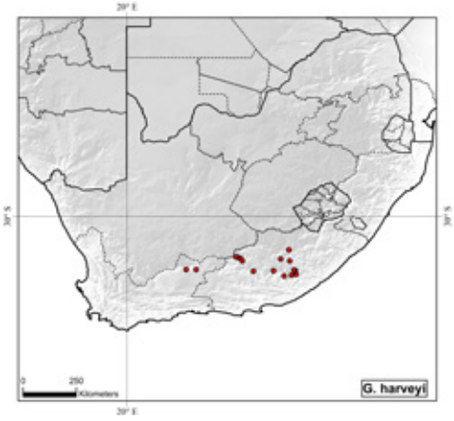


Fig. 610. Distribution of *Geranium harveyi*.

According to Hilliard & Burtt (1985: 188), some specimens of *G. harveyi* can have glandular hairs on pedicels or sepals. These specimens, which also have longer petals have been reidentified as *G. drakensbergense*, leaving *G. harveyi* as a species with eglandular indumentum. For more details see the discussion of *G. drakensbergense*.

241. Geranium canescens L'Hér. in Aiton, Hort. Kew. 2: 433. 1789. Type locality: "L'Herit. n. 12. tab. 38... Nat. of the Cape of Good Hope, Mr. Fr. Masson. Introd. 1787". Type: South Africa. Prom. bon. spei, 34°10'S, 18°25'E, *C.P. Thunberg s.n.* (lectotype, first-step, designated by Hilliard & Burtt 1985: 189, G-DC (microfiche 246), G-DC-00214926!, second-step, here designated).

Geranium glandulosum Lehm. ex Eckl. & Zeyh., Enum. Pl. Afr. Austral. 1: 58. 1834-35, nom. illeg., non Cav. 1788. Type locality: "Humidis fruticum non procul a pago 'Sommerset' in 'Hottentottsholland' (Stellenbosch). Oct.". Type: South Africa. Western Cape, pago Sommerset in Hottentottsholland, Stellenbosch, 34°04'S, 18°51'E, *C.F. Ecklon & C.L. Zeyher 447* (lectotype, designated by Hilliard & Burtt 1985: 189, S-G-2848 image!; isolectotype, SAM).

Perennial herbs, 24-70 cm tall. *Rootstock* 2.4-2.6 mm in diameter, ± vertical, not tuberculate, not turnip-shaped, without thickened roots. *Stem* ascending to suberect, leafy, not rooting at nodes, stolons absent, without vegetative stems, with retrorse, appressed, eglandular hairs 0.2-0.6 mm long. *Basal leaves* unknown, cauline leaves alternate and upper opposite; leaf laminas (1.2)2-3.3(3.8) cm long, 1.4-4.4 cm wide, not peltate, palmatifid [ratio main-sinus length/middle segment length = 0.75-0.86(0.88)], polygonal in outline, base cordate, not coriaceous, with nerves not projected, densely covered with greyish-white, eglandular hairs on the adaxial surface, silky-canescent on the abaxial surface; segments 5, in 1 plane, middle segment rhombic, (1.1)2.1-5.3(6.7) mm wide at the base [ratio segment width at the base/middle segment length = (0.08)0.17-0.24(0.26)], 5-11-lobed in distal half [ratio secondary sinus length/middle segment length = (0.17)0.22-0.28(0.29)]; petioles up to 12 cm long, without abscission zone, terete, not swollen, not deflexed in age, with retrorse, appressed, eglandular hairs 0.2-0.5 mm long; stipules 3.7-8.4 mm long, 1.1-4.5 mm wide, 2-3-fid, with linear lobes 2.6-6.6 mm deep, 0.3-0.6 mm wide, free, papery, brown, with eglandular hairs on abaxial surface, ± glabrous adaxially. *Inflorescence* a monochasial cyme; cymules 2-flowered, solitary [ratio cymule length/leaf length = 1.6-4.4]; peduncles (19)33-80(114) mm long, with patent to retrorse, eglandular hairs 0.2-0.4 mm long and patent, glandular hairs 0.2-0.8 mm long; bracteoles 2.7-6.4 mm long, 0.2-0.7 mm wide, linear-lanceolate, whorled; pedicels (22)27-34(45) mm long, with patent to retrorse, eglandular hairs 0.2-0.4 mm long and patent, glandular hairs 0.3-0.7 mm long. Flowers actinomorphic. *Sepals* (6.5)6.9-7.6(10) mm long, 2.2-3.4 mm wide, lanceolate, smooth, not accrescent, nerves 3, mucro (0.4)0.5-0.9(1) mm long [ratio mucro length/sepal length = 0.07-0.12(0.14)], silky-canescent, with appressed eglandular hairs 0.2-0.4 mm long and patent, glandular hairs 0.4-0.7 mm long on the abaxial surface, glabrous adaxially. *Petals* (6.2)6.3-7.5(8.5) mm long, (3)3.2-4.4 mm wide, erect-patent, slightly emarginate (notch 0.1-0.8 mm deep), without claw, white, hairy on the base of the adaxial surface, glabrous abaxially, ciliate on the basal margin, with hairs 0.2-0.4 mm long. *Stamens* 10, both whorls bearing anthers; filaments (3.4)3.9-5.8(5.9) mm long, lanceolate, unknown color, with scattered eglandular hairs 0.2-0.3 mm long on the abaxial surface and margin; anthers 0.9-1.4 mm long, unknown color. Nectaries 5, hemispheric, with a tuft of hairs at the top, dorsally glabrous. *Gynoecium* 3.8-6.2 mm long, unknown color. *Fruit* (17.4)18-24(26.7) mm long, erect, discharge of seed-ejection type; mericarps 2.9-3.9 mm long, 1.5-2.2 mm wide, without a strand of fibers, not compressed at the apex, smooth, without basal beak, with a basal callus, without a basal prong, brown, with ± patent, eglandular hairs 0.3-1.1 mm long and patent, glandular hairs 0.4-0.9 mm long; rostrum 11.6-19.4 mm long, with a narrowed apex 1.7-2.9 mm long, not twisted, with patent, eglandular hairs 0.2-0.4 mm long and patent, glandular hairs 0.3-0.8 mm long; stigmatic remnants 1.2-2.4 mm long, with 5 glabrous lobes. *Seeds* 2-2.4 mm long, 1.2-1.6 mm wide, finely reticulate, uniformly colored, brown, glabrous. Cotyledons with entire margin. Fig. 611.

Pollen. *Geranium*-type (Bortenschlager 1967: 431; Verhoeven & Venter 1992: 441, 442).

Chromosome number. Unknown.

Phenology. Collected in flower from September to November.

Distribution. This species ranges through southwestern Western Cape, plus an isolated locality in Northern Cape, in South Africa (Fig. 612).

Habitat. Dry slopes, streambanks and roadsides; 200-1550 m.

Additional specimens examined. **South Africa.** Northern Cape: Fraseburg, Riethuisies, on way from farmhouse to Spitzkop, 32°16'S, 21°27'E, 1 Apr. 1994, *Bruyns 5991* (BOL). Western Cape: Worcester, Du Toits Peak, 33°45'S, 19°10'E, 4 Nov. 1951, *Esterhuysen 19219* (BOL, PRE); Stellenbosch, 33°56'S, 18°52'E, Nov. 1912, *Worsdell s.n.* (K); Biesievlei, Jonkershoek, 33°57'S, 18°56'E, 11 Oct. 1945, *Rycroft 1004* (PRE); Cape Peninsula, Orange Kloof, 33°59'S, 18°23'E, Oct. 1946, *Power 32265* (BOL); Cape Peninsula, Orange Kloof, 33°59'S, 18°23'E, 16 Oct. 1932, *Salter 2821* (BM); Cape Peninsula, N slope of Vlakkenberg, 34°1'S, 18°23'E, 8 Sep. 1952, *Salter 9075* (BM, MO); farm Rustenburg, 34°2'S, 18°47'E, 6 Sep. 1946, *Strey & al. 839* (M); Caledon district, Palmiet Rivier, 34°8'S, 19°3'E, 13 Oct. 1894, *Schlechter 5419* (C, MO, Z); Keermoskloof, Salmonsdam Nature Reserve, Stanford, 34°25'S, 19°39'E, 11 Sep. 1981, *Hugo 2628* (MO); Pearl mountain, 34°39'S, 19°29'E, Oct. 1886, *Cummings 112* (NY, US).

Discussion. Geranium canescens is a perennial herb similar to *G. harveyi*, with a spreading, suberect to ascending stem. The stem is branched from the base, somewhat lignified in the lower part and naked or with the remains of stipules, apparently without rosette. However, these data should be taken with caution because they are based on a single complete herbarium specimen [that is in agreement with the description provided by Hilliard & Burtt (1985: 189)]. In contrast to *G. harveyi*, the inflorescence of *G. canescens* has glandular hairs on peduncles, pedicels, sepals and fruits. The leaves of *G. canescens* are quite similar those of *G. harveyi* in outline and lobe division, but as stated by Hilliard & Burtt (1985: 188) they are "more markedly discolorous than those of *G. harveyi* and the indumentum is thinner (the leaf blade is often visible through the hairs on the lower surface)". On the upper surface the indumentum is also less dense than in *G. harveyi*. The stipules of *G. canescens* are bifid or trifid with narrow and deep lobes. Additional differences between *G. canescens* and *G. harveyi* are the longer sepals, shorter and white petals of the former. The specimen *Bruyns 5991* (BOL) has a less dense indumentum on the abaxial surface but otherwise fit well with *G. canescens*.

Hilliard & Burtt (1985: 189) designated the lectotype of *G. canescens* on the herbarium G-DC, but did not indicate which specimen of the three included in the "microfiche 246" was the type. One of these specimens is G-DC-00214926 that, according to N. Fumeaux (*in litt.*), has the annotation of "Prom. bon. spei Thunberg" on the back of the sheet, and, the annotation of "G. canescens Lh" on the front, handwritten by L'Héritier. Furthermore, it seems to be used to prepare the drawing mentioned in the protologue (L'Héritier 1792, tab. 38). Consequently, I selected such specimen as lectotype in second step.

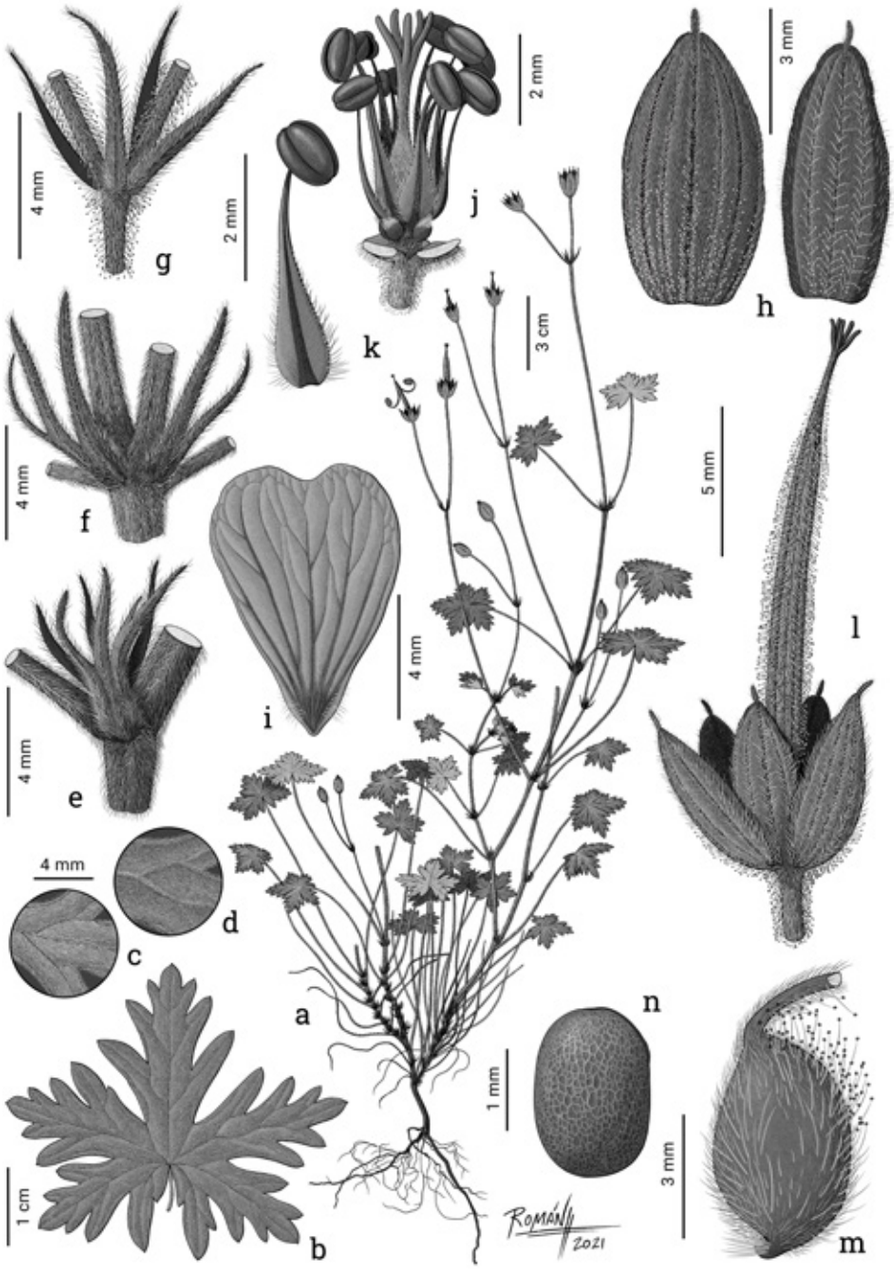


Fig. 611. *Geranium canescens*. a. Habit. b. Leaf. c. Detail of the adaxial surface of the leaf. d. Detail of the abaxial surface of the leaf. e, f. Stipules. g. Bracteoles. h. Sepals. i. Petal. j. Flower without sepals and petals. k. Stamen. l. Fruit. m. Mericarp. n. Seed. (Based on: a, f, g, l-m, *Rycroft 1004*, PRE; b-e, *Salter 32365*, BOL; h-k, n, *Esterhuysen 19219*, BOL).

Fig. 612. Distribution of *Geranium canescens*.

242. Geranium drakensbergense Hilliard & B.L. Burtt, Notes Roy. Bot. Gard. Edinburgh 42(2): 190, 173 fig. 1 H. 1985. Type locality: "Natal, Underberg distr., 2929 CB, Cobham Forest Reserve, ridge above Upper Polela Cave, c. 2285m, 22 xi 1976, Hilliard & Burtt 9323 (NU holo.; E, K, MO, S, STE iso.)". Type: South Africa. KwaZulu-Natal, Underberg distr., Cobham Forest Reserve, ridge above Upper Polela Cave, 29°40'S, 29°20'E, 22 Nov. 1976, *O.M. Hilliard & B.L. Burtt 9323* (holotype, NU-0015561-0 image!; isotypes, E-00200417!, K!, MO-2424570!, NBG-STE, S).

Perennial herbs, 20-47 cm tall. *Rootstock* ca. 6 mm in diameter, ± horizontal, not tuberculate, not turnip-shaped, without thickened roots. *Stem* ascending to suberect, leafy, not rooting at nodes, stolons absent, without vegetative stems, with retrorse, appressed, eglandular hairs 0.3-0.6 mm long. *Basal leaves* unknown, cauline leaves alternate and upper opposite; leaf laminas (1.9)2.2-2.7(4.2) cm long, 2.7-4.7 cm wide, not peltate, deeply palmatifid [ratio main-sinus length/middle segment length = (0.74)0.87-0.94(0.97)], polygonal in outline, base cordate, not coriaceous, with nerves not projected, with sparse appressed, eglandular hairs (rarely sericeous) on the adaxial surface and sericeous (rarely densely hairy) on the abaxial surface; segments 5, in 1 plane, middle segment rhombic, (0.8)1.2-2.7(4.2) mm wide at the base [ratio segment width at the base/middle segment length = 0.06-0.19(0.24)], (5)8-11(14)-lobed in distal half [ratio secondary sinus length/middle segment length = (0.23)0.33-0.42(0.47)]; petioles up to 18 cm long, without abscission zone, terete, not swollen, not deflexed in age, with retrorse, appressed, eglandular hairs 0.2-0.5 mm long; stipules 6.4-10.5 mm long, 1.9-5.6 mm wide, 2-4-fid, with linear lobes 4-8.2 mm deep, 0.4-1.1 mm wide, free, papery, brown, with eglandular hairs on abaxial surface, ± glabrous adaxially. *Inflorescence* a monochasial cyme; cymules 2-flowered, solitary [ratio cymule length/leaf length = (1.5)2.2-3.9(9.1)]; peduncles (29)51-89(125) mm long, with retrorse, ± appressed, eglandular hairs 0.2-0.6 mm long and, usually, patent, glandular hairs 0.3-0.9 mm long; bracteoles 3.9-8 mm long, 0.6-1.2 mm wide, linear-lanceolate, whorled; pedicels (11)23-44(61) mm long, with retrorse, ± appressed, eglandular hairs 0.2-0.4 mm long and patent, glandular hairs 0.2-0.9 mm long. Flowers actinomorphic. *Sepals* (6.1)7.3-7.9(8.8) mm long, 2.2-3.9 mm wide, lanceolate, smooth, not accrescent, nerves 3, mucro (0.5)0.8-0.9(1.1) mm long [ratio mucro length/sepal length = (0.07)0.11-0.13(0.15)], with appressed to ± patent, eglandular hairs 0.2-0.5 mm long and, patent, glandular hairs 0.3-0.9 mm long on the abaxial surface, glabrous adaxially. *Petals* (10.8)12.4-16.6(18.2) mm long, (6.7)8.1-11.9(12.8) mm wide, erect-patent, emarginate (notch 0.4-2.2 mm deep), without claw, purple, hairy on the base of the adaxial surface, glabrous abaxially, ciliate on the basal margin, with hairs 0.4-0.9 mm long. *Stamens* 10, both whorls bearing anthers; filaments (4.6)5.1-6.1(8.4) mm long, lanceolate, yellow, with eglandular hairs 0.1-0.6 mm long on the abaxial surface and margin; anthers (1.2)1.6-2(2.3) mm long, yellow. Nectaries 5, hemispheric, with a tuft of hairs at the top, dorsally glabrous. *Gynoecium* 5.2-8.9 mm long, purple. *Fruit* (23.7)25.2-26.2(28.3) mm long, erect, discharge of seed-ejection type; mericarps 3.4-4.5 mm long, 1.6-2.1 mm wide, without a strand of fibers, not compressed at the apex, smooth, without basal beak, with a basal callus, without a basal prong, brown, with erect-patent, eglandular hairs 0.5-0.9 mm long and patent, glandular hairs 0.4-0.7 mm long; rostrum 15.3-20.1 mm long, with a narrowed apex 1-3.9 mm long, not twisted, with patent, eglandular hairs 0.1-0.3 mm long and patent, glandular hairs 0.5-0.7 mm long; stigmatic remnants 2.7-3.3 mm long, with 5 glabrous lobes. *Seeds* 2.2-2.7 mm long, 1-1.6 mm wide, finely reticulate, uniformly colored, brown, glabrous. Cotyledons with entire margin. Fig. 613.

Pollen. *Geranium*-type (Verhoeven & Marais 1990: 168; Verhoeven & Venter 1992: 441, 442).

Chromosome number. Unknown.

Phenology. Collected in flower from October to February.

Distribution. This species ranges from central Eastern Cape to Lesotho and southern KwaZulu-Natal, in South Africa (Fig. 614).

Habitat. Moist and shade places at foot of cliffs and along streams; 1200-2850 m.

Additional specimens examined. **Lesotho.** Qacha's Nek: Sani pass Lodge, 30°8'S, 28°40'E, 3 Feb. 1982, *Hedberg & Hedberg 82151* (UPS). **South Africa.** Eastern Cape: Green Mountain, 30 km N of Adelaide, 32°26'S, 26°17'E, 19 Jan. 1981, *Plowes 6058* (MO); Somerset East, Boschberg, 32°41'S, 25°32'E, 24 Oct. 1980, *Hilliard & Burtt 13216* (MO, NU); Somerset Oos, Bosberg, 32°41'S, 25°32'E, Nov. 1967, *Van der Walt 247* (PRE). KwaZulu-Natal: Underberg, Gxalingenwa valley, between Sani Pass and Polela, 29°38'S, 29°23'E, 11 Dec. 1983, *Hilliard & Burtt 17191* (E, M, MO, UPS); Underberg district, Chameleon Cave area, 5 miles N of Castle View farm, 29°39'S, 29°16'E, 1 Dec. 1984, *Hilliard & Burtt 17777* (E, K, PRE); Underberg, Cobham Forest Reserve, Lakes cave area, 29°40'S, 29°20'E, 12 Dec. 1982, *Hilliard & Burtt 15913* (E, K, MO, NU); Underberg district, Garden Castle Forest Reserve, Mlambonja valley, 29°44'S, 29°14'E, 5 Jan. 1982, *Hilliard & Burtt 14895* (E, MO, NU, PRE); Underberg, Bushman's Nek, Thamathu Cave, 29°49'S, 29°9'E, 6 Feb. 1976, *Hilliard & Burtt 9007* (E, K, NU).

Discussion. Geranium drakensbergense is a perennial herb with a suberect to ascending stem, branched from the base. The branch bases are usually naked or with the remains of stipules and petioles, and ending sometimes in tufts of leaves. The leaf lamina is deeply palmatipartite but the divisions do not reach the base.

Geranium drakensbergense is also well characterized by its long and wide petals and the glandular indumentum of the inflorescence.

The stem and petioles of *G. drakensbergense* are covered by sparse appressed, retrorse, eglandular hairs. On the inflorescence there are also patent, glandular hairs, especially on pedicels and sepals. The leaves are usually discolour, covered by sparse appressed eglandular on the adaxial surface and sericeous on the abaxial surface. Some specimens (i.e.: *Hilliard and Burtt 9007*, K, NU), however, are less hairy below, but otherwise fit well with the type, as noted Hilliard & Burtt (1985: 191).

Around of Bosberg, some 500 km southwest of the range of *G. drakenbergense*, some distinctive plants grow that deserve a special comment [*Hilliard & Burtt 13216* (NU), *Van der Walt 247* (PRE) and *MacOwen 289* (K, W, WU)]. These specimens were identified by Hilliard & Burtt (1985: 188) as *G. harveyi*. Although the indumentum of their leaves and stems is very similar to that of *G. harveyi*, these plants differ in several important characters, to include them in that species. They have significantly longer sepals and petals that *G. harveyi* and glandular hairs on the inflorescence (never found in *G. harveyi*). Bosberg plants could be separated from *G. drakensbergense* because they have a denser indumentum on stem and petioles, and especially on the adaxial surface of the leaf lamina. The leaf lamina is somewhat less divided than *G. drakensbergense* but with some overlap. The habit and fruit are not well known. All of these characters, however, do not seem very robust considering the variability of *G. drakensbergense*. Therefore these specimens are included here in *G. drakensbergense* with some doubts, awaiting further collections to clarify whether they deserve to be described as a new species.

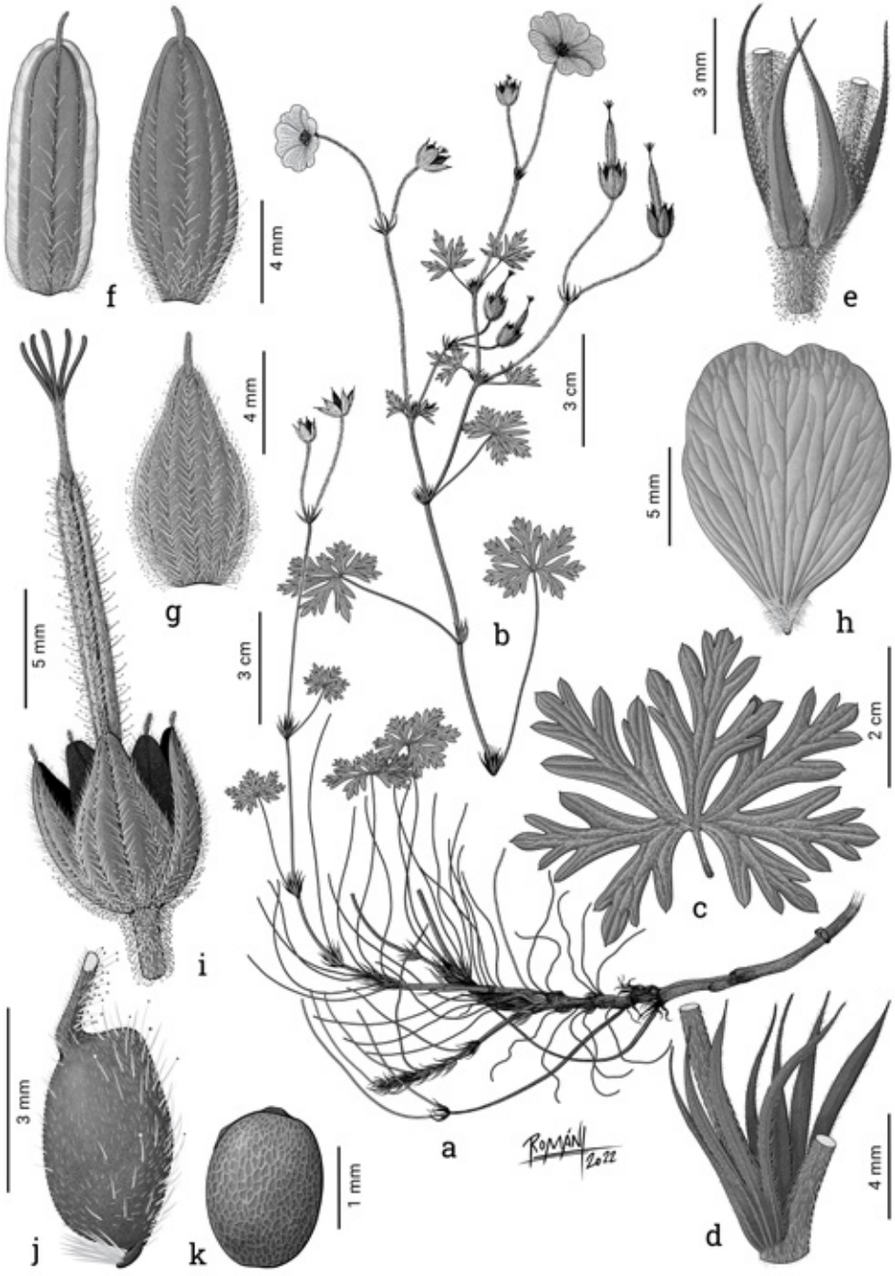


Fig. 613. *Geranium drakensbergense*. a, b. Habit. c. Leaf. d. Stipules. e. Bracteoles. f, g. Sepals. h. Petal. i. Fruit. j. Mericarp. k. Seed. (Based on: a, b, g, *Hilliard & Burtt 14895*, NU; c, *Hilliard & Burtt 17191*, E; d-f, h-k, *Hilliard & Burtt 9007*, NU).

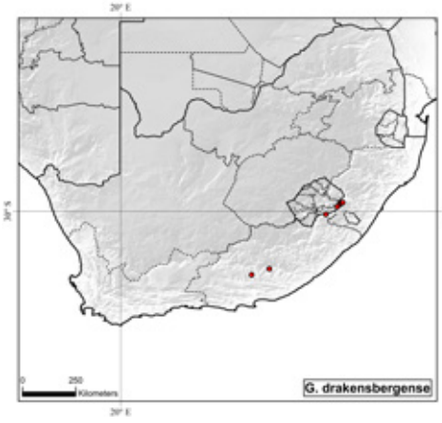


Fig. 614. Distribution of *Geranium drakensbergense*.

243. Geranium angustipetalum Hilliard & B.L. Burtt, Notes Roy. Bot. Gard. Edinburgh 42(2): 185, 173 fig. 1 J. 1985. Type locality: "Natal, Underberg distr., 2929 CC, Bushman's Nek, Thamathu cave, 2285m, 6 ii 1976, Hilliard & Burtt 9006 (NU holo.; E, STE iso.)". Type: South Africa. KwaZulu-Natal, Underberg, Bushman's Nek, Thamathu cave, 29°49'S, 29°09'E, 6 Feb. 1976, *O.M. Hilliard & B.L. Burtt 9006* (holotype, NU-0015562-0 image!; isotypes, E-00200450!, NBG-0199115-0 image!, STE).

Perennial herbs, 36-42 cm tall. *Rootstock* and roots unknown. *Stem* ascending to suberect, leafy, not rooting at nodes, stolons absent, without vegetative stems, with retrorse, appressed, eglandular hairs 0.3-0.8 mm long. *Basal leaves* unknown, cauline leaves alternate and upper opposite; leaf laminas 1.9-3.4 cm long, 2.4-3.8 cm wide, not peltate, palmatifid [ratio main-sinus length/middle segment length = 0.73-0.85], polygonal in outline, base cordate, not coriaceous, with nerves not projected, with sparse appressed, eglandular hairs on the adaxial surface and sericeous (or grey-sericeous) on the abaxial surface; segments 5, in 1 plane, middle segment rhombic, 3.2-4 mm wide at the base [ratio segment width at the base/middle segment length = 0.18-0.25], 5-13-lobed in distal half [ratio secondary sinus length/middle segment length = 0.21-0.27]; petioles up to 15 cm long, without abscission zone, terete, not swollen, not deflexed in age, with retrorse, appressed, eglandular hairs 0.2-0.6 mm long; stipules 9-9.3 mm long, 3.2-6.3 mm wide, 3-5-fid, with linear lobes 5.8-6.7 mm deep, 0.3-0.6 mm wide, free, papery, brown, with eglandular hairs on abaxial surface, ± glabrous adaxially. *Inflorescence* a monochasial cyme; cymules 2-flowered, solitary [ratio cymule length/leaf length = 1.6-3.6]; peduncles 35-110 mm long, with retrorse, ± appressed, eglandular hairs 0.3-0.8 mm long and patent, glandular hairs 0.5-1 mm long; bracteoles 4.3-6.3 mm long, 0.7-0.9 mm wide, linear-lanceolate, whorled; pedicels 24-43 mm long, with retrorse, ± appressed, eglandular hairs 0.2-0.5 mm long and patent, glandular hairs 0.4-1.1 mm long. Flowers actinomorphic. *Sepals* 6-6.5 mm long, 2.1-3.1 mm wide, lanceolate, smooth, not accrescent, nerves 3, mucro 0.9-1.1 mm long [ratio mucro length/sepal length = 0.15-0.19], with appressed to ± patent, eglandular hairs 0.2-0.8 mm long and patent, glandular hairs 0.6-1.5 mm long on the abaxial surface, glabrous adaxially. *Petals* 8.6-12.2(13.5) mm long, 4.6-6.4 mm wide, erect-patent, slightly

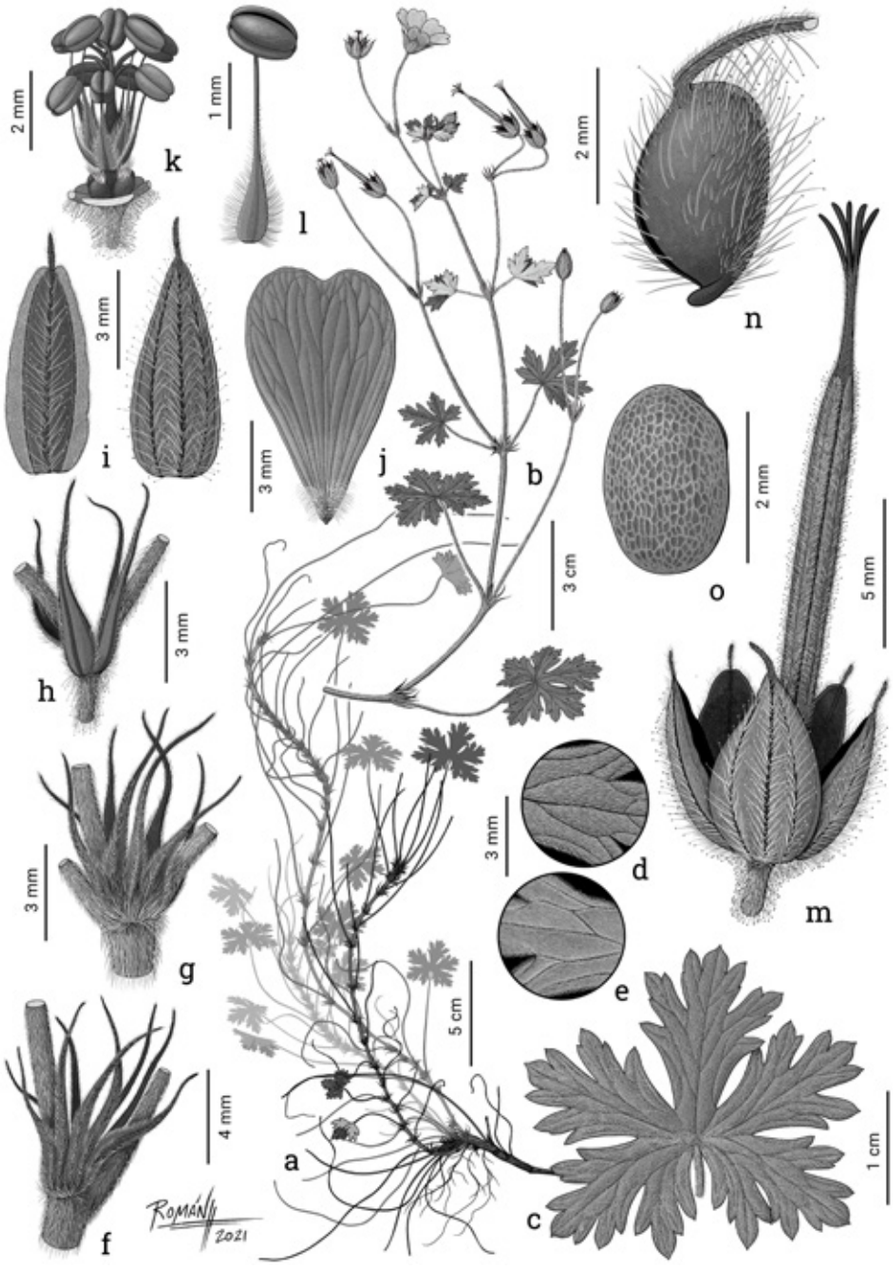


Fig. 615. *Geranium angustipetalum*. a, b. Habit. c. Leaf. d. Detail of the adaxial surface of the leaf. e. Detail of the abaxial surface of the leaf. f, g. Stipules. h. Bracteoles. i. Sepals. j. Petal. k. Flower without sepals and petals. l. Stamen. m. Fruit. n. Mericarp. o. Seed. (Based on: a-g, i, m-o, *Hilliard & Burtt 9006*, E; h, j-l, *Matcher 10*, NU).

Fig. 616. Distribution of *Geranium angustipetalum*.

emarginate (notch ca. 0.5 mm deep), without claw, purple, hairy on the base of the adaxial surface, glabrous abaxially, ciliate on the basal margin, with hairs ca. 0.5 mm long. *Stamens* 10, both whorls bearing anthers; filaments 3-4 mm long, lanceolate, yellow, with eglandular hairs 0.4-0.5 mm long on the abaxial surface and margin; anthers 1.2-1.3 mm long, yellow. Nectaries 5, hemispheric, with a tuft of hairs at the top, dorsally glabrous. *Gynoecium* 4-5 mm long, purple. *Fruit* 20-24 mm long, erect, discharge of seed-ejection type; mericarps 3.1-3.4 mm long, 1.2-1.8 mm wide, without a strand of fibers, not compressed at the apex, smooth, without basal beak, with a basal callus, without a basal prong, brown, with erect-patent, eglandular hairs 0.7-1 mm long and patent, glandular hairs 0.8-1 mm long; rostrum 16.5-16.8 mm long, with a narrowed apex 2.4-2.5 mm long, not twisted, with patent, eglandular hairs 0.2-0.3 mm long and patent, glandular hairs 0.9-1 mm long; stigmatic remnants 2.4-2.5 mm long, with 5 glabrous lobes. *Seeds* ca. 2.3 mm long, ca. 1.4 mm wide, finely reticulate, uniformly colored, brown, glabrous. Cotyledons not studied. Fig. 615.

Pollen. Ornamentation not studied.

Chromosome number. Unknown.

Phenology. Collected in flower in February.

Distribution. This species is endemic to KwaZulu-Natal, in South Africa (Fig. 616).

Habitat. Grassland at the foot of moist cliffs; 2300-2350 m.

Discussion. Geranium angustipetalum is a rare species known only from the type locality. This species is very similar to *G. drakensbergense*, from which it can be differentiated by the characters indicated below. *Geranium angustipetalum* has leaves a bit less divided with the middle segment wider at the base. Its sepals and petals are shorter and the latter narrower. In addition, the glandular hairs of the inflorescence, especially those of the sepals, are finer and longer that those of *G. drakensbergense*.

It would be useful to have more collections to know the variability of *G. angustipetalum* and check if the traits on which it is based are stable or if it could be included in the variability of *G. drakensbergense.* Until there are more collections, *G. angustipetalum* is recognized here with some doubts. It is interesting to note that *G. drakensbergense* is common in the area and has been collected in the same locality where *G. angustipetalum* has been described.

Despite its name, the petals of *G. angustipetalum* are not as narrow like those of *G. wakkerstroomianum*. *Geranium brycei*, with which it has sometimes been compared, is a much more robust plant, with larger, more deeply divided leaves that have a characteristic abaxial surface indumentum, and longer sepals and petals.

244. Geranium ornithopodioides Hilliard & B.L. Burtt, Notes Roy. Bot. Gard. Edinburgh 42(2): 220, 175 fig. 3 B. 1985. Type locality: "Natal, Pinetown distr., 2930 DD, Molweni kloof, c. 600 m, 12 x 1973, Hilliard & Burtt 6834 (NU holo., E iso.)". Type: South Africa. KwaZulu-Natal, Pinetown distr., Molweni kloof, 29°43'S, 30°54'E, 12 Oct. 1973, *O.M. Hilliard & B.L. Burtt 6834* (holotype, NU-0015566-0; isotype, E-00200412!).

Perennial herbs, 32-58 cm tall. *Rootstock* 3-4 mm in diameter, ± vertical, not tuberculate, not turnip-shaped, without thickened roots. *Stem* climbing, leafy, not rooting at nodes, stolons absent, without vegetative stems, with patent, eglandular hairs 1.5-2.6 mm long and patent, glandular hairs 0.6-1.8 mm long. *Basal leaves* in a deciduous rosette, cauline leaves alternate and upper opposite; leaf laminas (5.4)5.8-8.6(9.8) cm long, 5.9-10.6 cm wide, peltate, palmatifid [ratio main-sinus length/middle segment length = (0.59)0.62-0.70 (0.71)], polygonal in outline, base cordate, not coriaceous, with nerves not projected, with ± appressed, eglandular hairs on the adaxial surface and with ± long, spread, eglandular hairs, abaxially; segments 5, in 1 plane, middle segment rhombic, (12.6)13.4-18.9(21.1) mm wide at the base [ratio segment width at the base/middle segment length = (0.25)0.26-0.32], 7-11-lobed in distal half [ratio secondary sinus length/middle segment length = (0.13)0.14-0.16]; petioles up to 16 cm long, without abscission zone, terete, not swollen, not deflexed in age, with patent, eglandular hairs 1.9-2.4 mm long and patent, glandular hairs 0.7-1.5 mm long; stipules 8.1-11 mm long, 4.6-6.9 mm wide, 3-5-fid, with linear lobes 4.8-9 mm deep, 0.6-1.5 mm wide, free, papery, brown, with eglandular hairs on abaxial surface, ± glabrous adaxially. *Inflorescence* a monochasial cyme; cymules 2-flowered, solitary [ratio cymule length/leaf length = 1-2.2]; peduncles (27)30-71(90) mm long, with patent, eglandular hairs 1.1-2.5 mm long and patent, glandular hairs 0.8-1.6 mm long; bracteoles 4.4-5.9 mm long, 0.7-1 mm wide, linear-lanceolate, whorled; pedicels (10)14-22(23) mm long, with patent, eglandular hairs 0.5-2.3 mm long and patent, glandular hairs 1.1-1.8 mm long. Flowers actinomorphic. *Sepals* 6.5-8.3(9.2) mm long, 2.7-4.9 mm wide, lanceolate, smooth, not ac-

crescent, nerves 3, mucro 0.8-1.2(1.3) mm long [ratio mucro length/sepal length = 0.09-0.20], with ± appressed, eglandular hairs 0.2-0.9 mm long and patent, glandular hairs 1-1.2 mm long on the abaxial surface, glabrous adaxially. *Petals* (10.2)10.4-11.2(11.6) mm long, (5.2)5.3-6.2(6.4) mm wide, erect-patent, rounded, without claw, pink, hairy on the base of the adaxial surface, glabrous abaxially, ciliate on the basal margin, with hairs 0.5-0.6 mm long. *Stamens* 10, both whorls bearing anthers; filaments 6.3-6.8 mm long, lanceolate, unknown color, with eglandular hairs 0.2-0.3 mm long on the abaxial surface and margin; anthers 1.7-1.9 mm long, unknown color. Nectaries 5, hemispheric, glabrous. *Gynoecium* 6.8-7.3 mm long, unknown color. *Fruit* 27-31 mm long, erect, discharge of seed-ejection type; mericarps 4.5-4.6 mm long, 1.9-2.2 mm wide, without a strand of fibers, not compressed at the apex, smooth, without basal beak, with a basal callus, without a basal prong, black, with erect-patent, eglandular hairs 1.8-2.3 mm long and usually, patent, glandular hairs 0.6-1.1 mm long; rostrum 20-24 mm long, with a narrowed apex 3.5-4.3 mm long, not twisted, with ± patent, eglandular hairs 0.1-0.2 mm long and ± patent, glandular hairs 0.6-1.1 mm long; stigmatic remnants 1.6-2.1 mm long, with 5 hairy lobes. *Seeds* 2.7-2.8 mm long, 2.3-2.4 mm wide, finely reticulate, uniformly colored, brown, glabrous. Cotyledons with entire margin. Fig. 617.

Pollen. *Geranium*-type (Verhoeven & Venter 1992: 441, 442).

Chromosome number. Unknown.

Phenology. Collected in flower in October.

Distribution. This species is endemic to KwaZulu-Natal, in South Africa (Fig. 618).

Habitat. Grassland and edge of forest paths; 450-600 m.

Additional specimens examined. **South Africa.** KwaZulu-Natal: Pinetown distr., Krantz kloof, 29º44'S, 30º50'E, Oct. 1921, *Haygarth 22749* (PRE); Krantzkloof Nature Reserve, above Nkutu Gorge, 29º44'S, 30º50'E, 26 Oct. 2001, *Styles 70* (NU).

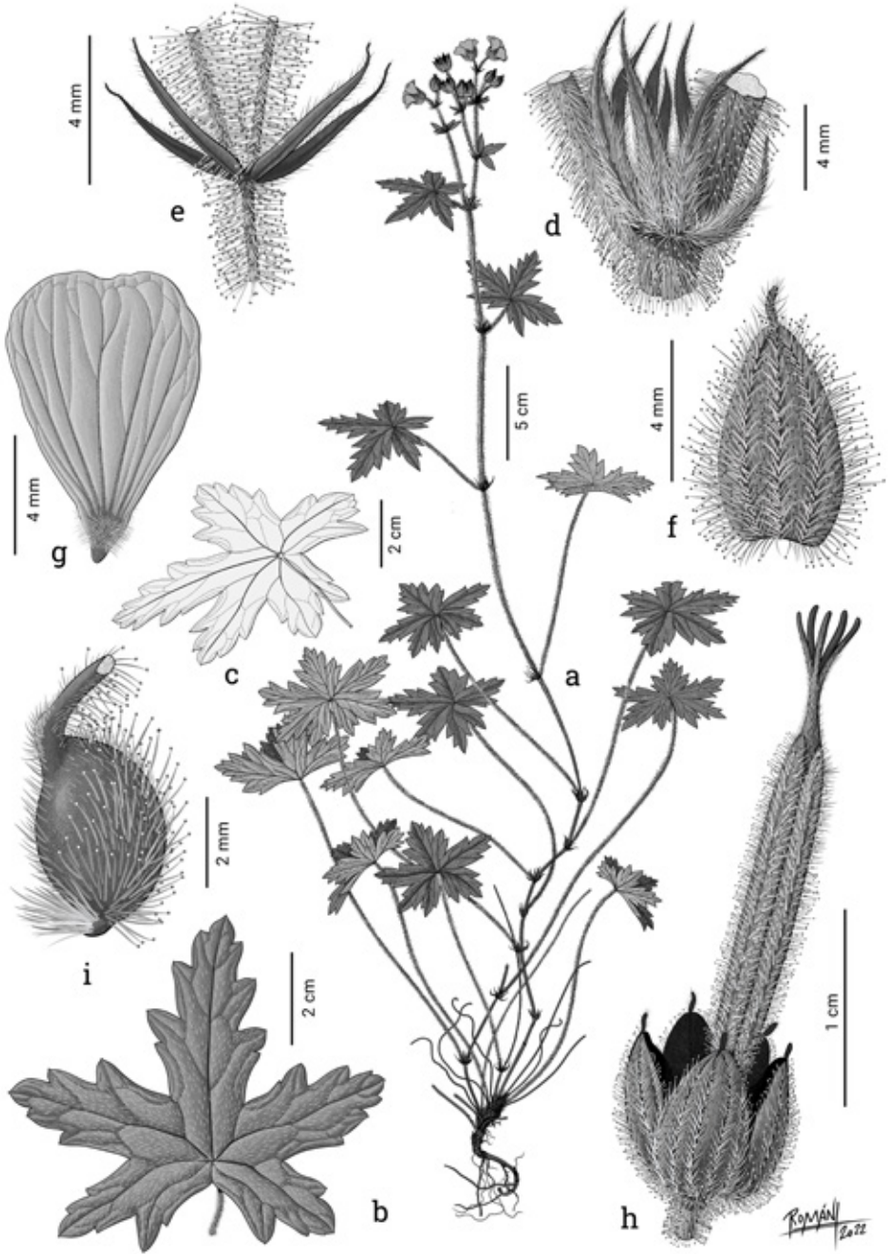


Fig. 617. *Geranium ornithopodioides*. a. Habit. b. Leaf, adaxial surface. c. Leaf, abaxial surface. d. Stipules. e. Bracteoles. f. Sepal. g. Petal. h. Fruit. i. Mericarp. (Based on: a, e, f, *Hilliard & Burtt 6834*, E; b, c, g, *Haygarth 22749*, PRE; d, h, i, *Styles 70*, NU).

Fig. 618. Distribution of *Geranium ornithopodioides*.

Discussion. Geranium ornithopodioides is a climbing herb that leans back on the surrounding vegetation. It has a weak vertical rootstock branching from the base into multiple aerial stems. The shape of its leaves resembles that of *G. ornithopodon*, except for a detail of great importance: the petiole is attached near the center of the blade, not at the margin as is the case in the rest of the known species of *Geranium*. *Geranium ornithopodioides* is also distinguished by a peculiar indumentum comprised of soft, long and patent, eglandular hairs, especially on the stem, petioles, peduncles and pedicels, which are accompanied by other somewhat shorter glandular hairs. These long, soft, eglandular hairs are also found on the abaxial surface of the leaves, where no glandular hairs have been observed.

According Scott-Shaw & von Staden (2007) there are three locations for this species, two inside the boundaries of Kranzkloof Nature Reserve and other in Umzinto district. The latter is an excessively transformed area where the presence of surviving specimen needs to be confirmed.

245. Geranium baurianum R. Knuth in Engl., Pflanzenr. IV.129 (Heft 53): 156. 1912. Type locality: "Kapland: Barzija, 1000 m (R. Baur, Austro-Afric. n. 182! -- Typus in herb. Berol.).-- Blühend Mai". Type: South Africa. Eastern Cape, Kapland, Baziya, 31°33'S, 28°25'E, *R. Baur 182* (holotype, B destroyed). South Africa. Eastern Cape, Baziya Mt., 31°33'S, 28°25'E, 10 Feb. 1981, *O.M. Hilliard & B.L. Burtt 13907* (neotype, here designated, K!; isoneotype, NU-0089048!).

Perennial herbs, 21-42 cm tall. *Rootstock* 4.8-13.4 mm in diameter, ± vertical, not tuberculate, turnip-shaped, with thickened roots along the rootstock. *Stem* procumbent to ascending, leafy, not rooting at nodes, stolons absent, without vegetative stems, with patent to retrorse, not appressed, eglandular hairs 0.5-1.5 mm long. *Basal leaves* in a ± persistent rosette, cauline leaves alternate and upper opposite; leaf laminas (1.7)2.2-3.8(4.9) cm long, 1.5-5.9 cm wide, not peltate, palmatifid [ratio main-sinus length/middle segment length = (0.28)0.32-0.43(0.47)], suborbicular in outline, base cordate, not coriaceous, with nerves not projected, subglabrous or with scattered, spread, eglandular hairs on the adaxial surface and with ± abundant, spread, eglandular hairs abaxially; segments 5, in 1 plane, middle segment obtriangular, (7)10.1-15.6(19.9) mm wide at the base [ratio segment width at the base/middle segment length = (0.50)0.58-0.75(0.78)], 5-8(9)-lobed in distal half [ratio secondary sinus length/middle segment length = (0.05)0.10-0.13(0.14)]; petioles up to 9 cm long, without abscission zone, terete, not swollen, not deflexed in age, with ± patent, eglandular hairs 0.2-1.4 mm long; stipules 3.8-6.3 mm long, 2-5.7 mm wide, (2)5-6-fid, with linear lobes 2.5-4.8 mm deep, 0.4-0.8 mm wide, free, papery, brown, with eglandular hairs on both surfaces and on the margin. *Inflorescence* a monochasial cyme; cymules 2-flowered, solitary [ratio cymule length/leaf length = (1.5)3-4(4.5)]; peduncles (20)22-48(91) mm long, with patent, eglandular hairs 0.4-1.1 mm long; bracteoles 3.7-6.1 mm long, 0.5-1.1 mm wide, linear-lanceolate, whorled; pedicels (11)14-30(47) mm long, with patent, eglandular hairs 0.4-1.1 mm long. Flowers actinomorphic. *Sepals* (6.2)7.1-7.9(9.4) mm long, 2.6-4.2 mm wide, lanceolate, smooth, not accrescent, nerves 3, mucro (0.6)0.7-1.1(1.5) mm long [ratio mucro length/sepal length = (0.09)0.11-0.13(0.23)], with ± patent, eglandular hairs 0.6-1.1 mm long and, rarely, patent, glandular hairs 0.7-0.9 mm long on the abaxial surface, glabrous adaxially. *Petals* (11.5)13.1-14(14.8) mm long, (6.3)6.5-8.1(9) mm wide, erect-patent, slightly emarginate (notch 0.3-1.3 mm deep), without claw, pale pink to light purple, hairy on the base of the adaxial surface, glabrous abaxially, ciliate on the basal margin, with hairs 0.4-0.7 mm long. *Stamens* 10, both whorls bearing anthers; filaments (3.7)4.7-5.6(5.7) mm long, lanceolate, yellow, pilose on the abaxial surface, ciliate on the proximal half, with hairs 0.2-0.5 mm long; anthers (1.3)1.4-1.5(1.7) mm long, yellow. Nectaries 5, hemispheric, glabrous. *Gynoecium* 4.4-6.6 mm long, yellow. *Fruit* (17)22.4-18.2(20) mm long, erect, discharge of seed-ejection type; mericarps 2.7-3.5 mm long, 1.3-2 mm wide, without a strand of fibers, not compressed at the apex, smooth, without basal beak, with a basal callus, without a basal prong, black, with erect to patent, eglandular hairs 0.4-0.9 mm long; rostrum 11-15.6 mm long, with a narrowed apex 1.9-3.1 mm long, not twisted, with ± patent, eglandular hairs 0.4-0.7 mm long and, rarely, scattered ± patent, glandular hairs 0.4-0.5 mm long; stigmatic remnants 1.9-2.7 mm long, with 5 glabrous lobes. *Seeds* 2.2-2.4 mm long, 1.4-1.7 mm wide, finely reticulate, uniformly colored, brown, glabrous. Cotyledons with entire margin. Fig. 619.

Pollen. *Geranium*-type (Verhoeven & Venter 1992: 440, 442).

Chromosome number. Unknown.

Phenology. Collected in flower from October to February.

Distribution. This species ranges from central Eastern Cape to southern KwaZulu-Natal, in South Africa (Fig. 620).

Habitat. Moist grassy mountain slopes, rocky grassland and forest edges; 0-1700 m.

Additional specimens examined. **South Africa.** Afr. Austr., *Drège s.n.* (K). Eastern Cape: Transkei, Tabankulu district, Tabankulu Mountain, 30°59'S, 29°21'E, 16 Nov. 1973, *Hilliard & Burtt 7268* (NU, PRE); near Ugie, forest reserve near Prentjiesberg, 31°8'S, 28°8'E, 12 Nov. 2000, *Potgieter 383* (NU); Elliot-Maclear district, boundary Bastervoetpad, 31°19'S, 28°4'E, 15 Feb. 1983, *Hilliard & Burtt 16697* (NU); Faku's Territory, 31°20'S, 29°30'E, 1864, *Sutherland s.n.* (K); Transkei, Satannas Nec, 31°35'S, 27°56'E, 10 Feb. 1981, *Hil-*

liard & Burtt 14537 (M, NU, PRE); Transkei, Tsolo district, above Mhlahlane, 31°53'S, 27°47'E, 17 Jan. 1984, *Hutchings 904* (NU); Los Tafelberg, 32°1'S, 26°40'E, Dec., *Drège 7513b* (PRE); Stockenstrom district, Katberg Pass, about 5 km from turnoff to hotel on road to Queenstwon, 32°27'S, 26°39'E, 23 Dec. 1980, *Germishuizen 1576* (PRE); Stockenstrom district, Katberg Pass, 32°27'S, 26°39'E, 26 Jan. 1979, *Hilliard & Burtt 12389* (K, NU); Amatole Mountains, below Gaikas Kop, 32°33'S, 26°56'E, 3 Dec. 1982, *Furness & Phillipson 70* (MO); Amatole Mountains, near Gaika's Kop, 32°33'S, 26°56'E, 17 Dec. 1984, *Phillipson 999* (MO, PRE); Stutterheim district, Thomas Mountain, 32°34'S, 27°14'E, 9 Dec. 1981, *Hilliard & Burtt 14791* (B, K, MO); Stutterheim district, Kabusie Forest, 32°35'S, 26°56'E, 20 Oct. 1980, *Hilliard & Burtt 13192* (K, M, NU); Alisa Farm, near summit of Kubusie Mountain, N slope, 32°37'S, 27°22'E, 11 Dec. 1995, *Victor 745* (PRE). KwaZulu-Natal: Weza State Forest, from King's Halt Hut to Ngeli Peak, 30°36'S, 29°39'E, 26 Jan. 1985, *Balkwill & al. 2728* (MO); Weza State Forest, Ingeli Peak, 30°36'S, 29°35'E, 19 Nov. 1986, *MacDevette 1299* (PRE); Alfred district, Zuuberg, 30°46'S, 29°5'E, 20 Nov. 1977, *Hilliard & Burtt 10543* (MO, PRE); Alfred district, Zuuberg, 30°46'S, 29°5'E, 29 Nov. 1973, *Hilliard & Burtt 7517* (K, MO, NU).

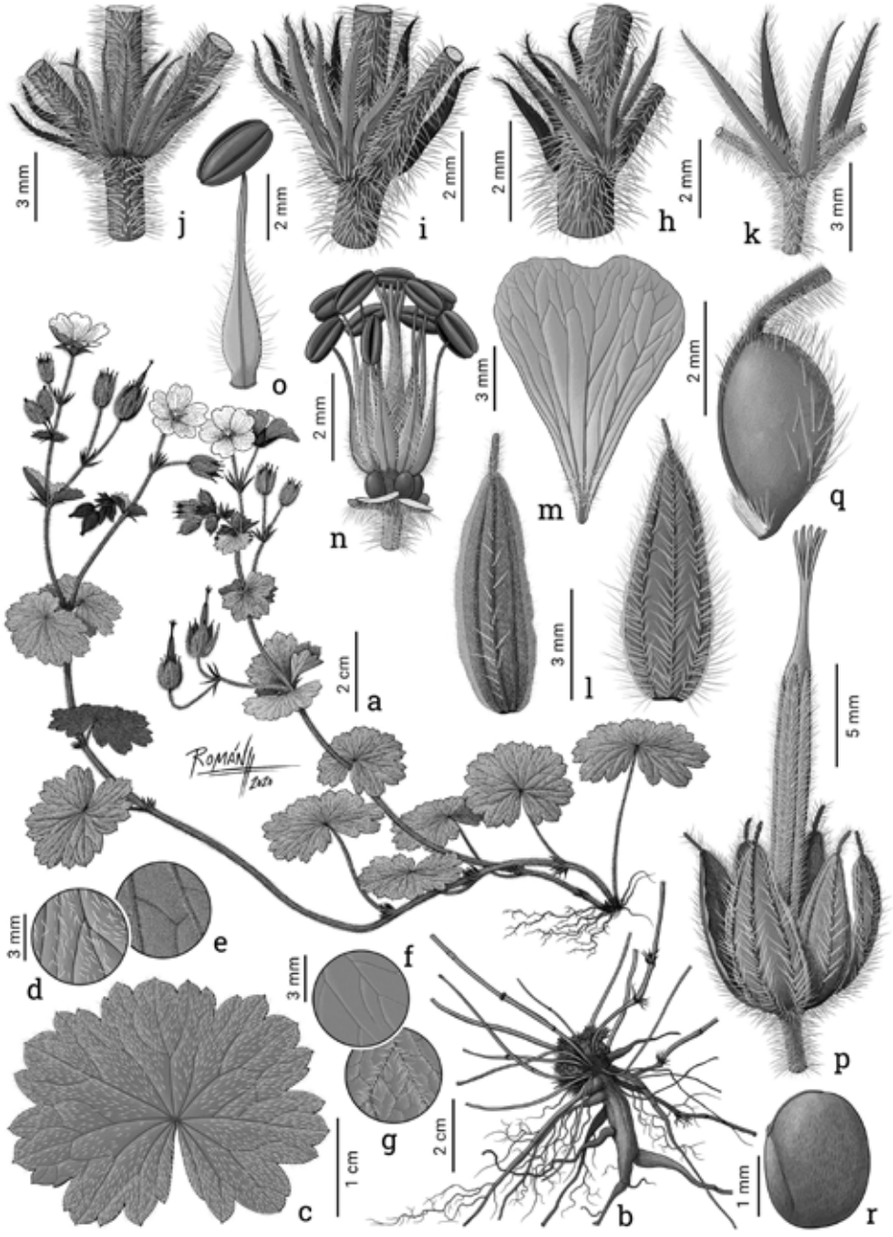


Fig. 619. *Geranium baurianum*. a, b. Habit. c. Leaf. d, f. Details of the adaxial surface of the leaf. e, g. Details of the abaxial surface of the leaf. h-j. Stipules. k. Bracteoles. l. Sepals. m. Petal. n. Flower without sepals and petals. o. Stamen. p. Fruit. q. Mericarps. r. Seed. (Based on: a, f, g, j-l, n, o, *Hilliard & Burtt 13192*, NU; b, c, *Hilliard & Burtt 13907*, K; d, e, m, p-r, *Hilliard & Burtt 12389*, K; h, *MacDevette 1299*, PRE; i, *Hilliard & Burtt 14537*, PRE).

Discussion. Geranium baurianum is easily recognized by its suborbicular leaves, shallowly divided and shortly petiolate or sessile on the medium and upper part of the shoot. The indumentum is predominantly eglandular. Some specimens can have glandular hairs on sepals, but not in all fragments of the collection. The indumentum of the leaves varies considerably in density. In buds or when young the leaves can be whitish because the dense indumentum. Normally the leaf lamina is subglabrous adaxially, with some hairs towards the margin, but some specimens have scattered to quite densely spread hairs all over of the surface. On the abaxial surface the indumentum is more dense but never sericeous. The stipules are flabellate in outline usually with 5-6, linear, deep lobes but, trifid stipules sometimes appear in some nodes. The rootstock is vertical and carrot-like, although not as thick as in some species from Australia and South America. The rootstock bears

Fig. 620. Distribution of *Geranium baurianum*.

several lateral thickened roots as well as other thin roots.

The holotype of *G. baurianum* was lost during the Berlin fire at 1943. No duplicate has been located in K, GRA, NU or PRE herbaria. Consequently, a neotype has been proposed from the Baur's original locality.

Geranium baurianum has sometimes been compared to *G. contortum* from which it is distinguished by its much less deeply divided leaves and its turnip-shaped rootstock. Additionally, *G. baurianum* has more divide stipules, shorter peduncles, and usually an eglandular indumentum.

246. Geranium amatolicum Hilliard & B.L. Burtt, Notes Roy. Bot. Gard. Edinburgh 42(2): 211, 174 fig. 2 E. 1985. Type locality: "E Cape, Stutterheim distr., 3227 CA/B, Thomas Mountain, c.4-4600ft, 9 xii 1981, Hilliard & Burtt 14788 (NU holo.; E, K, PRE, S, STE iso.)". Type: South Africa. Eastern Cape, Stutterheim distr., Thomas Mountain, 32°34'S, 27°14'E, 9 Dec. 1981, *O.M. Hilliard & B.L. Burtt 14788* (holotype, NU-0015565-0 image!; isotypes, E-00200413 image!, K-000417232-000417233!, NBG-0199120-0 image!, PRE-0715767-0 image!, S-09-11885 image!, STE).

Perennial herbs or subshrubs, 20-71 cm tall. *Rootstock* 5-6 mm in diameter, ± vertical, not tuberculate, not turnip-shaped, without thickened roots. *Stem* ascending to suberect, leafy, not rooting at nodes, stolons absent, without vegetative stems, with patent, eglandular hairs 0.1-0.7 mm long and, patent, glandular hairs 0.4-1.4 mm long. *Basal leaves* unknown, cauline leaves alternate and upper opposite; leaf laminas (2.7)3.8-4.7(6.9) cm long, 3-8.1 cm wide, not peltate, palmatifid [ratio main-sinus length/middle segment length = (0.66)0.72-0.80(0.84)], polygonal in outline, base cordate, not coriaceous, with nerves not projected, usually with spread, long and short, eglandular and glandular hairs on both surfaces, sometimes lacking some of them; segments 5, in 1 plane, middle segment rhombic, (5.77)6.2-13.5(13.9) mm wide at the base [ratio segment width at the base/middle segment length = (0.22)0.25-0.35(0.49)], 7-16(21)-lobed in distal half [ratio secondary sinus length/middle segment length = (0.14)0.15-0.21(0.24)]; petioles up to 14 cm long, without abscission zone, terete, not swollen, not deflexed in age, usually with patent, eglandular hairs 0.1-1 mm long and patent, glandular hairs 0.2-1.5 mm long, sometimes lacking some of them; stipules 5.6-14.3 mm long, 1.8-9 mm wide, 3-5-fid, with linear lobes 4.3-12 mm deep, 0.3-0.9 mm wide, free, papery, brown, with eglandular and glandular hairs on both surfaces and on the margin. *Inflorescence* a monochasial cyme; cymules 2-flowered, solitary [ratio cymule length/leaf length = (1.2)1.6-1.9(5)]; peduncles (37)62-80(145) mm long, usually with patent, eglandular hairs 0.1-0.4 mm long and patent, glandular hairs 0.2-1.6 mm long, sometimes lacking some of them; bracteoles 3.2-13.3 mm long, 0.4-1.2 mm wide, linear-lanceolate, whorled; pedicels (23)25-53(719 mm long, usually with patent, eglandular hairs 0.1-0.3 mm long and patent, glandular hairs 0.2-1.9 mm long, sometimes lacking some of them. Flowers actinomorphic. *Sepals* (7)8.4-9.7(11.3) mm long, 2.6-4 mm wide, lanceolate, smooth, not accrescent, nerves 3, mucro (1.7)2.4-3.2(3.6) mm long [ratio mucro length/sepal length = (0.21)0.26-0.36(0.42)], usually with patent, eglandular hairs 0.1-1.1 mm long and patent, glandular hairs 0.8-1.9 mm long, sometimes lacking some of them. *Petals* (12.6)13.6-18.4(19.9) mm long, (8.9)9-11.6(12.2) mm wide, erect-patent, slightly emarginate (notch 0.3-0.6 mm deep) or rounded, without claw, purple, hairy on the base of the adaxial surface, glabrous abaxially, ciliate on the basal margin, with hairs 0.4-0.7 mm long. *Stamens* 10, both whorls bearing anthers; filaments 5-9.2 mm long, lanceolate, yellow, pilose on the abaxial surface, ciliate on the proximal half, with hairs 0.2-0.6 mm long; anthers (1.5)1.7-2.2(2.5) mm long, yellow. Nectaries 5, hemispheric, usually glabrous. *Gynoecium* 6-10 mm long, purple. *Fruit* (21.9)24.2-28(29.4) mm long, erect, discharge of seed-ejection type; mericarps 3.4-5 mm long, 1.8-2.1 mm wide, without a strand of fibers, not compressed at the apex, smooth, without basal beak, with a basal callus, without a basal prong, black, with ± patent, eglandular hairs 0.9-1.6 mm long and patent, glandular hairs 0.5-3 mm long; rostrum 14.3-22.7 mm long, with a narrowed apex 2.3-4.4 mm long, not twisted, with patent, eglandular hairs 0.1-0.7 mm long and patent, glandular hairs 0.5-1 mm long; stigmatic remnants 2.2-3.6 mm long, with 5 sometimes hairy lobes. *Seeds* 2.1-2.4 mm long, 1.4-1.5 mm wide, finely reticulate, uniformly colored, brown, glabrous. Cotyledons with entire margin. Fig. 621.

Pollen. *Geranium*-type (Verhoeven & Venter 1992: 440, 442).

Chromosome number. Unknown.

Phenology. Collected in flower from October to January.

Distribution. This species ranges through central Eastern Cape, in South Africa (Fig. 622).

Habitat. Among rocks, along streams, steep slopes with trees and bushes and roadsides; 800-1650 m.

Additional specimens examined. **South Africa.** Eastern Cape: distric of Queenstown, 32°15'S, 26°1'E, 1860, *Cooper 432* (MA, BM, NY); Cathcart, Vindovogelberg, 32°17'S, 27°8'E, 8 Dec. 1981, *Hilliard & Burtt 14750* (B, K, MO, NU, PRE); Stockenstrom, division, forest below Katberg Pass, 32°27'S, 26°39'E, 26 Oct. 1946, *Esterhuysen 13228* (BOL); Katberg, 32°27'S, 26°39'E, Dec. 1893, *Galpin 1739* (PRE); Katberg Pass, 32°27'S, 26°39'E, 28 Oct. 1980, *Hilliard & Burtt 13260* (K, MO, NU, PRE); Bathurst district, Katberg mountain areas, 32°27'S, 26°39'E, Oct. 1963, *Sioey 3490* (M); Katberg Pass, 32°27'S, 26°39'E, 25 Nov. 1985, *Steiner 1104* (MO); Amatole Mountains, Gaika's Kop, 32°32'S, 26°56'E, 17 Dec. 1984, *Phillipson 1000* (MO); Seymour, Gaika's Kop, 32°32'S, 26°56'E, 13 Dec. 1985, *Phillipson & Hutchings 20* (MO); Stutterheim district, N end of Kabaku hills, 32°33'S, 27°26'E, 10

Oct. 1942, *Acocks 404* (K, PRE); Stutterheim distr., Thomas Mountain, 32º34'S, 27º14'E, 9 Dec. 1981, *Hilliard & Burtt 14796* (NU); Hogsback falls between Forester's office and arboretum, 32º35'S, 26º56'E, 11 Jan. 1960, *Comins 1856* (PRE); Hogsback Forest Reserve, Fort Beaufort, 60 mi NNE Grahamstown, 32º35'S, 26º56'E, 18 Oct. 1968, *Dahlstrand 1559* (GB, MO); Hogsback Forest Reserve, Fort Beaufort, 60 mi NNE Grahamstown, 32º35'S, 26º56'E, 25 Nov. 1969, *Dahlstrand 1804* (GB); Hogsback Forest Reserve, Fort Beaufort, 32º35'S, 26º56'E, 14 Jan. 1971, *Dahlstrand 2620* (GB, MO); Hogsback, above Kettlespout Falls, 32º35'S, 26º57'E, 9 Dec. 1977, *Hilliard & Burtt 10946* (PRE, NU); Amatole Mts, Menziesberg, 32º35'S, 26º53'E, 14 Dec. 1985, *Hilliard & Burtt 18824* (K, MO, NU); Seymour, Meanziesberg, 32º35'S, 26º53'E, 14 Dec. 1985, *Phillipson & Hutchings 118* (K, MO); Hogsback Forest Reserve, 32º35'S, 26º56'E, 29 Sep. 1976, *Stirton 6258* (PRE); Stutterheim district, Gubu Dam, 32º36'S, 27º16'E, 11 Dec. 1981, *Hilliard & Burtt 14802* (K, NU, PRE); Amatole Mts., near Hogsback, along Hogsback Pass, 32º36'S, 26º50'E, 9 Nov. 1984, *Phillipson 933* (MO, UPS).

Discussion. Geranium amatolicum is a perennial herb with a spreading stem suberect to ascending. The stem is branched from the base, somewhat lignified in the lower part and naked or with the remains of stipules, apparently without rosette. According to to Hilliard & Burtt (1985: 213) some specimens spread by means of overground stems (not rooting). This is not easy to check on herbarium sheets. Noticeably, the specimen *Stirton 6258* (PRE) is a fragment of a very robust plant, perhaps a subshrub. This is another example of how the habit and the underground parts of South African cranesbills are still poorly understood. The leaves of *G. amatolicum* are palmatifid and not deeply divided, the petals and the sepals are long, and the long sepal mucro is strongly characteristic. The indumentum of *G. amatolicum* is very variable. The specimens with long glandular hairs mixed with shorter ones, glandular and eglandular, are the most frequent. Sometimes the long glandular hairs disappear or become infrequent in some parts of the plant (for instance on the leaf lamina). As Hilliard & Burtt (1985: 213) noted, it is more frequent on plants from Hogsback area, but it

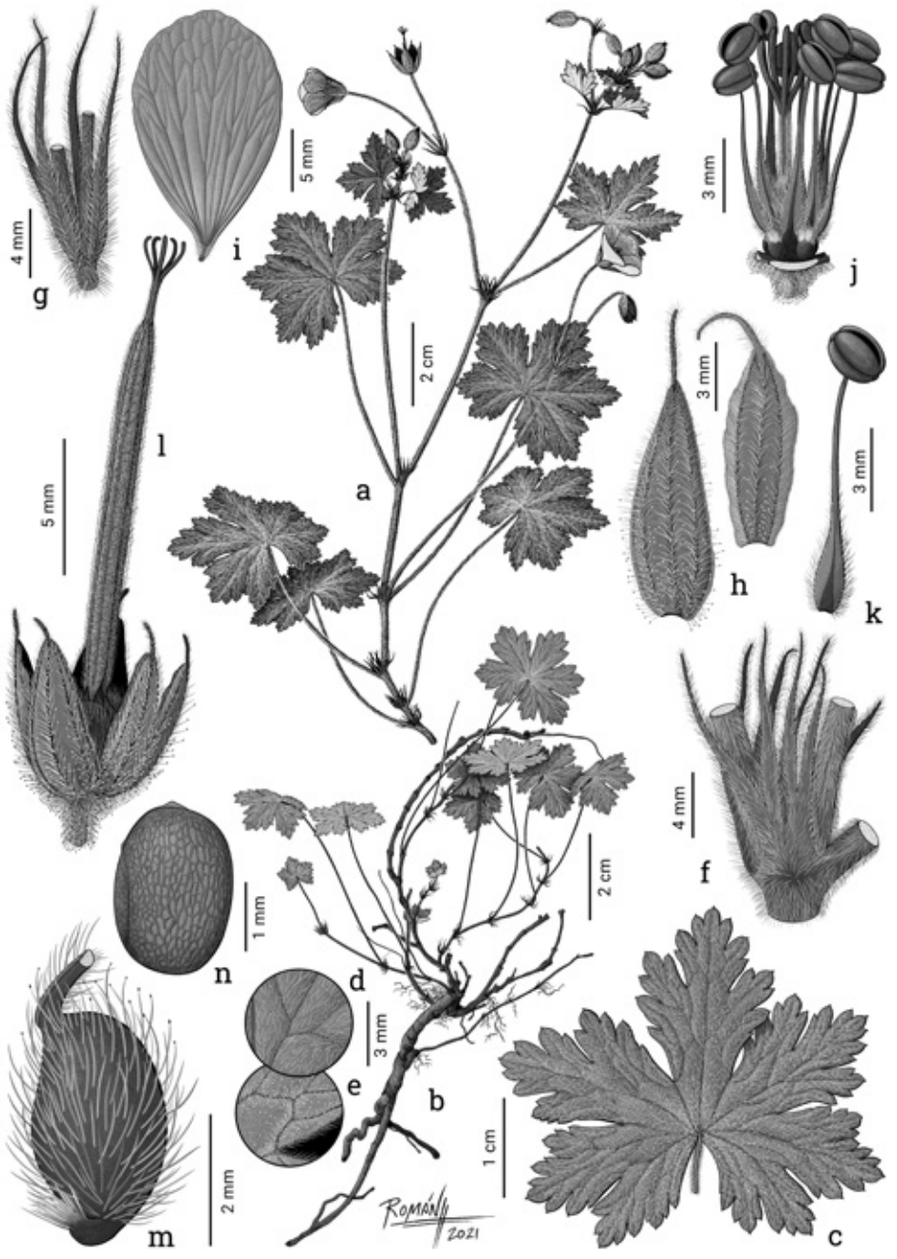


Fig. 621. *Geranium amatolicum*. a, b. Habit. c. Leaf. d. Detail of the adaxial surface of the leaf. e. Detail of the abaxial surface of the leaf. f. Stipules. g. Bracteoles. h. Sepals. i. Petal. j. Flower without sepals and petals. k. Stamen. l. Fruit. m. Mericarp. n. Seed. (Based on: a, c, f-k, *Hilliard & Burtt 13260*, NU; b, d, e, *Hilliard & Burtt 14796*, NU; l-n, *Hilliard & Burtt 14802*, NU).

Fig. 622. Distribution of *Geranium amatolicum*.

occurs in different combinations that seem unstable. These authors indicated that it may be no more than a local form, which seems correct.

Geranium amatolicum is easy to differentiate from *G. schlechteri* by its larger petals and by the long mucro of the sepals. The former has a restricted and allopatric distribution in relation to the latter, that is distributed more northwards.

247. Geranium grandistipulatum Hilliard & B.L. Burtt, Notes Roy. Bot. Gard. Edinburgh 42(2): 213, 174 fig. 2 I. 1985. Type locality: "E Cape, Stutterheim distr., W end of Kabaku Hills, 19 ix 1942, Acocks 9089 (PRE holo.)". Type: South Africa. Eastern Cape, Stutterheim distr., W end of Kabaku Hills, 32°31'S, 27°26'E, 19 Sep. 1942, *J.P. Acocks 9089* (holotype, PRE-0663524-0 image!).

Perennial herbs or subshrubs, 18-41 cm tall. *Rootstock* and roots unknown. *Stem* ascending to erect, leafy, not rooting at nodes, stolons absent, without vegetative stems, with patent, eglandular hairs 0.7-1.4 mm long and, usually, patent, glandular hairs ca. 1 mm long. *Basal leaves* unknown, cauline leaves alternate and upper opposite; leaf laminas 3.3-5.4 cm long, 3.8-7 cm wide, not peltate, palmatifid [ratio main-sinus length/middle segment length = 0.65-0.76], polygonal in outline, base cordate, not coriaceous, with nerves not projected, usually with ± appressed, eglandular and glandular hairs on both surfaces, sometimes lacking glandular ones; segments 5, in 1 plane, middle segment rhombic, 4.6-13.1 mm wide at the base [ratio segment width at the base/middle segment length = 0.21-0.40], 15-33-lobed in distal half [ratio secondary sinus length/middle segment length = 0.13-0.30]; petioles up to 15 cm long, without abscission zone, terete, not swollen, not deflexed in age, with patent, eglandular hairs 0.3-1.4 mm long and usually, patent, glandular hairs 0.3-0.8 mm long; stipules 3.5-14.3 mm long, 1.9-6.6 mm wide, 2-3-fid, with lanceolate lobes 1.7-8.2 mm deep, 1.4-2.2 mm wide, free, papery, brown, with eglandular hairs on abaxial surface, ± glabrous adaxially. *Inflorescence* a monochasial cyme; cymules 2-flowered, solitary [ratio cymule length/leaf length = 1.3-2.9]; peduncles 30-84 mm long, with patent, eglandular hairs 0.2-1.6 mm long and usually, patent, glandular hairs ca. 1.2 mm long; bracteoles 3.6-9.6 mm long, 1.4-1.7 mm wide, lanceolate, whorled; pedicels 9-21 mm long, with patent, eglandular hairs 0.4-1.1 mm long and patent, glandular hairs 0.3-1.2 mm long. Flowers actinomorphic. *Sepals* 6.7-10.1 mm long, 2.8-4 mm wide, lanceolate, smooth, not accrescent, nerves 3, mucro 1-1.5 mm long [ratio mucro length/sepal length = 0.16-0.18], with ± patent, eglandu-

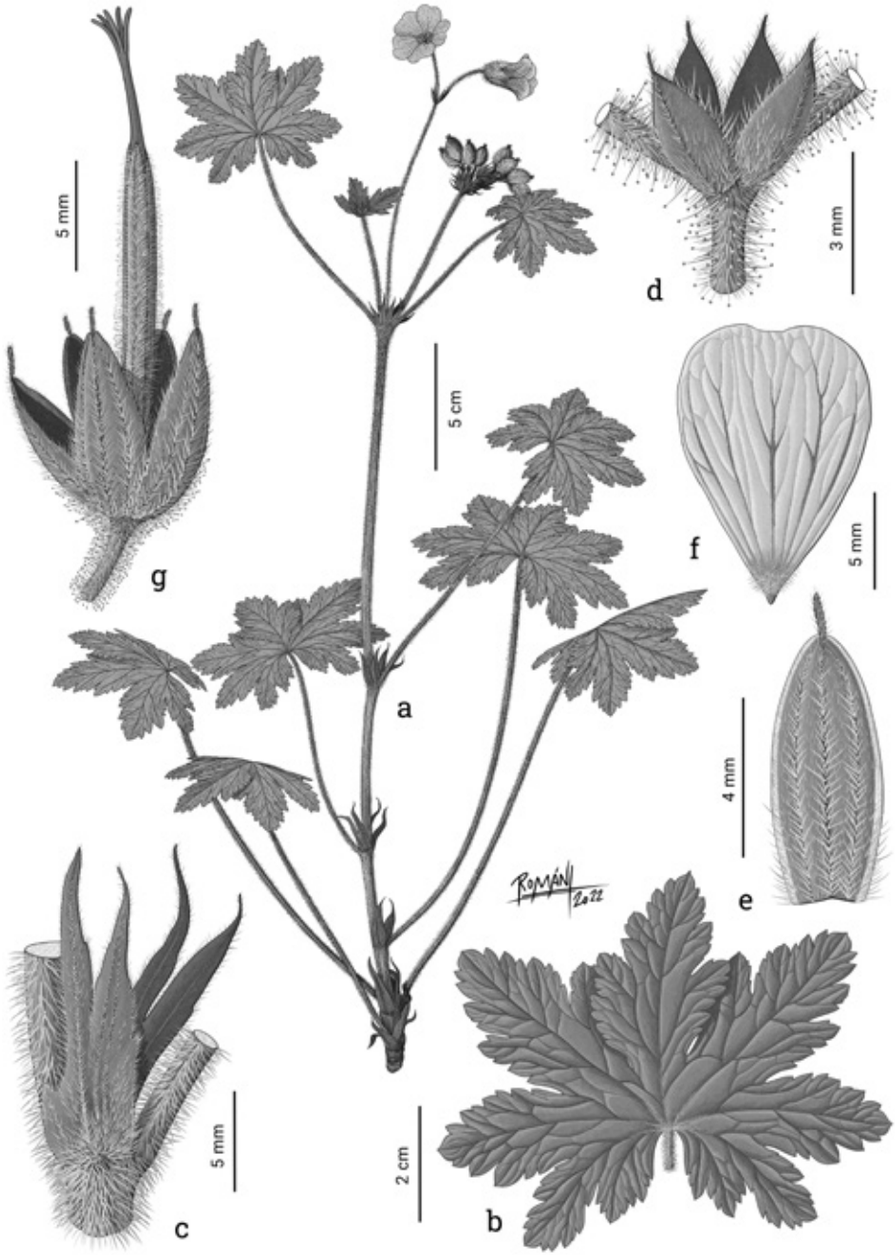


Fig. 623. *Geranium grandistipulatum*. a. Habit. b. Leaf. c. Stipules. d. Bracteoles. e. Sepal. f. Petal. g. Fruit. (Based on: a-c, *Bester 1712*, PRE: d-g, *Gibby & Compton 162*, BM).

Fig. 624. Distribution of *Geranium grandistipulatum*.

lar hairs 0.4-0.8 mm long and, patent, glandular hairs 0.3-0.4 mm long on the abaxial surface, glabrous adaxially. *Petals* 14.3-18.9 mm long, 10-13.9 mm wide, erect-patent, rounded or emarginate (notch ca. 2.5 mm deep), without claw, rose pink, hairy on the base of the adaxial surface, glabrous abaxially, ciliate on the basal margin, with hairs 0.2-0.5 mm long. *Stamens* 10, both whorls bearing anthers; filaments 5.8-8.2 mm long, lanceolate, unknown color, with eglandular hairs 0.3-0.5 mm long on the abaxial surface and margin; anthers ca. 1.8 mm long, unknown color. Nectaries 5, hemispheric, glabrous. *Gynoecium* 4-5 mm long, unknown color. *Fruit* 25-26 mm long, erect, discharge of seed-ejection type; mericarps ca. 3.3 mm long, ca. 1.7 mm wide, without a strand of fibers, not compressed at the apex, smooth, without basal beak, with a basal callus, without a basal prong, brown, with erect-patent, eglandular hairs 0.3-0.4 mm long and patent, glandular hairs 0.8-0.9 mm long; rostrum 18-19 mm long, with a narrowed apex 4-5 mm long, not twisted, with patent, eglandular hairs 0.3-0.4 mm long and patent, glandular hairs 0.7-0.8 mm long; stigmatic remnants 2.2-2.3 mm long, with 5 glabrous lobes. *Seeds* unknown. Cotyledons not studied. Fig. 623.

Pollen. *Geranium*-type (Verhoeven & Venter 1992: 441, 442).

Chromosome number. Unknown.

Phenology. Collected in flower from September to November.

Distribution. This species is endemic to Eastern Cape, in South Africa (Fig. 624).

Habitat. Grassland and forest clearings and among stones; 1000-2050 m.

Additional specimens examined. **South Africa.** Eastern Cape: Maclear, Bastervoetpad, farm Snowy Side, 27 km NNW of Ugie, 31°8'S, 27°59'E, 17 Nov. 1993, *Bester 1712* (PRE); Transkei, raod from Umtata towards Port St. Johns, Misty Mountain, 31°32'S, 28°56'E, 6 Nov. 1985, *Gibby & Crompton 162* (BM).

Discussion. Geranium grandistipulatum is a rare species infrequently collected, of which only two samples have been obtained on loan, in addition to the image of the type. With these samples it has been difficult to accurately determine the variability of the species and to prepare a more detailed description, especially as regards the subterranean parts and the fruit. Nevertheless, *Geranium grandistipulatum* is very well characterized against the rest of the South African species by its stipules, whose divisions are shallow and relatively wide. Its leaves are shallowly divided and its indumentum variable in the few samples examined. The bracteoles appear somewhat wider than in other species in the region. It is differentiated from *G. amatolicum* by its shorter sepal mucro.

248. Geranium schlechteri R. Knuth in Engl., Pflanzenr. IV.129 (Heft 53): 207. 1912. Type locality: "Natal: Lidgetton 1200 m (Medley Wood a. 1896 n. 6217!). Kaffraria: Zuurberge 1400 m (Pl. Schlechterianae a. 1895 n. 6567!)". Type: South Africa. KwaZulu-Natal, Mt. Currie-Alfred districts, Zuurberge, 30°30'S, 29°20'E, 2 Feb. 1895, *F.R. Schlechter 6567* (lectotype, designated by Hilliard & Burtt 1985: 205, BOL-136331; isolectotypes, C!, GRA-0001545-0, LD-1999668!, LE!, MA-617383!, NY-4206188!, P-00390248!, PRE-0663880-0, US-3291553!, W!, WU!, Z-000181404!).

Geranium ornithopodon var. *lilacinum* Kuntze, Revis. Gen. Pl. 3(3): 32. 1898. Type locality: "Natal: Van Reenen's Pass". Type: South Africa. KwaZulu-Natal, Van Reenen's Pass, 28°22'S, 29°22'E, 20 Mar. 1894, *O. Kuntze s.n.* (lectotype, designated by Hilliard & Burtt 1985: 205, K-000417231!; isolectotypes, NY-4206184!, US image!).

Geranium exellii J. R. Laundon, Bol. Soc. Brot. ser. 2, 35: 62, [foto 2]. 1961. Type locality: "S. Rhodesia: Untali District, Engwa, 1980 m., fl. 2.II.1955, Exell, Mendonça & Willd 109 (BM!, holotype; LISC!, isotype; SRGH!, isotype); Himalayas, Engwa, 2130 m., fl. & fr. 2.III.1954, Willd 4462 (K!, SRGH!). Mozambique: Manica e Sofala, Tsetsera, 1980-2140 m., fl. & fr. 10.II.1955, Exell, Mendonça & Willd 337 (BM!, LISC!, SRGH!)". Type: Zimbabwe. Umtali District, Engwa, 19°22'S, 32°46'E, 2 Feb. 1955, *A.W. Exell, F.A. Mendonça & H. Willd 109* (holotype, BM-000797002 image!; isotypes, LISC-000725 image! SRGH-0097975-0 image!).

Perennial herbs, (21)50-70(200) cm tall. *Rootstock* 4.2-8 mm in diameter, ± vertical, not tuberculate, not turnip-shaped, usually with thickened roots along the rootstock. *Stem* procumbent, leafy, not rooting at nodes, stolons absent, without vegetative stems, with patent to retrorse, eglandular hairs 0.3-1.5 mm long and, patent, glandular hairs 0.9-2.3 mm long. *Basal leaves* unknown, cauline leaves alternate and upper opposite; leaf laminas (1.9)2.7-3.7(5.4) cm long, 2.1-6.7 cm wide, not peltate, palmatifid [ratio main-sinus length/middle segment length = (0.72)0.74-0.81(0.86)], polygonal in outline, base cordate, not coriaceous, with nerves not projected, usually with spread, long and short, eglandular and glandular hairs on both surfaces; segments 5, in 1 plane, middle segment rhombic, (2.4)4.5-6.6(11.7) mm wide at the base [ratio segment width at the base/middle segment length = (0.11)0.17-0.32(0.35)], 7-16-lobed in distal half [ratio secondary sinus length/middle segment length = (0.17)0.20-0.23(0.28)]; petioles up to 19 cm long, without abscission zone, terete, not

swollen, not deflexed in age, with patent to retrorse, eglandular hairs 0.3-0.7 mm long and patent, glandular hairs 0.4-2.4 mm long; stipules 3.5-7.2 mm long, 1.3-3.7 mm wide, 2-3-fid, with lanceolate lobes 2-5.3 mm deep, 0.3-1.3 mm wide, free, papery, brown, with eglandular and glandular hairs on both surfaces and on the margin. *Inflorescence* a monochasial cyme; cymules 2-flowered, solitary [ratio cymule length/leaf length = 1.1-3.4]; peduncles (19)27-54(77) mm long, with patent to retrorse, eglandular hairs 0.2-1 mm long and patent, glandular hairs 0.7-2.2 mm long; bracteoles 2.2-4.7 mm long, 0.5-1.1 mm wide, linear-lanceolate, whorled; pedicels (12)13-21(39) mm long, with patent to retrorse, eglandular hairs 0.2-0.5 mm long and patent, glandular hairs 0.6-1.9 mm long. Flowers actinomorphic. *Sepals* (4.7)4.9-6(6.5) mm long, 1.7-2.9 mm wide, lanceolate, smooth, not accrescent, nerves 3, mucro (0.4)0.8-1.1(1.4) mm long [ratio mucro length/sepal length = (0.07)0.15-0.21(0.24)], usually with patent, eglandular hairs 0.1-0.8 mm long and patent, glandular hairs 0.7-2.4 mm long. *Petals* (6.6)8.6-12.6(14) mm long, (2.8)4-7.6(8.8) mm wide, erect-patent, slightly emarginate (notch 0.4-1 mm deep) or, rarely, rounded, without claw, white to pink, hairy on the base of the adaxial surface, glabrous abaxially, ciliate on the basal margin, with hairs 0.2-0.5 mm long. *Stamens* 10, both whorls bearing anthers; filaments (2.8)4.1-4.8(6.3) mm long, lanceolate, white, with scattered eglandular hairs 0.2-0.4 mm long on the abaxial surface and margin; anthers (0.9)1.1-1.4(1.6) mm long, yellow. Nectaries 5, hemispheric, glabrous. *Gynoecium* 3.8-6.2 mm long, white. *Fruit* (18)19.7-23.5(24.8) mm long, erect, discharge of seed-ejection type; mericarps 2.8-3.9 mm long, 1.5-2 mm wide, without a strand of fibers, not compressed at the apex, smooth, without basal beak, with a basal callus, without a basal prong, black, with ± patent, eglandular hairs 0.6-2.4 mm long and patent, glandular hairs 0.8-1.5 mm long; rostrum 12.8-17.5 mm long, with a narrowed apex 1.3-2.3 mm long, not twisted, with patent, eglandular hairs 0.1-0.5 mm long and patent, glandular hairs 0.4-1.5 mm long; stigmatic remnants 1.3-1.9 mm long, with 5 glabrous lobes. *Seeds* 2.4-2.9 mm long, 1.6-1.8 mm wide, finely reticulate, uniformly colored, brown, glabrous. Cotyledons with entire margin. Figs. 625, 626.

Pollen. *Geranium*-type (Verhoeven & Venter 1992: 441, 442).

Chromosome number. Unknown.

Phenology. Collected in flower from January to December.

Distribution. This species ranges from northern Eastern Cape to Mpumalanga, in South Africa, plus few localities between Mozambique and Zimbabwe border (Fig. 627).

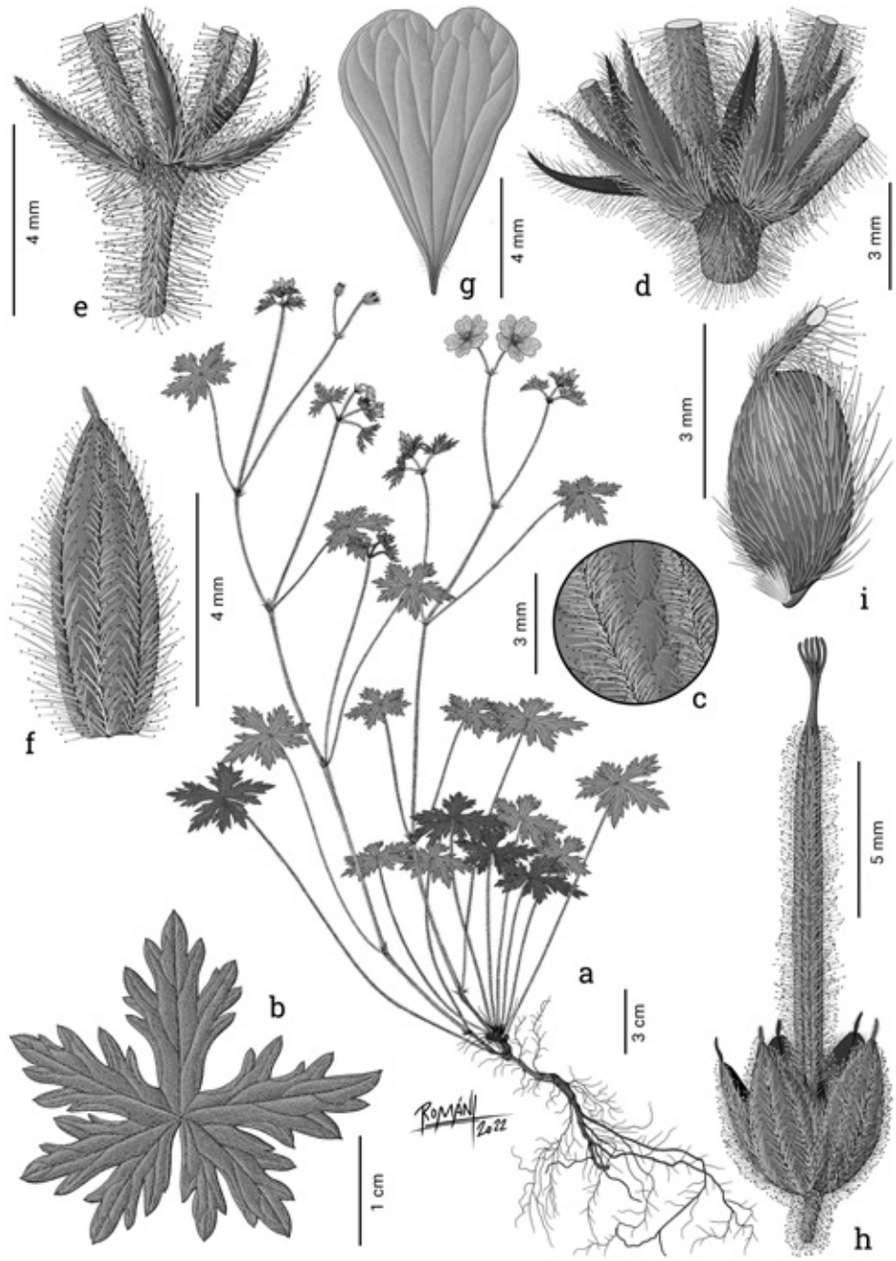


Fig. 625. *Geranium schlechteri*. a. Habit. b. Leaf. c. Detail of the abaxial surface of the leaf. d. Stipules. e. Bracteoles. f. Sepal. g. Petal. h. Fruit. i. Mericarp. (Based on: a-c, *Hilliard & Burtt 7018*, NU; d, e, *Hilliard & Burtt 15307*, PRE; f-i, *Aedo & al. 14979*, MA).

Fig. 626. *Geranium schlechteri* (Based on: a, b, *Aedo & al. 15029*; c, d, *Aedo & al. 15072,* MA).

Fig. 627. Distribution of *Geranium schlechteri*.

Habitat. Disturbed areas, moist grassland, sometimes in the shelter of rocks and forest edges; 0-2750 m.

Representative specimens examined. **Lesotho.** Berea: Mateka district, 29°14'S, 27°53'E, 22 Mar. 1951, *Bruce 352* (K). Qacha's Nek: Sehlabathebe Reserve, 29°52'S, 29°4'E, 27 Jan. 1975, *Bayliss 189* (B, GH, NY, Z); Sehlabathebe National Park, W to the lodge, 29°52'S, 29°4'E, 9 Jan. 1978, *Hoener 1986* (K, MO, PRE); Kapcolonie, Makomerin, 30°7'S, 28°33'E, Feb. 1914, *Jacottet s.n.* (Z). **Mozambique.** Manica: Manica e Sofala, Tsetsera, 19°22'S, 32°48'E, 10 Feb. 1955, *Exell 337* (BM). **South Africa.** Eastern Cape: Transkei, Qachasnek, valley just below border police station, 30°7'S, 28°41'E, 3 Feb. 1988, *Strever 574* (PRE); Transkei, Thaba Chitja, Ongeluk's Neck, 30°20'S, 28°18'E, 7 Dec. 1985, *Hutchings & Hutchings 1948* (MO); Maclear, Elands heights, Rush valley, 30°48'S, 28°13'E, Mar. 2000, *Edwards 1870* (E); Maclear, farm Rockwater, 31°5'S, 28°20'E, 23 Feb. 1993, *Bester 158* (PRE); Elliot district, Bastervoetpad, 31°9'S, 27°59'E, 15 Feb. 1983, *Hilliard & Burtt 16702* (NU). Free State: Nonnashoek, 5 mi ZO. van Bethlehem, 28°15'S, 28°22'E, 19 Jan. 1969, *Werger 248* (PRE); Harrysmith district, Kerkenberg, 28°30'S, 29°6'E, 31 Mar. 2007, *Meyer 4938* (PRE); Culvers, Weenen div., 29°18'S, 29°42'E, Dec. 1923, *Rogers 28469* (Z); Mpendhle, Runnymead, 30°0'S, 30°31'E, 23 Dec. 1964, *Moll 1473* (K). KwaZulu-Natal: Ekomela farm, Luneburg, Paulpietersburgh district, 27°18'S, 30°36'E, 3 Mar. 1994, *Ngwenya & Sing 1256* (PRE); Harrismith, at foot of Platberg, next to Botanic Garden, 28°13'S, 30°12'E, 10 Feb. 1970, *Jooste s.n.* (C, MO); Bergville district, Royal Natal National Park, Tugela Gorge path, 28°44'S, 28°54'E, 23 Mar. 1981, *Hilliard & Burtt 14457* (B, NU, PRE); pr. Cathedral peak, 28°56'S, 29°11'E, 15 Jan. 2008, *Aedo & al. 15029* (MA); pr. Mike Pass, 28°58'S, 29°14'E, 15 Jan. 2008, *Aedo & al. 15702* (MA); Howick, Karkloof, Dartmoor Farm near Mt. Gilboa, 29°15'S, 30°15'E, 6 Apr. 2017, *Young 2589* (NU); Estcourt district, Kamberg Nature Reserve, Stillerust Vlei, 29°23'S, 29°40'E, 7 Jan. 1976, *Hilliard & Burtt 8737* (NU, MO); Pietermaritzburg, Town Bush valley, 29°34'S, 30°19'E, Mar. 1947, *Staton 61* (NU); pr. Sani Pass, 29°36'S, 29°20'E, 14 Jan. 2008, *Aedo & al. 14979* (MA); Underberg district, valley botton of Umzimkulu river above Drakensberg Garden hotel, 29°45'S, 29°15'E, 27 Jan. 1975, *Hilliard & Burtt 7740* (K, MO); Byrne, 29°49'S, 30°11'E, 25 Mar. 1932, *Galpin 12035* (W); Hlabeni forest, Creighton, 29°56'S, 29°45'E, 14 Mar. 2002, *Potgieter & Thompson 740* (NU); Weza Satate Forest road to the lookout tower on Lovedale Plantation, 30°36'S, 29°39'E, 8 Dec. 1984, *Balkwill & al. 2421* (MO); Margate, St. Michaels beach, 30°49'S, 30°24'E, 3 Mar. 2013, *Buira 1790* (MA). Mpumalanga: Wakkerstroom district, Oshoek farm, 29°35'S, 29°17'E, 28 Dec. 1960, *Devenish 397* (PRE). **Zimbabwe.** Manicaland: Umtali district, Himalayas, Engwa, 19°22'S, 32°46'E, 2 Mar. 1954, *Willd 4462* (LISC).

Discussion. Geranium schlechteri is a perennial herb with a long, spreading, procumbent stem that reach 2 m in length. The stem is branched from the base, where it is naked and with the remains of stipules. The short and vertical rootstock is in some specimens thin and without thickened roots while in others is more robust and with thickened roots. Probably the former correspond to young specimens. However, there are not enough specimens collected with the underground parts to clarify this trait. *Geranium schlechteri* is easily distinguished by its palmatipartite leaves, not deeply divided, clothed with soft glandular hairs on the abaxial surface, its 2-3-fid stipules, its short sepals and petals. The indumentum of *G. schlechteri* comprises both glandular and eglandular hairs. Long and soft glandular hairs are usually very dense on stems, petioles and inflorescence

and are found less densely throughout the plant, although they are sometimes rare on the adaxial surface of the leaves.

Laundon (1961: 62) described *G. exellii* based on three collections from the border between Mozambique and Zimbabwe, about 900 km north of the northernmost known localities of *G. schlechteri.* This author considered that the cut of the leaf, somewhat more divided, is an important feature to differentiate *G. exellii* from *G. schlechteri*, in addition to other minor characters. These collections show slightly more divided leaves than is usual, but otherwise fall within the range of variation encompassed by my concept of G. *schlechteri*.

249. Geranium contortum Eckl. & Zeyh., Enum. Pl. Afric. Austral. 1: 59. 1834-35. Type locality: "Ad declivitates gramineas montis 'Winterberg' altit. V (Kafferland). Dec.". Type: South Africa. Eastern Cape, Kafferland, montis 'Winterberg', 32°19'S, 26°14'E, *C.F. Ecklon & C.L. Zeyher 450* (lectotype, designated by Hilliard & Burt 1985: 214, S-07-8904 image!; isolectotypes, SAM, C!).

Perennial herbs, 17-36 cm tall. *Rootstock* 2.2-2.8 mm in diameter, ± horizontal, not tuberculate, not turnip-shaped, without thickened roots. *Stem* ascending to suberect, leafy, not rooting at nodes, stolons absent, without vegetative stems, with ± patent to retrorse, eglandular hairs 0.3-1 mm long, and sometimes, patent glandular hairs 0.3-0.4 mm long. *Basal leaves* not present (no rosette), cauline leaves alternate and upper opposite; leaf laminas (1.9)2-2.6(3.1) cm long, 2-3.3 cm wide, not peltate, palmatifid [ratio main-sinus length/middle segment length = (0.75)0.77-0.83(0.85)], polygonal in outline, base cordate, not coriaceous, with nerves not projected, with sparse, ± appressed, eglandular hairs on both surfaces, and sometimes wih scattered, glandular hairs on the abaxial surface; segments 5, in 1 plane, middle segment rhombic, (2.2)3.6-5.3(5.4) mm wide at the base [ratio segment width at the base/middle segment length = (0.21)0.25-0.31(0.33)], 7-14-lobed in distal half [ratio secondary sinus length/middle segment length = (0.25)0.31-0.37(0.40)]; petioles up to 9 cm long, without abscission zone, terete, not swollen, not deflexed in age, with ± patent to retrorse, eglandular hairs 0.4-1.1 mm long, and sometimes, patent glandular hairs 0.3-0.4 mm long; stipules 6.8-10.1 mm long, 1.8-6.3 mm wide, 2-3-fid, with linear lobes 4-8.5 mm deep, 0.4-0.6 mm wide, free, papery, brown, with eglandular hairs on ab-

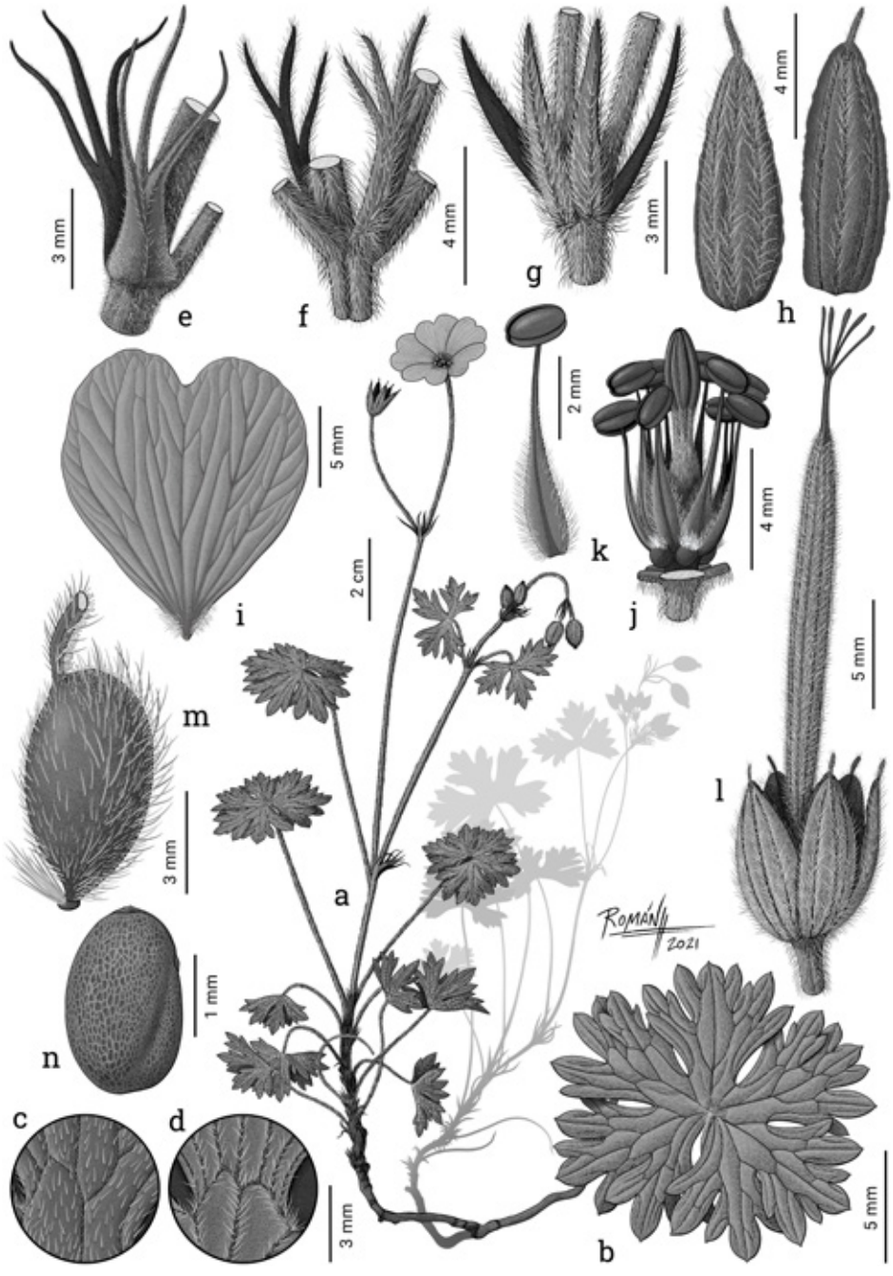


Fig. 628. *Geranium contortum*. a. Habit. b. Leaf. c. Detail of the adaxial surface of the leaf. d. Detail of the abaxial surface of the leaf. e, f. Stipules. g. Bracteoles. h. Sepals. i. Petal. j. Flower without sepals and petals. k. Stamen. l. Fruit. m. Mericarp. n. Seed. (Based on: a, f, g, i-k, *Hilliard & Burtt 14797*, NU; b-e, h, *Hilliard & Burtt 14782*, NU; l-n, *Rattray 47*, NU).

Fig. 629. Distribution of *Geranium contortum*.

axial surface, ± glabrous adaxially. *Inflorescence* a monochasial cyme; cymules 2-flowered, solitary [ratio cymule length/leaf length = (1.6)2.5-4.4(4.9)]; peduncles (17)47-77(93) mm long, with patent to retrorse, eglandular hairs 0.2-1.5 mm long and, usually, patent, glandular hairs 0.2-0.5 mm long; bracteoles 4.9-8.5 mm long, 0.4-0.8 mm wide, linear-lanceolate, whorled; pedicels (17)30-42(44) mm long, with patent to retrorse, eglandular hairs 0.4-1.3 mm long and, usually, patent, glandular hairs 0.3-1.2 mm long. Flowers actinomorphic. *Sepals* (7.3)7.6-8.4(8.7) mm long, 2.4-3.1 mm wide, lanceolate, smooth, not accrescent, nerves 3, mucro (0.9)1-1.3(1.4) mm long [ratio mucro length/sepal length = (0.11)0.13-0.17 (0.19)], with appressed to ± patent, eglandular hairs 0.3-0.8 mm long and, usually, patent, glandular hairs 0.1-0.3 mm long on the abaxial surface, glabrous adaxially. *Petals* (12.6)13.2-15.8(18.2) mm long, (6.5)7.9-11(16.6) mm wide, erect-patent, emarginate (notch 0.7-2.3 mm deep) or, rarely, rounded, without claw, purple, hairy on the base of the adaxial surface, glabrous abaxially, ciliate on the basal margin, with hairs 0.3-0.8 mm long. *Stamens* 10, both whorls bearing anthers; filaments (5)5.2-5.6(5.7) mm long, lanceolate, yellow, with scattered eglandular hairs 0.2-0.5 mm long on the abaxial surface and margin; anthers (1.8)1.9-2.2 mm long, unknown color. Nectaries 5, hemispheric, with a tuft of hairs at the top, dorsally glabrous. *Gynoecium* 4.1-6.7 mm long, unknown color. *Fruit* 25.1-28.8(30.6) mm long, erect, discharge of seed-ejection type; mericarps 2.8-4 mm long, 1.5-2.1 mm wide, without a strand of fibers, not compressed at the apex, smooth, without basal beak, with a basal callus, without a basal prong, brown, with ± patent, eglandular hairs 0.2-1.2 mm long and patent, glandular hairs 0.2-0.4 mm long; rostrum 17.9-22.8 mm long, with a narrowed apex 1.8-3.5 mm long, not twisted, with ± patent, eglandular hairs 0.1-0.7 mm long and patent, glandular hairs 0.2-0.4 mm long; stigmatic remnants 2.6-3.7 mm long, with 5 glabrous lobes. *Seeds* 2.6-2.8 mm long, 1.7-1.8 mm wide, finely reticulate, uniformly colored, brown, glabrous. Cotyledons with entire margin. Fig. 628.

Pollen. *Geranium*-type (Verhoeven & Venter 1992: 441, 442).

Chromosome number. Unknown.

Phenology. Collected in flower from December to January.

Distribution. This species ranges through central Eastern Cape, in South Africa (Fig. 629).

Habitat. Damp grassland; 1400-1950 m.

Additional specimens examined. **South Africa.** Eastern Cape: 25 km from cala turn off on road to Engcobo, 31°32'S, 27°51'E, 12 Jan. 1997, *Bredenkamp 1138* (PRE); Cathcart, Windvogelberg, 32°17'S, 27°6'E, 8 Dec. 1981, *Hilliard & Burtt 14782* (E, NU, PRE); Bedford district, farm Quaggashoek, at Telkom tower, 32°19'S, 26°21'E, 19 Jan. 2016, *Steyn 2240* (PRE); Seymour, summit of Nico Malan Pass, 32°30'S, 26°49'E, 22 Jan. 1990, *Edwards 724* (NU, BOL); Stutterheim district, Thomas Mountain, 32°34'S, 27°14'E, 9 Dec. 1981, *Hilliard & Burtt 14797* (E, NU); without locality, Dec. 1917, *Rattray 47* (PRE).

Discussion. Geranium contortum is a small plant, with a long thin and ± horizontal rootstock. The stem is branched from the base, somewhat lignified in the lower part. At the apex of each branch the leaves are crowded, but apparently without forming a rosette, becoming distant upwards. The indumentum of *G. contortum* is highly variable. Specimens with both glandular and eglandular hairs, are the most frequent. Sometimes the glandular hairs disappear or become infrequent in some parts of the stem, petiole, leaf lamina or even on the inflorescence.

Geranium contortum is easy to differentiate from *G. schlechteri* by its longer sepals and petals, and the lack of the long, soft glandular hairs characteristic of the latter. *Geranium ornithopodon* also has shorter sepals, a very different leaf cut, and lacks glandular hairs.

250. Geranium ornithopodon Eckl. & Zeyh., Enum. Pl. Afr. Austral. 1: 59. 1834-35. Type locality: "In rupis hiatu nemoroso prope 'Nieuwe Post' in finibus 'Caffrariae' (Ceded Territory). Jun.". Type: South Africa. Eastern Cape, Ceded Territory, pr. Nieuwe Post, in finibus Caffrariae, 33°22'S, 25°50'E, June, *C.F. Ecklon & C.L. Zeyher 449* (lectotype, first-step, designated by Hilliard & Burtt 1985: 216, S-G-2851 image!, second-step, here designated; isolectotype, SAM-0030063A-0 image!).

Geranium flanaganii Schltr. ex R. Knuth, Bot. Jahrb. Syst. 40: 69. 1908. Type locality: "Östliches Kapland: Korugha, auf Hügeln um 660 m (Schlechter, Pl. austro-africanae a. 1895 n. 6182 -- Typus in herb. Schlecht.!). -- Blühend und fruchtend in Januar". Type: South Africa. Eastern Cape, Komgha, 32°34'S, 27°53'E, 4 Jan. 1895, *F.R. Schlechter 6182* (holotype, B destroyed; lectotype, designated Hilliard & Burtt 1985: 218, GRA-0001541-0 image!; isolectotype, Z-64966!).

Geranium knysnaense R. Knuth, Repert. Spec. Nov. Regni Veg. 18: 292. 1922, [31 Dec. 1922]. Type locality: "Natal: Friedenau, Alexandra City (Rudatis a. 1908, no. 375 [159]!).-Südöstliches Kapland: Knysna (Newelsgat!). Blanco (Schlechter a. 1894, no. 5769!)". Type: South Africa. Western Cape, Kapland, Blanco, 33°56'S, 22°24'E, 1 Nov. 1894, *F.R. Schlechter 5769* (lectotype, designated by Hilliard & Burtt 1985: 217, BOL-136330; isolectotypes, B-101043913!, C!, G-412274!, GH-969549!, GRA-0001543-0, H-1472128!, LD-1994036!, PRE-0663879-0, P-00390247!, Z!).

Perennial herbs, 25-90 cm tall. *Rootstock* and roots unknown. *Stem* ascending to suberect, leafy, not rooting at nodes, stolons absent, without vegetative stems, with patent to retrorse, appressed, eglandular hairs 0.3-0.9 mm long, and rarely, patent glandular hairs 0.7-0.8 mm long. *Basal leaves* not present (no rosette), cauline leaves alternate and upper opposite; leaf laminas (2.8)3.7-4.7(7) cm long, 3-7-9 cm wide, not peltate, palmatifid [ratio main-sinus length/middle segment length = (0.71)0.74-0.82(0.84)], polygonal in outline, base cordate, not coriaceous, with nerves not projected, with ± appressed, eglandular hairs on both surfaces; segments 5, in 1 plane, middle segment rhombic, (4.9)6-9-9.4(15.4) mm wide at the base [ratio segment width at the base/middle segment length = (0.19)0.24-0.31(0.49)], 5-9(11)-lobed in distal half [ratio secondary sinus length/middle segment length = (0.08)0.12-0.16(0.19)]; petioles up to 14 cm long, without abscission zone, terete, not swollen, not deflexed in age, with ± patent to retrorse appressed, eglandular hairs 0.3-1.1 mm long and, rarely, patent, glandular hairs 0.4-0.5 mm long; stipules 3.6-11.8 mm long, 2.1-8.4 mm wide, (3)4-5-fid, with linear lobes 2.9-8 mm deep, 0.2-0.7 mm wide, free, papery, brown, with eglandular hairs on abaxial surface, ± glabrous adaxially. *Inflorescence* a monochasial cyme; cymules 2-flowered, solitary [ratio cymule length/leaf length = (1.2)1.8-4.8(11.8)]; peduncles (16)28-54(78) mm long, with retrorse, eglandular hairs 0.1-1.6 mm long and usually, patent, glandular hairs 0.3-1 mm long; bracteoles 2.2-6 mm long, 0.3-0.8 mm wide, linear-lanceolate, whorled; pedicels (11)15-25(34) mm long, with retrorse, eglandular hairs 0.2-1.2 mm long and usually, patent, glandular hairs 0.3-0.8 mm long. Flowers actinomorphic. *Sepals* (4.5)5.2-6.8(7.7) mm long, 1.9-3.7 mm wide, lanceolate, smooth, not accrescent, nerves 3, mucro (0.7)1.1-1.5(1.9) mm long [ratio mucro length/sepal length = (0.15)0.19-0.24(0.32)], with ± patent, eglandular hairs 0.1-1.1 mm long and, usually, patent, glandular hairs 0.3-1 mm long on the abaxial surface, glabrous adaxially. *Petals* (5.9)7.7-13.1(15.3) mm long, (3.7)4.9-7.2(9.3) mm wide, erect-patent, rounded, without claw, pink or white, hairy on the base of the adaxial surface, glabrous abaxially, ciliate on the basal margin, with hairs 0.2-0.6 mm long. *Stamens* 10, both whorls bearing anthers; filaments (3.7)4.2-7(8.6) mm long, lanceolate, yellow, with scattered eglandular hairs 0.1-0.5 mm long on the abaxial surface and margin; anthers (0.7)1-1.5(1.8) mm long, purple. Nectaries 5, hemispheric, glabrous. *Gynoecium* 4-8.3 mm long, yellow. *Fruit* (20)21.3-25.3(28.4) mm long, erect, discharge of seed-ejection type; mericarps 2.9-3.9 mm long, 1.4-2 mm wide, without a strand of fibers, not compressed at the apex, smooth, without basal beak, with a basal callus, without a basal prong, brown, with erect-patent, eglandular hairs 0.1-0.9 mm long and usually, patent, glandular hairs 0.4-1 mm long; rostrum 13.5-20.7 mm long, with a narrowed apex 1.1-3.4 mm long, not twisted, with ± patent, eglandular hairs 0.1-0.5 mm long and ± patent, glandular hairs 0.4-1 mm long; stigmatic remnants 1.5-3 mm long, with 5 hairy lobes. *Seeds* 1.8-2.3 mm long, 1.1-1.6 mm wide, finely reticulate, uniformly colored, brown, glabrous. Cotyledons with entire margin. Fig. 630.

Pollen. *Geranium*-type (Verhoeven & Venter 1992: 446, 442).

Chromosome number. Unknown.

Phenology. Collected in flower from January to December.

Distribution. This species ranges from Western Cape to Limpopo, in South Africa (Fig. 631).

Habitat. Dunes, grassland, roadsides, damp grounds and forest edges; 0-1800 m.

Additional specimens examined. **South Africa.** Eastern Cape: Alfred District, Harding, Bedford farm, 30°34'S, 30°2'E, 1 Mar. 1983, *Hilliard & Burtt 16724* (NU); Harding, Bedford farm, 30°34'S, 30°2'E, 12 Oct. 1969, *Strey 9157* (PRE); Baviaans Kloof, 31°9'S, 25°56'E, 10 Nov. 1974, *Bayliss 6891* (MO); Pondoland district, Port Saint John's, 31°37'S, 29°32'E, 18 Oct. 1951, *Bruce 454* (LD, K); distric of Queenstown, 31°53'S, 26°52'E, 1860, *Cooper 434* (MA, NY, W, Z); Elliotdale district, The Haven, 32°14'S, 28°54'E, 11 Sep. 1966, *Gordom-Gray 670* (NU); Kentani, 32°30'S, 28°19'E, Oct. 1907, *Pegler 2229* (Z); Victoria east, Ft. Beaufort, 32°35'S, 26°55'E, 16 Nov. 1942, *Giffen 1505* (MO); Stutterheim district, Gubu Dam, 32°36'S, 27°16'E, 11 Dec. 1981, *Hilliard & Burtt 14799* (MO); Amatole Mts., near Hogsback, along Hogsback Pass, 32°36'S, 26°50'E, 9 Nov. 1984, *Phillipson 932* (UPS); East London district, Gonubie Mouth, 32°56'S, 28°0'E, 18 Oct. 1980, *Hilliard & Burtt 13169* (B, K, M, MO, NU); East London district, road to Quenera river mouths, 32°57'S, 27°57'E, 14 Dec. 1981, *Hilliard & Burtt 14829* (NU); Addo, Zuurberg, 33°18'S, 25°42'E, 10 Jan. 2013, *Buira 1710* (MA); Grahamstown Natur Reserve, 33°18'S, 26°31'E, 2 Dec. 1977, *Hilliard & Burtt 10834* (K, NU); Huamnsdorp district, 38 km W versus pago Assegaai Bosch, 33°23'S, 26°15'E, 20 Sep. 1930, *Fries & al. 1252* (LD, PRE); Krom river, 34°8'S, 24°50'E, 11 Sep. 1960, *Acocks 21471* (M). KwaZulu-Natal: Alfred district, Main Cape road, near Weza turnoff, 14 Nov. 1973, *Hilliard & Burtt 7219* (MO, NU, PRE); Hlabisa district, Dukuduku forest Umfolozi Take off Works road, 28°21'S, 32°20'E, 21 Nov. 1978, *Dooley 2196* (NU); Mtunzini, 28°57'S, 31°45'E, Sep. 1928, *Thode A1524* (PRE); Kranskop district, 28°58'S, 30°52'E, 2 Oct. 1982, *Manning 274* (NU); Karkloof, Mbona Estate, 29°17'S, 30°4'E, Oct. 1999, *Edwards 1788* (NU); Pinetown district, Everdon, 29°27'S, 30°15'E, 16 Sep. 1973, *Hilliard 5382* (K); Tweedie, 29°28'S, 30°11'E, Nov. 1908, *Pegler & Wood 11035* (WU); Mt Ashley, 29°32'S, 30°7'E, 23 Oct. 1964, *Moll 1307* (PRE); Camperdown district, Inchanga, 29°44'S, 30°39'E, 12 Oct. 1973, *Hilliard & Burtt 6833* (MO, NU); Underberg, Ipolela, 29°47'S, 29°29'E, Jan. 1916, *Rogers 15105* (K); Umzinto district,Vernon Crookes Nature Reserve, 29°54'S, 30°56'E, 2 Oct. 1983, *Balkwill & Manning 973* (K); Polela district, Hlabeni, on Creighton road, 29°56'S, 29°45'E, 16 Jan. 1978, *Hilliard & Burtt 11218* (NU); Alexandra district, station Dumisa, Campbelltown, 30°15'S, 30°23'E, 14 June 1913, *Rudatis 1936* (G, PR, W, Z); Weza State Forest, near Mona, 30°36'S, 29°39'E, 8 Dec. 1984, *Balkwill & al. 2411* (MO); Uvongo, 30°49'S, 30°23'E, 12 Jan. 1937, *Mogg 13385* (MO); South Coast, Saint Michaels-on-Sea, 30°49'S, 30°24'E, 10 Oct. 1973, *Mogg 38290* (PRE); Marina Beach, 30°56'S, 30°18'E, 21 Oct. 1986, *MacDevette 1188* (PRE); Port Edward, above Umtamvuna River, 30°56'S, 30°8'E, 19 Sep. 1974, *Nicholson 1490* (PRE). Western Cape: George, Plockendorf, 5 Nov. 1928, *Gillet 2077* (PRE); George, Groenkop,

33º55'S, 22º32'E, 19 Oct. 1976, *Geldenhuye 355* (PRE); Mossel Bay division, a km Sw of Ruiterbos, 33º56'S, 22º2'E, 12 Oct. 1972, *Bremer 319* (MO); Langle near Knysna lagoon, 34º2'S, 23º1'E, 6 Oct. 1931, *Duthie 1133* (BOL); Cape Peninsula, W side of Hout Bay, 34º2'S, 18º21'E, 23 Oct. 1937, *Salter 7026* (BOL); Brakriver, 34º3'S, 22º13'E, 31 Oct. 1894, *Penther 2213* (PRE, W); Caledon, Piet-se-Bos, road to beach, 34º13'S, 19º25'E, 23 Sep. 1981, *Williams 730* (MO).

Discussion. Geranium ornithopodon is a perennial herb with a spreading stem, ascending to suberect. The total length is unknown since only fragments are represented in the collections studied. The only specimen available with basal and underground parts (*Hilliard & Burtt 13485*, M, NU) has a stem branched from the base, not lignified in the lower part and naked or with the remains of stipules, apparently without rosette, and with a separated rootstock fragment which is difficult to interpret. The leaves of *G. ornithopodon* are palmatifid, not deeply divided, and paler but not sericeous below. The middle leaf segment shows a characteristic outline with 1-2(3) well marked, spread lobes on each side (usually with additional lobelets) and with ± parallel sides below the lower lobes (sometimes slightly obcuneiform).

The inflorescence usually has an indumentum of both glandular and eglandular hairs, although in some specimens glandular hairs are scarce, while on petioles and stem glandular hairs are very rare. According to Hilliard & Burtt (1985: 217-220) *G. onithopodon* has been traditionally characterized by its spread hairs versus the appressed ones of *G. flanaganii*. These authors analyze the variability and geographic distribution of the indumentum and correctly conclude that these species cannot be differentiated by the density or position of its eglandular hairs. However, Hilliard & Burtt (1985: 217-220) consider that *G. ornithopodon* is a species of short sepals and petals, which extends over Western Cape and Eastern Cape and accept *G. flanaganii* as an independent species because of its longer sepals

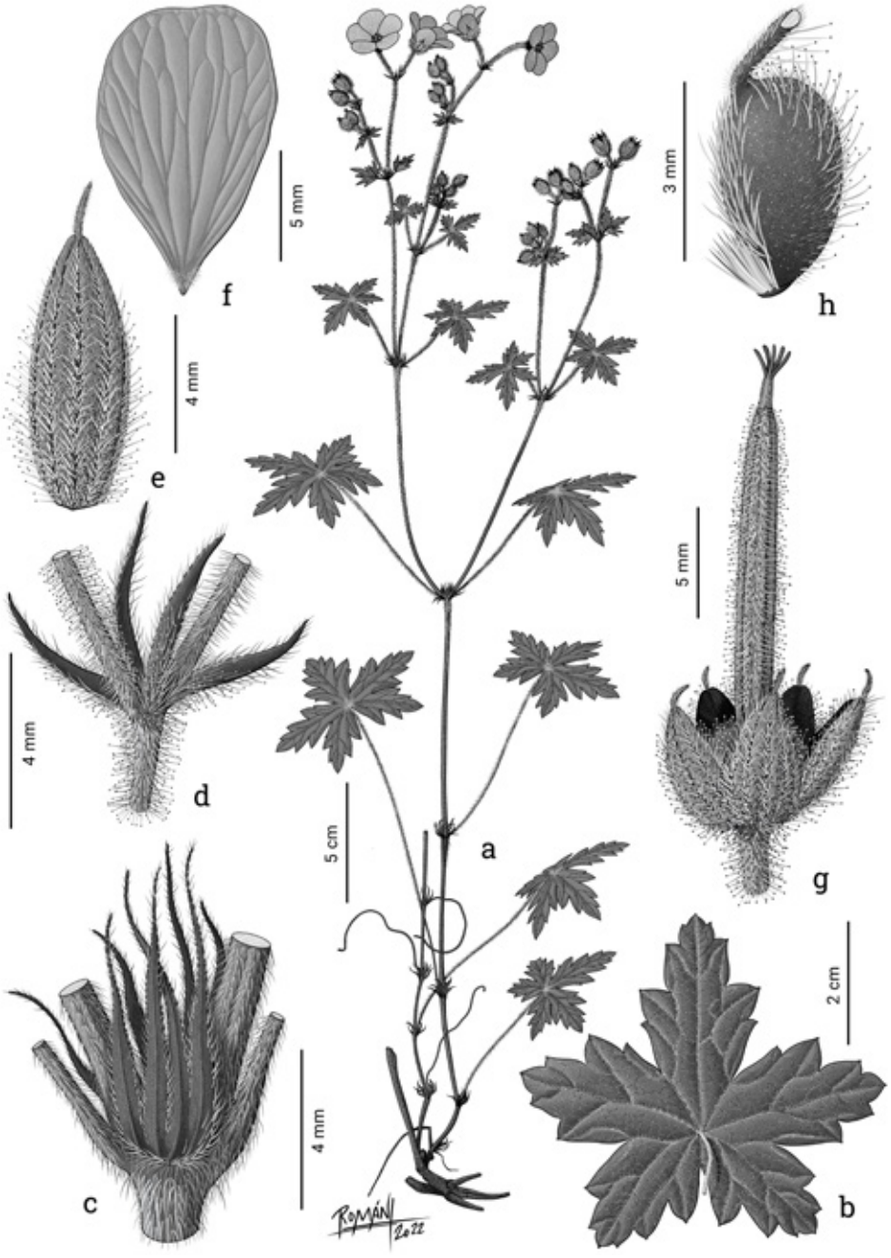


Fig. 630. *Geranium ornithopodon*. a. Habit. b. Leaf. c. Stipules. d. Bracteoles. e. Sepal. f. Petal. g. Fruit. h. Mericarp. (Based on: a, c, *Hilliard & Burtt 13485*, M; d, e, *Pegler 1158,* BM; b, *Hilliard & Burtt 6835*, NU; f, h, *Hilliard & Burtt 6833*, NU; g, *Salter 7026*, BOL).

Fig. 631. Distribution of *Geranium ornithopodon*.

and petals. The latter ranges from southernmost Swaziland through Natal to Eastern Cape. They indicate a list of specimens difficult to include in *G. flanaganii* and suggest that hybridization may have played an important role in the variability found in these species. Hilliard & Burtt (1985: 217-220) were very aware of the difficulties of their proposal to fit this difficult group of geraniums into a taxonomic system.

In the present study, it has been found that the plants from Western Cape consistently have small flowers but those of Natal are highly variable, in general with some longer sepals and petals but with a wide overlap. A great variability in these characters that does not show geographic tendencies has been found throughout the Eastern Cape. Variability has also been found within the same specimens. For example, in *Ecklon & Zeyher 449* (SAM) (isolectotype of *G. ornithopodon*), a flower has sepals of c. 4.5 mm and another of 5.9-6 mm. In fact, if the differentiation criteria proposed by Hilliard & Burtt (1985: 217-220) were applied, it would be difficult to attribute many specimens to one of the two species with certainty. It is obvious, however, that the synonymization of *G. flanaganii* that is proposed here is not a completely satisfactory solution that perhaps can be amended with a more in-depth study.

Hilliard & Burtt (1985: 216) indicated as type of *G. ornithopodon* the number "*Ecklon & Zeyher 443*". This is probably a mistake. In SAM-0030063A-0 there is a label in Hilliard's hand that states "Isotype" for this sheet numbered as "449". The specimen S-G-2851 is a sterile branch of *Ecklon & Zeyher 449*. On the same sheet there is a specimen of *G. wakkerstroomianum* collected by Drège, well separated (numbered S-07-8947) and with an identification label in Hilliard and Burtt's hand. S-07-8946 is a single leaf of *Ecklon & Zeyher 449*. To clarify the matter, I think that S-G-2851 should be proposed as lectotype in second-step.

251. Geranium wakkerstroomianum R. Knuth, Repert. Spec. Nov. Regni Veg. 45: 62. 1938. Type locality: "Südl. Transvaal: Distr. Wakkerstroom, Stoney Moon Kloof, in Gebüschen (Galpin a. 1930 n. 9813 -- Typus in herb. Berol.!).-- Blühend und fruchtend Januar". Type: South Africa. Mpumalanga, S Transvaal, Wakkerstroom, Stoney Moon Kloof, 1930, 27°21'S, 30°08'E, *E.E. Galpin 9813* (holotype, B destroyed; lectotype, designated by Hilliard & Burtt 1985: 208, K-000417237!; isolectotype, PRE-0663525-0).

Geranium ornithopodon var. *album* Kuntze, Revis. Gen. Pl. 3(3): 32. 1898. Type locality: "Capland: Molteno. Natal: Van Reenen's Pass". Type: South Africa. KwaZulu-Natal, Van Reenen's Pass, 28°22'S, 29°22'E, 20 Mar. 1894, *O. Kuntze s.n.* (lectotype, designated by Hilliard & Burtt 1985: 208, K!; isolectotype, NY-04206185!).

Perennial herbs, (18)27-75(100) cm tall. *Rootstock* 3.5-4 mm in diameter, ± vertical, not tuberculate, not turnip-shaped, without thickened roots. *Stem* procumbent to ascending, leafy, not rooting at nodes, stolons absent, without vegetative stems, with patent, eglandular hairs 0.4-1.7 mm long. *Basal leaves* not present (no rosette), cauline leaves alternate and upper opposite; leaf laminas (1.6)1.8-5.3(7) cm long, 1.8-7.9 cm wide, not peltate, palmatifid [ratio main-sinus length/middle segment length = (0.69)0.71-0.82], polygonal in outline, base cordate, not coriaceous, with nerves not projected, with ± appressed, eglandular hairs on both surfaces, sometimes densely on the abaxial surface; segments 5, in 1 plane, middle segment rhombic, (2.4)3.4-10(14.7) mm wide at the base [ratio segment width at the base/middle segment length = (0.19)0.20-0.28(0.40)], 7-13(19)-lobed in distal half [ratio secondary sinus length/middle segment length = (0.14)0.15-0.20(0.24)]; petioles up to 22 cm long, without abscission zone, terete, not swollen, not deflexed in age, with ± patent, eglandular hairs 0.4-1.6 mm long; stipules 3.2-8.3 mm long, 1.1-4.3 mm wide, 2-3-fid, with linear lobes 2.6-6.2 mm deep, 0.4-0.6 mm wide, free, papery, brown, with eglandular hairs on abaxial surface, ± glabrous adaxially. *Inflorescence* a monochasial cyme; cymules 2-flowered, solitary [ratio cymule length/leaf length = (1.4)1.7-3(5.5)]; peduncles (23)40-53(58) mm long, with patent, eglandular hairs 0.2-1.2 mm long and, rarely, patent, glandular hairs 1-1.3 mm long; bracteoles 2.3-5 mm long, 0.2-0.7 mm wide, linear-lanceolate, whorled; pedicels (12)18-27(46) mm long, with patent, eglandular hairs 0.2-1.3 mm long and, rarely, patent, glandular hairs 1-1.3 mm long. Flowers actinomorphic. *Sepals* (5)5.1-6.6(7) mm long, 1.7-2.5 mm wide, lanceolate, smooth, not accrescent, nerves 3, mucro (0.6)0.8-1.2 mm long [ratio mucro length/sepal length = (0.12)0.15-0.19(0.22)], with ± patent, eglandular hairs 0.4-1.6 mm long and, rarely, patent, glandular hairs 0.8-1.3 mm long on the abaxial surface, glabrous adaxially. *Petals* (7.2)9.6-11.5(12.2) mm long, (2.4)3.7-4.3(5) mm wide, erect-patent, emarginate (notch 0.8-2.1 mm deep), without claw, white or pink, hairy on the base of the adaxial surface, glabrous abaxially, ciliate on the basal margin, with hairs 0.3-0.4 mm long. *Stamens* 10, both whorls bearing anthers; filaments (5.1)5.4-5.9(6.3) mm long, lanceolate, white, with scattered eglandular hairs 0.1-0.4 mm long on the abaxial surface and margin; anthers (1.1)1.3-1.5(1.6) mm long, blue. Nectaries 5, hemispheric, glabrous. *Gynoecium* 4.3.7.4 mm long, pink. *Fruit* 18.4-20.5(27.8) mm long, erect, discharge of seed-ejection type; mericarps 2.6-3.4 mm long, 1.3-2 mm wide, without a strand of fibers, not compressed at the apex, smooth, without basal beak, with a basal callus, without a basal prong, black, with ± patent, eglandular hairs 0.5-1.1 mm long and, rarely, patent, glandular hairs 1-1.3 mm long; rostrum 12.4-21.7 mm long, with a narrowed apex 2.5-5.6 mm long, not twisted, with patent, eglandular hairs 0.2-0.7 mm long and, rarely, patent, glandular

hairs 1-1.5 mm long; stigmatic remnants 1-2.7 mm long, with 5 glabrous lobes. *Seeds* 2-2.4 mm long, 1.2-1.6 mm wide, finely reticulate, uniformly colored, brown, glabrous. Cotyledons with entire margin. Figs. 632, 633.

Pollen. *Geranium*-type (Verhoeven & Venter 1992: 441, 442).

Chromosome number. Unknown.

Phenology. Collected in flower from January to December.

Distribution. This species ranges from Eastern Cape to Limpopo, in South Africa (Fig. 634).

Habitat. Grassy slopes, damp sheltered places around rocks and on the edge of forest patches, or in marshy grassy places; 350-2600 m.

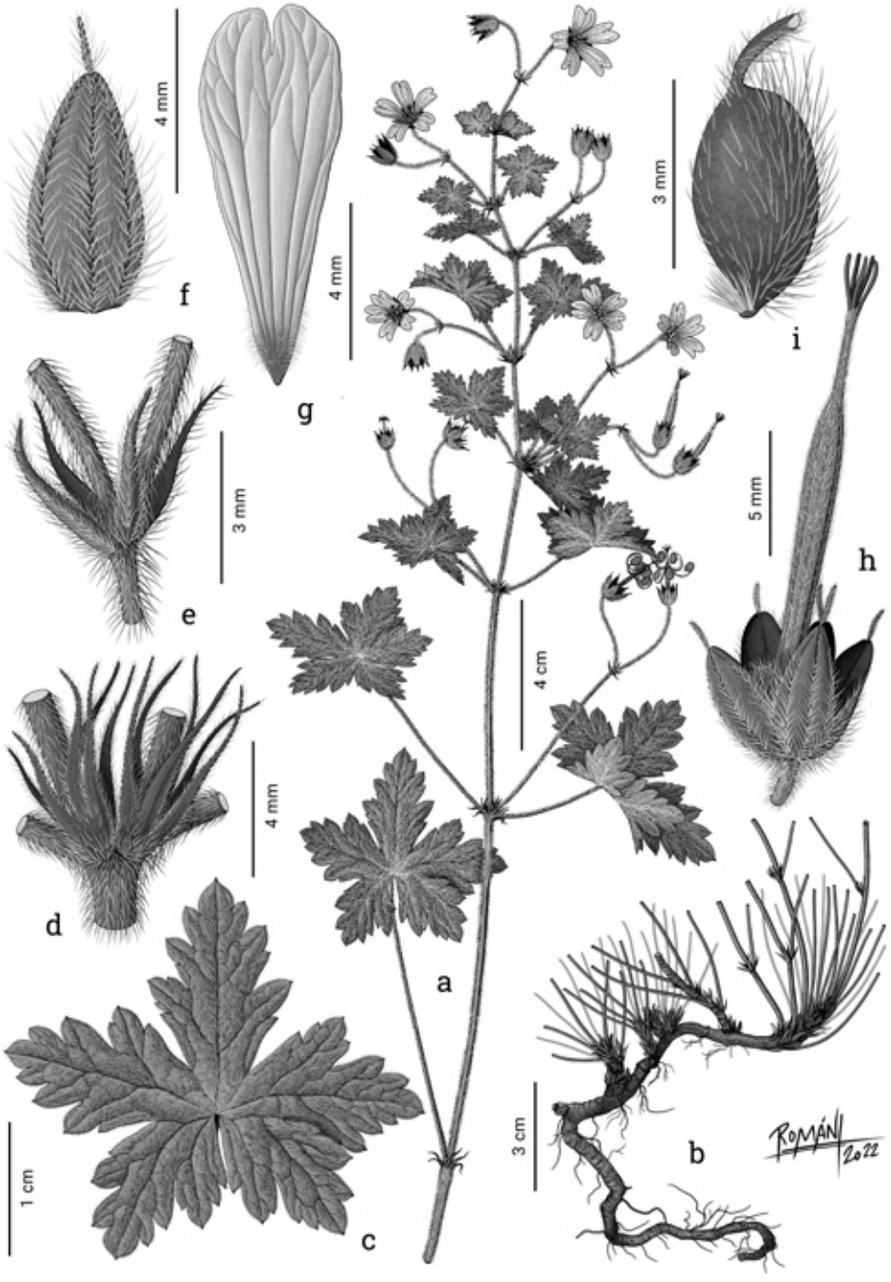


Fig. 632. *Geranium wakkerstroomianum*. a, b. Habit. c. Leaf. d. Stipules. e. Bracteoles. f. Sepal. g. Petal. h. Fruit. i. Mericarp. (Based on: a, c-h, *Hilliard & Burtt 14200,* NU; b, i, *Potgieter 292*, NU).

Fig. 633. *Geranium wakkerstroomianum* (Based on: *Buira 1742,* MA, photo: A. Buira).

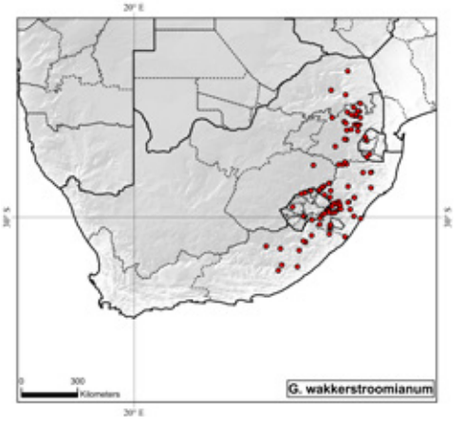


Fig. 634. Distribution of *Geranium wakkerstroomianum*.

Representative specimens examined. **Lesotho.** Berea, Advance Post, 29°15'S, 29°50'E, Dec. 1964, *Guillarmod 4799* (PRE). Butha-Buthe: Butha-Buthe, 28°43'S, 28°30'E, 1 Jan. 1960, *Guillarmod 4145* (PRE). Leribe: Rampais Nek, Woodlot between Leribe and Butha-Buthe, 28°49'S, 28°13'E, 22 Sep. 1983, *Richardson 228* (NU). Maseru: Korokoro road, 29°30'S, 27°37'E, 16 Mar. 1975, *Schmitz 6395* (PRE). Qacha's Nek: Sehlabathebe, 29°52'S, 29°3'E, 11 May 1973, *Phillips s.n.* (NU); 24 km N of Ramas Gate, 30°2'S, 28°56'E, 25 Oct. 1976, *Bayliss 7827* (G, GH, NY, Z); Kapcolonie, Makomerin, 30°7'S, 28°33'E, Feb. 1914, *Jacottet 825* (Z). **South Africa.** Eastern Cape: mont Inciswa, 30°48'S, 29°23'E, 27 Jan. 1895, *Schlechter 6478* (Z); Katkop, 30°52'S, 28°32'E, 7 Feb. 1984, *Hutchings 967* (MO); near Ugie, slopes of the Prentjiesberg, 31°8'S, 28°8'E, 11 Feb. 2000, *Potgieter 292* (NU); Maclear district, Ugie, farm Surat, 31°11'S, 28°14'E, 30 Jan. 1923, *Britten 4669* (PRE); Broughton, near Molteno, 31°23'S, 26°21'E, Dec. 1892, *Flanagan 1571* (K, US); Dordrecht, 31°30'S, 27°2'E, 22 Mar. 1964, *Bayliss 2108* (B); Transkei, Satannas Nec, near Engcobo, 31°35'S, 27°56'E, 28 Nov. 1981, *Hilliard & Burtt 14536* (K, NU); 25 km from Cala at turn off to Engcobo, 31°37'S, 27°51'E, 12 Jan. 1997, *Germishuizen 8811* (PRE); Cathcart district, Windvogelberg, 32°17'S, 27°6'E, 8 Dec. 1981, *Hilliard & Burtt 14781* (NU); Amatole Mountains, near Gaika's Kop, 32°33'S, 26°56'E, 17 Dec. 1984, *Phillipson 1007* (K, MO). Free State: Mafube, 27°30'S, 28°37'E, Nov. 1907, *Jacottet 92* (G); Harrismith district, Kerkenberg, 28°30'S, 29°8'E, 4 Jan. 1979, *Hilliard & Burtt 11943* (K, NU). KwaZulu-Natal: Zuurbergen, 1 Feb. 1895, *Schlechter 6576* (C, MA, NY, PREW, US, WU, Z); Ngome, 30 km from Nongoma on road to Vryheid, 27°51'S, 31°22'E, 14 Oct. 1982, *Germishuizen 2050* (PRE); Bergville district, Olivierhoek Pass, 28°37'S, 29°0'E, 22 Feb. 1999, *Balkwill 11011* (B, C, MO); Cathedral peak Forest reserve station, 28°55'S, 29°9'E, 5 Oct. 1950, *Killick 974* (K); Mt. Gilboa, 29°17'S, 30°17'E, Feb. 2002, *Edwards 2806* (NU); Underberg, Loteni Nature Reserve, W of Eagle rock, 29°28'S, 29°31'E, 30 Oct. 1990, *Gibby 507* (BM); Pietermaritsburg, Zwartkop mountain, 29°37'S, 30°23'E, 31 Mar. 1934, *Humbert 14649* (MA); Souther Drakensberg, near Gxalingenwa Cave, 29°38'S, 29°21'E, 6 Feb. 2013, *Buira 1742* (MA); Bulwer district, Sunset, Marwaga, 29°43'S, 29°41'E, 31 Dec. 1973, *Rennie 466* (K); Polela district, Sunset farm, Bulwer mtn, Lurane cliffs, 29°46'S, 29°39'E, 7 Jan. 1982, *Rennie 1301* (NU); Biggersberg, One tree Hill farm, 29°57'S, 28°8'E, 16 Mar. 1996, *Ngwenya 1441* (PRE); Mt. Currie district, Mt. Currie, 30°28'S, 29°25'E, 15 Nov. 1973, *Hilliard & Burtt 7245* (MO, NU); Kokstad, 30°32'S, 29°25'E, Nov. 1883, *Tyson 1240* (MO). Limpopo: below Entabeni, Zoutpansberg, 22°59'S, 30°16'E, 20 Aug. 1930, *Hutchinson & Gillet 4289* (BM, K); Transvaal, Pietersburg, 23°54'S, 29°28'E, Feb. 1924, *Rogers 25464* (Z); Transvaal, Pietersburg, 23°54'S, 29°28'E, Dec. 1917, *Rogers & Moss 414* (Z); Lekgalameetse Natural Reserve, the Downs Forest under Cyprus Point, 24°7'S, 30°10'E, 13 Aug. 1985, *Stalmans 596* (MO); Lekgalameetse National Reserve, The Downs, 24°7'S, 30°10'E, 23 Dec. 1985, *Stalmans 870* (K). Mpumalanga: Pelgrimsrus district, Mariepskop, 24°32'S, 30°52'E, 26 Mar. 1969, *Vorster 538* (MO); Steenkampsberg Pass, 24°43'S, 30°33'E, 23 Feb. 1996, *Snow & Burgoyne 7077* (MO); top of Mt. Anderson N of the Long Tom Pass, 25°4'S, 30°39'E, 8 Feb. 2000, *Goldblatt 11254* (MO); Long Tom Pass, 25°8'S, 30°37'E, 2 Feb. 1959, *Werdermann & Oberdieck 2151* (B, K, US); Dullstroom, Halfgewonnen farm, 25°13'S, 29°31'E, 27 Nov. 1980, *Drews 179* (MO); Nelspruit district, Berlin State forest, 6 km E of Kaapsehoop, 25°32'S, 30°43'E, 23 Jan. 1992, *Balkwill 6867* (B); Elandshoogte, near Machadodorp, 25°33'S, 30°36'E, 3 Mar. 1981, *Hilliard & Burtt 14158* (NU); Carolina district, on the farm Goedgelgen, 25°47'S, 30°26'E, 17 Nov. 1993, *Balkwill 8513* (B, MO); Barberton, Piggs Peak, 25°49'S, 30°13'E, 22 July 1957, *Levyns 9983* (BOL); Waterval Onder, farm Goedeverwachting, 26°15'S, 30°7'E, 1 Oct. 1949, *Prosser 1236* (K); 50 km from Chrissiemeer on road to Lochiel, 26°16'S, 30°12'E, 6 Mar. 1986, *Germishuizen 3885* (MO); Wakkerstroom, Oshoek, 26°36'S, 29°40'E, 3 Feb. 1960, *Devenish 193* (K). **Swaziland.** Hhohho: Mbabane district, about 20 km N of Mbabane, 26°8'S, 31°6'E, 8 Apr. 1966, *Maguire 7626/125* (B, G, LD, W, Z); Mbabane district, 3 mi NE of Forbes Reef, 26°10'S, 31°6'E, 13 Feb. 1962, *Schlieben 9553* (B, G, LD, M, W, Z); Hhohho district, 4 km NE of Mbabane, 26°18'S, 31°10'E, 8 Apr. 1977, *Kemp 842* (MO, US). Shiselweni: Hlatikulu, 26°58'S, 31°19'E, Jan. 1911, *Stewart 8788* (K); Louwsberg, 2 mi E of Goedgegun, 27°6'S, 31°11'E, 24 Dec. 1967, *Ross 1747* (B, G, LD, MO, W, Z).

Discussion. Geranium wakkerstroomianum is a perennial herb with a spreading stem, procumbent to ascending. The stem is branched from the base, somewhat lignified in the lower part and naked or with the remains of stipules, apparently without rosette. Its underground parts are poorly known owing to the scarce herbarium material available, but in some specimens a thin vertical rootstock appears. Hilliard & Burtt (1985: 208), however, stated that *G. wakkerstroomianum* has a thickened taproot, which has not been confirmed in the specimens studied. This species has palmatifid leaves, similar to those of *G. ornithopodon*, not deeply divided, with an indumentum of eglandular hairs sometimes more dense on the abaxial surface, but not so dense as to be considered sericeous. Most of the specimens have only eglandular hairs on the inflorescence, but occasionally glandular hairs are also found, and very rarely there are specimens which are nearly glabrous.

Geranium wakkerstroomianum, which has sometimes been confused with *G. ornithopodon*, is easily identified by its narrow petals (in absolute terms and in relation to their length) which are markedly emarginate. This trait, which distinguishes it from all the species in the section, is sometimes difficult to observe in herbarium specimens if the flowers are not carefully prepared.

252. Geranium caffrum Eckl. & Zeyh., Enum. Pl. Afr. Austral.: 58. 1834-35. Type locality: "In hortis Caffrorum vetustis prope 'Philipstown' ad flumen 'Katrivier' (Ceded Territory). Oct.". Type: South Africa. Easthern Cape, prope Philipstown ad flumen Kat rivier, 32°34'S, 26°45'E, Oct., *C.F. Ecklon & C.L. Zeyher 448* (lectotype, designated by Hilliard & Burtt 1985: 199, S-07-8893 image!; isolectotype, SAM).

Geranium caffrum var. *robusta* Eckl. & Zeyh., in sched., unknown date. Type locality: "In hiatu laterali montium "Van Stadensriviersberge" (altit. IV. Mai". Type: South Africa. Eastern Cape, Stadensriviersberge, 33°54'S, 25°12'E, *C.F. Ecklon & C.L. Zeyher s.n.* (lectotype, here designated, S-G-2845 image!).

Geranium dregei Hilliard & B.L. Burtt, Notes Roy. Bot. Gard. Edinburgh 42(2): 201, 174 fig. 2 D. 1985. Type locality: "Cape, Middelburg distr., farm Compassberg, banks above sluit, 25 xii 1951, Esterhuysen

19706 (BOL holo., PRE iso.)". Type: South Africa. Eastern Cape, Middelburg distr., farm Compassberg, 31°37'S, 26°04'E, 25 Dec. 1951, *E.E. Esterhuysen 19706* (holotype, BOL-136332 image!; isotype, PRE-0663463-0 image!).

Geranium natalense Hilliard & B.L. Burtt, Notes Roy. Bot. Gard. Edinburgh 42(2): 204, 174 fig. 2 H. 1985. Type locality: "Natal, Lions River distr., Karkloof, farm 'Ehlatini', 4500ft, 15 ii 1947, Moll 3467 (PRE holo.; K, NH, NU iso.)". Type: South Africa. KwaZulu-Natal, Lions River distr., Karkloof, farm 'Ehlatini', 29°17'S, 30°04'E, 15 Feb. 1947, *E.J. Moll 3467* (holotype, PRE-0663878-0 image!; isotypes, K, NH-0060076-0 image!, NU-21706 image!).

Perennial herbs, 23-80 cm tall. *Rootstock* 3-3.5 mm in diameter, ± vertical, not tuberculate, not turnip-shaped, without thickened roots. *Stem* ascending to suberect, leafy, not rooting at nodes, stolons absent, without vegetative stems, with retrorse, appressed, eglandular hairs 0.2-0.7 mm long and rarely, patent glandular hairs 0.2-0.3 mm long. *Basal leaves* not present (no rosette), cauline leaves alternate and upper opposite; leaf laminas (2)3.7-5.4(6.4) cm long, 2.1-8.8 cm wide, not peltate, deeply palmatifid to palmatisect [ratio main-sinus length/middle segment length = (0.90)0.94-0.98(0.99)], polygonal in outline, base cordate, not coriaceous, with nerves not projected, with appressed, eglandular hairs on the adaxial surface and with appressed, eglandular hairs restricted to the nerves abaxially; segments 5, in 1 plane, middle segment rhombic (with linear-lanceolate lobes, (1.2)2.2-3.5(7.1) mm wide), (0.5)0.9-2(3.5) mm wide at the base [ratio segment width at the base/middle segment length = (0.03)0.04-0.07(0.09)], 5-18-lobed in distal half [ratio secondary sinus length/middle segment length = (0.18)0.24-0.27(0.57)]; petioles up to 17 cm long, without abscission zone, terete, not swollen, not deflexed in age, with retrorse, appressed, eglandular hairs 0.2-0.6 mm long and rarely, patent glandular hairs 0.2-0.3 mm long; stipules 2.6-9.3 mm long, 0.8-3.8 mm wide, 2-3-fid, with linear lobes 1.2-7.1 mm deep, 0.4-1 mm wide, free, papery, brown, with eglandular hairs on abaxial surface, ± glabrous adaxially. *Inflorescence* a monochasial cyme; cymules 2-flowered, solitary [ratio cymule length/leaf length = (1.6)1.8-3.1(6.5)]; peduncles (24)29-63(97) mm long, with retrorse, appressed, eglandular hairs 0.2-0.5 mm long and rarely, patent glandular hairs 0.2-0.3 mm long; bracteoles 1.1-4.9 mm long, 0.3-1 mm wide, linear-lanceolate, whorled; pedicels (7)9-20(31) mm long, with retrorse, appressed, eglandular hairs 0.1-0.5 mm long and usually, patent glandular hairs 0.2-0.4 mm long. Flowers actinomorphic. *Sepals* (5.1)5.3-5.9(7.7) mm long, 1.9-2.8 mm wide, lanceolate, smooth, not accrescent, nerves 3, mucro (0.3)0.8-1(1.2) mm long [ratio mucro length/sepal length = (0.06)0.12-0.17 (0.21)], with appressed, eglandular hairs 0.1-0.4 mm long and, usually, patent, glandular hairs 0.1-0.5 mm long on the abaxial surface, glabrous adaxially. *Petals* (6.5)7.5-10.5(15.1) mm long, (3.1)3.9-7(8.6) mm wide, erect-patent, rounded or slightly emarginate (notch 0.3-0.6 mm deep), without claw, usually white, sometimes pale pink, hairy on the base of the adaxial surface, glabrous abaxially, ciliate on the basal margin, with hairs 0.3-0.4 mm long. *Stamens* 10, both whorls bearing anthers; filaments (4)5.2-5.7(7.4) mm long, lanceolate, yellow, with eglandular hairs 0.1-0.3 mm long on the abaxial surface and margin; anthers (0.8)1.1-1.3(1.7) mm long, yellow. Nectaries 5, hemispheric, with a tuft of hairs at the top, dorsally glabrous. *Gynoecium* 3.9-7.8 mm long, purple. *Fruit* (20.9)23-26(26.9) mm long, erect, discharge of seed-ejection type; mericarps 3-3.6 mm long, 1.7-2.2 mm wide, without a strand of fibers, not compressed at the apex, smooth, without basal beak, with a basal callus, without a basal prong, black, with ± patent, eglandular hairs 0.6-1 mm long and, usually, patent, glandular hairs 0.3-0.7 mm long; rostrum 14.5-20.4 mm long, with a narrowed apex 2.6-4.6 mm long, not twisted, with ± patent, eglandular hairs 0.1-0.4 mm long and, usually, patent, glandular hairs 0.2-0.5 mm long; stigmatic remnants 1.9-2.9 mm long, with 5 hairy lobes. *Seeds* 1.7-2.4 mm long, 1.3-1.7 mm wide, finely reticulate, uniformly colored, brown, glabrous. Cotyledons with entire margin. Fig. 635.

Pollen. *Geranium*-type (Verhoeven & Venter 1992: 446).

Chromosome number. 2*n* = 22 (M. Gibby, in sched.).

Phenology. Collected in flower from October to April.

Distribution. This species ranges from Western Cape through Eastern Cape and KwaZulu-Natal to Mpumalanga, in South Africa (Fig. 636).

Habitat. Coastal grassland, roadsides, around marshes or along streambanks; 50-1900 m.

Additional specimens examined. **South Africa.** Eastern Cape: Southwell district, Baviaans Kloof, 31°9'S, 25°56'E, 11 Mar. 1973, *Bayliss 5605* (A, C, MO, NY, US); Middelburg distr., farm Onbekend, 31°36'S, 24°46'E, 22 Jan. 1935, *Verdoorn 1564* (PRE); Queenstown, banks of Komani River, 31°53'S, 26°52'E, Dec. 1896, *Galpin 2247* (PRE); Graaff Reinet district, foot of old Wapadsberg Pass near Bethesda Road, 31°54'S, 24°54'E, 26 Nov. 1981, *Hilliard & Burtt 10681* (K, MO, NU); Houd Constant, pass S of the farm to Moordenaarsrivier, 32°5'S, 24°14'E, 7 Nov. 1974, *Oliver 5262* (PRE); Katberg Pass above Readesdale turn, 32°27'S, 26°39'E, 28 Oct. 1980, *Hilliard & Burtt 13259* (B, M, K, PRE); Somerset east, Buffelshoekse pass, on R337 N from Pearson, 32°29'S, 25°13'E, 17 Oct. 1990, *Gibby & Barrett 462* (BM); Stutterheim district, Gubu Dam below Kubusie forets, 32°34'S, 27°17'E, 14 Dec. 1977, *Hilliard & Burtt 11048* (NU); Stutterheim district, Gubu Dam below Kubusie forets, 32°34'S, 27°17'E, 14 Dec. 1977, *Hilliard & Burtt 11049* (PRE); Stutterheim district, Gubu Dam, 32°34'S, 27°17'E, 11 Dec. 1981, *Hilliard & Burtt 14801* (B, K, MO, NU); Stutterheim, 32°34'S, 27°25'E, Dec. 1913, *Rogers 12718* (Z); Kabusie forest area, mt. Kemp at Gubu Dam, 32°40'S, 27°15'E, 26 Nov. 1980, *Batten 569* (NU); Somerset East, Bester's Hoek, 32°43'S, 25°35'E, 25 Oct. 1980, *Hilliard & Burtt 13243* (MO); Kei Road, near King William's Town, 32°52'S, 27°23'E, 2 Oct. 1976, *Bayliss 8002* (A, B, M, MO, NY, US, Z); Albany district, Riebeek East, 33°12'S, 26°8'E, 2 Jan. 1974, *Bayliss 6313* (B, M, MO, NY, US, Z); 6 mi

from Botanical Research Unit, on Fort Beaufort road, Grahamstown, 33°18'S, 26°31'E, 20 Oct. 1977, *Brink 580* (C, B, K, MO, US); Sandy Drift near Grahamstown, 33°18'S, 26°31'E, Oct. 1901, *Daly 50* (PRE, Z); pr. Grahamstown, 33°21'S, 26°30'E, 12 Oct. 1994, *Phillipson 4277* (K, MO). KwaZulu-Natal: Natal, 1862, *Cooper 1191* (MA, W); Natal, 1862, *Cooper 2047* (NY, Z); Drakensberg, Upper Tugela, 28°48'S, 29°9'E, 11 Dec. 1988, *Everson 1131* (NU); Drakensberg, Cathedral Peak, Mhlwazini valley, 28°55'S, 29°8'E, 1 Apr. 1977, *Smith s.n.* (NU); Drakensberg, Cathkin Park, 29°0'S, 29°25'E, 4 Feb. 1932, *Galpin 11722* (PRE, K); Bergville, Mlambonja valley, Cathedral peak Forest Station, 29°0'S, 29°16'E, 25 Feb. 1952, *Killick 1780* (NU, NY, UPS); Cathedral peak, 29°0'S, 29°16'E, 9 Feb. 1982, *Lambinon 82/431* (MO); Pietermaritzburg, just outside of Greytown, 29°3'S, 30°35'E, 11 Nov. 1983, *Buthelezi 323* (E); Tabamhlope Research Station, 29°7'S, 29°38'E, 8 Jan. 1938, *West 558* (PRE); Karkloof forest, Mshwate river valley near Mbona, 29°17'S, 30°4'E, 2 Oct. 1898, *Wirminghaus 1051* (NU); Lions River district, Nottingham Road, 29°21'S, 29°59'E, 22 Jan. 1956, *Edwards 1131* (NU, PRE); Nottingham Road, 29°21'S, 29°59'E, Mar. 1939, *McClean 828* (MO); Balgowan, Glen Arum, 29°23'S, 30°3'E, 3 Apr. 1919, *Mogg 3805* (PRE). Mpumalanga: Komati Poort, 25°26'S, 31°57'E, 19 Dec. 1897, *Schlechter 11850* (GB). Northern Cape: Modder river near Kimberley, 29°1'S, 24°38'E, Dec. 1892, *Flanagan 1892* (PRE). Western Cape: distric of Beaufort, 32°16'S, 22°41'E, 1860, *Cooper 439* (BM, K, MA, W, Z); Ceres div., slopes of Bokkeveld Tafelberg, 32°50'S, 19°10'E, 8 Dec. 1940, *Esterhuysen 3899* (BOL); Koude Bokkeveld Tafelberg, 32°50'S, 19°10'E, 22 Jan. 1897, *Schlechter 10099* (G, K, LD, MO, PR, US, W, Z); near George, 33°57'S, 22°27'E, 8 Mar. 1976, *Bayliss 7211* (MO).

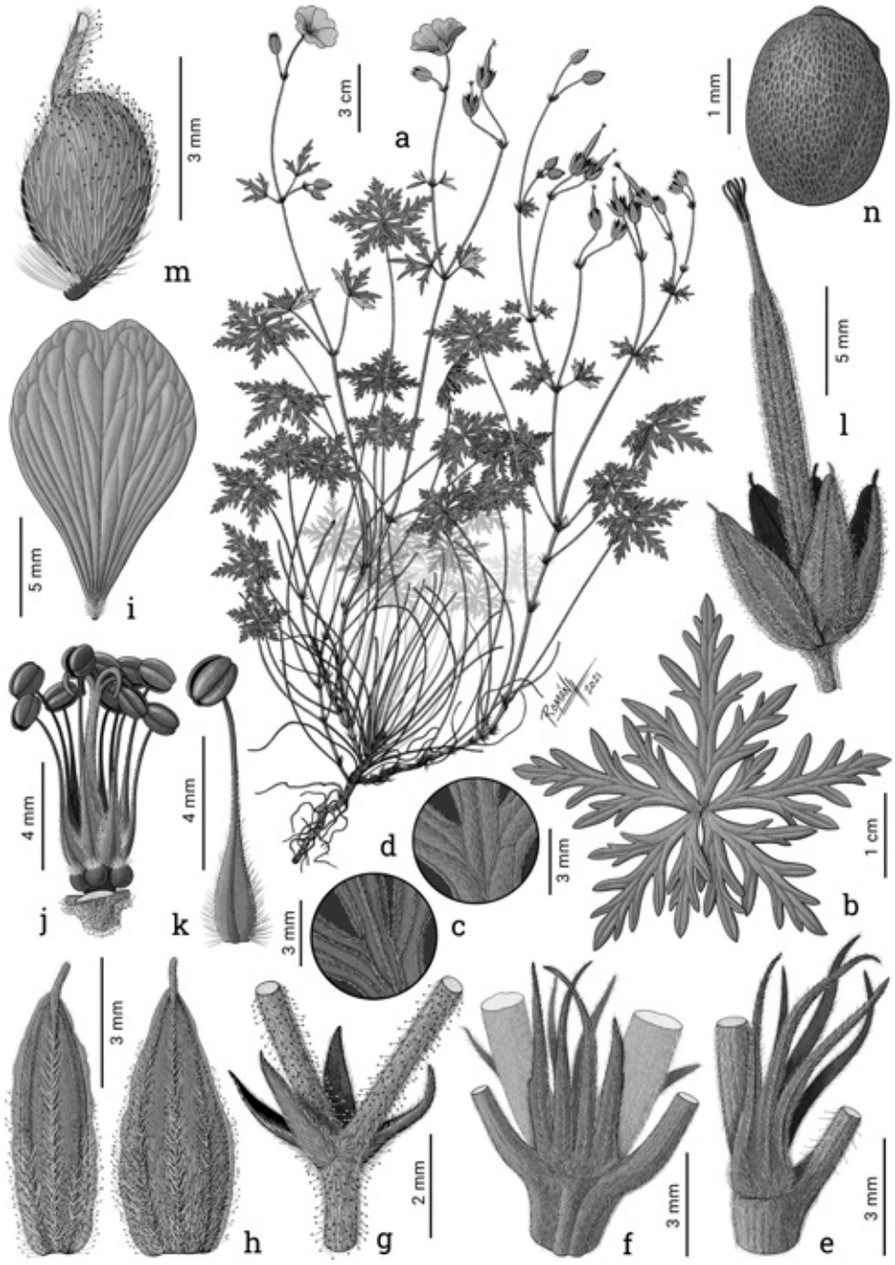


Fig. 635. *Geranium caffrum*. a. Habit. b. Leaf. c. Detail of the abaxial surface of the leaf. d. Detail of the adaxial surface of the leaf. e, f. Stipules. g. Bracteoles. h. Sepals. i. Petal. j. Flower without sepals and petals. k. Stamen. l. Fruit. m. Mericarp. n. Seed. (Based on: a, e, g, i-l, *Hilliard & Burtt 14801*, NU; b-d, f, *Hilliard & Burtt 10681*, K; h, m, n, *Hilliard & Burtt 13259*, NU).

Discussion. Geranium caffrum is a perennial herb with a spreading stem, suberect to ascending. The stem is branched from the base, somewhat lignified in the lower part and naked or with the remains of stipules, apparently without rosette. Its underground parts are poorly known owing to the scarcity of herbarium material, but in some specimens a thin vertical rootstock appears. Hilliard & Burtt (1985: 199), however, stated that *G. caffrum* has a long thickened taproot and a stem that roots. This has not been confirmed in the spec-

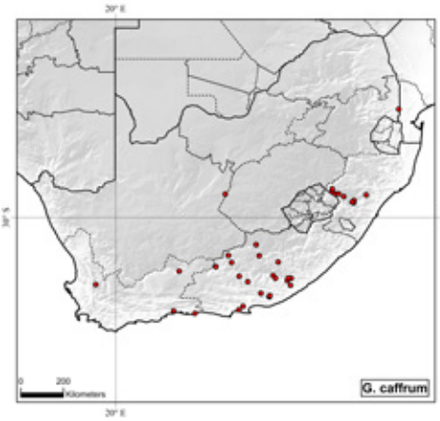


Fig. 636. Distribution of *Geranium caffrum*.

imens studied. The leaves are deeply palmatifid or even palmatisect, with narrow segments, slightly revolute on the margins. The middle segment has a narrow base and few lateral narrow lobes, the lowermost usually entire or with 1-2 teeth. The leaves are sparsely appressed-pubescent on both surfaces, but with hairs restricted to the nerves and margins on the abaxial surface, although scattered hairs can be found between the nerves exceptionally. In the most typical specimens (see the next paragraph) the stem, petiole and inflorescence indumentum is formed by appressed, eglandular hairs. It is also common to find patent, glandular hairs only on pedicels and sepals, but not in all specimens.

Hilliard & Burtt (1985: 201) described *G. dregei* as a species closely allied to *G. caffrum* with smaller flowers and spreading hairs on stem, petioles and lower leaf surface. In the specimens examined (*Esterhuysen 19706,* BOL image!, PRE image!; *Flanagan 1892*, PRE; *Verdoon 1564*, PRE) there is some variation in these characters. The sepals and petals are short but fall within the variability of *G. caffrum*. Plants from Middelburg district (the type and *Verdoon 1564*) lack glandular hairs on the inflorescence and have a denser indumentum. Its eglanduliferous hairs are not clearly appressed on the stem, petiole and leaf surface, being sometimes spread. On the abaxial surface of the leaf they extend beyond the nerves while in the typical *G. caffrum* they are appressed and are restricted to the nerves. However, these indumentum characters show a certain internal variation in the studied samples, which discourages their taxonomic use without other supporting characters. With the data currently available, it seems preferable to consider *G. dregei* as a local form of denser indumentum. Further collections would be necessary to better understand the variability of these populations and eventually separate them as an independent species.

Hilliard & Burtt (1985: 204) described *G. natalense* based on a collection from Karkloof forest in Natal. They also examined an additional collection from this area plus three collections by T. Cooper from Natal, without precise locality. They differentiate *G. natalense* from *G. schlechteri* by its more deeply cut leaves and by less markedly glandular indumentum. I think, however, that *G. natalense* is more closely related to *G. caffrum*. I have examined three images of the type collection and another specimen from the Karkloof forest (*Wirminghans 1051*, NU), plus *Cooper 1191* and *2047*. Cooper's collections fall well within the variability of *G. caffrum*. The type collections and *Wirminghans 1051* are, however, a bit different. They are characterized by leaves somewhat less deeply divided than the typical *G. caffrum,* and with a somewhat denser and less appressed indumentum. Nevertheless there does not appear to be any character that differentiates it conclusively. With the data currently available it seems preferable to consider *G. natalense* a local form that deserves a deeper study. Further collections would be necessary to better understand the variability of these populations and eventually separate them as an independent species.

Mary Gibby made a chromosome count of *G. caffrum:* 2*n* = 22 [based on *Gibby & Barret 462* (BM)], that remains unpublished, annotated in a small label on the voucher. She has kindly authorized me to publish it now in this monograph.

---

253. Geranium subglabrum Hilliard & B.L. Burtt, Notes Roy. Bot. Gard. Edinburgh 42(2): 202, 174 fig. 2 F. 1985. Type locality: "Natal, Alfred distr., 3029 DB, farm Rooivaal near Harding, 2 iii 1983, Hilliard & Burtt 16748 (NU holo., E iso.)". Type: South Africa. KwaZulu-Natal, Alfred distr., farm Rooivaal near Harding, 28°23'S, 29°44'E, 2 Mar. 1983, *O.M. Hilliard & B.L. Burtt 16748* (holotype, NU-0014140-2 image!; isotypes, E-00200416!, K-000417236!, M-0108609!, MO-3840637!, NH-0103763-0 image!, P-00086012!, PRE-0714032-0 image!, S-G-2854).

Perennial herbs, 30-80 cm tall. *Rootstock* and roots unknown. *Stem* ascending to suberect, leafy, not rooting at nodes, stolons absent, without vegetative stems, with retrorse, appressed, eglandular hairs 0.2-0.4 mm long. *Basal leaves* unknown, cauline leaves alternate and upper opposite; leaf laminas (4.3)5.4-8.2(9.1) cm long, 6.4-10.6 cm wide, not peltate, deeply palmatifid [ratio main-sinus length/middle segment length = (0.85)0.89-0.95(0.96)], polygonal in outline, base cordate, not coriaceous, with nerves not projected, with appressed, eglandular hairs on the adaxial surface and appressed, eglandular hairs restricted to the nerves abaxially; segments 5, in 1 plane, middle segment rhombic, (2.5)3.1-4.6(5.5) mm wide at the base [ratio segment width at the base/middle segment length = (0.06)0.08-0.10(0.15)], 11-16-lobed in distal half [ratio secondary sinus length/middle segment length = (0.14)0.17-0.26(0.30)]; petioles up to 20 cm long, without abscission zone, terete, not swollen, not deflexed in age, with retrorse, appressed, eglandular hairs 0.3-0.5 mm long; stipules 7.1-12.6 mm long, 1.8-7.7 mm wide, 2-3-fid, with lanceolate lobes 3.9-9.9 mm deep, 0.3-0.8 mm wide, free, papery, brown, with eglandular hairs on abaxial surface, glabrous adaxially. *Inflorescence* a monochasial cyme; cymules 2-flowered, solitary [ratio cymule length/leaf length = 4.5-9.6]; peduncles (41)51-64(69) mm long, with retrorse, uncinate, eglandular hairs 0.2-0.5 mm long and patent, glandular hairs 0.1-0.6 mm long; bracteoles 3.7-6.7 mm long, 0.5-0.8 mm wide, linear-lanceolate, whorled; pedicels (20)21-45(47) mm long, with retrorse, uncinate, eglandular hairs 0.2-0.5 mm long and patent, glandular hairs 0.3-0.6 mm long. Flowers actinomorphic. *Sepals* (5.6)6-6.8(7) mm long, 2-2.8 mm wide, lanceolate, smooth, not accres-

cent, nerves 3, mucro 1-1.3(1.4) mm long [ratio mucro length/sepal length = 0.15-0.23(0.26)], with appressed, eglandular hairs 0.2-0.5 mm long and patent, glandular hairs 0.3-0.7 mm long on the abaxial surface, glabrous adaxially. *Petals* (8.1)11.2-11.7(12) mm long, (5.1)5.5-7.6(8.2) mm wide, erect-patent, rounded, without claw, pink, hairy on the base of the adaxial surface, glabrous abaxially, ciliate on the basal margin, with hairs 0.2-0.5 mm long. *Stamens* 10, both whorls bearing anthers; filaments (4)4.2-6.3(7.1) mm long, lanceolate, yellow, with eglandular hairs 0.1-0.4 mm long on the abaxial surface and margin; anthers (1)1.5-1.7(1.9) mm long, yellow. Nectaries 5, hemispheric, with a tuft of hairs at the top, dorsally glabrous. *Gynoecium* 4.9-6.3 mm long, purple. *Fruit* 21-23 mm long, erect, discharge of seed-ejection type; mericarps 2.7-3.2 mm long, 1.2-1.7 mm wide, without a strand of fibers, not compressed at the apex, smooth, without basal beak, with a basal callus, without a basal prong, brown, with ± patent, eglandular hairs 0.4-0.5 mm long and patent, glandular hairs 0.4-0.7 mm long; rostrum 15.8-18.5 mm long, with a narrowed apex 2.7-4.8 mm long, not twisted, with ± patent, eglandular hairs 0.1-0.2 mm long and patent, glandular hairs 0.3-0.7 mm long; stigmatic remnants 1.9-2.1 mm long, with 5 glabrous lobes. *Seeds* unknown. Cotyledons not studied. Fig. 637.

Pollen. *Geranium*-type (Verhoeven & Venter 1992: 441, 442).

Chromosome number. Unknown.

Phenology. Collected in flower from December to March.

Distribution. This species ranges from northern Eastern Cape to KwaZulu-Natal, in South Africa (Fig. 638).

Habitat. Streamsides near the edge of forest patches; 1100-1350 m.

Additional specimens examined. **South Africa.** Eastern Cape: Transkei, Isolo district, road from Ngadu forest to Bele, 31°19'S, 28°40'E, 29 Feb. 1983, *Hutchings 833* (E, NU); Mjika, Ngadu, 31°25'S, 28°40'E, 2 Dec. 1983, *Hutchings 833b* (MO); Engcobo district, Baziya mountain, Mpolompo valley, 31°33'S, 28°23'E, 2 Feb. 1981, *Hilliard & Burtt 13949* (E, NU); Engcobo district, Ba-

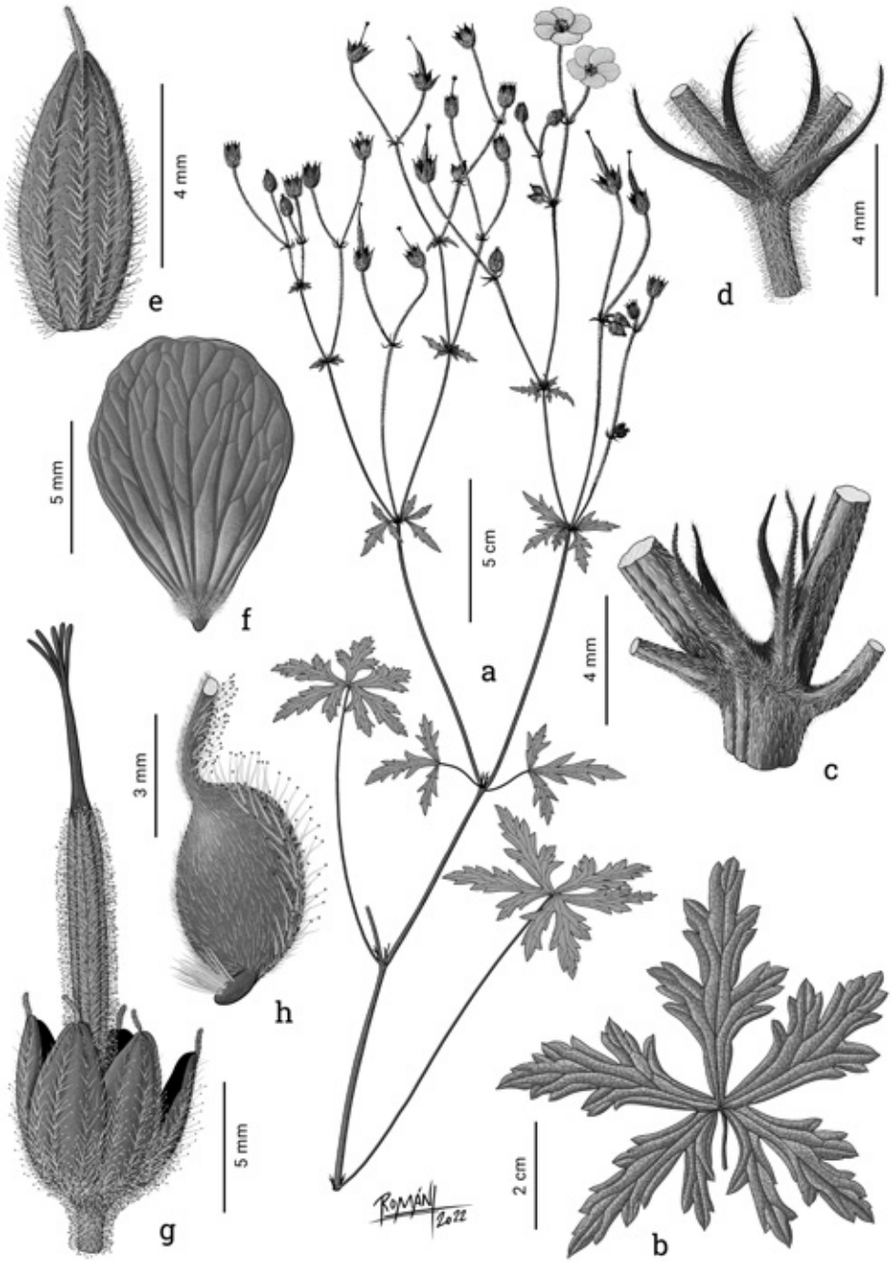


Fig. 637. *Geranium subglabrum*. a. Habit. b. Leaf. c. Stipules. d. Bracteoles. e. Sepal. f. Petal. g. Fruit. h. Mericarp. (Based on: *Hilliard & Burtt 16748*, E).

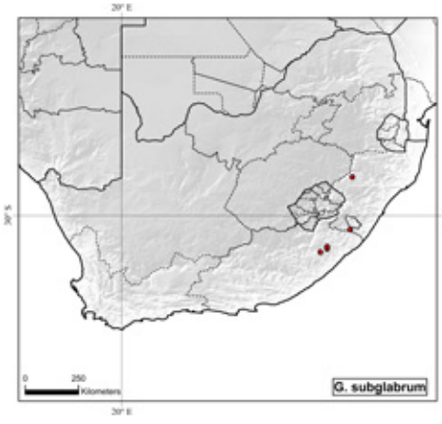


Fig. 638. Distribution of *Geranium subglabrum*.

ziya mountain, Mpolompo valley, 31º33'S, 28º23'E, 1 Feb. 1983, *Hilliard & Burtt 16357* (E, NU). KwaZulu-Natal: Weza State Forest, near Mona, 30º36'S, 29º39'E, 8 Dec. 1984, *Balkwill & al. 2420* (E, MO).

Discussion. Geranium subglabrum is a rare species, with few specimens available. Among the herbarium fragments studied none have either underground parts or seeds. According Hilliard & Burtt (1985: 202) is a "... clump-forming perennial herb, stems of indeterminate length, straggling, ... ". It is quite similar to *G. caffrum* in general appearance. The leaves of *G. subglabrum* are somewhat larger and less deeply divided than *G. caffrum* (but never to be considered palmatisect). The middle segment has a base wider than in *G. caffrum,* without revolute margins and the lateral lobes are also wider and more divided. Both species share an indumentum of antrorse, appressed hairs that are restricted to the nerves and margins on the abaxial surface. In *G. subglabrum*, the indumentum of stems and petioles is only of retrorse, appressed, eglandular hairs while in *G. caffrum*, glandular hairs can sometimes be also found. On the contrary, in *G. subglabrum*, glandular hairs are always found on peduncles, pedicels and sepals, while in *G. caffrum*, some specimens lack these hairs.

The differences between *G. subglabrum* and *G. sparsiflorum* are addressed under the latter.

---

254. Geranium sparsiflorum R. Knuth, Bot. Jahrb. Syst. 40: 68. 1908. Type locality: "Östliches Kapland: Zuurberge, an grasigen Stellen um 1700 m (Schlechter, Pl. austro-africanae n. 6590. -- Typus in Herb. Schlecht.!)". Type: South Africa. KwaZulu-Natal, Mt. Currie-Alfred districts, Zuurbergen, 30°30'S, 29°20'E, 1 Feb. 1895, *F.R. Schlechter 6590* (holotype, B destroyed; lectotype, here designated, P-00390255!; isotypes, BM-000796986, G-412307!, GRA-0001546-0, LE!, WU!).

Geranium alticola Schltr. ex R. Knuth, Bot. Jahrb. Syst. 40: 71. 1908. Type locality: "Natal: Van Reenen, auf steinigem Bodem um 2300 m (Schlechter, Pl. austro-africanae a. 1895 n. 6994-Typus in herb. Schlechter.!)". Type: South Africa. KwaZulu-Natal, Van Reenen, 28°22'S, 29°22'E, 6 Mar. 1895, *F.R. Schlechter 6994* (holotype, B destroyed; lectotype, designated by Hilliard & Burtt, 1985: 203, S; isolectotypes, GRA, Z-17694!).

Perennial herbs, 35-51 cm tall. *Rootstock* 5.8-6.3 mm in diameter, ± vertical, not tuberculate, not turnip-shaped, with thickened roots along the rootstock. *Stem* ascending to suberect, leafy, not rooting at nodes, stolons absent, without vegetative stems, with patent, eglandular hairs 0.4-0.7 mm long and, patent, glandular hairs 1.1-1.7 mm long. *Basal leaves* in a ± persistent rosette, cauline leaves alternate and upper opposite; leaf laminas (3.2)3.6-6(7.4) cm long, 3.3-8.8 cm wide, not peltate, deeply palmatifid [ratio main-sinus length/ middle segment length = (0.80)0.82-0.89(0.91)], polygonal in outline, base cordate, not coriaceous, with nerves not projected, with appressed, eglandular and sometimes glandular hairs on the adaxial surface and with ± appressed, eglandular and patent, glandular hairs usually restricted to the nerves abaxially; segments 5, in 1 plane, middle segment rhombic, (2.1)4.2-7.1(8.1) mm wide at the base [ratio segment width at the base/middle segment length = 0.11-0.18(0.19)], 7-17-lobed in distal half [ratio secondary sinus length/middle segment length = (0.23)0.24-0.43(0.47)]; petioles up to 38 cm long, without abscission zone, terete, not swollen, not deflexed in age, with patent, eglandular hairs 0.2-0.6 mm long and patent, glandular hairs 0.6-1.3 mm long; stipules 3-4.7 mm long, 1.1-2.1 mm wide, 2-fid, with lanceolate lobes 1.5-2.8 mm deep, 0.6-0.8 mm wide, free, papery, brown, with eglandular and glandular hairs on abaxial surface, glabrous adaxially. *Inflorescence* a monochasial cyme; cymules 2-flowered, solitary [ratio cymule length/ leaf length = 2.4-4]; peduncles 41-85(93) mm long, with ± patent, eglandular hairs 0.2-0.6 mm long and patent, glandular hairs 0.6-1.6 mm long; bracteoles 2.5-4.4 mm long, 0.6-0.9 mm wide, linear-lanceolate, whorled; pedicels (17)23-36(37) mm long, with ± patent, eglandular hairs 0.2-0.8 mm long and patent, glandular hairs 0.6-2.1 mm long. Flowers actinomorphic. *Sepals* (6.3)6.6-7.6 mm long, 2.1-3.1 mm wide, lanceolate, smooth, not accrescent, nerves 3, mucro (0.5)0.6-0.9(1) mm long [ratio mucro length/ sepal length = (0.09)0.10-0.13(0.14)], with appressed, eglandular hairs 0.2-0.4 mm long and patent, glandular hairs 0.9-1.7 mm long on the abaxial surface, glabrous adaxially. *Petals* 13.1-13.8 mm long, 6.8-9.1 mm wide, erect-patent, rounded, without claw, pink, hairy on the base of the adaxial surface, glabrous abaxially, ciliate on the basal margin, with hairs 0.4-0.6 mm long. *Stamens* 10, both whorls bearing anthers; filaments 5.6-7 mm long, lanceolate, yellow, with scattered eglandular hairs 0.2-0.4 mm long on the abaxial surface and margin; anthers 1.1-1.9 mm long, yellow. Nectaries 5, hemispheric, glabrous. *Gynoecium* 5.8-6.8 mm long, pale pink. *Fruit* 18-21 mm long, erect, discharge of seed-ejection type; mericarps 3.1-3.3 mm long, 1.3-1.4 mm wide, without a strand of fibers, not compressed at the apex, smooth, without basal beak, with a basal callus, without a basal prong, brown, with ± patent, eglandular hairs 0.4-0.5 mm long and patent, glandular hairs 1.3-1.4 mm long; rostrum 12-16 mm long, with a narrowed apex 1.7-3.1 mm long, not twisted, with ± patent, eglandular hairs 0.1-0.3 mm long and patent, glandular hairs 0.9-1.1 mm long; stigmatic remnants 2.2-2.3 mm long, with 5 hairy lobes. *Seeds* unknown. Cotyledons not studied. Fig. 639.

Pollen. *Geranium*-type (Verhoeven & Venter 1992: 444).

Chromosome number. Unknown.

Phenology. Collected in flower from August to March.

Distribution. This species ranges through northern Eastern Cape and KwaZulu-Natal, in South Africa (Fig. 640).

Habitat. Bog and damp grassland; 1650-2200 m.

Additional specimens examined. **South Africa.** Eastern Cape: Transkei, Port St. John, Mateku, 31°18'S, 29°43'E, 27 Aug. 1969, *Strey 8967* (K); Transkei, Magwa Estates, Lusikisiki district, 31°26'S, 29°38'E, 5 Sep. 1979, *Germishuizen 1177* (PRE). KwaZulu-Natal: Alfred district, Harding, farm Bedford, 30°34'S, 29°53'E, 1 Mar. 1983, *Hilliard & Burtt 16726* (E).

Discussion. Geranium sparsiflorum is a perennial herb with a spreading, ascending to suberect stem. Its underground parts are poorly known owing to the scarcity of available herbarium material, but in some specimens a short vertical rootstock with thickened roots appears.

The leaves of *G. sparsiflorum* are deeply palmatifid and similar those of *G. subglabrum*. Both species share leaves with a middle segment wider at the base than in *G. caffrum,* without revolute margins and with lateral lobes also wider and more divided. As in *G. caffrum* and *G. subglabrum*, the indumentum of the leaf abaxial surface of *G. sparsiflorum* is restricted mainly to the nerves. *Geranium sparsiflorum* differs from these other two species by its long, soft, glandular hairs that regularly appear on sepals, peduncles, pedicels, petioles, stem and leaves. In *G. caffrum* and *G. subglabrum* when these hairs are present, they are appreciably shorter.

Geranium schlechteri resembles G. *sparsiflorum* in its long glanduliferous hairs, but it is easily differentiated from the latter by its smaller, less deeply divided leaves, with hairs all over the abaxial surface, and by its shorter sepals.

Knuth (1908: 71) proposed a holotype for *G. alticola* in "herb. Schlechter", that is in B, which was destroyed. Thus Hilliard & Burtt (1985: 202) rightly chose a lectotype among the available duplicates of *Schlechter 6994.* Additionally, Hilliard & Burtt (1985: 202) indicated a possible labeling confusion about the type locality of

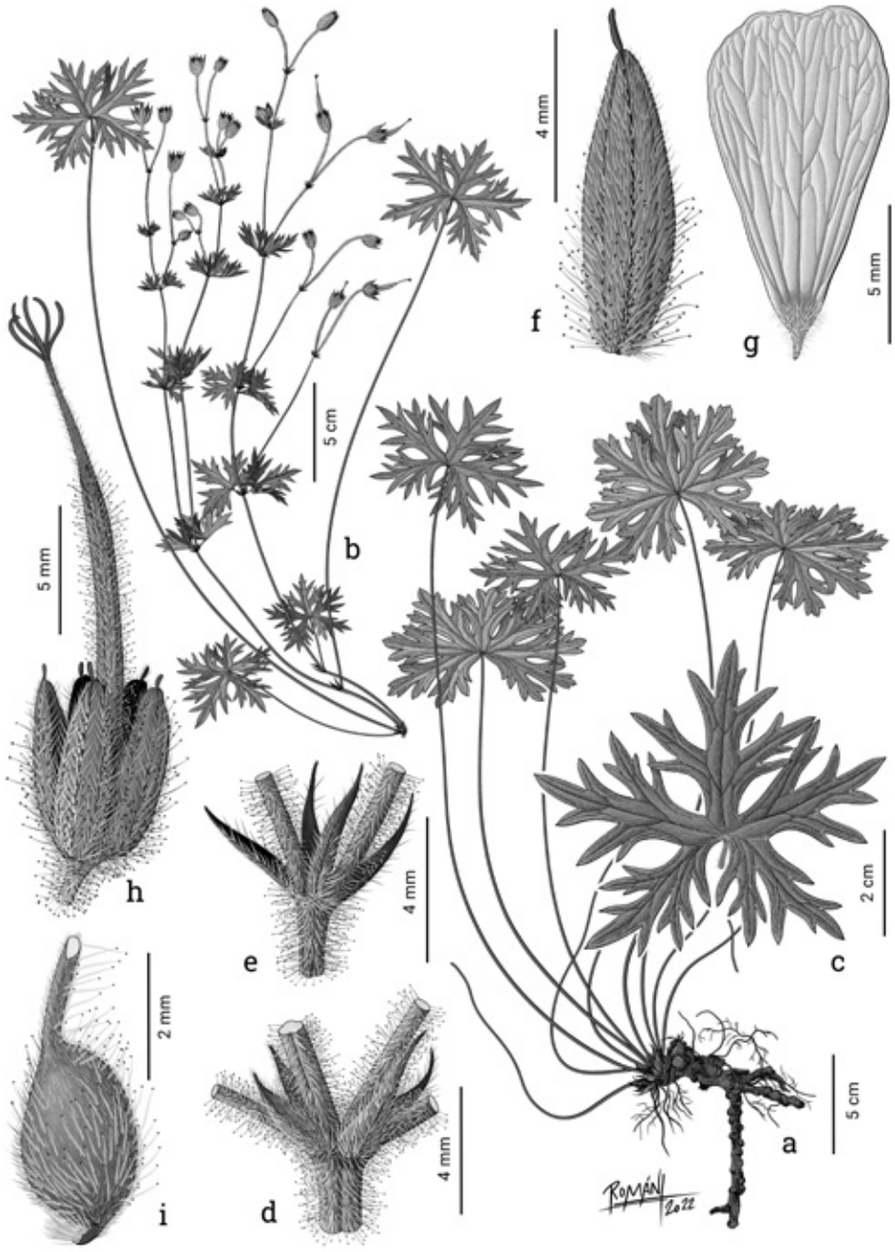


Fig. 639. *Geranium sparsiflorum*. a, b. Habit. c. Leaf. d. Stipules. e. Bracteoles. f. Sepal. g. Petal. h. Fruit. i. Mericarp. (Based on: a, *Hilliard & Burtt 16726*, E; b, c, h, i, *Schlechter 6590*, G; d-g, *Schlechter 6994*, W).

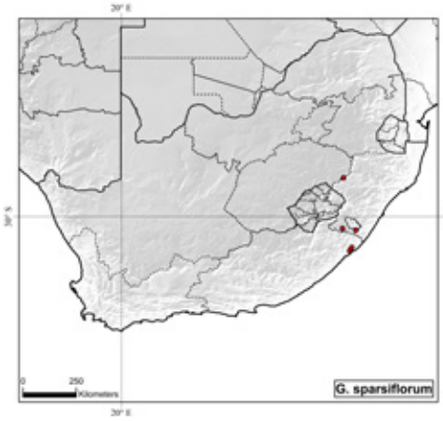


Fig. 640. Distribution of *Geranium sparsiflorum*.

G. alticola. If confirmed, the area of *G. sparsiflorum* would be reduced to the southern of Natal and the northern part of the Eastern Cape.

II.e Geranium sect. **Dissecta** Yeo, Bot. J. Linn. Soc. 89: 10. 1984. Type: *Geranium dissectum* L. (art. 10.8).

Leaves and petiole without any abscission zone. *Stipules* lanceolate, entire, sometimes with a very short bifid apex. *Mericaps* with a basal prong.

255. Geranium asphodeloides Burm. f., Spec. Bot. Geran.: 28. 1759. Type locality: "Habitat in Italia". Type: Italy. Lucania, Potenza, montis Foi, loco le Dragonare dicto, 40º38'N, 15º48'E, 21 May 1922, *A. Fiori & A. Beguinot 2725* (neotype, designated by Aedo & al. 2005b: 543, G!; isoneotypes, P!, RO!).

Geranium orientale Mill., Gard. Dict. ed. 8, n.° 10. 1768. Type locality: "The tenth sort was discovered by Dr. Tournefort in the Levant, from whence he sent the seeds to the Royal Garden at Paris... ". Type: unknown locality, cultivated at Chelsea Physic Garden, London, *Ph. Miller s.n.* (lectotype, designated by Aedo & al. 2005b: 543, BM-000796354 image!).

Geranium pallens M. Bieb., Fl. Taur.-Caucas. 2: 138. 1808. *Geranium asphodeloides* subsp. *pallens* (M. Bieb.) Woronow in Kusn., N. Busch & Fomin, Fl. Cauc. Crit. 3(7): 27. 1908. Type locality: "Habitat in Iberiâ occidentali. D. Steven". Type: Georgia. Iberia, ex Cartalinia ad fl. Prone, Abano, 42º36'N, 44º23'E, 1805, *C. Steven s.n.* (lectotype, designated by Novoselova 1998: 152, LE!; isolectotype, H-1366898!).

Geranium nemorosum Ten., Fl. Napol. 1: lxx. 1811-15. *Geranium pyrenaicum* var. *nemorosum* (Ten.) DC., Prodr. 1: 643. 1824. *Geranium asphodeloides* var. *nemorosum* (Ten.) Boiss., Fl. Orient. 1: 878. 1867. *Geranium asphodeloides* subsp. *nemorosum* (Ten.) Fritsch, Mitt. Naturwiss. Vereines Steiermark 50: 380. 1914. Type locality: "Luogo natale ec. Nasce nelle praterie elevate di Basilicata e di Calabria; la var. B. presso Trivento ed Avellino" [according to Tenore, Fl. Napol. 5: 81. 1835-36]. Type: Italy. Basilicata, Balvano, 40º39'N, 15º30'E, *M. Tenore s.n.* (lectotype, designated by Aedo & al. 2005b: 543, NAP image!).

Geranium fasciculatum Pančić, Verh. Zool.-Bot. Vereins Wien 6: 492. 1856. Type locality: "Buschige Hügel im ganzen Aleksinacer und Kragujevacer Kr.; bei Kragujevac am Metinobrdo äusserst häufig". Type: Serbia. Kragujevac, 44°00'N, 20°50'E, May 1850, *J. Pančić s.n.* (lectotype, designated by Aedo & al. 2005b: 544, W-0051624!; isolectotype, BR-0000013347062 image!).

Geranium tauricum Rupr., Mém. Acad. Imp. Sci. Saint Pétersbourg ser. 7, 15(2): 268. 1869. *Geranium asphodeloides* subsp. *tauricum* (Rupr.) Fritsch, Mitt. Naturwiss. Vereines Steiermark 50: 381. 1914. Type locality: "Proximum G. pallenti est G. tauricum* sive G. collinum tauricum M. Bieb. Suppl. 1819 (nec 1808) et herb!". Type: Russia. Ex Tauria merid., 1810, *M. Bieberstein s.n.* (lectotype, designated by Aedo & al. 2005b: 544, LE image!).

Perennial herbs, 20-51 cm tall. *Rootstock* 4-9.8 mm in diameter, ± horizontal, not tuberculate, not turnip-shaped, with thickened, fasciculate roots. *Stem* erect, leafy, not rooting at nodes, stolons absent, without vegetative stems, with retrorse, appressed, eglandular hairs 0.2-1.6 mm long and, sometimes, patent, glandular hairs 0.2-1 mm long. *Basal leaves* in a deciduous rosette, cauline leaves opposite; leaf laminas 2-5.5 cm long, 2.3-7.1 cm wide, not peltate, palmatifid [ratio main-sinus length/middle segment length = 0.52-0.73], polygonal in outline, base cordate, not coriaceous, with nerves not projected, pilose, with appressed, eglandular hairs on both surfaces; segments 5-7, in 1 plane, middle segment rhombic, 2.8-10.5 mm wide at the base [ratio segment width at the base/middle segment length = 0.20-0.36], 3-12-lobed in distal half [ratio secondary sinus length/middle segment length = 0.20-0.38]; petioles up to 16 cm long, without abscission zone, terete, not swollen, not deflexed in age, with retrorse, appressed, eglandular hairs 0.2-1 mm long and, sometimes, patent, glandular hairs 0.2-1.8 mm long; stipules 2.4-8.8 mm long, 0.9-2.6 mm wide, lanceolate to acuminate, free, papery, brownish red, with eglandular and, sometimes, glandular hairs on abaxial surface and on the margin, glabrous adaxially. *Inflorescence* a monochasial cyme; cymules 2-flowered, solitary [ratio cymule length/leaf length = 1.1-5.2]; peduncles 17-113 mm long, with patent to retrorse, eglandular hairs 0.2-1.2 mm long and, sometimes, patent, glandular hairs 0.2-0.5(1) mm long; bracteoles 2.8-6.3 mm long, 0.4-1.1 mm wide, linear, whorled; pedicels 13.5-31 mm long, with patent to retrorse, eglandular hairs 0.2-1.2 mm long and, usually, patent, glandular hairs 0.2-0.5(0.9) mm long (mainly towards the apex). Flowers actinomorphic. *Sepals* 5.1-9.2 mm long, 1.9-3.5 mm wide, lanceolate, smooth, not accrescent, nerves 3, mucro 0.7-1.9 mm long [ratio mucro length/sepal length = 0.12-0.36], with ± patent, eglandular hairs 0.3-0.8 mm long and patent, glandular hairs 0.3-1 mm long on the abaxial surface, glabrous adaxially (sometimes only with eglandular hairs). *Petals* 8.5-16.5 mm long, (4.8)6.1-8.5 mm wide, erect-patent, rounded to retuse, with claw 0.4-0.6 mm long, purple, glabrous on both surfaces, ciliate on the basal margin, with hairs 0.3-0.8 mm long. *Stamens* 10, both whorls bearing anthers; filaments 4.1-7.1 mm long, lanceolate, white with purple apex, ciliate except on the apex, with hairs 0.1-0.2 mm long; anthers 0.9-2.1 mm long, blue. Nectaries 5, hemispheric, with a tuft of hairs at the top, dorsally glabrous. *Gynoecium* 3.4-8,8 mm long, dark purple. *Fruit* 20.2-26 mm long, erect, discharge of seed-ejection type; mericarps 2-3.4 mm long, 1.3-2.5 mm wide, without a strand of fibers, not compressed at the apex, smooth, without basal beak, withouth a basal callus, with a basal prong, brown, with patent, eglandular hairs 0.2-0.6 mm long and, sometimes, patent, glandular hairs 0.2-0.8 mm long; rostrum 15.2-20.9 mm long, with a narrowed apex 3.7-6.9 mm long, not twisted, with patent, eglandular hairs 0.1-0.3 mm long and patent, glandular hairs 0.4-0.8 mm long; stigmatic remnants 0.9-1.9 mm long, with 5 glabrous lobes. *Seeds* 1.6-2.1 mm long, 1.2-1.8 mm wide, reticulate, uniformly colored, brown, gla-

brous. Cotyledons with entire margin. Figs. 641, 642.

Pollen. *Geranium*-type (Aedo & al. 2005b: 541).

Chromosome number. 2*n* = 24, 26, 28, 30+f.

Phenology. Collected in flower from March to August.

Distribution. This species ranges from southern Italy, through Balkans (Albania, Bulgaria, Serbia, North Macedonia and Greece) to Krym, Turkey, Georgia and northwestern Syria (Fig. 643).

Habitat. Forests, scrub, meadows, and banks; 0-2150 m.

Representative specimens examined. **Albania.** Berat: Tomor-Gebirges, östlich Berat, Kloster Abbas Ali, Kalk, 40°42'N, 20°7'E, 19 June 1928, *Markgraf 1342* (B). Durrës: Kruja, Mamuras, 41°33'N, 19°40'E, 31 May 1928, *Markgraf 1180* (B). Gjirokastër: Mali Thate, 40°11'N, 19°55'E, May, *Bourcart s.n.* (P). Tirana: Bathore, Kodrina, 41°22'N, 19°47'E, 10 May 1956, *Qosja s.n.* (W). **Bulgaria.** Burgas: Rezovo, Krai granicnia, 41°59'N, 28°1'E, 21 May 1972, *Petrova s.n.* (SOM); Strandsha, Brodilovo, 42°5'N, 27°51'E, 26 June 1972, *Petrova s.n.* (SOM). Yambol: Strandza, supra Velika, 42°3'N, 27°0'E, 19 Apr. 1975, *Petrova s.n.* (G, MA, W). **Georgia.** Adjara: Batum, Godenski Pereval, 41°38'N, 41°38'E, 21 June 1912, *Holmberg 1828* (LD); Adzharia, distr. Schuachevi, flumen Tschirucha,

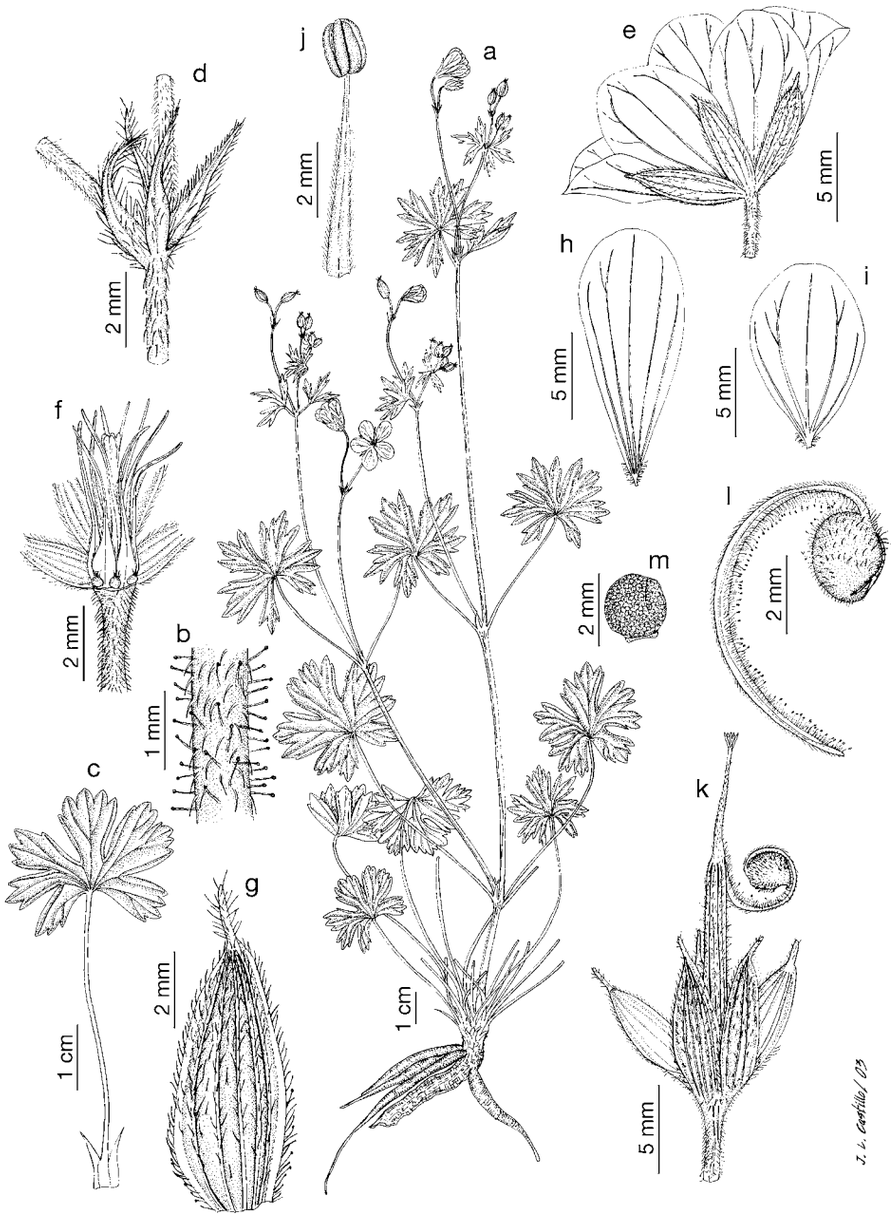


Fig. 641. *Geranium asphodeloides*. a. Habit. b. Stem indumentum. c. Leaf. d. Bracts. e. Flower. f. Androecium and gynoecium. g. Sepal. h-i. Petals. j. Stamen. k. Fruit. l. Mericarp. m. Seed. (Based on: a-g, i-j, *Petrova s.n.,* MA-209961; h, *Barbey s.n.,* G; k-m, *Burnat s.n.,* G).

Fig. 642. *Geranium asphodeloides* (Based on: *Calvo 852,* MA, photo: J. Calvo).

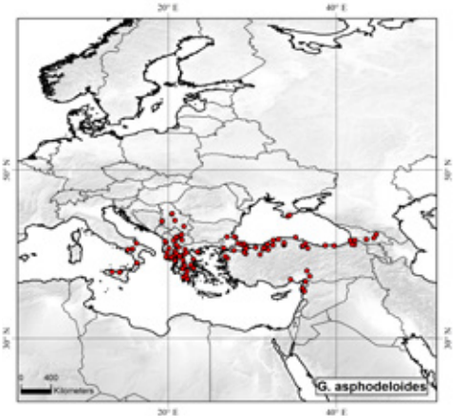


Fig. 643. Distribution of *Geranium asphodeloides*.

41°40'N, 42°10'E, 15 July 1992, *Khkhriakov s.n.* (MA). Mtskheta-Mtianeti: Pasanauri, Caparuka-Tal, 42°21'N, 44°42'E, 7 June 1982, *Meyer 13755* (JE). Samtskhe-Javakheti: Kartli, 2 km E Bakuriani, 41°45'N, 43°33'E, 15 July 1997, *Schönswetter & Tribsch s.n.* (WU). Tbilisi: Tiflis, Gori, Bakuriani, 41°45'N, 43°32'E, 15 June 1923, *Kozlowsky s.n.* (G, LD, PR). **Greece.** Epirus: Ioánnina, entre col de Katara et Ioannina, 39°47'N, 21°10'E, 21 June 1973, *Burdet & Charpin 10284* (G); Metsovo, puerto de Katara, estacion Snowplow, 39°47'N, 21°13'E, 27 July 2007, *Calvo & al. 852* (MA); Metsovo, pr. embalse Aoos Springs, 39°48'N, 21°9'E, 27 July 2007, *Calvo & al. 947* (MA); Ioannina, Milea, 39°50'N, 21°14'E, 17 June 1987, *Willing 3067* (B). Ionian Islands: Corfu, 39°35'N, 19°50'E, 8 Apr., *Aketournin? s.n.* (P). Peloponnese: Lakonia, Taigetos Mts., Ladagha gorge, 37°4'N, 22°17'E, 24 June 2007, *Aedo & al. 14259* (MA); Ahaia, Akrata, Zarochla, ladera NE del monte Helmos, 37°58'N, 22°17'E, 24 June 2007, *Navarro & al. 7073* (MA). Thessaly: montis Pelion, pr. Volos, 39°24'N, 23°1'E, 4 May 1961, *Rechinger 22697* (G, W). West Macedonia: Macedonia, Grevenon, W Perivoli, 39°59'N, 21°7'E, 4 July 1978, *Moller & al. 1176* (G); Makedonien, 1 km NW Pisoderion, 40°48'N, 21°15'E, 5 July 1978, *Krendl s.n.* (G). **Italy.** Apulia: Barletta, 41°18'N, 16°16'E, 1860 (G). Basilicata: Pignola, loco Puggio Ricciardi? dicto, 40°33'N, 15°46'E, 24 May 1925, *Gavioli s.n.* (MA). Calabria: entre Nicastro et Monteleone, 38°58'N, 16°18'E, *Reynier s.n.* (G). Sicilia: Mistretta, 37°56'N, 14°22'E, (RO); Bosoco della Rocca, 37°53'N, 13°23'E (RO). **North Macedonia.** Pelagonia: Galicica, Otesevo, 40°59'N, 20°55'E, 16 May 1981, *Micevski s.n.* (W); Resen, a lacu Prespa, 41°5'N, 21°0'E, 29 May 1958, *Rechinger 19744* (W). Polog: supra Mavrovo, 41°38'N, 20°40'E, 23 May 1918, *Bornmüller 3667* (HBG); NE lake Mavrovo, along road to Gostivar, 41°47'N, 20°54'E, 22 June 1965, *Ooststroom 24010* (L); Sar-planina, Kobelica, Tetovo, 42°1'N, 20°59'E, 10 July 1936, *Behr s.n.* (B, PR). Skopje: ad secturas Rud. Orasje (etiam Radusa) dictas in vicinitate oppidi general Hanriev, 42°5'N, 21°12'E, May 1938, *Mach s.n.* (PR). Vardar: N Ljirbotan gebirge, 41°40'N, 21°40'E, July 1957, *Seitter s.n.* (G). **Russia.** Krym: Tauria, *Nikita* (P); Crimea, Yalta, Nikita, 44°30'N, 34°14'E, 30 May 1959, *Davis 33154* (G); Tauria, Compiere, 44°37'N, 34°28'E, 1832, *Prefrott s.n.* (LE). **Serbia.** ad Devolin, May 1895, *Adamovic s.n.* (B, P). Belgrade: ad Topcider, 44°46'N, 20°27'E, May, *Pančic s.n.* (G); Belgrad, Rakowitza, 44°49'N, 20°30'E, 27 May 1888, *Bornmüller s.n.* (B, RO, W). Southern and Eastern Serbia: m. Krstilovica, 42°18'N, 21°37'E, 4 June 1896, *Adamovic s.n.* (HBG, G, P, SOM, W); Nisch, montis Souva Planina, 43°18'N, 21°53'E, May, *Petrovic s.n.* (COI, G, P, W). **Syria.** Latakia: Slenfé, 35°35'N, 36°12'E, *Guittonneau 73070307* (GUITT); Bhamra, 35°37'N, 36°3'E, 1 May 1909, *Haradjian 2748* (G, W); Frolouk, Yildiz, 35°51'N, 35°55'E, June 1956, *Pabot 807* (G); Frolouk, Quenzeul Dagh, 35°51'N, 35°55'E, 1 June 1956, *Pabot s.n.* (G); Kessab, Karadourane, 35°56'N, 35°59'E, 1 June 1956, *Pabot s.n.* (G). **Turkey.** Paphlagonia australis, montis Ilkas-dagh (m. Olgassys) supra Karakol, inter Cankri et Tossia, 20 June 1929, *Bornmüller 13946* (HBG). Balikesir: Bandirma, Erdek, monte Malya Tepeler, 40°27'N, 27°50'E, 12 May 2000, *Castroviejo 15201* (MA). Bolu: al S de Abant Golu, 40°35'N, 31°17'E, 18 June 2001, *Aedo & al. 6165* (MA). Çanakkale: Evciler, Kaz Dagi, Mt. Ido, 39°44'N, 26°48'E, 13 May 2000, *Castroviejo 15220* (MA). Istanbul: Thracia, Balabán, Terkos lake, Durusu Park, 41°12'N, 28°35'E, 16 May 2000, *Castroviejo 15308* (MA); Kilyos ad litus Ponti Euxini, 41°15'N, 29°1'E, 21 Apr. 1961, *Rechinger 21898* (G, MA, W); Thracia, Pinarça, NW de Estambul, 41°17'N, 28°18'E, 16 May 2000, *Castroviejo 15357* (MA). Kahramanmaraş: Türkoğlu, 37°23'N, 36°50'E, 10 May 1998, *Ilçim 342* (MA). Kastamonu: Çankiri, N side of Ilgaz Dag, 41°10'N, 33°45'E, 28 July 1962, *Davis & al. 38346* (E); Paphlagonia, Wilajet Kastambuli, Tossia, Kaiseridere, 41°21'N, 33°46'E, 26 June 1892, *Sintenis 4416* (G, P, W); Sinop, entre Kurucasile y Sinop, 7 km al W de Denizkonak, 41°46'N, 33°6'E, 21 June 2001, *Valcárcel & al. 222VV01* (MA). Kocaeli: Istanbul, Yalova, Kaplicalar, 40°39'N, 29°15'E, 8 Apr. 1961, *Demiriz 4315* (E); Samsun, Meseli Düz, 41°0'N, 36°0'E, 25 Apr. 1964, *Tobey 536* (E). Sinop: Sinop, NW of town near beach, 42°0'N, 35°9'E, 6 May 1963, *Tobey 10A* (E).

Discussion. Geranium asphodeloides is the most widespread of the three perennial species of the section. It is easily distinguished from *G. sintenisii* by its ± horizontal, not turnip-shaped rootstock, with thick, fleshy, fasciculate roots, and its petals (4.8)6.1-8.5 mm wide. By contrast, *G. sintenisii* has ± vertical, turnip-shaped rootstock, without thick, fleshy, fasciculate roots, and narrow petals (3.5-4.8 mm wide). Rare herbarium specimens of *G. asphodeloides* showing relatively narrow petals were collected at the end of July. These specimens also had well developed fruits. Such data suggest that extemporaneous flowering could produce smaller petals, a fact that should be considered when critical specimens are identified (specimens with lower petal width). *Geranium sintenisii* consistently has glandular hairs on the stem, petioles, and inflorescence, whereas in *G. asphodeloides* glandular hairs are not always present. If present, glandular hairs are short and straight in *G. asphodeloides*, whereas they are long and a bit tortuous in *G. sintenisii*. *Geranium crenophilum* is similar to *G. asphodeloides* in rootstock, roots, and petal features, although it shows glandular hairs as described in *G. sintenisii*. *Geranium asphodeloides* varies considerably in the presence and distribution of glandular hairs. There are specimens with no glandular hairs, others with scattered glandular hairs restricted to sepal bases, or with more or less copious glandular hairs on stems and inflorescences. In some plants a part of the pedicels have glandular hairs and elsewhere none or few. Such variability does not show any geographical pattern.

Bobrov (1949) recognized from Russia two independent species related to *G. asphodeloides*: *G. tauricum* endemic to the Crimea and characterized by its indumentum of eglandular hairs, short stipules (4-5 mm long), and long petals (15-17 mm long), and *G. pallens* distributed throughout the Caucasus and characterized by its indumentum of glandular hairs, long stipules (6-8 mm long), and short petals (12-17 mm long). As discussed above, indumentum variability does not support the differentiation of any taxa from *G. asphodeloides*. In the same way, length of stipules and petals of the specimens studied from the Crimea and Caucasus fall into the variability of those characters in *G. asphodeloides*. Novoselova (1998) showed that the previously mentioned characters are quite variable in Caucasian plants, although recognized *G. pallens* as subspecies of *G. asphodeloides.*

No original specimen of *G. asphodeloides* has been located at G, where Burman herbarium is kept. Thus, a

neotype was designated from Italy, in accordance with the protologue (Aedo & al. 2005b: 543). *Geranium asphodeloides* was recorded from Iran by Parsa (1952). However, Schönbeck-Temesy (1970) included this species in "species incertae" in Iran (and I agree with this opinion), since she did not find any specimen supporting those records.

256. Geranium crenophilum Boiss., Diagn. Pl. Orient. ser. 1, 8: 117. 1849. *Geranium asphodeloides* subsp. *crenophilum* (Boiss.) Bornm., Repert. Spec. Nov. Regni Veg. Beih. 89(3): 134. 1936. Type locality: "Hab. secùs fontem et rivum e pariete septentrionali rupium ponè pagum Eden Libani sitorum oriundum. Legi Julio ineunte". Type: Lebanon. Ehden, 34º16'N, 35º58'E, June 1846, *E. Boissier s.n.* (lectotype, designated by Aedo & al. 2005b: 548, G-BOIS!; isolectotypes, K- 000729285!, P-00712066!).

Geranium asphodeloides var. *hispidum* Boiss., Fl. Orient. 1: 878. 1867. Type locality: "Hab. in dumosis Armeniae ad Trapezuntem (Calv! Bourg!), Iberiae occid. (Stev! in herb. DC. et Ledeb.), Libani ad fontes et rivulos (Boiss! Bl! Ky exs. 346!)". Type: Lebanon. ad Bcharre, 34º15'N, 36º02'E, 30 July 1855, *T. Kotschy 346* (lectotype, designated by Aedo & al. 2005b: 548, MA-617364!; isolectotypes, G-BOIS!, MPU-018478!, P-00712064!, PR-955528!, US-00624270 image!, W!).

Perennial herbs, 28-80 cm tall. *Rootstock* 4.1-14 mm in diameter, ± horizontal, not tuberculate, not turnip-shaped, with thickened roots along the rootstock. *Stem* erect, leafy, not rooting at nodes, stolons absent, without vegetative stems, with patent, eglandular hairs 0.3-0.8 mm long and patent, glandular hairs 0.6-2.1 mm long. *Basal leaves* in a deciduous rosette, cauline leaves opposite; leaf laminas 1.6-7.2 cm long, 2.1-8.7 cm wide, not peltate, palmatifid [ratio main-sinus length/middle segment length = 0.53-0.74], polygonal in outline, base cordate, not coriaceous, with nerves not projected, pilose, with appressed, eglandular and glandular hairs on both surfaces; segments 5-7, in 1 plane, middle segment rhombic, 4.1-14.3 mm wide at the base [ratio segment width at the base/middle segment length = 0.20-0.39], 5-13-lobed in distal half [ratio secondary sinus length/middle segment length = 0.21-0.37]; petioles up to 10.7 cm long, without abscission zone, terete, not swollen, not deflexed in age, with patent, eglandular hairs 0.2-1 mm long and, sometimes, patent, glandular hairs 0.2-2.4 mm long; stipules 2.5-9 mm long, 0.9-3.5 mm wide, lanceolate to acuminate, free, papery, brownish red, with eglandular and, sometimes, glandular hairs on abaxial surface and on the

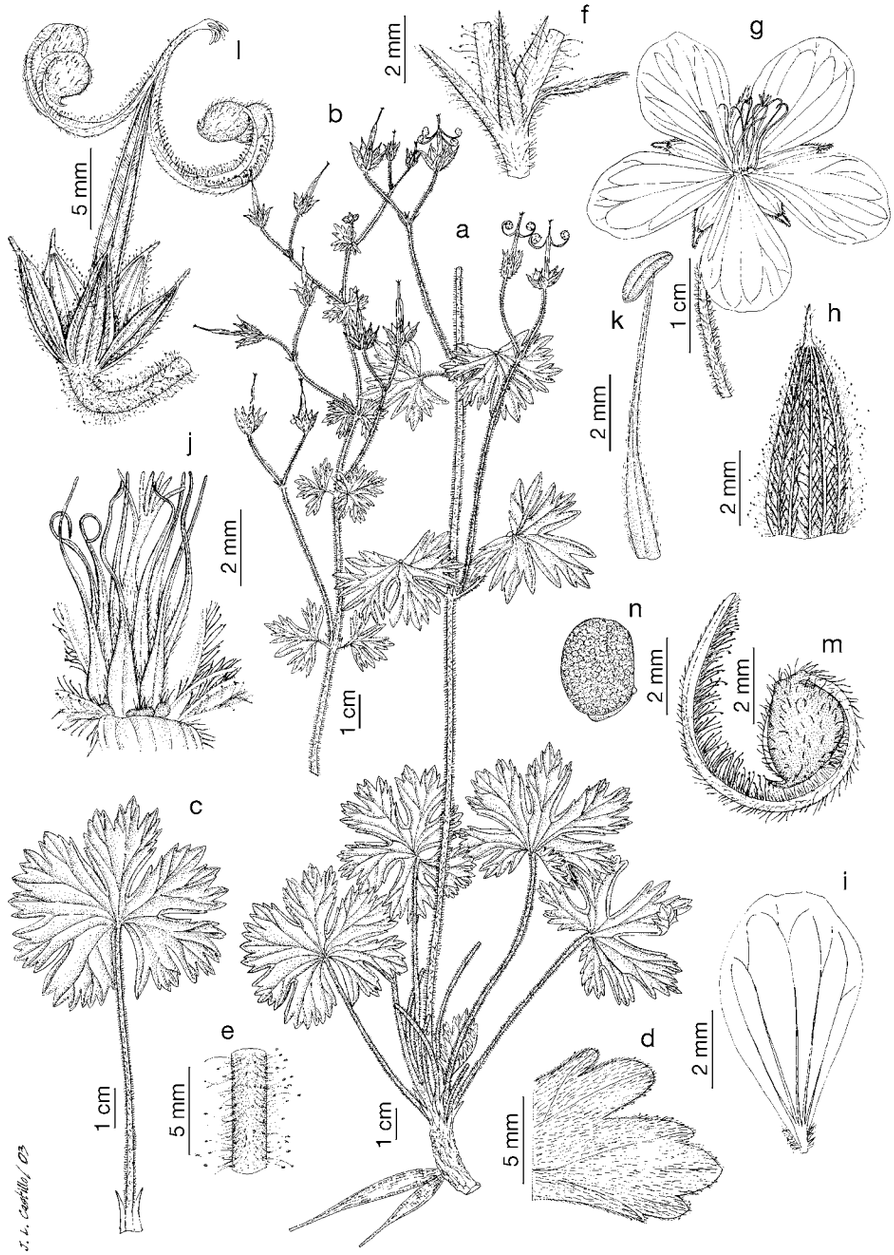


Fig. 644. *Geranium crenophilum*. a-b. Habit. c. Leaf. d. Leaf indumentum. e. Stem indumentum. f. Bracts. g. Flower. h. Sepal. i. Petal. j. Androecium and gynoecium. k. Stamen. l. Fruit. m. Mericarp. n. Seed. (Based on: a-n, *Pabot s.n.,* G).

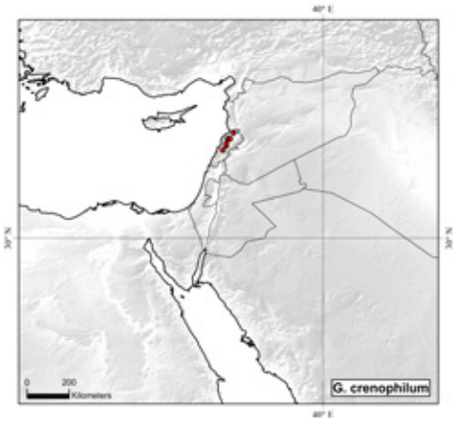


Fig. 645. Distribution of *Geranium crenophilum*.

margin, glabrous adaxially. *Inflorescence* a monochasial cyme; cymules 2-flowered, solitary [ratio cymule length/leaf length = 1.1-4.9]; peduncles 22-99 mm long, with patent to retrorse, eglandular hairs 0.2-0.9 mm long and patent, glandular hairs 0.2-1.4 mm long; bracteoles 3.1-6.4 mm long, 0.4-0.8 mm wide, linear, whorled; pedicels 9-33 mm long, with patent to retrorse, eglandular hairs 0.2-0.9 mm long and patent, glandular hairs 0.2-2 mm long. Flowers actinomorphic. *Sepals* 5.6-8.7 mm long, 1.9-3.8 mm wide, lanceolate, smooth, not accrescent, nerves 3, mucro 0.7-1.8 mm long [ratio mucro length/sepal length = 0.12-0.26], with ± patent, eglandular hairs 0.2-1 mm long and patent, glandular hairs 0.3-1.5 mm long on the abaxial surface, glabrous adaxially (sometimes only with eglandular hairs). *Petals* 9-15 mm long, 5-9.4 mm wide, erect-patent, rounded, with claw 0.4-0.6 mm long, purple, glabrous on both surfaces, ciliate on the basal margin, with hairs 0.2-0.3 mm long. *Stamens* 10, both whorls bearing anthers; filaments 4.7-6.6 mm long, lanceolate, white with purple apex, ciliate except on the apex, with hairs 0.1-0.2 mm long; anthers 1.4-2.1 mm long, unknown color. Nectaries 5, hemispheric, with a tuft of hairs at the top, dorsally glabrous. *Gynoecium* 4.2-6 mm long, unknown color. *Fruit* 20-26 mm long, erect, discharge of seed-ejection type; mericarps 2.3-3 mm long, 1.7-2,3 mm wide, without a strand of fibers, not compressed at the apex, smooth, without basal beak, withouth a basal callus, with a basal prong, brown, with patent, eglandular hairs 0.3-0.7 mm long and patent, glandular hairs 0.5-1.2 mm long; rostrum 15.2-22.2 mm long, with a narrowed apex 3.7-5.7 mm long, not twisted, with patent, eglandular hairs 0.2-0.8 mm long and patent, glandular hairs 0.6-1.7 mm long; stigmatic remnants 1-1.8 mm long, with 5 glabrous lobes. *Seeds* 2-2.3 mm long, 1.5-1.7 mm wide, reticulate, uniformly colored, brown, glabrous. Cotyledons with entire margin. Fig. 644.

Pollen. *Geranium*-type (Aedo & al. 2005b: 541).

Chromosome number. 2*n* = 26.

Phenology. Collected in flower from May to August.

Distribution. This species is endemic to Lebanon (Fig. 645).

Habitat. Meadows, stream and channel shores; 1450-1900 m.

Additional specimens examined. **Lebanon.** Mount Lebanon: jugi Sanin, 20 July 1897, *Bornmüller 273* (HBG, P); Syria, Sanin, June 1822, *Ehrenberg 1875* (P); Khan Sannin, Ain Dara, 33º46'N, 35º43'E, 28 July 1936, *Mouterde 5578* (G); Khan Sannin, 33º57'N, 35º52'E, 13 May 1934, *Mouterde 3093b* (G); Khan Sannin, 33º57'N, 35º52'E, 17 May 1937, *Mouterde 6079* (G); Sannin, 33º57'N, 35º52'E, 2 June 1879, *Peyron 627b* (G); Afka, 34º3'N, 35º52'E, 7 June 1883, *Peyron 627* (G). North: Dimane, 34º15'N, 35º57'E, 14 1864, *Blanche 1165* (P); Hasroum, 34º15'N, 35º56'E, 15 1864, *Blanche 1165-4* (P); supra Eden, 34º16'N, 35º58'E, 24 June 1884, *Ahetourmen? s.n.* (P); Eden, 34º16'N, 35º58'E, 1861, *Blanche 1165-5* (P); Ehden, 34º16'N, 35º58'E, 2 July 1910, *Bornmüller 11542* (E, G, HBG); Ehden, 34º16'N, 35º58'E, 11 June 1947, *Mouterde 8985b* (G, P); Ehden, 34º16'N, 35º58'E, June 1855, *Post s.n.* (E, G); Ehden, 34º31'N, 36º10'E, 23 Aug. 1955, *Pabot s.n.* (G); Ehden, sumu de Mar Sarkis, 34º31'N, 36º10'E, 6 June 1954, *Pabot s.n.* (G).

Discussion. Geranium crenophilum shares with *G. asphodeloides* two important characters: a) ± horizontal, not turnip-shaped rootstock, with thick, fleshy, fasciculate roots, and b) wider petals. However, this species has constantly glandular hairs on the stem, petioles, and inflorescence, whereas in *G. asphodeloides* glandular hairs are not always present. As stated above, glandular hairs of *G. asphodeloides* are short and straight, whereas they are long and a bit tortuous in *G. crenophilum*. Mouterde (1966) recorded *G. crenophilum* from Syria. However, the specimen supporting this record (Bhamra, *Haradjian 2748*, G) is *G. asphodeloides*.

257. Geranium sintenisii Freyn, Bull. Herb. Boissier 3: 104. 1895. *Geranium asphodeloides* subsp. *sintenisii* (Freyn) P.H. Davis, Notes Roy. Bot. Gard. Edinburgh 28: 36. 1967. Type locality: "Armenia turcica, Gümüschkhane, Karagölldagh: in valle Schadachlar ad rivulum d. 3. aug. 1894 leg. Sintenis (exs. 7050)". Type: Turkey. Armenia turcica, szandschak Gümüschkhane, Karagoelldagh, in valle Schadachlar, 40º22'N, 39º06'E, 3 Aug. 1894, *P. Sintenis 7050* (lectotype, designated by Knuth 1912: 156, B destroyed; lectotype, here designated, G-00365778!; isolectotypes, BM-000796457!, BR-0000005109265 image!, E-00164364!, F!, FR-0031356 image!, JE-00018735 image!, K-000729284!, LD-1069903 image!, P-00757903!, PR-375703!, PRC-455273 image!, TBI-1025295 image!, W!, WRSL!, Z).

Geranium ibericum var. *parviflorum* Boiss., Fl. Orient. 1: 876. 1867. *Geranium parviflorum* (Boiss.) Hand.-Mazz., Ann. K.K. Naturhist. Hofmus. 23: 161. 1909, nom. illeg., non Curtis, 1782. *Geranium wiedemannii* P.H. Davis, Notes Roy. Bot. Gard. Edinburgh 22: 25. 1955. Type locality: "Hab. in monte Jyldisdagh Anatoliae bor. (Wiedem!)". Type: Turkey. Hab. in monte Jyldisdagh, 40º08'N, 36º56'E, *F.J. Wiedemann s.n.* (lectotype, designated by Aedo & al. 2005b: 548, LE!; isolectoype, G-BOIS!).

Geranium davisianum Peşmen & Güner, Notes Roy. Bot. Gard. Edinburgh 38(3): 436. 1980. Type locality: "Turkey. A8 Rize: distr. Çamlihemş in, Amlakit Ya. Arkavit to Husayd, 2000-2400 m, Picea orientalis-Rhododendron mixed forest, on igneous rock, 24 vii 1974, A. Güner 1182 (holotypus HUB, iso. E)". Type: Turkey.

Rize, Çamlihemsin, Amlakit Ya. Arkavit to Husayd, 41º01'N, 41º00'E, 24 July 1974, *A. Güner 1182* (holotype, HUB; isotype, E!).

Geranium chelikii Kit Tan & Yildiz, Notes Roy. Bot. Gard. Edinburgh 45(3): 440. 1989. Type locality: "Turkey B6 Sivas: Şerefiye, Köse Daği, Cehennem dere, wet meadow, 1800-2000m, 11 viii 1984, B. Yildiz & N. Çelik, Y. 4994 (holo. E, iso. Cumhuriyet Üniversitesi, Sivas)". Type: Turkey. Sivas, Şerefiye, Köse Daği, Cehennem dere, 39º55'N, 38º21'E, *B. Yildiz & N.* Çelik 4994 (holotype, E not located; isotype, CUFH not located).

Perennial herbs, 26-64 cm tall. *Rootstock* 4.4-9.2 mm in diameter, ± vertical, not tuberculate, turnip-shaped, without thickened roots. *Stem* erect, leafy, not rooting at nodes, stolons absent, without vegetative stems, with patent, glandular hairs 1-3.4 mm long. *Basal leaves* in a deciduous rosette, cauline leaves opposite; leaf laminas 2.1-6.9 cm long, 2.6-8.8 cm wide, not peltate, palmatifid [ratio main-sinus length/middle segment length = 0.60-0.71], polygonal in outline, base cordate, not coriaceous, with nerves not projected, pilose, with appressed, eglandular and glandular hairs on both surfaces; segments 5-7, in 1 plane, middle segment rhombic, 4.1-9.5 mm wide at the base [ratio segment width at the base/middle segment length = 0.20-0.28], 7-18-lobed in distal half [ratio secondary sinus length/middle segment length = 0.17-0.27]; petioles up to 24 cm long, without abscission zone, terete, not swollen, not deflexed in age, with patent, glandular hairs 0.9-2.5 mm long and, sometimes, patent, eglandular hairs ca. 0.4 mm long; stipules 4.4-11.1 mm long, 1.8-4 mm wide, lanceolate to acuminate, free, papery, brownish red, with eglandular and, sometimes, glandular hairs on the margin, glabrous on both surfaces. *Inflorescence* a monochasial cyme; cymules 2-flowered, solitary [ratio cymule length/leaf length = 1.6-2.1]; peduncles 17-71 mm long, with patent to retrorse, eglandular hairs 0.3-0.6 mm long and patent, glandular hairs 1-1.6 mm long; bracteoles 2.2-5.4 mm long, 0.4-1.2 mm wide, linear, whorled; pedicels 8-25 mm long, with patent to retrorse, eglandular hairs 0.2-0.6 mm long and patent, glandular hairs 1-1.7 mm long. Flowers actinomorphic. *Sepals* 5.6-7.2 mm long, 1.8-3.1 mm wide, lanceolate, smooth, not accrescent, nerves 3, mucro 0.8-1.8 mm long [ratio mucro length/sepal length = 0.14-0.27], with ± patent, eglandular hairs 0.3-0.6 mm long and patent, glandular hairs 0.3-1.4 mm long on the abaxial surface, glabrous adaxially (sometimes only with eglandular hairs). *Petals* 9.1-16.3 mm long, 3.5-4.8 mm wide, erect-patent, rounded, with claw 0.4-0.6 mm long, purple, glabrous on both surfaces, ciliate on the basal margin, with hairs 0.3-0.5 mm long. *Stamens* 10, both whorls bearing anthers; filaments

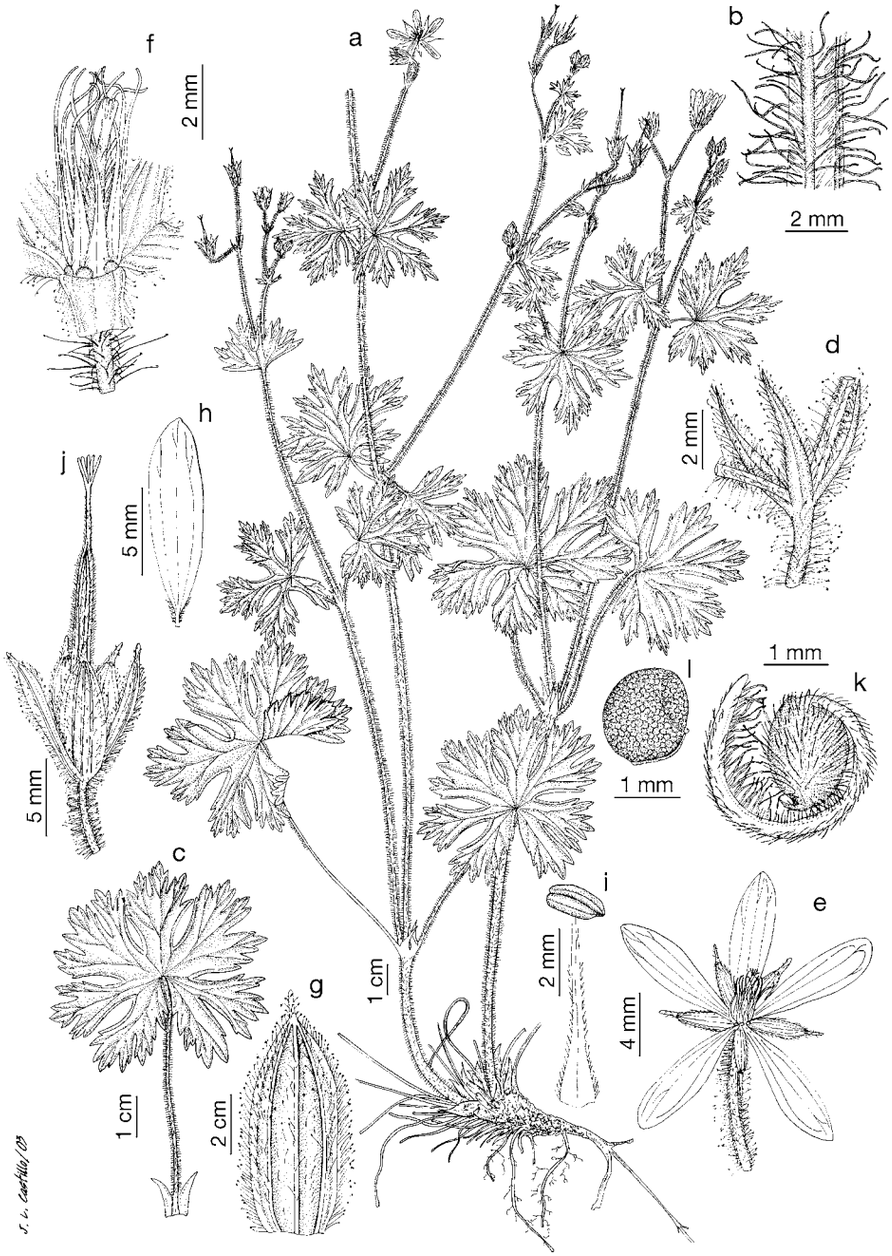


Fig. 646. *Geranium sintenisii*. a. Habit. b. Stem indumentum. c. Leaf. d. Bracts. e. Flower. f. Androecium and gynoecium. g. Sepal. h. Petal. i. Stamen. j. Fruit. k. Mericarp. l. Seed. (Based on: a-l, *Nisa 712,* MA).

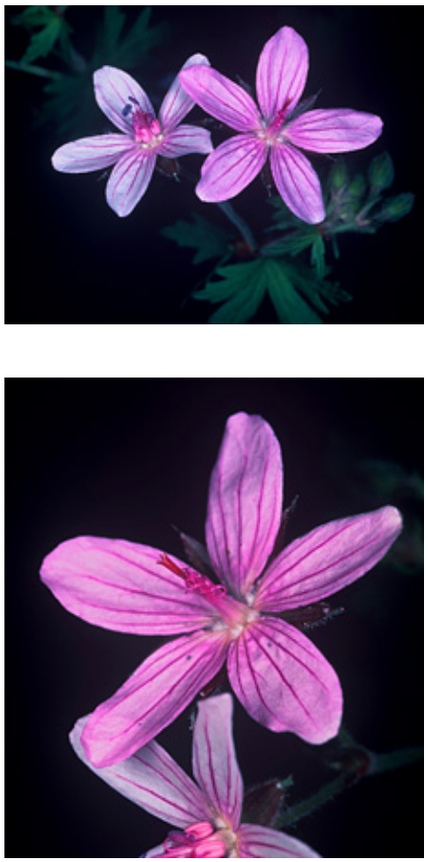


Fig. 647. *Geranium sintenisii* (Based on: *Herrero 1169*, MA, photo: A. Prunell).

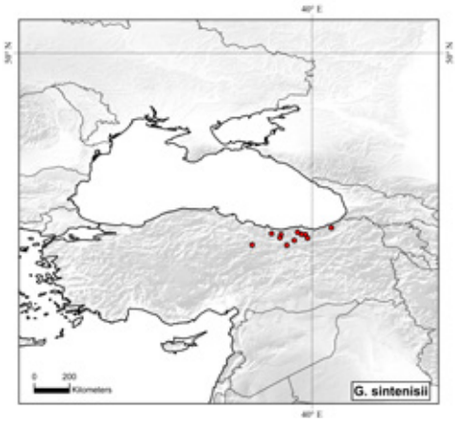


Fig. 648. Distribution of *Geranium sintenisii*.

3.8-7 mm long, lanceolate, white with purple apex, ciliate except on the apex, with hairs 0.1-0.2 mm long; anthers 1.2-2 mm long, blue. Nectaries 5, hemispheric, with a tuft of hairs at the top, dorsally glabrous. *Gynoecium* 4.5-6.9 mm long, dark purple. *Fruit* 19.6-26.5 mm long, erect, discharge of seed-ejection type; mericarps 2.3-3.1 mm long, 1.4-2 mm wide, without a strand of fibers, not compressed at the apex, smooth, without basal beak, withouth a basal callus, with a basal prong, brown, with patent, eglandular hairs 0.2-0.5 mm long, and patent, glandular hairs 0.6-1.1 mm long; rostrum 14.7-20.3 mm long, with a narrowed apex 3.7-6.2 mm long, not twisted, with patent, eglandular hairs 0.2-0.6 mm long and patent, glandular hairs 0.6-1.3 mm long; stigmatic remnants 1-2.1 mm long, with 5 glabrous lobes. *Seeds* 1.5-2.3 mm long, 1.3-2.3 mm wide, reticulate, uniformly colored, brown, glabrous. Cotyledons with entire margin. Figs. 646, 647.

Pollen. *Geranium*-type (Aedo & al. 2005b: 539).

Chromosome number. 2*n* = 26.

Phenology. Collected in flower from June to August.

Distribution. This species ranges through northeastern Turkey (Fig. 648).

Habitat. Meadows, stream bnaks, and rocky slopes; 600-2100 m.

Additional specimens examined. **Turkey.** Giresun: Guemueschkhane, in monte Ulugoba pr. vicum Fol, ad alpem Zowon, 40°7'N, 38°43'E, 13 July 1907, *Handel-Mazzetti 647* (W); Balabandaglari above Tamdere, 40°30'N, 38°22'E, 6 Aug. 1952, *Davis & al. 20471* (E); Trabzon, carretera de Torul a Trabzon, vertiente N, porto Zigana, 40°40'N, 38°25'E, 26 June 2001, *Nisa & al. 712* (MA). Gümüşhane: carretera de Yeniyol a Yagmurdere, subida al puerto de Kostandagi, vertiente S, 40°29'N, 39°47'E, 25 June 2001, *Herrero & al. 1402* (MA). Ordu: Canik Daglari, carretera de Ordu a Çambasi, c. 10 km de Çambasi, 40°43'N, 37°56'E, 23 June 2001, *Herrero & al. 1169* (MA). Trabzon: Lazistan, Djimil, 40°40'N, 39°40'E, July 1866, *Balansa s.n.* (G, P); Trabzon, Hamsikoy, 40°41'N, 39°28'E, 24 July 1960, *Stainton & Henderson 6329* (E); Trapezunti, in ditione vici Fol Koei, 40°47'N, 39°16'E, 11 July 1907, *Handel-Mazzetti 413* (W).

Discussion. Like *Geranium crenophilum*, *G. sintenisii* has constantly long, glandular hairs on stem, petioles, and inflorescence, similar both in shape and size. However, *G. sintenisii* can be distinguished by its ± vertical, turnip-shaped rootstock, without thick fleshy, fasciculate roots, and by its narrow petals. *Geranium chelikii* was described as endemic to the Sivas region of Turkey (the same area as *G. sintenisii*) (Yildiz & Tan 1989). It has been impossible to examine the type or any collection from the type locality of this species. The holotype was apparently sent to E. There, H. Hoy kindly made two exhaustive searches without success. Dr. Askoy (from Istanbul) has contacted to staff at CUFH where the isotype was deposited, also without success. Yildiz & Tan (1989) described *G. chelikii* as bearing "roots slender" rather than "fleshy, fusiform roots" as in *G. asphodeloides*. They also indicated that *G. chelikii* has narrow petals (4-5 mm wide). All these data strongly suggest that *G. chelikii* should be considered as synonym of *G. sintenisii*. *Geranium sintenisii* was recorded from Iran by Köie (1945). Later, Parsa (1952) mentioned the same collection. Schönbeck-Temesy (1970) included this species in "species incertae" in Iran, since she did not find any specimen supporting those records. However, the specimens supporting this record (*Köie 339*, C, and *Köie s.n.*, C) are *G. rotundifolium*.

258. Geranium dissectum L., Cent. Pl. I: 21. 1755. Type locality: "Habitat in Europa australiori". Type: "Habitat in Europa australiori" (lectotype, designated by Carolin 1965: 336, LINN 858.82 image!).

Geranium dissectum var. *minimum* Picard, Mém. Soc. Agric. Boulogne-sur-Mer 1: 122. 1837. Type locality: "Manchecourt, sur les rideaux très-secs". Type: France. Manchecourt, 48°14'N, 2°20'E, *C. Picard s.n.* (no original material located).

Geranium dissectum var. *palmatum* Picard, Mém. Soc. Agric. Boulogne-sur-Mer 1: 122. 1837. Type locality: "Se trouve sur les pelouses sèches, fortifications de la porte Marcadet". Type: France. Abbeville, porte Marcadet, 50°06'N, 1°49'E, *C. Picard s.n.* (no original material located).

Geranium dissectum var. *pumilum* Peterm., Fl. Lips. Excurs. 512. 1838. Type locality: ".. ante portam Aeusseres-Petersthor, ad pagos Konnewitz, Schönfeld, Eutritzsch, Möckern, Kl.-Zschocher etc". Syntypes: Germany. ante portam Aeusseres-Petersthor, ad pagos Konnewitz [51°18'N, 12°22'E], Schönfeld, Eutritzsch [51°22'N, 12°23'E], Möckern [51°22'N, 12°20'E], Kl.-Zschocher [51°18'N, 12°19'E], *L. Petermann s.n.* (no original material located).

Geranium dissectum var. *byzantinum* Griseb., Spic. Fl. Rumel. 1: 123. 1843. *Geranium dissectum* [b] *byzantinum* (Griseb.) Graebn. in Asch. & Graebn., Syn. Mitteleur. Fl. 7(1): 44. 1913. *Geranium dissectum* f. *byzantinum* (Griseb.) Borza, Consp. Fl. Roman. 2: 174. 1949. Type locality: "In Bithynia: in scaturiginosis ins. Principo sociale et in arenois maritimis pr. Hersek sparse!". Type: Turkey. Bithynia, ins. Principo, pr. Hersek, 40°44'N, 29°30'E, *A.H.R. Grisebach s.n.* (no original material located; according to Strid 2000: 294, no material at GOET).

Geranium dissectum var. *subintegrilobatum* Godet, Fl. Jura: 128. 1852. *Geranium dissectum* f. *subintegrilobatum* (Godet) Gams in Hegi, Ill. Fl. Mitt.-Eur. 4(3): 1682. 1924. Type locality: "... dans les terrains incultes du Chantier Roulet, près de Neuchâtel". Type: Switzerland. Neuchâtel, Chantier, Roulet, 47º04'N, 6º49'E, Aug. 1850, *Ch. Godet s.n.* (lectotype, designated by Aedo & al. 2005b: 553, NEU!).

Geranium dissectum [C] *baumgartenianum* Schur ex Graebn. in Asch. & Graebn., Syn. Mitteleur. Fl. 7(1): 44. 1913. *Geranium dissectum* f. *erectum* Patze ex Gams in Hegi, Ill. Fl. Mitt.-Eur. 4(3): 1682. 1924. Type locality: "...Siebenbürgen". Type: Romania. Siebenbürgen [Transylvania], *F. Schur s.n.* (no original material located).

Geranium dissectum var. *furcatum* Schur, Enum. Pl. Transsilv.: 138. 1866. *Geranium dissectum* [B] *furcatum* (Schur) Graebn. in Asch. & Graebn., Syn. Mitteleur. Fl. 7(1): 44. 1913. *Geranium dissectum* f. *furcatum* (Schur) Gams in Hegi, Ill. Fl. Mitt.-Eur. 4(3): 1682. 1924. Type locality: "Auf sandigen Aeckern bei Hermannstadt. Jul. Aug.". Type: Romania. prope Cibinium, 45º48'N, 24º09'E, June 1848, *F. Schur s.n.* (lectotype, here designated, LW-00205549 image!).

Geranium pusillum var. *malvifolium* Baumg. ex Schur, Enum. Pl. Transsilv.: 138. 1866. Type locality: "bei Hermannstadt. Mai - Septbr.". Type: Romania. Hermannstadt, 45º48'N, 24º09'E, *F. Schur s.n* (no original material located).

Geranium dissectum var. *albidum* Kuntze, Trudy Imp. S.-Peterburgsk. Bot. Sada 10: 176. 1887. *Geranium dissectum* [1] *album* (Kuntze) Graebn. in Asch. & Graebn., Syn. Mitteleur. Fl. 7(1): 44. 1913. Type locality: "Talysch". Type: Iran. Talysch, 40º42'N, 48º03'E, May 1886, *O. Kuntze 34* (lectotype, designated by Aedo & al. 2005b: 553, LE!; isolectotype, US-00611128 image!).

Geranium dissectum var. *purpureum* Kuntze, Trudy Imp. S.-Peterburgsk. Bot. Sada 10: 176. 1887. *Geranium dissectum* [1] *purpureum* (Kuntze) Graebn. in Asch. & Graebn., Syn. Mitteleur. Fl. 7(1): 44. 1913. *Geranium dissectum* f. *purpureum* (Kuntze) Gams in Hegi, Ill. Fl. Mitt.-Eur. 4(3): 1682. 1924. Type locality: "Batum". Type: Georgia. Batum, 41º38'N, 41º38'E, *O. Kuntze 48* (lectotype, here designated, US-00611130 image!).

Geranium dissectum var. *roseum* Kuntze, Trudy Imp. S.-Peterburgsk. Bot. Sada 10: 176. 1887. *Geranium dissectum* [1] *roseum* (Kuntze) Graebn. in Asch. & Graebn., Syn. Mitteleur. Fl. 7(1): 44. 1913. *Geranium dissectum* f. *roseum* (Kuntze) Gams in Hegi, Ill. Fl. Mitt.-Eur. 4(3): 1682. 1924. Type locality: "Talysch". Type: Iran. Talysch, 40º42'N, 48º03'E, May 1886, *O. Kuntze 189* (lectotype, here designated, US-00611129 image!).

Geranium dissectum var. *glutinosum* N. Terracc., Nuov. Giorn. Bot. Ital. ser. 2, 14: 138. 1907. *Geranium dissectum* [III] *glutinosum* (N. Terracc.) Graebn. in Asch. & Graebn., Syn. Mitteleur. Fl. 7(1): 44. 1913. Type locality: "alla Costa della Rocca". Type: Italy. Costa della Rocca, *N. Terracciano s.n.* (no original material located).

Geranium dissectum var. *villosum* N. Terracc., Nuov. Giorn. Bot. Ital. ser. 2, 14: 138. 1907. *Geranium dissectum* [II] *villosum* (N. Terracc.) Graebn. in Asch. & Graebn., Syn. Mitteleur. Fl. 7(1): 44. 1913. Type locality: "Pisterola". Type: Italy. Pisterola, 40º44'N, 15º28'E, *N. Terracciano s.n.* (no original material located).

Geranium laxum Hanks ex Hanks & Small in Underw. & Britton (eds.), N. Amer. Fl. 25(1): 9. 1907. Type locality: "Type collected at Oyhut, Chehalis County, Washington, July 8, 1897, Frank H. Lamb 1263". Type: U.S.A. Washington, Chehalis Co., Oyhut, 46°40'N, 122°58'W, 7 Aug 1897, *F.H. Lamb 1263* (lectotype, designated by Aedo 2000: 64, MO-251016!; UC-fragment!; isolectotype, US image!).

Geranium decumbens R. Knuth in Engl., Pflanzenr. IV.129 (Heft 53): 215. 1912, nom. illeg., non Balb. 1814. *Geranium tiguense* Aedo & Muñoz Garm., Kew Bull. 52(3): 726. 1997. Type locality: "Ecuador: Tigua, auf Alpenmatten (Sodiro, Specim. Fl. Ecuad. a. 1894 n. 212! -- Typus in Herb. Berl.)". Type: Ecuador. Cotopaxi. Tigua, 0°56'S, 78°51'W, 1894, *L. Sodiro 212* (holotype, B destroyed; lectotype, designated by Aedo 2012: 420, P-00493019!).

Geranium dissectum f. *albiflorum* R. Fern., Bol. Soc. Brot. ser. 2, 22: 69. 1948. Type locality: "Typus in Herbario Instituti Botanici Universitatis Conimbrigensis (leg. A. Fernandes et Sousa 1686, 7-5-1947). Habitat in pratis humidiusculis, loco dicto Herdade da Coelheira (Serra de Ossa) in Transtagana. Floret Maj". Type. Portugal. Serra de Ossa, Herdade da Coelheira, 38°43'N, 7°37'W, 7 May 1947, *A. Fernandes & F. Sousa 1686* (holotype, COI photocopy!).

Annual herbs, (7)15-69 cm tall. *Stem* erect, leafy, with retrorse, not appressed, eglandular hairs 0.5-1.2 mm long. *Basal leaves* in a ± persistent rosette, cauline leaves opposite (rarely alternate near the base); leaf laminas (2.4)2.7-3.5(8) cm long, 2.5-5.4 cm wide, not peltate, deeply palmatifid [ratio main-sinus length/middle segment length = 0.78-0.88(0.94)], polygonal in outline, base cordate, not coriaceous, with nerves not projected, pilose, with appressed, eglandular (and sometimes glandular) hairs on both surfaces; segments 5-7, in 1 plane, middle segment rhombic, 2-5 mm wide at the base [ratio segment width at the base/middle segment length = 0.09-0.18], 3-9-lobed in distal half [ratio secondary sinus length/middle segment length = 0.32-0.63]; petioles up to 16 cm long, without abscission zone, terete, not swollen, not deflexed in age, with retrorse to subpatent, usually eglandular hairs 0.4-1.2 mm long; stipules 3.4-9.7 mm long, 1-3 mm wide, lanceolate (sometimes with a short bifid apex), free, papery, brownish red, with eglandular hairs on abaxial surface and on the margin, glabrous adaxially. *Inflorescence* a monochasial cyme; cymules 2-flowered, solitary [ratio cymule length/leaf length = 0.4-0.8]; peduncles 6-50 mm long, with patent, mainly eglandular hairs 0.2-0.9 mm long, sometimes only with patent, glandular hairs 0.3-0.6 mm long; bracteoles 2-4.8 mm long, 0.4-0.9 mm wide, lanceolate, whorled; pedicels 6-13 mm long, with patent, eglandular hairs 0.2-0.9 mm long and, usually, patent, glandular hairs 0.2-0.6 mm long. Flowers actinomorphic. *Sepals* (4.2)4.6-5.8(7.1) mm long, 1.7-2.7 mm wide, lanceolate, smooth, not accrescent, nerves

3, mucro 0.8-2 mm long [ratio mucro length/sepal length = 0.18-0.30], with ± patent, eglandular hairs 0.3-0.7 mm long and patent, glandular hairs 0.2-0.8 mm long on the abaxial surface, glabrous adaxially (sometimes only with eglandular hairs). *Petals* (2.9)3.8-5.2(5.8) mm long, 1.7-2.8 mm wide, erect-patent, emarginate (notch 0.2-0.5 mm deep), without claw, purple, glabrous on both surfaces, ciliate on the basal margin, with hairs 0.2-0.3 mm long. *Stamens* 10, both whorls bearing anthers; filaments 1.2-3 mm long, lanceolate with an abruptly narrowed apex, white, glabrous except for a some cilia 0.1-0.2 mm long on the proximal half; anthers 0.3-0.5 mm long, purple. Nectaries 5, hemispheric, glabrous. *Gynoecium* 1.1-3 mm long, purple. *Fruit* 15.1-18.5 mm long, erect, discharge of seed-ejection type; mericarps 2.3-2.9 mm long, 1.7-2.2 mm wide, without a strand of fibers, not compressed at the apex, smooth, without basal beak, without a basal callus, with a basal prong, brown, with patent, eglandular hairs 0.2-0.7 mm long and, sometimes, patent glandular hairs 0.1-0.5 mm long; rostrum 11.1-13.5 mm long, with a narrowed apex 1.6-2.7 mm long, not twisted, with patent, eglandular hairs 0.1-0.6 mm long and patent, glandular hairs 0.3-0.6 mm long; stigmatic remnants 0.6-1 mm long, with 5 hairy lobes. *Seeds* 1.7-2.2 mm long, 1.2-2 mm wide, reticulate, uniformly colored, brown, glabrous. Cotyledons with entire margin. Figs. 649, 650.

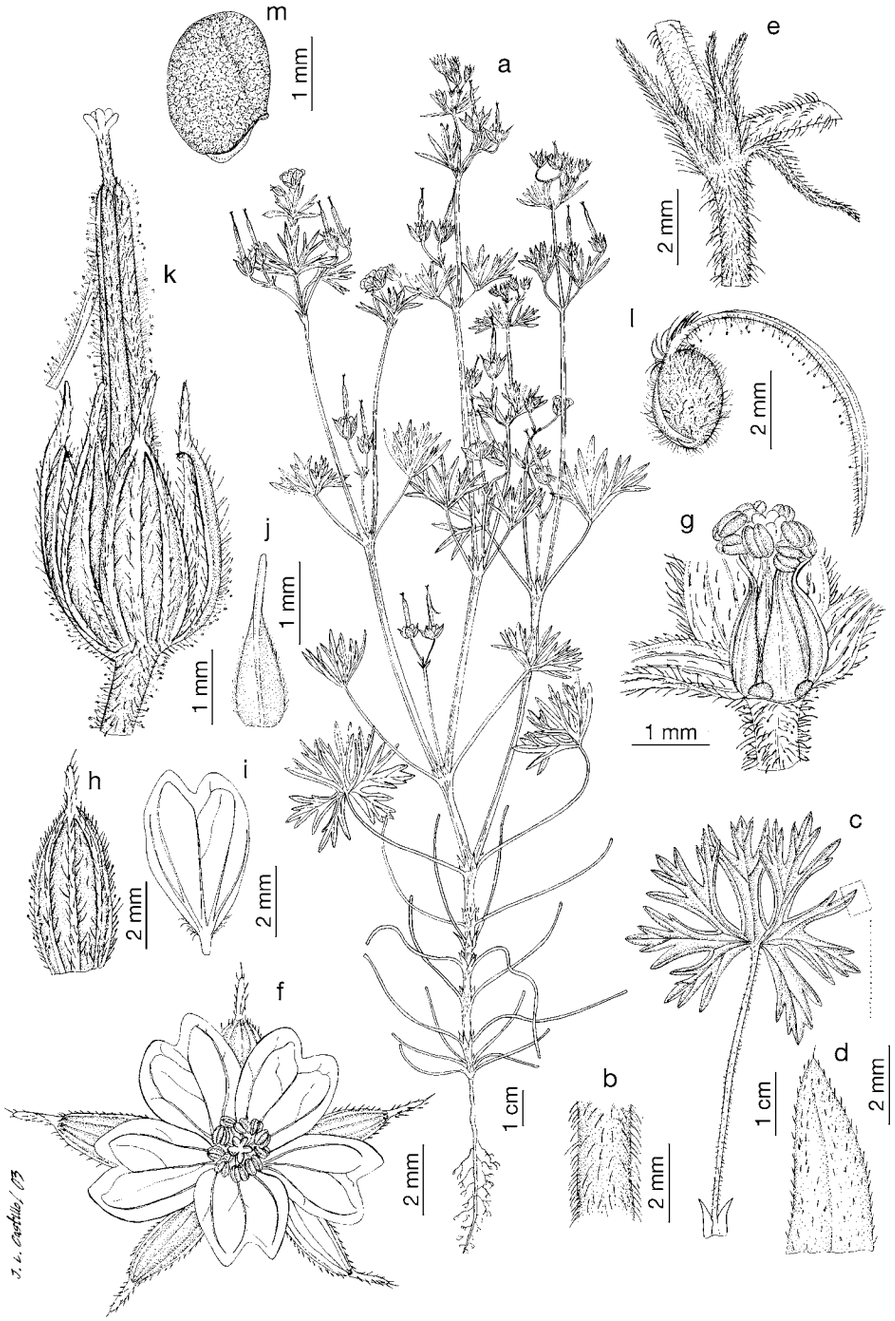


Fig. 649. *Geranium dissectum*. a. Habit. b. Stem indumentum. c. Leaf. d. Leaf indumentum. e. Bracts. f. Flower. g. Androecium and gynoecium. h. Sepal. i. Petal. j. Stamen. k. Fruit. l. Mericarp. m. Seed. (Based on: a-j, *Aedo 3492,* MA; k-m, *Aedo 2087,* MA).

Pollen. *Geranium*-type (Aedo & al. 2005b: 539; Bortenschlager 1967: 425; Gagnepain 1903: 87; Shehata 2008: 69; Stafford & Blackmore 1991: 65; Velasco 1992b: 56).

Chromosome number. 2*n* = 22.

Phenology. Collected in flower from January to December.

Distribution. This species ranges from Europe to central Asia and northern Africa and it is introduced in South Africa, southwestern Canada, U.S.A., Haiti, Ecuador, southern South America, Hawaii, Australia and New Zealand (Fig. 651).

Habitat. Disturbed areas, fields, prairies, moist places and edge of forests; 0-2000 m.

Representative specimens examined. **Afghanistan.** Takhar: Taluqan, 36°44'N, 69°33'E, 28 Apr. 1965, *Podlech 10315* (M). **Albania.** Vlorë: Valona, monte Asna, 40°28'N, 19°28'E, 10 Apr. 1915, *Pireli s.n.* (Fl). **Algeria.** Tlemcen: Ghar Rouban, 34°36'N, 1°46'W, *Pomel s.n.* (MPU). **Argentina.** Buenos Aires: San Isidro, 19 Oct. 1928, *Parodi 8566* (GH). Entre Ríos: Gualeguaychú, Ea. Rincón de Landa, sobre el río Uruguay, a la altura de Perdices, 33°22'S, 58°36'W, 30 Oct. 1990, *Bacigalupo & Fortunato 1413* (CTES, MO). **Armenia.** Syunik: pr. Kafan, 39°12'N, 46°27'E, 26 June 2005,

Fig. 650. *Geranium dissectum* (Based on: a-c, *Aedo 25909*, MA; d, e, without voucher, from Madeira, Portugal, photo: M. Sequeira).

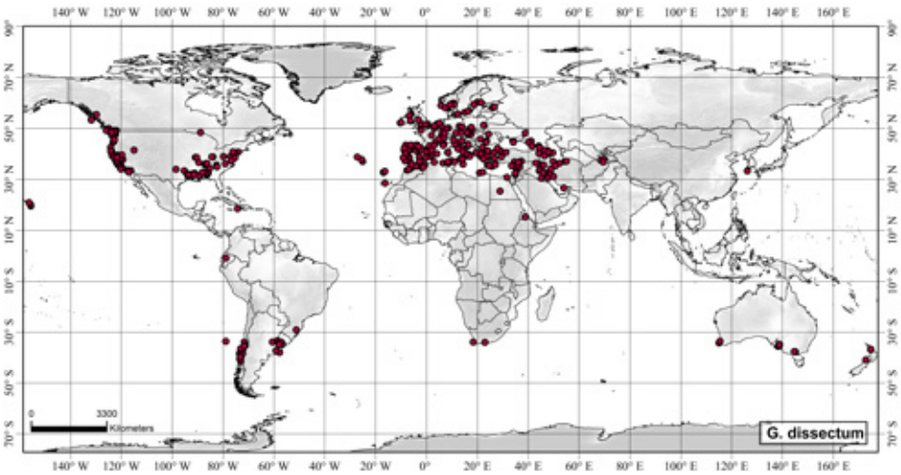


Fig. 651. Distribution of *Geranium dissectum*.

Gonzalo & al. 238 (MA). **Australia.** South Australia: Southern Lofty, 6 km NE of McLaren Flat, 35°11'S, 138°36'E, 29 Sep. 1917, *Bell 368* (AD, MA). Victoria: Craigieburn Grassland Reserve, 100 m NE from the E end of Barry road, 37°40'S, 144°58'E, 11 Nov. 2009, *Walsh 6899* (MA). Western Australia: Kudardup, 34°16'S, 115°5'E, 12 Nov. 1955, *Royce 5187* (PERTH). **Austria.** Burgenland: Nordburgenland, 1,6 km SSE der Eisenbahn-haltestelle Parndorf-Ort, 47°30'N, 16°25'E, 24 July 2004, *Barta 2004-323* (MA). **Azerbaijan.** Ganja-Qazakh: Gandzha, Kazach, pr. fl. Jora, 40°40'N,

46°21′E, 6 May 1928, *Kolakovsky s.n.* (LE). **Belgium.** Flemish: West-Vlaanderen, Roeselare, Rumbeke, Oekensestraat, 50°55′N, 3°9′E, 27 Aug. 2009, *Calvo & Hantson 4106* (MA). **Brazil.** Rio Grande do Sul: Kappesberg, pr. Montnegro, 29°10′S, 51°11′W, 5 Jan. 1947, *Henz s.n.* (PACA). **Bulgaria.** Burgas: Ponti meridionalis, pr. Ahtopol, 42°6′N, 27°57′E, 20 Apr. 1975, *Petrova & Ivanova 937* (MA). **Canada.** British Columbia: Whiffin Spit at Sooke W of Victoria, 48°21′N, 123°45′W, 4 June 1961, *Calder & MacKay 29978* (DAO). Ontario: Lake Superior, Silver Islet, 48°22′N, 88°50′W, 31 Aug. 1871, *Gillman 62* (NY). **Chile.** Biobío: pr. Concepción, mirador Alemán, 36°30′S, 73°2′W, 4 Nov. 2001, *Aedo 6724* (MA). Juan Fernández Is.: Isla Más a Tierra, 33°38′S, 78°52′W, 10 Nov. 1966, *Angulo 114* (CONC). **Croatia.** Split-Dalmatia: Dalmatia, Lesina, 43°10′N, 16°26′E, *Boteri s.n.* (W). **Cyprus.** Larnaca: Xylofagou, 34°57′N, 33°54′E, 18 Apr. 2019, *Medina & al. 10085* (MA). **Czech Republic.** South Moravian: Brno, 49°12′N, 16°37′E, June 1870, *Schur 764b* (P). **Denmark.** Sjælland: Hundige Strand, SW of Copenhagen, 55°36′N, 12°20′E, 11 June 1984, *Hansen 12305* (MA). **Egypt.** New valley: Dakhala Oasis, Ezab el Mauhub, 25°19′N, 28°58′E, 16 Mar. 1967, *El Hadidi & al. s.n.* (MO). **Eritrea.** Central: Amasen, Ad-Rassi, 15°14′N, 38°50′E, 28 Apr. 1902, *Pappi & Pappi 4931* (FT). **Estonia.** Tartu: Tartu, 58°21′N, 26°44′E, *Kapp s.n.* (TAA). **Finland.** Åland: Åland, 60°15′N, 20°0′E, 1883, *Ericksson s.n.* (MA). **France.** Occitanie: Aude, Ligean a Sainte Croix, 43°8′N, 1°10′E, 1902, *Sennen (frère) s.n.* (MA). **Georgia.** Mtskheta-Mtianeti: Kaischaur, 42°26′N, 44°30′E, Sep. 1860, *Owerin s.n.* (LE). **Germany.** North Rhine-Westphalia: Westfalen, Munster, 51°49′N, 7°52′E, 29 June 1906, *Giwtf s.n.* (W). **Great Britain.** Channel Islands: Jersey, 49°13′N, 2°7′W, May 1831, *Lagasca s.n.* (MA). England: Coates, pr. Cirencester, 51°42′N, 2°2′W, 5 June 1996, *Aedo 3857* (MA). **Greece.** Kriti: Siaripidiana, 35°24′N, 24°43′E, 21 Apr. 1988, *Damanakis s.n.* (NHMC). Peloponnese: Korinthia, carretera de Trikala a Xilokastro, 38°0′N, 22°28′E, 22 June 2007, *Herrero & al. 3554* (MA). **Haiti.** near Mare Boeuf, Mornes des Commissaires, 18°26′N, 74°18′W, 2 Jan. 1942, *Holdridge 937* (F). **Hungary.** Győr-Moson-Sopron: Koronczo, 47°35′N, 17°32′E, *Ebenhöch s.n.* (LE). **Iran.** Khuzestan: Gotvand, río Karum, 32°13′N, 48°48′E, May 1899, *Martínez de la Escalera s.n.* (MA). **Iraq.** Baghdad: Baghdad, 33°20′N, 44°23′E, Mar., *Martínez de la Escalera s.n.* (MA). **Ireland.** Munster: Dingle, Kerry, 52°8′N, 10°16′W, 8, *Mamble 26-69* (K). **Israel.** Tel-Aviv: between Petah-Tikwa and Herzlia, N of Tel-Aviv, 32°9′N, 34°49′E, 21 Apr. 1935, *Eig & al. 347* (FI, LE, RO). **Italy.** Basilicata:, pr. Viggianello, 39°56′N, 16°4′E, 12 Apr. 2015, *Aedo 22558* (MA). Sardegna: Alghero, rio Monumtones, 40°33′N, 8°19′E, 25 Apr. 1978, *Valsecchi s.n.* (SS). Sicilia: Palermo, Portela Mandarini, 37°51′N, 14°6′E, 3 June 2000, *García & al. 1402* (MA). **Lebanon.** Mount Lebanon: Hadeth, 33°49′N, 35°31′E, 12 Apr. 1933, *Mouterde 2265* (P). **Libya.** Marj: Cyrenaica, inter Tauchiram et Barcem, 32°30′N, 20°54′E, 20 Apr. 1938, *Maire & Weiller 329* (MPU). **Malta.** Malta is.: insula Melita (hodie Malta), 35°53′N, 14°24′E, 6 May 1907, *Sommier s.n.* (FI). **Morocco.** Tanger-Tetouan-Al Hoceima: Rif, Aït Aixa, Beni Nef, 35°3′N, 4°7′W, *Font Quer s.n.* (BC). **Netherlands.** Zeeland: pr. Oude, Tonge, isl. Goeree-Overflakkee, 51°42′N, 4°12′E, 10 June 1958, *Florschütz & al. 506* (MA). **New Zealand.** South Island, Tasman, pr. Takaka, 40°55′S, 172°48′E, 12 Dec. 2011, *Calvo 5801* (MA). Kermadec Is.: Sunday Is., 29°16′S, 177°54′W, May 1889, *Cheeseman s.n.* (K). **Norway.** Agder: Vest-Agder, Mandal, 58°1′N, 7°26′E, Aug. 1881, *Fridtz s.n.* (O). **Poland.** Opole: Silesia, Slask, Biala Pruduicka, 50°23′N, 17°39′E, 7 July 1961, *Stojanowska 512* (LE). **Portugal.** Estremadura: Gourelha, Morelinho, pr. Sintra, 26 Mar. 1992, *Aedo & al. CN-91* (MA); Madeira: Madeira, Faja da Nogueira, 32°44′N, 16°54′W, 26 June 2000, *Navarro 3079* (MA). **Romania.** Sud-Vest Oltenia: Oltenia, distr. Dolj, 44°30′N, 23°30′E, 30 Apr. 1972, *Cîrtu & Cîrtu s.n.* (MA). **Russia.** Dagestan: Dagestan, Kurinskij, ad Bilidshi, 4 Apr. 1902, *Alexeenko 15711* (LE). Krasnodar: Maikop, 44°36′N, 40°6′E, 1924, *Pastuchov s.n.* (LE). Krym: Yalta, 44°30′N, 34°10′E, 10 May 1901, *Gold s.n.* (LE). North Ossetia: Alagir, pr. Zui pagum, 43°2′N, 44°13′E, 5 Sep. 1861, *Ruprecht s.n.* (LE). **Serbia.** Southern and Eastern Serbia:, ad Vranpka Banja, 42°32′N, 22°0′E, Apr. 1895, *Adamovic s.n.* (P). **South Africa.** Western Cape: Cape Town, 33°55′S, 18°25′E, 23 Aug. 1878, *Debeaux 17* (P). **South Korea.** Jeju: Jeju-si Seogwipo-si, 33°16′N, 126°12′E, 21 May 2014, *Park & al. 141046* (KH). **Spain.** Asturias: playa de Tereñes, pr. Ribadesella, 26 Apr. 1992, *Aedo 2039* (MA). Baleares: Mallorca, Almedrá a Tossals Verds, 39°46′N, 2°49′E, 4 June 1998, *Aedo & al. 4594* (MA). Canarias: Tenerife, Anaga mountains, near Roque de los Pasos, 12 July 1969, *Kers & Wanntorp 4083* (S). **Sweden.** Stockholm: Uppland, Djuro, pr. lacum Vittrasle, 59°19′N, 18°41′E, 24 June 1927, *Samuelsson s.n.* (MO). **Switzerland.** Vaud: à Bex, 46°15′N, 7°1′E, 1898, *s.n.* (MO). **Syria.** Homs: Homs, 34°44′N, 36°43′E, 23 Apr. 1933, *Gombault 2264* (P). **Tajikistan.** Khatlon: Buchara orientalis, urbe Kabadian, 37°28′N, 68°33′E, 17 Apr. 1883, *Regel s.n.* (LE). **Tunisia.** Kef: entre Sidi Merzoug y Aïn Limghaassel, 36°17′N, 8°47′E, 28 Mar. 2009, *Calvo & al. 3360* (MA). **Turkey.** Bolu: al S de Abant Golu, 40°35′N, 31°17′E, 18 June 2001, *Aedo & al. 6241* (MA). **Ukraine.** Luhansk: Sakarpatskya obl., Sever[?], Chyapel[?], 48°7′N, 38°51′E, 12 June 1957, *Igoshina s.n.* (LE). **Uruguay.** Flores: Arroyo Grande, Santa Adelaida, 33°58′S, 57°6′W, Nov., *Gallinal & al. 922* (F). **USA.** Alabama: Crenshaw Co., Crenshaw County highway 11 at the S side of Gin Creek, 31°44′N, 86°19′W, 29 Mar. 2002, *Diamond 12999* (MA). California: San Diego Co., Shepard Canyon, just E of Santo Road, Tierrasanta, 32°49′N, 117°5′W, 8 Apr. 2005, *Schwenkmeyer 119* (SD). Hawaii: Hawaii Is., Hawaii National Park, Mauna Loa, 19°28′N, 155°36′W, 13 May 1945, *Fagerlund & Mitchell 1068* (BISH). Maryland: Wicomico Co., Willards, 38°23′N, 75°20′W, 1 May 1939, *Earle 2007* (PH). West Virginia: Randolph Co., Elkins, 38°55′N, 79°50′W, 27 June 1957, *Davis 12113* (WVA).

Discussion. Geranium dissectum is the most common and widespread species of the section. It is easily distinguished from all other species of sect. *Dissecta* by deeply divided leaves, short petals, and annual life-span. This species shows cymules shorter than the adjacent leaf, whereas in the three perennial species of the section cymules are longer than the adjacent leaf. *Geranium dissectum* has been frequently confused with *G. columbinum*, which is characterized by seed-ejection with callus fruit (not prong). Additionally, *G. dissectum* has cymules not overtopping the subtending leaf whereas in *G. columbinum* pedicel and peduncle together clearly overtop the subtending leaf. Sometimes it is possible to find depauperate plants of *G. dissectum*, fertile but with the leaves not fully developed. Some such specimens have leaves with undivided segments, and have been named var. *subintegrilobatum*. However, no other character state is associated with this size reduction, which suggests that this form also does not deserve taxonomic recognition.

Geranium dissectum has been recorded from Japan (Akiyama 2001; Asai 1975). Unfortunately, it has been impossible to examine the specimens supporting these records. The specimen supporting the record of *G. dissectum* in Peru (Taylor 1993b) is an

unidentified species of sect. *Geranium*. *Geranium dissectum* was also recorded from the Dominican Republic (Moscoso 1943), although no specimen was mentioned. The specimens kept at the National Herbarium (JBSD) as *G. dissectum* are *G. carolinianum*. However, one voucher of *G. dissectum* from Haiti makes reliable its presence from Dominican Republic.

III. Geranium subg. **Tuberosa** (Boiss.) Aedo, Acta Bot. Malac. 42: 299. 2018. Type: *Geranium tuberosum* L. (art. 10.8).

Fruit of seed-ejection type. At dispersal, each single seed is launched from mericarp by the explosive recurvature of the awn, while the awn and the mericarp wall remain attached to the columella. *Mericarp* longitudinally compressed at the apex, twisted at its attachment to the awn and without basal prong nor callus.

IIIa. Geranium sect. **Tuberosa** (Boiss.) Reiche in Engl. & Prantl, Nat. Pflanzenfam. 3(4): 8. 1890. *Geranium* [§] *Tuberosa* Boiss., Fl. Orient. 1: 869. 1867. *Geranium* subsect. *Tuberosa* (Boiss.) Yeo, Bot. J. Linn. Soc. 89: 12. 1984. Type: *Geranium tuberosum* L. (art. 10.8).

Perennials herbs with tuberculate rootstock.

259. Geranium kotschyi Boiss., Diagn. Pl. Orient. ser. 1, 6: 30. 1846. Type locality: "Geranium Kotschyi Boiss. loc. cit. [in pl. Kotsch. Pers.] Febr. 1845... Hab. in glareosis prope nives montis Kuh-Barfi prope Schiraz Kotschy No. 331". Type: Iran. Fars, montis Kuh-Barfi prope Schiraz, 29º36'N, 52º32'E, 3 May 1842, *T. Kotschy 331* (lectotype, designated by Davis 1970: 111, G-BOIS-00365774!; isotypes, BM-000606767!, FI-010373!, GOET-004065 image!, H!, JE!, K-000074050!, MO-251006!, O!, P-00712106!, S05-9884!, UPS!, W!, WRSL!, WU!, Z!).

Perennial herbs, 8-51 cm tall. *Rootstock* vertical, tuberculate, with tubercles subglobose, 5.4-18.8 mm long, 7.8-22.5 mm wide (ratio tubercle width/tubercle length = 0.6-1.4), superimposed, without non-tuberous separations, not turnip-shaped, without thickened roots. *Stem* erect, leafy, not rooting at nodes, stolons absent, without vegetative stems, with patent to retrorse, eglandular hairs 0.1-0.5 mm long and, usually, patent, glandular hairs 0.1-1 mm long. *Basal leaves* in a deciduous rosette, cauline leaves opposite (the first pair usually at stem bifurcation); leaf laminas 1.7-6.6 cm long, 2.2-6.6 cm wide, not peltate, palmatifid to palmatisect [ratio main-sinus length/middle segment length = 0.54-0.95], polygonal in outline, base cordate, not coriaceous, not reticulate, with nerves not projected, with appressed, eglandular hairs on both surfaces; segments 5-13, in 1 or more plane, middle segment rhombic, 0.5-4.4 mm wide at the base [ratio segment width at the base/middle segment length = 0.02-0.20], (1)3-12-lobed in distal half [ratio secondary sinus length/middle segment length = 0.18-0.72]; petioles up to 10 cm long, without abscission zone, terete, not swollen, not deflexed in age, with patent to retrorse, eglandular hairs 0.1-0.7 mm long and, usually, patent, glandular hairs 0.1-0.2 mm long; stipules 2.1-5.7 mm long, 0.7-2.9 mm wide, lanceolate, free, papery, brown, with eglandular hairs on abaxial surface and on the margin, glabrous adaxially. *Inflorescence* a dichasial cyme; cymules 2-flowered, solitary or in aggregates at the top of each branch [ratio cymule length/leaf length = 1-3]; peduncles 7-48 mm long, with patent, eglandular hairs 0.1-0.9 mm long and, usually, patent, glandular hairs 0.2-0.7 mm long; bracteoles 0.7-2.1 mm long, 0.3-0.7 mm wide, linear-lanceolate, whorled; pedicels absent or 3-15 mm long, with patent, eglandular hairs 0.2-0.9 mm long and, usually, patent, glandular hairs 0.1-1 mm long. Flowers actinomorphic. *Sepals* 3.5-6 mm long, 1.5-3.1 mm wide, lanceolate, smooth, not accrescent, nerves 3, mucro (0)0.2-0.8 mm long [ratio mucro length/sepal length = 0.04-0.18], with ± patent, eglandular hairs 0.5-1.7 mm long and usually patent glandular hairs 0.1-0.4 mm long on the abaxial surface, glabrous adaxially. *Petals* 6.8-12.6 mm long, 4.2-8.6 mm wide, erect-patent, emarginate (notch 0.5-2.6 mm deep), without claw, purple, glabrous on both surfaces, rarely hairy on the base of the adaxial surface, ciliate on the basal margin, with hairs 0.3-0.5 mm long. *Stamens* 10, both whorls bearing anthers; filaments 4.3-6.5 mm long, lanceolate, pink, pilose on the abaxial surface, ciliate on the proximal half, with hairs 0.2-0.9 mm long; anthers 1.3-2 mm long, purple. Nectaries 5, hemispheric, glabrous. *Gynoecium* 3.6-6.9 mm long, dark purple. *Fruit* 15.6-21.9 mm long, erect, discharge of seed-ejection type; mericarps 2.8-3.8 mm long, 1.4-2 mm wide, without a strand of fibers, compressed at the apex, smooth, without basal beak, without a basal callus, without a basal prong, brown, with ± patent, eglandular hairs 0.1-1.2 mm long and sometimes patent, glandular hairs 0.2-0.6 mm long; rostrum 10.9-15.9 mm long, with a narrowed apex 1.1-3.2 mm long, twisted distally, with ± patent, eglandular hairs 0.1-0.4 mm long and, sometimes, patent, glandular hairs 0.3-0.5 mm long; stigmatic remnants 0.9-1.6 mm long, with 5 glabrous lobes. *Seeds* 1.9-2.7 mm long, 1.2-1.8 mm wide, smooth, uniformly colored, brown, glabrous. Cotyledons with entire margin.

Pollen. *Geranium*-type.

Chromosome number. Unknown.

Phenology. Collected in flower from March to August.

Distribution. This species ranges from western Iran, through Tadzhikistan, Turkmenistan, Uzbekistan to northwestern Afghanistan.

Habitat. Grassy or rocky slopes, sometimes on halophytic steppe with *Artemisa*; 500-3300 m.

1. Leaves with 9-13 segments, in more than 1 plane; middle segment with 6-12 lobes; pedicels usually with glandular hairs. **259a.** subsp. **kotschyi**

1. Leaves with 5-7(9) segments, in 1 plane; middle segment with (1)3-7 lobes; pedicels usually without glandular hairs. **259b.** subsp. **charlesii**

259a. Geranium kotschyi Boiss. subsp. **kotschyi**

Stem with patent to retrorse eglandular hairs 0.1-0.4 mm long and, usually, patent glandular hairs 0.1-1 mm long. *Leaf lamina* 1.7-3.9 cm length, 2.2-4.7 cm wide, palmatifid to palmatisect (ratio main-sinus length/middle segment length = 0.75-0.89); segments 9-13, in more than 1 plane, 0.5-1.5 mm at the base, 6-12-lobed in distal half; petioles with patent to retrorse eglandular hairs 0.2-0.7 mm long and, usually, patent glandular hairs 0.1-0.2 mm long. *Peduncles* 7-30 mm length, with patent eglandular hairs 0.2-0.5 mm long and, usually, patent glandular hairs 0.3-0.4 mm long; pedicels 3-13 mm length, with patent eglandular hairs 0.2-0.5 mm long and, usually, patent glandular hairs 0.2-0.4 mm long. *Sepals* 3.5-5.6 mm long, 1.5-2.8 mm wide, with ± patent, eglandular hairs 0.6-1.2 mm long and, usually, patent glandular hairs 0.1-0.4 mm long on the abaxial surface, glabrous adaxially. *Petals* 6.8-11.8 mm long, 5-8.6 mm wide, glabrous on both surfaces, ciliate on the basal margin, with hairs 0.3-0.5 mm long. Fig. 652 a-j, 653 e.

Pollen. Geranium-type (Aedo & Estrella 2006: 22; Bortenschlager 1967: 427).

Chromosome number. Unknown.

Phenology. Flowering specimens from March to August.

Distribution. This subspecies ranges from western to central Iran (Figure 654).

Habitat. Rocky areas, on limestone or volcanic rocks, usually near melting snow; 1700-2900 m.

Additional specimens examined. **Iran.** Kuh Gasas?eud, 1 July 1909, *Strauss s.n.* (JE); Isfahan: Esfahan, Golpayegan, 30°27'N, 50°17'E, 20 June 1908, *Strauss s.n.* (JE); Esfahan, Kuh-e Surmandeh (Kuh-e Alijuq), N Semirom, 31°24'N, 51°34'E, Aug. 1974, *Rechinger 47526* (G); Esfahan, 32°38'N, 51°43'E, *Aucher-Éloy 4301* (G, FI); Esfahan, Kuh-e Karkas (Kuh-i Kargiz) pr. stationem radar, 33°27'N, 51°48'E, Aug. 1974, *Rechinger 46603* (G). Kerman: Sultanabad, pr. Chaladjistan, 28°22'N, 56°15'E, May 1899, *Strauss s.n.* (JE, LD, Z). Kohgiluyeh and Boyer-Ahmad: Kohgiluyeh, Boyer Ahmad, 30°51'N, 51°27'E, 4 May 1973, *Hewer 1962* (K). Lorestan: Shah pasand to Shahrud above summit of pass, 33°5'N, 49°10'E, 10 May 1966, *Furse 7165* (K); Kuh-e Safid Khaneh, 33°24'N, 49°21'E, June 1903, *Strauss s.n.* (JE); Lorestan, Ostan 2, Sefid Khok, 33°38'N, 48°4'E, 2 June 1956, *Schmid 5555* (G); Ostan-e Lorestan, Kuh Besri, 33°44'N, 48°49'E, 4 June 1910, *Strauss s.n.* (JE); Trehall, Kuh Nogreh Kemer, 33°31'N, 48°27'E, 25 May 1892, *Strauss s.n.* (JE). Mazandaran: N Kohrud range, Kuh-i-Gurau, 36°3'N, 52°15'E, 24 Apr. 1962, *Furse 1577* (K); Mazandaran, Kohrud, 36°3'N, 52°15'E, May 1905, *Strauss s.n.* (JE). Semnan: highest pass between Semnan and Fizouz-Kuh, 35°34'N, 53°23'E, 20 May 1978, *Wendelbo & Assadi 29761* (GB). Tehran: jugi Elbursensis occid., in alpinis Lädd montium Totschal, 35°53'N, 51°25'E, 4 June 1902, *Bornmüller 6511* (E, G, HBG, JE, L, LD, PR, WRSL, WU, Z); Tehran, Alborz mountains, W of Emamzadeh Davood, after Rendan, above Taloon, 35°53'N, 51°16'E, 9 May 2013, *Noroozi 2942* (MA); in m. Elbrus, pr. pagum Passgala, 35°49'N, 51°25'E, May 1843, *Kotschy 112* (BM, G, UPS, W).

259b. Geranium kotschyi subsp. **charlesii** (Aitch. & Hemsl.) P.H. Davis, Israel J. Bot. 19: 111. 1970. *Geranium tuberosum* var. *charlesii* Aitch. & Hemsl., Bot. Mag. 112, tab. 6910. 1886. *Geranium charlesii* (Aitch. & Hemsl.) Vved. in Nevski, Trudy Bot. Inst. Akad. Nauk SSSR, Ser. 1, Fl. Sist. Vyss. Rast. 4: 304. 1937. Type locality: "... was raised from tubers sent to Kew by Dr. Aitchinson weh on the Affghan Boundary Commission... It was found commonly in crevices of limestone rocks at an altitude of 3000 feet on the north and eastern sides of the Kambno Pass, Badghis, in May, 1885, and it flowered in Kew in the same month of the following year". Type: Afghanistan. Faryab. Kambno Pass, Badghis, 35°53'N, 64°28'E, 2-3 May 1885, *J.E. Aitchison 379* (lectotype, designated by Bobrov 1949: 62, K!; isolectotypes, BM-000606788!, C!, E!, P-00757960!, S!).

Stem with patent to retrorse eglandular hairs 0.1-0.5 mm long. *Leaf lamina* 2-6.6 cm length, 2.8-6.6 cm wide, palmatifid to palmatisect (ratio main-sinus length/middle segment length = 0.54-0.95); segments 5-7(9), in 1 plane, 0.8-4.4 mm at the base, (1)3-7-lobed in distal half; petioles with patent to retrorse eglandular hairs 0.1-0.5 mm long. *Peduncles* 7-4.8 mm length, with patent eglandular hairs 0.1-0.9 mm long and, rarely, patent glandular hairs 0.2-0.7 mm long; pedicels 3-1.5 mm length, with patent eglandular hairs 0.2-0.9 mm long and, rarely, patent glandular hairs 0.1-1 mm long. *Sepals* 4.3-6 mm length, 2-3.1 mm wide, with ± patent, eglandular hairs 0.5-1.7 mm long. *Petals* 7.3-12.6 mm length, 4.2-8.4 mm wide, glabrous on both surfaces, ciliate on the basal margin (rarely hairy on the base of adaxial surface), with hairs 0.3-0.4 mm long. Fig. 652 k, l, 653 a-d.

Pollen. *Geranium*-type (Aedo & Estrella 2006: 25).

Chromosome number. Unknown.

Phenology. Flowering specimens from April to August.

Distribution. This subspecies ranges from northeasten Iran, through Tadzhikistan, Turkmenistan and Uzbekistan to northwestern Afghanistan (Figure 654).

Habitat. Grassy or rocky slopes (on limestone, granite, sandstone, or gypsum), sometimes on halophytic steppes with *Artemisa* L.; 500-3300 m

Representative specimens examined. **Afghanistan.** Baghlan: N side of Salang pass, 35°18'N, 69°2'E, 8 June 1964, *Furse 6601* (K). Bamyan: Bamian, Band-i Amir, 34°50'N, 67°13'E, June 1969, *Hager 32* (W); Parvan, E side of Shibar pass near the summit, 34°54'N, 68°15'E, 20 May 1962, *Hedge & Wendelbo 3317* (E, M). Faryab: Ghour, E of Laal Sar Sangal, 35°41'N, 64°17'E, 10 June 1969, *Hedge & Wendelbo 8739* (G, GB). Ghazni: 20 mi NE Ghasni, 33°32'N, 68°24'E, 8 May 1964, *Furse 5669* (E, M). Herat: Sabzak pass on road from Herat to Qala Nau, 34°38'N, 63°6'E, 16 May 1969, *Hedge*

& al. 8071 (GB). Kabul: bei Minar tschakri unteren Logartal, 34°24′N, 69°17′E, 5 May 1950, *Gili 1455* (W); Kabul, Berg Scher Darwasa, 34°30′N, 69°8′E, 4 May 1950, *Neubauer 455* (W). Kandahar: NW Obeh, gorge near hot spring hotel, 32°16′N, 65°15′E, 26 Apr. 1971, *Gibbons 192* (K); Khost: Paktia, nearer Gandez, 33°34′N, 69°34′E, 14 May 1971, *Carter 1208* (K). Paktia: Deh Kundi, Sar-i-Nil, 33°42′N, 69°8′E, 7 June 1949, *Edelberg 1949* (C). **Iran.** Golestān: Gorgan, from Shahpassand to Shahrud, after Kosh Yeilagh, 36°49′N, 54°26′E, 18 May 1978, *Wendelbo & Assadi 29650* (GB); Gorgan, Mohamed Reza Shah Wildlife Park, plain along road to Almeh, 37°5′N, 55°31′E, 30 Apr. 1974, *Wendelbo & al. 10970* (E, W). North Khorasan: Khorasan, montes Kopet-Dagh, in jugo Alamli, 37°50′N, 58°0′E, 3 June 1948, *Rechinger 7263* (W). Razavi Khorasan: Khorasan, Gardaneh Shotur Rah 20 km N Kashmar, 35°4′N, 60°57′E, 4 May 1975, *Rechinger 51237* (W); Khorasan, montes Kuh-e Nishapur, Darreh Abshar supra Akhlomat, 36°12′N, 58°47′E, 30 May 1948, *Rechinger 4620* (E, G, W); Khorasan, in mont inter Meschhed et Nischapur, 36°17′N, 59°36′E, 5 May 1913, *Dietz s.n.* (WU); Khorasan, montes Hazar Masdjid, 36°52′N, 59°26′E, 8 June 1948, *Rechinger 5110B* (G). **Pakistan.** Khyber Pakhtunkhwa: Chitral, Mastuj track, Kuragh, 36°1′N, 71°45′E, 26 May 1958, *Stainton 2520* (BM). **Tajikistan.** Khatlon: Iuzmviy Tadzikistan, Gora Imanaskari k e. ot kishl, Daran-iman, kamenistie sklonui, 37°41′N, 69°35′E, 5 June 1960, *Bocancev & Egorova 1004* (LE); Shuroabad, 37°50′N, 70°2′E, 18 June 1935, *Linczevski & Masiennikova 441* (LE); S Tadjikistan, E slope of Gordanie, along the path from the village Gandzhino to the place Mundy, 38°1′N, 68°28′E, 19 May 1965, *Neplie 331* (MA); Southern Tadzhikistan, E slope of Gazimailyk mountain range, near village Sharituz, 38°3′N, 68°31′E, 14 May 1939, *Tazba 392* (LE); Saiglok mountain range, E slope, near village Sebiston, 38°15′N, 69°17′E, 23 May 1979, *Kamelin & Makhmedov 324* (LE). Sughd: plantae Hissaricae, pr. Stalinabad, 38°33′N, 68°46′E, 25 May 1934, *Zaprjagaev 98* (LE); Gissarsky mountain range, S slope, river Varzob basin between villages Firnozoabad and Sharsheuga, 38°45′N, 68°48′E, 22 May 1964, *Stepanenko & Kudriashova 2254* (LE); valle Kondara ad rivulum Kondricka, procul ab oppido Stalinabad, 38°48′N, 68°49′E, 28 May 1959, *Deyl s.n.* (MA, PR). **Turkmenistan.** Ahal: central part of Kopet-dag mountains, river Arvaz basin, Yailakh canyon, 37°49′N, 58°0′E, 29 May 1962, *Guvanov & al. s.n.* (LE); pr. Ashabad, 37°56′N, 58°22′E, 23 Apr. 1897, *Litvinov 1143* (G, LE, WU); montium Gosi-Mailik, ad fluvii Kafirnagam, 37°56′N, 58°22′E, 3 May 1883, *Regel s.n.* (LE); montes Kopet-dag, pagum Vanovskoie, in valle rivi Firiuzinka, 37°57′N, 58°7′E, 16 Apr. 1986, *Vašák s.n.* (LE). Balkan: Transcaspia, Kursurz-Arvaz, 38°14′N, 57°9′E, 18 Apr. 1905, *Androssov s.n.* (LE); Karakal, 38°34′N, 56°44′E, 1916, *Tschernjakovskaja 525* (LE). Daşoguz: Zakaspiiskaya province, Ashkhabadsky distr., mountains near Kizyl (Arvash), 41°54′N, 59°44′E, 18 Aug. 1905, *Androssov s.n.* (LE). Lebap: Karliukskogo raj., 37°35′N, 66°20′E, 27 June 1934, *Nevski 449* (LE); Mary: Sakarvkasskaia, Kopem, Recnaia dolina, 38°0′N, 61°0′E, 17 May 1954 (LE). **Uzbekistan.** Bukhara: Bujara, Shajrisiabs, 39°46′N, 64°25′E, 7 June 1896, *Lipsky 3432* (BM, C, H, LE, S, W). Jizzakh: Samarcanda,

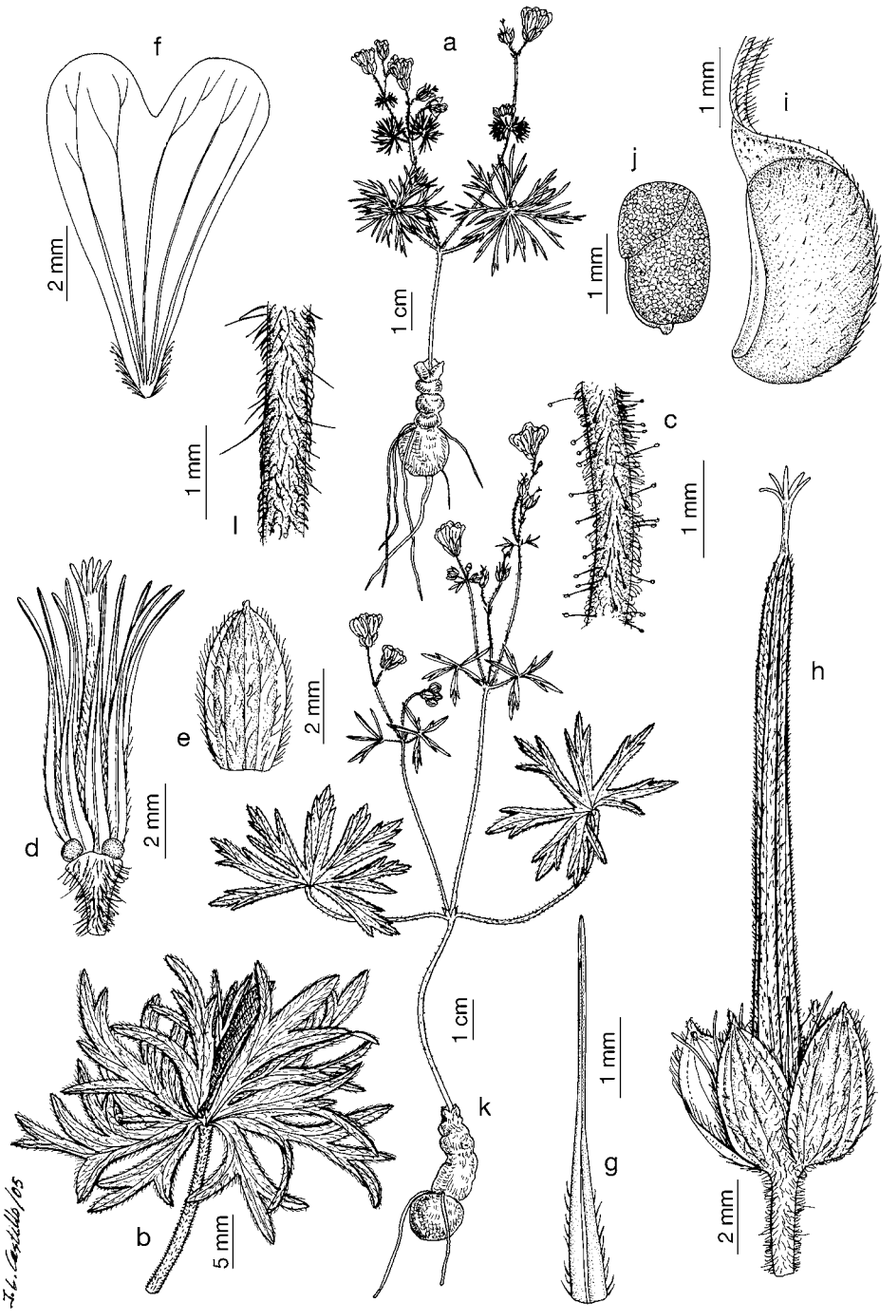


Fig. 652. *Geranium kotschyi* subsp. *kotschyi.* a. Habit. b. Leaf. c. Indumentum of the pedicel. d. Flower without petals and sepals. e. Sepal. f. Petal. g. Staminal filament. h. Fruit. i. Mericarp. j. Seed. (Based on: a, c-g, *Furse 1577,* K; b, *Strauss s.n., 20 Mar. 1908*, JE; h-j, *Strauss s.n., 4 June 1910*, JE). *Geranium kotschyi* subsp. *charlesii.* k. Habit. l. Indumentum of the pedicel. (Based on: k, *Kamelin & al. 44,* LE; l, *Carter 916,* K).

near Dzhizak, near village Irane, 40º6'N, 67º49'E, 11 Apr. 1915, *Fedtschenko 222* (LE). Kashkadarya: Zeravshansky mountains, Aman-Kutan pass, 39º19'N, 66º16'E, 8 May 1961 (LE). Samarkand: Aman-Kutan, 39º18'N, 66º56'E, 25 Apr. 1913, *Fedtschenko 1036* (LE); Samarcanda, gora Samburak, 39º38'N, 66º53'E, 13 May 1913, *Fedtschenko 1640* (LE). Surkhandarya: Surkhandarja, 5 km from Machai village, 38º17'N, 67º0'E, 9 May 2012, *Khassanov 12-101* (MO).

Discussion. Geranium kotschyi is recognized by its vertical rootstock composed of subglobose and superimposed tubercles. Tubercles are adjacent, without non-tuberous separations, and diminish in size towards rootstock apex. *G. kotschyi* is also characterized by the absence of the terminal cymule at the first bifurcation of the stem. The remaining species of the sect. *Tuberosa* have a horizontal rootstock with tubercles joined by non-tuberous separations, and usually a terminal cymule at the first bifurcation of the stem. Most plants have the first pair of leaves at stem bifurcation although, rarely, there are specimens with a pair of opposed leaves below this bifurcation. Basal leaves are absent at flowering time in most herbarium specimens. However, I could check in plants cultivated at Madrid Botanical Garden (*Aedo 9888*) that this feature is variable, and that sometimes basal leaves are present at flowering time. The most important differences between subsp. *kotschyi* and subsp. *charlesii* are found in the leaf shape. The subsp. *kotschyi* has leaves with many segments, which are in more than 1 plane, and the middle segment has many lobes, while subsp. *charlesii* has more simple leaves with few segments in 1 plane and the middle segment with few lobes. In the north of Iran, where both taxa grow, there are intermediate specimens. This strongly supports Davis' proposal (1970) to consider such taxa as subspecies. On the other hand, leaves of subsp. *charlesii* are variable. It usually has deeply divided leaves with narrow segments, but some specimens show broad and not deeply divided segments, and others have segments without lateral lobes. These forms are widespread in all areas of subsp. *charlesii*, and they do not show other distinctive features. The presence of glandular hairs on the inflorescence is useful, as a secondary character, to distinguish subsp. *kotschyi*, although it is not constant. On the contrary, subsp. *charlesii* can occasionally have glandular hairs (Davis 1970).

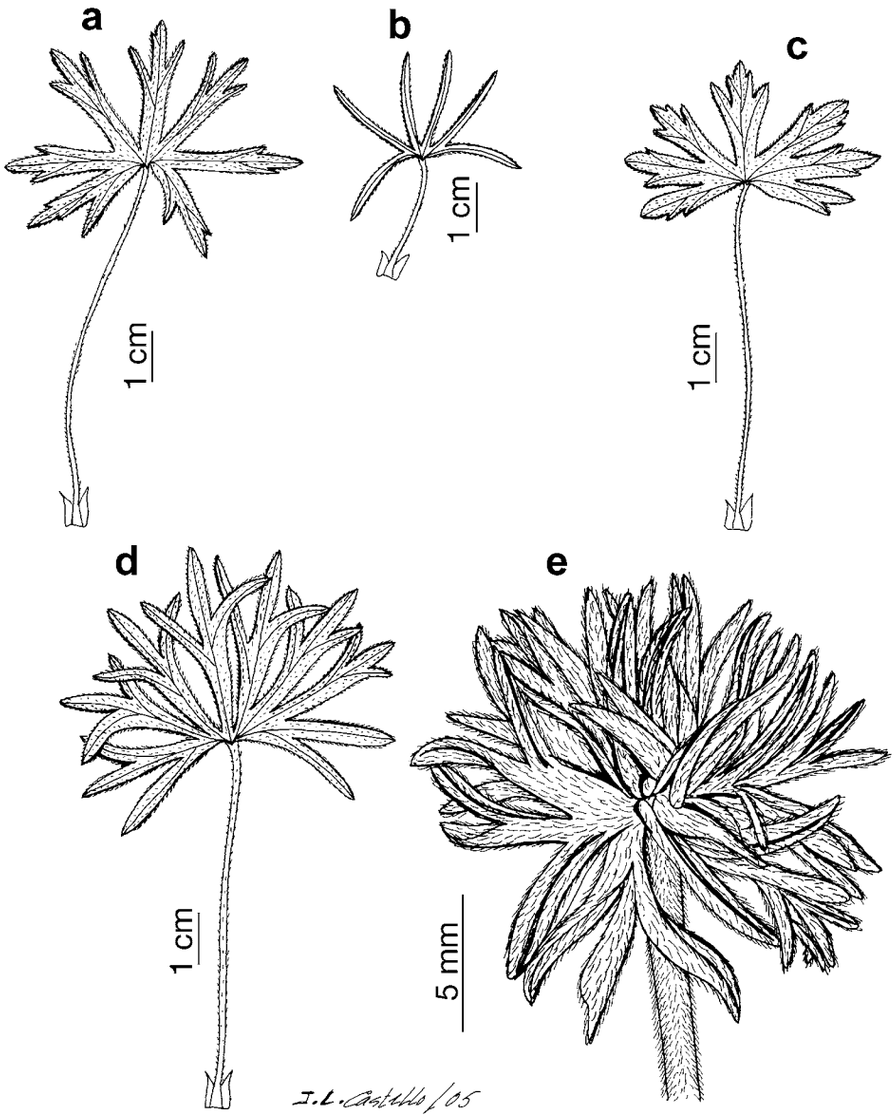


Fig. 653. Leaf variability of *Geranium kotschyi* subsp. *charlesii.* (Based on: a, *Kamelin & al. 44,* LE; b: *Linczevski & Maslennikova 441,* LE; c: *Carter 916,* K; d: *Androssow s.n., 18 Apr. 1905*, LE). *Geranium kotschyi* subsp. *kotschyi* (Based on: e, *Aedo 9888,* MA).

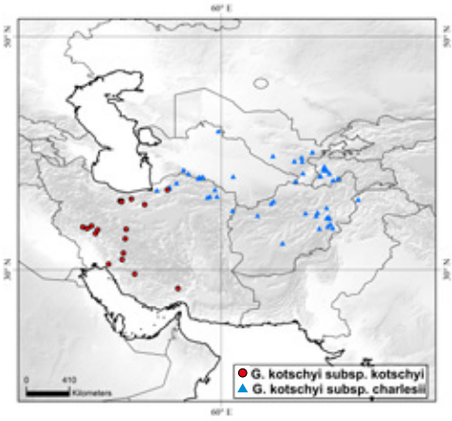


Fig. 654. Distribution of *Geranium kotschyi.*

260. Geranium libanoticum A. Schenk, Pl. Spec. Schubert: 39. 1840. Type locality: "Hab. in cedreto montis Libanon, ubi florentem stirpem legerunt Dr. Erdl et Roth initio Maji, 5877' a. o.". Type: Lebanon, montis Lebanon, 34º00'N, 35º59'E, *M.P. Erdl & J.R. Roth s.n.* (no original material located). Lebanon. Les Cèdres, supra Bcharré, 34º15'N, 36º01'E, 8 May 1965, *H. Roessler 5348* (neotype, designated by Aedo & Estrella 2006: 32, M!).

Perennial herbs, 14-35 cm tall. *Rootstock* ± horizontal, tuberculate, with tubercles subglobose, 4.4-13.1 mm long, 4.9-10.5 mm wide (ratio tubercle width/tubercle length = 0.6-1.3), with non-tuberous separations 5.9-26.9 mm long, (1.7)2.2-5.2 mm wide, not turnip-shaped, without thickened roots. *Stem* erect, leafy, not rooting at nodes, stolons absent, without vegetative stems, with patent to retrorse, eglandular hairs 0.3-1.3 mm long, sometimes glabrous. *Basal leaves* in a ± persistent rosette, cauline leaves opposite (1 pair below the first bifurcation); leaf laminas 3-7 cm long, 4.1-10.5 cm wide, not peltate, palmatisect, polygonal in outline, base cordate, not coriaceous, not reticulate, with nerves not projected, with appressed, eglandular hairs on both surfaces; segments 5-7, in 1 plane, middle segment rhombic, 0.7-2.6 mm wide at the base [ratio segment width at the base/middle segment length = 0.02-0.06], 11-33-lobed in distal half [ratio secondary sinus length/middle segment length = 0.30-0.49]; petioles up to 14 cm long, without abscission zone, terete, not swollen, not deflexed in age, with patent to retrorse, eglandular hairs 0.3-1.8 mm long; stipules 2.7-5.2 mm long, 1.3-2.2 mm wide, lanceolate, free, papery, brown, with eglandular hairs on abaxial surface and on the margin, glabrous adaxially. *Inflorescence* a dichasial cyme; cymules 2-flowered, solitary or in aggregates at the top of each branch [ratio cymule length/leaf length = 1.3-2.4]; peduncles 0-12(22) mm long, with patent, eglandular hairs 0.2-0.8 mm long; bracteoles 1.4-3.1 mm long, 0.5-1.1 mm wide, linear-lanceolate,

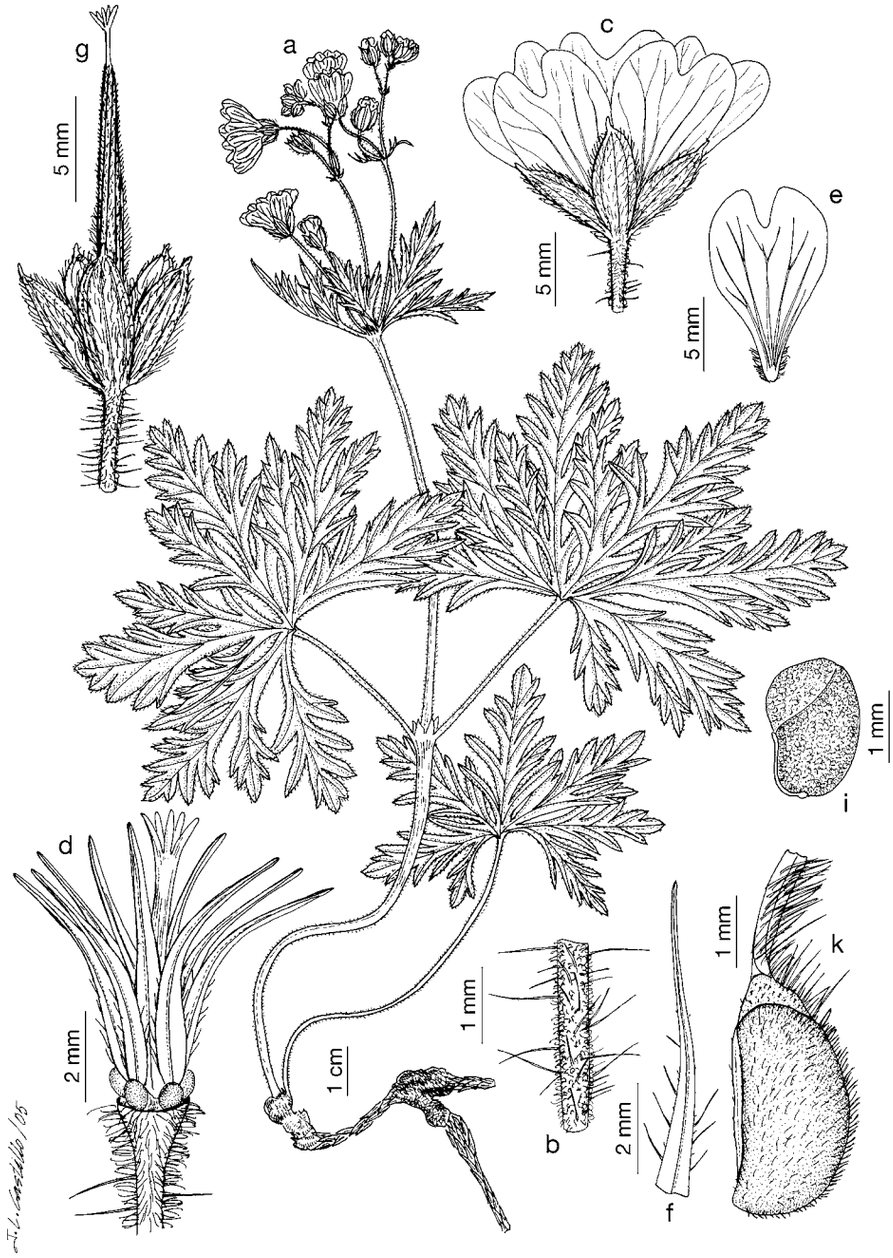


Fig. 655. *Geranium libanoticum.* a. Habit. b. Indumentum of the pedicel. c. Flower. d. Flower without petals and sepals. e. Petal. f. Staminal filament. g. Fruit. h. Mericarp. i. Seed. (Based on: a-f, *Roessler 5348,* M; g-i, *Zederbauer s.n.,* June 1902, WU).

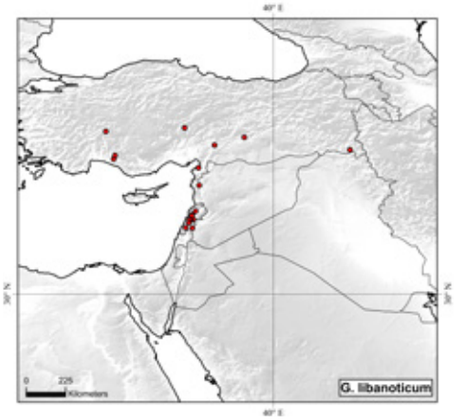


Fig. 656. Distribution of *Geranium libanoticum*.

whorled; pedicels 7-24 mm long, with patent, eglandular hairs 0.2-1 mm long. Flowers actinomorphic. *Sepals* (4.8)5.2-6.5(7.3) mm long, 2.2-3.9 mm wide, lanceolate, smooth, not accrescent, nerves 3, mucro 0.5-1.6 mm long [ratio mucro length/sepal length = 0.08-0.33], with ± patent, eglandular hairs 0.4-1.7 mm long on the abaxial surface, glabrous adaxially. *Petals* 9.7-13(15.9) mm long, 6.2-14.9 mm wide, erect-patent, emarginate (notch 0.8-3.8 mm deep), without claw, purple, glabrous on both surfaces, ciliate on the basal margin, with hairs 0.3-0.5 mm long. *Stamens* 10, both whorls bearing anthers; filaments 4.5-6 mm long, lanceolate, pink, pilose on the abaxial surface, glabrous or ciliate on the proximal half, with hairs 0.3-1.3 mm long; anthers 1.5-2.6 mm long, yellow. Nectaries 5, hemispheric, glabrous. *Gynoecium* 4.1-6 mm long, dark purple. *Fruit* 18.3-20.5 mm long, erect, discharge of seed-ejection type; mericarps 2.8-4 mm long, 1.5-2.4 mm wide, without a strand of fibers, compressed at the apex, smooth, without basal beak, without a basal callus, without a basal prong, black, with ± patent, eglandular, hairs 0.2-1.7 mm long; rostrum 12.9-16.3 mm long, with a narrowed apex (2.1)2.4-3.2 mm long, twisted distally, with ± patent, eglandular hairs 0.2-1.1 mm long; stigmatic remnants 1-1.5 mm long, with 5 glabrous lobes. *Seeds* 2.1-2.7 mm long, 0.7-1.8 mm wide, finely reticulate, uniformly colored, brown, glabrous. Cotyledons with entire margin. Fig. 655.

Pollen. *Geranium*-type (Aedo & Estrella 2006: 22).

Chromosome number. 2*n* = 28.

Phenology. Collected in flower from March to June.

Distribution. This species ranges from southern Turkey, through western Syria to Lebanon (Fig. 656).

Habitat. Stony open areas of *Quercus* L. and *Cedrus* Mill. forests, on igneous or volcanic rocks; 1100-2600 m.

Additional specimens examined. **Lebanon.** Samin, *Ehrenberg s.n.* (G); Samin, 11 June 1904, *Kneucker 194* (JE). Beqaa: W col de Zahlé, 33º50'N, 35º54'E, 18 Apr. 1957, *Pabot s.n.* (BM). Mount Lebanon: Maasser, 33º39'N, 35º40'E, 2 May 1957, *Mouterde s.n.* (G); Ain Sofar, 33º48'N, 35º42'E, 24 Mar. 1933, *Meinertzhagen s.n.* (BM); 26 km a Beirut orientem versus infra Dahr el Baidar, 33º48'N, 35º45'E, 24 May 1957, *Rechinger 13308* (W); vers Faraya, 34º1'N, 35º49'E, May 1965, *Mouterde s.n.* (G); après Qartaba, route d'Afka, 34º5'N, 35º51'E, 20 Mar. 1957, *Pabot s.n.* (G). Nabatieh: Sueda, jebel Druze, 33º24'N, 35º30'E, 15 Apr. 1933, *Meinertzhagen s.n.* (BM). North: Bcharré, 34º15'N, 36º1'E, 21 Apr. 1959, *Polunin 5345* (E); Aiz Er Rab pr. Cedretum, 34º15'N, 36º1'E, 12 June 1932, *Samuelsson 2377* (S); Becharré, 34º15'N, 36º1'E, 8 May 1965, *Zerny s.n.* (W). **Syria.** pr Ivedria, 1836, *Kotschy 111* (W); Damascus: Mt. Hermon, 33º23'N, 35º51'E, 29 June 1906, *[illegible] 191* (MA); Golan, Mt. Hermon, 33º23'N, 35º51'E, 23 Apr. 1975, *Lyshede s.n.* (C); Latakia: sous le sommet des Alamites, Sleufé, 35º35'N, 36º12'E, 6 May 1954, *Pabot s.n.* (G). **Turkey.** Adiyaman: Dar Dagh, Jarpuz, 38º3'N, 38º31'E, June 1914, *Tölg s.n.* (W). Antalya: Akseri-Güzelsu, bei Sadiklar, 36º56'N, 31º48'E, 20 Apr. 1985, *Nydegger 40339* (G); E Yarpuz, Nur Daglari, C6 Syhan, 37º7'N, 31º52'E, 5 June 1973, *Sorger 73-22-8* (W). Hakkâri: Süvarihalil geçidi, 37º24'N, 43º57'E, 14 June 1984, *Baytop 54359* (ISTE). Hatay: Amanus mount, 36º29'N, 36º10'E, June 1906, *Haradjian 738* (G); Hatay, Belen, Karlik Tepe, above Sogukoluk, 36º29'N, 36º10'E, 23 Apr. 1957, *Davis & Hedge 27100* (BM, E); Amanus mountains, Karlik Tepe, above Sogukoluk, 36º29'N, 36º10'E, 1 May 1967, *Mitchell 2656* (E). Kahramanmaraş: Maras, Ahirdag, Tsmek, 37º39'N, 36º59'E, 5 May 2000, *Ilçim 889* (MA). Kayseri: Erdschias dagh, Pelikartyny, 38º32'N, 35º27'E, June 1902, *Zederbauer s.n.* (W, WU). Konya: Aksehir, Tekke koyu ustleri, Danasekisi, 38º21'N, 31º24'E, 29 May 1974, *Dökmeci & Dogantan 28804* (ISTE).

Discussion. Geranium libanoticum has a characteristic rootstock with tubercles joined by broad non-tuberous separations. It is also easily separated from *G. tuberosum* by its rostrum with a longer narrowed apex. Both *G. macrostylum* and *G. linearilobum* are partially sympatric with *G. libanoticum*. The first can be differentiated by its glandular hairs and the second by its alternate cauline leaves. This species was described by Schenk (1840) based on material from Lebanese mountains. According to Stafleu & Cowan (1985: 134), Schenk's herbarium and types at WB and LZ were destroyed. I have been looking for original material in other herbaria where further Schenk's material has been kept, without success. Thus, a neotype from the same area was selected. The record of *G. libanoticum* from Iran by Davis (1970: 111) is based in *Stapf 491* (WU). This specimen lacks underground parts and has a pair of opposite leaves below the first bifurcation (as *G. libanoticum* and some specimens of *G. tuberosum*), but the fruit is unequivocally of *G. tuberosum* since it has a short (1.1 mm long) narrowed apex.

261. Geranium linearilobum DC. in Lam. & DC., Fl. Franç. ed. 3, 5: 629 [in note]. 1815. *Geranium tuberosum* var. *linearilobum* (DC.) Kuntze, Trudy Imp. S.-Peterburgsk. Bot. Sada 10: 177. 1887. *Geranium tuberosum* subsp. *linearilobum* (DC.) Schmalh., Fl. Ssredn. Jushn. Rossii 1: 194. 1895. Type locality: "Hab. in Siberiâ" ["in nemoribus et campestribus ad Wolgam infer. et in promont. Caucasico. G. tuberosum Bieb. fl. taur. 2. p. 135. excl. syn. Lin. Cav. Lam. Mor. (v.s.) " sec DC., Prodr. 1: 640. 1824]. Type: Russia. Volvograd, Sarepta, 48°30'N, 44°29'E, 1822, *F.E. Fischer s.n.* (lectotype, designated by Aedo & Estrella 2006: 35, G-DC-00214976!).

Geranium tuberosum var. *transversale* Kar. & Kir., Bull. Soc. Imp. Naturalistes Moscou 15(1): 176. 1842. *Geranium tuberosum* [III] *transversale* (Kar. & Kir.) Graebn. in Asch. & Graebn., Syn. Mitteleur. Fl. 7(1): 39. 1913. *Geranium transversale* (Kar. & Kir.) Vved. in Pavlov, Fl. Centr. Kazakh. 2: 429. 1935. *Geranium linearilobum* subsp. *transversale* (Kar. & Kir.) P.H. Davis, Israel J. Bot. 19: 105. 1970. Type locality: "In fruticetis collium Songoriae prope Ajagus. Fl. Majo". Type: Kazakhstan. In fruticetis collium Songoriae prope Ajagus, 47º55'N, 80º22'E, 1841, *G.S. Karelin & I.P. Kiriloff 1331* (lectotype, designated by Davis 1970: 106, LE!; isolectotypes, BM-000624055!, BR-0000008434036!, K-000729498!, P-00757956!, MW, W!).

Geranium tuberosum var. *sefidianum* Pau in Pau & C. Vicioso, Trab. Mus. Nac.

Ci. Nat., Ser. Bot. 14: 18. 1918. Type locality: "Habit. Kouh-Sefid". Type: Iran. Markazi, Kouh-Sefid, 33º49'N, 50º16'E, June, *F. Martínez de la Escalera s.n.* (lectotype, designated by Aedo & Estrella 2006: 35, MA-71443!).

Geranium persicum Schönb.-Tem. in Rech. f. (ed.), Fl. Iran. 69: 9, tab. 4. 1970. Type locality: "Typus: Furse 1649, W!... Persia:... C: Tehr.:... 56 km E Tehran, 2000 m, Furse 1649!...". Type: Iran. Elburz, 35'E of Tehran, 35º42'N, 52º04'E, 29 Apr. 1962, *P. Furse 1649* (holotype, W; isotypes, K!, LE-00014586!).

Geranium baschkyzylsaicum Nabiev, Bot. Mater. Gerb. Inst. Bot. Akad. Nauk Uzbeksk. SSR 20: 33. 1982. Type locality: "Tian Schan Occidentalis, Alatau Taschkentensis, systema fl. Basch-kyzyl-saj, ad declive arboreo-fruticosum in ascensu ad trajectum. 1939. V. 31 fl., A. Butkov, 10 (TAK)". Type: Uzbekistan. Tian Schan Occidentalis, Alatau Taschkentensis, systema fl. Basch-kyzyl-saj, 41º16'N, 69º13'E, 31 May 1939, *A. Butkov 10* (holotype, TASH image!).

Perennial herbs, 19-46 cm tall. *Rootstock* ± horizontal, tuberculate, with tubercles subglobose, 6.2-13.7 mm long, 6.1-13.7 mm wide (ratio tubercle width/tubercle length = 0.5-1.2), with non-tuberous separations 0.8-48.5 mm long, 0.6-2.1 mm wide, not turnip-shaped, without thickened roots. *Stem* erect, leafy, not rooting at nodes, stolons absent, without vegetative stems, with patent to retrorse, eglandular hairs 0.1-0.8 mm long. *Basal leaves* in a ± persistent rosette, cauline leaves alternate 1(2) in middle of shoot and upper opposite; leaf laminas 2.3-6.6 cm long, 2.9-8.4 cm wide, not peltate, palmatisect, polygonal in outline, base cordate, not coriaceous, not reticulate, with nerves not projected, with appressed, eglandular hairs on both surfaces; segments 5-7, in 1 plane, middle segment rhombic (rarely linear-lanceolate), 0.6-0.8 mm wide at the base [ratio segment width at the base/middle segment length = 0.01-0.03], (1)3-15-lobed in the apex [ratio secondary sinus length/middle segment length = 0.23-0.84]; petioles up to 15.5 cm long, without abscission zone, terete, not swollen, not deflexed in age, with patent to retrorse, eglandular hairs 0.1-0.8 mm long; stipules 2-3.5 mm long, 1-2.5 mm wide, lanceolate, free, papery, brown, with eglandular hairs on abaxial surface and on the margin, glabrous adaxially. *Inflorescence* a dichasial cyme with monochasial branches; cymules 2-flowered, solitary or in aggregates at the top of each branch [ratio cymule length/leaf length = 1.3-2.9]; peduncles 3-56 mm long, with patent, eglandular hairs 0.2-1 mm long; bracteoles 0.8-2.7 mm long, 0.4-1 mm wide, linear-lanceolate, whorled; pedicels absent or 4-22 mm long, with patent, eglandular hairs 0.3-1.1 mm long. Flowers actinomorphic. *Sepals* 4.4-6.8 mm long, 1.9-4.1 mm wide, lanceolate, smooth,

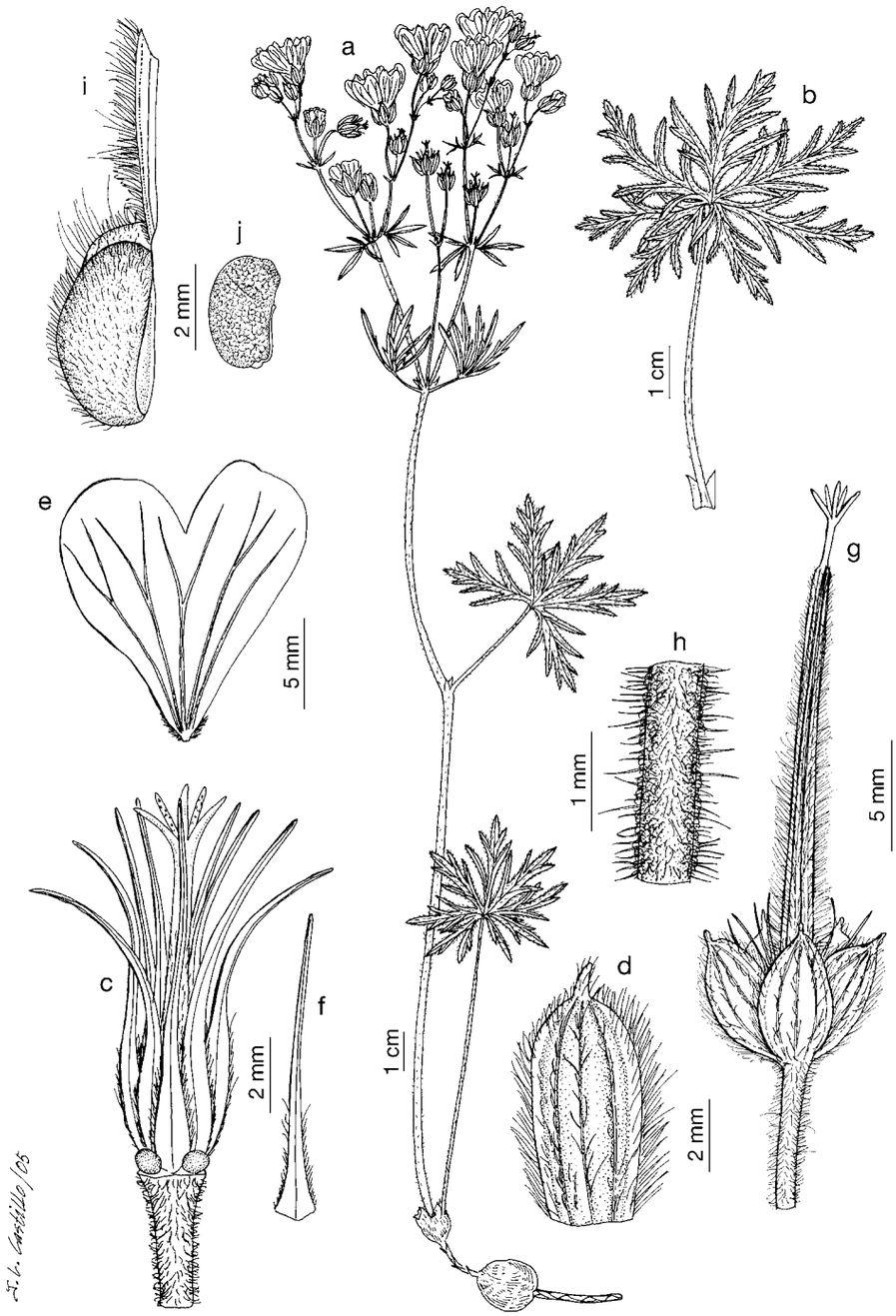


Fig. 657. *Geranium linearilobum.* a. Habit. b. Leaf. c. Flower without petals and sepals. d. Sepal. e. Petal. f. Staminal filament. g. Fruit. h. Indumentum of the pedicel. i. Mericarp. j. Seed. (Based: a-f, *Hewer 1941,* K; *g*-i, *Becker s.n., s.d.,* WU).

not accrescent, nerves 3, mucro 0.23-2.7 mm long [ratio mucro length/sepal length = 0.05-0.42], with ± patent, eglandular, hairs 0.3-2.2 mm long on the abaxial surface, glabrous adaxially. *Petals* (8.2)10.3-13.7(15.2) mm long, 4.9-12.6 mm wide, erect-patent, emarginate (notch 0.9-4.8 mm deep), without claw, purple, glabrous on both surfaces, ciliate on the basal margin, with hairs 0.2-0.7 mm long. *Stamens* 10, both whorls bearing anthers; filaments 3.5-7.8 mm long, lanceolate, pink, pilose on the abaxial surface, ciliate on the proximal half, with hairs 0.3-2.7 mm long; anthers 1.1-2.4 mm long, yellow. Nectaries 5, hemispheric, glabrous. *Gynoecium* 4.3-6.2 mm long, dark purple. *Fruit* 21.2-29.2 mm long, erect, discharge of seed-ejection type; mericarps 3.7-4.8 mm long, 1.6-2.1 mm wide, without a strand of fibers, compressed at the apex, smooth, without basal beak, without a basal callus, without a basal prong, brown, with ± patent, eglandular, hairs 0.3-2.2 mm long; rostrum 15.3-24.5 mm long, with a narrowed apex 1.7-3 mm long, twisted distally, with ± patent, eglandular hairs 0.4-1.1 mm long; stigmatic remnants 1.1-2.3 mm long, with 5 glabrous lobes. *Seeds* 2-2.5 mm long, 1.1-1.6 mm wide, finely reticulate, uniformly colored, brown, glabrous. Cotyledons with entire margin. Figs. 657, 658.

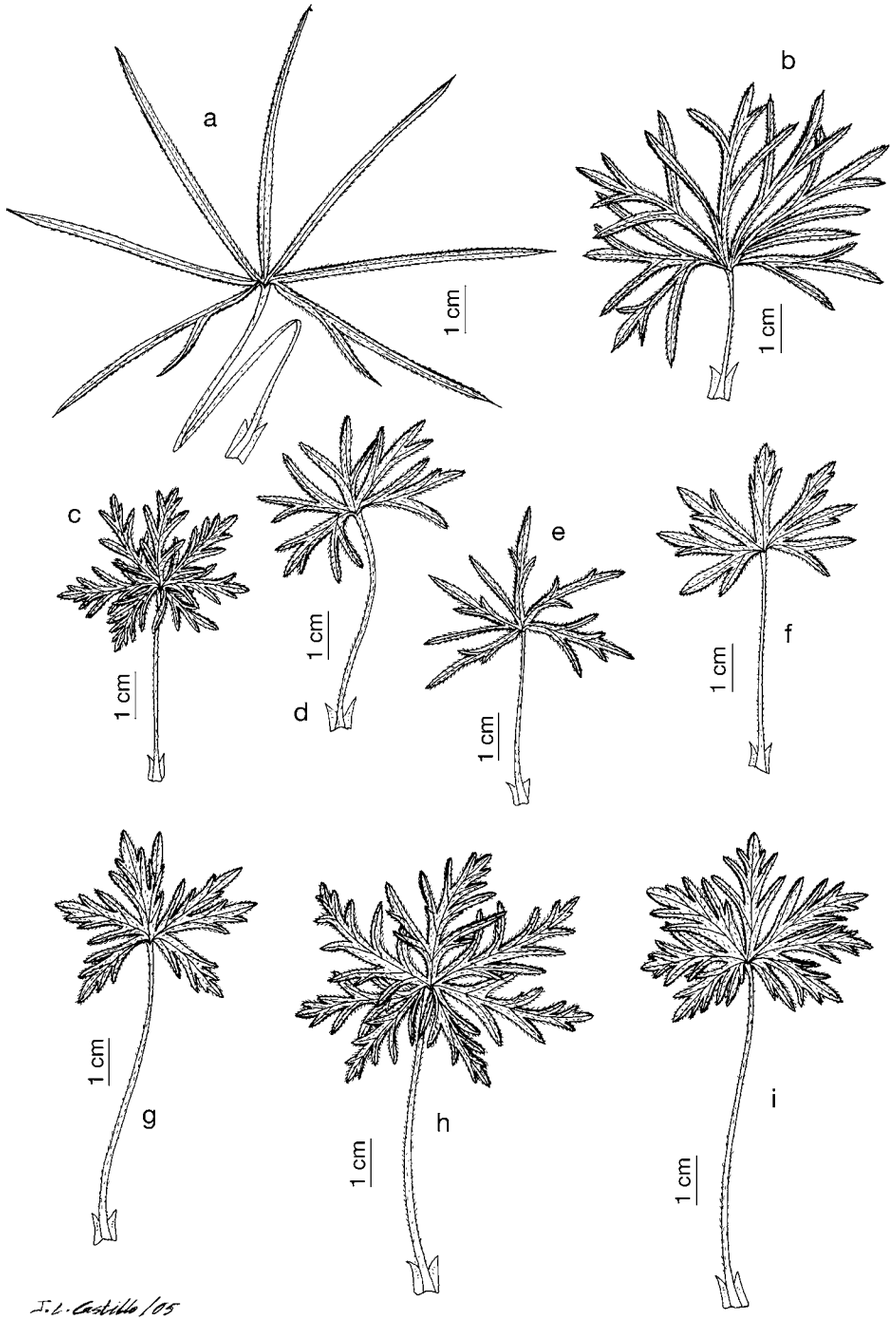


Fig. 658. Leaf variability of *Geranium linearilobum.* (Based on: a, *Kamelin & al. s.n., 4 May 1976*, LE; b, *Belianina & al. 86,* LE; c, *Rechinger 39327,* W; d, *Kühlewein s.n.,* W; e, *Knorring 61,* LE; f, *Goloskokov 4480,* K; g, *Rachkovskaya 423,* LE; h, *Pabot 2723,* G; i, *Rachkovskaya 5450,* LE).

Pollen. *Geranium*-type (Aedo & Estrella 2006: 25).

Chromosome number. Unknown.

Phenology. Collected in flower from April to July.

Distribution. This species ranges from southern Russia to central Asia (from Caucasus and eastern Turkey to western China and northwestern Afghanistan) (Fig. 659).

Habitat. Stony slopes (on granite or limestone), *Artemisia* L. steppes, open forests of *Juniperus* L. or fileds; 900-4000 m.

Representative specimens examined. **Armenia.** Gegharkunik: Megrinsky distr., river Masrik canyon, near village Newadi, 40°12'N, 45°38'E, 20 Apr. 1980, *Sagatelian s.n.* (LE); Gegharkunik prov., Chambarak distr., NE lake Sevan, 40°28'N, 45°20'E, 3 June 2004, *Vitek & al. 04-0128* (MA, W); Sevan, 40°32'N, 44°56'E, 30 May 1960, *Sovig s.n.* (LE). Kotayk: area WNW of Charentsavan, N of Buzhakan, 40°29'N, 44°31'E, 7 June 2006, *Vitek 06-1344* (MA, W). Syunik: NW of Meghri, between Vagravar and Legvas, 38°57'N, 46°11'E, 29 Apr. 2005, *Fayvush & al. 05-0270* (MA); Kafansky raj., Pjrum, 39°15'N, 46°20'E, 28 June 1979, *Popova 29* (LE). **Azerbaijan.** Lankaran: Yardymlynsky distr., near village Dag-Uzew, Mt. Uzun-bashi, 38°51'N, 48°7'E, 21 May 1980, *Popova & al. 305* (LE). Nakhchivan: Najichevanskaia, nera village Nasychvas, 19 June 1931, *Karjaginet & Safiev s.n.* (LE); Najichevanskaia, Ordubadskiy, Sangesurskiy jrebet v 5-7 km severo-vostocnee g. Ordubda, 38°53'N, 46°0'E, 18 June 1956, *Egorova & al. 901* (LE); Najichevanskaia, Najichevanskiy raj., na vershine massiva Karagut (Karakush), 39°30'N, 45°15'E, Apr. 1948, *Grossheim & al. s.n.* (LE). **Chi-**

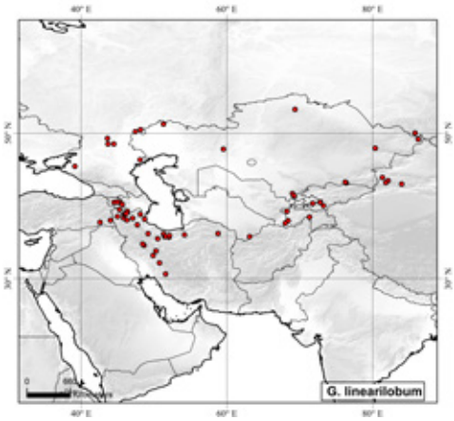


Fig. 659. Distribution of *Geranium linearilobum*.

na. Xinjiang: central Tian-schan, Ak-tasch, 43°0'N, 84°0'E, 30 May 1934, *Korotkova 8* (LE); Kok-Tcrek-Tckkes juntion Tckker valley, 43°12'N, 81°49'E, 1 June 1936, *Ludlow 655* (BM); distrito Yili, población Gongliu, Ya Ma Tu, 43°28'N, 82°8'E, 27 Apr. 1959, *Li Anren & Zhu Jiaran 10242* (PE); distrito Yili, población Xin Yuanu, 43°54'N, 81°21'E, 26 Apr. 1965, *Zhou Tai Yan 650091* (KUN). **Iran.** Alborz: montes Elburs centr., in jugo Kandawan, 36°8'N, 51°18'E, 26 May 1937, *Rechinger 474* (K, LD, S, Z). Chaharmahal and Bakhtiari: Schurderell, 32°10'N, 50°45'E, 19 May 1884, *Knapp s.n.* (C, WU). East Azerbaijan: Azerbaijan orient., 44 km a lacu Shebli versus Mianeh, 37°24'N, 47°42'E, 6 May 1971, *Rechinger 39327* (W). Kohgiluyeh and Boyer-Ahmad: Zagros Mt., 14 mi about Yasuj, 30°39'N, 51°35'E, 30 Apr. 1973, *Hewer 1941* (K). Mazandaran: Damavar, Bakhtiari, 35°55'N, 52°7'E, 3 May 1940, *Koelz 15151* (W); Tehran: Galanduak, Basti, 35°49'N, 51°36'E, 7 May 1974, *Sanii 11259* (H). Semnan: Najiu, 25 km Khorramabad, 36°2'N, 54°11'E, 14 May 1937, *Köie 590* (C). West Azerbaijan: Zanjireh pr. Khvoy, 38°33'N, 44°59'E, 21 May 1884, *Knapp s.n.* (WU). Zanjan: 34 km W Khorramdareh, 36°11'N, 49°11'E, 13 May 1960, *Pabot 2723* (G). **Kazakhstan.** Akmola: Barankulsky distr., Kokshetau mountains, 53°15'N, 69°21'E, 20 May 1958, *Rachkovskaya 423* (LE). Aktobe: Turgai, Irgiz distr., between the lake Tamalak-kul and the lake Tchabar-kul, 47°48'N, 59°31'E, 29 Apr. 1914, *Dessiatoff 91* (S). Almaty: jugi Alatau Transiliensis, systema fl. Uzun-Kargalay, ad W pagum Fabricznoje, 43°9'N, 76°24'E, 12 May 1963, *Goloskokov 4480* (K, H, S, W); Semirechenskaya prov., Vermy distr., near Vermy town, 43°16'N, 76°15'E, 11 Apr. 1916, *Gorodetzky 54* (LE). East Kazakhstan: deserti Soongoro-Kirghisici, pr. Arkat, montibus Tarbagatai, 49°9'N, 86°16'E, 1840, *Karelin & Kiriloff 164* (BR). South Kazakhstan: near Dzhilga railway station, 41°42'N, 69°0'E, 9 Apr. 1926, *Jarmolenko 13* (LE). West Kazakhstan Karaganda prov., bank of river Taldy-Manaka, 50°12'N, 47°26'E, 26 May 1958, *Rachkovskaya 5450* (LE); Uralskaia gub., Uralskaia, 51°14'N, 51°18'E, 9 May 1924, *Larin 40* (LE). **Kyrgyzstan.** Osh: Oshsky distr., river Yassa to Sur-tash mountain pass, near river Kara-Kuntdzhu, 40°30'N, 72°48'E, 7 June 1913, *Knorring 116* (LE); Osch, distr., Kok-Bel, 40°01'N, 73°16'E, 6 May 1913, *Knorring 61* (LE). **Russia.** Altay: Altai, 50°0'N, 85°50'E, *Palitow s.n.* (WU, Z). Astrakhan: pr. Astrachan, 46°20'N, 48°5'E, 1848, *Claus s.n.* (LE). Krasnodar: Zaricyn distr., Olchowka, 45°26'N, 39°8'E, May 1889, *Persidski s.n.* (LE). Saratov: Saratov, Novousensk, Kostyczevskaja experim. stat., 50°28'N, 48°9'E, 27 May 1900, *Bogdan 3432* (WA). Volvograd: Sarepta, 48°30'N, 44°29'E, *Becker s.n.* (JE). **Tajikistan.** Gorno-Badakhshan: Darvazsky range, N slope to river Zarako, near village Farkint, 38°28'N, 71°21'E, 1986, *Kinzikaeva & Shibkova 1381* (LE). Khatlon: Sarybulak, 37°38'N, 68°1'E, 23 Apr. 1878, *Regel s.n.* (LE); Aktau Mts., near Akbulak stream, 37°58'N, 68°24'E, 24 May 1959, *Bocancev & Iunusov 104* (LE). Sughd: Pamir-Alay, Basseyn r. Guralash, 39°15'N, 68°15'E, 13 June 1935, *Sakrshevskiy 353* (LE). **Turkey.** Kayseri: Siirt, Kulle, Herakol dag, 37°45'N, 42°35'E, 17 June 1936, *Frödin 50* (UPS, W). Van: N side of Erek Dag, above Degirmenkoy, 38°1'N, 44°1'E, 6 June 1966, *Davis 44498* (K). **Turkmenistan.** Mary: Kuldscha, 35°47'N, 63°7'E, 20 Apr. 1877, *Regel s.n.* (LE). **Uzbekistan.** Fergana: in monte Taglit-i-Soliman ad Osh, 40°21'N, 71°47'E, 10 Apr. 1899, *Paulsen 1619* (C). Tashkent: Syr-Darja, Taschkent, Kaplanbek, 41°23'N, 69°13'E, 7 Apr. 1923, *Korovin & al. s.n.* (BR, C, G, K, KRA, MA, S).

Discussion. Geranium linearilobum could be confused with *G. malviflorum* since both have cauline alternate leaves and lack glandular hairs on the inflorescence. However the first is easily recognized by its subglobose tubercles, and by its smaller petals and sepals. Davis (1970: 105) recognized two subspecies under *G. linearilobum*. According this author plants with deeply dissected leaf segments into few linear laciniae should be considered as subsp. *linearilobum* (Fig. 658 a, d), while specimens incised or pinnatifid leaf segments belong to subsp. *transversale* (Fig. 658 h, i). Bobrov (1949: 61) accepted these taxa as species, indicating that *G. transversale* could also be separated from *G. linearilobum* by its longer hairs on the stem. I have found that the type of *G. transversale* shares with the type of *G. linearilobum* leaves with deeply dissected leaf segments. On the other hand, the type of *G. persicum* shows pinnatifid leaf segments, which is more in accordance with the Bobrov's (1949) or Davis' (1970) concept of *G. transversale*. Schönbeck-Temesy (1970: 3) recognized two species in Iran (*G. linearilobum* and *G. persicum*) based and leaf division and staminal filament shape. The variability of leaf shape in *G. linearilobum* is really remarkable and it has not been possible to relate to any geographical area or other characters as hair length or staminal filaments shape. The case showed in Fig. 658 a is very rare and only found in some northern localities, where also leaves with pinnatifid segments are found. Thus these taxa are here considered as synonyms for the reasons above mentioned. The record of *G. linearilobum* from Iraq by Davis (1970: 106) is based in *Al Kas 18606* and *Rawi 22220*. I was not able to locate these specimens and, unfortunately, Davis (1970) did not specify in what herbaria they were.

262. Geranium macrostylum Boiss., Diagn. Pl. Orient. ser. 1, 1: 58. 1843. *Geranium tuberosum* var. *macrostylum* (Boiss.) Boiss., Fl. Orient. 1: 873. 1867. *Geranium tuberosum* [II] *macrostylon* (Boiss.) Graebn. in Asch. & Graebn., Syn. Mitteleur. Fl. 7(1): 39. 1913. *Geranium tuberosum* subsp. *macrostylum* (Boiss.) Hayek, Repert. Spec. Nov. Regni Veg. Beih. 30: 575. 1925. Type locality: "Hab. ad umbram Juniperorum in regione alpinâ, Mesogis supra Tralles, Cadmi, Tmoli; legi Jun. 1842". Type: Turkey. montis Lydiae, Mesogis supra Tralles, 37°51'N, 27°49'E, June 1842, *E. Boissier s.n.* (lectotype, designated by Aedo & Estrella 2006: 39, G-BOIS!; isolectotypes, BM-000606712!, C!, FI!, K!, MA-617292!, MW, O!, P00757950!).

Perennial herbs, 12.5-41 cm tall. *Rootstock* ± horizontal, tuberculate, with tubercles subglobose, 10-18.1 mm long, 6.7-14.2 mm wide (ratio tubercle width/tubercle length = 0.6-1), with non-tuberous separations 10.6-50.2 mm long, 0.5-1.7 mm wide, not turnip-shaped, without thickened roots. *Stem* erect, leafy, not rooting at nodes, stolons absent, without vegetative stems, with patent, eglandular hairs 0.3-1.4 mm long and patent, glandular hairs 0.3-0.6 mm long. *Basal leaves* in a ± persistent rosette, cauline leaves opposite (1 pair below the first bifurcation); leaf laminas 3.3-7.2 cm long, 3.6-7.3 cm wide, not peltate, palmatisect, polygonal in outline, base cordate, not coriaceous, not reticulate, with nerves not projected, with appressed, eglandular hairs on both surfaces; segments 7, in 1 plane, middle segment rhombic, 0.6-1.5 mm wide at the base [ratio segment width at the base/middle segment length = 0.02-0.06], 7-16(34)-lobed in distal half [ratio secondary sinus length/middle segment length = 0.27-0.46]; petioles up to 11 cm long, without abscission zone, terete, not swollen, not deflexed in age, with patent to retrorse, eglandular hairs 0.2-0.8 mm long; stipules 2.5-5.2 mm long, 0.8-2.6 mm wide, lanceolate, free, papery, brown, with eglandular hairs on abaxial surface and on the margin, glabrous adaxially. *Inflorescence* a dichasial cyme; cymules 2-flowered, solitary or in aggregates at the top of each branch [ratio cymule length/leaf length = 1.5-3.9]; peduncles 8-27 mm long, with patent (sometimes uncinate), eglandular hairs 0.1-0.7 mm long and patent, glandular hairs 0.2-0.5 mm long; bracteoles 0.9-2.6 mm long, 0.4-1 mm wide, linear-lanceolate, whorled; pedicels absent or 7-16 mm long, with patent, sometimes uncinate, eglandular hairs 0.2-0.6 mm long and patent, glandular hairs 0.3-0.6 mm long. Flowers actinomorphic. *Sepals* 5.1-7 mm long, 2-3.4 mm wide, lanceolate, smooth, not accrescent, nerves 3, mucro 0.4-1.3 mm long [ratio mucro length/sepal length = 0-08-0.23], with ± patent, eglandular hairs 0.5-3.2 mm long and patent glandular hairs 0.4-0.9 mm long on the abaxial surface, glabrous adaxially. *Petals* 7.7-14.1 mm long, 6.5-12.3 mm wide, erect-patent, emarginate (notch 0.7-3.8 mm deep), without claw, purple, glabrous on both surfaces, ciliate on the basal margin, with hairs 0.3-1.1 mm long. *Stamens* 10, both whorls bearing anthers; filaments 3-6.6 mm long, lanceolate, pink, pilose on the abaxial surface, ciliate on the proximal half, with hairs 1-2.1 mm long; anthers 1-2.4 mm long, yellow. Nectaries 5, hemispheric, glabrous. *Gynoecium* 3.8-5.8 mm long, dark purple. *Fruit* 19.4-23.2 mm long, erect, discharge of seed-ejection type; mericarps 2.9-3.7 mm long, 1.4-2.1 mm wide, without a strand of fibers, compressed at the apex, smooth, without

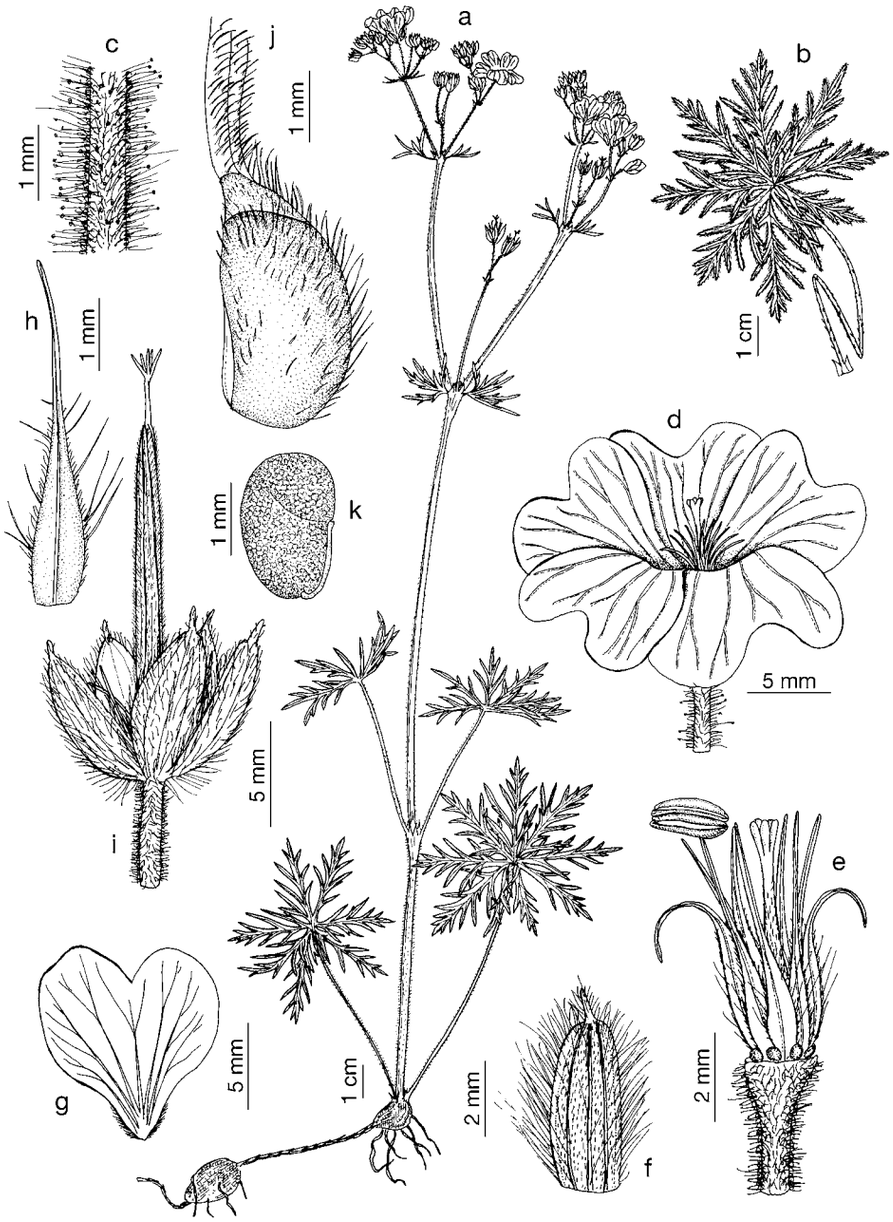


Fig. 660. *Geranium macrostylum.* a. Habit. b. Leaf. c. Indumentum of the pedicel. d. Flower. e. Flower without petals and sepals. f. Sepal. g. Petal. h. Staminal filament. i. Fruit. j. Mericarp. k. Seed. (Based on: a-h, *Seitter s.n., 1963*, Z; i-k, *Lemperg 442,* PR).

basal beak, without a basal callus, without a basal prong, black, with ± patent, eglandular hairs 0.6-2 mm long and patent, glandular hairs 0.4-0.6 mm long; rostrum 14-17.7 mm long, with a narrowed apex 2.4-2.9 mm long, twisted distally, with ± patent, eglandular hairs 0.2-0.5 mm long and patent, glandular hairs 0.3-0.7 mm long; stigmatic remnants 0.9-1.4 mm long, with 5 glabrous lobes. *Seeds* 2.1-2.8 mm long, 1.2-2.1 mm wide, finely reticulate, uniformly colored, brown, glabrous. Cotyledons with entire margin. Figs. 660, 661.

Pollen. *Geranium*-type (Aedo & Estrella 2006: 25).

Chromosome number. 2*n* = 28, 42.

Phenology. Collected in flower from April to June.

Distribution. This species ranges from North Macedonia, Bulgaria, Greece to Krym and Turkey and it is introduced in Austria (Fig. 662).

Habitat. Meadows, open areas of *Quercus* L., *Platanus* L., *Abies* Mill., and *Pinus* L. forests, on limestone or volcanic rocks; 50-2200 m.

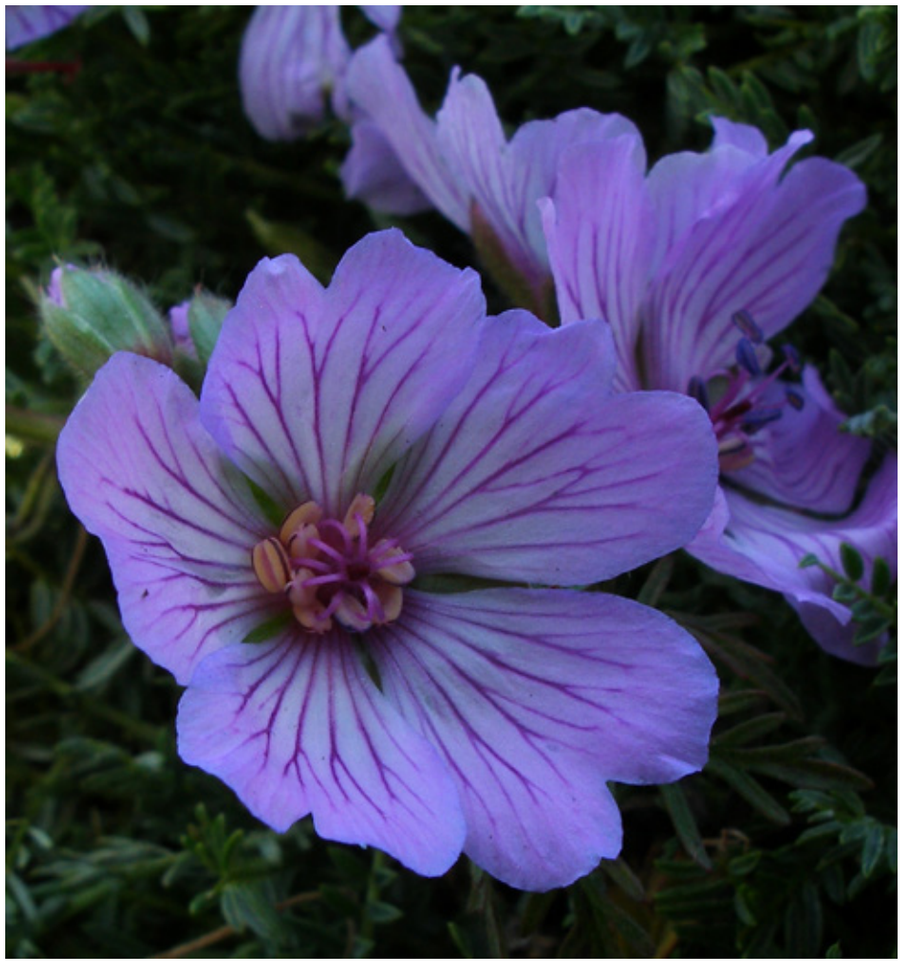


Fig. 661. *Geranium macrostylum* (Based on: *Aedo 14079,* MA).

Representative specimens examined. **Austria.** Vienna: Wien, 14 May 2006, *Barta s.n.* (MA); Wien, 48°12'N, 16°22'E, 17 May 2009, *Barba s.n.* (W). **Bulgaria.** Blagoevgrad: Blagoevgradski okr., suchi trevisti mesta, 41°46'N, 23°31'E, 25 May 1984, *Cestmediev s.n.* (SOM). Plovdiv: Sreden Pirin, po skalist varovit teren na vr Baba, okolo, 41°56'N, 24°49'E, 1 June 1941, *Kitanov s.n.* (SOM). Stara Zagora: Iztocni Rodopi, chrastalaci na kamenist teren v okolnostite na s. Gabarevo, 42°37'N, 25°10'E, 11 May 1996, *Vasilev s.n.* (SOM). **Greece.** East Macedonia and Thrace: Thasos, Mt. Elias, 40°43'N, 24°40'E, 24 May 1891, *Sintenis & Bornmüller 555* (K, PR). Epirus: m. Miteikeli et Olycika, distr. Janina, 39°29'N, 20°47'E, 9 June 1896, *Baldacci 307* (BM); Kreikka, Epirus, Joannina, Zagori, Vradeto, 39°39'N, 20°51'E, 27 May 1996, *Räsänen 318* (H). Central Greece: Phokis, Mt. Parnassos, 38°31'N, 22°37'E, 5 May 1963, *Segelberg 5563* (S); Viotia, Levadhia, SSE slopes of Mt. Parnassos, N of Arahova, 38°31'N, 22°37'E, 28 May 1967, *Stamatiadou 280* (C); Amfissa, 38°31'N, 22°22'E, 18 May 1970, *Stork 7025* (S); Phocis, Mt. Iti, 5 km NNW of Pavliani, 38°47'N, 22°19'E, 2 June 1985, *Gustavsson 8960* (C). Central Macedonia: Thessalonicam, 40°38'N, 22°57'E, *Dimonie s.n.* (WU). North Aegean: Samos, Kosmodeo, 37°44'N, 26°48'E, 11 May 1993, *Emanuelsson 1699* (S). Peloponnese: Laconia, Mt. Malevo, 37°10'N, 22°15'E, 5 May 1929, *Guiol 488* (BM); Arcadia, Menalon, 37°38'N, 22°17'E, 20 May 1986, *Burri & Krendl s.n.* (W); Mt. Mainalon, 37°39'N, 22°15'E, June 1970, *Nikolopoulos 4176* (Z); Peloponeso, Korinthia, Killini, 37°55'N, 22°24'E, 22 June 2007, *Herrero & al. 3461* (MA); Peloponnesos, Olonos, 37°57'N, 21°48'E, 7 June 1935, *Cyrén s.n.* (S); Peloponnesos, Erymanthos, 37°48'N, 21°43'E, 2 June 1970, *Bocquet 8811* (Z); Achaia, Kalavrita, Mts. Chelmos, Mt. Avgho, 37°59'N, 22°11'E, 21 June 2007, *Aedo & al. 14123* (MA). Thessaly: Karsama, 25 km W von Karditsa, 39°20'N, 21°40'E, 20 June 1987, *Baltisberger & Meili 11318* (Z); Thessalia, Trikila, 39°32'N, 21°45'E, 10 June 1937, *Lemperg 442* (K, LE); Thessalia, Chaliki, Turnara, 39°40'N, 21°8'E, 28 June 1896, *Sintenis 679* (JE); Thessaly, Tirnavou, Mt. Ossa, E side, 39°48'N, 22°39'E, 26 May 1974, *Strid & Andersen 8675* (C); Olympos, Sparmos, 40°2'N, 22°19'E, *Cyrén s.n.* (S). West Macedonia: Kozanis, Voiou, Mt. Vourinos, 10 km SE of Siatista, 40°11'N, 21°40'E, *Hartvig & Franzén 8916* (C); Macedonia, Pisoderion, 40°46'N, 21°15'E, 27 May 1932, *Alston & Sandwith 505* (BM, K,

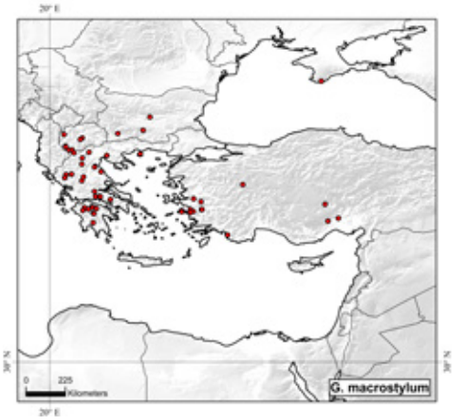


Fig. 662. Distribution of *Geranium macrostylum*.

S). **North Macedonia.** Pelagonia: Galicica planina, zw. Prespa- u. Ohridsee, Kalk, 40°55'N, 21°0'E, May 1969, *Leute 273* (W); Peristergebirge, gegen Ochridsee, nasse Wiese, 40°55'N, 21°10'E, 1963, *Seitter s.n.* (Z). Polog: montis Koza, supra Han-Mavrova, 41°43'N, 20°45'E, 12 May 1918, *Bornmüller 3668* (HBG, JE). Southwestern: 8 km SE of Ohrid, 41°5'N, 20°50'E, 10 June 1971, *Chater 326* (BM); d, Jaffa, 41°7'N, 20°49'E, 27 May 1938, *Lenander s.n.* (S). Vardar: Ohriprope Han-Abei-pas, montium Babuna, 41°28'N, 21°35'E, 5 May 1918, *Bornmüller 3670* (HBG); Babuna geb., Isvor, 41°32'N, 21°41'E, 26 May 1963, *Ooststroom 23274* (L). **Russia.** Krym: Ay-Petri, 44°28'N, 33°59'E, 28 May 1901, *Vankov s.n.* (LE). **Turkey.** Adana: Pozanti-Bürück, 37°24'N, 34°52'E, 20 May 1952, *Akbas s.n.* (E). Aydin: Izmir, N side of Samsun Dag, above Guzelcamli, 37°42'N, 27°15'E, 24 Apr. 1965, *Davis 41771* (K); Selçuk Söke yolu, Söke yakini, 37°45'N, 27°24'E, 9 Apr. 1971, *Baytop 19153* (ISTE); 2 km N Kusadasi, 37°51'N, 27°15'E, 7 Apr. 1982, *Buchner s.n.* (W); Aydin, Cariai, 37°51'N, 27°51'E, 1842, *Pinard s.n.* (G, OXF). Izmir: 3 km N Alanky, 38°15'N, 27°48'E, 20 May 1992, *Malicky s.n.* (W); Izmir, Nif Dag, 38°24'N, 27°25'E, 31 May 1966, *Bocquet 2779* (Z). Muğla: Fethiye, Baba dagi, 36°32'N, 29°10'E, 26 May 1976, *Polunin 14031* (E). Karaman: Güllek Maaden, 37°15'N, 34°20'E, June 1836, *Kotschy 365* (W). Kütahya: Eshisehin-Sundihen dag, Belce alam, 39°8'N, 29°57'E, 11 June 1971, *Ehim 437* (E). Niğde: Hasan Dag below Taspinar Yayla, 38°7'N, 34°11'E, 17 June 1952, *Davis & al. 19001* (BM, E, K).

Discussion. Geranium macrostylum is characterized by its rootstock with subglobose tubercles joined by remarkable slender non-tuberous separations, by its inflorescence with glandular hairs, and by its opposite pair of leaves below the first bifurcation. It could be confused with specimens of *G. tuberosum* with opposite leaves below the first bifurcation. However, the longer narrowed apex of the rostrum and the glandular hairs of the inflorescence easily permit one to distinguish both species. *Geranium tuberaria* shares with *G. macrostylum* the presence of glandular hairs on the inflorescence. However, the first has 1-3 alternate cauline leaves while the second has a pair of opposite leaves on the stem. Exceptionally, I have found one specimen of *G. macrostylum* with one additional alternate cauline leaf (*Davis 41771,* K!). Furthermore, leaves of *G. macrostylum* are more deeply divided and with narrower segments than in *G. tuberaria*. Glandular hairs of petioles and pedicels of *G. macrostylum* are shorter than those of *G. tuberaria*, while glandular hairs of sepals and mericarps are longer. *Geranium macrostylum* was recorded in Albania by Qosja (1992: 207), but no specimen has been located to support such record. Davis (1970: 104) recorded this species from Croatia based on *Pichler s.n.* I was not able to locate this specimen and, unfortunately, Davis (1970) did not specify in which herbarium it was.

263. Geranium malviflorum Boiss. & Reut., Pugill. Pl. Afr. Bot. Hispan.: 27. 1852, ["malvaeflorum"]. *Geranium tuberosum* subsp. *malviflorum* (Boiss.) Malag., Subsp. Var. Geogr. 11. 1973. Type locality: "Hab. in pinguibus montanis Mauritaniae suprà Tlemsen propè molendinaria ad radices Atlantis sita (Boiss. et Reuter) in montibus Ronda Hisp. Australis (Boiss.)". Type: Algeria. Tlemsen, 34°52'N, 1°18'W, 1849, *E. Boissier & G.F. Reuter s.n.* (lectotype, designated by Burdet & al. 1984: 788, G-00190589!; isolectotypes, E-00129665!, LE!, P!, W!, WU!).

Geranium tuberosum var. *debile* Ball, J. Bot. 11: 302. 1873. Type locality: "Hab. In regione superiori Atlantis Majoris. Legimus nondum florentem in convalle Ait Mesan! et in Monte Djebel Tezah! Alt. 2300m-2600m. Specimen unicum mancum florentem invenit cl. G. Maw". Type: Morocco. Ait Mesan & Djebel Tezah, 31°13'N, 8°14'W, *G. Maw s.n.* (no original material located).

Perennial herbs, 17-64(70) cm tall. *Rootstock* ± horizontal, tuberculate, with tubercles fusiform, 15.3-37.9 mm long, 7.4-13.2 mm wide (ratio tubercle width/tubercle length = 0.3-0.5), with non-tuberous separations 15.3-31.3 mm long, 2-2.8 mm wide, not turnip-shaped, without thickened roots. *Stem* erect, leafy, not rooting at nodes, stolons absent, without vegetative stems, with patent, eglandular hairs 0.2-2 mm long. *Basal leaves* in a ± persistent rosette, cauline leaves alternate (1-2 below the first bifurcation) and upper opposite; leaf laminas (3)3.8-6.9(7.5) cm long, (3.7)4.6-8.6(11.5) cm wide, not peltate, palmatisect, polygonal in outline, base cordate, not coriaceous, not reticulate, with nerves not projected, with appressed, eglandular hairs on both surfaces; segments 5-7, in 1 plane, middle segment rhombic, 0.9-3.2 mm wide at the base [ratio segment width at the base/middle segment length = 0.02-0.10], 7-21-lobed in distal half [ratio secondary sinus length/middle segment length = 0.25-0.6]; petioles up to 28 cm long, without abscission zone, terete, not swollen, not deflexed in age, with patent, eglandular hairs 0.2-1.6 mm long; stipules 2.3-4.3 mm long, 1.1-2 mm wide, lanceolate, free, papery, brown, with eglandular hairs on abaxial surface and on the margin, glabrous adaxially. *Inflorescence* a dichasial cyme with monochasial branches; cymules 2-flowered, usually in aggregates at the top of each branch [ratio cymule length/leaf length = 1.2-4.8]; peduncles 21-40(65) mm long, with patent, eglandular hairs 0.2-2.1 mm long; bracteoles 1.8-5.2 mm long, 0.3-1.1 mm wide, lanceolate, whorled; pedicels absent or 7-28 mm long, with patent, eglandular hairs 0.2-1.9 mm long. Flowers actinomorphic. *Sepals* (6.7)7.5-9.1 mm long, 3-5.1 mm wide, lanceolate, smooth, not accrescent, nerves 3-5, mucro 0.7-1.7 mm long [ratio mucro length/sepal length = 0.09-0.25], with ± patent, eglandular, hairs 0.2-2.5 mm long on the abaxial surface, glabrous adaxially. *Petals* (10.3)16.5-19.3(21) mm long, (6)11-16.6 mm wide, erect-patent, emarginate (notch 1.2-3.3 mm deep), without claw, purple, glabrous on both surfaces, ciliate on the basal margin, with hairs 0.3-1.1 mm long. *Stamens* 10, both whorls bearing anthers; filaments 6-8.6 mm long, lanceolate, purple, pi-

lose on the abaxial surface, ciliate on the proximal quarter, with hairs 0.5-2.7 mm long; anthers 1.7-3 mm long, yellow. Nectaries 5, hemispheric, glabrous. *Gynoecium* 4.2-8.7 mm long, dark purple. *Fruit* 27.3-37.8 mm long, erect, discharge of seed-ejection type; mericarps 3.6-5.4 mm long, 1.3-3 mm wide, without a strand of fibers, compressed at the apex, smooth (rarely with 1-2 transverse veins at the apex), without basal beak, without a basal callus, without a basal prong, black, with ± patent, eglandular, hairs 0.2-2.4 mm long; rostrum 19.8-30.7 mm long, with a narrowed apex 2.7-7.3 mm long, twisted distally, with erect-patent, eglandular hairs 0.1-1.8 mm long; stigmatic remnants 1.2-3.3 mm long, with 5 glabrous lobes. *Seeds* 2-2.8 mm long, 1.7-1.8 mm wide, finely reticulate, uniformly colored, brownish red, glabrous. Cotyledons with entire margin. Figs. 663, 664.

Pollen. *Geranium*-type (Aedo & Estrella 2006: 25; Bortenschlager 1967: 427; Velasco 1992b: 57).

Chromosome number. 2*n* = c. 56.

Phenology. Collected in flower from March to September.

Distribution. This species ranges from southern Portugal and Spain to nothwestern Africa (Morocco and Algeria) (Fig. 665).

Habitat. Fields, grassy or rocky places in open areas of *Quercus* L. and *Cedrus* Mill. forests (or limestone or volcanic rocks); 200-2500 m.

Representative specimens examined. **Algeria.** Ain Defla: Aurasii montes, circa Sgag, 36°17'N, 1°44'E, 17 June 1938, *Maire s.n.* (MPU); Milianah, 36°18'N, 2°9'E, *Pomel s.n.* (MPU). Algiers: Alger, Bou-Chicao, 36°47'N, 3°3'E, 30 Apr. 1938, *Dubuis s.n.* (MPU). Batna: Dj. Aures, 20 mi from Batna to Arris, 35°14'N, 6°10'E, 15 May 1971, *Davis 52370* (BM); Lambesfa, cercle de Batna, prov. Constantine, 35°29'N, 6°15'E, 21 May 1853, *Perraudiere s.n.* (MPU). Blida: gorges de la Chiffa, 36°27'N, 2°44'E, May, *Humbert s.n.* (MPU). Bouïra: Aumale, 36°9'N, 3°41'E, 28 May 18??, *Chabert s.n.* (FI); Djurdjura, S de l'Akouker, 36°27'N, 4°9'E, 5 July 1934, *Dubuis s.n.* (MPU). Khenchela: Djebel Tougour près Batna, Constantine, 35°6'N, 6°45'E, 22 May 1853, *Perraudiere s.n.* (MPU). Médéa: entre Médéa et Berrouaghia, 36°10'N, 2°52'E, 15 May 1965, *Faurel s.n.* (MPU). Sétif: Constantine, N Djebel Tababor, au-dessus du col d'El Fedja, 36°32'N, 5°27'E, 28 May 1952, *Faurel s.n.* (MPU); inter Sitifim et Ain-Abessa, 36°17'N, 5°17'E, 24 Apr. 1919, *Maire s.n.* (MPU). Skikda: Djebel Bou Anech, 37°3'N, 7°14'E, 30 Mar. 1884, *Mouillefarine s.n.* (MPU). Tiaret: O. Sidi Djilali, 35°17'N, 0°51'E, 5 May 1916, *Maire s.n.* (MPU). Tissemsilt: Teniet El Had to Rod Point des Cèdres, 35°52'N, 2°1'E, 31 May 1975, *Davis 58478* (BM). Tlemcen: massif de Ghar Rouban, Djebel Touzairt, 34°36'N, 1°46'W, 2 June 1936, *Faurel s.n.* (MPU); Aïn-Ghoraba, plateau de Terni, 34°47'N, 1°21'W, 19 Apr. 1856, *Cosson s.n.* (MPU); cascades E of Tlemcen, 34°52'N, 1°18'W, 23 Apr. 1971, *Davis 51469* (BM). **Morocco.** Drâa-Tafilalet: Grand Atlas, Ourika, au dessus d'Anfegein, 30°44'N, 6°33'W, 9 July 1921, *Maire s.n.* (MPU); Massif du Toubkal, au dessus de Chamharouch, Azib Taouount, 31°2'N,

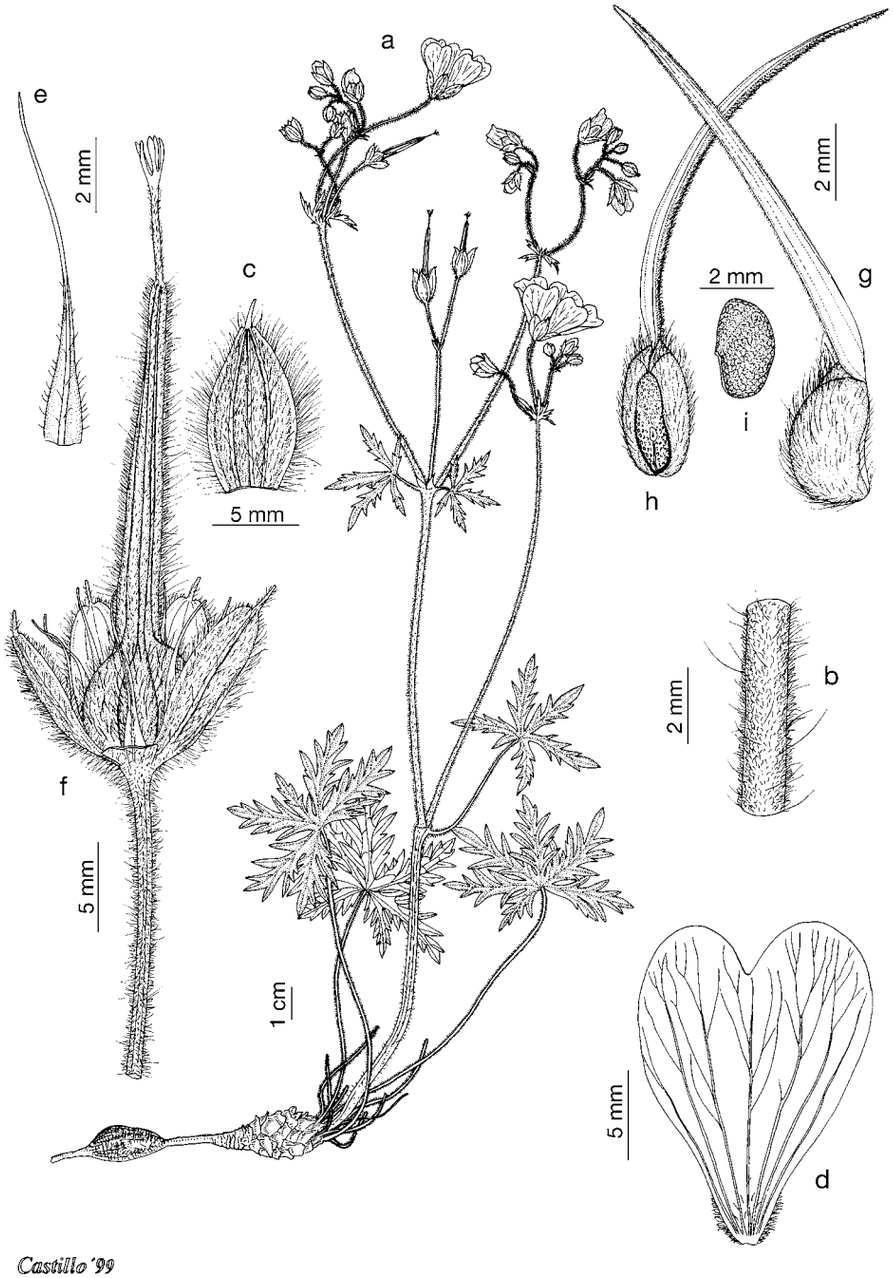


Fig. 663. *Geranium malviflorum.* a. Habit. b. Indumentum of the pedicel. c. Sepal. d. Petal. e. Staminal filament. f. Fruit. g-h. Mericarp. i. Seed. (Based on: a, *Retz 84449,* MA; b, c, e-i, *Ladero & Hurtado s.n.,* MA-324290; d, *Ladero & Hurtado s.n.,* MA-324290).

Fig. 664. *Geranium malviflorum* (Based on: *Navarro & al. 3483,* MA).

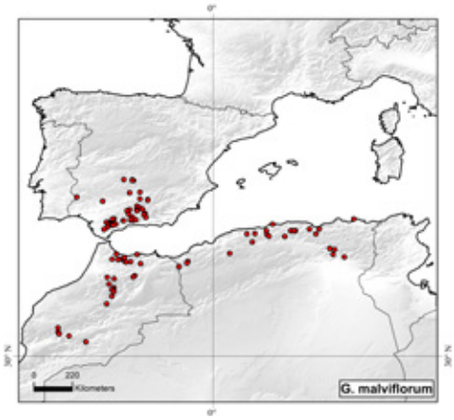


Fig. 665. Distribution of *Geranium malviflorum*.

7°25'W, 30 May 1939, *Metw & Sauvage 793* (MPU). Fès-Meknès: Moyen Atlas, Ifrane, 33°31'N, 5°7'W, 9 May 1936, *Samuelsson 7554* (S); Atlas Medius, El Hajeb, 33°42'N, 5°22'W, 14 May 1934, *Wall s.n.* (S); Tazza, Djebel Berkane, 34°45'N, 3°44'W, 25 May 1994, *Díez & al. 3188/94* (BC); Tazzeka, road from Taza to Maghraoua, above Ras-El-Ma, 33°59'N, 5°6'W, 25 Apr. 1995, *Jury & al. 16881* (BC). Marrakesh-Safi: Oued Moulay Brahim below Asni, above Marrakech, 31°14'N, 7°59'W, 14 Apr. 1969, *Davis 49368* (BM); High Atlas, Marrakesh-Ouarzazat road, Taddert, 31°27'N, 7°59'W, 15 Apr. 1937, *Chaworth-Musters 101* (BM). Tanger-Tetouan-Al Hoceima: versus collem Tizzi Iffri dictum, Atlante rhiphaeo, 34°51'N, 4°15'W, 8 June 1927, *Font Quer s.n.* (BM, FI, G, MA); Tétouan, cerca de Boureit, Bab Berré, 34°58'N, 4°54'W, 29 May 1981, *Fernández Casas & al. FC 5346* (MA); Chefchaouen, Bab Taza, collado de Bab el Karn, 34°59'N, 5°12'W, 19 June 1993, *Molero Briones & al. JMM-4168/1* (BC); Al Hoceima, cerca de Tleta Ketama, 35°14'N, 3°55'W, 28 May 1981, *Fernández Casas & al. FC 5274* (MA). **Portugal.** Baixo Alentejo: Barrancos, castelo de Noudar, 38°11'N, 7°1'W, 1 May 2011, *Porto & Aedo 18339* (LISU, MA). **Spain.** Cádiz: Sierra de Aljibe, 36°31'N, 5°37'W, 27 May 1895, *Porta & Rigo 103* (FI, JE, LD, M, S, WU, Z). Ciudad Real: San Lorenzo de Calatrava, pr. Cerro Navalcón, arroyo Grande, 38°26'N, 3°46'W, 11 May 2008, *Quintanar & Calvo 2203* (MA). Córdoba: Sierra de Rute, Las Lagunillas, 37°18'N, 4°21'W, 16 May 1980, *Gallego & al. s.n.* (SEV). Granada: Zafarraya, El Almendral, 36°58'N, 4°8'W, 18 May 1982, *Molero Mesa & Martínez Parras s.n.* (MA). Jaén: Despeñaperros, 38°5'N, 3°46'W, 6 May 1970, *Borja & Carreras s.n.* (MAF). Málaga: puerto de Tabizna, pr. Montejaque, 36°45'N, 5°14'W, 5 May 2000, *Aedo & al. 5447* (MA); Antequera, Sierra de la Chimenea a El Toreal, Los Navazos, 36°58'N, 4°36'W, 19 May 1976, *Cabezudo & al. s.n.* (MA). Sevilla: entre San Nicolás del Puerto y Cazalla, 37°58'N, 5°41'W, 13 May 1973, *Calero & al. s.n.* (SEV).

Discussion. Geranium malviflorum is the most robust species of the section. It also has longer petals and sepals, and fusiform tubercles unique in the group. *G. malviflorum* shares with *G. tuberaria* alternate leaves on the stem, although it could easily be differentiated by the absence of glandular hairs. I have found little variability in this species. The most noticeable was one specimen with two seeds per mericarp, and some other with subopposite cauline leaves. According to Davis (1970: 104), *G. malviflorum* is also present in Tunisia, although no specimen is mentioned. I was not able to locate any specimen from this country. Both Bonnet & Barratte's catalogue (1896: 82) and Pottier's flora (1979: 429) only recorded one species of sect. *Tuberosa*: *G. tuberosum*.

264. Geranium tuberaria Jacquem. ex Cambess. in Jacquem., Voy. Inde 4: 33, tab. 37. 1844. Type locality: "Geranium tuberaria. Jacquem. Mss. ... Frequens in nemoribus prope castellum vulgo Ouri in regno Cachemir. Floret Maïo". Type: India. regno Cachemir, *V. Jacquemont s.n.* (lectotype, designated by Aedo & Estrella 2006: 44, P-00757944!; isolectotype, MPU!).

Perennial herbs, 26-50 cm tall. *Rootstock* ± horizontal, tuberculate, with tubercles subglobose, 10.1-22.2 mm long, 8.3-19.1 mm wide (ratio tubercle width/tubercle length = 0.6-1.1), with non-tuberous separations 3.7-49.2 mm long, 1.2-3 mm wide, not turnip-shaped, without thickened roots. *Stem* erect, leafy, not rooting at nodes, stolons absent, without vegetative stems, with patent, eglandular hairs 0.5-1.7 mm long and patent, glandular hairs 0.2-0.6 mm long. *Basal leaves* in a ± persistent rosette, cauline leaves alternate (1-3 below the first bifurcation) and upper opposite; leaf laminas 1.9-5.5 cm long, 3.4-7.1 cm wide, not peltate, palmatifid [ratio main-sinus length/middle segment length = 0.60-0.80], polygonal in outline, base cordate, not coriaceous, not reticulate, with nerves not projected, with appressed, eglandular and sometimes glandular hairs on both surfaces; segments 5, in 1 plane, middle segment rhombic, 1.6-5.3 mm wide at the base [ratio segment width at the base/middle segment length = 0.06-0.19], 10-19-lobed in distal half [ratio secondary sinus length/middle segment length = 0.27-0.35]; petioles up to 22 cm long, without abscission zone, terete, not swollen, not deflexed in age, with patent, eglandular hairs 0.5-1.1 mm long and patent, glandular hairs 0.2-0.4 mm long; stipules 2.4-5.3 mm long, 0.5-1.4 mm wide, lanceolate, free, papery, brown, with eglandular hairs on abaxial surface and on the margin, glabrous adaxially. *Inflorescence* a dichasial cyme; cymules 2-flowered, solitary [ratio cymule length/leaf length = 1.3-

2.4]; peduncles 12-104 mm long, with patent, eglandular hairs 0.4-1 mm long and patent, glandular hairs 0.3-0.6 mm long; bracteoles 1.6-3.5 mm long, 0.3-0.7 mm wide, linear-lanceolate, whorled; pedicels 9-35 mm long, with patent, eglandular hairs 0.6-1.1 mm long and patent, glandular hairs 0.3-0.8 mm long. Flowers actinomorphic. *Sepals* 6.1-9.5 mm long, 2.2-4.2 mm wide, lanceolate, smooth, not accrescent, nerves 3, mucro 0.6-1.2 mm long [ratio mucro length/sepal length = 0.09-0.19], with ± patent, eglandular hairs 1.1-2.5 mm long and usually patent glandular hairs 0.3-0.7 mm long on the abaxial surface, glabrous adaxially. *Petals* 11.7-21.4 mm long, 8.3-14.8 mm wide, erect-patent, emarginate (notch 0.8-2 mm deep), without claw, purple, glabrous on both surfaces, ciliate on the basal margin, rarely hairy around all margin, with hairs 0.3-0.5 mm long. *Stamens* 10, both whorls bearing anthers; filaments 5.4-8.5 mm long, lanceolate, pink, pilose on the abaxial surface, ciliate on the proximal half, with hairs 1.4-2.8 mm long; anthers 1.3-2.4 mm long, yellow. Nectaries 5, hemispheric, glabrous. *Gynoecium* 4.5-8.5 mm long, dark purple. *Fruit* 17.4-32.6 mm long, erect, discharge of seed-ejection type; mericarps 2.8-4.9 mm long, 2-2.4 mm wide, without a strand of fibers, compressed at the apex, smooth (rarely with 2-3 transverse veins at the apex), without basal beak, without a basal callus, without a basal prong, brown, with ± patent, eglandular hairs 0.4-1 mm long and patent, glandular hairs 0.3-0.4 mm long; rostrum 12.2-25.9 mm long, with a narrowed apex 1.9-3.1 mm long, twisted distally, with ± patent, eglandular hairs 0.1-0.6 mm long and patent, glandular hairs 0.3-0.6 mm long; stigmatic remnants 1.1-1.8 mm long, with 5 glabrous lobes. *Seeds* 2.4-3.2 mm long, 1.2-2.1 mm wide, finely reticulate, uniformly colored, brown, glabrous. Cotyledons not studied. Fig. 666.

Pollen. *Geranium*-type (Aedo & Estrella 2006: 22).

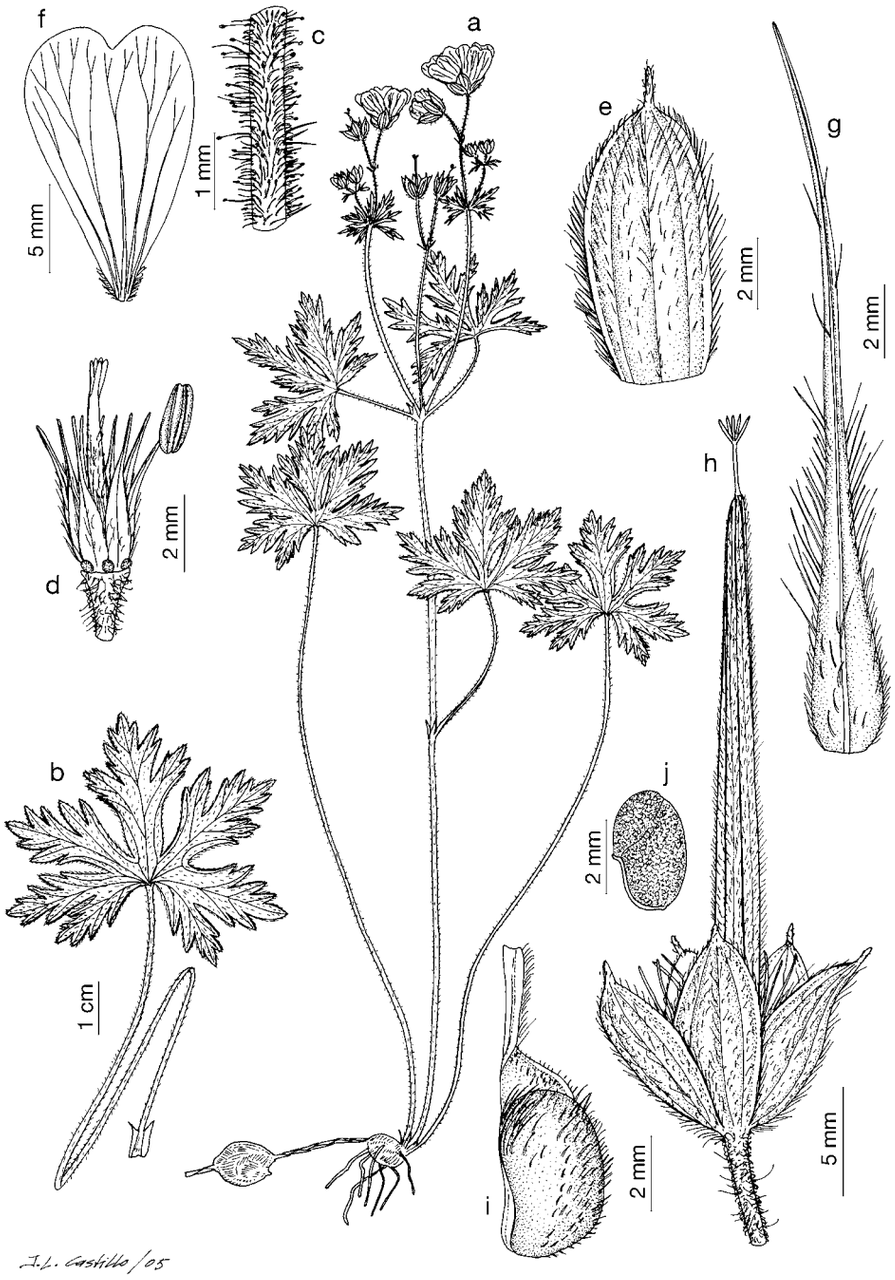


Fig. 666. *Geranium tuberaria.* a. Habit. b. Leaf. c. Indumentum of the pedicel. d. Flower without petals and sepals. e. Sepal. f. Petal. g. Staminal filament. h. Fruit. i. Mericarp. j. Seed. (Based on: a-g, *Ellis s.n., Aug. 1880*, K; h-j, *Hooker & Thompson s.n., s.d.,* C).

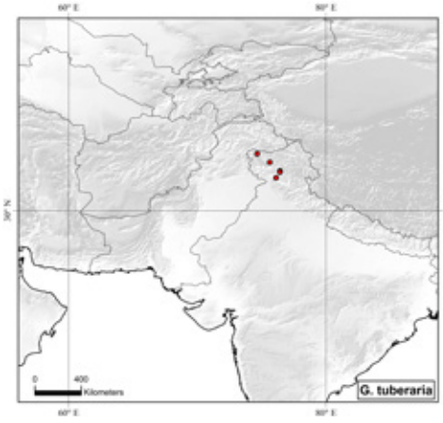


Fig. 667. Distribution of *Geranium tuberaria*.

Chromosome number. Unknown.

Phenology. Collected in flower from April to August.

Distribution. This species ranges through northwestern India (Jammu and Kashmir and Himachal Pradesh) (Fig. 667).

Habitat. Grassy hill slopes or fields; 2000-3600 m.

Additional specimens examined. **India.** [withouth locality], 11 May 1881 (CAL); hab Himal. Bor. Occ., *Hooker & Thomson s.n.* (BM, C, FI, G, K, L, LD, NY, P, S, UPS, W, Z); Himachal Pradesh: Chenas valley, Chamba, 32°33'N, 76°7'E, Aug. 1880, *Ellis s.n.* (K); Pangi, below Sach Pass, between pass and Dunai Sarai, 33°0'N, 76°25'E, 8 June 1981, *Sayers 3700* (BM); Chenas valley, Kilar, 33°5'N, 76°25'E, 9 June 1979, *Stainton 8109* (BM); Jammu-Kashmir: Wardwan valley, 33°45'N, 75°38'E, 6 May 1976, *Stainton 7539* (BM); Athwatu, Bandapur, 34°25'N, 74°39'E, 25 Apr. 1940, *Ludlow & Sherriff 7582* (BM).

Discussion. This species endemic to NW India was not included in Davis' (1970) revision of sect. *Tuberosa*. However, it has a "seed-ejection-type" fruit, with no structure for retaining the seed in the pre-explosive interval, and is twisted at its attachment to the awn, because it unequivocally belongs to this section (Yeo, 1984). Its differences with *G. macrostylum* and *G. malviflorum* have been mentioned under these species. It can be differentiated from *G. linearilobum*, which also has alternate cauline leaves, by the presence of glandular hairs on the inflorescence. *G. tuberaria* is a species with little variability. Some specimens have subopposite leaves. The mericarp is usually smooth but occasionally has 2-3 transversal veins at the apex. Petals are usually ciliate on the basal margin, although rarely they have hairs around all.

---

265. Geranium tuberosum L., Sp. Pl.: 680. 1753. Type locality: "Habitat in Anglia?". Type: "Habitat in Anglia?" (lectotype, designated by Davis 1970: 107, BM-000646404, herb. Cliff.!).

Geranium radicatum M. Bieb., Fl. Taur.-Caucas. 2: 134. 1808, nom. illeg., non Lapeyr. 1795-1801. *Geranium tuberosum* [ß] radicatum (M. Bieb.) Kuntze, Trudy Imp. S.-Peterburgsk. Bot. Sada 10: 177. 1887. Type locality: "Crescit in Tauriae campestribus et in Iberiâ. Floret Aprili, Majo". Type: Russia. ex Tauria, *M. Bieberstein s.n.* (lectotype, designated by Aedo & Estrella 2006: 46, LE!; isolectotype, MW).

Geranium tuberosum var. *ramosum* Lindl., Edward's Bot. Reg. 25, tab. 10. 1839. Type locality: "The plant now figured, collected near Potenza by the Hon. W. F. Strangways, ...". Type: Edward's Bot. Reg.: 25, tab. 10. 1839. (lectotype, designated by Aedo & Estrella 2006: 46).

Geranium tuberosum var. *linearifolium* Boiss., Fl. Orient. 1: 873. 1867. *Geranium tuberosum* subsp. *linearifolium* (Boiss.) P.H. Davis, Notes Roy. Bot. Gard. Edinburgh 22: 26. 1956. Type locality: "Hab. in nemorosis et campestribus Caucasi (MB.), Persiae ad Ispahan (Auch. exs. 4301!) et Schiraz (Ky exs. 990!)". Type: Iran. Fars, Schiras, 29°36'N, 52°32'E, May 1842, *T. Kotschy 990* (lectotype, designated by Davis 1970: 108, G-BOIS!; isolectotypes, BM-000606757!, P-00757964!).

Geranium tuberosum f. *angustilobum* Woronow in Kusn., N. Busch & Fomin, Fl. Cauc. Crit. 3(7): 12. 1908. Type locality: "Hab. in siccis, campestribus et stepposis Tauriae, Cis- et Transcaucasiae. - [Mount Bedene-kyr slope. 16.V.98. fl. Golde! Sudak. IV.43. fl. Trauttv.! Iberia. fl. Wilhelms! fl. Adam! Zuvand. fl. Herb. Bong.!]" [in Russian]. Type: Georgia. Ex Iberia, 1823, *J.I. Adam s.n.* (lectotype, designated by Aedo & Estrella 2006: 46, LE photo!).

Geranium tuberosum var. inciso-*dentatum* Woronow in Kusn., N. Busch & Fomin, Fl. Cauc. Crit. 3(7): 12. 1908. *Geranium tuberosum* [V] *inciso-dentatum* (Woronow) Graebn. in Asch. & Graebn., Syn. Mitteleur. Fl. 7(1): 40. 1913. Type locality: "Exsicc. Sintenis. Iter orient. (1894). n° 5633! Hab. in siccis, campestribus et stepposis Transcaucasiae. — [Abkhazia (Abchasia). fl. Lagovsky! Imeretia. V.30. fl. Schovitz! Iberia. fl. Steven! fl. fr. Wilhelms! Georgia. fl. Lagovsky! Martkobi. IV.78. fl. Smirnov! In Somkhetia (Somchetia) mountains. fl. fr. Herb. Ledeb.! Krstsanisy near Tiflis. 20.V.58. fl. Owerin! Tiflis. Frequently in the fields. 22.IV.30. fl. Schovitz! Elisavethpol. In the fields. IV. N 350. fl. Frick! Helenendorff. Dry places. fl. fr. Hohenack.[er]! Karsskaya region. Ardagon. near Matsra. 13.VI.03. fl. fr. Mikhailovsky! Kars. fl. Lagovsky! Khassan-kala on Arak!; (Turkey border). fl. Lagovsky! Armenia. fl. fr. Schovitz! Eilar station. Stony places. 15.V.00. fl. Fomin!]" [in Russian]. Type: Turkey. Gümüschkhane, 40°22'N, 39°50'E, 24 May 1894, *P. Sintenis 5633* (lectotype, designated by Aedo & Estrella 2006: 46, L!; isolectotypes, LD!, P!, Z!).

Geranium tuberosum var. *pinnatifidum* Woronow in Kusn., N. Busch & Fomin, Fl. Cauc. Crit. 3(7): 11. 1908. *Geranium tuberosum* [IV] *pinnatifidum* (Woronow) Graebn. in Asch. & Graebn., Syn. Mitteleur. Fl. 7(1): 39. 1913. Type locality: "Exsicc. Kolenati, n° 1287 (part., cum G. linearilobo DC. commixtum!). — Callier, Iter taur. tert. (1900) n° 569! — B. M. W. Fl. Cauc. exsicc. n° 117! Hab. in siccis, campestribus et stepposis Tauriae, Cis- et Transcaucasiae. — [Crimea steppes, fl. Herb. Ledeb.! Near Besharap village, non-cultivated places. 1.V.00. fl. n° 569. Kallie! Feodosia. Edges of the fields. 19.V.00. fl. fr. Puring! Between Feodosia and Koktebel. 10.V.05. fl. Busch! Koktebel. Steppes. 23.IV.03. fl. Golde! Fields near Koktebel. 29.IV.05. fl. Unge! Between Otuz village and Imaretsky forest. 11.V.05. fl. Busch! Sevastopol. North slopes to the sea. 15.V.90. fl. Herb. Yur. Garden! Balaklavskaya valley. 30.IV.05. fl. Busch! Balaklava. 15.IV.89. fl. Pachosky! Kerch. 5.VI.89. fl. Pachosky! Kerchensky peninsula. Salty steppe between Kerch and Stary (Old) Karantin. 7.IV.06. fl. Klopotov! Kerchensky peninsula. Fields near Adzhikushina village. 15.IV.06. fl. Klopotov! Kubanskaya region. Eisk. 21.IV.90. fl. Lipsk.[y]! Taman. 24.IV.92. fl. Lipsk.[y]! Kislyakovka. 23.VI.90. fl. Lipsk.[y]! Anapa. 1.V.90. fl. Lipsk.[y]! Armavir. 11.V.90. fl. Lipsk.[y]! Sevastopolskaya region. 1886. fl. Krasnov! Stavropolskaya region, Vinodelnoye. IV. 91. fl. fr. Akinf.[iev]! (sub G. leniarilobo). Polkovnichii Yar. Iohannisdorff colony. 15.IV.81. fl. Normann! Kalaus. 20.V.91. fl. Akinf.[iev]! Rybnoie lake. 28.V.92. fl. Lipsk.[y]! Sengileevka. 25.IV.90. fl. Lipsk. [y]! Kubanskaya region. Umanskaya and Kavkazskaya villages. III—IV.87. fl. fr. jun. Gagman! (ad potius var. inciso-dentatum m.?). Terskaya region. Mineralnye Vody. 20.V.89. fr. Lipsk.[y]! Crimea. Herb. M.B. fl. (sub. G. radicato). Novorossiisk. 20.IV.89. fl. fr.; 10.IV.91. fl.; 8.V.92. fl. Lipsk.[y]! The same place, 20.IV.89. fl. fr. jun. Pachosky! The same place. 9.VI.96. fr. Desoulavi! Caucasus. fr. Nordmann! Imeretia and Kakhetia (Kachetia). fl. Eichvald! Vardisubani near Tiflis. 2.IV.61. fl. Owerin! Teletskie mountains near Tiflis. 12.IV.61. fl. Owerin! Telety. fl. Medvedev! Georgia. Herb. Acad.! Muganskaya steppe. 1/2.IV.96. fl. fr. Levandovsky! Bakinskaya region, Dzhevatsky distr. southern slope of Tekle-dagh mountain range to the SE from Adzhikabul. 3.IV.07. fl. Shelkovnikov! Bakinskaya region, Dzhevatsky distr. Near Zubovskaya station. Mount Baba-boza slopes. 450'. 2.IV.07. fl.

Shelkovnikov! Borchala and Shuragel. n° 157. fl. Koch! Tiflis. Kodzhorskoie highway. Fields, dry places. 16.IV.06. fl. fr. Sosnovsky! Near Tiflis. 18.IV.57. n° 363. fl. Pomortsev! Near Tiflis, fields. fl. Wilh.! Vera river near Tiflis. 2.IV.61. fl. Owerin! Near Tiflis. Along Vera river. 13.IV.07. fl. Pagirev! Katerinienfeld. 21.IV.27. fl. fr. Schovitz! Elisabethpol. IV.44. Kolenati! Helenendorf. Dry places. fl. fr. Hohenack. [er]! Elisabethpolskaya region. Near Helenendorf colony. Fields. V. fl. Hohenack. [er].! Sarial. 6.IV.44. fl. Kolenati! Near Tatun. Fields. fl. fr. Hohenack.[er].! Karaklis. V.85. n° 506. fl. fr. Radde! Near Olanlyar village, field. 7.V. fl. Khotsyatovsky! Erivanskaya region. Novo-Bayazetsky distr. Near Solak village. 13.V.05. fl. Mylov! Bakinskaya region. Lenkoransky distr. Eshkachi village. 29.IV.07. fl. Shelkovnikov! Besides that: Caucasus. fl. Henning! Planted from Mtskheta to Tiflis Botanical Garden. 13.IV.07. fl.!]" [in Russian]. Type: Russia. Krasnodar, Chernomorsky distr., Novorossiisk, 44°42'N, 37°47'E, 20 May 1889, *V. Lipsky s.n.* (lectotype, designated by Aedo & Estrella 2006: 46, LE photo!).

Geranium stepporum P.H. Davis, Notes Roy. Bot. Gard. Edinburgh 28: 35. 1967. Type locality: "B8 Erzurum: Pasinler to Horasan, 1700 m, Davis 29466 (holo. E!)". Type: Turkey. B8 Erzurum, Pasinler to Horasan, 39º59'N, 41º56'E, *P.H. Davis & I. Hedge 29466* (holotype, E-00129703!; isotype, BM-000606736!).

Geranium tuberosum subsp. *deserti-syriacum* P.H. Davis, Notes Roy. Bot. Gard. Edinburgh 28: 35. 1967. Type locality: "Turkey: C7 Urfa to Akçakale, 16 km from Urfa, 500 m, Davis 28083 (holo. E!)" da otras localidades... Type: Turkey: C7 Urfa to Akçakale, 16 km from Urfa, 37º02'N, 38º52'E, *P.H. Davis & I. Hedge 28083* (holotype, E-00129711!; isotype, BM!).

Geranium tuberosum subsp. *micranthum* Schönb.-Tem. in Rech. f. (ed.), Fl. Iran. 69: 7, tab. 2. 1970.Type locality: "Furse 2021, W!... Iraq:... Kurd.: 32 km E Sanadaj versus Hamadan, 15. V. 1962, Furse 2021!...". Type: Iraq. 2 km E Sanadaj versus Hamadan, 35º17'N, 47º18'E, 15 May 1962, *P. Furse 2021* (holotype, W!).

Perennial herbs, 16-48 cm tall. *Rootstock* ± horizontal, tuberculate, with tubercles subglobose, 6.6-23.7 mm long, 6.7-19.9 mm wide (ratio tubercle width/tubercle length = 0.6-1.2), with non-tuberous separations 5.1-36.6 mm long, 0.6-2.2(2.7) mm wide, not turnip-shaped, without thickened roots. *Stem* erect, leafy, not rooting at nodes, stolons absent, without vegetative stems, with patent to retrorse, eglandular hairs 0.2-0.6 mm long. *Basal leaves* in a ± persistent rosette, cauline leaves opposite (the first pair usually at stem bifurcation; sometimes 1 pair below the first bifurcation); leaf laminas 2-9.7 cm long, 2.8-12.4 cm wide, not peltate, palmatisect, polygonal in outline, base cordate, not coriaceous, not reticulate, with nerves not projected, with appressed, eglandular hairs on both surfaces; segments 5-9, in 1 plane, middle segment rhombic (sometimes lanceolate), 0.5-1.4 mm wide at the base [ratio segment width at the base/middle segment length = 0.01-0.03], 7-35-lobed in distal half [ratio secondary sinus length/middle segment length = 0.04-0.59]; petioles up to 15 cm long, without abscission zone, terete, not swollen, not deflexed in age, with patent to retrorse, eglandular hairs 0.1-0.5 mm long; stipules 1.9-3.5 mm long, 0.7-2.4 mm wide, lanceolate, free, papery, brownish red, with eglandular hairs on abaxial surface and on the margin, glabrous adaxially. *Inflorescence* a dichasial cyme with usually monochasial branches; cymules 2-flowered, usually in aggregates at the top of each branch [ratio cymule length/leaf length = 0.8-2.3]; peduncles 19-54 mm long, with patent, eglandular hairs 0.1-0.6 mm long; bracteoles 0.7-3 mm long, 0.3-1 mm wide, linear-lanceolate, whorled; pedicels absent or 7.4-22.6 mm long, with patent, eglandular hairs 0.2-1.1 mm long. Flowers actinomorphic. *Sepals* 4.2-6.3(6.6) mm long, 2.2-3.9 mm wide, lanceolate, smooth, not accrescent, nerves 3-5, mucro 0.3-1.4 mm long [ratio mucro length/sepal length = 0.07-0.31], with ± patent, eglandular, hairs 0.5-2 mm long on the abaxial surface, glabrous adaxially. *Petals* 6.9-12(17.1) mm long, 4.2-14.3 mm wide, erect-patent, emarginate (notch 0.9-4.4 mm deep), without claw, purple, glabrous on both surfaces, ciliate on the basal margin, with hairs 0.5-1 mm long. *Stamens* 10, both whorls bearing anthers; filaments 2.5-5.4 mm long, lanceolate, pink, pilose on the abaxial surface, ciliate on the proximal half, with hairs 0.2-1.5 mm long; anthers 0.8-2.3 mm long, yellow. Nectaries 5, hemispheric, glabrous. *Gynoecium* 2.7-4.9 mm long, dark purple. *Fruit* 13.3-15.8 mm long, erect, discharge of seed-ejection type; mericarps 3-4.1 mm long, 1.4-1.9 mm wide, without a strand of fibers, compressed at the apex, smooth, without basal beak, without a basal callus, without a basal prong, brown, with ± patent, eglandular hairs 0.2-1.6 mm long; rostrum 8.6-16.2 mm long, with a narrowed apex 0.2-0.5(2.1) mm long, twisted distally, with erect-patent, eglandular hairs 0.3-1 mm long; stigmatic remnants 0.9-1.6 mm long, with 5 glabrous lobes. *Seeds* 2-2.9 mm long, 1.3-2 mm wide, smooth, uniformly colored, brown, glabrous. Cotyledons with entire margin. Figs. 668-670.

Pollen. *Geranium*-type (Aedo & Estrella 2006: 22).

Chromosome number. 2*n* = 28.

Phenology. Collected in flower from February to June.

Distribution. This species ranges from southern Europe (from France to southern Russia) and northern Africa (from Algeria to Libya) to western Asia (from Turkey to Iran) (Fig. 671).

Habitat. Open areas of *Quercus* L., *Abies* Mill., and *Pinus* L. forests, scrubland with *Crataegus* L., *Cistus* L., and *Pistacia* L., and *Artemisia* L. steppes (on limestone or basaltic rocks) or fields; 0-2800 m.

Representative specimens examined. **Algeria.** Batna: Djebel Itche-Ali, 35º33'N, 6º2'E, *Lefrane s.n.* (BR). Sétif: Setif, 36º11'N, 5º24'E, 20 Apr. 1938, *Andreánszky s.n.* (W); Le Hamma, pres Constantine, 36º27'N, 6º38'E, Apr. 1889, *Girord s.n.* (G). **Armenia.** Ararat: Kotauk, Aboyhan, between Tsornatap and Verin-Jrashen, 9.5 km E of Yerevan, 40º8'N, 44º49'E, 11 May 2004, *Rico & al. 1661* (MA, MO). Syunik: Sjunik prov., 5 km WSW of Meghri, 38º54'N, 44º11'E, 1 May 2005, *Fayvush & al. 05-0535* (MA). Vayots Dorz: 6 km SSE Areni, SE monastery Noravank, 39º40'N, 45º14'E, 27 Apr. 2005, *Fayvush & al. 05-0084* (MA). **Azerbaijan.** Aran: steppa

Shirvan, 40°14'N, 48°0'E, 19 Apr. 1931, *Sachokia s.n.* (HBG). Ganja-Qazakh: Elisabetpol, Kariaginy, pr. Dzebrail, 40°40'N, 46°21'E, 20 Apr. 1911, *Woronow s.n.* (MA, MPU). Nakhchivan: Nachrespublica, prope Bilar, 39°4'N, 45°50'E, 30 May 1933, *Grilipko s.n.* (LE). **Bulgaria.** Haskovo: Haskovo, 41°55'N, 25°33'E, June 1897, *Stribrny s.n.* (E). Kyustendil: va varovita cakalesta niva po Risa, Konjavska pl. sevizt. ot s. Razdavica, 42°23'N, 22°42'E, 10 May 1959, *Jordanov s.n.* (SOM). Pleven: Slavjanka, 43°28'N, 24°52'E, 29 Apr. 1990, *Pasaliev s.n.* (SOM). **Croatia.** Dubrovnik-Neretva: Dalmacia, bei Ragusa, 42°39'N, 18°4'E, *Petter s.n.* (S). Split-Dalmatia: Sucurac, pr. Spalato, 43°33'N, 16°25'E, 16 May 1905, *Lindberg s.n.* (H). Zadar: Zara, 44°7'N, 15°14'E, 12 Apr. 1895, *Cinzberger s.n.* (WU). **Cyprus.** Famagusta: Boghaz, 35°18'N, 33°57'E, 21 Mar. 1970, *Hansen s.n.* (C). Larnaka: Larnaka, 34°55'N, 33°37'E, 22 Feb. 1880, *Sintenis & Rigo 832* (BR, LD, MPU, PR, S, WU). Paphos: Kato Paphos, a gauche de la route Paphos-Limasol, a moins de 500 m de la mer, 34°45'N, 32°24'E, Mar. 1999, *van Buggenhout s.n.* (MA). **Egypt.** South Sinai: deserto of Mt. Sinai and Akkaba, 28°58'N, 33°50'E (G). **France.** Occitanie: Hérault, Agde, 43°19'N, 3°27'E, Apr., *Lisberus s.n.* (BC). Provence-Alpes-Côte d'Azur: Var, La Seyne-sur-Mer, 43°6'N, 5°22'E, Apr., *Robin s.n.* (BC); Bouches-du-Rhône, Marseille, 43°19'N, 5°23'E, 1826, *Jacquemont s.n.* (MPU). Alpes Maritimes, Fréjus, 43°26'N, 6°44'E (Z). **Georgia.** Tbilisi: Tiflis, pr. ruinas Ker-Ogly, 42°15'N, 42°42'E, 2 May 1924, *Grossheim s.n.* (MPU). **Greece.** Central Greece: m. Parnassus, supra Arachova, 38°29'N, 22°35'E, 23 Apr. 1962, *Roessler 4244* (M). Central Macedonia: Saloniki, 40°38'N, 22°56'E, Apr. 1905, *Adamovic 237* (WU). Kriti: Sfakia, Anopoli, 35°12'N, 24°5'E, 3 Apr. 1994, *Bergmeier 3643* (NHMC). Peloponnese: Argolis, Mt. Parnon, inter oppidulum Agios Joannis et coenobium Maleviz, 37°12'N, 22°38'E, 4 May 1980, Černoch *36672* (MA). South Aegean: Cos Is., Cos to Asclepieion, 36°50'N, 27°10'E, 27 Mar. 1965, *Davis 40412* (E). **Iran.** Hamadan: Gandj Nameh, 35°10'N, 48°42'E, 14 Apr. 1947, *Lindberg 17* (LD). Kerman: Sultanabad, 28°22'N, 56°15'E, 26 Apr. 1890, *Strauss s.n.* (JE). Kermanshah: Bisitun, 34°23'N, 47°25'E, 22 Apr. 1963, *Jacobs 6363* (W). Khuzestan: in m. Noa-kuh, 30°58'N, 49°55'E, June 1910, *Bornmüller s.n.* (JE). West Azerbaijan: Azerbaijan occid., Maku, 39°17'N, 44°33'E, 5 May 1971, *Rechinger 39237* (W). **Iraq.** Erbil: Erbil, 36°11'N, 43°59'E, 22 Mar. 1961, *Hadac 3788* (PR); Derbend, 36°54'N, 44°54'E, 4 June 1960, *Hadac 2062* (PR). Kirkuk: Jarmo, 35°27'N, 44°24'E, 19 Mar. 1955, *Helbaek 387* (C). Nineveh: Mosul, S Sinjar, 36°20'N, 41°43'E, 8 Mar. 1965, *Al-Ani 9381* (GH). Saladin: inter Hadhar et Balad Sinjar, 34°0'N, 44°8'E, 18 Mar. 1961, *Hadac 3561* (PR). **Israel.** Jerusalem: Judean Mts., Hartuv, 31°46'N, 35°0'E, 8 Mar. 1924, *Eig s.n.* (MA). Northern: Nazareth, 32°41'N, 35°18'E, Apr. 1925, *Druce s.n.* (OXF). Tel Aviv: Jaffa, 32°3'N, 34°45'E, 11 Mar. 1911, *Meyers & Dinsmore 4465* (G). **Italy.** Basilicata: Lucania, Potenza, pr. Basento flumen, 40°38'N, 15°48'E, 23 Apr. 1922, *Gavioli s.n.* (BC, BM, FI, WU, Z). Lazio: Roma, nella villa Medici, 41°54'N, 12°28'E, 1849, *Barbieri s.n.* (FI). Sardegna: Cagliari, 39°13'N, 9°6'E,

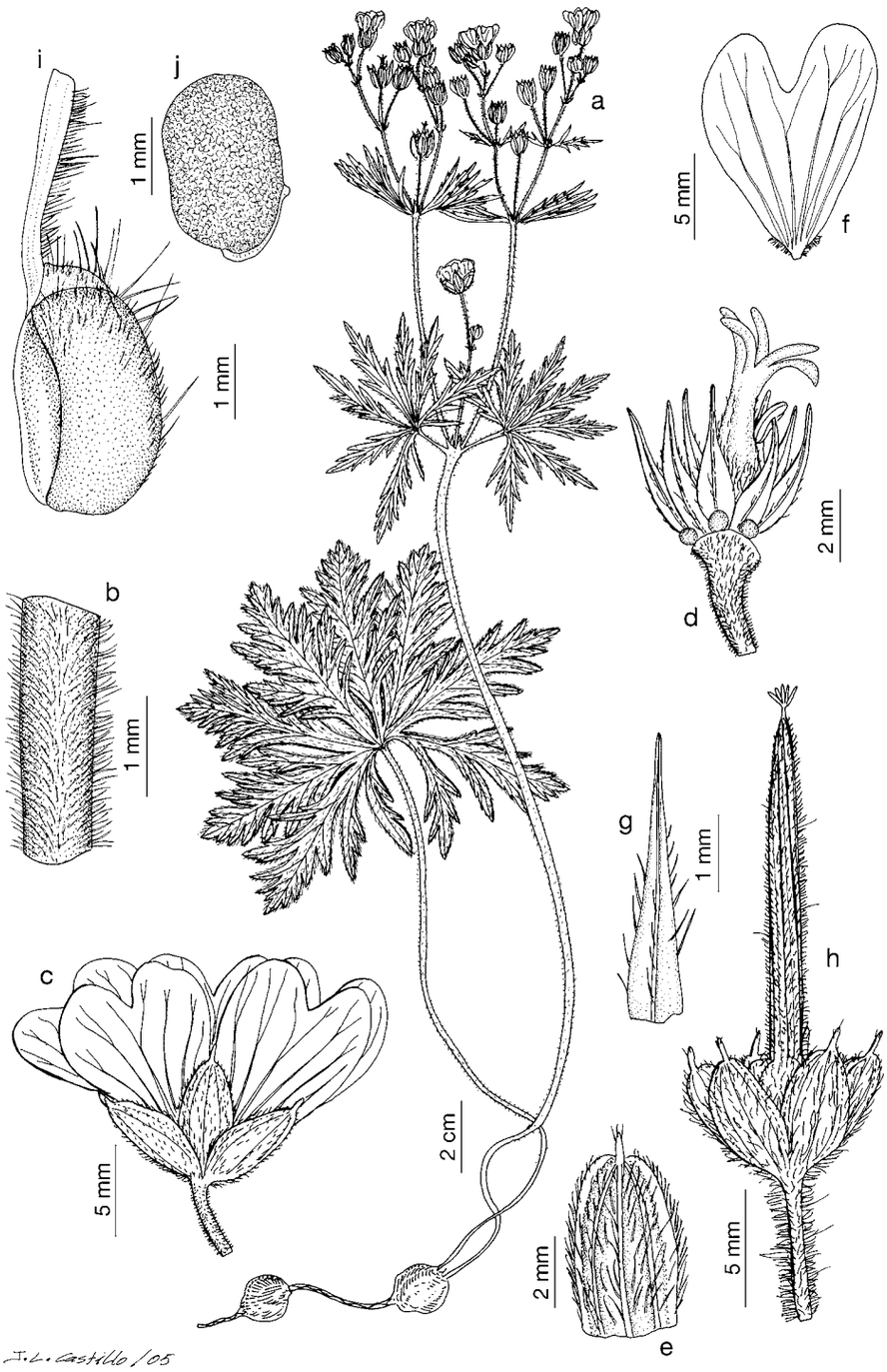


Fig. 668. *Geranium tuberosum.* a. Habit. b. Indumentum of the pedicel. c. Flower. d. Flower without petals and sepals. e. Sepal. f. Petal. g. Staminal filament. h. Fruit. i. Mericarp. j. Seed. (Based on: a-g, *Segelberg 15309,* S; h-j, *Herrero & al. 1732,* MA).

Muller s.n. (UPS). Sicilia: Ragusa, 5 km N Comiso, 36°56'N, 14°36'E, 17 Apr. 1964, *Segelberg 17404* (S). Umbria: Colle dell'Oro, dintorni di Terni, 42°33'N, 12°38'E, 22 Apr. 1889, *Mari s.n.* (FI). **Jordan.** Aqaba: 1-4 km S Ras en Naqb, 29°59'N, 35°29'E, 19 Mar. 1975, *Boulos & Jallad 7349* (LD, E); Petra, 30°19'N, 35°25'E, 23 Mar. 1952, *Dubertret 56* (G). Madaba: Mabada, 31°42'N, 35°47'E, 2 Apr. 1976, *Swahn J6* (BM). **Lebanon.** Beirut: Beirut, 33°53'N, 35°30'E, 29 Mar. 1893, *Post s.n.* (Z). Mount Lebanon: Ghazir, 34°1'N, 35°40'E, 10 Mar. 1934, *Busujan 61* (Z). North: Eden, 34°16'N, 35°58'E, 6 May 1869, *Blanche s.n.* (P). South: Deir Moukhalles, 33°24'N, 35°17'E, 17 June 1878, *Gaillardot 1681b* (JE); **Libya.** Cyrenaica, pr. Bir Gariba, 23 Apr. 1938, *Maire & Weiller 337* (MPU). Jabal al Akhdar: Cyrene, 32°49'N, 21°51'E, 29 Mar. 1954, *Guichard 25* (BM). Derna: 25 km W Derna, 32°50'N, 22°24'E, 11 Mar. 1982, *Anderberg 1146* (S). **North Macedonia.** Skopje: in m. Wodno, pr. Garnje Vodno, 41°57'N, 21°23'E, 30 Apr. 1918, *Bornmüller 3684* (HBG). Vardar: Veles, 41°42'N, 21°46'E, May 1918, *Burgeff 219* (JE). **Palestine.** Nablus: Nablus, 32°13'N, 35°16'E, Apr. 1928, *Range s.n.* (Z). **Russia.** Krasnodar: Novorossijik, 44°42'N, 37°45'E, 27 May 1908, *Luther s.n.* (H). Krym: Sebastopol, 44°36'N, 33°32'E, 2 May 1974, *Kotov s.n.* (G); Simpheropol, 15 kn N, pr. Urozhainoie, 45°2'N, 34°0'E, 2 May 1991, *Vašák s.n.* (BR). **Syria.** Aleppo Aleppo, 36°12'N, 37°10'E, 1841, *Kotschy s.n.* (FI). Damascus: Mt. Hermon, 1 km E of Qalát Namrud, 33°24'N, 35°53'E, 4 Apr. 1989, *Danin 51.011* (G); Damascus, 33°31'N, 36°17'E, Apr. 1905, *Druce s.n.* (OXF). Daraa: Sanamein, 33°5'N, 36°10'E, 4 Apr. 1954, *Pabot s.n.* (E, G). **Tunisia.** Béja: Sidi-Zehili, 36°36'N, 9°7'E, 9 Apr. 1888, *Barratte s.n.* (P); Béja, 36°43'N, 9°10'E, 30 Mar. 1953, *Faurel s.n.* (MA, MPU). Siliana: 10 km from Martar to Sbeitla, 35°53'N, 9°13'E, 5 May 1975, *Davis & Lamond 57247* (BM). Tunis: Soukra près Marra, 36°52'N, 10°15'E, 28 Mar. 1884, *Doûmet-Adanson & Bonnet s.n.* (P). **Turkey.** Erzurum: Kars, 9 mi from Horasan to Karaurgan, 40°2'N, 42°10'E, 13 June 1957, *Davis & Hedge 29522* (BM). Izmir: Malatya, Nemrud-Dagi bei Adiyaman, 38°56'N, 27°25'E, May 1970, *Wannenmacher s.n.* (W). Karaman: Konya, Ermenek-Gülnar, Uçbölük, 36°38'N, 32°53'E, 20 Apr. 1990, *Nydegger 45181* (G). Kastamonu: Kastamonu-Kure, 41°58'N, 33°45'E, 8 June 1954, *Davis 21710* (BM, E, K). Kahramanmaraş: Maras, Ahir dag above Maras, 37°39'N, 36°58'E, 1 May 1957, *Davis & Hedge 27373* (E). Mersin: Taurus, Anamur, Kas Yaylasi, 36°4'N, 32°50'E, 22 Apr. 1958, *Markgraf 11181* (Z); Mersin, between Gülnar and Gilindire, 36°20'N, 33°23'E, 15 Apr. 1956, *Davis 26020* (BM).

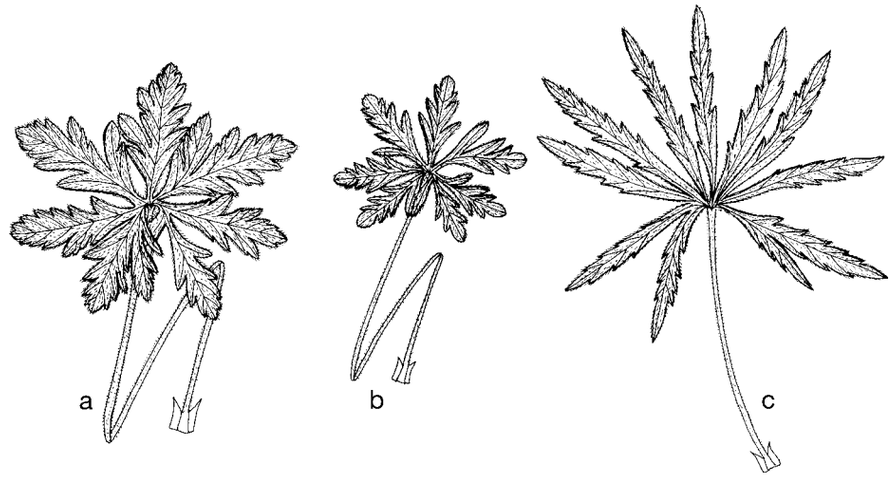


Fig. 669. Leaf variability of *Geranium tuberosum.* a, b. Basal leaves. c. Cauline leaf (Based on: a, *Eliosh s.n., 9 Apr. 1980*, Z; b, *Samuelsson 2418,* LD; c, *Sintenis 264,* WU).

Fig. 670. *Geranium tuberosum* (Based on: *Muñoz Garmendia & al. 4534*, MA).

Discussion. Geranium tuberosum is a species that extends from France to Iran, which exhibits significant variability. As Davis (1970) already mentioned, its narrowed apex of the rostrum is shorter than any other taxa in the group. Other differences with different species of the section have been previously mentioned. Davis (1970: 106) recognized two subspecies under *G. tuberosum*. According to this author, plants with deeply divided leaf segments and lacking a pair of leaves below the first bifurcation should be considered as subsp. *tuberosum*, while specimens incised or dentate leaf segments and with a pair of leaves below the first bifurcation belong to subsp. *linearifolium*. To Davis (1970) subsp. *tuberosum* occurs from France to west Iran, and subsp. *linearifolium* grow from central Turkey to central Iran. This opinion is also shared by Schönbeck-Temesy (1970: 3), who prefers the specific rank to both taxa (*G. tuberosum* and *G. stepporum*). I have found plants

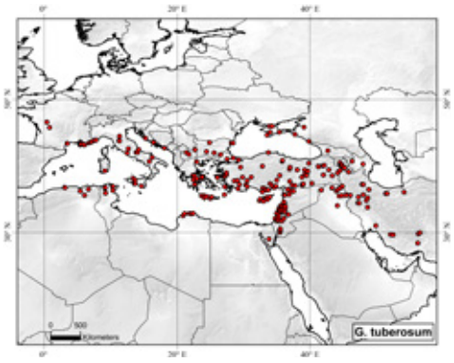


Fig. 671. Distribution of *Geranium tuberosum*.

with a pair of cauline leaves scattered through the area of the species. This character is not related with leaf division. Additionally, variation in leaf division appears to be continuous. As Davis (1970: 108) stated, *G. tuberosum* is exceptionally variable in Turkey and related areas. In these places specimens with all possible combinations of the previously mentioned characters (sometimes in the same collection: i.e., *Bornmüller 13945*, BM!, LD!, Z!) are common. Thus these taxa are here considered as synonyms for the reasons above mentioned. Two collections from Turkey (*Aznavour 491*, G!) and *Davis 21710* (BM!, E!, K!) are exceptional in having glandular hairs on the inflorescence. In the first the fruit has a rostrum with a short narrowed apex, such as *G. tuberosum*. The second has fruits that are not well developed but is otherwise typical of *G. tuberosum*. Some specimens show a tendency to develop an unequal ramification, and in rare cases to have one alternate cauline leaf. These exceptions have been observed in gathering of normal plants. In this species base of stem and petioles are very thin, which could facilitate their breakage and avoids tubercle predation. Davis (1970: 107) recorded *G. tuberosum* from Romania based on *Borza & Buia 2000* (9 May 1939, C!, O!, W!, Z!). This specimen was collected in "Caliacra, Dobroega, pr. Ghiaur-Suiuciuc", a locality now belonging to Bulgaria. Şervănescu (1959: 119) did not mention any species of sect. *Tuberosa* as belonging to Romania flora. I was not able to locate any specimen of *G. tuberosum* from Albania, although it was recorded there by Qosja (1992: 207). This species was also recorded from Corse (Briquet & Litardière 1936: 14) but it has not been collected again (Gamisans & Jeanmonod, 1993: 182).

According to Van Loon (1984b: 269), the report of chromosome number 2*n* = 28 for *G. tuberosum* (Van Loon & Oudemans 1982: 343) is based on a wrongly identified specimen of *G. macrostylum*.

IIIb. Geranium sect. **Lanuginosa** Rouy in Rouy & Foucaud, Fl. France 4: 87. 1897. Type: *Geranium lanuginosum* Lam. (art. 10.8).

Geranium subsect. *Mediterranea* R. Knuth in Engl., Pflanzenr. 53: 107. 1912. Type: *Geranium platypetalum* Fisch. & C.A. Mey. (designated by Yeo 1984: 12).

Geranium sect. *Bohemica* Tzvelev in Nov. Syst. Pl. Vasc. 29: 95. 1993. Type: *Geranium bohemicum* L. (art. 10.8).

Annual or perennial herbs with a ± horizontal rootstock, not tuberculate.

266. Geranium bohemicum L., Cent. Pl. II: 25. 1756. *Geranium caeruleum* Moench, Methodus: 284. 1794, nom. illeg. Type locality: "Habitat in Bohemia? Miller". Type: Czech Republic. Bohemia, *Ph. Miller s.n.* (lectotype, designated by Novoselova 1998: 150, LINN 858.69 image!).

Annual herbs, 20-73 cm tall. *Stem* erect, leafy, with patent, eglandular hairs 1.2-2.9 mm long and patent, glandular hairs 0.5-0.8 mm long. *Basal leaves* in a ± persistent rosette, cauline leaves alternate (1-3) and upper opposite; leaf laminas 2.2-6.8 cm long, 3.1-8.8 cm wide, not peltate, palmatifid [ratio main-sinus length/middle segment length = 0.47-0.57], polygonal in outline, base cordate, not coriaceous, not reticulate, with nerves not projected, pilose, with appressed, eglandular (and sometimes glandular) hairs on both surfaces; segments 5(7), in 1 plane, middle segment rhombic, 4-11.4 mm wide at the base [ratio segment width at the base/middle segment length = 0.15-0.29], 7-27-lobed in distal half [ratio secondary sinus length/middle segment length = 0.15-0.21]; petioles up to 15 cm long, without abscission zone, terete, not swollen, not deflexed in age, with uncinate, eglandular hairs 0.1-0.3 mm long, patent eglandular hairs 1.4-2.7 mm long, and patent, glandular hairs 0.4-1.2 mm long; stipules 5.8-11.5 mm long, 0.7-2.4 mm wide, lanceolate, free, papery, brown, with eglandular and glandular hairs on abaxial surface and on the margin, glabrous adaxially. *Inflorescence* a dichasial cyme with monochasial branches; cymules 2-flowered, solitary [ratio cymule length/leaf length = 1-2.9]; peduncles 11-68 mm long, with uncinate, eglandular hairs 0.1-0.3 mm long, patent, eglandular hairs 2-3 mm long and patent, glandular hairs 0.3-0.6 mm long; bracteoles 1.4-5.5 mm long, 0.3-0.8 mm wide, linear-lanceolate, whorled; pedicels 4-30 mm long, with uncinate eglandular hairs 0.1-0.3 mm long, patent, eglandular hairs 1.6-2.6 mm long and patent, glandular hairs 0.3-0.6 mm long. Flowers actinomorphic. *Sepals* 5.2-12.4 mm long, 2.2-6.9 mm wide, lanceolate, smooth, accrescent, nerves 5, mucro 1.1-3.4 mm long [ratio mucro length/sepal length = 0.15-0.45], with patent eglandular hairs 1.8-2.6 mm long and patent glandular hairs 0.4-0.7 mm long on the abaxial surface, glabrous adaxially. *Petals* (5.5)5.8-7.7(9.4) mm long, 3.5-6.9 mm wide, erect-patent, emarginate (notch 0.6-1.5 mm deep), without claw, blue, hairy on the base of the adaxial surface, glabrous abaxially, ciliate on the basal and apical margin, with hairs 0.3-0.7 mm long. *Stamens* 10, both whorls bearing anthers; filaments 2.8-4.7 mm long, lanceolate, pink, pilose on the abaxial surface, ciliate on the proximal half, with hairs 0.4-1 mm long; anthers 0.7-1.3 mm long, yellow. Nectaries 5, hemispheric, with a tuft of hairs at the top, dorsally glabrous. *Gynoecium* 3-4 mm long, purple. *Fruit* 24-29.9 mm long, erect, discharge of seed-ejection type; mericarps 4.9-6.1 mm long, 1.7-2.9 mm wide, without a strand of fibers, compressed at the apex, smooth, without basal beak, without a basal callus, without a basal prong, black, with ± patent eglandular hairs 1.2-2.4 mm long and scattered glandular hairs 0.4-0.8 mm long at the apex; rostrum 17.3-23.2 mm long, without a narrowed

apex, twisted distally, with patent, eglandular 0.5-1.7 mm long and patent, glandular hairs 0.3-0.7 mm long; stigmatic remnants 0.8-2.2 mm long, with 5 hairy lobes. *Seeds* 2.8-4.4 mm long, 1.5-2 mm wide, finely reticulate, mottled, brown, glabrous. Cotyledons with with a notch on each side margin. Figs. 672 a-j, 673.

Pollen. *Geranium*-type (Aedo & al. 2007: 99; Stafford & Blackmore 1991: 66; Velasco 1992b: 57).

Chromosome number. 2*n* = 28.

Phenology. Collected in flower from April to November.

Distribution. This species ranges from southern Finland to Spain and Greece, Caucasus and northern Turkey (Fig. 675).

Habitat. Open areas of *Quercus* L., *Fagus* L., *Abies* Mill., *Picea* A. Dietr. and *Pinus* L. forests, on limestone or acid rocks, usually on recently burned sites; 0-1800 m.

Representative specimens examined. **Albania.** Korçë: Greca ultra fines Kuci, 40º39'N, 20º49'E, 25 July 1900, *Baldacci 211* (BM, G, MO, W). Kukës: inter opp. Prizzen et Debra jacentes, declivibus meridionalis montium Koritnik supra rivum Luma as pagum P?dbregja pr. stationem militarem Kula Lums, 42º6'N, 20º24'E, 1 July 1918, *Kümmerle s.n.* (HBG, PR). **Belorussiya.** Minsk: Minsk, 53º54'N, 27º34'E, 11 Apr. 1901, *Bordzilowski s.n.* (LE). **Bosnia-Herzegovina.** bei Banja Stijena, 43º46'N, 18º53'E, 26 June 1910, *Malý s.n.* (G); Bara-Pale, 43º48'N, 18º33'E, 25 Aug. 1907, *Malý s.n.* (LD); Sarajevo, 43º51'N, 18º25'E, 24 July 1929, *Fiedler 9001* (B). **Bulgaria.** Kyustendil: m. Rila, supra monaster, 42º8'N, 23º21'E, 1939, *Lindberg s.n.* (H, LD). Plovdiv: Rhodope centrales ad vicum Backovo in monte Cervenata stena, 41º57'N, 24º52'E, 12 June 1936, *Klášterský s.n.* (PR); Pozenska planina, Raulsko-to kale, Rusalski dol., 42º44'N, 24º59'E, 16 July 1953, *Tancev s.n.* (SOM). **Czech Republic.** Karlovy Vary: pr. Eger, 50º3'N, 12º22'E (RO); pr. Carlsbad, 50º14'N, 12º52'E, *Buek s.n.* (HBG, WAG). Prague: circa Pragam, 50º6'N, 14º21'E, 1820, *Opiz s.n.* (B). **Finland.** Central Finland: Saarijärvi, Linnankylä, 62º40'N, 25º25'E, 19 July 1959, *Koskinen s.n.* (H). Pirkanmaa: Tampere, Aitolahti, Tarastenjärvi, 61º33'N, 23º53'E, 31 July 1988, *Kääntönen s.n.* (H). Southwest Finland: Abo Skargard, Vijshront, 60º9'N, 21º36'E, 4 July 1967, *Hansen s.n.* (C); Aura, Järykselä, 60º36'N, 22º33'E, 27 Oct. 1960, *Laine & Suominen s.n.* (H). **France.** Auvergne-Rhône-Alpes: Montroc, Savoy, 46º0'N, 6º56'E, June 1914, *Maude s.n.* (BM). Provence-Alpes-Côte d'Azur: Var, Les Maures de Canneson, 43º11'N, 6º19'E, June 1867, *Théveneau s.n.* (BR); Alpes-Maritimes, environs de Villars du Var, au Pic des Quatre-Cantons, 43º58'N, 7º4'E, 29 June 1909, *Briquet & al. 2021* (F, MPU, Z); Alpes-Maritimes, rochers de Marval près Saint Sauveur de Tinée, 44º5'N, 7º6'E, 19 June 1914, *Burnat & al. s.n.* (Z). **Georgia.** Adjara: Batumskaya oblats, 41º38'N, 41º40'E, 1911, *Woronow 4388* (LE); Kartli, Bakuriani, 41º46'N, 43º32'E, 14 Aug. 1998, *Merello & al. 2079* (MA). **Germany.** Baden-Württemberg: Baden, Friburg, 47º59'N, 7º50'E, July 1891, (MPU). Saxony: Schlesien, Priobus,

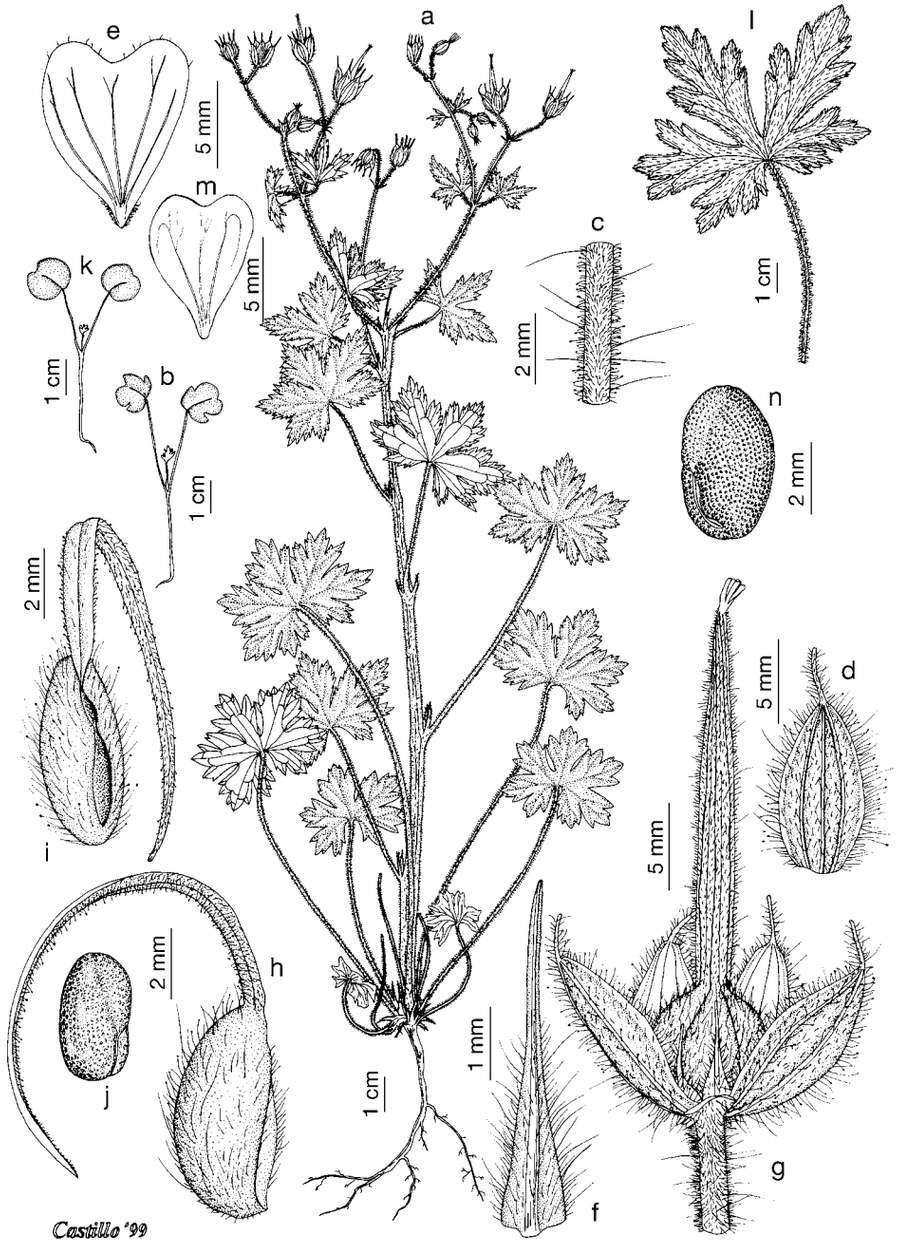


Fig. 672. *Geranium bohemicum*. a. Habit. b. Cotyledons. c. Indumentum of the peduncle. d. Sepal. e. Petal. f. Staminal filament. g. Fruit. h, i. Mericarp. j. Seed. (Based on: a, *Montserrat s.n.*, MA-359961; b, c, *Aedo 2440*, MA; d, e, f, *Sesé 198.1312,* JACA; g, *Montserrat s.n.*, MA-252442; h-j, *López s.n.*, MA-213282). *Geranium lanuginosum*. k. Cotyledons. l. Leaf. m. Petal. n. Seed. (Based on: k-m, *Montserrat s.n.,* BC-99741; n, *Fontes & al. 1115*, LISE).

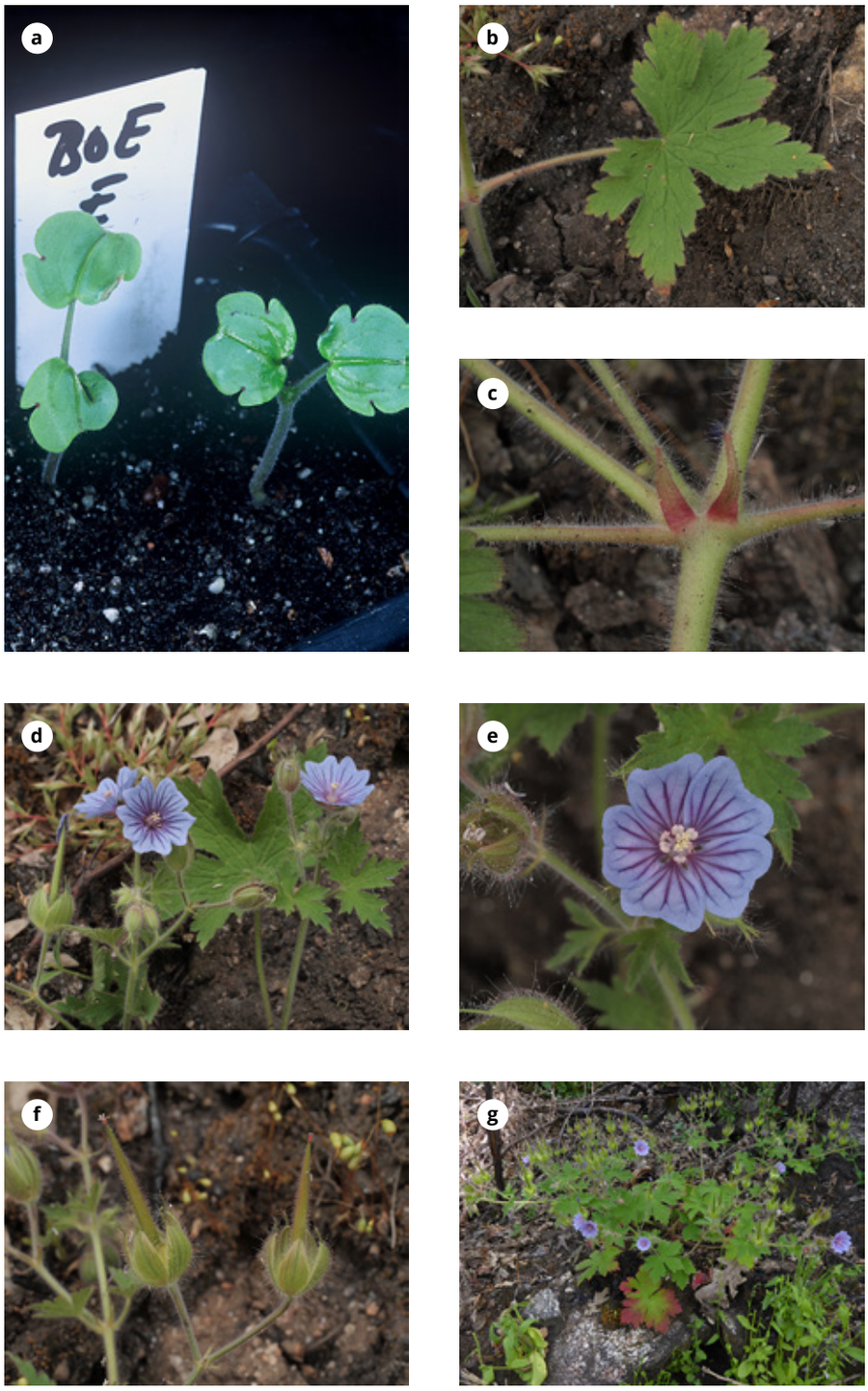


Fig. 673. *Geranium bohemicum* (Based on: a, *Aedo 2440,* MA; b-g, *Aedo 24061*, MA).

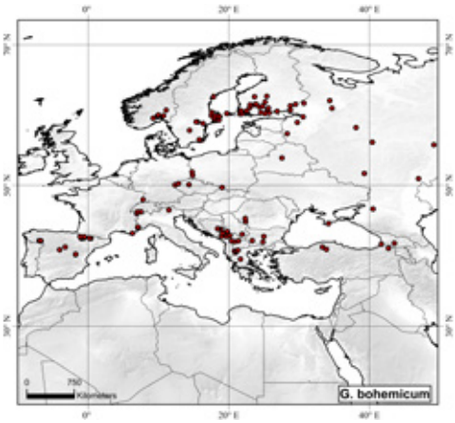


Fig. 675. Distribution of *Geranium bohemicum.*

Buchgarten bei Tränke, 51°26'N, 14°52'E, June, *Behr & Behr s.n.* (MA); Sachsen, inter Niesky & Muskau, 51°23'N, 14°47'E, June, *Behr & Behr s.n.* (JE). **Greece.** Thessaly: Makedonien, Vernon Oros, zwischen Drosopigi und Nimfeon, am Kamm, 39°31'N, 21°40'E, 8 July 1978, *Krendl s.n.* (W). West Macedonia: Kastoria, 1 km SO Mesovraho, 40°27'N, 20°59'E, 15 June 1989, *Willing 6526* (B); Florinis, Mt. Boutsi, pr. Vatochorion, 40°42'N, 21°8'E, 9 July 1981, *Strid & al. 18843* (B, G); NW Macedonia, above Armensko, 40°47'N, 21°18'E, 24 June 1932, *Alston & Sandwith 447* (BM). **Italy.** Trentino-Alto Adige: Tirol, Hoeknergebiet am Rande einer Valdlichtving, 8 July 1910, *Vetter s.n.* (S, W); in Tirolia meridionali media, Gummer, 46°30'N, 11°30'E, *Ambrosi s.n.* (E). Umbria: nele selve del monte Subosis, Aug. 1898, *Bellini s.n.* (RO). **Montenegro.** Andrijevica: in m. Jerinja glava prope Andrijevica, 42°44'N, 19°44'E, July 1906, *Rohlena s.n.* (JE). Nikšić: in m. Vardar, supra monast Piva, 42°46'N, 19°1'E, July 1905, *Rohlena s.n.* (PR). Žabljak: in silvis Tmora dictis apud Podgora, pr. Zabljak, 43°12'N, 19°8'E, 31 July 1930, *Novak 4556* (PRC). **North Macedonia.** Polog: in reg. superior Strmno pl., 42°0'N, 20°51'E, Aug. 1899, *Formánek s.n.* (PR). Skopje: Skopje, montes Skopska Crna Gora, pagus Banjane, NW montis Meseriz, 42°6'N, 21°23'E, 21 Aug. 1979, *Skalicky & Rejzlova s.n.* (PRC). **Norway.** Oslo: Oslo, 59°54'N, 10°45'E, 1906 (O). Vestfold og Telemark: Notodden, Blefjell, 59°33'N, 9°16'E, 26 July 1987, *Sunding s.n.* (O); Viken: Buskerud, Ringerike, Stubal, under Ingeborg, 59°52'N, 9°52'E, 28 Aug. 1988, *Engelskjon & Steilnes s.n.* (C). **Poland.** Silesian: Braslaw, Grodziszki, 49°42'N, 19°4'E, 4 Aug. 1937, *Dabkowska s.n.* (F). **Romania.** Sud-Vest Oltenia: Caras-Severin, cacuminis montis Domogled supra Baile Herculane, 44°52'N, 22°24'E, 2 July 1931, *Borza s.n.* (MO). Vest: Oltenia, distr. Mehedinti, in silva montis Macropriciu, pr. Vîrciorova, 45°18'N, 22°21'E, 17 July 1948, *Morariu s.n.* (C, G, H, JE, M, MAF, O, S, W, Z). **Russia.** Karelia: Sortavala, Melloinen, Palaneen, 61°41'N, 30°41'E, 20 July 1931, *Tiirikka s.n.* (H). Krym: Tauria, 44°34'N, 34°11'E, 30 June 1906, *Junge s.n.* (LE). Pskov: Ostrov, 57°21'N, 28°19'E,

27 June 1914, *Puring s.n.* (LE). Rostov: Millerovo, 46°39'N, 40°30'E, 20 June 1939, *Nurljuskin s.n.* (LE). Saratov: Kuznetskiy Uezd, Na Zapad Razezda Eljuzan Syrzr., 50°57'N, 46°58'E, 4 July 1917, *Stuckenberg s.n.* (BC). St. Petersburg: Luga, in silva locis deustis pr. Nataljino, 58°57'N, 29°45'E, 14 July 1911, *Litvinov 2518a* (C, H, S, WA). Tatariya: Kazan, 55°46'N, 49°9'E, 27 June 1914, *Graft 69* (LE). Vladimir: Vladimir, 56°8'N, 40°24'E, 27 June 1914, *Nasarov 3716* (LE). Voronezh: Voronezskoi gub., 51°42'N, 39°16'E, 24 June 1913, *Dubjanskija s.n.* (LE). Yaroslavl: in reg. Swir., Nikola, 58°13'N, 38°5'E, 27 June 1875, *Elfving s.n.* (H). **Serbia.** Southern and Eastern Serbia: Bic Planina, apud oppidum Priboj, 43°3'N, 21°55'E, 22 June 1930, *Novak 372* (PRC). Šumadija and Western Serbia: Luka, montium Tikva et Kameniva apud oppido Nova Varos, 43°27'N, 19°48'E, 6 July 1930, *Novak 2356* (PRC). **Spain.** Cuenca: Sierra de Valdemeca, 40°13'N, 1°44'W, 21 July 1979, *López s.n.* (MA). Guadalajara: El Cardoso de la Sierra, arroyo la Ortigosa, 41°8'N, 3°29'W, 19 June 2016, *Galán s.n.* (MA). Huesca: Lurte en camino de Acher, a la izquierda del Barranco de la Espata, sobre el campamento, 42°34'N, 0°46'W, 21 June 1983, *Calvo s.n.* (JACA). Navarra: Sierra de Navascués, 42°42'N, 1°6'W, 8 July 1914, *Soulié s.n.* (MPU). Segovia: Balsain, 40°50'N, 4°1'W, 23 July 1968, *Silvestre 2659/68* (SEV). Zamora: Porto, embalse de San Sebastián, 42°8'N, 6°56'W, 30 June 2016, *Aedo & Bariego 24061* (MA). Zaragoza: Sierra de Santo Domingo, Longás, 42°28'N, 0°56'W, 26 July 1976, *García s.n.* (JACA). **Sweden.** Kalmar: Torsas, 56°24'N, 16°1'E, 18 July 1888, *Areskog s.n.* (BR, JE). Örebro: Breven-Regna, Skogsnäva, 59°1'N, 15°35'E, June 1955, *Baveaar s.n.* (L). Uppsala: Upland, Stromsberg, 60°23'N, 17°35'E, 25 Sep. 1882, *Vesterlund s.n.* (JE). **Switzerland.** supre Mariles, Helvet. occid., Aug., *Walther s.n.* (BC). Valais: vallée d'Anniviers, entre Vercorin et Pensec, 46°15'N, 7°32'E, 10 Aug. 1879, *Burnat s.n.* (FI). Vaud: Alpes de Morcles, 46°13'N, 7°2'E, 19 Aug. 1878, *Wolf s.n.* (COI, HBG, JE, LD, MA). **Turkey.** Ardahan: 30 km E Ardahan, 41°3'N, 42°42'E, 7 Aug. 1982, *Sorger & Buchner 82-112-4* (W). Kastamonu: Paphagonia, Wilajet Kastambuli, Tossia, Giaurdagh, 40°54'N, 33°53'E, 29 July 1892, *Sintenis 4863* (BM, FI, G, JE, LD, P, PR, S, Z); N side of Ilgaz Dag, 41°13'N, 33°19'E, 28 Aug. 1962, *Davis & al. 38345* (E).

Discussion. Geranium bohemicum is recognized by its cotyledons, which are notched on each side, its brownish seeds with clearer areas, its petals with ciliae on the apical margin, and its hairy nectaries. It has usually been considered closely related to *G. lanuginosum*. However, the latter species has entire cotyledons, uniformly reddish seeds, petals without ciliae at the apex, and glabrous nectaries. Additionally, in *G. bohemicum* the leaves are not as deeply divided (the ratios main-sinus length/middle segment length, and secondary sinus length/middle segment length are lower), and the eglandular hairs of peduncles and pedicels are longer than in *G. lanuginosum*. *Geranium bohemicum* shares with *G. lanuginosum* some character states not present in the remaining species of sect. *Lanuginosa*. Both are annuals, with accrescent sepals, inflorescence in dichasial cyme with monochasial branches, and blackish mericarps. Additionally, they have shorter petals, staminal filaments, anthers, and gymnoecia than the perennials species of the section. The fruits are also shorter, without narrowed apices in the rostrum, and the abaxial side of the stigmatic remnants is hairy instead of glabrous, as in the perennial species.

According to Dahlgren (1952) and Milberg (1994), the seeds remain viable over long time periods (at least 129 years). If not subjected to heat, the seeds do not easily germinate. This species often appears suddenly after forest fires, as can be confirmed from many herbarium labels. Thus, *G. bohemicum* seems to be well adapted to occasional natural forest fires that may occur after long time lags. This could partially explain its scattered distribution and temporal disappearance in some localities.

267. Geranium lanuginosum Lam., Encycl. 2: 655. 1788. *Geranium bohemicum* subsp. *lanuginosum* (Lam.) O. Bolòs & Vigo, Butll. Inst. Catalana Hist. Nat. 38: 81. 1974. Type locality: "... celle-ci que M. l'Abbé Poiret a trouvée en Afrique, qu'il nous a communiquée... Cette plante croît dans la Numidie. (v.s.)" [according to Briquet (1936: 9) from la Calle]. Type: Algeria. Numidie, *J.L. Poiret s.n.* (lectotype, designated by Aedo & al. 2007: 107, P-00389440!).

Geranium perreymondii Shuttleworth & A. Huet in H. Roux, Bull. Soc. Bot. Hort. Prov. 1880: 139. 1880. Type locality: "G. bohemicum. G.G., 1, p. 299 (non L. ni Koch)... Var.-Fréjus. (G.G.) Broussailes le long du chemin de Collobrières à la Verne. (Huet !). A.-M.-L'Esterel, vallon de la Grande Ragues. (G.G.) La Napoule. (Hanry) Maures de Tanneron. (Ard.)". Type: France. Collobrières, 43°14'N, 6°18'E, 14 May 1873, *A. Huet s.n.* (neotype, designated by Aedo & al. 2007: 107, BC!; isoneotypes, FI-010376!, G-00365980!, Z!).

Geranium bohemicum subsp. *depraehensum* E.G. Almq., Svensk Bot. Tidskr. 10: 411, fig. 1A, 2b. 1916. *Geranium deprehensum* (E.G. Almq.) Lindm., Bot. Soc. Exch. Club Brit. Isles 7: 765. 1925. Type locality: "Hab. Sueciae ad Ekvik prope Segersgärde paroeciae Lofta Smolandiae, ubi unicum inventum est specimen, quod in generationibus conpluris prolem stabilem produxit". Type: Sweden. Ad Ekvik prope Segersgärde paroeciae Lofta Smolandiae, 57°50'N 16°32'E, *E.G. Almquist s.n.* (lectotype, designated by Aedo & al. 2007: 107, Svensk Bot. Tidskr. 10: 2 fig. 1A. 1916).

Annual herbs, 29-61 cm tall. *Stem* erect, leafy, with patent, eglandular hairs 1.2-2.1 mm long and patent, glandular hairs 0.2-0.9 mm long. *Basal leaves* in a ± persistent rosette, cauline leaves alternate (1-3) and upper opposite; leaf laminas 3.2-8.6 cm long, 3.8-10.5 cm wide, not peltate, palmatifid [ratio main-sinus length/middle segment length = 0.58-0.68], polygonal in outline, base cordate, not coriaceous, not reticulate, with nerves not projected, pilose, with appressed, eglandular (and sometimes glandular) hairs on both surfaces; segments 5(7), in 1 plane, middle segment rhombic, 3.3-8.1 mm wide at the base [ratio segment width at the base/middle segment length = 0.10-0.19], 10-18-lobed in distal half [ratio secondary sinus length/middle segment length = 0.21-0.36]; petioles up to 20 cm long, without abscission zone, terete, not swollen, not deflexed in age, with uncinate, eglan-

Fig. 674. *Geranium lanuginosum* (Based on: *Aedo 24060,* MA).

dular hairs 0.1-0.3 mm long, patent, eglandular hairs 1.1-2.2 mm long and patent, glandular hairs 0.3-0.7 mm long; stipules 5.3-13.9 mm long, 1-2.1 mm wide, linear-lanceolate (sometimes with a short bifid apex), free, papery, brown, with eglandular hairs on abaxial surface and on the margin, glabrous adaxially. *Inflorescence* a dichasial cyme with monochasial branches; cymules 2-flowered, solitary [ratio cymule length/leaf length = 1.3-3.4]; peduncles 4-59 mm long, with uncinate, eglandular hairs 0.1-0.3 mm long, patent, eglandular hairs 0.3-1.9 mm long and patent, glandular hairs 0.4-0.6 mm long; bracteoles 1.8-4.7 mm long, 0.4-0.9 mm wide, linear-lanceolate, whorled; pedicels 3-24 mm long, with uncinate eglandular hairs 0.1-0.3 mm long, patent, eglandular hairs 0.2-1.6 mm long and patent glandular hairs 0.4-0.7 mm long. Flowers actinomorphic. *Sepals* 5-9.9 mm long, 1.9-5.4 mm wide, lanceolate, smooth, accrescent, nerves 5, mucro 0.9-2.5 mm long [ratio mucro length/sepal length = 0.16-0.31], with patent eglandular hairs 0.9-3.3 mm long and patent glandular hairs 0.6-1 mm long on the abaxial surface, glabrous adaxially. *Petals* (5.4)6.3-6.9(8.3) mm long, 3.1-6.1 mm wide, erect-patent, emarginate (notch 0.4-1.2 mm deep), without claw, blue, glabrous on both surfaces, ciliate on the basal margin, with hairs 0.3-0.5 mm long. *Stamens* 10, both whorls bearing anthers; filaments 3.1-4 mm long, lanceolate, pink, pilose on the abaxial surface, ciliate on all of its length, with hairs 0.5-1.3 mm long; anthers 0.6-1.1 mm long, yellow. Nectaries 5, hemispheric, glabrous. *Gynoecium* 3.1-4 mm long, purple. *Fruit* 18-29.5 mm long, erect, discharge of seed-ejection type; mericarps 4.1-5.5 mm long, 1.5-2.6 mm wide, without a strand of fibers, compressed at the apex, smooth, without basal beak, without a basal callus, without a basal prong, black, with ± patent eglandular hairs 1.5-2.8 mm long and scattered glandular hairs 0.4-0.9 mm long at the

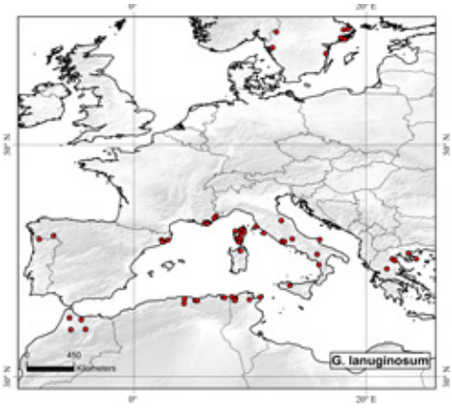


Fig. 676. Distribution of *Geranium lanuginosum.*

apex; rostrum 12.1-20.5 mm long, without a narrowed apex, twisted distally, with patent, eglandular 0.2-0.9 mm long and patent, glandular hairs 0.5-0.8 mm long; stigmatic remnants 1-1.8 mm long, with 5 hairy lobes. *Seeds* 2.5-3.4 mm long, 1.3-2.1 mm wide, reticulate, uniformly colored, brownish red, glabrous. Cotyledons with entire margin. Figs. 672 k-n, 674.

Pollen. *Geranium*-type (Aedo & al. 2007: 99; Stafford & Blackmore 1991: 68).

Chromosome number. 2*n* = 42, 48.

Phenology. Collected in flower from March to September.

Distribution. This species ranges from southern Europe (from Portugal to Greece) to northwestern Africa (from Morocco to Tunisia) and it is introduced in Sweden (Fig. 676).

Habitat. Open areas of *Castanea* Mill., *Corylus* L. or *Quercus* L. forests, on limestone or acid rocks, usually on recently burned sites; 0-1600 m.

Representative specimens examined. **Algeria.** Béjaïa: Constantine, Djebel Bababor, 36°33'N, 5°27'E, 29 June 1880, *Cosson s.n.* (P); Kefrida, foret de Tedefelt, 36°34'N, 5°16'E, *Battandier s.n.* (MPU). Bouïra: de Taourirt a El Kseur, 36°19'N, 4°18'E, May (MPU). El Taref: Bone, 36°49'N, 7°48'E, 1906, *Gandoger s.n.* (MO); Constantine, pres La Calle, 36°53'N, 8°26'E, 6 May 1841, *Durieu s.n.* (P, BR). Tizi Ouzou: Alger, Tamgout d'Azazga, 36°43'N, 4°21'E, 21 May 1952, *Faurel s.n.* (MPU). **France.** Corse: mont Cagne, 41°34'N, 9°4'E, Mar. 1828, *Serafino s.n.* (K); in montibus inter Bastiam et Nonya, 42°42'N, 9°27'E, June 1832, *Salis s.n.* (K). Provence-Alpes-Côte d'Azur: Var, foret des Maures à la Verne près de Collobrieres, 43°11'N, 6°19'E, 15 May 1873, *Shuttleworth s.n.* (FI, Z); Var, Les Mayons du Luc, vers le Cros de Mouton, 43°18'N, 6°22'E, 19 June 1951, *Rodié s.n.* (MPU); Alpes Maritimes, Grasse, 43°40'N, 6°54'E, 19 June 1923, *Rodié s.n.* (MPU); Alpes- Maritimes, Pierrefeu, 43°52'N, 7°4'E, June 1890, *Mailho s.n.* (G). **Greece.** Central Macedonia: Macedonia, ep. Pierias, between Mt. Olympus and Titaros, NW slopes of Vulgara, 10 km along forest road branching off from main road 2.5 km S of Ag. Dimitrios, 40°9'N, 22°15'E, 27 June 1976, *Strid & Gustavsson 11830* (ATH); Thessalonikis Eparchia, Lagada, Stena Rentinas (Makedonika Tempi), along Richios river, 40°39'N, 23°38'E, 11 May 1997, *Theodoropoulos 574* (TAUF). Mount Athos: Penino Athos, ad Chilandar, 40°9'N, 24°20'E, Apr. 188?, *Breuer s.n.* (PR). Thessaly: Agrapha, in regione inferiori m. Pindi cirac monasterium Koróna, 39°18'N, 21°47'E, 20 June 1895, *Heldreich s.n.* (E, JE, LD, W); Larisis, Thessalia, Kato Olimbos, Siliana-Schlucht, 40°0'N, 22°28'E, *Bergmeier s.n.* (GOET). **Italy.** Calabria: monte Tarago, inter Santa Agata di Esaro et Belvedere, 39°38'N, 15°56'E, 11 July 1914, *Lacaita s.n.* (BM). Sardegna: Limbara pressa la retta del Gingantino, 40°51'N, 9°10'E, June 1895, *Martelli s.n.* (GB); Tempio, Monte Limbardo, 40°51'N, 9°9'E, 16 May 1882, *Reverchon 253* (BM, BR, E, JE, K, LD, MPU, PR, Z). Sicilia: Palermo, Ficuzza, Godrano, Gungo di Cerro, 37°51'N, 13°25'E, 11 June 1960, *Segelberg 11660* (S). Tuscany: promontorio di Piombino, W di La Sedia e a N di C. Mariti, 42°57'N, 10°30'E, 4 May 1951, *Pichi Sermolli s.n.* (FI). **Morocco.** Fès-Meknès: Jebela, 34°3'N, 5°27'W, 1923, *Lynes s.n.* (BM); Tazekka, foret de Bab Ahzar, 34°5'N, 4°11'W, 5 June 1952, *Sauvage 9732* (MPU). Tanger-Tetouan-Al Hoceima: in Atlante rifano, Ketama, 34°54'N, 4°33'W, 15 June 1929, *Maire s.n.* (MPU); Rif, Mexeroh, 35°4'N, 5°34'W, 4 May 1930, *Font Quer s.n.* (BC). **Portugal.** Minho: Ponte da Barca, Lindoso, vale do Cabril, prox. Da ponte da Varzea, 41°51'N, 8°11'W, 15 June 1945, *Fontes & al. 1115* (LISE). **Spain.** Barcelona: Sierra de Montseny, Turó d'en Moixell, Can Prat, 41°47'N, 2°22'E, 22 May 1996, *Gutiérrez s.n.* (MA); Zamora: Porto, embalse de San Sebastián, 42°8'N, 6°56'W, 30 June 2016, *Aedo & Bariego 24060* (MA). **Sweden.** Kalmar: Smaland, Lofta, Ekvik, pr. villam Segersgarde, 57°51'N, 16°32'E, 19 June 1926, *Almquist 1112* (BM, C, F, G, H). Uppsala: Almunge, Sagen, 59°54'N, 18°3'E, 12 July 1970, *Lindén s.n.* (H); Uppland, Ununge parish, Myra, 59°58'N, 18°27'E, 29 Aug. 1998, *Ekman 98409* (S). **Tunisia.** Jendouba: N de Fernana, Kroumirie, Fedj El-Saha ou Camp de la Santé, 36°34'N, 8°41'E, 30 June 1883, *Cosson & al. s.n.* (P); N d'Aïn-Draham, 36°45'N, 8°45'E, 8 July 1883, *Cosson & al. s.n.* (P). Nabeul: Dj. Cheban, 36°51'N, 10°52'E, 20 May 1883, *Cosson & al. s.n.* (P). Zaghouan: massif forestier d'El-Fedja, Oued Batah, 36°39'N, 9°56'E, 1888, *Cosson s.n.* (P). **Turkey.** Istanbul: Constantinople, au dessous de Lazkeuy, 41°6'N, 28°54'E, 11 June 1893, *Aznavour 503b* (G).

Discussion. Differences between *G. lanuginosum* and *G. bohemicum* are addressed in the discussion under the latter species. It is interesting to note that glandular hairs on the mericarp are restricted to the apex as well as in *G. bohemicum*, *G. gracile*, and *G. renardii*. *Geranium perreymondii* was validly published (Roux 1880) by reference to the Godron's (1847) description of *G. bohemicum*. According to the Shenzhen Code (art. 7.8), the type should be selected among the specimens mentioned by Godron (1847). Unfortunately, not one of those specimens was traced. Thus, a specimen mentioned by Roux (1880) was selected as type, which must then be considered to be a neotype (Aedo & al. 2007: 107). Since no original material of *G. bohemicum* subsp. *depraehensum* was located, this name was typified on an illustration. It should be indicated that specimens collected later by Almquist (labeled by himself as "depraehensum") are unequivocally *G. lanuginosum*. According to Dahlgren (1952), *G. lanuginosum* seeds are similar to those of *G. bohemicum* in germination features.

The ranges of both species overlap only in the Iberian Peninsula and southern France, where sympatric populations are very rare. I have been able to verify the abundance of the two species in the locality discovered by P. Bariego [Spain, Zamora, Porto, *Aedo & Bariego 24061* (MA)]. They were in flower at the same time and in the same plot, but no intermediate specimens were found.

268. Geranium gracile Ledeb. in Nordm., Bull. Sci. Acad. Imp. Sci. Saint-Pétersbourg 2(20): 314. 1837. Type locality: "Hab. In Awhasien auf dem Gebirge Hirtscha 3000 Fuss hoch". Type: Georgia. Awhasien, auf dem Gebirge Hirtscha, 43º00'N, 41º30'E, *A. Nordmann s.n.* (lectotype, designated by Novoselova 1998: 155, LE!; isolectotype, H-1663822!).

Geranium trilobum K. Koch, Linnaea 15: 716. 1841, nom. illeg., non Thunb. 1800. *Geranium gracile* var. *trilobum* (K. Koch) Boiss., Fl. Orient. 1: 876. 1867. Type locality: "In monte Nakerala". Type: Georgia. In Radscha et in monte Nakarala (in Imeretia), 42º05'N, 42º30'E, 1836, *K. Koch 970* (lectotype, designated by Aedo & al. 2007: 108, LE!).

Geranium gracile var. *glabriusculum* Albov, Prodr. Fl. Colchic.: 45. 1895, ["glabriuscula"]. Type locality: "Mingrelia: m. Kwira, 1890 m. (N.A. 1894)". Type: Georgia. Mingrelia, m. Kwira, 42º30'N, 41º50'E, 1894, *N.M. Albov s.n.* (no original material located).

Perennial herbs, 19-80 cm tall. *Rootstock* 5.1-9.7 mm in diameter, ± horizontal, not tuberculate, not turnip-shaped, without thickened roots. *Stem* erect, leafy, not rooting at nodes, stolons absent, without vegetative stems, with patent to retrorse, eglandular hairs 0.3-1.7 mm long. *Basal leaves* in a deciduous rosette, cauline leaves opposite; leaf laminas 3.3-13.1 cm long, 4.5-20.1 cm wide, not peltate, palmatifid [ratio main-sinus length/middle segment length = 0.69-0.78], polygonal in outline, base cordate, not coriaceous, not reticulate, with nerves not projected, pilose, with appressed, eglandular hairs on both surfaces; segments (3)5, in 1 plane, middle segment ovate, 6.7-26.7 mm wide at the base [ratio segment width at the base/middle segment length = 0.19-0.32], (14)20-23(34)-lobed in distal half [ratio secondary sinus length/middle segment length = 0.04-0.09]; petioles up to 27.5 cm long, without abscission zone, terete, not swollen, not deflexed in age, with patent to retrorse, eglandular hairs 0.5-1.6 mm long; stipules 6.7-20.2 mm long, 1.6-4.4 mm wide, lanceolate, free, papery, brown, with eglandular hairs on both surfaces and on the margin. *Inflorescence* a monochasial cyme; cymules 2-flowered, solitary [ratio cymule length/leaf length = 1.2-4.8]; peduncles 24-84 mm long, with uncinate, eglandular hairs 0.1-0.3 mm long, patent, eglandular hairs 0.5-1.1 mm long and patent, glandular hairs 0.2-0.5 mm long; bracteoles (2.5)3.5-4.3(6.1) mm long, 0.5-3.5 mm wide, linear-lanceolate, whorled; pedicels 15-38 mm long, with ± uncinate eglandular hairs 0.1-0.3 mm long and patent, glandular hairs 0.2-0.5 mm long. Flowers actinomorphic. *Sepals* 6.2-8.3 mm long, 2.5-4.7 mm wide, lanceolate, smooth, not accrescent, nerves 3-5, mucro 1-2.6 mm long [ratio mucro length/sepal length = 0.15-0.32], with ± patent eglandular hairs 1.2-2.9 mm long and patent glandular hairs 0.3-0.65 mm long on the abaxial surface, glabrous adaxially. *Petals* (13.6)17.7-20.5(27.3) mm long, 5.4-10.6 mm wide, erect-patent, emarginate (notch 0.8-4.2 mm deep), without claw, purple, hairy on the base of the adaxial surface, glabrous abaxially, ciliate on the basal margin, with hairs 0.3-0.8 mm long. *Stamens* 10, both whorls bearing anthers; filaments 7.8-11.9 mm long, lanceolate, white, pilose on the abaxial surface, ciliate on the proximal half, with hairs 0.1-1.7 mm long; anthers 1.1-2.1 mm long, yellow. Nectaries 5, hemispheric, glabrous. *Gynoecium* 7.8-10.8 mm long, purple. *Fruit* 29.7-44.3 mm long, erect, discharge of seed-ejection type; mericarps 3.7-5.9 mm long, 1.8-2.4 mm wide, without a strand of fibers, compressed at the apex, smooth, without basal beak, without a basal callus, without a basal prong, brown, with ± patent eglandular hairs 0.5-1.2 mm long and some glandular hairs 0.1-0.5 mm long at the apex; rostrum 22-35 mm long, with a narrowed apex 1.8-4.4 mm long, twisted distally, with ± patent eglandular hairs 0.1-1.9 mm long and patent, glandular hairs 0.3-0.7 mm long; stigmatic remnants 1.9-3.6 mm long, with 5 glabrous lobes. *Seeds* 2.8-3.3 mm long, 1.5-2.1 mm wide, finely reticulate, uniformly colored, brownish red, glabrous. Cotyledons with entire margin. Figs. 677, 678.

Pollen. *Geranium*-type (Aedo & al. 2007: 99).

Chromosome number. 2*n* = 26.

Phenology. Collected in flower from April to October.

Distribution. This species ranges from northeastern Turkey to Caucasus and northern Iran (Fig. 679).

Habitat. Forests of *Fagus* L., *Picea* A. Dietr. or *Abies* Mill., or scrubland with *Rhododendron* L.; 700-2360 m.

Additional specimens examined. **Georgia.** Abkhazia: Abkhazeti, gorge Bzibi, right bank nr. Blue lake, 1 Aug. 1948, *Purtsklivanidze s.n.* (MA); Samegrela, M. Okhachkuye, 42º46'N, 41º55'E, 7 Aug. 1959, *Kemularia & al. s.n.* (MA); Abchazia, m. Apiantcha, 42º59'N, 41º16'E, May 1920, *Woronow s.n.* (L); Abchasien, Kodortal, 43º6'N, 41º44'E, 6 Aug. 1912, *Rikli s.n.* (Z); Sukhumi vicinitas latior pagi Akhalsheni, haud procul limenem reservati naturale Gumistinski zapovednik, 43º6'N, 41º1'E, 8 Aug. 1983, *Vašák s.n.* (BR, G); Abjauska SSP, Gudaugtsksh, Aualitsa, 43º10'N, 40º42'E, 9 July 1980, *Doliagova & al. 339* (LE); Abkhasie, Crete Bzypiskhevi, 43º17'N, 40º23'E, 2 Oct. 1893, *Alboff 325* (FI); Abdhazskaya A.S.S.R., on mount Mamzishka above Gagra, on the Black Sea coast, 43º18'N, 40º20'E, 25 July 1984, *McNeal 165* (MO); Gagra, berge am nördlichen Ortsrand, 43º19'N, 40º14'E, 18 June 1987, *Krebs 1953* (B); Sukhumi vicinitas latior pagi Pskhu, apud rivum Beshta, 43º23'N, 40º50'E, 8 Aug. 1983, *Vašák s.n.* (BR); Abchazia, Gudauty, pr. lacum Ritza, 43º27'N, 40º32'E, 4 Sep. 1936, *Kolakovsky 3219* (C, H, KRA, S, W, WA); lake Ritza, slope of Mt. Psheshikha, 43º27'N, 40º32'E, 8 July 1974, *Sokolova s.n.* (LE). Imereti: Makoena ad fl. Rion, 42º4'N, 42º30'E, June 1877, *Brotherus s.n.* (H); Imereti, de Shovi a Ambrolauri, 42º23'N, 43º0'E, 14 July 2002, *Muñoz Centeno & al. s.n.* (MA). Samegrelo-Zemo Svaneti: Svanetia libera ad limites Abkhasiae in jugo alpino inter flumina Neuskra et Seken, 43º4'N, 42º5'E, 23 Aug. 1890, *Sommier & Levier 250bis* (FI). Samtskhe-Javakheti: Cartalinia, montis Tzkhra-Tzkharo brachium Imeretinum, 41º40'N, 43º34'E, 9 July 1923, *Juzepczuk 70* (LE); Kartli, Borjomi region, 7 km N of Bakuriani, 41º43'N, 43º30'E, 11 Aug. 1998, *Merello & al. 2792* (MA, LE); Kartli, Bakuriani, Tskhra Tskaro, 41º44'N, 43º31'E, 9 Sep. 1997, *Gagnidze & al. 920* (MA); Tiflis, Gori, pr. Bakuriani,

41°45'N, 43°33'E, 11 July 1923, *Kozlowsky 188* (LD, LE, PR, S, Z); Kartli, nordhang des berges Kokhta gora, c. 2 km SE Bakuriani, 41°45'N, 43°32'E, 15 July 1997, *Schönswetter & Tribsch s.n.* (WU); Borzomskij r-n, pos. Bakuriani, Trialetskij chr. gora, 41°45'N, 43°50'E, 26 July 1961, *Volkova & Ivanina s.n.* (LE); Borjom, in nemoribus ad rivum Bordjounka, 41°50'N, 43°22'E, 15 July 1890, *Sommier & Levier 250* (FI); ab Bakuriani bei Borshom, 41°51'N, 43°24'E, 25 Aug. 1912, *Rikli s.n.* (Z). **Iran.** Alborz: Kandavan, 36°8'N, 51°18'E, 31 May 1938, *Gauba 1454* (B). Gilan: mountain above Damesh-east of Rudbar, 36°48'N, 49°22'E, 21 June 1975, *Wendelbo & Ala 18170* (E, W); Asalem to Khalkhal, near Sefid Poshteh, 37°42'N, 48°56'E, 16 July 1975, *Wendelbo & Assadi 18409* (W). Mazanderan: Kalar Dasht, 36°34'N, 51°15'E, 30 May 1938, *Gauba K 1225-b* (W). **Russia.** Krasnodar: vicinity of Krasnaya Polyna settlement, Mt. Achishkho, bank of Beshenka river, 43°43'N, 40°7'E, 2 July 2006, *Naumenko & al. s.n.* (MA). **Turkey.** Giresun: 3 km SO Kümbet, 40°33'N, 38°25'E, 7 July 1969, *Sorger 69-27-24b* (W). Gümüşhane: Armenia turcica, Sipikordagh, ad ripas Szadagh-tschai pr. Szadagh, 39°52'N, 39°35'E, 19 Aug. 1890, *Sintenis 2514b* (LD). Ordu: below Cambasi, 40°39'N, 37°58'E, 14 July 1965, *Tobey 1292* (E). Trabzon: Hamsiköy, 40°41'N, 39°28'E, 1934, *Balls 1650* (E); Trabzon, 2 km S of

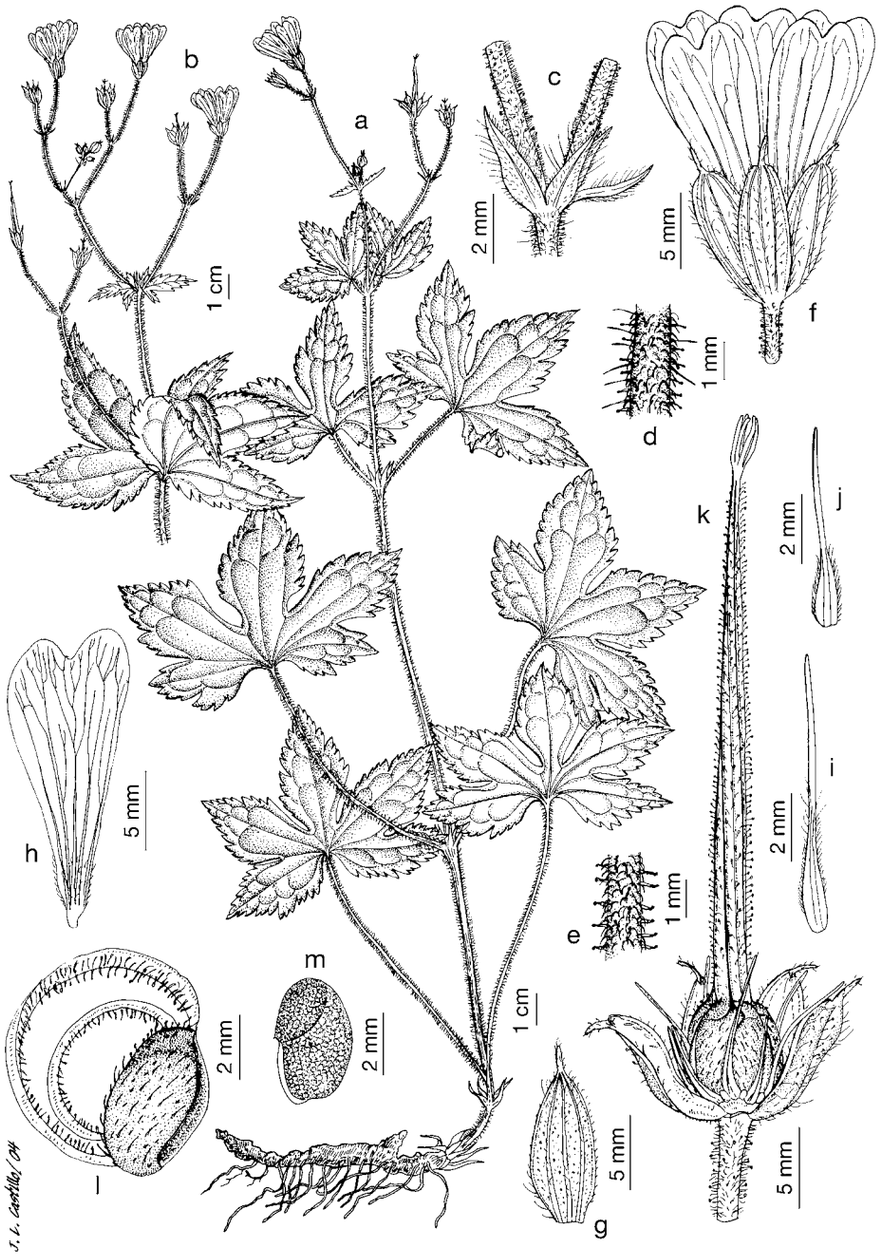


Fig. 677. *Geranium gracile*. a. Habit. b. Inflorescence. c. Bracteoles. d. Indumentum of the peduncle. e. Indumentum of the pedicel. f. Flower. g. Sepal. h. Petal. i, j. Staminal filaments. k. Fruit. l. Mericarp. m. Seed. (Based on: a, c-f, h-j, *Valcárcel & al. 370VV01*, MA; b, *Schönswetter & Tribsch s.n.*, *15 July 1997*, WU; g, k-m, *Tobey 1292,* E).

Fig. 678. *Geranium gracile* (Based on: *Aedo 12782,* MA).

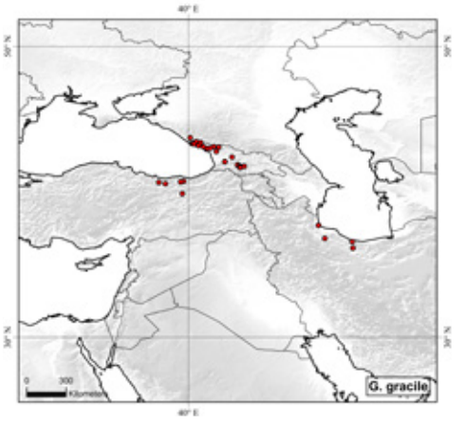


Fig. 679. Distribution of *Geranium gracile*.

Hamsiköy, 40º41'N, 39º28'E, 23 Aug. 1972, *Uotila 19724* (H); Trabzon, Bachtal oberhalb Hamsi Köy, 40º41'N, 39º28'E, 29 Aug. 1971, *Walter 10428* (HBG); Pontus, Sumila, 40º43'N, 39º40'E, 5 Aug. 1889, *Sintenis 1514* (LD, W, WU); Trabzon, monasterio de Sumelas, 40º43'N, 39º40'E, 27 June 2001, *Valcárcel & al. 370VV01* (MA).

Discussion. Geranium gracile shows some features not present in other perennial species of sect. *Lanuginosa*. This taxon usually has more than one pair of opposite leaves on the stem, the inflorescence is a monochasial cyme, and the cymules are solitary (not in aggregates at the top of the branches). Additionally, its petals are the narrowest of the group. Among the perennial species, *G. gracile* shares with *G. ibericum*, *G. peloponnesiacum*, *G. platypetalum*, and *G. renardii* the presence of glandular hairs on the inflorescence. Superficially, *G. gracile* is similar to *G. nodosum* in flower appearance and particularly in leaf form. Leaves of both species have marked ovate segments, with the wider part near the base, and with less deeply divided secondary divisions. Yeo (2002a) suggested that this similarity could be related with the analogous forestry habitat of both species. Knuth (1912) includes *G. gracile* and *G. nodosum* in sect. *Striata* R. Knuth, overlooking the fact that fruit structure unequivocally approaches *G. gracile* of sect. *Lanuginosa*.

269. Geranium renardii Trautv. in Trautv., Regel, Maxim. & C. Winkl., Decas Pl. Nov.: 5. 1882. Type locality: "In Ossetia, ad. fl. Didi Liachva, in alpe Brutsabseli, 16 Jul. 1881 legerunt A. H. et V. F. Brotherus". Type: Georgia. Ossetia, in alpe Brutsabseli, ad fl. Didi Liachva, 42º24'N, 44º15'E, 16 July 1881, *A.H. Brotherus & V.F. Brotherus 215* (lectotype, designated by Knuth 1912: 110, LE!; isolectotype, BM-000606718!, G-00365775!, H-1368908!).

Perennial herbs, 14-35 cm tall. *Rootstock* 7.6-14.2 mm in diameter, ± horizontal, not tuberculate, not turnip-shaped, without thickened roots. *Stem* erect, leafy, not rooting at nodes, stolons absent, without vegetative stems, with patent to retrorse, eglandular hairs 0.3-0.8 mm long. *Basal leaves* in a ± persistent rosette, cauline leaves opposite; leaf laminas 2.3-7.2 cm long, 2.6-8.5 cm wide, not peltate, palmatifid [ratio main-sinus length/middle segment length = 0.26-0.59], polygonal in outline, base cordate, not coriaceous, reticulate, with nerves projected on the abaxial surface, sunken adaxially, pilose above and sericeous beneath, with ± patent eglandular hairs on both surfaces; segments 5(7), in 1 plane, middle segment ± obtriangular, 5.6-23 mm wide at the base [ratio segment width at the base/middle segment length = 0.29-0.49], (12)16-21(29)-lobed in distal half [ratio secondary sinus length/middle segment length = 0.07-0.20]; petioles up to 22 cm long, without abscission zone, terete, not swollen, not deflexed in age, with patent to retrorse, eglandular hairs 0.3-0.6 mm long; stipules 6.2-11.1 mm long, 1.3-4.2 mm wide, lanceolate, free, papery, brown, with eglandular hairs on both surfaces and on the margin. *Inflorescence* a dichasial cyme; cymules 2-flowered, solitary or in aggregates at the top of each branch [ratio cymule length/leaf length = 1.3-3.9]; peduncles 5-62 mm long, with uncinate, eglandular hairs 0.1-0.3 mm long, patent, eglandular hairs 0.4-1.2 mm long, and rarely patent, glandular hairs 0.2-0.4 mm long; bracteoles (3.4)4.7-6.1(10.4) mm long, 0.7-1.9 mm wide, linear-lanceolate, whorled; pedicels absent or 6-23 mm long, with uncinate eglandular hairs 0.1-0.3 mm long, patent, eglandular hairs 0.6-1.5 mm long and, usually, patent glandular hairs 0.2-0.9 mm long. Flowers actinomorphic. *Sepals* 7.4-10.9 mm long, 3.2-5.1 mm wide, lanceolate, smooth, not accrescent, nerves 5-7, mucro 0.6-1.4 mm long [ratio mucro length/sepal length = 0.05-0.15], with ± patent eglandular hairs (0.3)1-3.4 mm long and, usually, patent, glandular hairs 0.3-0.9 mm long on the abaxial surface, glabrous adaxially. *Petals* (15.1)16.8-20.3(23) mm long, 10-14.8 mm wide, patent, emarginate (notch 1-5.5 mm deep), without claw, white with violet veins, glabrous on the adaxial surface, hairy on the base of the abaxial surface, ciliate on the basal margin, with hairs 0.3-0.7 mm long. *Stamens* 10, both whorls bearing anthers; filaments 7.2-12.9 mm long, lanceolate, white with deep purple apex, pilose on the abaxial surface, ciliate on the proximal half, with hairs 1-2.8 mm long; anthers 1.9-3.3 mm long, yellow. Nectaries 5, hemispheric, glabrous. *Gynoecium* 5.8-9.9 mm long, pink. *Fruit* 23-34.5 mm long, erect, discharge of seed-ejection type; mericarps 5-6.6 mm long, 2-2.8 mm wide, without a strand of fibers, compressed at the apex, smooth, without basal beak, without a basal callus, without a basal prong, brown, with ± patent eglandular hairs 0.8-1.8 mm long and, sometimes, scattered glandular hairs 0.4-0.8 mm long at the apex; rostrum 15.9-26 mm long, with a narrowed apex 3.4-5.2 mm long, twisted distally, with ± patent eglandular hairs 0.5-2.4 mm long and, rarely, patent glandular hairs 0.3-0.7 mm long; stigmatic remnants 1.4-3.1 mm long, with 5 glabrous lobes. *Seeds* 3-3.6 mm long, 1.4-2.1 mm wide, finely reticulate, uniformly colored, brownish red, glabrous. Cotyledons with entire margin. Figs. 680, 681.

Pollen. *Geranium*-type (Aedo & al. 2007: 99).

Chromosome number. Unknown.

Phenology. Collected in flower from May to August.

Distribution. This species ranges through western and central Caucasus (Fig. 682).

Habitat. Alpine meadows or scrubland with *Rhododendron* L. and *Juniperus* L.; 2000-3300 m.

Additional specimens examined. **Georgia.** Abkhazia: Abjasia, Jrebet' Ercog (Ircyj), Cjalta-dzyj, 5 July 1902, *Woronow 534* (LE, MPU); Svanetia, Uscepbe, r. Gupie, 42º54'N, 41º44'E, 20 Aug. 1977, *Gagnidze & al. s.n.* (K); Abkhazia, river Kodori can-

yon, near village Levii (Left) Gentsvisch, 43º6'N, 41º44'E, 19 Aug. 1990, *Konechnaya & Khaare s.n.* (LE); Abkhasia in valle fluminis Kliutseh infra jugum Klukhor, 43º14'N, 41º52'E, 27 Aug. 1890, *Sommier & Levier s.n.* (FI). Imereti: Makoena ad fl. Rion, 42º4'N, 42º30'E, June 1877, *Brotherus s.n.* (K). Mtskheta-Mtianeti: river Chernaya, Aragvi, village Bakurkhevi, 42º28'N, 44º47'E, 20 July 1973, *Menitsky s.n.* (LE). Racha-Lechkhumi and Kvemo Svaneti: Racha, upper part riv. Tsckhra?ya, 42º30'N, 43º30'E, 22 July 1966, *Gagnidze s.n.* (MA); Svanetia in jugo Latpari inter flumina Hippum et Ingur, 42º52'N, 42º58'E, 4 Aug. 1890, *Sommier & Levier s.n.* (FI). Samegrelo-Zemo Svaneti: Svanetia superior, in valle suprema flum. Inguri, circa pedem meridion montis Schara, in montibus a pago Usguli (Cazasi), 42º55'N, 43º4'E, 23 July 1988, *Fischer & al. C88-19*

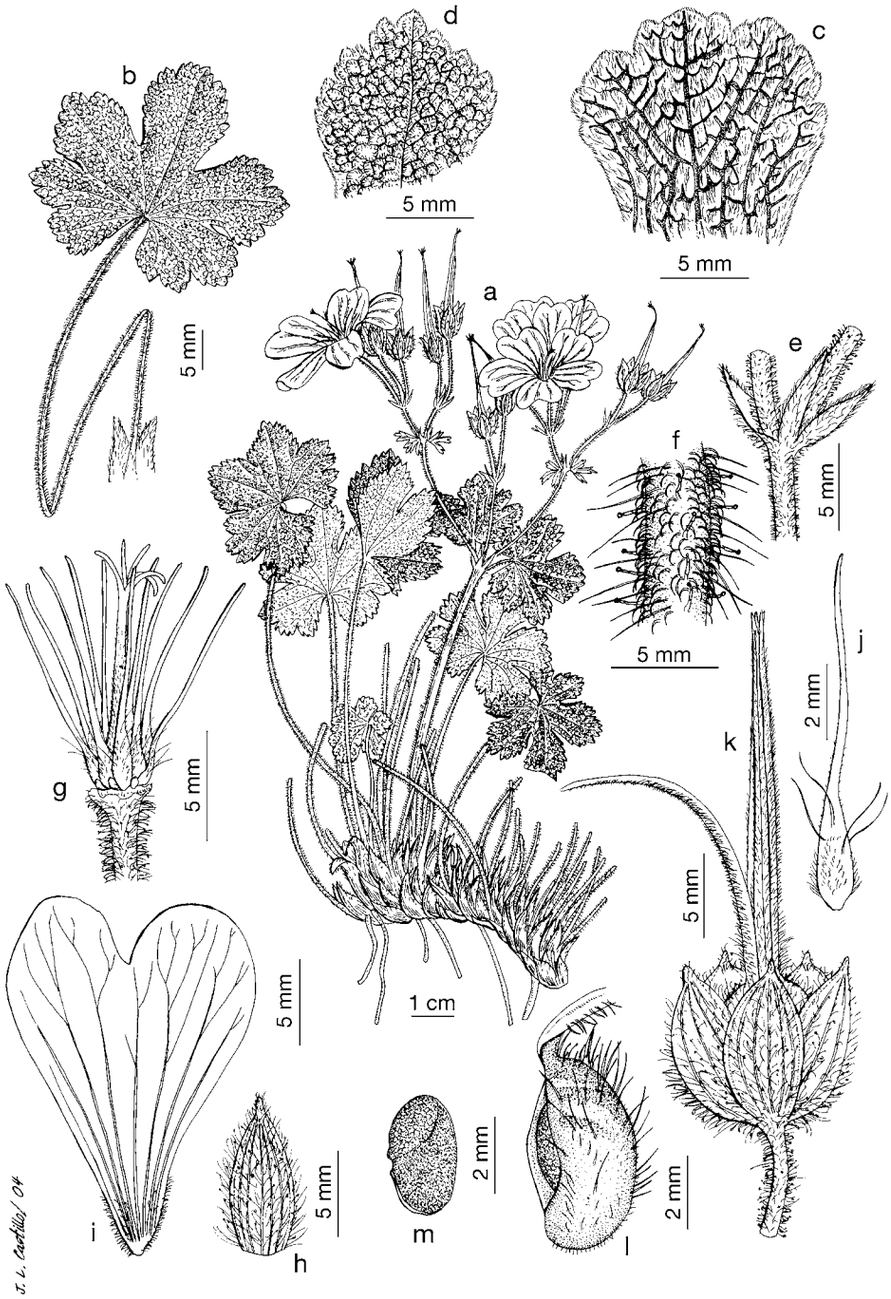


Fig. 680. *Geranium renardii*. a. Habit. b. Leaf. c. Detail of the leaf adaxial side. d. Detail of the leaf abaxial side. e. Bracteoles. f. Indumentum of the pedicel. g. Flower without petals and sepals. h. Sepal. i. Petal. j. Staminal filaments. k. Fruit. l. Mericarp. m. Seed. (Based on: a-j, *Busch s.n.*, *May 1907*, LE; k-m, *Busch 775*, LE).

Fig. 681. *Geranium renardii* (Based on: *Aedo 4478,* MA).

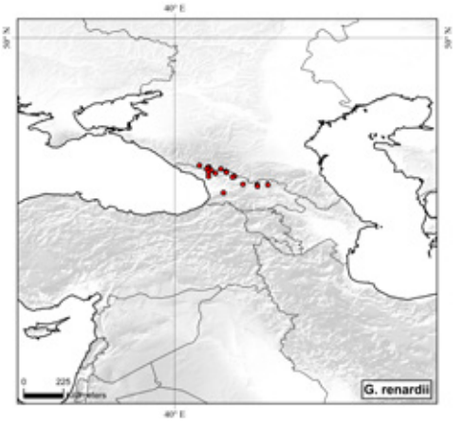


Fig. 682. Distribution of *Geranium renardii*.

(WU); Verkhniaya (Upper) Svanetia, Mestiisky distr., place Lagvzalieri, 43º4'N, 42º5'E, 5 July 1977, *Klochkova 254* (LE); Svanetia libera ad limites Abkhasiae in jugo alpino inter flumina Neuska et Seken, 43º4'N, 42º5'E, 23 Aug. 1890, *Sommier & Levier s.n.* (FI); Podoshva lednika Gul (massiv g. Ushba), Verjn, Svanetia, Kutaissk gub., 43º7'N, 42º39'E, 21 July 1911, *Schelkovnikov s.n.* (LE). South Ossetia: Ermani, Mt. Fidar-khokh, 42º28'N, 44º14'E, 25 Aug. 1958, *Gochina s.n.* (LE); Iugo-Osetinskaya, Senokosnyj lug Bulataty-feten, 12 July 1930, *Busch s.n.* (G); Iugo-Osetinskaya, Guachurii, Senokosnyj subal'pijskij lug na g., 9 July 1930, *Busch s.n.* (K, LE, WU). **Russia.** Kabardino-Balkaria: Kuban prov., Gau??u-ga??, May 1907, *Busch 775* (LE); Kuban prov., 1907, *Busch & Klopotow s.n.* (MA); Kabardino, Balkarskaya, Bolshoy Kavkaz, Elbrus area, along track to and near the Shkhelda glacier, 43º10'N, 42º38'E, 22 June 1982, *Klackenberg 820622-28* (S); massif du mont Elbruz, 43º17'N, 42º22'E, 28 July 1978, *Leonard 7184* (BR, K); Kuban, Teberda, 43º23'N, 41º45'E, 5 July 1907, *Endaurowa s.n.* (LE, WA); Baksan, in declivibus austro-occidentalibus montis Cheget, 43º28'N, 41º16'E, 15 Aug. 1978, *Vašák s.n.* (WU). Karachayevo-Cherkasskaiya: Dombai, Murra-Atschi-tora, 43º17'N, 41º39'E, 1988, *Arnold s.n.* (JE); massif du mont Dombay, 43º17'N, 41º39'E, 29 July 1978, *Leonard 7199* (BR); Zapadnuiy Kavkaz, Teberdinskiy zapovednik g. Malaia Jatipara, vost, greben, Subal'piyskiy lug., 43º22'N, 41º42'E, 2 July 1963, *Pavlov s.n.* (MA, MPU). Stavropol: Stavropolvskij kray., Teberdinskiy gos. sapovedni, Cucjurskiy pereval, 43º22'N, 41º42'E, 14 July 1974, *Makridin & Kirjman s.n.* (G).

Discussion. The leaves of this species are distinctive, permitting *G. renardii* to be distinguished even in vegetative state. They have a noticeable reticulate nervation projected on the abaxial surface, and sunken adaxially. The leaf lamina is green but pilose on the abaxial surface (mainly on the nerves), and densely covered with a patent, sericeous indumentum beneath which is both on the nerves and the sunken surface between them. The inflorescence is dichotomously branched with a long pedunculate cymule at the main fork. Terminal cymules are usually in aggregates (sometimes with short or without pedicels) at the top of the branches, resembling umbels. This type of inflorescence is shared with the following species of sect. *Lanuginosa* (*G. ibericum, G. platypetalum*, *G. peloponnesiacum*, *G. libani*, *G. gymnocaulon*, and *G. kurdicum*). The indumentum shows some variability in *G. renardii*. On the inflorescence, glandular hairs are usually restricted to pedicels and sepals, and in a few cases can be observed on peduncles. However, in some specimens only eglandular hairs are present. Petals are hairy on the base of abaxial surface, and on the basal margin, but in exceptional cases, they can be present all the entire margin, from the base to the notch.

270. Geranium ibericum Cav., Diss. 4: 209, tab. 124 fig. 1. 1787 [nom. cons.]. Type locality: "Habitat in Oriente. Vidi figuratum a Tournefortio, apud D. de Jussieu". Type: Georgia. Bakuriani, Tskhra Tskaro, 41°44'N, 43º31'E, 10 Aug. 1997, *R. Gagnidze & G. Nakhutsrishvili 918* (conserved type by Aedo 2005: 207, MA-626647!).

Geranium montanum Hablitz ex Pall., Neue Nord. Beytr. Phys. Geogr. Erd-Völkerbeschreib. 4: 51. 1784. [nom. rej.]. Type locality: "Gilan und auf den Gilanischen Gebirgen. Samamisischen Gebirge". Type: Iran. Gilan, In alpib. Samamisius [Kuh-e Somamus], 36º50'N, 50º23'E, Aug., *C. Hablizl s.n.* (lectotype, designated by Novoselova 1998: 157, LE!).

Geranium ibericum var. *subglandulosum* Rupr., Mém. Acad. Imp. Sci. Saint Pétersbourg ser. 7, 15(2): 269. 1869. Type locality: "In Caucaso iberico alpino (M. Bieb. 1808 n. 1343; in herb. ejus adest a Stevenio 1806 missum flor. et ab Adam fl. et defl. petalis 12 lin. emarginatis vel cum lacinula media). In reg. subalpina ad torrentem Terek alt. 600 - 1200 hex. (Meyer n. 1808), scil. pr. Darial ad riv. Kistinka alt. 680 hex. 13 Sept.; pr. Sion alt. c. 950 hex. 14 Sept. et in m. Kasbek alt. 1200 - 1266 hex. 17 Sept. (Meyer mss. I, 226, 290, 241); in m. Kasbek alt. 1140 hex. et in pratis alp. m. Gudgora 12 Aug. flor. (Kolenati! ex Meyer 1849 p. 49). Ad rivulum Baidara alt. 1160 hex. 21 Aug. fl. legi caule humiliori 7 - 9 poll., petalis 11 - 13 lin.; idem sed filamentis glabris in m. Bai Gora ad fontes Araguae alt. 1140 - 960 hex. 22 Sept. fl. legit D. Owerin, haec forma differt a G. batrachioide grandifloro: indumento specifico nec retrorsum adpresso, petalis bifidis, pedunculis post anthesin non refractis, filamentis ad insertionem non fasciculato-barbatis. Cauc. orient. copiose in reg. alp. m. Dindidagh, alt. 1400 - 1500 hex. 10 Jul. flor. legi var. humiliorem subsemipedalem, petalis 10 -12 lin. ... Cauc. minor: Somchetia pr. Alawersk init. Jul. fl. primis (Eichwald! p. 29); Karabagh in reg. alp. m. Kaepesdagh 11 Jul. fl., caule 6 - 10 poll. (Kolenati!). Nullibi alias in terris finitimis, excepto ß. subglanduloso, vide supra.". Syntypes: Georgia. Caucaso iberico alpino, 1808, *M. Bieberstein s.n. 1343*; *C. Steven s.n.*, 1806, *J. I. Adam* s.n.; torrentem Terek, 42º41'N, 44º30'E, *C. A. Meyer 1808*; pr. Darial ad riv. Kistinka, 42º43'N, 44º37'E, 13 Sep., *C. A. Meyer? s.n.*; pr. Sion, 42º36'N, 44º35'E, 14 Sept.; m. Kasbek, 42º41'N, 44º30'E, 17 Sep. *C. A. Meyer 226, 290, 241*; m. Gudgora 12 Aug., *F. A. Kolenati s.n.*; ad rivulum Baidara, 42º32'N, 44º29'E, 21 Aug.; m. Bai Gora ad fontes Araguae, 22 Sept., *A. P. Owerin s.n*. Azerbaijan. Cauc. orient., m. Dindidagh, 41°40'N, 46º56'E, 10 July. Armenia. Cauc. minor, Somchetia pr. Alawersk, 41°12'N, 44º28'E, July, *K. Eichwald s.n.*; Karabagh in reg. alp. m. Kaepesdagh, 11 July, *F.A. Kolenati s.n.* (no original material located).

Geranium ibericum var. *album* Lauman in L.H. Bailey, Cycl. Amer. Hort.: 640. 1900. Type locality: [not indicated]. Type: no original material located.

Geranium ibericum var. *hyrcanum* Woronow in Kusn., N. Busch & Fomin, Fl. Cauc. Crit. 3(7): 31. 1908. Type locality: "Hab. in ditione Talysch Transcaucasiae. — [Dawara. V.70. n° 52. fl. Radde! Shindan-kala. 13.VI.80. fl. Radde! Kazhby post, Lenkoransky region. 27.IV.98. fl. Levandovsky! (flores majores). Talysh. Near Sangada stream near mount Bolo-band. 5000'. 3.VIII.97. n° 7347. fl. fr. Alex.[eenko]! Talysh. mount Nudus-galasi. 7000'. 17.VI.94. fl. Lomakin! — Besides that: planted in Caucasian Department of Tiflis botanical garden; delivered from Kys-yurda in Talysh]" [in Russian]. Type: Azerbaijan. Gub. Baku, Talysch, ad rivulum Sangada haud procul m. Bolo-band, 38º39'N, 48º30'E, 3 Aug. 1897, *T. Alexeenko 7347* (lectotype, designated by Aedo & al. 2007: 113, LE!).

Geranium jubatum Hand.-Mazz., Ann. K.K. Naturhist. Hofmus. 23: 160, Taf. 9 Fig. 2. 1909. *Geranium ibericum* subsp. *jubatum* (Hand.-Mazz.) P.H. Davis, Notes Roy. Bot. Gard. Edinburgh 22: 24. 1955. Type locality: "In den obersten Rhododendron-Beständen an der Waldgrenze, 1700-1900 m. Nordhang des Ulugoba (Nr. 618). Zwischen Orükbeli und Aladja Dagh (Nr. 1129). Ferner: Gümüschkhane: in declivibus supra Istavros (Sintenis, It. orient., 1889, Nr. 1670). Montagnes entre Baïbout et Trébisonde (Montbret, Nr. 2536). Mon-

tagne d' .... (unleserlich) (Montbret, Herb. Hofmuseum Wien). Erzinghan: Sipikordagh, in fruticetis (Sintenis, Iter orient., 1889, Nr. 1101)". Type: Turkey. Trapezunti, Aladja Dagh, 40º08'N, 38º43'E, 15 July 1907, *H.F. Handel-Mazzetti 1129* (lectotype, designated by Aedo & al. 2007: 113, W!; isolectotype, MA-617277!).

Perennial herbs, 18-48 cm tall. *Rootstock* 6.8-11.5 mm in diameter, ± horizontal, not tuberculate, not turnip-shaped, without thickened roots. *Stem* erect, leafy, not rooting at nodes, stolons absent, without vegetative stems, with patent, eglandular hairs 0.2-3.6 mm long and, rarely, patent, glandular hairs 0.3-0.4 mm long. *Basal leaves* in a ± persistent rosette, cauline leaves opposite; leaf laminas 4.7-8.6 cm long, 5.6-10.5 cm wide, not peltate, palmatifid [ratio main-sinus length/middle segment length = 0.50-0.68], polygonal in outline, base cordate, not coriaceous, not reticulate, with nerves not projected, pilose, with appressed, eglandular (and sometimes glandular) hairs on both surfaces; segments 5(7), in 1 plane, middle segment rhombic, 5.4-13.7 mm wide at the base [ratio segment width at the base/middle segment length = 0.13-0.26], (14)16-24(39)-lobed in distal half [ratio secondary sinus length/middle segment length = 0.23-0.35]; petioles up to 25 cm long, without abscission zone, terete, not swollen, not deflexed in age, with patent, eglandular hairs 0.2-3 mm long and, rarely, patent, glandular hairs 0.2-0.3 mm long; stipules 6.6-17.1 mm long, 1.3-4.8 mm wide, lanceolate, free, papery, brown, with eglandular hairs on abaxial surface and on the margin, glabrous adaxially. *Inflorescence* a dichasial cyme; cymules 2-flowered, solitary or in aggregates at the top of each branch [ratio cymule length/leaf length = 1.1-2.7]; peduncles 4-63 mm long, with uncinate, eglandular hairs 0.1-0.3 mm long, patent, eglandular hairs (1)2.1-2.5(3.3) mm long and, sometimes, patent, glandular hairs 0.2-1.5 mm long; bracteoles (3.2)5.2-6.4(8.2) mm long, 0.6-1.4 mm wide, linear-lanceolate, whorled; pedicels absent or 6-19 mm long, with uncinate eglandular hairs 0.1-0.3 mm long, patent, eglandular hairs 1.2-3.5 mm long and, sometimes, patent glandular hairs 0.3-1.1 mm long. Flowers actinomorphic. *Sepals* 9-13.3 mm long, 3.7-6.7 mm wide, lanceolate, smooth, not accrescent, nerves 5-7, mucro 1.4-3.3 mm long [ratio mucro length/sepal length = 0.11-0.27], with patent eglandular hairs 1.6-3.8 mm long and sometimes patent glandular hairs 0.5-1.6 mm long on the abaxial surface, glabrous adaxially. *Petals* (15.4)19.5-24.9(28.4) mm long, 12.1-22.5 mm wide, patent, emarginate (notch 1.1-3.5 mm deep), without claw, blue, glabrous on both surfaces, ciliate on the basal margin, with hairs 0.3-0.7 mm long. *Stamens* 10, both whorls bearing anthers; filaments 8.9-11.4 mm long, lanceolate, pink, pilose on the abaxial surface, ciliate on the proximal half, with hairs 0.2-3.2 mm long; anthers 2.2-3.3 mm long, blue black. Nectaries 5, hemispheric, glabrous. *Gynoecium* 6.1-10.6 mm long, dark purple. *Fruit* 29.7-39.4 mm long, erect, discharge of seed-ejection type; mericarps 4.8-6.5 mm long, 1.9-2.9 mm wide, without a strand of fibers, compressed at the apex, smooth, without basal beak, without a basal callus, without a basal prong, brown, with ± patent eglandular hairs 0.2-2.8 mm long and, sometimes, patent glandular hairs 0.3-0.9 mm long; rostrum 22.2-33 mm long, with a narrowed apex 2.6-6.7 mm long, twisted distally, with ± patent, eglandular hairs 0.8-2.3 mm long and, rarely, patent, glandular hairs 0.3-0.4 mm long; stigmatic remnants 2.4-4.4 mm long, with 5 glabrous lobes. *Seeds* 3.3-4.2 mm long, 1.7-2.2 mm wide, finely reticulate, uniformly colored, brownish red, glabrous. Cotyledons with entire margin. Figs. 683, 684.

Pollen. *Geranium*-type (Aedo & al. 2007: 99; Bortenschlager 1967: 427; Park & Kim 1997: 312; Stafford & Blackmore 1991: 73).

Chromosome number. 2*n* = 28, 56?

Phenology. Collected in flower from May to September.

Distribution. This species ranges from northeastern Turkey, Caucasus to northern Iran and it is introduced in Canada, Great Britain and U.S.A. (Fig. 685).

Habitat. Alpine meadows, rocky slopes, and among *Rhododendron* L. thickets, on schistose or igneous rocks; 100-3100 m.

Representative specimens examined. **Armenia.** Gegharkunik: pr. Zod, 40º12'N, 45º51'E, 26 July 1928, *Schelkovnikov & Kara-Murza s.n.* (KRA, LE); supra oram boreo-occidentalem lacus Sevan, 40º35'N, 44º55'E, 17 July 1975, *Avetisian 12915* (G); Sevan, 40º35'N, 44º55'E, 12 July 1970, *Avetisian & al. s.n.* (G). Kotayk: Mt. Tehenis (mt. Ali Beck) above Tsakhadzor, N Erevan, 40º31'N, 44º43'E, 5 Aug. 1984, *McNeal 453* (C, MO); Kotayk, pr. Tsahkadzor, 40º32'N, 44º41'E, 22 June 2005, *Castroviejo & al. 17696* (MA); Razdanskiy r-n Ampasap, podaem so storonui s. Megradzor, 40º36'N, 44º39'E, 5 Aug. 1986, *Menishkiy & al. s.n.* (LE). Lori: Kirovakaiskj rajon, s. Tamdzhagiran, 40º50'N, 44º35'E, 8 Aug. 1972, *Avemus? s.n.* (MA). Yerevan: Erevan, in peripheria ad urbe Cahkadzor, 40º10'N, 44º30'E, 27 July 1984, *Cuba 212* (G). **Azerbaijan.** Lankaran: Lenkoran, 38º45'N, 48º51'E, 21 July 1931, *Matveeva 695* (LE); **Canada.** British Columbia: Victoria, 22 June 1896, *Anderson & al. 200* (V). Newfoundland Is.: Beach Cove, 47º35'N, 53º15'W, 1928, *Ayre 605* (GH). **Georgia.** Kakheti: Bogdanovsky r-n, Meshdu sel. Bogdanovka i oz. Jancali, 41º37'N, 45º35'E, 12 July 1960, *Tzvelev & Yerepanov 975* (LE). Mtskheta-Mtianeti: Kartli, gorge Tana, left bank r. Mshrali-khevi, 41º51'N, 44º53'E, 1 July 1966, *Guinianidze s.n.* (MA); Mtiuleti, distr. Dusheti, r. Meketi, m. Meketi, 42º6'N, 44º40'E, 28 July 1967, *Zanitazadze s.n.* (MA); Pasanauri, Caparuka-Tal, 42º21'N, 44º42'E, 7 June 1982, *Meyer 13761* (JE); in monte Kasbek, 42º41'N, 44º30'E, 12 Aug. 1844, *Kolenati 2164* (LE). Racha-Lechkhumi and Kvemo Svaneti: Svanetia in jugo Latpari inter flumina Hippum et Ingur, 42º52'N, 42º58'E, 3 Aug. 1890, *Sommier & Levier s.n.* (FI); Racha-Lechkhumi, from Shovi along the road to Mamisoni pass, 43º43'N, 42º39'E, 13 July 2002, *Schneeweiss & al. 8011* (BM, W). Samtskhe-Javakheti: Javakheti, Bogdanovka distr., M. Madatapa, 41º10'N, 43º46'E, 22 June 1967, *Zanitazadze s.n.* (MA); Tiflis, Gori, mons Kochta pr. Bakuriani, 41º45'N, 43º28'E, 22 July 1920, *Kochreidze s.n.* (LE).South Ossetia: bl. Shalauri, uroc. Uallag-fars, subal'piyskiy senokosnuiy lug., 42º16'N, 43º27'E, 31 July 1930, *Busch & Busch s.n.* (LE); Georgian military highway, between Ordzhonikid-

ze and Tblisti, N of Krestovoyy pereval, 42°25'N, 44°3'E, 4 July 1971, *Fraser Jenkins 3025* (BM); Kutais, Swonethia, Soc. Kala in jugi Chudnjer, 42°28'N, 43°54'E, 25 Aug. 1910, *Dsosno?eny s.n.* (WU); South Osetia, the upper Big Liahva, the gorge of the river Middle Ermani-don, 42°31'N, 44°11'E, 17 Aug. 1956, *Gochina s.n.* (MA). **Great Britain.** Wales: Abernant, Aberdare, 51°52'N, 4°24'W, 13 June 1974, *Pell s.n.* (NMW); Pont Glanrafon, Cribyn, 52°7'N, 4°9'W, 7 June 1991, *Chater s.n.* (NMW). **Iran.** Gilan: Ghilan, 37°0'N, 49°50'E, *Aucher-Éloy 4303* (BM, FI, W). Tehran: Elburz Mts., Kaladash valley N Elburz, 35°40'N, 52°3'E, 2 Aug. 1956, *McDougall 44* (BM). **Turkey.** Artvin: Çoruh, Savval tepe, Murgul üstleri, 41°9'N, 41°27'E, 12 Aug. 1957, *Davis & Hedge 32285* (BM, E, ISTE). Erzurum: Armenia turcica, Szanschak Gumuschkane, Karagölldagh, 39°42'N, 41°15'E, 31 July 1894, *Sintenis 7053* (E, JE, LD, WRSL, Z). Giresun: Balabandaglari above Tamdere, above Avsar Yayla, 40°30'N, 38°22'E, 7 Aug. 1952, *Davis & al. 20570* (BM, E). Gümüşhane: puerto de Kostandagi, vertiente N, 40°30'N, 39°46'E, 25 June 2001, *Herrero & al. 1550* (MA). Rize: 8 km antes Ovit Dagi Geçidi, vertiente N, 40°39'N, 40°43'E, 29 June 2001, *Nisa 893* (MA); Haldizam, Harami Dagh, 40°50'N, 40°35'E, 29 July 1934, *Balls 1892* (BM, E); Kavron-Hochtal, Kaçkar-massiv, 30 km SE Çamlihemsin, 40°50'N, 41°8'E, 10 Sep. 1980, *Sorger 80-62-25* (W); SE Trabzon, near village of Dernek, 41°9'N, 40°57'E, 2 June 1977, *Lancaster s.n.* (BM). Trabzon: Trabzon, Bayburt, 3 km N of pass, 40°32'N, 40°15'E, 11 July 1960, *Stainton & Henderson 6202* (E, M). **USA.** Colorado: Boulder Co., disturbed site along Boulder Creek, 37°48'N, 107°7'W, 16 June 1993, *EPOB 4520* (COLO). Maine: Hancock Co., from Mt. [?]eserd Nursery Bar Harbor, 44°23'N, 68°12'W, 2 June 1910 (GH). Washington: Kitsap Co., near junction of Johnson Way NE

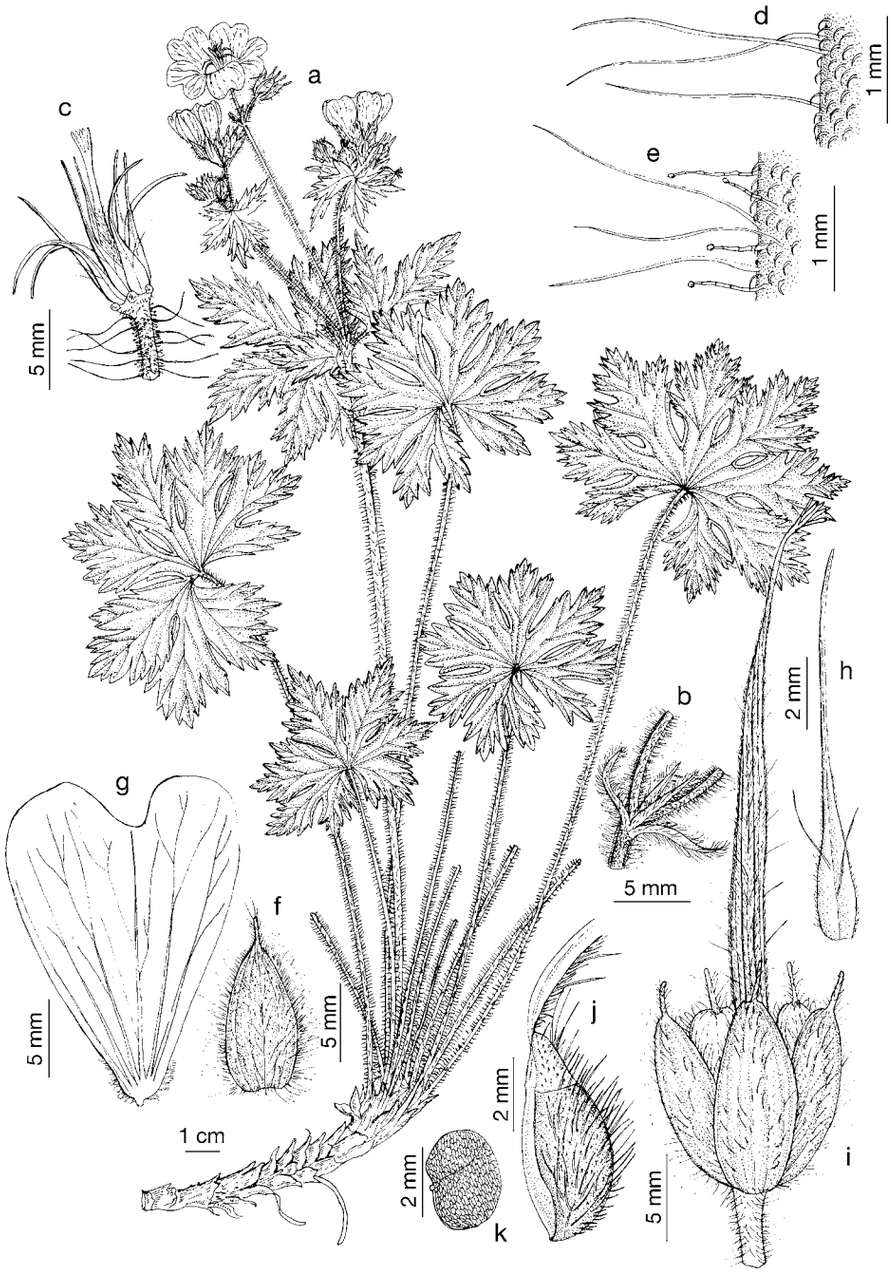


Fig. 683. *Geranium ibericum*. a. Habit. b. Bracteoles. c. Flower without petals and sepals. d, e. Indumentum of the pedicel. f. Sepal. g. Petal. h. Staminal filament. i. Fruit. j. Mericarp. k. Seed. (Based on: a-d, f-h, *Menishkiy & al. s.n.*, *5 Aug. 1986*, LE; b, c, e, *Scheidweiler s.n.*, *June 1861*, BR; i-k, without collector, BR-825853).

Fig. 684. *Geranium ibericum* (Based on: *Aedo 4477,* MA).

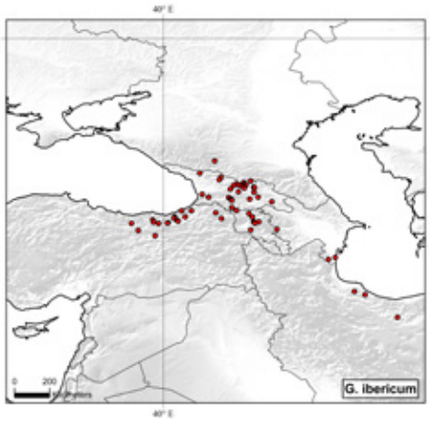


Fig. 685. Distribution of *Geranium ibericum*.

and Peterson Way NE, 47º42'N, 122º37'W, 17 May 2017, *Zika 28748* (MA).

Discussion. Geranium ibericum has a characteristic dense indumentum of long, soft, patent eglandular hairs along the inflorescence. However, the presence and distribution of glandular hairs is variable. In some specimens, these hairs are lacking, while in others they are abundant and intermixed with eglandular ones, together with some intermediate forms. Collections with both extremes (*Davis & Hedge 32285*, *Sintenis 7053*, *Woronow & Schelkownikow, Herb. Fl. Cauc. 32*) are not rare. *Geranium montanum* was accepted by Bobrov (1949), who also recognized *G. ibericum*. They were distinguished by the presence of glandular hairs on the inflorescence in the first and the absence in the second. Davis (1967) treated Turkish specimens with glandular hairs as *G. ibericum* subsp. *jubatum.* Both taxa are here considered as synonyms for the reasons above mentioned. *Geranium ibericum* shares with *G. platypetalum* a general appearance as well as the indumentum of long, soft, patent eglandular hairs along the inflorescence. However, in *G. platypetalum* glandular hairs are always present, even on the basal part of the stem. *Geranium ibericum* has leaves with rhombic middle segments, while *G. platypetalum* has obtriangular segments. Additionally, *G. platypetalum* has longer bracteoles, longer sepal mucros, and shorter petals than *G. ibericum*.

The first effective lectotypification of *G. ibericum* appears to be that of Novoselova (1998), who designated the Cavanilles plate as the "type". The proposal by Novoselova is technically correct, but it could be improved by designating an epitype for a more precise application of the name. However, during the review of the proposal to conserve the name *G. ibericum* (Aedo 2005), J. McNeill and J.H. Wiersema kindly suggested a simpler solution, and thus I proposed a conserved type. According to Van Loon (1984b: 268) the chromosome count of 2*n* = 56 for this species (Gauger 1937: 529) should be confirmed.

Geranium ibericum is an endemic species from Caucasus that is widely used in gardens and occasional or naturalized in Canada, Great Britain, and U.S.A.

271. Geranium platypetalum Fisch. & C.A. Mey., Index Sem. Hort. Petrop. [1]: 28. 1835. *Geranium ibericum* var. *platypetalum* (Fisch. & C.A. Mey.) Boiss., Fl. Orient. 1: 876. 1867. Type locality: "Hab. in montibus et subalpinis Somchetiae, Iberiae, Talüsch". Type: Azerbaijan. In proclivibus saxosis altiorum regionum montis, Sarial im Elisabethpolytan. Provin, 40º40'N, 46º21'E, June-July 1834, *R.F. Hohenacker s.n.* (neotype, designated by Novoselova 1998: 157, LE!; isoneotypes, BM-000606754!, BR-0000008258489!, E-00331077!, FI-010374!, GOET-004068!, HBG-517291!, JE-00019308!, L-0279856!, M!, MA!, RO!, W!, WU!, WRSL!).

Geranium platypetalum var. *albipetalum* Erik & Demirkuş, Doga Bilim Derg, A 10(1): 101, fig. 2. 1986. Type locality: "(Turkey). A8/9 Artvin: Kaçkal Dağı, Cehennem Deresi, 3000 m, 13.8.1984, N. Demirkuş 2635". Type: Turkey. Artvin, Kaçkal Dağı, Cehennem Deresi, 40º50'N, 41º09'E, 13 Aug. 1984, *N. Demirkuş 2635* (holotype, HUB).

Perennial herbs, 25-57 cm tall. *Rootstock* 6.2-13.8 mm in diameter, ± horizontal, not tuberculate, not turnip-shaped, without thickened roots. *Stem* erect, leafy, not rooting at nodes, stolons absent, without vegetative stems, with patent, eglandular hairs 0.2-4.9 mm long and, usually, patent, glandular hairs 0.6-1.8 mm long. *Basal leaves* in a ± persistent rosette, cauline leaves opposite; leaf laminas 3.6-11.2 cm long, 4.6-12.8 cm wide, not peltate, palmatifid [ratio main-sinus length/middle segment length = 0.43-0.58], polygonal in outline, base cordate, not coriaceous, not reticulate, with nerves not projected, pilose, with appressed, eglandular (and sometimes glandular) hairs on both surfaces; segments 5(7), in 1 plane, middle segment ± obtriangular, 9.6-27.1 mm wide at the base [ratio segment width at the base/middle segment length = 0.28-0.49], (9)17-25(29)-lobed in distal half [ratio secondary sinus length/middle segment length = 0.15-0.26]; petioles up to 30 cm long, without abscission zone, terete, not swollen, not deflexed in age, with uncinate, eglandular hairs 0.1-0.3 mm long, patent, eglandular hairs 2.2-4.7 mm long and, usually, patent, glandular hairs 0.3-1.8 mm long; stipules 6.5-13 mm long, 2.2-4.6 mm wide, broadly lanceolate, free, papery, brown, with eglandular and glandular hairs on both surfaces and on the margin. *Inflorescence* a dichasial cyme; cymules 2-flowered, solitary or in aggregates at the top of each branch [ratio cymule length/leaf length = 1.5-3.4]; peduncles 22-134 mm long, with uncinate, eglandular hairs 0.1-0.3 mm long, patent, eglandular hairs (1.9)2.5-3.6(4.8) mm long and patent, glandular hairs 0.7-1.5 mm long; bracteoles (8.4)9.6-14.1(18.8) mm long, 0.7-1.6 mm wide, linear-lanceolate, whorled; pedicels absent or 8-23 mm long, with uncinate eglandular hairs 0.1-0.3 mm long, patent, eglandular hairs 2.2-4.5 mm long and patent, glandular hairs 0.9-2 mm long. Flowers actinomorphic. *Sepals* 8.2-12.5 mm long, 3-5.4 mm wide, lanceolate, smooth, not accrescent, nerves 5-7, mucro 2-5.5 mm long [ratio mucro length/sepal length = 0.20-0.51], with patent eglandular hairs 0.2-5.4 mm long and patent glandular hairs 0.5-2.6 mm long on the abaxial surface, glabrous adaxially. *Petals* (14.7)16.7-18.7(20.9) mm long, 10.5-18.1 mm wide, patent, emarginate (notch 0.5-1.9 mm deep), without claw, blue, glabrous on both surfaces, ciliate on the basal margin, with hairs 0.3-0.6 mm long. *Stamens* 10, both whorls bearing anthers; filaments 8.4-12.5 mm long, lanceolate, dark purple, pilose on the abaxial surface, ciliate on the proximal half, with hairs 2.5-4.1 mm long; anthers 2.7-3.4 mm long, blue black. Nectaries

5, hemispheric, glabrous. *Gynoecium* 7.8-11.2 mm long, dark purple. *Fruit* 31.7-38.8 mm long, erect, discharge of seed-ejection type; mericarps 4-5.5 mm long, 2-2.9 mm wide, without a strand of fibers, compressed at the apex, smooth, without basal beak, without a basal callus, without a basal prong, brown, with ± patent eglandular hairs 1-2.5 mm long and patent, glandular hairs 0.40-1 mm long; rostrum 22.3-30.9 mm long, with a narrowed apex 3.8-5.9 mm long, twisted distally, with ± patent, eglandular hairs 2.3-3.8 mm long and patent, glandular hairs 0.7-1 mm long; stigmatic remnants 1.6-3.8 mm long, with 5 glabrous lobes. *Seeds* 2.8-3.5 mm long, 1.8-2.4 mm wide, finely reticulate, uniformly colored, brownish red, glabrous. Cotyledons with entire margin. Figs. 686, 687.

Pollen. *Geranium*-type (Aedo & al. 2007: 99; Bortenschlager 1967: 427).

Chromosome number. 2*n* = 28, 42.

Phenology. Collected in flower from May to August.

Distribution. This species ranges from northeast Turkey to Caucasus and northern Iran (Fig. 688).

Habitat. Edge of *Betula* L., *Picea* A. Dietr. and *Abies* Mill. forests, or alpine meadows, on igneous rocks; 1200-2700 m.

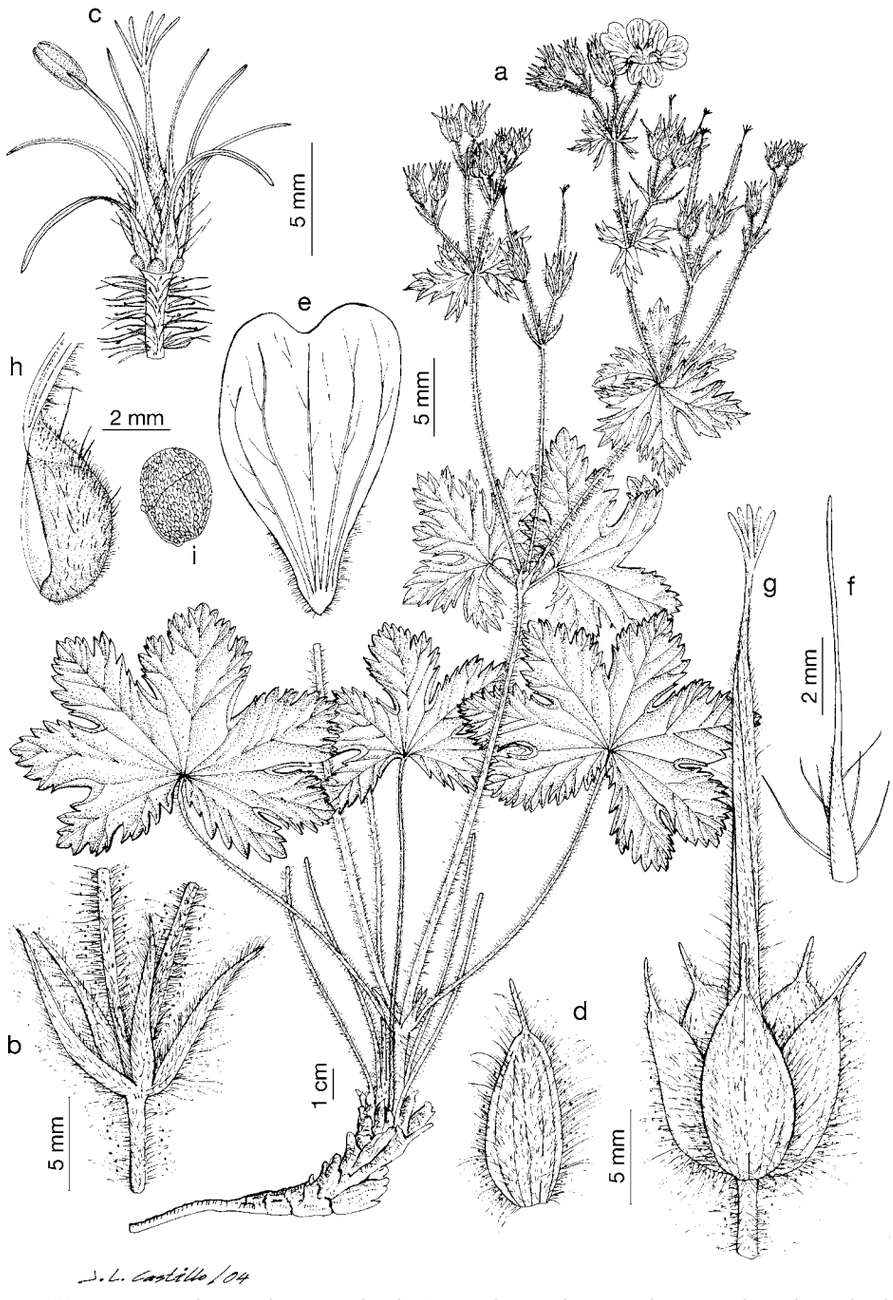


Fig. 686. *Geranium platypetalum*. a. Habit. b. Bracteoles. c. Flower without petals and sepals. d. Sepal. e. Petal. f. Staminal filament. g. Fruit. h. Mericarp. i. Seed (Based on: a-i, *Marcowicz s.n.*, *4 June 1901*, MA).

Representative specimens examined. **Armenia.** Gegharkunik: pr. Nor-Baiazet, in fuc. Gri-zör, 40°19'N, 45°7'E, 16 Aug. 1928, *Schelkovnikov & Kara-Murza s.n.* (LE). Lori: Mt. Lalvar, E of Sverdlov, 41°5'N, 44°25'E, 30 June 2003, *Vitek & al. 03-0411* (MA, W). Nagorno Karabaj: Karabakh, Shushi, c. 20 km SW of Stepanakert, 2.6 km NNW of Eghtsahogh, 39°42'N, 46°34'E, 9 June 2010, *Vitek & al. 10-0723* (MA, W). Syunik: Sjunik province, Kapan districk, Kajaran pass, from saddle c. 1.3 km W of top, 39°6'N, 46°8'E, 20 Aug. 2005, *Vitek & al. 05-1834* (MA, W); Caucasus, Goris, montes Karabakhskoie nagorje, pr. Brun, 39°30'N, 46°20'E, 27 July 1975, *Vašák s.n.* (M, MA). Tavush: Haghartsin monastery, 40°49'N, 44°53'E, 21 June 2005, *Castroviejo & al. 17652* (MA). **Azerbaijan.** Absheron: Baku, distr. Geokczai, in valle supra p. Dshuljan infer. ad m. Kupucz, 40°39'N, 47°44'E, 2 Aug. 1899, *Alexeenko s.n.* (LE). Ganja-Qazakh: prov. Elisabethpol, distr. Adzikent, 40°40'N, 46°21'E, 9 July 1912, *Schelkovnikov s.n.* (BM). Kalbajar-Lachin: Nucha, in pascuis alpinis Dashly-Bara, 39°48'N, 46°18'E, 25 June 1927, *Yarochenko s.n.* (LE). Upper Karabakh: Karabach austr., m. Ziarat, 39°31'N, 46°51'E, 4 July 1932, *Karjagin s.n.* (S). **Georgia.** Mtskheta-Mtianeti: prov. Terek, in valle Adyz-su, confl. Baksani, 42°22'N, 44°43'E, 22 July 1896, *Alexeenko 7344* (LE); Kazbegi distr., SE of Kazbegi village, 42°39'N, 44°38'E, 4 July 1984, *Eggli 396* (Z). Racha-Lechkhumi and Kvemo Svaneti: Svanetia libera, prope pagum Kala, 42°27'N, 43°5'E, 7 Aug. 1890, *Sommier & Levier s.n.* (FI); Ossetia, Jedisi ad fl. Didi Liachva, 42°33'N, 43°4'E, 20 July 1881, *Brotherus 210* (BM, BR, H, S); Mingrelie, Mt. Tschkhorotzkhon, 42°48'N, 42°25'E, 29 July 1894, *Alboff s.n.* (Z). Samegrelo-Zemo Svaneti: Mestia, 43°2'N, 42°43'E, 28 July 1979, *Vašák s.n.* (G, W); Svanetia libera occid, in jugo Djodissik, 43°4'N, 42°17'E, 23 Aug. 1890, *Sommier &*

Fig. 687. *Geranium platypetalum* (Based on: *Aedo 11454,* MA).

Levier s.n. (FI). Samtskhe-Javakheti: Achalzich, 41°38'N, 42°58'E, 2 July 1926, *Meffert 428* (LE); Tiflis, Borzom, pr. pagum Bakuriani, 41°46'N, 43°32'E, 27 July 1928, *Kozlowsky 340* (LE, LD). South Ossetia: Lars ad fl. Terek, 42°25'N, 44°3'E, 24 May 1881, *Brotherus 209* (BR, H). **Iran.** East Azerbaijan: inter Alibulagh et Delhi, 38°52'N, 46°41'E, 20 Sep. 1884, *Knapp s.n.* (WU); Ahar, Kuh Kaleybar, 38°27'N, 47°4'E, 4 Aug. 1968, *Tremé 13185E* (W). **Russia.** Dagestan: distr. Samur, pr. pagum Gedym, 41°35'N, 47°38'E, 7 Aug. 1900, *Alexeenko 7399* (LE); Tlarata, river Avarskoje Kojsu between Sovietskoe and Tlarata, 7 km from Kosob-Orta, 42°14'N, 46°22'E, 20 Aug. 1961, *Tzvelev & al. 3768* (LE). Kabardino-Balkaria: Dych-su, 43°3'N, 43°7'E, 12 July 1925, *Busch & Busch s.n.* (C); between Baksan and Bylym, mt. Elbrus, 43°40'N, 43°32'E, 13 July 1975, *Degener 34056* (MO); Caucasus centralis, distr. Baksan, in declivibus rivi Irik ad pedes montis Gubasanty, 43°41'N, 44°4'E, 17 Aug. 1978, *Vašák s.n.* (W). Karachayevo-Cherkasskaiya: Kuban, vallis fl. Teberda, 43°32'N, 41°47'E, 11 June 1908, *Busch & Busch s.n.* (C, E, H, LE, MPU, W, WA, WU). North Ossetia: Ossetia, Kassory, 4 June 1901, *Marcowicz s.n.* (MA); Digoria, Karaga river, 43°9'N, 44°9'E, 12 Aug. 1925, *Busch & Busch s.n.* (S). **Turkey.** Artvin: Yusufeli, Yaylalar Köyü, Çamyuva Mahallesi, 40°53'N, 41°16'E, 23 June 2015, *Dönmez 19509* (HUB); Çoruh (Artvin), Ardanuç-Kordevan dag, 41°7'N, 42°3'E, 27 June 1957, *Davis & Hedge 30108* (BM, E); Artvin, Yalnizcam Gebirge bei Karaköy, W von Savsat, 41°13'N, 42°27'E, 5 Aug. 1981, *Raus 4749* (B, BM); Artvin, 3 km E Karaköy, 41°13'N, 42°27'E, 4 Aug. 1981, *Sorger 81-73-10* (W). Erzurum: Dutlu Dagi nw Oltu, 40°43'N, 41°59'E, 16 July 1989, *Nydegger 44462* (G). Rize: 4 km antes Ovit Dagi Geçidi, vertiente N, 40°37'N, 40°46'E, 28 June 2001, *Nisa 891* (MA); Rize, 8 km antes Ovit Dagi Geçidi, vertiente N, 40°39'N, 40°43'E, 29 June 2001, *Nisa 893b* (MA); Rize, 4-5 km below top of Ikizdere-Ispir Pass on N side of Kirklar Dag, 40°44'N, 40°56'E, 8 Sep. 1970, *Fraser Jenkins 2355* (BM); Rize, Hemsin, Ortakoy-Cat, 41°3'N, 40°54'E, 2 Sep. 1952, *Davis 21255* (E). Trabzon: region alpine du Lazistan, au desus de Djmil, 40°40'N, 39°40'E, July 1866, *Balansa 1372* (GOET, JE, MA, RO, W, Z).

Discussion. Geranium platypetalum can be confused with glandular forms of *G. ibericum* (see discussion of *G. ibericum*, above). Basal leaves should

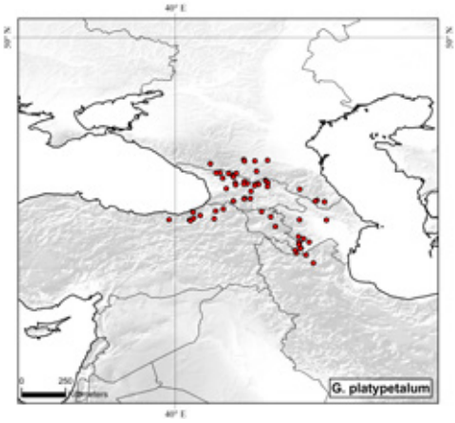


Fig. 688. Distribution of *Geranium platypetalum*.

be used to discriminate these species, because they show more clearly obtriangular segments than cauline ones. Hohenacker (1833) published "G. platypetalum Fisch. & Mey. in literis" based on a specimen collected in "montis Sarial", but with no description. This species was republished two years later by Fischer & Meyer (1835) with a full description, but without any reference to Hohenacker's publication. They indicated a general area, "Hab. in montibus et subalpinis Somchetiae, Iberiae, Talüsch", but did not list any particular specimens. Novoselova (1998) proposed the specimen collected in Sarial (and distributed by Hohenacker in the *Unio Itineraria exsiccata*) to be the lectotype. This specimen is not directly connected to the protologue. On the other hand, at LE there are no other specimens clearly connected to the protologue that would be a better choice as lectotype. Thus, I preferred to consider Hohenacker's specimen as neotype in order to avoid any nomenclatural disturbance and considering that it was collected in the area mentioned by Fischer & Meyer (1835), and perfectly fits the original description.

272. Geranium peloponnesiacum Boiss., Diagn. Pl. Orient. ser. 2, 1: 110. 1854. Type locality: "G. asphodeloides Fl. d. Morée ex spec. authentico in herb. Fauchè non Willd. Hab. in sylvis circâ templum Phigaleae in Peloponneso (herb. Fauchè)". Type: Greece. Peloponneso, templum Phigaleae, 37°24'N, 21°51'E, May 1830, *J.B. Fauché s.n.* (lectotype, designated by Aedo & al. 2007: 118, G-BOIS!).

Perennial herbs, 20-53 cm tall. *Rootstock* 5.3-13.3 mm in diameter, ± horizontal, not tuberculate, not turnip-shaped, without thickened roots. *Stem* erect, leafy, not rooting at nodes, stolons absent, without vegetative stems, with patent to retrorse, eglandular hairs 0.2-2 mm long. *Basal leaves* in a ± persistent rosette, cauline leaves opposite; leaf laminas 3-8.8 cm long, 3.2-10 cm wide, not peltate, palmatifid [ratio main-sinus length/middle segment length = 0.54-0.67], polygonal in outline, base cordate, not coriaceous, not reticulate, with nerves not projected, pilose, with appressed, eglandular hairs on both surfaces; segments 5(7), in 1 plane, middle segment rhombic, 4.1-10.8 mm wide at the base [ratio segment width at the base/middle segment length = 0.15-0.24], (11)12-16(17)-lobed in distal half [ratio secondary sinus length/middle segment length = 0.20-0.29]; petioles up to 18 cm long, without abscission zone, terete, not swollen, not deflexed in age, with patent to retrorse, eglandular hairs 0.2-2.9 mm long and patent, glandular hairs 0.2-0.3 mm long at the apex; stipules 8.8-12.5 mm long, 1.2-2.4 mm wide, lanceolate, free, papery, brown, with eglandular hairs on abaxial surface and on the margin, usually glabrous adaxially. *Inflorescence* a dichasial cyme; cymules 2-flowered, solitary or in aggregates at the top of each branch [ratio cymule length/leaf length = 2.1-3.1]; peduncles 14-104 mm long, with uncinate, eglandular hairs 0.1-0.3 mm long, patent, eglandular hairs 0.6-1(1.2) mm long and patent, glandular hairs 0.3-0.5 mm long; bracteoles (3.2)3.6-3.4(4.8) mm long, 0.5-0.9 mm wide, linear-lanceolate, whorled; pedicels absent or 5-34 mm long, with uncinate eglandular hairs 0.1-0.3 mm long, patent, eglandular hairs 0.6-1 mm long and patent, glandular hairs 0.3-0.5 mm long. Flowers actinomorphic. *Sepals* 7.2-10.8 mm long, 2.2-3.9 mm wide, lanceolate, smooth, not accrescent, nerves 3-5, mucro 1.2-3 mm long [ratio mucro length/sepal length = 0.16-0.41], with ± patent eglandular hairs 0.4-3.7 mm long and patent glandular hairs 0.2-0.5 mm long, usually at the base on the abaxial surface, glabrous adaxially. *Petals* (15.4)16.9-18.3(18.9) mm long, 9.5-12.8 mm wide, ± patent, emarginate (notch 1.2-3.5 mm deep), without claw, purple, glabrous on the adaxial surface, hairy on the base of the abaxial surface, ciliate on the basal margin, with hairs 0.3-0.6 mm long. *Stamens* 10, both whorls bearing anthers; filaments 6.5-8.4 mm long, lanceolate, pink, pilose on the abaxial surface, ciliate on the proximal half, with hairs 1-3 mm long; anthers 1.8-2.7 mm long, cream with blue edges. Nectaries 5, hemispheric, glabrous. *Gynoecium* 4.4-8.6 mm long, green. *Fruit* 43.6-44.7 mm long, erect, discharge of seed-ejection type; mericarps 6.3-6.4 mm long, 2.6-3.1 mm wide, without a strand of fibers, compressed at the apex, smooth, without basal beak, without a basal callus, without a basal prong, brown, with ± patent eglandular hairs 0.3-0.5 mm long and patent, glandular hairs 0.4-0.5 mm long; rostrum 33.7-35.1 mm long, with a narrowed apex 2.1-2.9 mm long, twisted distally, with ± patent, eglandular hairs 0.5-0.6 mm long and patent, glandular hairs 0.4-0.5 mm long; stigmatic remnants 2.3-3.2 mm long, with 5 glabrous lobes. *Seeds* 3-3.1 mm long, 2-2.2 mm wide, finely reticulate, uniformly colored, brownish red, glabrous. Cotyledons with entire margin. Figs. 689, 690.

Pollen. *Geranium*-type (Aedo & al. 2007: 99; Bortenschlager 1967: 427).

Chromosome number. Unknown.

Phenology. Collected in flower from April to June.

Distribution. This species ranges through central and southern Greece (Fig. 691).

Habitat. Abies Mill., *Castanea* Mill. and *Quercus* L. forests, on limestone substrates; 550-1500 m.

Additional specimens examined. **Greece.** Central Greece: Phthiotidos, Mt. Iti, 3 km W of Pavliani, 38°44'N, 22°20'E, 4 June 1985, *Gustavsson 9018* (C, G); Mt. Iti, c 3 km W of Pavliani, 38°44'N, 22°20'E, 26 May 1975, *Landström 2546* (LD); Phthiotidos, mons Callichromon supra monasterium Damasta, 38°48'N, 22°30'E, 4 May 1958, *Pinatzi 14376* (G); Evrytania, 2,2 km NW Kokkalia-Gipfel, 38°51'N, 21°52'E, 3 June 1991, *Willing 14175* (B). Peloponnese: Laconiae, in monte Malevo, pr. Hajos Petros, 37°10'N, 22°15'E, 26 Apr. 1857, *Orphanides 624* (FI, S, UPS, W); Achaia, Mt. Olenos (Erymanthos vet.), 37°59'N, 21°50'E, 12 June 1893, *Halácsy s.n.* (B, JE, LD, PR, W, WU); Evvia, ep. Karistias, Rouklia, ESE of the village, 38°4'N, 24°26'E, 8 May 1996, *Snogerup 12847* (LD); Attica, Mt. Parnes pr. Limiko, 38°10'N, 23°40'E, 17 Apr. 1930, *Guiol 1159* (BM, G). West Greece: Etolias-Akarnanias, Mesolongiou, 1 km S of Ano Kerasovon, 38°29'N, 21°27'E, 3 May 1996, *Nielsen 11132* (B, UPA); Etolia-Akarnania, 2,1 km SO Dhorvitsa, 38°32'N, 21°48'E, 16 May 1991, *Willing 12111* (B). West Macedonia: Grevena, 1,7 km SSW Dhasohori, 39°52'N, 21°48'E, 29 May 1993, *Willing 29044* (B); Kozanis, Kam-

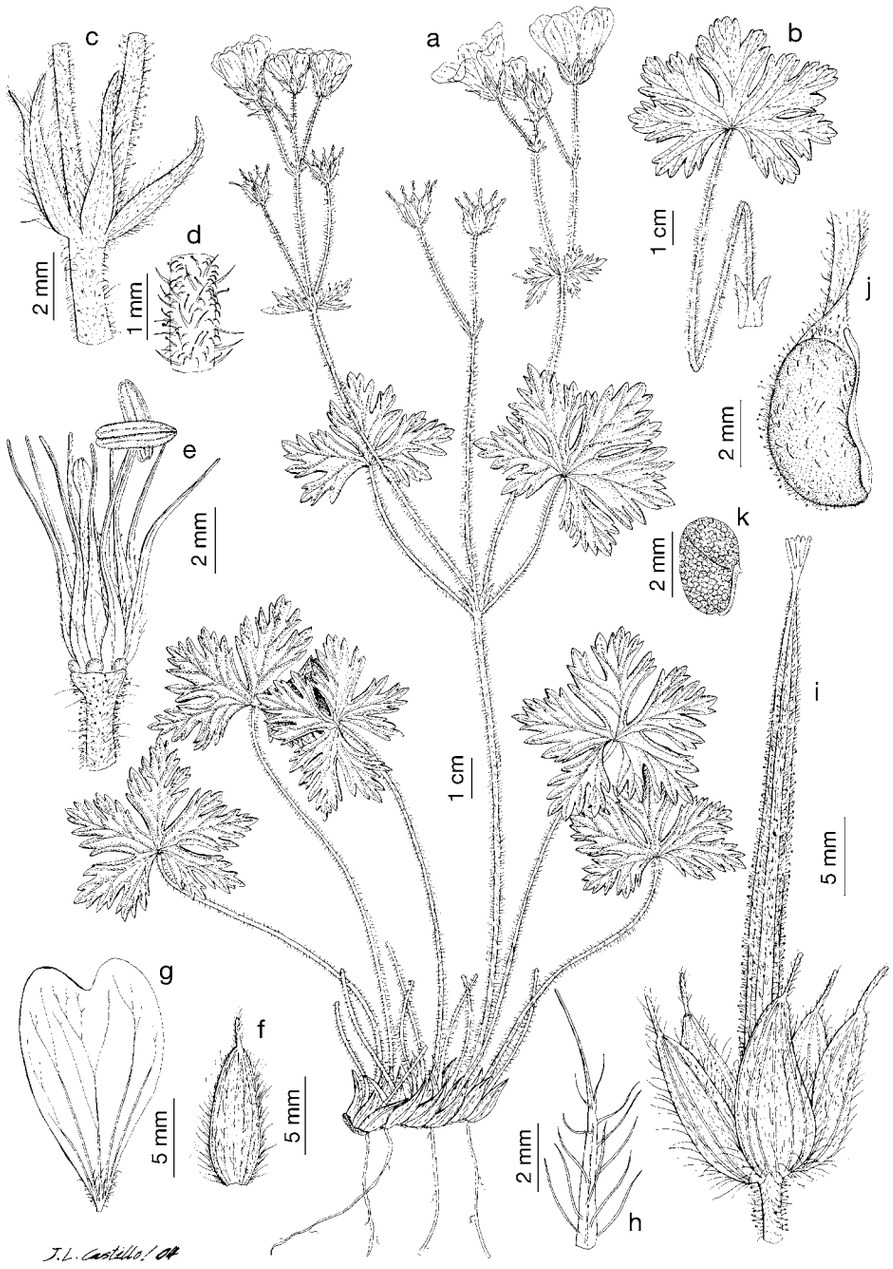


Fig. 689. *Geranium peloponnesiacum*. a. Habit. b. Leaf. c. Bracteoles. d. Indumentum of the pedicel. e. Flower without petals and sepals. f. Sepal. g. Petal. h. Staminal filaments. i. Fruit. j. Mericarp. k. Seed. (Based on: a, *Guiol 1159,* BM; b-k, *Snogerup 12847*, LD).

Fig. 690. *Geranium peloponnesiacum* (Based on: *Aedo 11392,* MA).

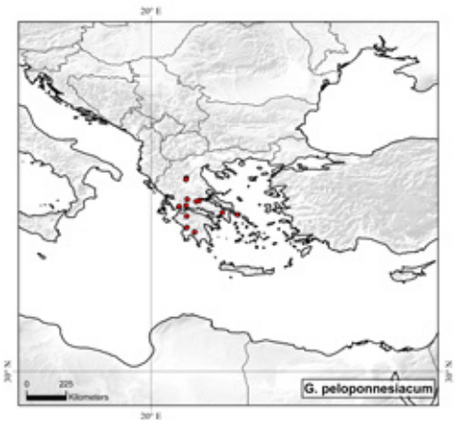


Fig. 691. Distribution of *Geranium peloponnesiacum*.

vounia, 1,8 km SSO Elati, 39º57'N, 21º49'E, 4 June 1992, *Willing 16830* (B).

Discussion. Geranium peloponnesiacum resembles *G. ibericum* and *G. platypetalum* by its long, soft, patent eglandular hairs along the inflorescence. However, in *G. peloponnesiacum* eglandular hairs are shorter, and petals are hairy on the base of the abaxial surface (petals glabrous on both surfaces in *G. ibericum* and *G. platypetalum*). The leaf lamina is more similar to *G. ibericum* because it has a rhombic middle segment (not obtriangular as in *G. platypetalum*). *Geranium peloponnesiacum* has fewer lobes per segment, and the bracteoles, anthers, staminal filaments and gynoecia are shorter than in both *G. ibericum* and *G. platypetalum*. Additionally, the sepal mucros of *G. peloponnesiacum* are relatively shorter (as in *G. ibericum*), while the petals are more similar in size to *G. platypetalum*. In dry specimens, the leaf abaxial surface of *G. peloponnesiacum* may be a bit whitish, as may also be found in *G. libani*. Nevertheless, the former species has always glandular hairs on the inflorescence, while in the latter they are only eglandular. Additionally, the notch at the apex of the petals is deeper in *G. peloponnesiacum* than in *G. libani*. *Geranium peloponnesiacum* is usually proterandrous, but some specimens with shorter anthers suggest that this species may also show gynodioecy.

273. Geranium libani P.H. Davis, Notes Roy. Bot. Gard. Edinburgh 22: 25. 1955. *Geranium peloponnesiacum* var. *libanoticum* Boiss. & C.I. Blanche ex Boiss., Diagn. Pl. Orient. ser. 2, 5: 73. 1856, [syn. subst.]. *Geranium libanoticum* (Boiss. & C.I. Blanche ex Boiss.) Boiss., Fl. Orient. 1: 877. 1867, nom. illeg., non Schenk. 1840. Type locality: "G. Libanoticum Boiss. et Blanche in pl. Syr. exs. non Schenck in Schubert. Hab. in montibus circâ Eden Libani cl. Reygasse ex Blanche". Type: Lebanon. Eden, 34º16'N, 35º58'E, 23 June 1854, *R. Reygasse 1164* (lectotype, designated by Aedo & al. 2007: 120, G-BOIS!; isolectotype, JE-00010393!).

Perennial herbs, 19-52 cm tall. *Rootstock* 6-12.7 mm in diameter, ± horizontal, not tuberculate, not turnip-shaped, without thickened roots. *Stem* erect, leafy, not rooting at nodes, stolons absent, without vegetative stems, with patent to retrorse, eglandular hairs 0.3-0.9 mm long. *Basal leaves* in a ± persistent rosette, cauline leaves opposite; leaf laminas 2.4-6.4 cm long, 3.2-8.8 cm wide, not peltate,

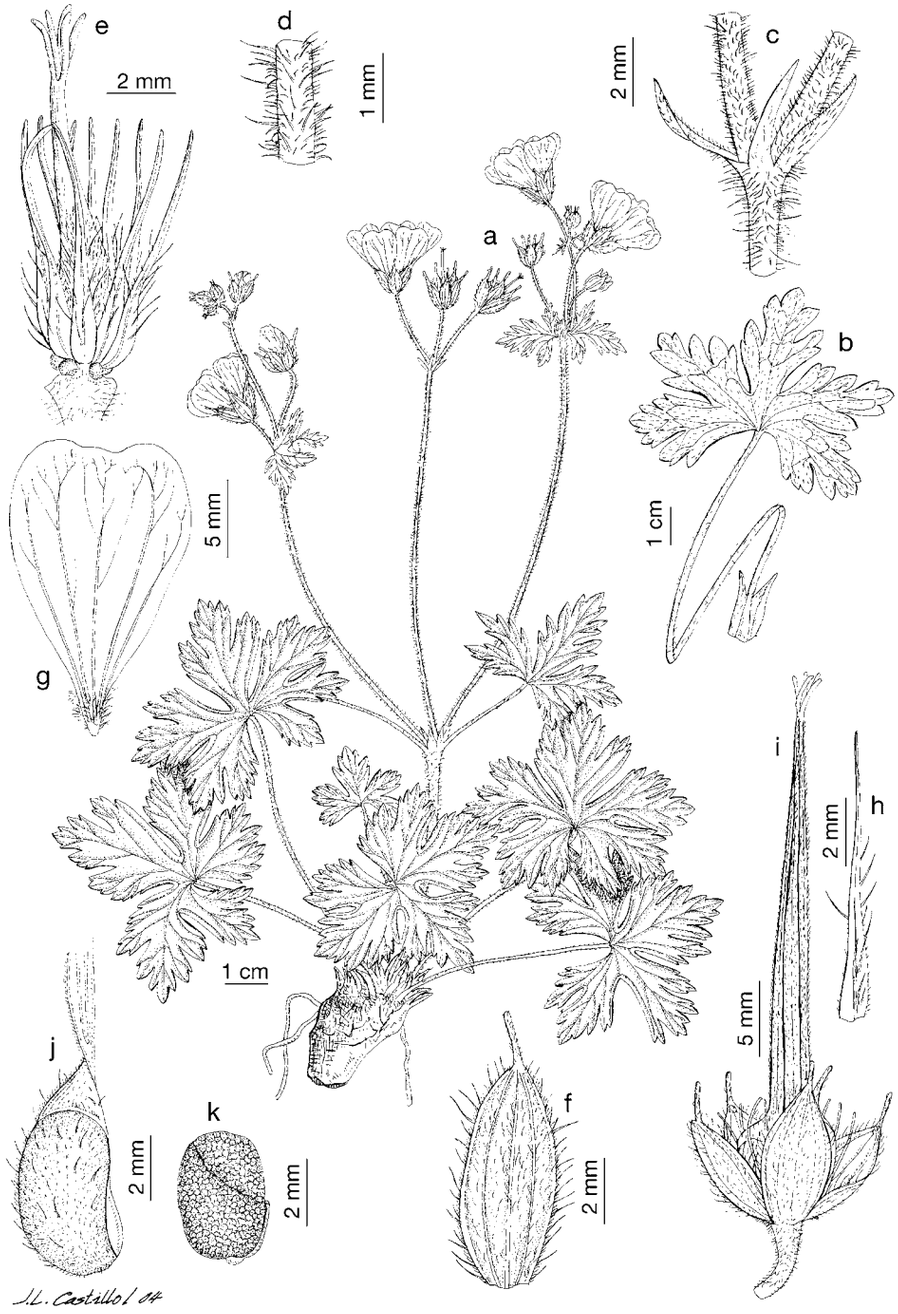


Fig. 692. *Geranium libani*. a. Habit. b. Leaf. c. Bracteoles. d. Indumentum of the pedicel. e. Flower without petals and sepals. f. Sepal. g. Petal. h. Staminal filaments. i. Fruit. j. Mericarp. k. Seed. (Based on: a-f, *Samuelsson 5105*, S; g, *Pabot s.n., 25 Apr. 1953*, G; h-k, *Bornmüller 11544*, G).

Fig. 693. *Geranium libani* (Based on: *Aedo 11393,* MA).

palmatifid [ratio main-sinus length/ middle segment length = 0.49-0.66], polygonal in outline, base cordate, not coriaceous, not reticulate, with nerves not projected, pilose, with appressed, eglandular hairs on both surfaces; segments 5(7), in 1 plane, middle segment rhombic, 3.7-10.3 mm wide at the base [ratio segment width at the base/middle segment length = 0.17-0.26], (8)9-13(16)-lobed in distal half [ratio secondary sinus length/middle segment length = 0.49-0.66]; petioles up to 18 cm long, without abscission zone, terete, not swollen, not deflexed in age, with patent to retrorse, eglandular hairs 0.3-0.9 mm long; stipules 3.8-10.5 mm long, 0.8-2 mm wide, lanceolate, free, papery, brown, with eglandular hairs on abaxial surface and on the margin, usually glabrous adaxially. *Inflorescence* a dichasial cyme; cymules 2-flowered, solitary or in aggregates at the top of each branch [ratio cymule length/leaf length = 1-3.2]; peduncles 14-137 mm long, with uncinate, eglandular hairs 0.1-0.3 mm long and patent, eglandular hairs 0.4-0.7(0.8) mm long; bracteoles (1.2)2-2.6(4.7) mm long, 0.4-0.8 mm wide, linear-lanceolate, whorled; pedicels absent or 13-27 mm long, with uncinate eglandular hairs 0.1-0.3 mm long and patent, eglandular hairs 0.5-1.1 mm long. Flowers actinomorphic. *Sepals* 6.4-9.5 mm long, 3-5.2 mm wide, lanceolate, smooth, not accrescent, nerves 3-5, mucro 1.3-2.3 mm long [ratio mucro length/sepal length = 0.14-0.33], with ± patent eglandular hairs 0.8-2.1 mm longon the abaxial surface, glabrous adaxially. *Petals* (10.4)12.9-16.9(18.3) mm long, 5.9-10.7 mm wide, ± patent, emarginate (notch 0.2-1.3 mm deep), without claw, blue, glabrous on the adaxial surface, hairy on the base of the abaxial surface, ciliate on the basal margin, with hairs 0.6-1.1 mm long. *Stamens* 10, both whorls bearing anthers; filaments 6.3-8.4 mm long, lanceolate, pink, pilose on the abaxial surface, ciliate on the proximal half, with hairs 0.9-2.4 mm long; anthers 1.3-3 mm long, blue. Nectaries 5, hemispheric, glabrous. *Gynoecium* 4.6-8.6 mm long, purple. *Fruit* 30.6-38 mm long, erect, discharge of seed-ejection type; mericarps 5-6.1 mm long, 1.9-2.5 mm wide, without a strand of fibers, compressed at the apex, smooth, without basal beak, without a basal

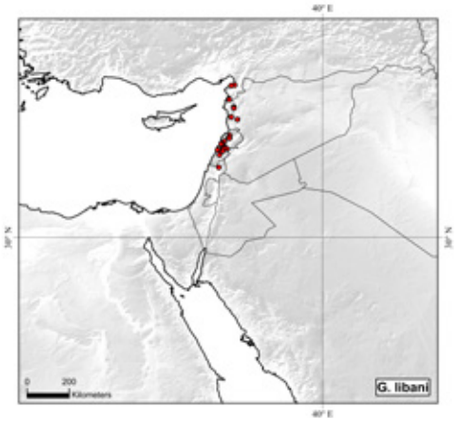


Fig. 694. Distribution of *Geranium libani*.

callus, without a basal prong, brown, with ± patent eglandular hairs 0.4-1.1 mm long; rostrum 23-31.2 mm long, with a narrowed apex 1.7-4.6 mm long, twisted distally, with ± patent, eglandular hairs 0.2-0.6 mm long; stigmatic remnants 1.4-2.2 mm long, with 5 glabrous lobes. *Seeds* 2.6-4.4 mm long, 1.4-2.6 mm wide, finely reticulate, uniformly colored, brownish red, glabrous. Cotyledons with entire margin. Figs. 692, 693.

Pollen. *Geranium*-type (Aedo & al. 2007: 99).

Chromosome number. 2*n* = 28.

Phenology. Collected in flower from April to June.

Distribution. This species ranges from southern Turkey, through western Syria and Lebanon to northern Israel (Fig. 694).

Habitat. Scrublands, edge of *Cedrus* Mill., *Ostrya* Scop. and *Quercus* L. forests, on limestone substrates; 400-2000 m.

Additional specimens examined. **Israel.** Northern: Upper Galilea, Wadi Hish, 33º0'N, 35º33'E, 7 May 1926, *Naftolsky s.n.* (FI, H, MA). **Lebanon.** au desous de la maison de Cheikh Rechen, 26 Apr. 1819, *Gaillardot 2487* (JE); col du Gör Bel, 15 Apr. 1936, *Mouterde 5011* (G). Baalbek-Hermel: Ain Zahalta, 33º48'N, 35º54'E, 19 June 1910, *Bornmüller 11544* (BM, E, G, HBG, W); col de Zahlé, 33º51'N, 35º49'E, 13 May 1943, *Mouterde 7743* (G). Mount Lebanon: Dschbel Barûk, 33º42'N, 35º43'E, 15 June 1910, *Bornmüller 11543* (BM, E, G, JE, LD, W, WU); Aramoun, 33º45'N, 35º30'E, 5 Apr. 1934, *Mouterde 2951* (G); Machnaga, 33º48'N, 35º46'E, 20 Apr. 1963, *Mouterde 12657* (G); Kafer Selouan, 33º49'N, 35º43'E, 31 May 1881, *Peyron 1304* (G); Feihoun (Kesrouan), 33º58'N, 35º44'E, 14 May 1931, *Gombault 1145* (MA); Feitroun, 33º58'N, 35º43'E, 10 May 1882, *Peyron s.n.* (G); Saidet el Hakle près Ghazir, 34º0'N, 35º39'E, 6 May 1935, *Bertschinger 1288* (MPU); Ghazir, 34º1'N, 35º39'E, 1934, *Busujan s.n.* (LD); Hiyata, au-desous de Ghazo, route de Chahtoul, 34º1'N, 35º42'E, 24 Apr. 1957, *Pabot s.n.* (G); entre Ehmej et Moukhada, 34º7'N, 35º47'E, 16 May 1957, *Pabot s.n.* (G). North: Becharres Gorge, 34º15'N, 36º1'E, 13 May 1933, *Meinertzhagen s.n.* (BM); Hasroun, 34º15'N, 36º1'E, 14 May 1961, *Mouterde 12421* (G); Raïfoun, 34º15'N, 36º0'E, 14 May 1932, *Samuelsson 1261* (S); Raïfoun, 34º15'N, 36º0'E, 4 June 1932, *Samuelsson 2016* (S); Arz er Raab, 34º15'N, 36º0'E, 9 June 1932, *Samuelsson 2264* (S); Cederlanden, 34º15'N, 36º0'E, 9 June 1932, *Samuelsson s.n.* (LD, S); Sir, 34º22'N, 36º1'E, 4 June 1933, *Mouterde 2353bis* (G). South: Jabal Kenissé, 33º32'N, 35º35'E, 15 June 1938, *Mouterde 6502* (G). **Syria.** Amonah, 15 June 1943, *Davis 6305A* (E). Hama: Wei el Beida, 35º3'N, 36º21'E, 15 May 1943, *Davis 6010A* (E). Latakia: Djebel Ansarieh, Slenfe, 35º32'N, 36º12'E, 18 May 1933, *Samuelsson 5105* (S); Slenfe, 35º35'N, 36º12'E, 6 May 1954, *Pabot s.n.* (G); col de Jaoubet Bourghal, Jebel Alaouite, 35º35'N, 36º12'E, 2 June 1956, *Pabot s.n.* (G); forêt du Peuzeul Dagh, Bassit, 35º54'N, 36º0'E, 25 Apr. 1953, *Pabot s.n.* (G); Kessab, 35º55'N, 35º58'E, 9 May 1945, *17873* (BM); Syria du Nord, Lattaquie, Aïn el Aramié, 35º56'N, 35º59'E, 19 Apr. 1933, *Gombault 2261* (P). Tartus: Est de Banias, route de Qsdmous, 35º9'N, 36º5'E, 7 Apr. 1956, *Pabot s.n.* (G). **Turkey.** Hatay: Belen, Karlik tepe near Soguk Oluk, 36º30'N, 36º5'E, 23 Apr. 1957, *Davis & Hedge 27038* (BM, E); Hatay, Iskenderun-Antakya, Belen, 36º30'N, 36º5'E, 27 Apr. 1990, *Nydegger 45264* (G); Hatay, Atik yaylasi, 36º31'N, 36º14'E, 26 Apr. 2000, *Ilçim 469* (MA).

Discussion. Differences between *G. libani* and *G. peloponnesiacum* are addressed in the discussion of that species. The leaf lamina of *G. libani* resembles that of *G. ibericum*, but it has fewer lobes per segment. Additionally, eglandular hairs are shorter than in *G. ibericum*, as are the petals and bracteoles. The petals of *G. libani* are hairy on the base of the abaxial surface, while they are glabrous on both surfaces in *G. ibericum.*

274. Geranium gymnocaulon DC., Prodr. 1: 640. 1824. Type locality: "in Iberiâ. (Steven) Radix et folia radicalia ignota. Flores ampli caerulei. (v. s.)". Type: Georgia. Iberia, *C. Steven s.n.* (lectotype, designated by Aedo & al. 2007: 122, G-DC!).

Geranium amethystinum Ledeb. in Nordm., Bull. Sci. Acad. Imp. Sci. Saint-Pétersbourg 2: 314. 1837. Type locality: "Hab. Auf den Gebirgen zwischen Guriel und Kabuleti, 5500 Fuss hoch". Type: Georgia. Adschar, 41º36'N, 42º04'E, *A. Nordmann 556* (lectotype, designated by Aedo & al. 2007: 122, H-1069984!).

Geranium ibericum var. *brachytrichum* Boiss., Fl. Orient. 1: 876. 1867, type locality: "Hab. in Iberiâ (Stev!), regione subalpinâ Adscharae (Nordm. in herb. Ledeb!)". Syntypes: Georgia. Iberia, *C. Steven s.n.*; Adscharae, *A. Nordmann s.n.* (no original material located).

Geranium gymnocaulon f. *grandiflorum* Rupr., Mém. Acad. Imp. Sci. Saint Pétersbourg ser. 7, 15(2): 272. 1869. Type locality: "Copiose inter Orizchale et m. Didigwerdi ab alt. 1400 hex. descendens 8 Aug. legi optime flor. var. grandifloram". Type: Georgia. Caucasus orientalis, Tuschetia, inter Orizchale et Didigwerdi, 42º21'N, 45º33'E, 8 Aug. 1861, *F.J. Ruprecht s.n.* (lectotype, designated by Aedo & al. 2007: 122, LE!).

Geranium gymnocaulon f. *pumilum* Rupr., Mém. Acad. Imp. Sci. Saint Pétersbourg ser. 7 15(2): 272. 1869. Type locality: "Tuschetia: inter Westomtha et Orizchale infra jugum Samkuriz zweri alt. 1500—1300 hex. 8 Aug. ... vidi quoque pumilum 9 Aug. inter Didigwerdi et Kartiani 1300—1400 hex.". Type: Georgia. Caucasus orientalis, Tuschetia, inter Westomtha et Orizchale infra Samkuris zweri, 42º21'N, 45º33'E, 8 Aug. 1861, *F.J. Ruprecht s.n.* (lectotype, designated by Aedo & al. 2007: 122, LE!).

Perennial herbs, 11-38 cm tall. *Rootstock* 4.5-12.2 mm in diameter, ± horizontal, not tuberculate, not turnip-shaped, without thickened roots. *Stem* erect, leafy, not rooting at nodes, stolons absent, without vegetative stems, with uncinate, eglandular hairs 0.1-0.3 mm long. *Basal leaves* in a ± persistent rosette, cauline leaves opposite; leaf laminas 2.6-5.3 cm long, 2.5-6.1 cm wide, not peltate, palmatifid [ratio main-sinus length/ middle segment length = 0.56-0.76], polygonal in outline, base cordate,

not coriaceous, not reticulate, with nerves not projected, pilose, with appressed, eglandular hairs on both surfaces; segments 5(7), in 1 plane, middle segment rhombic, 2.8-6.6 mm wide at the base [ratio segment width at the base/middle segment length = 0.10-0.23], (11)14-15(21)-lobed in distal half [ratio secondary sinus length/ middle segment length = 0.32-0.55]; petioles up to 18 cm long, without abscission zone, terete, not swollen, not deflexed in age, with uncinate, eglandular hairs 0.1-0.3 mm long; stipules 3.9-14.1 mm long, 1.3-2.8 mm wide, lanceolate, free, papery, brown, with eglandular hairs on abaxial surface and on the margin, glabrous adaxially. *Inflorescence* a dichasial cyme; cymules 2-flowered, solitary or in aggregates at the top of each branch [ratio cymule length/leaf length = 1.2-3.1]; peduncles 1.3-91 mm long, with uncinate, eglandular hairs 0.1-0.3 mm long; bracteoles (2.3)3.7-5.2(5.7) mm long, 0.6-1.3 mm wide, linear-lanceolate, whorled; pedicels absent or 4-24 mm long, with uncinate eglandular hairs 0.1-0.3 mm long and patent, eglandular hairs 0.4-1 mm long. Flowers actinomorphic. *Sepals* 7.2-10.9 mm long, 2.9-5.5 mm wide, lanceolate, smooth, not accrescent, nerves 5-7, mucro 1.9-2.8 mm long [ratio mucro length/sepal length = 0.22-0.38], with uncinate eglandular hairs 0.1-0.3 mm long and ± patent eglandular hairs 0.4-2.1 mm long on the abaxial surface, glabrous adaxially. *Petals* (12.1)15.4-16.7(20) mm long, 8.4-14.2 mm wide, patent, emarginate (notch 1.1-3.2 mm deep), without claw, blue, glabrous on both surfaces, ciliate on the basal and, sometimes, on the apical margin, with hairs 0.3-0.5 mm long. *Stamens* 10, both whorls bearing anthers; filaments 5.2-9.9 mm long, lanceolate, pink, pilose on the abaxial surface, ciliate on the proximal half, with hairs 0.1-2.5 mm long; anthers 1.8-2.5 mm long, blue. Nectaries 5, hemispheric, glabrous. *Gynoecium* 4.3-9.1 mm long, dark purple. *Fruit* 29.7-37.5 mm long, erect, discharge of seed-ejection type; mericarps 5.2-5.9 mm long, 2-2.8 mm wide, without a strand of fibers, compressed at the apex, smooth, without basal beak, without a basal callus, without a basal prong, brown, with ± patent eglandular hairs 0.2-2.2 mm long; rostrum 20.8-29.2 mm long, with a narrowed apex 2.2-4.7 mm long, twisted distally, with ± patent, eglandular hairs 0.2-1.7 mm long; stigmatic remnants 1.8-3.2 mm long, with 5 glabrous lobes. *Seeds* 3.1-4.2 mm long, 1.7-2.4 mm wide, finely reticulate, uniformly colored, brownish red, glabrous. Cotyledons with entire margin. Fig. 695.

Pollen. *Geranium*-type (Aedo & al. 2007: 99).

Chromosome number. 2*n* = 28, 56.

Phenology. Collected in flower from May to August.

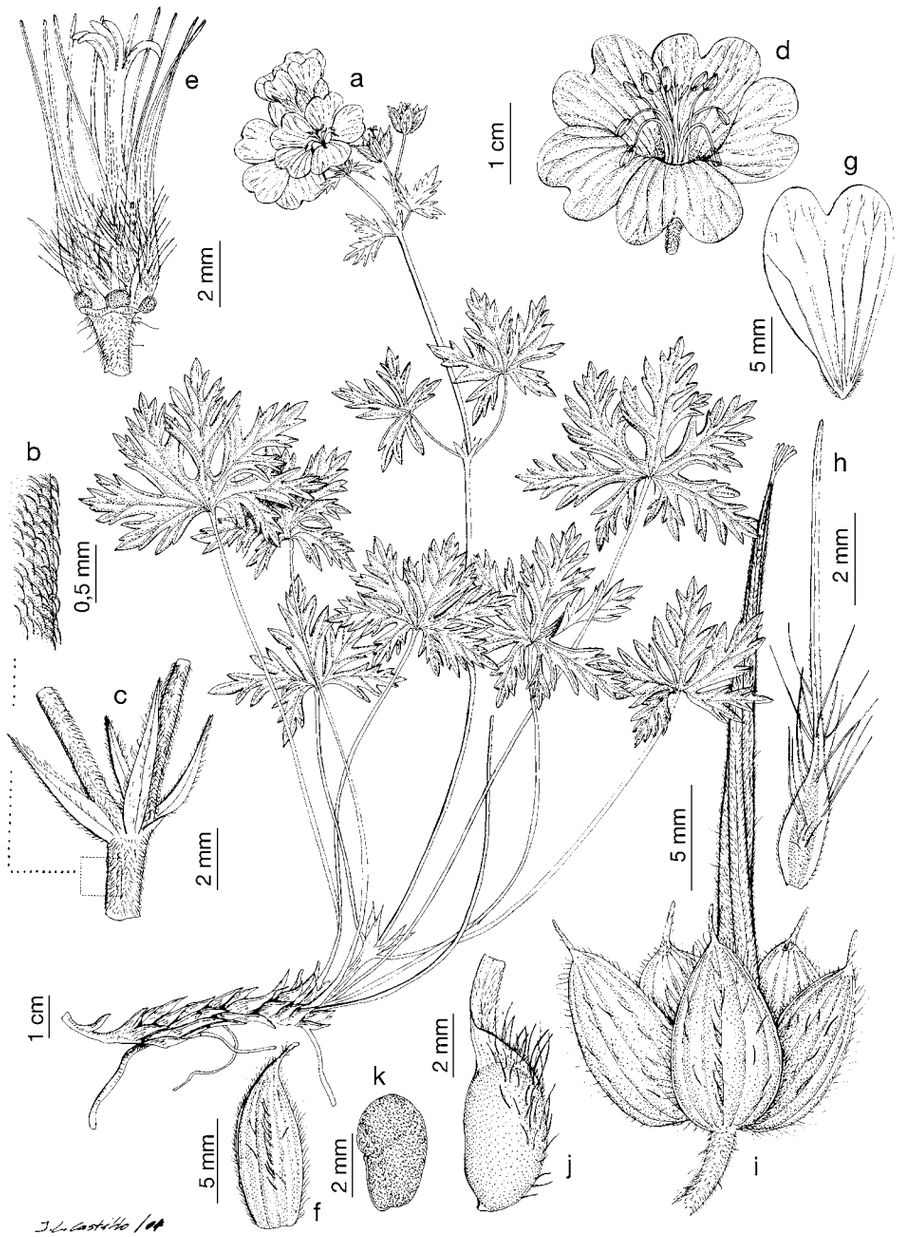


Fig. 695. *Geranium gymnocaulon*. a. Habit. b. Indumentum of the peduncle. c. Bracteoles. d. Flower. e. Flower without petals and sepals. f. Sepal. g. Petal. h. Staminal filament. i. Fruit. j. Mericarp. k. Seed. (Based on: a-g, *Ruprecht s.n.*, *8 Aug. 1861*, LE; h-k, *Sommier & Levier s.n.*, *1 Aug. 1890*, FI).

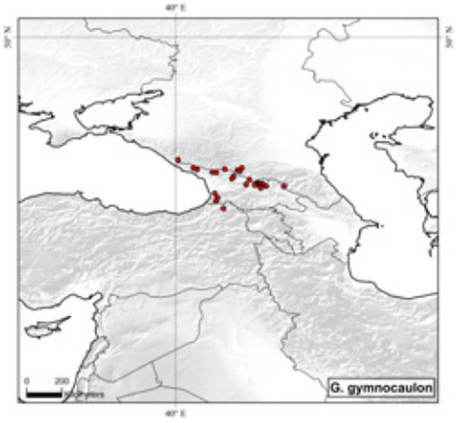


Fig. 696. Distribution of *Geranium gymnocaulon*.

Distribution. This species ranges from western to central Caucasus (Fig. 696).

Habitat. Alpine meadows, rocky slopes, and among *Rhododendron* L. and *Empetrum* L. thickets, on schistose rocks; 1700-3100 m.

Additional specimens examined. **Georgia.** Ratscha distr., Bassein r. Rion Okr Dopomisi, 27 Aug. 1965, *Gagnidze & Mikeladze s.n.* (E); Kutais, Soc. Cubechrvi (Svanetia), in jugi Utrvir, 1 Aug. 1910, *Sosnoversky s.n.* (WU); Armenia, *Szovits s.n.* (FI, M, S, WU, Z). Abkhazia: Abkhasie, montis Tskhra-Tskaro, 42°16'N, 44°22'E, 21 July 1916, *Kozlowsky 474* (LE, Z); distr. Gulripshi, vicinitas pagi Sakeni latior, in declivibus orientalis montis Guagua, 43°5'N, 41°53'E, 15 July 1979, *Vašák s.n.* (G); Abkhasie, distr. Suchum, monte Achata, 43°13'N, 41°6'E, 10 July 1931, *Petjaev s.n.* (KRA); Abkhasie, distr. Gudauty, inter montes Dzysra et Cipsira, 43°18'N, 40°54'E, 31 July 1935, *Kolakovsky s.n.* (LE). Adjara: Adjarie, mont Khino, 41°46'N, 42°9'E, 17 July 1893, *Alboff 274* (FI, G). Guria: Guriel, 42°0'N, 42°0'E, July 1830, *Szovits s.n.* (H). Mtskheta-Mtianeti: Guria, range Ajara-Imeretis, Bakhmaro, m. Sakornia, 42°22'N, 44°39'E, 23 Aug. 1950, *Zanitaradze s.n.* (MA); Georgian Military Road, Krestovyi Pass, 42°30'N, 44°27'E, 13 July 1975, *Kukkonen 12092* (H). Racha-Lechkhumi and Kvemo Svaneti: Svanetia in monte Tetenar supra pagum Ciolur ad flumen Hippum, Tzkhenis-Tzkhali, 42°45'N, 42°53'E, 1 Aug. 1890, *Sommier & Levier s.n.* (FI); Svanetia in jugo Latpari inter flumina Hippum et Ingur, 42°52'N, 42°58'E, 5 Aug. 1890, *Sommier & Levier s.n.* (FI). Samegrelo-Zemo Svaneti: Svanetia libera ad limites Abkhasiae, in jugo alpino inter flumina Neuska et Seken, 43°4'N, 42°5'E, 23 Aug. 1890, *Sommier & Levier s.n.* (FI). South Ossetia: Ossetia meridionale, Kudarskiy rayon, Al'pinyskiy lug na perevale Dsedo, 8 Aug. 1928, *Busch & Busch s.n.* (C); Ossetia meridionale, Kudarskiy rayon, region de Kondar, sommet du Mont Morakh, 28 July 1928, *Busch & Busch s.n.* (C, G, LE); Svaneti, range Khaskari, nr. lakes Kozuldi, 18 Aug. 1975, *Gagnidze s.n.* (MA); Mtiuleti, distr. Dusheti, Aragristavi, 42°21'N, 44°20'E, 9 Aug. 1967, *Zamfaradze s.n.* (MA); Kobi, pylae Krestovoj pereval, Georgian military highway, 42°25'N, 44°3'E, 1 Aug. 1987, *Cuba s.n.* (G, Z); South Ossetia, Syrkh-Laberta mountains, 42°27'N, 43°37'E, 19 Aug. 1928, *Busch & Busch s.n.* (O, S); Ozero Kel' i Kel'skiy pereval, 42°28'N, 44°19'E, 20 Aug. 1929, *Busch & Busch s.n.* (G); Kaukasus, Ermani, 42°29'N, 44°16'E, 10 July 1939, *Kutora s.n.* (W); Brittatskoe ushel'e Verjne-alpinyskiy lug v verjovaj pravogo Brittatui-gora, 42°31'N, 44°11'E, 18 Aug. 1930, *Busch & Busch s.n.* (LE); South-Ossetia, Sredne-Ermanskoe uscel, 42°33'N, 44°12'E, 22 Aug. 1935, *Busch & Busch s.n.* (BM); in jugo Mamisson, 42°42'N, 43°47'E, *Lojka s.n.* (FI). **Russia.** Kavkaz, 23 June 1957, *Posev s.n.* (C). Kabardino-Balkaria: Kuban prov., May 1907, *Busch 774* (LE); Balkaria, bliz perevala Shtulu, 23 Aug. 1927, *Busch & Busch s.n.* (WU); distr. Baksan, in declivibus austro-occidentalis montis Cheget, 43°8'N, 43°17'E, 15 Aug. 1978, *Vašák s.n.* (G, W); Balkaria, Agashtan, 43°11'N, 43°10'E, 18 July 1925, *Busch & Busch s.n.* (LE, O); Elbrus-Gebiet, Tschget, zwischen der Zwischenstation des Sesselliftd und Dongusorum-See, 43°14'N, 42°31'E, 25 July 1967, *Quasdorf 325* (B); Kabarda, Karasu, Ilkezi, Dogushja-su-algan, 43°18'N, 43°24'E, 24 July 1925, *Busch & Busch 2941* (C, G, H, K, KRA, LE, S, W, WA); Balkaria, alpinyskis lug na perevane Kala-srt, s Ilkezi na Karasu, 43°18'N, 43°24'E, 27 July 1927, *Busch & Busch s.n.* (K); Balkaria, Ilkezi, the right bBank of Ilkezi river, 43°18'N, 43°24'E, 25 July 1927, *Busch & Busch s.n.* (S); Balkaria, Ilkezi, Doguschja-su-aman, 43°18'N, 43°24'E, 26 July 1925, *Busch & Busch s.n.* (S, WU); Balkaria, Karasu, 43°18'N, 43°24'E, 17 Aug. 1925, *Busch & Busch s.n.* (C). Krasnodar: from Krasnaya Polyna to Mount Chugush, 43°43'N, 40°7'E, Aug. 1998, *Hermann* (M); vicinity of Krasnaya Polyna settlement, Mt. Achishkho, bank of Beshenka river, 43°43'N, 40°7'E, 2 July 2006, *Naumenko & al. s.n.* (MA). **Turkey.** Artvin: Batum, in monte Egre-su, 41°13'N, 42°27'E, 2 July 1912, *Holmberg 2081* (BM, S, UPS).

Discussion. Geranium gymnocaulon is sometimes mistaken for specimens of *G. ibericum* without glandular hairs. However, *G. gymnocaulon* has a characteristic indumentum on the peduncles and pedicels composed of short, uncinate hairs, lacking the long, soft, patent, eglandular hairs of *G. ibericum*. From *G. libani* (which has an indumentum quite similar to *G. ibericum*), it can be further distinguished by its petal indumentum which are glabrous on both surfaces, as opposed to *G. libani*, where the petals are hairy on the base of the abaxial surface, and by having a deeper notch at the petal apex. Some specimens of *G. gymnocaulon* have the basal part of the stem almost glabrous.

275. Geranium kurdicum Bornm., Repert. Spec. Nov. Regni Veg. 8: 82. 1910. Type locality: "Assyria: In pratis alpinis montis Helgurd ditionis oppidi Riwandus, Karduchiae austro-orientalis, alt. 22-2900 m s. m.; 26. Juni 1893, legi (Bornm., iter Persico-turcic. a. 1892-93, no. 998)". Type: Iraq. Assyria, montis Helgurd ditionis oppidi Riwandus, Karduchiae austro-orientalis, 36°46'N, 44°51'E, 26 June 1893, *J. Bornmuller 998* (lectotype, designated by Knuth 1912: 141, B destroyed; lectotype, here designated, LD-1089997!; isolectotypes, BR-0000008258618!, JE!, K-000074056!, W!, WU!).

Perennial herbs, 10-43 cm tall. *Rootstock* 3.8-10.8 mm in diameter, ± horizontal, not tuberculate, not turnip-shaped, without thickened roots. *Stem* erect, leafy, not rooting at nodes, stolons absent, without vegetative stems, glabrous or with scattered patent to retrorse, eglandular hairs 0.1-0.3 mm long. *Basal leaves* in a ± persistent rosette, cauline leaves opposite; leaf laminas 2.4-5.5 cm long, 3.2-6.9 cm wide, not peltate, deeply palmatifid [ratio main-sinus length/middle segment length = 0.71-0.84(0.90)], polygonal in outline, base cordate, not coriaceous, not reticulate, with nerves not projected, pilose, with scattered, appressed,

eglandular hairs on both surfaces; segments 5(7), in 1 plane, middle segment rhombic, 0.7-5.6 mm wide at the base [ratio segment width at the base/middle segment length = 0.03-0.15], (5)7-10(12)-lobed in distal half [ratio secondary sinus length/ middle segment length = 0.28-0.68]; petioles up to 19 cm long, without abscission zone, terete, not swollen, not deflexed in age, glabrous or with scattered, patent to retrorse, eglandular hairs 0.1-0.2 mm long; stipules 3.5-7.6 mm long, 1.2-1.7 mm wide, lanceolate, free, papery, brown, with eglandular hairs on abaxial surface and on the margin, glabrous adaxially. *Inflorescence* a dichasial cyme; cymules 2-flowered, solitary or in aggregates at the top of each branch [ratio cymule length/leaf length = 2-4.9]; peduncles 18-101 mm long, with scattered patent to retrorse, eglandular hairs 0.1-0.7 mm long; bracteoles (1.9)2.4-3.1(4.6) mm long, 0.5-0.8 mm wide, linear-lanceolate, whorled; pedicels absent or 9-34 mm long, with scattered patent to retrorse eglandular hairs 0.2-0.7 mm long. Flowers actinomorphic. *Sepals* 6.7-9.2 mm long, 3-4.5 mm wide, lanceolate, smooth, not accrescent, nerves 3-5, mucro 0.7-2.7 mm long [ratio mucro length/ sepal length = 0.10-0.30], with ± patent eglandular hairs 0.8-1.5 mm long on the abaxial surface, glabrous adaxially. *Petals* (9.8)12.8-14.1(15.2) mm long, 7.9-11.1 mm wide, erect-patent, emarginate (notch 0.9-2.5 mm deep), without claw, purple, hairy on the base of the adaxial surface, glabrous abaxially, ciliate on the basal margin, with hairs 0.3-0.7 mm long. *Stamens* 10, both whorls bearing anthers; filaments 5.3-7.6 mm long, lanceolate, pink, pilose on the abaxial surface, ciliate on the proximal half, with hairs 0.5-1.2 mm long; anthers 1.7-2.5 mm long, yellow. Nectaries 5, hemispheric, glabrous. *Gynoecium* 5-7.4 mm long, dark purple. *Fruit* 23.4-30.2 mm long, erect, discharge of seed-ejection type; mericarps 4.2-4.9 mm long, 1.7-2.2 mm wide, without a strand of fibers, compressed at the apex, smooth, without basal beak, without a basal callus, without a basal prong, brown, with ± patent eglandular hairs 0.4-1.5 mm long; rostrum 16.2-23.3 mm long, with a narrowed apex 1-2.9 mm long, twisted distally, with ± patent, eglandular hairs 0.2-0.6 mm long; stigmatic remnants 1.2-1.5 mm long, with 5 glabrous lobes. *Seeds* 3.1 mm long, 1.6 mm wide, finely reticulate, uniformly colored, brownish red, glabrous. Cotyledons not studied. Fig. 697.

Pollen. *Geranium*-type (Aedo & al. 2007: 99).

Chromosome number. Unknown.

Phenology. Collected in flower from June to September.

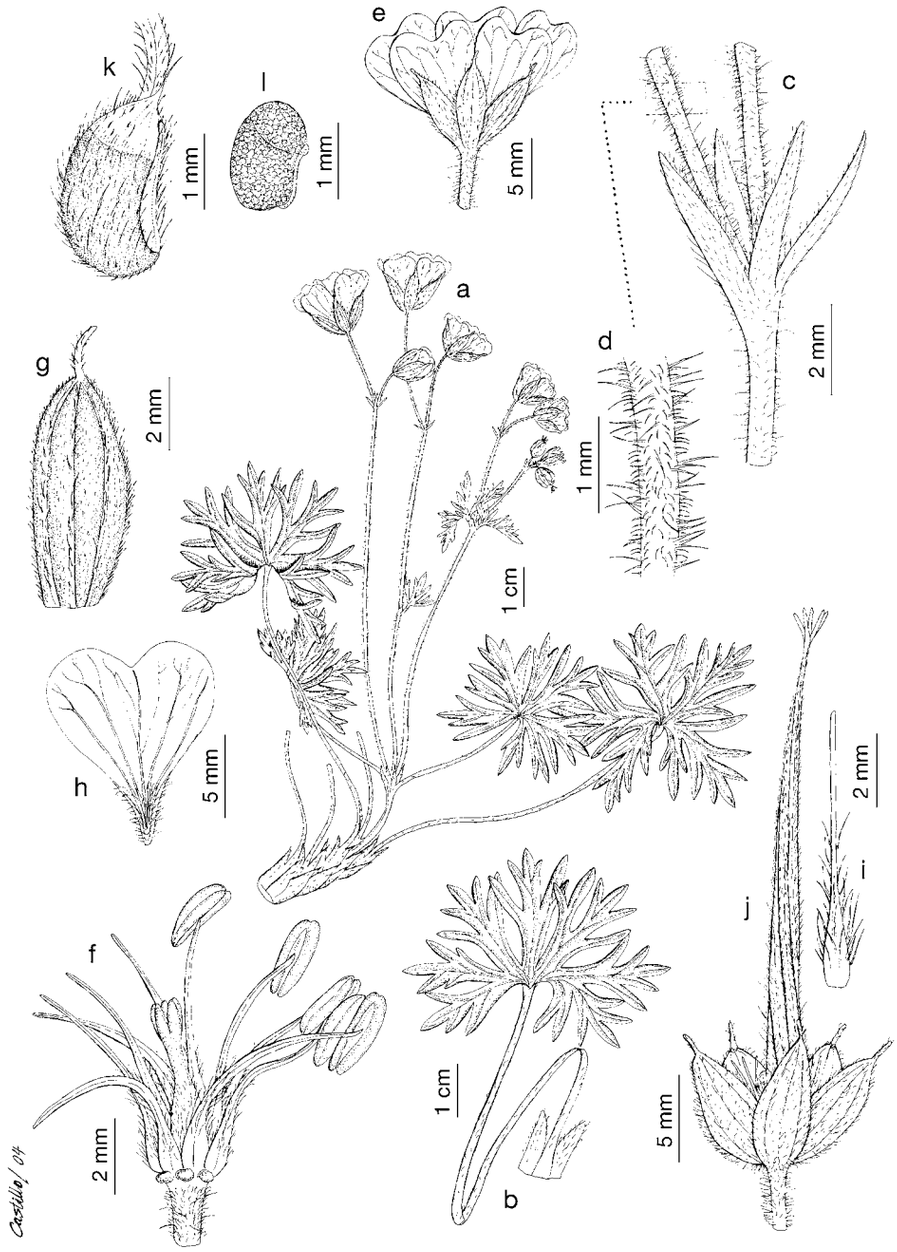


Fig. 697. *Geranium kurdicum.* a. Habit. b. Leaf. c. Bracteoles. d. Indumentum of the pedicel. e. Flower. f. Flower without petals and sepals. g. Sepal. h. Petal. i. Staminal filaments. j. Fruit. k. Mericarp. l. Seed. (Based on: a-h, *Bornmüller 998*, BR; i-l, *Bornmüller 998*, K).

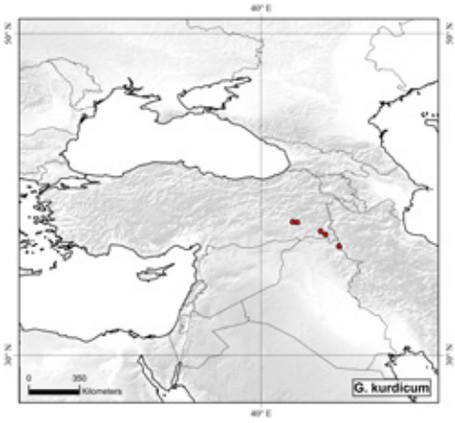


Fig. 698. Distribution of *Geranium kurdicum*.

Distribution. This species ranges from southeastern Turkey to northern Iraq (Fig. 698).

Habitat. Moist areas of alpine meadows; 2200-3500 m.

Additional specimens examined. **Iraq.** Erbil: Arl Gird Dagh, 36°45'N, 44°51'E, 24 July 1932, *Guest 2905* (K); N & W slopes in Helgord, 36°45'N, 44°51'E, 15 Aug. 1956, *Haley 136* (BM, K); Sarcal, ped montis Helgurd, 36°46'N, 44°51'E, 7 June 1960, *Hadac 2152* (PR); Helgurd, NW, 36°46'N, 44°51'E, 7 June 1960, *Prosser 2443* (PR); N of Helgord Range near Berma Sand Lake, 36°46'N, 44°51'E, 3 Sep. 1957, *Rawi 24776* (K). **Turkey.** Bitlis: Van, Satak, Kavussahap Dag, 38°15'N, 42°15'E, 23 July 1954, *Davis 23217* (BM); Bitlis, Kambos Dag above Hurmuz, 38°17'N, 41°58'E, 30 June 1954, *Davis 23386* (BM, K). Hakkâri: Cilo Tepe, 37°30'N, 44°0'E, 8 Aug. 1954, *Davis 24034* (BM, K); Kara Dag, 37°42'N, 43°42'E, 15 Aug. 1954, *Davis 24403* (BM, K).

Discussion. Geranium kurdicum can be easily distinguished from other species of sect. *Lanuginosa* by its deeply palmatifid leaves with deep and narrow secondary divisions. This species is glabrous or with scattered eglandular hairs on stem and petioles, and shows a more dense indumentum on peduncles and pedicels. In *G. kurdicum*, petal indumentum is similar to *G. gracile*, with hairs on the base of adaxial surface, although in the latter species petals are relatively longer and narrower.

IV. Geranium subg. **Robertium** (Picard) Rouy, in Rouy & Foucaud, Fl. France 4: 94. 1897. Type: *Geranium robertianum* L. (art. 10.8).

Fruit of carpel-projection type. At dispersal, the whole mericarp, containing the seed, is ejected by the propelling force of the explosive recurvature of the awn, while the awn remains attached to the columella. In sect. *Divaricata* the rostrum is not well developed, and thus the mericarp including the seed is shortly ejected.

IVa. Geranium sect. **Batrachioidea** W.D.J. Koch, Syn. Fl. Germ. Helv. 1: 139. 1835, ["batrachioides"]. *Geranium* sect. *Pyrenaica* R. Knuth in Engl., Pflanzenr. IV.129 (Heft 53): 46, 152. 1912. Type: *Geranium pyrenaicum* Burm. f. (designated by Yeo 1984: 15).

Herbs annual or perennial. *Flowers* actinomorphic. *Petals* emarginate, without claw. *Pollen* of *Geranium*-type. *Fruit* of carpel-projection type, operative; mericarps smooth or transversely wrinkled; rostrum not twisted. *Cotyledons* with entire margins.

276. Geranium aequale (Bab.) Aedo, Anales Jard. Bot. Madrid 55(2): 466. 1997. *Geranium molle* var. *aequale* Bab., Man. Brit. Bot. ed. 2, 65. 1847. Type locality: "near Leamington (1845). Mr. J.J. Murcott". Type: Great Britain. England, near Leamington, 52°15'N, 1°29'W, June 1845, *J.J. Murcott s.n.* (lectotype, designated by Carolin 1965: 333, CGE-05773!).

Geranium molle f. *preuschoffii* Abrom., Fl. Ost- & Westpreussen: 156. 1898. Type locality: "Wpr. Mbg. Pfarrgarten in Tannsee (Pff. 81)". Type: Germany. Westpreussen, Magdebug, Pfarrgarten in Tannsee, 51°43'N, 10°43'E, *J. Abromeit s.n.* (no original material located).

Annual herbs, 5-40 cm tall. *Stem* erect or ascending, leafy, with patent, eglandular hairs 0.1-2.1 mm long and patent, glandular hairs 0.1-0.2 mm long. *Basal leaves* in a persistent rosette, cauline leaves alternate; leaf laminas 1-3(5) cm long, 1.3-3.7(5.8) cm wide, not peltate, palmatifid [ratio main-sinus length/middle segment length = 0.60-0.75], orbicular to reniform in outline, base cordate, not coriaceous, with nerves not projected, with appressed, eglandular hairs on both surfaces; segments 5(7), in 1 plane, middle segment obtriangular, 1.4-4 mm wide at the base [ratio segment width at the base/middle segment length = 0.17-0.26], 3(6)-lobed at the apex [ratio secondary sinus length/middle segment length = 0.18-0.28]; petioles up to 24 cm long, without abscission zone, terete, not swollen, not deflexed in age, with patent, eglandular hairs 0.3-1.6 mm long and patent, glandular hairs 0.2-0.3 mm long; stipules 2.6-7 mm long, 1.1-4 mm wide, ovate-lanceolate (sometimes with a short bifid apex), free, papery, brown, with eglandular hairs on abaxial surface, glabrous adaxially. *Inflorescence* a dichasial cyme with monochasial branches; cymules 2-flowered, solitary [ratio cymule length/leaf length = 1.9-4.1]; peduncles 10-45(70) mm long, with patent, eglandular hairs 0.4-1.7 mm long and patent, glandular 0.1-0.2 mm long; bracteoles 0.9-3 mm long, 0.4-1.5 mm wide, lanceolate, sometimes lobed, whorled; pedicels 6.2-22 mm long, with patent, eglandular hairs 0.4-1.8 mm long and patent, glandular hairs 0.1-0.2 mm long. Flowers actinomorphic. *Sepals* (2.8)3.3-4(5) mm long, 1.4-2.1 mm wide, lanceolate, smooth, not accrescent, nerves 3, mucro 0.2-0.3 mm long [ratio mucro length/sepal length = 0.02-0.08], with patent, eglandular hairs 0.3-2 mm long and ± patent, glandular hairs 0.1-0.2 mm long on the abaxial surface, glabrous adaxially. *Petals* 1.6-3(4.6) mm long, 1-3 mm wide, erect-patent, emarginate (notch 0.2-1 mm deep), without claw, bright purple, glabrous on both surfaces, ciliate on the basal margin, with hairs 0.2-0.3 mm long. *Stamens*

10, both whorls bearing anthers; filaments 1.5-4.5 mm long, lanceolate, white with pink apex, glabrous except for a some cilia 0.1-0.2 mm long on the proximal half; anthers 0.4-0.6 mm long, purple. Nectaries 5, hemispheric, glabrous. *Gynoecium* 1.6-5 mm long, purple. *Fruit* 9-13.1 mm long, erect, discharge of carpel-projection type, operative; mericarps 1.3-1.9 mm long, 0.8-1.3 mm wide, without a strand of fibers, not compressed at the apex, smooth, without basal beak, without a basal callus, without a basal prong, brown, glabrous over most of the surface, densely ciliate at the base; rostrum 5.8-10.5 mm long, with a narrowed apex 0.5-1.5 mm long, not twisted, with erect-patent, eglandular hairs 0.1-0.3 mm long; stigmatic remnants 0.9-2 mm long, with 5 hairy lobes. *Seeds* 1.2-1.7 mm long, 0.7-1.2 mm wide, smooth, uniformly colored, brown, glabrous. Cotyledons with entire margin. Fig. 699.

Pollen. Ornamentation not studied.

Chromosome number. 2*n* = 26.

Phenology. Collected in flower from February to July.

Distribution. This species ranges through western Europe and it is introduced in U.S.A., southern Argentina and New Zealand (Fig. 700).

Habitat. Dry areas near villages, cultivated fields, open grass-covered hillsides, and edge of forests; 0-1600 m.

Representative specimens examined. **Argentina.** Tierra del Fuego: Estancia Harberton, Cutalataca, Gable Inner Channel, 54°15'S, 67°11'W, 23 Feb. 1966, *Goodall 282* (H); Estancia Harberton, Harberton side of Gable Inner Channel, 54°15'S, 67°11'W, 23 Feb. 1966, *Goodall 353* (H). **Austria.** Burgenland: Nordburgenland, Leihatal, 48°1'N, 16°46'E, 21 May 2009, *Barta s.n.* (MA). Vienna: Wien, Kaiserebersdorf, Valiergasse-Murhoferweg, 48°9'N, 16°28'E, 30 July 2005, *Barta 2005-389* (W); Wien, Kaiserebersdorf, Etrichstrasse, S Kreuzung, 48°12'N, 16°22'E, 2 June 2003, *Barta 2003-196* (W); Wien, 1.55-1.7 km ENE Bahn, 48°12'N, 16°25'E, 13 July 2005, *Barta s.n.* (W). **Belgium.** Flemish: pr. Tintomoje, route Tintomoje-Rome[?]ohomoje, 50°51'N, 5°28'E, 17 Aug. 1953, *Wilezek 1127* (K). Wallonia: Semois, 49°45'N, 5°29'E, 10 July 1920, *Vinck 422* (BR); Liège, Rocherath, vallée du Tröglichtenbach, 50°26'N, 6°18'E, 19 July 1985, *Fabri 857* (BR). **Denmark.** Fn[?]termglatte, 1938, *Marsen s.n.* (C). **Germany.** Hamburg: Samensammlung des Hamburgischen Staatsinstituts für angewandte Botanik, 53°33'N, 10°0'E, *Bredemann & Nieser 50* (K). Saxony: SW of Saxony, 51°20'N, 12°25'E, Aug., *[illegible]* (K). **Great Britain.** Channel Islands: Little Sark, , 49°26'N, 2°22'W, 7 June 1929, *Ballard & Gollon 228* (K). England: Chalk trof., Portsmouth Hill, N of Portsmouth, S Hanstr., 51°0'N, 2°0'W, 4 June 2000, *Clement & al. BR00/3* (MA); Andover, Hampshire, 51°12'N, 1°29'W, 12 June 1890, *Clarke 47304* (K); Kents, Thurfield, E of The Thinght, 51°13'N, 0°48'E, 3 June 1955, *Milne-Redhead 6610* (K); W Gloucester, 34, Avonmounth Dochs, 51°29'N, 2°41'W, 20 May 1933, *Sandwith s.n.* (K); Tarlton, Coates, m. Cirencester, 51°41'N, 2°3'W, 1 June 1945, *Airy Shaw & Nelmes s.n.* (MA); W Gloucester, 34, Tarlton, Coates, m. Cirencester, 51°42'N, 2°2'W, 1 June 1945, *Airy*

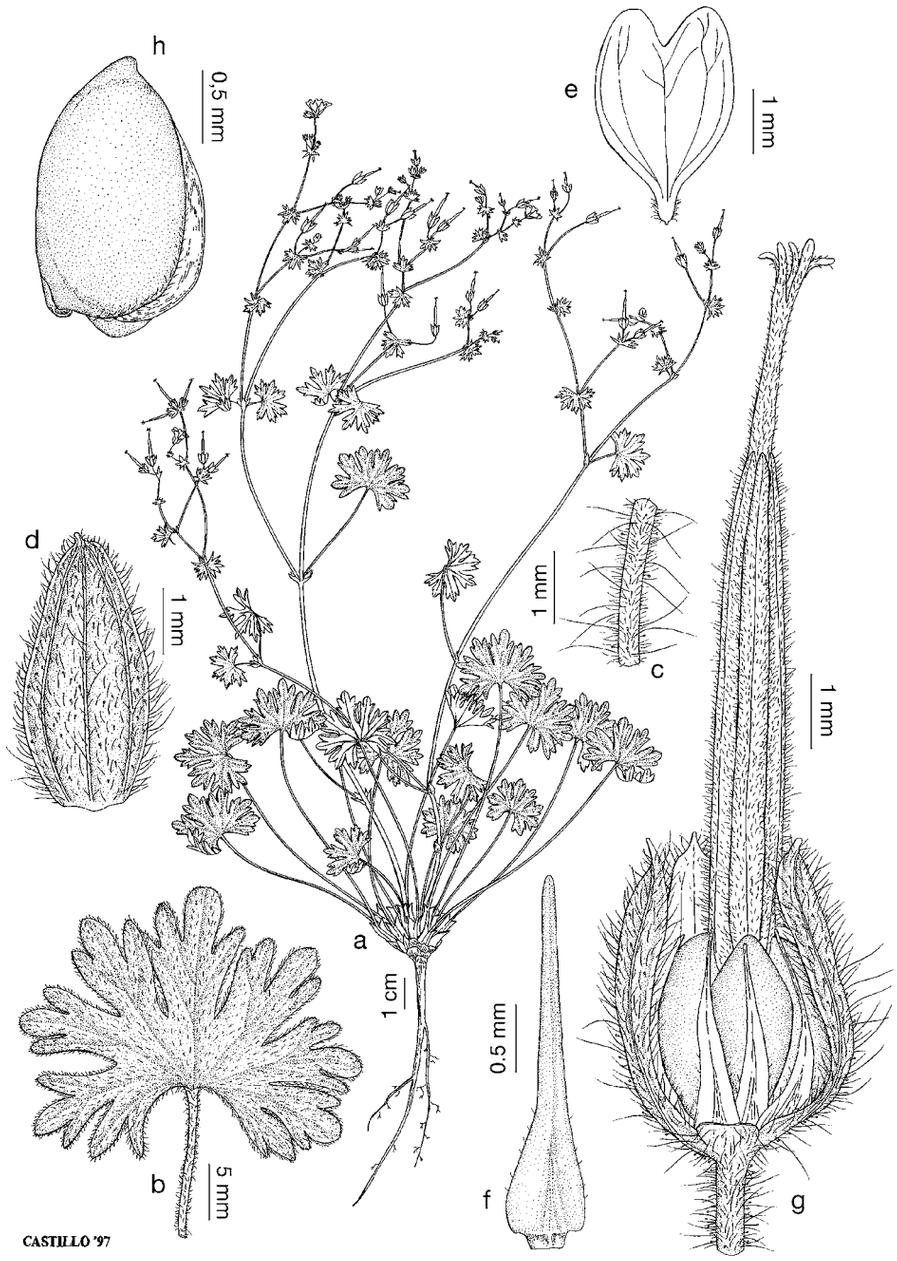


Fig. 699. *Geranium aequale*. a. Habit. b. Leaf. c. Peduncle. d. Sepal. e. Petal. f. Staminal filament. g. Fruit, one sepal removed. h. Mericarp. (Based on: *Airy Shaw & Nelmes s.n.*, MA-71231).

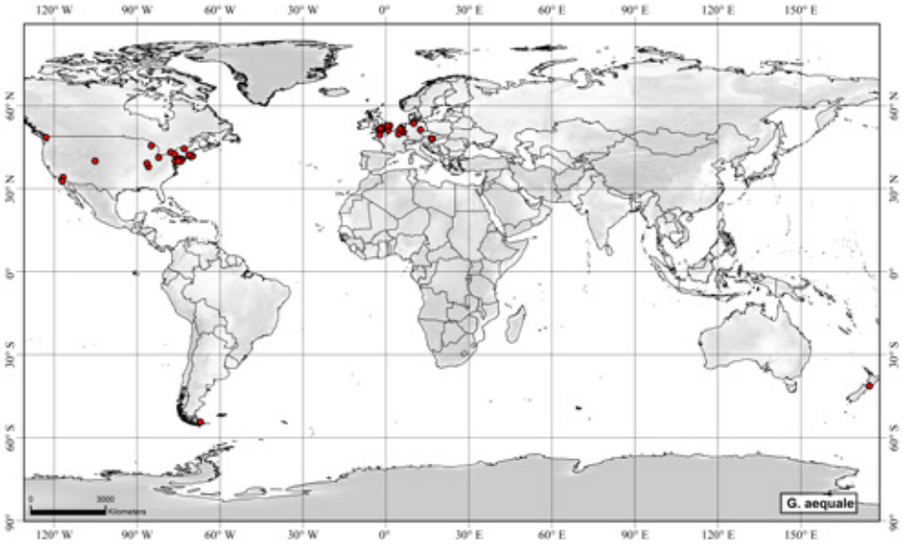


Fig. 700. Distribution of *Geranium aequale*.

Shaw & Nelmes 45 (K); E Gloucester, 33, North Cerney, Forsway, 51°45'N, 1°57'W, 11 Aug. 1945, *Milne-Redhead 5363* (K); Gogn o gog Hills, 52°10'N, 0°11'E, 19 May 1895, *Hoc[?]king 311* (K); Norfolk, Buxton, 52°45'N, 1°18'E, 1847, *Mann s.n.* (K); West Norfolk, Appleton, 52°49'N, 0°31'E, 22 July 1933, *Hubbard 9243* (K). **Netherlands.** North Brabant: Haren, 51°48'N, 5°31'E, 12 Aug. 1931, *Wasscher s.n.* (L). **New Zealand.** New Zealand North Is.: N. Zealan Wellington, 41°18'S, 174°47'E, 1848, *Colenso 1821* (K). **USA.** California: San Diego Co., San Diego, 3903 Georgia St., 32°42'N, 117°9'W, 1911, *Valentin s.n.* (UC); San Bernardino Co., San Bernardino mountains, S side, 34°5'N, 116°50'W, *Parish s.n.* (GH). Colorado: Boulder, 40°0'N, 105°16'W, 22 Sep. 1906, *Cockerey s.n.* (NY). Indiana: Monroe Co., Indiana University Campus, 39°9'N, 86°31'W, 13 June 1913, *Anderson 1752* (IND). Kentucky: Bullitt Co., Mt. Maples, Tablet Wall, 37°54'N, 85°57'W, 29 June 1958, *Gunn 1223* (KY). Massachusetts: Barnstable Co., Falmouth, 41°33'N, 70°36'W, 4 July 1895, *Deane s.n.* (MO); Norfolk Co., Wellesley, 42°17'N, 71°17'W, 27 May 1?48, *Cummings s.n.* (NY). Michigan: Emmet Co., Harbor Spring, 45°32'N, 84°55'W, 12 June 1903, *Morrice s.n.* (MSC). New Jersey: Ocean Co., Tom's River, 39°57'N, 74°11'W, 3 July 1916, *Wilson s.n.* (NY); Morris Co., above Sterlington, 40°50'N, 74°32'W, 28 May 1905, *Mackenzie 1261* (NY). New York: Nassau Co., Long Island, Hewlett, 40°38'N, 73°41'W, 30 May 1913, *Bicknell 5377* (NY). Ohio: Lorain Co., Oberlin, 41°17'N, 82°13'W, 8 June 1895, *Dick s.n.* (MO). Pennsylvania: Philadelphia, 39°57'N, 75°9'W, *Williamson s.n.* (NY); Lancaster, 40°2'N, 76°18'W, July, *Bitner s.n.* (NY). Vermont: Chittenden Co., Burlington, 44°27'N, 73°3'W, 11 May 1965, *Seymour 22651* (MO). Washington: San Juan Co., San Juan Is., Friday Harbor, 48°32'N, 123°0'W, 30 Apr. 1936, *Blanchard 22* (UC).

Discussion. Geranium subg. *Robertium* exhibits several different patterns of mericarp ornamentation, which are useful to differentiate the species. Thus, the absence of such ornamentation should also be of relevance. Consequently, I decided to recognize *G. aequale* as specifically distinct from *G. molle*. *Geranium aequale* is close to *G. molle*, from which it is easily distinguished by its smooth, densely ciliate mericarps (those in *G. molle* are transversely wrinkled and sparsely ciliate at the base). Moreover, the mericarps of *G. aequale* do not cover the seed completely, as in *G. molle*. The seeds of *G. aequale* have a thick testa, which may compensate for the slight protection provided by the mericarp. I was not able to find any intermediates between *G. aequale* and *G. molle*.

Clement (1997), Lawalrée (2000) and Veldkamp (2008) recorded some localities of this usually overlooked species from England, Belgium and The Netherlands respectively.

277. Geranium molle L., Sp. Pl.: 682. 1753. Type locality: "Habitat in Europa ad plateas". Type: Geranium omnium villosissimum in Vaillant, Bot. Paris., 79, tab. 15 fig. 3-3a. 1727 (lectotype, designated by Carolin 1965: 332-333). Spain. Madrid, San Martín de Valdeiglesias, puente de San Juan, 4°23'W, 40°21'N, 1 Apr. 1995, *C. Aedo 3428* (epitype, here designated, MA-552956!; isoepitypes, B, BM, C, COI, FI, G, L, LE, MO, P, PE, UPS, US, W).

Geranium villosum Ten., Fl. Napol. 1: lxi. 1811-1815, nom. illeg., non Mill. 1768. *Geranium pyrenaicum* subsp. *villosum* Ten. ex Nyman, Consp. Fl. Eur.: 138. 1878. *Geranium molle* subsp. *villosum* (Ten. ex Nyman) A. Terracc., Malpighia 4: 202. 1890. *Geranium molle* var. *villosum* (Ten. ex Nyman) Cout., Fl. Portug.: 371. 1913. Type locality: "Luogo natale ec. Non alligna che nelle regioni media et settentrionale del regno, cosí nelle praterie montuose che ne'luoghi meno elevati; la var. A al Tempone presso la Rotonda sul confine della Basilicata, al fondaco del Fico presso Nicastro ed in altri loughi di Calabria; la var. B. presso Monteleone; la var. C. a Balvano ed in Calabria ultra" [according Ten., Fl. Napol. 5: 83 (1835-36)]. Type: Italy. Pollino, 39°54'N, 16°11'E, *M. Tenore s.n.* (lectotype, designated by Aedo & al. 1998: 606, NAP photocopy!; isolectotype, FI!).

Geranium argenteum Lucé, Topogr. Nachr. Oesel.: 236. 1823, nom. illeg., non L. 1756. Type locality: [not indicated] [Saaremma Is., Estonia]. Type: Estonia, Saaremma Is., 58°28'N, 22°26'E, *J.W. Lucé s.n.* (no original material located).

Geranium molle var. *grandiflorum* Viv., Fl. Libyc. Spec.: 39. 1824. Type locality: "H. in totâ Cyrenaicâ". Type: Libya. Cyrenaica, *D. Viviani s.n.* (no original material located).

Geranium molle var. *minus* Chevall., Fl. Gén. Env. Paris 2(2): 802. 1828, ["miuus"]. Type locality: "Commun dans les bois et les décombres". Type: France. Commun dans les bois et les décombres, *F.F. Chevallier s.n.* (no original material located).

Geranium molle var. *parvulum* Ten., Syll. Pl. Fl. Neapol.: 334. 1831. *Geranium molle* [c] *parvulum* (Ten.) Graebn. in Asch. & Graebn., Syn. Mitteleur. Fl. 7(1): 52. 1913. Type locality: "in Calabria: Monteleone". Type: Italy. Calabria, Monteleone, 38°40'N, 16°06'E, *M. Tenore s.n.* (lectotype, designated by Aedo & al. 1998: 606, NAP image!).

Geranium villosum var. *villosissimum* Ten., Syll. Pl. Fl. Neapol.: 334. 1831. *Geranium molle* var. *arenarium* A. Terracc., Malpighia 4: 202. 1890, nom. illeg. Type locality:

"Monteleone". Type: Italy. Monteleone, 38º40'N, 16º06'E, *M. Tenore s.n.* (lectotype, designated by Aedo & al. 1998: 606, NAP photocopy!).

Geranium molle var. *suaveolens* Boenn. ex Rchb., Fl. Germ. Excurs.: 778. 1832. *Geranium molle* [I] *suaveolens* (Boenn. ex Rchb.) Graebn. in Asch. & Graebn., Syn. Mitteleur. Fl. 7(1): 52. 1913. *Geranium molle* f. *suaveolens* (Boenn. ex Rchb.) Gams in Hegi, Ill. Fl. Mitt.-Eur. 4(3): 1702. 1924. Type locality: "Auf bebautem Boden, Schutt, an Mauern, Planken". Type: Germany. Auf bebautem Boden, Schutt, an Mauern, Planken, *C.M. Boenninghausen s.n.* (no original material located).

Geranium molle var. *album* Picard, Mém. Soc. Agric. Boulogne-sur-Mer 1: 129. 1837. *Geranium molle* [I] *album* (Picard) Graebn. in Asch. & Graebn., Syn. Mitteleur. Fl. 7(1): 52. 1913. Type locality: "Manchecourt, etc". Type: France. Manchecourt, 48º14'N, 2º20'E, *C. Picard s.n.* (no original material located).

Geranium abortivum De Not. ex Ces., Bibliot. Ital. Giorn. Lett. 91: 349. 1838. *Geranium molle* var. *abortivum* (De Not. ex Ces.) Nyman, Consp. Fl. Eur.: 138. 1878. Type locality: "Prope Terranova in Sicilia legit Balsamo 1832". Type: Italy. Pr. Terranova in Sicilia, 37º03'N, 14º10'E, 1832, *G.G. Balsamo s.n.* (lectotype, designated by Aedo & al. 1998: 607, RO!).

Geranium brutium Gasp., Rendiconto Accad. Sci. Soc. Borbon. Napoli 1: 49. 1842. *Geranium molle* var. *brutium* (Gasp.) K. Malý, Verh. K.K. Zool.-Bot. Ges. Wien 54: 229. 1904. *Geranium molle* subsp. *brutium* (Gasp.) Graebn. in Asch. & Graebn., Syn. Mitteleur. Fl. 7(1): 53. 1913. Type locality: "crescit in herbosis collibus et sopibus Calabriae ulterioris prope Rosarnum". Type: Italy. Calabriae [Rosarno], 38º29'N, 15º58'E, *G. Gasparrini s.n.* (lectotype, designated by Aedo & al. 1998: 607, BM-000751351!).

Geranium leiocaulon Ledeb., Fl. Ross. 1(2): 470. 1842. *Geranium molle* [b] *leiocaulon* (Ledeb.) Graebn. in Asch. & Graebn., Syn. Mitteleur. Fl. 7(1): 52. 1913. Type locality: "Hab. in provincia Talüsch pr. Lenkoran! (Hansen pl. exs)". Type: Azerbaijan. Lenkoran, 38º45'N, 48º50'E, 1819, *Hansen s.n.* (lectotype, designated by Aedo & al. 1998: 607, H!).

Geranium stipulare Kunze, Flora 29: 698. 1846. *Geranium molle* var. *grandiflorum* Lange in Willk. & Lange, Prodr. Fl. Hispan. 3: 528. 1878, nom. illeg., non Viv. 1824. *Geranium molle* var. *stipulare* (Kunze) Nyman, Consp. Fl. Eur.: 138. 1878. *Geranium molle* f. *stipulare* (Kunze) K. Malý, Verh. K.K. Zool.-Bot. Ges. Wien 54: 229. 1904. *Geranium molle* subsp. *stipulare* (Kunze) Holmboe, Bergens Mus. Årbok 13: 6. 1907. *Geranium molle* [B] *stipulare* (Kunze) Graebn. in Asch. & Graebn., Syn. Mitteleur. Fl. 7(1): 52. 1913. Type locality: "537. In arenosis isthmi Gaditani copiose. Mart. c. fl. et fr.". Type: Spain. In arenosis isthmi Gaditani copiose, 36º29'N, 06º15'W, 12 Mar. 1845, *H.M. Willkomm 537* (lectotype, designated by Aedo & al. 1998: 607, K-000729305!; isolectotypes, BM!, FI-W!, MA-617365!, MO-251387!, W!).

Geranium molle var. *grandiflorum* Vis., Fl. Dalmat. 3: 212. 1851, nom. illeg., non Viv. 1824, ["grandiflora"]. Type locality: "Hab in agris, cultis et ruderatis circa Zara, Sebenico, Traù, Spalato, Ragusa, var. praecipue in saxosis ad Scagliari prope Cattaro et in Montenegro". Syntypes: Croatia, Zara, Sebenico, 43º44'N,15º53'E, Trau 43º30'N, 16º15'E, Spalato, 43º30'N, 16º265'E, Ragusa 42º39'N, 18º05'E; Montenegro. Scagliari prope Cattaro, 42º25'N, 18º46'E, *R. Visiani s.n.* (no original material located).

Geranium punctatum Kanitz, Linnaea 32: 569. 1864, nom. illeg., non Andrews, 1799. Type locality: "Habitat inter frutices Syrmii, unde a Wolny pro G. umbroso missum". Type: Croatia. Habitat inter frutices Syrmii, 45º20'N, 18º00'E, unde a Wolny pro G. umbroso missum, *A. Kanitz s.n.* (no original material located).

Geranium molle var. *macropetalum* Boiss., Fl. Orient. 1: 882. 1867. *Geranium macropetalum* (Boiss.) Posp., Fl. Oesterr. Küstenl. 2: 30. 1898. *Geranium molle* subvar. *macropetalum* (Boiss.) Gams in Hegi, Ill. Fl. Mitt.-Eur. 4(2): 1703. 1924. Type locality: "Hab. in cultis Corcyrae (Boiss!), Peloponnesi in Messeniâ et Arcadiâ (Heldr!)". Type: Greece. Arcadia, pr. Mazeïca, 37º30'N, 22º22'E, 29 Apr. 1861, *T. Heldreich 3404* (lectotype, designated by Aedo & al. 1998: 607, G-BOIS!).

Geranium molle var. *annuum* Schur, Verh. Naturf. Vereins Brünn 15: 161. 1877. *Geranium molle* [I] *annuum* (Schur) Graebn. in Asch. & Graebn., Syn. Mitteleur. Fl. 7(1): 52. 1913. *Geranium molle* f. *annuum* (Schur) Gams in Hegi, Ill. Fl. Mitt.-Eur. 4(3): 1702. 1924. Type locality: "Auf Rasenplätzen im Augarten, Oktober, November 1872". Type: Austria. Auf Rasenplätzen im Augarten, 48º13'N, 16º22'E, Oct.-Nov. 1872, *F. Schur s.n.* (no original material located).

Geranium molle var. *subperenne* Schur, Verh. Naturf. Vereins Brünn 15: 161. 1877. *Geranium molle* [II] *subperenne* (Schur) Graebn. in Asch. & Graebn., Syn. Mitteleur. Fl. 7(1): 52. 1913. *Geranium molle* f. *subperenne* (Schur) Gams in Hegi, Ill. Fl. Mitt.-Eur. 4(2): 1702. 1924. Type locality: "Bei Brünn die gewöhnliche Form, Mai-Juni". Type: Czech Republic. Bei Brünn, 49º11'N16º36'E, May-June, *F. Schur s.n.* (no original material located).

Geranium molle subsp. *pollinense* (N. Terracc. ex A. Terracc.) A. Terracc., Malpighia 4: 198. 1890. *Geranium pollinense* N. Terracc. ex A. Terracc., Malpighia 4: 198. 1890. Type locality: "Del monte Pollino alle Neviere ed all'Affircata". Type: Italy. Del monte Pollino alle Neviere, 39º54'N, 16º11'E, July 1887, *N. Terracciano s.n.* (lectotype, here designated, RO!).

Geranium molle [II] *tenuisecta* A. Terracc. ex Graebn. in Asch. & Graebn., Syn. Mitteleur. Fl. 7(1): 52. 1913. Type locality: "... nei colli sino a che sui monti...". Type: Italy. Nei colli sino a che sui monti..., *A. Terracciano s.n.* (no original material located).

Geranium molle [I] *trivialis* A. Terrac. ex Graebn. in Asch. & Graebn., Syn. Mitteleur. Fl. 7(1): 52. 1913, ["triviale"]. Type locality: "Porto d'Anzio". Type: Italy. Porto d'Anzio, 41º26'N, 12º37'E, *A. Terracciano s.n.* (no original material located).

Geranium oenense Borbás ex Hallier in W.D.J. Koch, Syn. Deut. Schweiz. Fl. 1: 454. 1891 [July 1891]. Type locality: "Baenitz Herb. Europ. 1891. Lief 62 Nr. 6315... von Hall b./Innsbruck (Murr)". Type: Austria. Innsbruck, Hall, 47º35'N, 14º26'E, May 1890, *J. Murr s.n.* (lectotype, designated by Aedo & al. 1998: 607, W!; isolectotypes, JE-00019565 image!, K!, P!, RO!).

Geranium molle f. *candidum* Beck, Fl. Nieder-Österreich.: 563. 1892. Type locality: "Vorkommen: Auf bebauten und wüsten Stellen, unter Buschwerk hie und da um Wien und bis gegen Baden, bei Laxenburg, Hainburg, Melk, Schenkenbrunn, Retz. V-IX". Syntypes: Austria. Auf bebauten und wüsten Stellen, unter Buschwerk hie und da um Wien [48º12'N, 16º22'E] und bis gegen Baden [48º00'N, 16º13'E], bei Laxenburg [48º04'N, 16º21'E], Hainburg [48º08'N, 16º56'E], Melk [48º13'N, 15º20'E], Schenkenbrunn [48º20'N, 15º29'E], Retz [48º45'N, 15º57'E], May-Nov., *G. Beck s.n.* (no original material located).

Geranium molle f. *seguieri* Paol. in Fiori & Paol., Fl. Italia 2: 235. 1901. Type locality: [not indicated]. Type: Italy. unknown locality and collector (no original material located).

Geranium molle f. *pinguis* K. Malý, Verh. K.K. Zool.-Bot. Ges. Wien 54: 229. 1904. *Geranium molle* [B] *pinguis* (K. Malý) Graebn. in Asch. & Graebn., Syn. Mitteleur. Fl. 7(1): 52. 1913. Type locality: "Novibazar: Žljeznicatal zwischen Prijepolje und Jabuka (Weisbach)". Syntypes: Serbia. Novibazar, kljeznicatal zwischen Prijepolje [43º23'N, 19º39'E] und Jabuka [43º24'N, 19º29'E], *A. Weisbach s.n.* (no original material located).

Geranium molle var. *grandiflorum* Lojac., Malpighia 20: 194. 1906, nom. illeg. Type locality: "In herbidis Palermo. Herb. Pan.!". Type: Italy. Palermo, 38º06'N, 13º21'E, June 1883, *M. Lojacono s.n.* (lectotype, here designated, FI!).

Geranium molle var. *caespitosum* N. Terracc., Nuov. Giorn. Bot. Ital. ser. 2, 14: 138. 1907. *Geranium molle* [b] *caespitosum* (N. Terracc.) Graebn. in Asch. & Graebn., Syn. Mitteleur. Fl. 7(1): 52. 1913. Type locality: "Pisterola". Type: Italy. Pisterola, 40º44'N, 15º28'E, *N. Terracciano s.n.* (no original material located).

Geranium brutium [b] *micranthum* N. Terracc., Bull. Orto Bot. Regia Univ. Napoli 3: 122. 1913. Type locality: "Pisterola a Signa sopra Vallesega.-- Junio, Julio". Type: Italy. Basilicata, Muro-Lucano a Signa, 40º44'N, 15º28'E, July 1909, *N. Terracciano s.n.* (lectotype, here designated, FI!).

Geranium molle var. *montanum* A. Terracc. ex N. Terracc., Bull. Orto Bot. Regia Univ. Napoli 3: 123. 1913. Type locality: "Acquanera.--Junio, Julio". Type: Italy. Acquanera, June-July, *N. Terracciano s.n.* (no original material located).

Geranium molle var. *bicolor* Soest in Heukels, Levende Natuur 27: 379. 1923. Type locality: [not indicated]. Type: Netherlands, Belvédère den Haag, 52º06'N, 4º18'E, 22 May 1922, *J.L. van Soest s.n.* (holotype, L-0820766 image!).

Geranium molle subsp. *sinjaricum* Al-Shehbaz & Al-Khakani, Candollea 38(1): 353. 1983. Type locality: "Iraq, Sinjar Mt., Gulley of Dair Aasy, May 7, 1975, I. Al-Shehbaz, A, Al-Mayah and F. Sharifi (BUH 30 568)". Type: Iraq. Sinjar Mt., Gulley of Dair Aasy, 36º20'N, 41º43'E, *I. Al-Shehbaz, A. Al-Mayah & F. Sharifi s.n.* (holotype, BUH-30568).

Annual herbs, 10-45 cm tall. *Stem* erect or ascending, leafy, with long patent, eglandular hairs 1-2.5 mm long and short, patent, glandular and eglandular hairs 0.2-0.5 mm long. *Basal leaves* in a persistent rosette, cauline leaves alternate; leaf laminas 0.9-4(8.2) cm long, 0.9-5.2(8.6) cm wide, not peltate, palmatifid [ratio main-sinus length/middle segment length = 0.54-0.75], orbicular to reniform in outline, base cordate, not coriaceous, with nerves not projected, with appressed, eglandular hairs on both surfaces; segments 5(7), in 1 plane, middle segment obtriangular, 1.5-5(12.1) mm wide at the base [ratio segment width at the base/middle segment length = 0.21-0.27], 3-4(14)-lobed at the apex [ratio secondary sinus length/middle segment length = 0.14-0.26]; petioles up to 28 cm long, without abscission zone, terete, not swollen, not deflexed in age, with patent, eglandular hairs 1-1.5 mm long and short, patent, eglandular and glandular hairs 0.2-0.5 mm long; stipules 3.6-10.9 mm long, 1.2-4 mm wide, lanceolate, free, papery, brown, with eglandular hairs on abaxial surface, glabrous adaxially. *Inflorescence* a dichasial cyme with monochasial branches; cymules 2-flowered, solitary [ratio cymule length/leaf length = 0.7-1.3]; peduncles 5-80 mm long, with patent, eglandular hairs 1-2.2 mm long and short, patent, eglandular and glandular hairs 0.1-0.5 mm long; bracteoles 1-5 mm long, 0.3-1.2 mm wide, lanceolate, whorled; pedicels 5-28 mm long, with patent, eglandular hairs 1-1.8 mm long and short (0.2-0.5 mm long) patent, eglandular and glandular hairs. Flowers actinomorphic. *Sepals* (1)2.5-5.5(6) mm long, 0.9-2.5 mm wide, lanceolate, smooth, not accrescent, nerves 3-5, mucro 0.2-0.3 mm long [ratio mucro length/sepal length = 0.03-0.10], with patent, eglandular hairs 1-2 mm long and ± patent, eglandular and glandular hairs 0.2-0.5 mm long on the abaxial surface, glabrous adaxially. *Petals* 3-8.5(10.5) mm long, 1.5-7 mm wide, erect-patent, emarginate (notch 0.7-2.5 mm deep), without claw, bright purple, glabrous on both surfaces, ciliate on the basal margin, with hairs 0.2-0.4 mm long. *Stamens* 10, both whorls bearing anthers; filaments 2-5 mm long, lanceolate, white, glabrous except for a some cilia 0.1-0.2 mm long on the proximal half; anthers 0.3-1.5 mm long, purple. Nectaries 5, hemispheric, glabrous. *Gynoecium* 2.4-6 mm long, purple. *Fruit* 8-14 mm long, erect, discharge of carpel-projection type, operative; mericarps 1.6-2.1 mm long, 1.1-1.4 mm wide, without a strand of fibers, not compressed at the apex, transversely wrinkled, without basal beak, without a basal callus, without a basal prong, brown, glabrous on the surface, with a few cilia at the base; rostrum 6-11 mm long, with a narrowed apex 1-3 mm long, not twisted, with erect-patent, eglandular hairs 0.1-0.3 mm long; stigmatic remnants 1-2 mm long, with 5 hairy lobes. *Seeds* 1.4-1.8 mm long, 1-1.2 mm wide, smooth, uniformly colored, brown, glabrous. Cotyledons with entire margin. Figs. 701, 702.

Pollen. *Geranium*-type (Bortenschlager 1967: 425; Park & Kim 1997: 314; Shehata 2008: 69; Stafford & Blackmore 1991: 62; Velasco 1992b: 59).

Chromosome number. 2*n* = 26.

Phenology. Collected in flower from January to December.

Distribution. This species ranges from Europe and northern Africa to western Himalayas, and it is introduced in southwestern Canada, U.S.A., southern South America, South Africa, Hawaii, Taiwan, Australia and New Zealand (Fig. 703).

Habitat. Roadsides, cultivated areas, waste places, open meadows, dunes, dry grassland, and edge of forests; 0-2500 m.

Representative specimens examined. **Afghanistan.** Afghanistan, 34º31'N, 69º8'E, 20 Apr. 1915 (K). **Albania.** Vlorë: Sarande, S Albania, 39º52'N, 19º59'E, 30 May 1933, *Alston & Sandwith 1222* (K). **Algeria.** Oran: Misserghin to Bou Tlelis, SW Oran, 35º36'N, 0º43'W, 27 Apr. 1971, *Davis 51692* (BM). **Argentina.** Buenos Aires: Sierra de la Ventana, Cerro Ventana, 38º2'S, 62º1'W, 28 Dec. 1978, *proyecto Ventania 349* (NY). Islas Malvinas: Puerto Stanley, York Bay, Cape Pembroke, 51º42'S, 57º59'W, 9 Feb. 1979, *Dimitri & al. 262* (SI). **Armenia.** Syunik: pr. Nerkin Hand village, 39º3'N, 46º31'E, 26 June 2005, *Gonzalo & al. 267* (MA). **Australia.** Lord Howe Is.: 0.4 km N of Pine Trees, 31º34'S, 159º5'E, 8 Sep. 1970, *Johnson & Rodd 1210* (K). New South Wales: Gingham Gap, Herveys Range, 29º11'S, 149º17'E, 18 Oct. 1978, *Coveny 10288* (K). Tasmania: Kents Group, Erith Is., 39º27'S, 147º17'E, 2 Jan. 1974, *Whinray 235* (AD). **Austria.** Tyrol: Insbrunk, 47º16'N, 11º24'E, *Kerner s.n.* (K). **Azerbaijan.** Absheron: Baku, distr. Saljany, sttepa Mil inter Karadanly et tumulum Boz-Tapa, 39º47'N, 48º2'E, 15 Apr. 1928, *Prilipko s.n.* (LE). **Belgium.** Flemish: Antwerpen, Mechelen, 50º44'N, 5º15'E, May 1999, *Buggenhout s.n.* (MA). **Bosnia-Herzegovina.** Mostar, 43º20'N, 17º48'E, 1895, *Raap 42* (K). **Bulgaria.** Montana: in graminosis pr. Berkovica, 43º14'N, 23º7'E, 1903, *Urumov s.n.* (SOM). **Canada.** Brit-

ish Columbia: S of Anderson Hill, McNeill Bay, 48º24'N, 123º18'W, 1973, *Harrison 111* (CAN). **Chile.** Biobío: parque Hualpén, morro Pompón, 36º48'S, 73º10'W, 21 Nov. 2001, *Aedo 6930* (MA). **Croatia.** Dubrovnik-Neretva: Curzola, 42º57'N, 17º8'E, 30 Mar. 1911, *Kirincic s.n.* (W). **Cyprus.** Limassol: pr. Koilani, 34º50'N, 32º52'E, 15 Apr. 2019, *Aedo & al. 26332* (MA). **Czech Republic.** Liberec: Doksy, Bohemia bor., 50º33'N, 14º39'E, 5 July 1980, *Hadinec & al. s.n.* (G). **Denmark.** Midtjylland: Brabrand, W of Aarhus, 56º9'N, 10º7'E, 22 May 1968, *Nielsen s.n.* (MA, W). **Egypt.** North Sinai: Gedeirat, East Sinai, 30º38'N, 34º26'E, Mar., *Meinertzhagen s.n.* (BM). **Estonia.** Võru: Osilia, Jerwen, Knig. Dineu, 57º49'N, 26º44'E, 31 May 1900, *Klinge s.n.* (LE). **Finland.** Åland: Alandia, Lemland, insula Slätholm, 60º4'N, 20º6'E, 9 June 1907, *Florström s.n.* (W, K). **France.** Auvergne-Rhône-Alpes: Puy-de Dôme, Bourg-Lastic, 45º39'N, 2º34'E, 31 May 1982, *Fabri & Schumacker 820531* (MA). Corse: Aitone valley, near Evisa, 42º15'N, 8º51'E, 21 Apr. 1928, *Edwards s.n.* (BM). **Georgia.** Samegrelo-Zemo Svaneti: Kutais, pr. Poti, 42º9'N, 41º40'E, 5 May 1902, *Alexeenko 7375* (LE). **Germany.** North Rhine-Westphalia:, Münster, 51º58'N, 7º26'E, 10 June 1906, *[illegible]* (W). **Great Britain.** Channel Islands.: Alderney, 49º43'N, 2º12'W, 13 June 1929, *Jackson 87* (K). Wales: Glamorganshire, 41, Pleasant Harbour between Abertow and Rhoose, 51º29'N, 3º40'W, 15 June 1949, *Lewis 124* (K). **Greece.** Kriti: Sfakia, road Skaloti, 35º11'N, 24º14'E, 1 Apr. 1994, *Bergmeier 3688* (NHMC). Peloponnese: Ahaia, carretera Kalavrita a Diakofto, c. Mega Spileo, 38º3'N, 22º8'E, 23 June 2007, *Navarro & al. 6888* (MA). **India.** Himachal Pradesh: Chumba, 32º34'N, 76º7'E, 7 Oct. 1894, *Clarke 23581* (K). **Iran.** Lorestan: Jaidar lake, 8 km W Mirabad, 33º7'N, 47º44'E, 16 Apr. 1960, *Bent & Wright 416-301* (W). **Iraq.** Dhi Qar: Agra, 31º29'N, 45º24'E, 11 May 1967, *Anders 1313* (W). **Ireland.** Leinster: Dublin, 53º22'N, 6º17'W, 1 June 1888, *Gamble 19987* (K). **Israel.** Haifa: monte Carmelo, Lifto, 32º40'N, 35º1'E, 17 Mar. 1908, *Ubach s.n.* (MA); **Italy.** Puglia: Testa del Gargano, 41º47'N, 16º10'E, 9 Apr. 2015, *Aedo 22480* (MA). Sardegna: Nouro, Bolotana, Badde Salghes, Mularza Noa, 40º20'N, 8º54'E, 2 June 2003, *Aedo & al. 9163* (MA). Sicilia: Palermo, Riserva di Bosco della Ficuzza, Roca Busambra, 37º51'N, 13º25'E, 31 May 2000, *Castroviejo & al. 15452* (MA). **Jordan.** Amman: Amman, 31º57'N, 35º56'E, 7 Mar. 1922, *Buston 11* (K). **Lebanon.** Beirut: Beirout, 33º52'N, 35º30'E, *Post s.n.* (K). **Libya.** Jabal al Akhdar: Jebel Akhdar, near Slonta, 32º36'N, 21º43'E, 1939, *Sandwith 2285* (K). **Malta.** Gozo Is.: Ujed Klemi, 36º2'N, 14º15'E, 20 Apr. 1907, *Sommier s.n.* (FI). **Montenegro.** Kotor: Cattaro, 42º25'N, 18º46'E, July 1882, *Marchesetti s.n.* (FI). **Morocco.** Tanger-Tetouan-Al Hoceima: Xauen, Jbel Lakra, Hauta-el-Kasdir, 35º6'N, 5º7'W, 22 June 1997, *Aedo & al. 4111 CA* (MA). **Netherlands.** Limburg: near Voerendaal, Limburg, 50º52'N, 5º56'E, 20 May 1950, *Willemsen s.n.* (AK). **New Zealand.** Kermadec Is.: Sunday Is., Kermadic group, 29º15'S, 177º52'W, Aug., *Cheeseman s.n.* (AK). New Zealand North Is.: Ahipara, Te Neke, 34º32'S, 172º43'E, Feb., *Nickerson s.n.* (AK). **North Macedonia.** Southeastern: Obri, 41º17'N, 22º38'E, 8 July 1968 (MA). **Norway.** Viken: Tisler, en af Slvolóerne, 58º59'N, 10º57'E, 25 May 1865, *Collet s.n.* (K). **Palestine.** Jerusalem: Judean Desert, near Mishor Adumim, 31º47'N, 35º19'E, 22 Mar. 1989, *Danin & al. 05.025* (G). **Poland.** Masovian: Varsoviae, 52º15'N, 2º0'E, *Fuckel s.n.* (BM). **Portugal.** Azores: Pico, cais do Pico, 38º28'N, 28º20'W, 29 Apr. 1965, *Sjögren 6056* (MA). Madeira: riberia da Fonte do Louro, 32º47'N, 16º55'W, 31 Aug. 2003, *Aedo 9703* (MA). Minho: pr. Monçao, 42º4'N, 8º28'W, 20 Apr. 2008, *Aedo 15581*

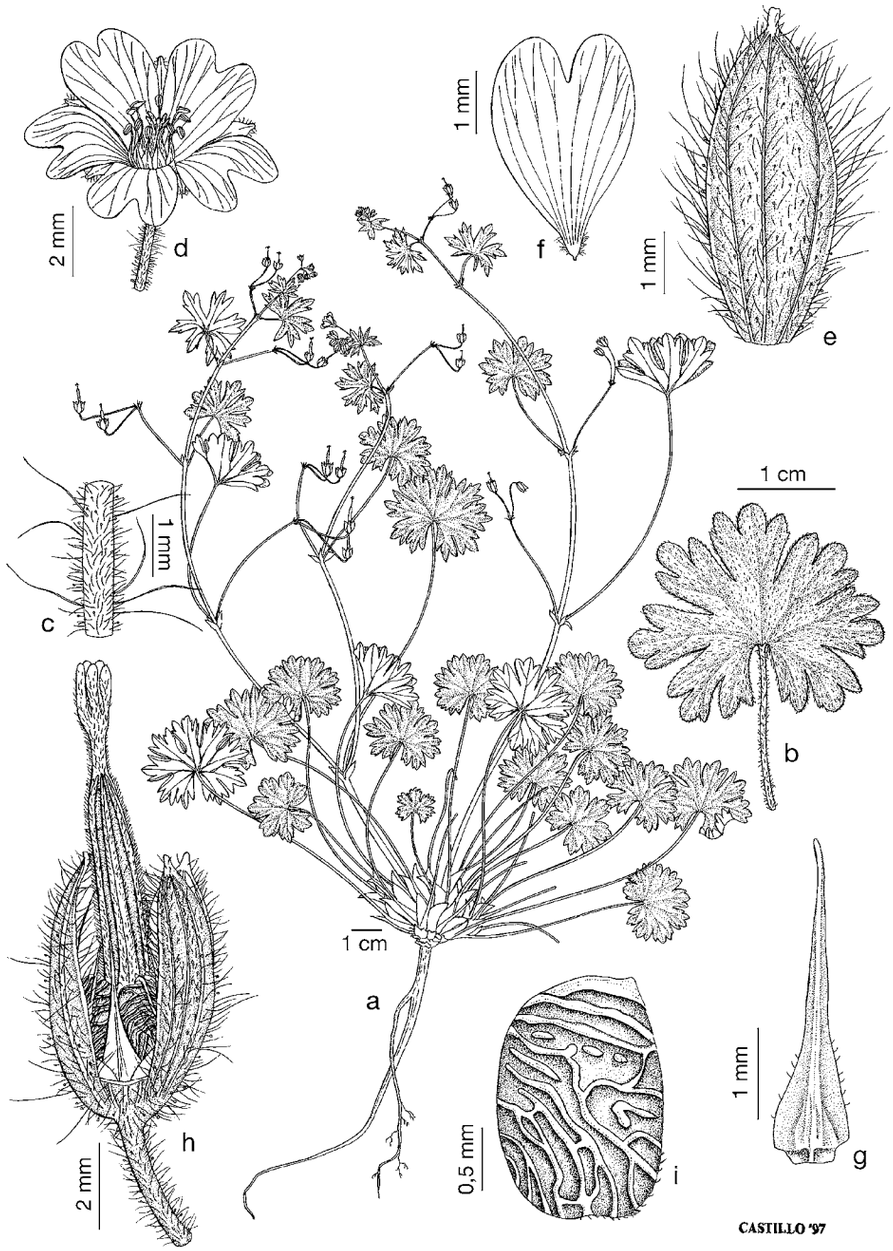


Fig. 701. *Geranium molle*. a. Habit. b. Leaf. c. Peduncle. d. Flower. e. Sepal. f. Petal. g. Staminal filament. h. Fruit, one sepal removed. i. Mericarp. (Based on: *Rigual s.n.*, MA-371877).

Fig. 702. *Geranium molle* (Based on: *Aedo 27195*, MA).

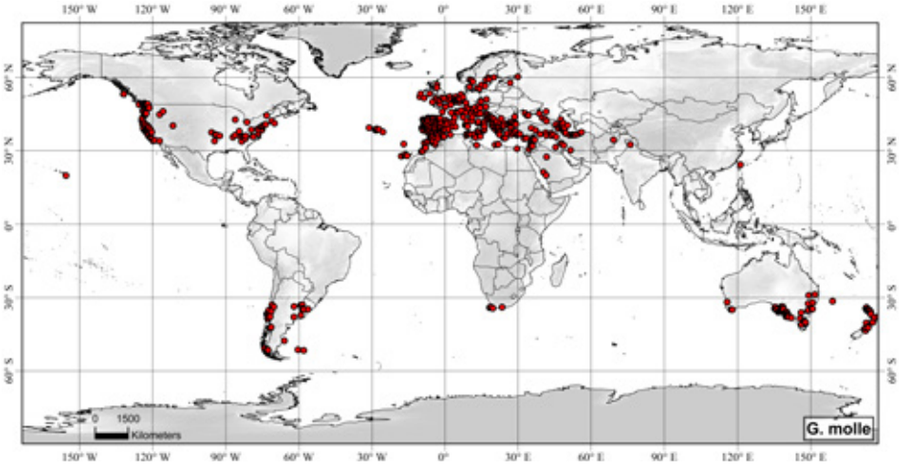


Fig. 703. Distribution of *Geranium molle*.

(MA). **Romania.** Sud-Est: Dobrogea, N Costinesti, am Bahndamm, 43°57'N, 28°37'E, 14 May 1976, *Krendl s.n.* (BM, G, W). **Russia.** Dagestan: Tarkitan u Machackaln, 42°53'N, 47°33'E, 16 Apr. 1966, *Kuvaev 1-7* (LE). Krym: Alupka, 44°25'N, 34°3'E, 20 May 1903, *Go?d s.n.* (LE). St. Petersburg: Lublinskoj gub., 60°19'N, 29°55'E, 18 May 1907, *Ganeschin s.n.* (W). **Saudi Arabia.** Al-Bahah: Souther Hejaz, Az Zafir, 19°58'N, 41°30'E, 7 Feb. 1971, *Ironside 71/104* (BM). **Serbia.** Šumadija and Western Serbia: Crni Vrh pr. Priboj, 43°35'N, 19°31'E, 23 June 1930, *Novak 552* (PRC). **South Africa.** Western Cape: Jonkershock, Stellenbosch division, 33°56'S, 18°52'E, 6 Oct. 1952, *Parker 4802* (K). **Spain.** Asturias: Berbes, pr. Ribadesella, 43°28'N, 5°9'W, 26 Apr. 1992, *Aedo 2044* (MA). Baleares: Ibiza, colina del Castillo, 38°55'N, 1°25'E, 12 Apr. 1949, *Palau s.n.* (MA). Canarias: El Hierro, Mocanal, 27°49'N, 17°56'W, 2 Jan. 2013, *Aedo 19651a* (MA). **Sweden.** Södermanland: Paroecia Ornö, Västanvik, 59°12'N, 16°49'E, 1 July 1927, *Asplund* (K). **Switzerland.** Vaud: Lausanne, 46°32'N, 6°40'E, Aug., *Favrat & Barbey s.n.* (K). **Syria.** Homs: Ain Ajouz, 34°48'N, 36°19'E, 5 May 2007, *Rico 2248* (MA). **Taiwan.** Taichung Co.: Hoping Township, 24°20'N, 121°18'E, 6 Aug. 2006, *Chen & al. 7369* (TAI). **Tunisia.** Nabeul: península de Cap Bon, pr. Taklisah, 36°46'N, 10°35'E, 31 Mar. 2009, *Quintanar & al. 3266* (MA). **Turkey.** Antalya: Sütlegen, Oluklar Yolu, 36°26'N, 29°36'E, 24 Apr. 1970, *Bozakman & Fitz 265* (W). Istanbul: Thracia, Pinarça, NW de Estambul, 41°17'N, 28°18'E, 16 May 2000, *Castroviejo 15356* (MA). **Uruguay.** Montevideo: Montevideo, Cerro, 34°50'S, 56°10'W, 1937, *Herter 1312b* (MO). **USA.** Arkansas: Marion Co., Buffalo State Park, ca. 15 mi SE Yellville, 36°10'N, 92°27'W, 23 May 1970, *D'Arcy & Porter 4426* (MO). California: Sonoma Co., Dumeans Hills Marsh, 16 May 1960, *Rubtzoff 4342* (CAS). Delaware: Sussex Co., Rehoboth, 38°39'N, 75°5'W, 23 May 1931, *Jones s.n.* (PH). Hawaii: Hawaii Is., Hamakua, Upper Paauhau, 19°53'N, 155°33'W, 3 June 1938, *Hosaka 2203* (BISH). Oregon: Clatsop Co., near Astoria, 46°11'N, 123°49'W, June, *Van Dyke 13180* (CAS). West Virginia: Pendleton Co., Pike Gap rd., 0.5 mi SE jct of St. Rt. 28 at Circleville, 38°40'N, 79°29'W, 31 May 1989, *Cusick 28120* (NY).

Discussion. Geranium molle is a very distinctive species, easily identified by its transversely wrinkled mericarp, glabrous on the surface and sparsely ciliate at the base. It grows naturally almost throughout Europe, in the circum-Mediterranean

area, Macaronesia, and central and western Asia. The eastern limit in Europe is not well known, because of the scarcity of herbarium material. In Asia, this species reaches the western Himalayas to 76°E in India. It has been introduced in many temperate areas of North America, South America, southern Africa, Hawaii, Taiwan and Australia. *Geranium molle* shares some characters with *G. aequale*, such as glabrous stamen filaments, an abruptly tapered fruit rostrum, and glabrous mericarp surface, supporting their close relationship.

A number of minor morphological variants of *G. molle* have been recognized in the literature, of which the most notable seems to be *G. brutium*. According to Webb & Ferguson (1968: 198), this is an eastern Mediterranean species similar to *G. molle* but frequently perennial (*G. molle* was considered annual by these authors), with the lowermost inflorescence leaves shorter than the peduncle or slightly exceeding it (as opposed to considerably longer in *G. molle*) and with petals 6-11 mm long (3-7 mm long in *G. molle*). Davis (1967: 460) and Persson (1987: 547) considered *G. brutium* as a subspecies of *G. molle*, whereas Pignatti (1982: 10) preferred specific rank. All of these authors used the above-mentioned characters to recognize *G. brutium*. All the studied material identified (by several authors) as *G. brutium* is clearly annual, though variable in stature and robustness. This was already pointed out by Boissier (1867: 880, 882). *Geranium molle* subsp. *sinjaricum*, described by Al-Shehbaz & al. (1983: 353) from Iraq, was said to be perennial. Unfortunately, I was not able to examine any original material on which this name was based, but all specimens studied from Iraq were annuals. The ratio between the length of the lowest inflorescence leaf and the peduncle varies considerably in *G. molle*, but independently of plant robustness and petal length. This suggests that *G. brutium* has been distinguished from *G. molle* only because of its longer petals. However, some plants with long petals can be found throughout the geographic range of *G. molle*, even in populations with mainly short petals. According to Yeo (*pers. comm*.) and my own observations, the earliest flowers usually exhibit the longest petals, with petal length diminishing as the season progresses. Moreover, the type specimen of *G. brutium* has petals 7.8 mm long, not far from the *G. molle* values. Consequently, the forms with long petals are here not accorded taxonomic recognition. Sometimes it is possible to find depauperate plants of *G. molle* (up to 5 cm high), fertile but with the leaves not fully developed. Some such specimens [e.g., *Florstrom s.n.* (K) from Finland, or *Davis & Bokhari 55856* (K) from Iran] have leaves with undivided lobes. However, no other character state is associated with this size reduction, which suggests that this form also does not deserve taxonomic recognition.

The chromosome number *2n* = 28 attributed to this species (Martin & al. 2022) should be confirmed. Carolin (1965) designated as type of *G. molle* a drawing by Vaillant (1727) that shows a branch and a detail of a flower. In this drawing the ornamentation of the mericarps, nor the indumentum of the plant or its annual life span cannot be appreciated. Therefore an epitype is designate for purposes of the precise application of the name.

278. Geranium pusillum L., Syst. Nat. ed. 10, 2: 1144. 1759, [V-VI, 1759]. *Geranium parviflorum* Curtis, Fl. Londin. 4(43), tab. 46. 1782, nom. illeg. *Geranium parviflorum* Chevall., Fl. Gén. Env. Paris 2(2): 802. 1828, nom. illeg. Type locality: "Habitat in Anglia, Gallia" [according to L., Sp. Pl. ed. 2, 2: 957 (1763)]. Type: "Habitat in Anglia, Gallia" (lectotype, designated by Holmgren 1997: 332, LINN-858.86 image!) [designation in Aedo & al. 1998: 611 was in error].

Geranium dubium Chaix, Pl. Vap.: 23. 1785. Type locality: "circà pagos frequens". Type: France. Circà pagos frequens [in agro vapincense, Gap, 44º33'N, 6º04'E], *D. Chaix s.n.* (no original material located).

Geranium humile Cav., Diss. 4: 202, tab. 83 fig. 2. 1787. *Geranium pusillum* var. *humile* (Cav.) Willd., Sp. Pl. 3(1): 714. 1800. *Geranium parviflorum* var. *humile* (Cav.) Chevall., Fl. Gén. Env. Paris 2(2): 803. 1828. Type locality: [not indicated]. Type: locality and collector unknown, specimen annotated in Cavanilles's hand as "humile" (lectotype, designated by Aedo & al. 1998: 611, MA-475736!).

Geranium pusillum var. *minus* Fr., Novit. Fl. Suec. Alt.: 213. 1828. *Geranium pusillum* f. *minus* (Fr.) Prahl, Krit. Fl. Schlezw.-Holst. 2: 37. 1889. Type locality: [not indicated]. Type: (no original material located).

Geranium delicatulum Ten. & Guss. in Ten., Fl. Napol. 5: xii, 84. 1835-1836. *Geranium pusillum* subsp. *delicatulum* (Ten. & Guss.) A. Terracc., Malphigia 4: 212. 1890. Type locality: "In graminosis montosis Aprutii: Majella: nella valle dell'Orfenta alla Cesa dopo il vado di S. Antonio". Type: Italy. Majella, 41º38'N, 14º00'E, *M. Tenore s.n*. (lectotype, designated by Aedo & al. 1998: 611, NAP; photocopy!; isolectotype, P!).

Geranium pusillum var. *elatum* Picard, Mém. Soc. Agric. Boulogne-sur-Mer 1: 133. 1837. Type locality: "Se trouve dans les terres fortes et les endroits herbeux". Type: France. Dans les terres fortes et les endroits herbeux, *C. Picard s.n.* (no original material located).

Geranium pusillum var. *exsertum* Peterm., Fl. Lips. Excurs.: 512. 1838. Type locality: "... ad praedium Pfaffendorf, ad pagos Leutzsch, Anger, Reudnitz, ad oppidum Delitzsch etc". Syntypes: Germany. ... ad praedium Pfaffendorf, ad pagos Leutzsch [51°21'N, 12°19'E], Anger, Reudnitz [51°19'N, 12°24'E], ad oppidum Delitzsch [51°31'N, 12°20'E] etc., *L. Petermann s.n.* (no original material located).

Geranium circinatum Kanitz, Linnaea 32: 570. 1864, ["circinatnm"]. *Geranium pusillum* [B] *circinatum* (Kanitz) Graebn. in Asch. & Graebn., Syn. Mitteleur. Fl. 7(1): 42. 1913. Type locality: "Habitat ad Varasdinum et in valle Vilena draga monte Croatiae". Type: Croatia. Habitat ad Varasdinum [46°18'N, 16°20'E] et in valle Vilena draga monte Croatiae, *A. Kanitz s.n.* (no original material located).

Geranium pusillum var. *axilliflorum* Schur, Enum. Pl. Transsilv.: 137. 1866. *Geranium pusillum* [*ß*] *axilliflorum* (Schur) Graebn. in Asch. & Graebn., Syn. Mitteleur. Fl. 7(1): 41. 1913. *Geranium pusillum* f. *axilliflorum* (Schur) Gams in Hegi, Ill. Fl. Mitt.-Eur. 4(3): 1704. 1924. Type locality: "Auf Sandboden am Zibinfluss bei Neppen-

dorf. Jul.". Type: Romania. Auf Sandboden am Zibinfluss bei Neppendorf, 45°47'N, 24°05'E, July, *F. Schur s.n.* (lectotype, here designated, LW-205547 image!).

Geranium pseudopusillum Schur, Oesterr. Bot. Z. 18: 317. 1868. *Geranium pusillum* [II] *pseudopusillum* (Schur) Graebn. in Asch. & Graebn., Syn. Mitteleur. Fl. 7(1): 42. 1913. Type locality: "Auf unbebauten steinig-sandigen Aeckern und Plätzen, unweit des Landgutes vor der Favoriten-Linie. Anfang Mai 1867". Type: Austria. Landgutes vor der Favoriten-Linie [Wien], 48°9'N, 16°24'E, May 1867, *F. Schur 761* (lectotype, here designated, FI!).

Geranium pusillum var. *albiflorum* Schur, Verh. Naturf. Vereins Brünn 15: 163. 1877. *Geranium pusillum* [1] *albiflorum* (Schur) Graebn. in Asch. & Graebn., Syn. Mitteleur. Fl. 7(1): 41. 1913. Type locality: "In Obstgärten bei Hermannstadt, eine Schattenform, Mai 1850". Type: Romania. Hermannstadt, 45°47'N 24°09'E, May 1850, *F. Schur s.n.* (no original material located).

Geranium pusillum var. *gracillimum* Schur, Verh. Naturf. Vereins Brünn 15: 162. 1877. *Geranium pusillum* [1] *gracillimum* (Schur) Graebn. in Asch. & Graebn., Syn. Mitteleur. Fl. 7(1): 42. 1913. *Geranium pusillum* f. *gracillimum* (Schur) Gams in Hegi, Ill. Fl. Mitt.-Eur. 4(3): 1704. 1924. Type locality: "Auf der Spitalswiese bei Brünn truppweise, Juni 1872". Type: Czech Republic. Auf der Spitalswiese bei Brünn truppweise, 49°11'N, 16°36'E, June 1872, *F. Schur s.n.* (no original material located).

Geranium pusillum var. *majus-grandifolium* Schur, Verh. Naturf. Vereins Brünn 15: 162. 1877. *Geranium pusillum* [2] *majus* (Schur) Graebn. in Asch. & Graebn., Syn. Mitteleur. Fl. 7(1): 42. 1913. *Geranium pusillum* f. *majus* Schur ex Săvul., Fl. Rep. Pop. Române 6: 142. 1959. Type locality: "In der Au der Schwarzawa bei Komein nächst Brünn, Juli 1870". Type: Czech Republic. In der Au an der Schwarzawa bei Komein nächst Brünn, 49°11'N, 16°36'E, July 1870, *F. Schur s.n.* (no original material located).

Geranium pusillum var. *rigidum* Schur, Verh. Naturf. Vereins Brünn 15: 163. 1877. *Geranium pusillum* [2] *rigidum* (Schur) Graebn. in Asch. & Graebn., Syn. Mitteleur. Fl. 7(1): 42. 1913. *Geranium pusillum* f. *rigidum* (Schur) Gams in Hegi, Ill. Fl. Mitt.-Eur. 4(3): 1704. 1924. Type locality: "Auf steinig-sandigem Boden vor der Favoritenlinie in der Nähe des Landgntes bei Wien, Mai 1867". Type: Austria. Auf steinig-sandigem Boden vor der Favoritenlinie in der Nähe des Landgntes bei Wien, 48°9'N, 16°24'E, May 1867, *F. Schur s.n.* (no original material located).

Geranium hybridum Hausskn., Mitt. Geogr. Ges. (Thüringen) Jena 3: 278. 1884, nom. illeg., non L. 1767. *Geranium hausskneckhtii* Soó, Syn. Syst.-Geobot. Fl. Veg. Hung. 6: 185. 1980. Type locality: "Ilmviaduktes bei Weimar". Type: Germany. Weimar, 50°58', 11°19'E, June 1884, *C. Hausskneckhtii s.n.* (lectotype, designated by Aedo & al. 1998: 611, JE-00019309!).

Geranium pusillum var. *luxurians* A. Terracc., Malphigia 4: 206. 1890. Type locality: "... che ho qui di Carlsbaad e dell'Alpe Gebbo (1165 m.) in val Cairasca (Ossola) Frizzi!". Syntypes: Italy. ... che ho qui di Carlsbaad e dell'Alpe Gebbo, 46°14'N, 8°12'E, in val Cairasca (Ossola), 46°08'N, 8°16'E, Frizzi, *A. Terracciano s.n.* (no original material located).

Geranium pusillum f. *subcalvum* Casp. ex Abrom., Fl. Ost- & Westpreussen 154. 1898. Type locality: "Wpr. Fl. zw. Kamin u. Obkaser Mühle, Abhang am Mochel-See (Km. 70)". Type: Germany. Fl. zw. Kamin u. Obkaser Mühle, Abhang am Mochel-See (Km. 70), *J. Abromeit s.n.* (no original material located).

Geranium pusillum var. *villosum* F. Saut., Oesterr. Bot. Z. 49: 402. 1899. *Geranium pusillum* [?] *villosum* (F. Saut.) Graebn. in Asch. & Graebn., Syn. Mitteleur. Fl. 7(1): 42. 1913. Type locality: "Bozen: an Weinbergsmauern in St. Johann, Guntschna, St. Magdalena, bei Caslar". Type: Italy. Bozen, an Weinbergsmauern in St. Johann, Guntschna, St. Magdalena, bei Caslar, 46°30'N, 11°20'E, *F. Sauter s.n.* (no original material located).

Geranium pusillum var. *condensatum* Druce, Bot. Soc. Exch. Club Brit. Isles 5: 17. 1917. Type locality: "... occurred at The Haven, Muddiford, Hants., and was sent by Mr C.B. Green in 1917". Type: Great Britain. England, The Haven, Muddiford, Hants., 51°08'N, 4°02'W, 27 July 1916, *C.B. Green s.n.* (lectotype, designated by Aedo & al. 1998: 611, OXF!).

Geranium pusillum var. *tenuilobum* Sennen, Pl. Espagne 1927 n.° 6058. 1928, in sched. Type locality: "Cerdagne: Angoustrine, coteaux granitiques herbeux, 1450". Type: France. Cerdagne, Angoustrine, 42°28'N, 1°57'E, 7 July 1927, *fr. Sennen s.n.* (lectotype, designated by Aedo & al. 1998: 611, BC-825290!; isolectotypes, BM!, MA-71059!, MA-71060!, MA-470864!, W!).

Annual herbs, 10-50 cm tall. *Stem* erect or ascending, leafy, with patent, eglandular hairs 0.1-0.3 mm long and patent, glandular hairs 0.1-0.2 mm long. *Basal leaves* in a persistent rosette, cauline leaves opposite; leaf laminas 1.5-3.8 cm long, 1.5-4.8 cm wide, not peltate, palmatifid [ratio main-sinus length/middle segment length = 0.30-0.75], orbicular to reniform in outline, base cordate, not coriaceous, with nerves not projected, with appressed, eglandular hairs on both surfaces; segments 5, in 1 plane, middle segment obtriangular, 2-4 mm wide at the base [ratio segment width at the base/middle segment length = 0.18-0.21], 3(5)-lobed at the apex [ratio secondary sinus length/middle segment length = 0.16-0.29]; petioles up to 12 cm long, without abscission zone, terete, not swollen, not deflexed in age, with patent, eglandular hairs 0.1-0.3 mm long and patent, glandular hairs 0.1-0.2 mm long; stipules 2-4 mm long, 1-1.5 mm wide, lanceolate, free, papery, brown, with eglandular hairs on abaxial surface, glabrous adaxially. *Inflorescence* a dichasial cyme with monochasial branches; cymules 2-flowered, solitary [ratio cymule length/leaf length = (0.9)1-3.7]; peduncles 5-32 mm long, with patent, eglandular and glandular hairs 0.1-0.3 mm; bracteoles 1.5-2 mm long, 0.4-0.5 mm wide, linear-lanceolate, whorled; pedicels 6-16 mm long, with patent, eglandular hairs 0.1-0.3 mm long and patent, glandular hairs 0.1-0.2 mm long. Flowers actinomorphic. *Sepals* 3-4.5 mm long, 1.5-2 mm wide, lanceolate, smooth, not accrescent, nerves 3-5, mucro 0.1-0.2 mm long [ratio mucro length/sepal length = 0.02-0.03], with patent, eglandular hairs 0.6-1 mm long and ± patent, eglandular and glandular hairs 0.2-0.5 mm long on the abaxial surface, glabrous adaxially. *Petals* 2-3 mm long, 1-1.5 mm wide, erect-patent, emarginate (notch 0.2-0.5 mm deep), without claw, pale purple, glabrous on both surfaces, ciliate on the basal margin, with hairs 0.1-0.2 mm long. *Stamens* 10, external whorl lacking anthers; filaments 1.2-1.5 mm long, lanceolate, white, pilose on the abaxial surface, ciliate on the proximal half, with hairs 0.1-0.2 mm long; anthers 0.2-0.4 mm long, purple. Nectaries 5, hemispheric, glabrous. *Gynoecium* 1.7-3 mm long, yellow. *Fruit* 8.9-11 mm long, erect, discharge of carpel-projection type, operative; mericarps 1.6-2.2 mm long, 0.8-1.1

mm wide, without a strand of fibers, not compressed at the apex, smooth, without basal beak, without a basal callus, without a basal prong, brown, with appressed, eglandular hairs 0.1-0.2 mm long on all the surface and a few cilia at the base; rostrum 6.3-9 mm long, without a narrowed apex, not twisted, with erect-patent, eglandular and glandular hairs 0.1-0.2 mm long; stigmatic remnants 0.5-0.7 mm long, with 5 hairy lobes. *Seeds* 1.5-1.8 mm long, 0.8-1.1 mm wide, finely reticulate, uniformly colored, brownish red, glabrous. Cotyledons with entire margin. Figs. 704, 705.

Pollen. *Geranium*-type (Bortenschlager 1967: 425; Stafford & Blackmore 1991: 78; Velasco 1992b: 59).

Chromosome number. 2*n* = 26, 34?

Phenology. Collected in flower from March to December.

Distribution. This species ranges through Europe to central Asia (to northern Pakistan) and northern Africa, and it is introduced in North America, southern South America, eastern Siberia, Taiwan, Hawaii and New Zealand (Fig. 706).

Habitat. Cultivated areas, waste places, rocky slopes, and dry grassland, meadows, and edge of forests; 0-2550 m.

Representative specimens examined. **Afghanistan.** Panjshir: Parwan, Khanju Tal, Seitentab des Panjir Tales bei Khejol, 35º15'N, 69º30'E, 26 May 1973, *Anders & Podlech 9997* (G). **Algeria.** Batna: C Aurès, Dj. Makmel, vers le Dj. El-Malou, 35º19'N, 6º16'E, 1 July 1920, *Maire s.n.* (MPU). **Andorra.** Sant Julià de Lòria: Pont de la Margineda, borde del río Valira, 42º29'N, 1º29'E, 4 July 1992, *Aedo & al. CN-869* (MA). **Argentina.** Córdoba: San Alberto, Pampa de Achala, Estancia San Miguel, 31º43'S, 64º46'W, 27 Jan. 1983, *Barboza 21* (CORD). **Armenia.** Lori: Spitak distr., Shirak range, near Shirakamut, 40º51'N, 44º11'E, 26 June 2004, *Vitek & al. 04-1681* (MA, MO, W). **Austria.** Lower Austria: Niederösterreich, bei Mautern, 48º22'N, 15º34'E, 1899, *Kerner s.n.* (MA). **Azerbaijan.** Absheron: Baku, distr. Saljany, sttepa Mil inter Karadanly et tumulum Boz-Tapa, 39º47'N, 48º2'E, 15 Apr. 1928, *Prilipko s.n.* (LE). **Belgium.** Wallonia: Visé, 50º44'N, 5º42'E, 1870, *Hardy s.n.* (BR). **Belorussiya.** Minsk: S Khojn Mozyr., 52º4'N, 29º12'E, 2 1905, *Bordzilowski s.n.* (LE). **Bosnia-Herzegovina.** Sarajevo, 43º51'N, 18º23'E, 30 June 1911, *Preissman s.n.* (W). **Bulgaria.** Blagoevgrad: carretera de Nova Lovcha a Paril, 41º26'N, 23º41'E, 6 July 2004, *Quintanar 1198* (MA). **Canada.** Alberta: Banff, 51º10'N, 115º34'W, Sep., *Sanson 1028* (NY). Ontario: Manitoulin Is., Mindemoya, Manitoulin distr., 45º44'N, 82º10'W, 11 July 1976, *Soper & al. 13563* (CAN). **Chile.** Magallanes: Última Esperanza, Parque Nacional Torres del Paine, NW part of Lago del Toro at Sede Administrativa, 51º11'S, 72º59'W, 4 Dec. 1996, *Elvebakk 96:783* (CONC). **Cyprus.** Nicosia: pagum Prodromo, 34º57'N, 32º50'E, 10 May 1862, *Kotschy 704* (K, W). **Czech Republic.** Hradec Králové: Rekos, lago Vodni Nadrz Nove mesto nad Metuji, 50º23'N, 16º4'E, 9 Sep. 2000, *Castroviejo 15666* (MA). **Denmark.** Sjælland: Holle, Hove, 54º43'N, 11º19'E, 30 June 1941, *Andersen s.n.* (C). **Estonia.**

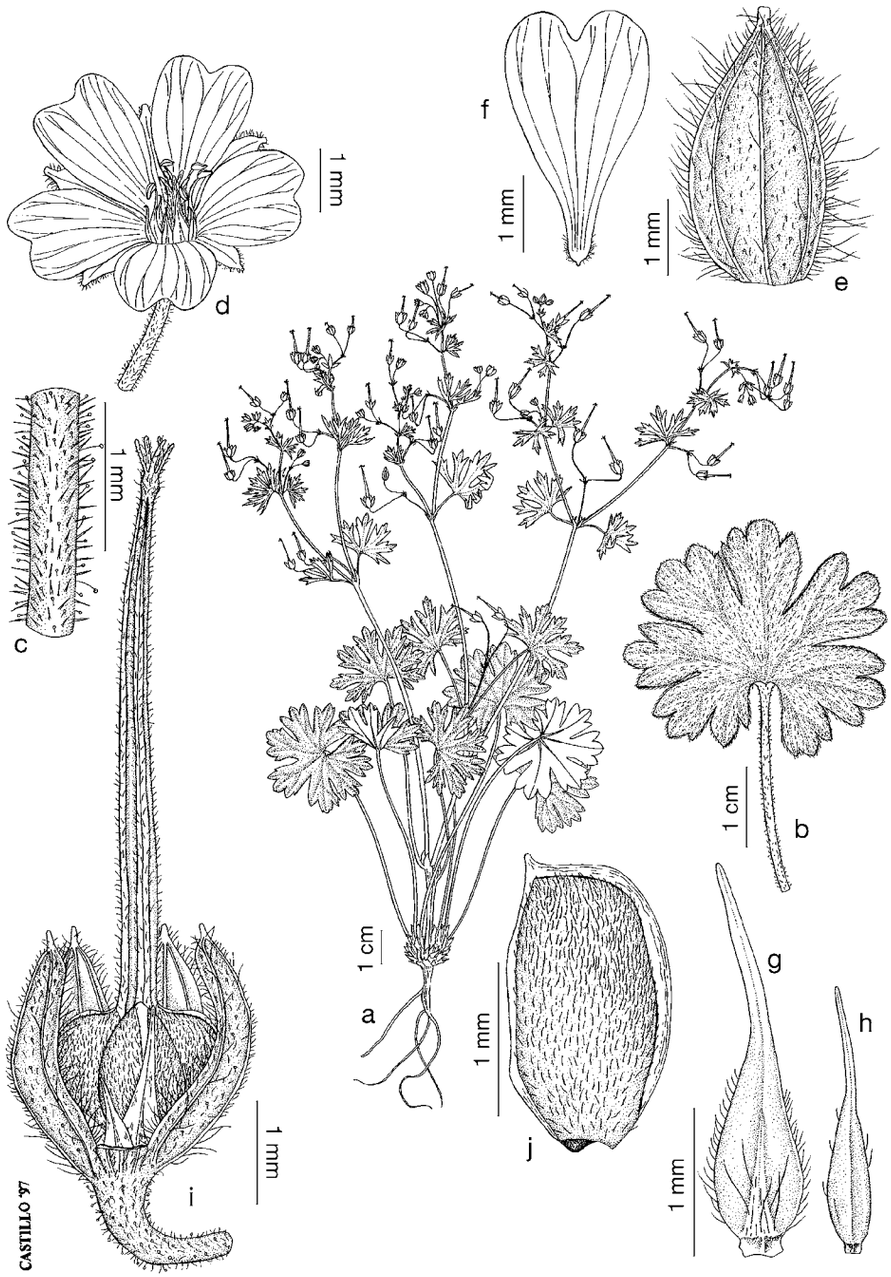


Fig. 704. *Geranium pusillum*. a. Habit. b. Leaf. c. Peduncle. d. Flower. e. Sepal. f. Petal. g, h. Staminal filaments. i. Fruit, one sepal removed. j. Mericarp. (Based on: a-d, i, j, *Anttila s.n.*, MA-180451; e-h, *Aedo 2371*, MA).

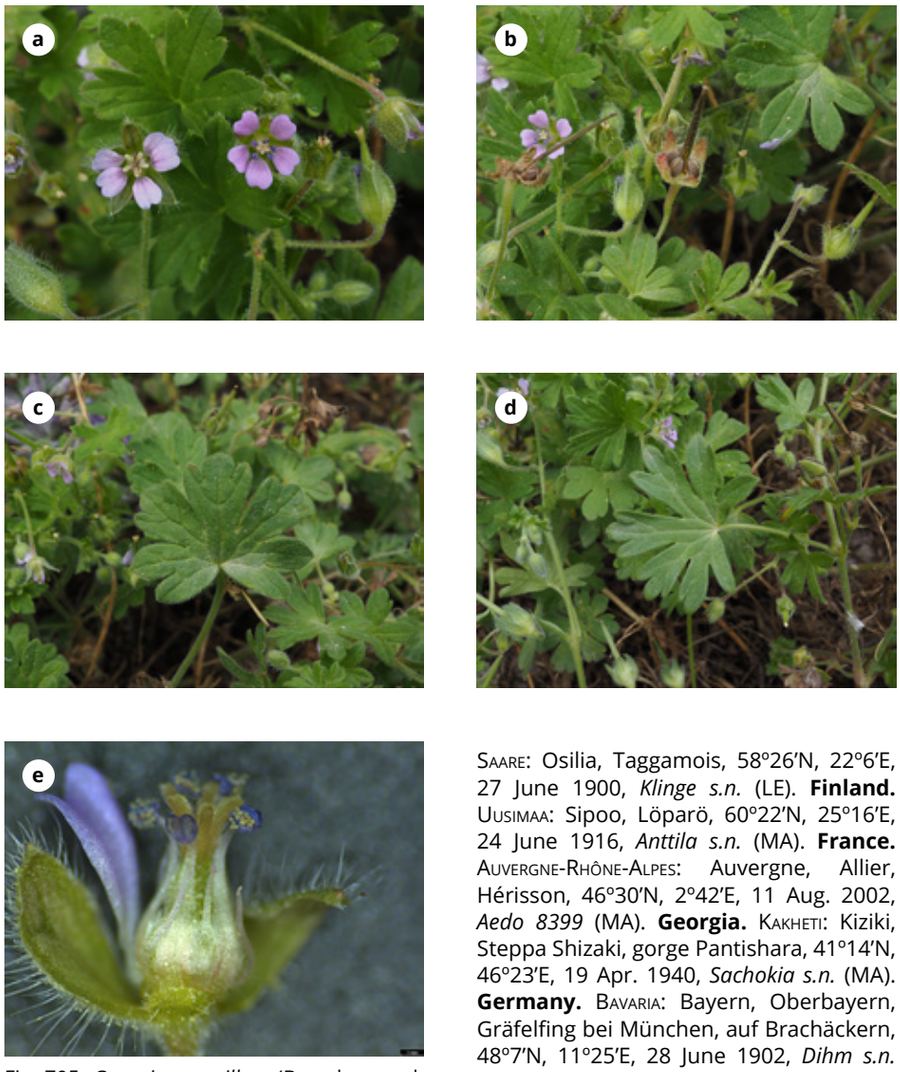


Fig. 705. *Geranium pusillum* (Based on: a-d, *Aedo 27061,* MA; e, *Aedo 27472*, MA).

Saare: Osilia, Taggamois, 58°26'N, 22°6'E, 27 June 1900, *Klinge s.n.* (LE). **Finland.** Uusimaa: Sipoo, Löparö, 60°22'N, 25°16'E, 24 June 1916, *Anttila s.n.* (MA). **France.** Auvergne-Rhône-Alpes: Auvergne, Allier, Hérisson, 46°30'N, 2°42'E, 11 Aug. 2002, *Aedo 8399* (MA). **Georgia.** Kakheti: Kiziki, Steppa Shizaki, gorge Pantishara, 41°14'N, 46°23'E, 19 Apr. 1940, *Sachokia s.n.* (MA). **Germany.** Bavaria: Bayern, Oberbayern, Gräfelfing bei München, auf Brachäckern, 48°7'N, 11°25'E, 28 June 1902, *Dihm s.n.* (MA). **Great Britain.** Scotland: Edinburgh, 55°55'N, 3°15'W, 23 June 1842, *Moyle s.n.* (K). **Greece.** Thessaly: in valle Tempe fluvii Pinios pr. Rapsani, 39°54'N, 22°32'E, 2 May 1961, *Rechinger 22564* (MA). **Hungary.** Pest: Erdely, 47°16'N, 19°20'E 12 June 1912, *Bark s.n.* (K). **India.** Jammu-Kashmir: Dorus, Kashmir, 34°27'N, 74°24'E, 3 June 1958, *Thaplujal 26416* (L). **Iran.** Golestān: Gorgan, Mohammad Reza Shah National Park, cascades E Tang-e-Gol, 36°49'N, 54°26'E, 4 June 1975, *Rechinger 52617* (G). **Iraq.** Maysan: ruins c 6 km SE of Kut el Imara, 32°30'N, 45°51'E, 20 Mar. 1947, *Gillett 6744* (K). **Ireland.** Leinster: Dublin, 53°22'N, 6°17'W, July, *Meade s.n.* (K). **Italy.** Aosta Valley: Val d'Aosta, Saint Denis, NW di Cellier-Neuf, 45°45'N, 7°34'E, 8 May 2007, *Bovio s.n.* (FI). **Kazakhstan.** Zhambyl: SW Kirtsidskogo krebet, 42°30'N, 73°0'E, 2 June 1963, *Sholosmokov s.n.* (LE). **Kyrgyzstan.** Osh: Kara-Kirgiziya, Arsian-gag, 24 Aug. 1925, *Massaiemov 384* (LE). **Latvia.** Saulkrasti: iskerflakke paa N Bredden af Peterupe, 57°15'N, 24°24'E, 4 July 1928, *Grontved s.n.* (C). **Moldova.** Ungheni: Kodry, Kornemjskij raj., 47°21'N, 28°0'E, 24 Sep. 1949, *Borisova 1668* (LE). **Morocco.** Fès-Meknès: refugio de Taffert, Atlas Medio, 33°38'N, 4°9'W, 23 June 1997, *Aedo & al. 4144* (MA). **Netherlands.** Friesland: Harich, 52°54'N, 5°34'E, 4 July 1972, *Slim s.n.* (L). **New Zealand.** New Zealand North Is.: Wellington Harbour, 41°18'S, 174°47'E, 2 Apr. 1941, *Healy s.n.* (CHR). **North Macedonia.** Polog: ad secturas Rud. Orasje (etiam Radusa) dictas in vicinitate oppidi general Hanriev, 42°5'N, 21°12'E, May 1938, *Mach s.n.* (PR). **Norway.** Viken: Mellem Bug, 59°17'N, 10°40'E, 10 July 1939, *Holmope s.n.* (K). **Pakistan.** Khyber Pakhtunkhwa: Swat, NW Pakistan, in valle Jabba E Kolalai, 34°4'N, 71°44'E, 4 June 1965, *Rechinger 30709* (W). **Poland.** Subcarpathian: Silesia inferior, Rakowice Wielkie apud Lwowek Slaski, 50°5'N, 19°59'E, 18 July 2007, *Koziol & al. s.n.* (FI). **Portugal.** Beira Alta: Trancoso, 40°46'N, 7°20'W, *Sampaio 1909* (MA). **Romania.** Centru: Cluj-Napoca, Buru, gorges de Cheile Turzii, Munti Trascau, 46°23'N, 23°33'E, 14 July 1998, *Güemes & Bacchetta 2536* (MA). **Russia.** Bryansk: Pogar, in valle fluv. sudest prope Markovsk, 52°35'N, 33°15'E, 8 June 1980, *Skvortsov s.n.* (M). Dagestan: Temir Chan Schura, 42°49'N, 47°7'E, 28 June 1898, *Alexeenko 7321* (LE). Kaliningrad: mont UmaKovo, 54°40'N, 20°30'E, 28 May 1949, *Pobedimova & al. 23* (LE). Kaluga: Peremyschl, in valle fluv. Oka, pr. Korekozovo, 54°21'N, 36°12'E, 23 June 1971, *Skvortsov s.n.* (M). Krasnodar: Maikop, 44°36'N, 40°6'E, 1921, *Pastuchov s.n.* (MA). Krym: Severnoe Chernomovskoe poberezhe, 45°34'N, 32°52'E, 22 May 1948, *Pobedimova 189* (LE). North Ossetia: prov. Terek, pr. st. viae ferr. Borokowo, 1 May 1901, *Alexeenko 7410* (LE). Novgorod: Pobereze Finskago zalina, Chudskoe lake, 57°19'N, 30°52'E,

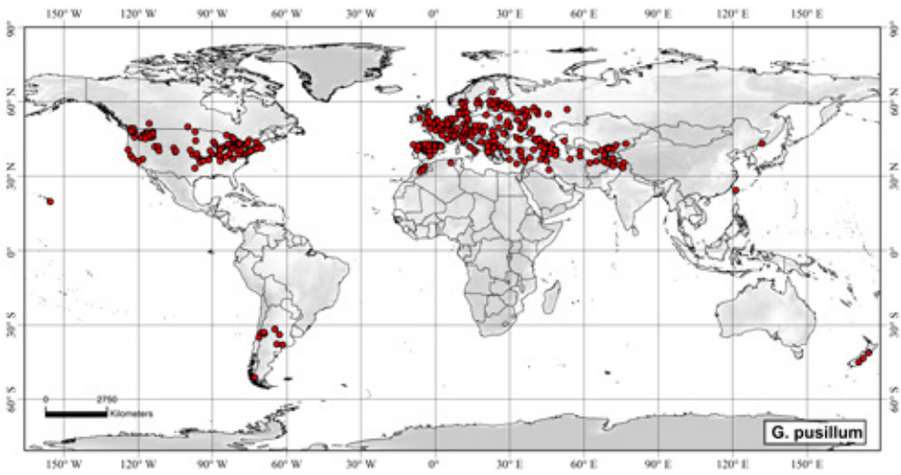


Fig. 706. Distribution of *Geranium pusillum*.

July, *Romenskij s.n.* (LE). Primorye: Vladivostok, 43°7'N, 131°54'E, 12 Apr. 1931, *[illegible]* (LE). Pskov: prope urb. Pskow, 57°50'N, 28°20'E, 19 Aug. 1902, *Andrejew 1608* (G). Ryazan: Kasimovskij raj., ca. 6 km SE Shcherbatovka, 54°55'N, 41°25'E, 8 1973, *Kiseleva s.n.* (LE). Smolensk: Tavrich gub., Dneprovsk u. okrest g. Aleshki, 55°39'N, 33°54'E, 17 June 1909, *Transhel s.n.* (LE). St. Petersburg: Leningradskaya obl., Pskovskij okr., Seredkinskij raj., 57°10'N, 28°41'E, 2 Aug. 1927, *Ganeschin & al. s.n.* (LE). Stavropol: North Caucausus, Kislovogski, 43°55'N, 42°43'E, 5 June 1984, *Fedtschenko s.n.* (LE). Tver: Prov. Twer, 56°51'N, 35°54'E, 26 Sep. 1926, *Iljinskii s.n.* (LE). Vladimir: Melenmovo, Vladimirskoya Okolotilya, 56°16'N, 41°19'E, 30 June 1913, *Nazarov 4361* (LE). **Serbia.** Šumadija and Western Serbia: pr. oppido Priboj, 43°24'N, 20°42'E, 26 June 1930, *Novak 946* (PRC). **Slovenia.** Mura: pr. Verzej, 46°35'N, 16°9'E, 14 Aug. 2017, *Aedo 25261* (MA). **Spain.** Cantabria: Fontibre, 43°1'N, 4°11'W, 28 July 2009, *Aedo 16897* (MA). Murcia: Los Calares, Moratalla, 38°10'N, 2°10'W, 9 June 1984, *Selma s.n.* (MUB). **Sweden.** Södermanland: Ornö, Västanvik, 59°12'N, 16°49'E, 1 July 1927, *Asplund s.n.* (K). **Switzerland.** Genève: La Garenne, 46°13'N, 6°5'E, 31 May 1967, *Burdet & al. s.n.* (MA). **Syria.** Latakia: Kessab, 35°56'N, 35°59'E, 25 Apr. 1953, *Pabot 194* (G). **Taiwan.** Taichung Co.: Hoping Hsiang, along Hsien road 124 to Wuling Farm, 24°20'N, 121°18'E, 4 May 2000, *Chia-hua Lin 256* (MO). **Tajikistan.** Khatlon: between Gordanie and Aruktau, near village Gandzhino, 37°56'N, 68°34'E, 9 May 1965, *Neplie 90* (MA). **Turkey.** Istanbul: Estambul, jardines del palacio de Topkapi, 40°1'N, 28°58'E, 6 July 2001, *Aedo 6683* (MA). **Turkmenistan.** Ahal: Zakaspijskuyo obl., Askhabad, 37°56'N, 58°22'E, 25 Apr. 1912, *Lipsky 1444* (LE). **Ukraine.** Sumy: Charkow, distr. Sumy, Grebenniki, 50°55'N, 34°49'E, 5 May 1906, *Androssov s.n.* (LE). **USA.** California: Tulare Co., Tule River, Sierra Nevada, 36°2'N, 119°49'W, 10 July 1908, *Peirson 2021* (CAS). Connecticut: Fairfield Co., Bridgeport, 41°10'N, 73°12'W, 18 June 1908, *Eames 5929* (PH). Hawaii: Hawaii Is., Maunakea, 19°42'N, 155°30'W, July, *Faurie 856* (BISH, BM, G). Idaho: Benewah Co., Saint Joe, 47°18'N, 116°21'W, 11 June 1932, *Christ 1582* (NY). Missouri: Oregon Co., Thayer Cementery, E side of Highway 63 at its juntion with Business Highway 19, 36°31'N, 91°32'W, 2 May 2000, *Summers 9465* (MA). Texas: Denton Co., 1.1 mi W of junction of Boss Range rd. and co rd 407 on co rd 404, then N 6 mi from junction of Starder ln, 33°12'N, 97°7'W, 8 May 2012, *Singhurst 19308* (MA). **Uzbekistan.** Tashkent: Tian-schan occidentalis, pr. urbem Taschkent, 41°16'N, 69°13'E, 25 May 1928, *Vvedensky s.n.* (BR, K).

Discussion. Geranium pusillum has only five anther-bearing stamens, a rare feature in *Geranium*, which is also found in *G. texanum*. Both species are easily distinguished by the type of fruit, which is of the carpel-projection type in the former and of the seed-ejection type in the latter. *Geranium pusillum* has been frequently confused with *G. pyrenaicum*, a closely related perennial species with ten anther-bearing stamens. It is also often confused with *G. rotundifolium*, another widespread annual species. However, *G. rotundifolium*, a member of subgenus *Geranium*, has typical seed-ejection fruits, reticulate seeds, and ten anther-bearing stamens. *Geranium pusillum* is indigenous in the Eurasian portion of its range. The eastern limit of *G. pusillum* in Europe is not well known, because of the scarcity of herbarium material. In Asia, this species reaches the western Himalayas to 75°E in Jammu-Kashmir. *Geranium pusillum* has been introduced to many temperate areas of North America, South America, eastern Siberia, Taiwan, Hawaii and New Zealand.

The name *G. pusillum* has often been attributed to "Burm. f., Spec. Bot. Geran. 1759"; however, that work was published on 17 August, about two months after the Linnaean protologue. According to Van Loon (1984c: 283) the chromosome numbers 2*n* = 34 attributed to this species should be disregarded.

279. Geranium pyrenaicum Burm. f., Spec. Bot. Geran. 27. 1759, [nom. cons.]. Type locality: "Habitat in Pyrenaeis". Type: Spain. Lérida, Alto Anéu, Pla de la Dinada, 42°39'N, 1°00'E, 7 July 1992, *S. Castroviejo & al. 12009* (conserved type by Aedo & Fumeaux 2012: 256, MA-512048).

Perennial herbs, 15-70(110) cm tall. *Rootstock* 3.5-11.2 mm in diameter, vertical, not tuberculate, not turnip-shaped, without thickened roots. *Stem* erect, leafy, not rooting at nodes, stolons absent, without vegetative stems, with long, patent, eglandular hairs 0.9-1.4 mm long and short, patent, eglandular and glandular hairs 0.1-0.5 mm long. *Basal leaves* in a persistent rosette, cauline leaves opposite; leaf laminas 2.8-6.9 cm long, 2.5-7.5 cm wide, not peltate, palmatifid [ratio main-sinus length/middle segment length = 0.50-0.72], orbicular to reniform in outline, base cordate, not coriaceous, with nerves not projected, with appressed, eglandular hairs on both surfaces; segments 5, in 1 plane, middle segment obtriangular, 4-14.5 mm wide at the base [ratio segment width at the base/middle segment length = 0.23-0.43], (3)7-10(12)-lobed at the apex [ratio secondary sinus length/middle segment length = 0.08-0.24]; petioles up to 25 cm long, without abscission zone, terete, not swollen, not deflexed in age, with patent, eglandular hairs 1-1.5 mm long, and short, patent, eglandular and glandular hairs 0.1-0.5 mm long; stipules 3-11.2 mm long, 0.9-5.2 mm wide, lanceolate (sometimes with a short bifid apex), free, papery, brown, with eglandular hairs on abaxial surface, glabrous adaxially. *Inflorescence* a dichasial cyme with monochasial branches; cymules 2-flowered, solitary [ratio cymule length/leaf length = 1-3.6]; peduncles 10-46 mm long, with patent, eglandular hairs 0.8-1.4 mm long and short, patent, eglandular and glandular hairs 0.1-0.5 mm long; bracteoles 2.5-5 mm long, 0.5-0.8 mm wide, lanceolate, sometimes lobed, whorled; pedicels 10-30 mm long, with patent, eglandular and glandular hairs 0.1-0.5 mm long and, sometimes, patent, eglandular hairs (0.5) 0.7-1.3 mm long. Flowers actinomorphic. *Sepals* 3.2-5.6 mm long, 1.6-2.5 mm wide, lanceolate, smooth, not accrescent, nerves 3, mucro 0.2-0.4 mm long [ratio mucro length/sepal length = 0.05-0.09], with ± patent, eglandular and glandular hairs 0.1-0.7 mm long on the abaxial surface, glabrous adaxially. *Petals* 7-11 mm long, 3.6-6.5 mm wide, erect-patent, emar-

ginate (notch 1-3 mm deep), without claw, bright purple, glabrous on both surfaces, ciliate on the basal margin, with hairs 0.3-0.5 mm long. *Stamens* 10, both whorls bearing anthers; filaments 2.7-5 mm long, lanceolate, purple, pilose on the abaxial surface, ciliate on the proximal half, with hairs 0.1-0.2 mm long; anthers 0.6-1.2 mm long, purple. Nectaries 5, hemispheric, glabrous. *Gynoecium* 3.2-4.5 mm long, purple. *Fruit* 13.9-20 mm long, erect, discharge of carpel-projection type, operative; mericarps 2.4-3.3 mm long, 1.1-1.6 mm wide, without a strand of fibers, not compressed at the apex, smooth, without basal beak, without a basal callus, without a basal prong, brown, with appressed, eglandular hairs ca. 0.1 mm long or glabrous, not ciliate at the base, rarely glabrous; rostrum 8.5-15 mm long, without a narrowed apex, not twisted, with erect-patent, eglandular and glandular hairs 0.1-0.2 mm long; stigmatic remnants 1.5-1.8 mm long, with 5 hairy lobes. *Seeds* 2-2.7 mm long, 0.7-1.4 mm wide, finely reticulate, uniformly colored, brown, glabrous. Cotyledons with entire margin.

Pollen. *Geranium*-type (Bortenschlager 1967: 431; Gagnepain 1903: 86; Velasco 1992b: 59).

Chromosome number. 2*n* = 20, 22-24, 28.

Phenology. Collected in flower from January to October.

Distribution. This species ranges from Europe to western Asia (to northern Iran) and northwestern Africa and it is introduced in Canada, U.S.A. and Australia.

Habitat. Roadsides, waste places, field margins, and forest edges; 0-2650 m.

1. Mericarps with appressed, eglandular hairs; pedicels with patent, eglandular and glandular hairs 0.1-0.5 mm long and, rarely, patent, eglandular hairs 0.7-1.3 mm long. **279a**. subsp. **pyrenaicum**

1. Mericarps glabrous; pedicels with patent, eglandular and glandular hairs 0.1-0.2 mm long and, usually, patent, eglandular hairs (0.5)0.7-1.3 mm long. **279b**. subsp. **lusitanicum**

279a. Geranium pyrenaicum Burm. f. subsp. **pyrenaicum**

Geranium perenne Huds., Fl. Angl.: 265. 1762. Type locality: "Habitat in pratis montanis. Ad ripam fluvii inter Bingley et Kighley in agro Eboracensis; prope Enfield, et inter Hyde-Park et Little-Chelsea". Type: Great Britain. England, locality and collector unknown (lectotype, designated by Aedo & al. 1998: 611, LINN-858.80 image!).

Geranium umbrosum Waldst. & Kit. in Waldst., Descr. Icon. Pl. Hung. 2: 131, tab. 124. 1803-1805. *Geranium pyrenaicum* var. *umbrosum* (Waldst. & Kit.) DC., Prodr. 1: 643. 1824. *Geranium pyrenaicum* subvar. *umbrosum* (Waldst. & Kit.) Nyman, Consp. Fl. Eur. 137. 1878. Geranium *pyrenaicum* [b] *umbrosum* (Waldst. & Kit.) Graebn. in Asch. & Graebn., Syn. Mitteleur. Fl. 7(1): 33. 1913. Type locality: "Crescit in umbrosis ad thermas Herculis, Julio florens". Type: Hungary. *P. Kitaibel s.n*. (lectotype, designated by Aedo & al. 1998: 615, BM-000751348!; isolecto, PR-155805!).

Geranium pyrenaicum var. *pumilum* Picard, Mém. Soc. Agric. Boulogne-sur-Mer 1: 131. 1837. Type locality: "L'espèce et la variété croissent dans les mêmes lieux, ... Cette belle espèce n'est point comprise parmi celles de la flore de la Somme; néamoins on l'avait déjà trouvée plusieurs fois. Ainse M. Baillon possède un échantillon qu'il a ramassé, il y a plus de vingt ans, dans la cour de l'hôpital; moi-même, depuis plus de dix ans, je l'avais recuillie à Amiens; enfin M. Boucher, dans son catalogue, l'indique à la porte St.-Gilles; mais M. Baillon regardait sa plante comme semée par hasard. Mes echantillons étaient restés confondus avec d'autres espèces dans mon herbier; le catalogue des plantes d'Abbeville et de ses environs ne semblait pas une preuve suffisante aux yeux des botanistes, parce que cet ouvrage contient l'indication d'une foule de plantes exotiques qui ont pu être trouvées quelquefois parme les décombres, sans que l'on puisse, raisonnablement, por ce fait, les considérer comme indigènes. Ceci explique comment le G. pyrenaicum parut nouveau à tous les amateurs, lorsque, en 1834, je le retrouvai précisément dans la localité indiquée autrefois par M. Boucher. On la trouve à Abbeville, sur le versant du rempart, du côté du champs de Foire, et à la porte St.-Gilles, dans les fortifications; à Amiens, sur le rempart, auprès du Jardin des Plantes, et dans le jardin même, sur le petit rideau qui se trouve au-devant de la salle des Démonstrations". Syntypes: France. À Abbeville, 50º06'N, 1º50'E, sur le versant du rempart, du côté du champs de Foire, et à la porte St.-Gilles, dans les fortifications; à Amiens, 49º53'N, 2º17'E, sur le rempart, auprès du Jardin des Plantes, et dans le jardin même, sur le petit rideau qui se trouve au-devant de la salle des Démonstrations, *C. Picard s.n.* (no original material located).

Geranium minae Tineo, Pl. Rar. Sicil.: 25. 1846, ["Minaae"]. *Geranium pyrenaicum* var. *minae* (Tineo) Nyman, Consp. Fl. Eur.: 138. 1878. Type locality: "In elatioribus montosis, apricis, lapidosis; var. [α] Isnello alla Costa dell oro; al Ferro Minà; [ß] Monte di Cammarata". Type: Italy. monte Ferro, 37º53'N, 14º01'E, *F. Minà 514* (lectotype, designated by Aedo & al. 1998: 615, PAL!).

Geranium pyrenaicum var. *subvillosum* Schur, Enum. Pl. Transsilv.: 137. 1866. Type locality: "In den Weinbergen bei Hammersdorf. Jun". Type: Romania. In den Hammersdorf, 45º49'N, 24º11'E, June, *F. Schur s.n.* (lectotype, here designated, LW-205567 image!).

Geranium pyrenaicum var. *albiflorum* Schur, Oesterr. Bot. Z. 18: 316. 1868. *Geranium pyrenaicum* [1] *albiflorum* (Schur) Graebn. in Asch. & Graebn., Syn. Mitteleur. Fl. 7(1): 33. 1913. Type locality: "Die Var. c. ist schwächlicher als die anderen und wächst auf schattigen Rasenplätzen in Wäldern und Obstgärden, häufig ist sie im Garten des k.k. Theresianums, wo ich nur diese beobachtet habe. Blüht während des ganzen Sommers". Type: Austria. Garten des k.k. Theresianums, Wien, 48º11'N, 16º22'E, *F. Schur s.n.* (no original material located).

Geranium pyrenaicum [ß] *pilosum* Rupr., Mém. Acad. Imp. Sci. Saint Pétersbourg ser. 7 15(2): 275. 1869. Type locality: "D. Owerin legit 15-22 Sept. pr. Kaischaur alt. 1000-750 hex. et in m. Bai Gora alt. 1140-900 hex.; ultimo loco ß pilosum... ". Type: Georgia. Caucasus, circa Kaischaur, Bai Gora, 42º30'N, 44º30'E, 22 Sep. 1860, *A.P. Owerin s.n*. (lectotype, here designated, LE!).

Geranium pyrenaicum [2] *grandiflorum* Schur ex Graebn. in Asch. & Graebn., Syn. Mitteleur. Fl. 7(1): 33. 1913. Type locality: [no locality in Schur in Verh. Naturf. Vereins Brünn 15: 161 (1877)]. Type: Romania. *F. Schur s.n.* (no original material located).

Geranium pyrenaicum [3] *parviflorum* Schur ex Graebn. in Asch. & Graebn., Syn. Mitteleur. Fl. 7(1): 33. 1913. Type locality: [no locality in Schur in Verh. Naturf. Vereins Brünn 15: 161 (1876)]. Type: Romania. *F. Schur s.n.* (no original material located).

Geranium rhaeticum Brügger, Jahresber. Naturf. Ges. Graubüdens 39: 56. 1885. Type locality: "Die ohne Zweifel hy-

bride Zwischenform wurde bisher (Sommer 1882) nur einmal in der Umgebung von Chur (Lürlibad) gefunden, wo die Stammarten, wozu sich bisweilen noch G. molle geselt, sehr häufig beisammen wachsen". Type: Switzerland. Chur, Lürlibad, 46°51'N, 9°32'E, *Ch.C. Brügger s.n.* (no original material located).

Geranium pyrenaicum subsp. *australe* A. Terracc., Malpighia 4: 209. 1890. Type locality: "n. 638, Palermo alla Pizzuta Todaro!". Type: Italy. Palermo alla Pizzuta, 37°59'N, 13°15'E, *A. Todaro 638* (lectotype, designated by Aedo & al. 1998: 616, K!; isolectotype, FI!).

Geranium pyrenaicum var. *gracilescens* A. Terracc., Malpighia 4: 211. 1890. *Geranium pyrenaicum* [b] *gracilescens* (A. Terracc.) Graebn. in Asch. & Graebn., Syn. Mitteleur. Fl. 7(1): 33. 1913. Type locality: "d'Abruzzo e degli alti monti romani, e qui e là sino in Basilicata". Type: Italy. D'Abruzzo e degli alti monti romani, e qui e là sino in Basilicata, *A. Terracciano s.n.* (no original material located).

Geranium pyrenaicum var. *montanum* A. Terracc., Malpighia 4: 208. 1890. Type locality: "monte Pollino all'Afforcata N. Terracciano!, sommità del Coccorello in Abruzzo Cherici! Velino Sanguinetti!". Type: Italy. Calabria, monte Pollino alla Forcata, 39°54'N, 16°11'E, July 1886, *N. Terracciano s.n.* (lectotype, here designated, RO!).

Geranium pyrenaicum var. *mutilum* Beck, Fl. Nieder-Österreich.: 563. 1892. *Geranium pyrenaicum* [4] *mutilum* (Beck) Graebn. in Asch. & Graebn., Syn. Mitteleur. Fl. 7(1): 33. 1913. Type locality: "bei Hütteldorf, Laxemburg". Type: Austria. Bei Hütteldorf, 48°12'N, 16°16'E, Laxemburg, 48°04'N, 16°21'E, *G. Beck s.n.* (no original material located).

Geranium pyrenaicum var. *depilatum* Sommier & Levier, Trudy Imp. S.-Peterburgsk. Bot. Sada 16: 102. 1900. *Geranium depilatum* (Sommier & Levier) Grossh. in Grossh. & Schischk., Sched. Herb. Pl. Or. Exsicc. 14: 36. 1928. Type locality: "Rekom, fl. fr. (Lojka)". Type: Georgia. Rekom, 42°13'N, 44°20'E, *H. Lojka s.n.* (no original material located) Georgia. Svanetia, pr. Kala, 42°28'N, 43°54'E, 7 Aug. 1890, *S. Sommier & E. Levier 260* (neotype, here designated, FI!).

Geranium pyrenaicum var. *patulivillosum* Hausskn. & Bornm. ex Bornm., Mitth. Thüring. Bot. Vereins 20: 10. 1904-1905. Type locality: "Anatolia: Pontus austr., in rupestribus umbrosis prope oppidum Amasia in regione inferiore montis Lokman; 600 m s. m.: leg. 9. V. 1890 (no. 1974)". Type: Turkey. Pontus australis, Amasia, mt. Lokman, 40°39'N, 35°50'E, 9 May 1890, *J. Bornmüller 1974* (lectotype, designated by Aedo & al. 1998: 616, JE!).

Geranium pyrenaicum var. *leiocarpum* Guss. ex Lojac., Malpighia 20: 195. 1906. Type locality: "Lojac. exsicc. pl. Pizzuta. Herb. Pan.!". Type: Italy. Pizzuta, 37°59'N, 13°15'E, *M. Lojacono s.n.* (no original material located).

Geranium crinitum N. Terracc., Bull. Orto Bot. Regia Univ. Napoli 3: 122. 1913. Type locality: "In apricis pascuis saxosis calcareis; pressi del Piscone di Pisterola.-- Majo, Junio". Type: Italy. Pisterola, 40°44'N, 15°28'E, *N. Terracciano s.n.* (lectotype, designated by Aedo & al. 1998: 616, NAP; photocopy!).

Geranium pyrenaicum [b] *murense* N. Terracc., Bull. Orto Bot. Regia Univ. Napoli 3: 122. 1913. Type locality: "S. Vito vecchio, e nei pressi del Piscone di Pisterola.-- Junio, Julio et iterum Septembri, Octobri". Type: Italy. S. Vito vecchio, e nei pressi del Piscone di Pisterola, 40°44'N, 15°28'E, *N. Terracciano s.n.* (no original material located).

Geranium pyrenaicum var. *malvaceum* Beauverd, Bull. Murith. Soc. Valais. Sci. Nat. 42: 183. 1925. Type locality: "Hab. -- Vallesia: in saxosis supra Bourg-St-Pierre, ca. 1650 m. alt., ubi copiose, lg. Beauverd 25 VII. 1919; id. supra Stalden prope Vispam, in saxosis herbosis cum var. typica mixtum, ca. 900 m. alt., lg. Beauverd 18 VI. 1921". Type: Switzerland. Bourg-St-Pierre, 45°56'N, 7°12'E, 25 July 1919, *G. Beauverd s.n.* (lectotype, designated by Aedo & al. 1998: 616, G!).

Geranium pyrenaicum var. *longepedicellatum* Sennen, Pl. Espagne 1926 n.° 5688. 1927, in sched. Type locality: "Cerdagne: Llivia, Estavar, les Escaldes, 1250-1400 m". Type: Spain. Cerdagne, Llivia, Estavar, les Escaldes, June 1926, *fr. Sennen s.n.* (lectotype, designated by Aedo & al. 1998: 616, BC-12495!; isolectotypes, BM!, MA-71633!, MA-471335!, W!).

Geranium pyrenaicum f. *pallidum* Gilmour & Stearn, J. Bot. 70 Suppl.: 6. 1932, VIII-1932 [in sched., cum descr. 1931?]. Type locality: "Hab. Hills Road, near Strangeways Research Hospital, Cambridge, England, by roadside and along hedge-banks with Stachys sylvatica, Veronica Chamaedrys, Caucalis Anthriscus, Trifolium pratense, etc. Leg. et det. J.S.L. Gilmour & W.T. Stearn, August 1931". Type: England. Hab. Hills Road, near Strangeways Research Hospital, Cambridge, 52°12'N, 0°06'E, Aug. 1931, *J.S.L. Gilmour & W.T. Stearn s.n.* (lectotype, designated by Aedo & al. 1998: 616, K!; isolectotype, UPS photo!, W!).

Geranium pyrenaicum var. *turolense* Sennen, Diagn. Nouv. Pl. Espagne Maroc 1935: 262. 1935. Type locality: "Hab.-Teruel, talus, marges. Leg. H. León". Type: Spain. Teruel, 40°20'N, 1°06'W, Aug. 1935, *León (frère) s.n., Pl. Espagne n.° 9773* (lectotype, designated by Aedo & al. 1998: 616, BC-88765!; isolectotype, MAF-25378!).

Geranium elbursense Gilli, Repert. Spec. Nov. Regni Veg. 46: 44. 1939. Type locality: "Nord-Iran: Demawend. In pascuis super Rehne, 2640 m. An einer durch hohe Trachytfelsblöcke sehr unebenen Stelle, die stark beweidet ist. 22.VII.1936". Type: Iran. Tehran, Demawend, 35°43'N, 52°04'E, 22 July 1936, *A. Gilli s.n.* (lectotype, designated by Aedo & al. 1998: 616, W!).

Stem 15-70(110) cm tall. *Pedicels* 10-30 mm long, with patent, eglandular and glandular hairs 0.1-0.5 mm long and, rarely, patent, eglandular hairs 0.7-1.3 mm long. *Mericarps* 2.4-3.3 mm long, with appressed, eglandular hairs ca. 0.1 mm long, not ciliate at the base. Fig. 707 a-g.

Pollen. Geranium-type (Bortenschlager 1967: 431; Gagnepain 1903: 86; Velasco 1992b: 59).

Chromosome number. 2*n* = 20?, 22-24?, 26, 28?

Phenology. Collected in flower from January to October.

Distribution. This species ranges from Europe to western Asia (northern Iran) and northwestern Africa and it is introduced in Canada, U.S.A. and Australia (Fig. 709).

Habitat. Roadsides, waste places, and field margins; 0-2650 m.

Representative specimens examined. **Albania.** Lezhë: m. Parmu, Alpes alb. sept., distr. Scutari, 41°41'N, 19°47'E, 14 July 1897, *Baldacci 257* (BM). **Algeria.** Khenchela: Aurès, versant N du Chelia, Ain-Taferfra, 35°20'N, 6°40'E, 26 June 1920, *Maire s.n.* (MPU). **Andorra.** Andorra la Vella: San Miguel d'Engolasters, 42°30'N, 1°33'E, 16 July 2011, *Aedo & al. 18535* (MA). **Armenia.** Gegharkunik: pr. Pambak, 40°23'N, 45°32'E, 20 June 2005, *Aedo & al. 11890* (MA). **Australia.** South Australia: Southern Lofty, Bridgewater, 35°2'S, 138°46'E, 13 Jan. 1998, *Bates 49564* (AD). **Austria.** Carinthia: Petzen bei Bleiburg, 46°35'N, 14°47'E, 29 June 1966, *Melzer s.n.* (W). **Azerbaijan.** Quba-Khachmaz: Kubinsky distr., near village Kusary, 41°25'N, 48°26'E, 21 June 1900, *Grigoriev s.n.* (MA). **Belgium.** Wallonia: Goffontanie, 50°33'N, 5°45'E, 7 June 1935, *Mosseray s.n.* (K). **Bosnia-Herzegovina.** weed in garden of British consulate, Sarajevo, 43°51'N, 18°24'E, May, *Gilliat-Smith 3325* (K). **Bulgaria.** Smolyan: Central Rhodope Mts., Smolyan, pr. Gela, 41°39'N, 24°33'E, 28 June 2004, *Aedo & al. 10145* (MA). **Canada.** Ontario: Grey Co., W

of Beaverdale, 44°24'N, 80°38'W, 20 June 1973, *Whiting 1666* (CAN). Québec: Québec, 46°50'N, 71°15'W, 12 Aug. 1934, *Louis-Marie (père) s.n.* (MA). **Czech Republic.** Central Bohemian: Jicin, entre Stre Hom y castillo de Kost, 50°28'N, 15°7'E, 7 Sep. 2000, *Castroviejo 15645* (MA). **Denmark.** Nordjylland: Norup Östermark, E of Assens, NE Jylland, 56°40'N, 10°7'E, 23 June 1995, *Larsen 45320* (MA). **Finland.** Southwest Finland: Aboa, 60°27'N, 22°17'E, 1878, *Hollmén s.n.* (MA). **France.** Provence-Alpes-Côte d'Azur: Hautes Alpes, col de Gleize, 44°37'N, 6°4'E, 2 June 2011, *Aedo 18425* (MA). **Georgia.** Shida Kartli: Kartli, m. Djam-djama, 41°55'N, 44°25'E, 15 July 1966, *Chiuthileidze & al. s.n.* (MA). **Germany.** Bavaria: Bayern, Oberbayern, Neufreimann N München, auf Brachäckern, 48°15'N, 11°30'E, 11 June 1902, *Dihm s.n.* (MA). **Great Britain.** England: Coates, pr. Cirencester, 51°42'N, 2°2'W, 5 June 1996, *Aedo 3856* (MA). **Greece.** Peloponnese: Achaia, Kalavrita, Mts. Chelmos, Mt. Avgho, 37°59'N, 22°11'E, 21 June 2007, *Aedo & al. 14156* (MA). **Hungary.** Pest: Erdely, Brafsó, 47°16'N, 19°20'E, 18 May 1898, *Kuel s.n.* (BC). **Iran.** Mazanderan: Nezva Kuh area, near Orim, 35°59'N, 53°10'E, 5 July 1959, *Wendelbo 1051* (W). **Ireland.** Leinster: Dublin, 53°22'N, 6°17'W, June, *Gamble 20055* (K). **Italy.** Aosta Valley: Val d'Aosta, Ponto Romano-Porrosau, 45°35'N, 7°48'E, 11 Aug. 1927, *Cuatrecasas s.n.* (MAF). Sicilia: Palermo, Riserva di Bosco della Ficuzza, Roca Busambra, 37°51'N, 13°25'E, 31 May 2000, *Castroviejo & al. 15476* (MA). **Latvia.** Jelgava: Aligra, Auchi, 56°35'N, 23°57'E, 8 June 1949, *[illegible] 33* (LE). **Lebanon.** Mount Lebanon: Jisr el Hajar, 33°59'N, 35°49'E, June, *Ehrenberg s.n.* (K). **Montenegro.** Plav: Prokletije-Gebirge, Cakor, 42°40'N, 20°0'E, 25 July 1975, *Krendl s.n.* (W). **Morocco.** Marrakesh-Safi: gorge between refuge Nelter, Imlil Toubkal, H. Atlas, 31°8'N, 7°55'W, 14 July 1966, *Thorp 100* (BM). **Netherlands.** Limburg: Maastricht, 50°51'N, 5°41'E, 10 Sep. 1950, *Jacobs s.n.* (L). **North Macedonia.** Southwestern: NE von Debar, 41°32'N, 20°32'E, 4 July 1976, *Krendl s.n.* (W). **Norway.** Vestfold og Telemark: Telemark, Kragero, Kragero tettsted, Tallakshavn, 58°53'N, 9°25'E, 15 June 1981, *Ouren 38042* (C). **Poland.** Lower Silesian: bei Breslau, 51°6'N, 17°2'E, May, *Sintenis s.n.* (W). **Romania.** Centru: in nemoribus Transilvania, Hammsdorft, 45°49'N, 24°11'E, *Schur s.n.* (W). **Russia.** Krasnodar: Kubanskaya prov., pinewoods along Mahar, near veterinary point, 45°37'N, 39°58'E, 30 July 1909, *Busch 973* (MA). Krym: in graminosis montis Tschatyr-Dagh, 44°40'N, 34°24'E, 5 July 1900, *Halácsy 570* (B, W, M). North Ossetia: Terek prov., 43°28'N, 44°11'E, 8 June 1911, *Busch s.n.* (W). **Serbia.** Šumadija and Western Serbia: Bic Planina, montis Grad, apud Priboj, 43°35'N, 19°31'E, 22 June 1930, *Novak 155* (PRC). **Slovenia.** Upper Carniola: Triglav N. P., inter Kranjska Gora et Mojstrana, 46°29'N, 13°49'E, 28 May 2010, *Calvo 4697* (MA). **Spain.** Cantabria: Liencres, 43°28'N, 3°55'W, 25 June 2000, *Aedo 5788* (MA). **Sweden.** Stockholm: Marieberg, 59°20'N, 18°1'E, 6 Sep. 1902, *Velander s.n.* (BC). **Switzerland.** Valais: Val d'Entremont, Valsorey, 45°59'N, 7°14'E, 19 July 1927, *Cuatrecasas s.n.* (MAF). **Turkey.** Antalya: Kuhu Dag S von Elmali, gebiet von Ciglikara, 36°30'N, 29°50'E, 7 July 1969, *Fitz & Spitzenberger 233* (W). Bolu: al S de Abant Golu, 40°35'N, 31°17'E, 18 June 2001, *Aedo & al. 6179* (MA). **USA.** California: Alameda Co., Berkeley campus, E side of Botany building, 37°52'N, 122°16'W, 15 July 1914, *Jepson s.n.* (JEPS). New York: Bronx Co., New York Botanical Garden, Bronx Park,

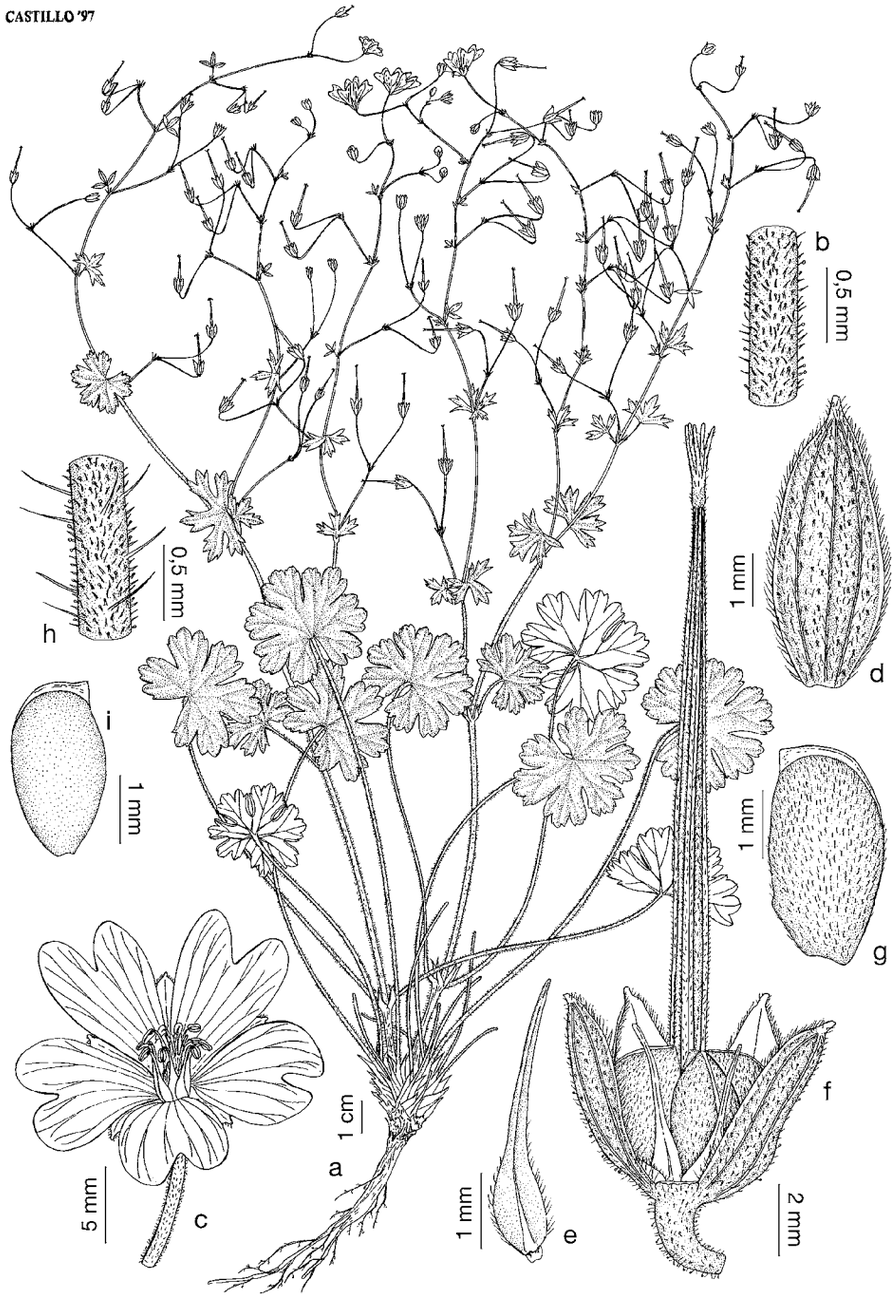


Fig. 707. *Geranium pyrenaicum* subsp. *pyrenaicum*. a. Habit. b. Pedicel. c. Flower. d. Sepal. e. Staminal filament. f. Fruit, one sepal removed. g. Mericarp. (Based on: a, b, d-g, *Aedo 2084*, MA; c, *Navarro & al. 340*, MA). *Geranium pyrenaicum* subsp. *lusitanicum*. h. Pedicel. i. Mericarp. (Based on: *Losa s.n.*, MA-71620).

40º51'N, 73º52'W, 20 Sep. 1940, *Gilly 426* (NY). Vermont: Windsor Co., Woodstock, 43º38'N, 72º30'W, 15 July 1962, *Sawyer 205* (VT). Washington: King Co., 0.7 km W of North Lake, 47º18'N, 122º18'W, 21 May 2017, *Zika 28759* (MA).

279b. Geranium pyrenaicum subsp. **lusitanicum** (Samp.) S. Ortiz, Anales Jard. Bot. Madrid 47(1): 244. 1990. *Geranium pyrenaicum* raça *lusitanicum* Samp., Man. Fl. Port.: 273. 1911. *Geranium lusitanicum* (Samp.) Samp. ex Miranda Lopes, Bol. Soc. Brot. ser. 2, 5: 245. 1928. *Geranium pyrenaicum* var. *lusitanicum* (Samp.) Samp., Fl. Port.: 331. 1947. Type locality: "Do Minho ao Alto Alemtejo". Type: Portugal. Castro Laboreiro, 42º01'N, 8º09'W, July 1903, *G. Sampaio s.n.* (lectotype, designated by Aedo & al. 1998: 618, PO-4606!).

Geranium pyrenaicum var. *majus* Pau ex Merino, Fl. Galicia 1: 283. 1905. Type locality: "La var. al borde de las acequias, paredes y cimientos de los molinos en Rivas Pequeñas, Ber, Lugo, y en Cudeiro, Orense (Merino). Fl. en verano. (V. vivam)". Type: Spain. Rivas Pequeñas, 42º35'N, 7º28'W, *B. Merino s.n.* (lectotype, designated by Aedo & al. 1998: 618, LOU!).

Stem (23)40-75(110) cm tall. *Pedicels* 13-22 mm long, with patent, eglandular and glandular hairs 0.1-0.2 mm long and, usually, patent, eglandular hairs (0.5)0.7-1.3 mm long. *Mericarps* 2.7-3 mm long, glabrous. Figs. 707 h, i, 708.

Pollen. Geranium-type.

Chromosome number. 2*n* = 26.

Phenology. Collected in flower from June to July.

Distribution. This subspecies is endemic to northern Portugal and central and western Spain (Fig. 709).

Habitat. Waste places, field margins, and forest edges; 0-1850 m.

Representative specimens examined. **Portugal.** Alto Alentejo: Castelo de Vide, 39º25'N, 7º27'W, June, *Sampaio s.n.* (PO). Beira Alta: Sabugal, Quadrazais, junto ao rio Côa na reserva, 40º19'N, 6º59'W, 2 June 1988, *Ladero & Lousa s.n.* (LISI); Moimenta da Beira, Vila da Rua, beira da Ribeira, 40º58'N, 7º36'W, 26 June 1977, *Costa s.n.* (PO). Beira Baixa: Mata do Fundao, 39º51'N, 8º1'W, June, *Tavares s.n.* (PO); Meda, dentro do Castelo, 40º57'N, 7º15'W, 5 Oct. 1976, *Costa s.n.* (MA, PO). Douro Litoral: Baiao, VilaMorim, 41º9'N, 8º2'W, 18 Apr. 1961, *Cabral s.n.* (LISI). Minho: Póvoa de Lanhoso, Quintal de S. Geus, 41º35'N, 8º16'W, May, *Sampaio s.n.* (PO); Caldas do Gerez, 41º42'N, 8º10'W, June, *Murray s.n.* (K). Trás-os-Montes: Tabuaço, Vale da Figueira, 41º6'N, 7º33'W, May, *Barbosa & García 8083* (LISI); Vinhais, Tuizelo, 41º54'N, 7º3'W, 28 May 1972, *Marcos & Almeida s.n.* (LISI). **Spain.** Álava: Ichine, Mt. Gorbea, 43º2'N, 2º46'W, 24 July 1947, *Guinea 4019* (MA). Asturias: Belmonte, Faedo, 43º17'N, 6º12'W, 20 Aug. 1995, *Aedo 3700* (MA). Ávila: Hoyocasero, 40º23'N, 4º58'W, 7 July 1989, *Castroviejo & al. 10785 SC* (MA); Ávila, al pie de la muralla, 40º39'N, 4º41'W, 7 June 1992, *Aedo 2080* (MA). Burgos: pr. Valle del Sol, 42º11'N, 3º18'W, 12 July 1975, *Fuentes s.n.* (MA); Santa Coloma de Rudrón, 42º40'N, 3º53'W, 11 July 1982, *Galán Cela 124* (MA). Cáceres: El Humilladero, Guadalupe, 39º27'N, 5º19'W, 19 June 1948, *Caballero s.n.* (MA); Baños de Montemayor, 40º19'N, 5º51'W, 17 May 1944, *Caballero s.n.* (MA). Guadalajara: El Cerrón, 41º10'N, 3º27'W, July, *Caballero s.n.* (MA). Jaén: Sierra de Segura, 12 June 1960, *Rivas Goday & al. s.n.* (MAF). La Coruña: Sobrado de los Monjes, 43º2'N, 8º0'W, 15 June 1983, *Gómez Vigide s.n.* (LOU). LA Rioja: Villoslada de Cameros, 42º7'N, 2º4'W, 11 June 1977, *Mendiola s.n.* (MA); Arnedillo, Peñalmonte, 42º12'N, 2º14'W, 14 Oct. 1972, *Segura Zubizarreta s.n.* (MA). León: La Baña, sierra de la Cabrera, camino del Lago, 42º15'N, 6º45'W, 10 July 1981, *Lansac*

Fig. 708. *Geranium pyrenaicum* subsp. *lusitanicum* (Based on: *Aedo 6140,* MA).

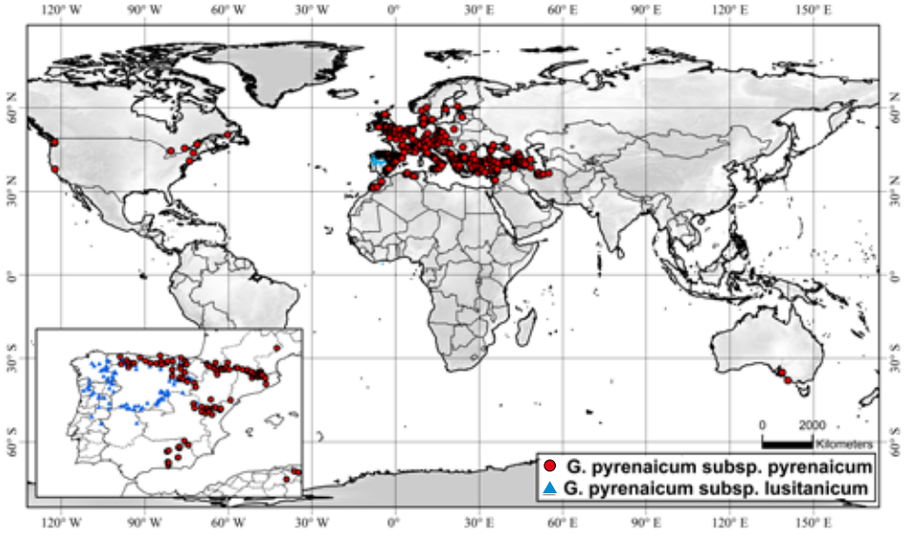


Fig. 709. Distribution of *Geranium pyrenaicum.*

& Nieto Feliner 239 GN (MA); Puente Orugo, 42º58'N, 5º59'W, 10 June 1993, *Aedo 2594* (MA). Lugo: bosque de la Rogueira, Courel, 42º36'N, 7º6'W, *Merino s.n.* (LOU); Becerreá, 42º51'N, 7º9'W, 25 Aug. 1992, *Navarro & Monasterio 964b* (MA). Madrid: El Escorial, Fuente de la Reina, 40º33'N, 4º9'W, 29 June 1969, *Valdés Bermejo & Jiménez s.n.* (MA); Rascafría, monasterio del Paular, 40º54'N, 3º53'W, 15 June 2001, *Aedo 6140* (MA). Orense: Humoso, 42º8'N, 7º3'W, *Merino s.n.* (LOU); Manzaneda, Cabeza de Manzaneda, 42º15'N, 7º18'W, 27 July 1983, *Silva Pando s.n.* (LOU). Palencia: Dehesa de Montejo, valle de Tosande, 42º51'N, 4º32'W, 14 July 1995, *Monasterio 1341* (MA). Pontevedra: Lalín, 42º52'N, 7º52'W, 18 June 1990, *Gómez Vigide s.n.* (LOU). Salamanca: Montemayor del Río, 40º20'N, 5º53'W, 3 Aug. 1983, *Rico & Guillén s.n.* (MA); Castañar de las Honfrías, Linares del Río Frío, 40º35'N, 5º55'W, 15 June 1974, *Castroviejo s.n.* (MA). Segovia: Altos del puerto de la Quesera, 41º13'N, 3º25'W, 24 June 1973, *Gómez & al. s.n.* (MA); Castrojimeno, 41º23'N, 3º29'W, 14 May 1983, *Romero s.n.* (MA). Soria: Cañón del río Lobos, 41º46'N, 3º5'W, 7 June 1980, *Buades s.n.* (MA); Santa Inés, 42º0'N, 2º48'W, 12 June 1961, *Segura Zubizarreta s.n.* (MA). Valladolid: carretera a Puras, 41º11'N, 4º38'W, 17 June 1976, *Fuentes s.n.* (MA). Vizcaya: Gorbea, 43º2'N, 2º46'W, 24 July 1947, *Guinea 4020* (MA); monte Gorbea, 43º2'N, 2º46'W, 24 July 1948, *Guinea 4034* (MA). Zamora: Ribadelago, prados de Seoanez, 42º7'N, 6º44'W, 17 Oct. 1986 (MA); Rivadelago, barranco del Fornillo, 42º7'N, 6º44'W, June, *Losa s.n.* (MA).

Discussion. Geranium pyrenaicum is the only perennial species in section *Batrachioidea*. *Geranium pusillum* seems to be the closest relative of *G. pyrenaicum*. The mericarps of *G. pyrenaicum* are quite similar to those of *G. pusillum*: smooth, with appressed eglandular hairs (except for subsp. *lusitanicum*), but slightly smaller. As the remaining species of the section, both species have emarginate petals and the chromosome number 2*n* = 26.

Geranium pyrenaicum grows naturally in almost all of Europe, the Caucasus, Asia Minor, northern Iran, and northwest Africa. It has been introduced in some temperate areas of northeastern North America, Australia and probably in central and northern Europe (Brandes 2004; Ciaciura 2001).

Among the great number of morphological variants formally described under *Geranium pyrenaicum*, only that here segregated as subspecies *lusitanicum* seems of some importance. *Geranium pyrenaicum* subsp. *lusitanicum* comprises plants from northwestern Spain and Portugal with glabrous mericarps and long, patent, eglandular hairs on the peduncles and pedicels. In this area, all specimens examined exhibit these features. However, eastward, in the eastern portion of the Cantabrian range and in the Iberian range, where the two subspecies occur sympatrically, the indumentum of the peduncles and pedicels is variable. This was pointed out by Ortiz (1989: 243), who proposed subspecific rank for these entities. The rank of subspecies is here used according to Du Rietz (1930), for allopatric taxa merging morphologically where they come into contact. Lidén (1986) described subspecies as "taxa believed to be allopatrically evolved from a common ancestor, not sufficiently different to be recognized as species, i.e. resulting from primary speciation at an early stage". This could be the case in *G. pyrenaicum*, considering its geographical distribution and weak morphological divergence. I consider occasional specimens with glabrous mericarps from within the geographic range of *G. pyrenaicum* subsp. *pyrenaicum* to be discordant elements representing minor variation of no taxonomic relevance. However, if such individuals were confinned as more common, the status of subsp. *lusitanicum* would have to be reconsidered. It seems that some chromosome numbers different to 2*n* = 26 attributed to this species should be disregarded (Van Loon 1984b: 270).

IVb. Geranium sect. **Divaricata** Rouy in Rouy & Foucaud, Fl. France 4: 88. 1897. Type. *Geranium divaricatum* Ehrh. (art. 10.8).

Annual or perennial herbs. *Flowers* actinomorphic. *Petals* emarginate, without claw. *Pollen* of *Geranium*-type. *Fruit* of carpel-projection type, inoperative; mericarps with transverse ribs; rostrum not twisted. *Cotyledons* with a notch on each side.

280. Geranium albanum M. Bieb., Fl. Taur.-Caucas. 2: 137. 1808. Type locality: "Crescit in Albaniâ ibericâ, circa pagum Wakiri. D. Steven". Type: Georgia. Ex Albaniâ ibericâ, Wakiri [Bakir district, pr. Signakh, 41º37'N, 45º54'E], *C. Steven s.n.* (lectotype, designated by Aedo 1998: 619, LE, photo!).

Geranium cristatum Steven, Mém. Soc. Imp. Naturalistes Moscou 4: 50, tab. 5. 1813. Type locality: "In subalpinis ad rivulum Jucharibasch". Type: Azerbaijan. Jucharibasch, pr. Sudur, 41º21'N, 48º03'E, *C. Steven s.n.* (lectotype, designated by Aedo 1998: 620, H-1366863!; isolectotype, LE!).

Perennial herbs, 40-60 cm tall. *Rootstock* 6-8 mm in diameter, ± horizontal, not tuberculate, not turnip-shaped, with thickened roots along the rootstock. *Stem* erect, leafy, not rooting at nodes, stolons absent, without vegetative stems, with patent, eglandular hairs 1-2 mm long and short, patent, glandular and eglandular hairs 0.2-0.5 mm long. *Basal leaves* in a deciduous rosette, cauline leaves opposite; leaf laminas 2.3-5.2 cm long, 3-4.5 cm wide, not peltate, palmatifid [ratio main-sinus length/middle segment length = 0.65-0.75], pentagonal in outline, base cordate, not coriaceous, with nerves not projected, with appressed, eglandular hairs on both surfaces; segments 5(7), in 1 plane, middle segment rhombic, 4-7 mm wide at the base [ratio segment width at the base/middle segment length = 0.25-0.27], 7-9-lobed in distal half [ratio secondary sinus length/middle segment length = 0.14-0.26]; petioles up to 11 cm long, without abscission zone, terete, not swollen, not deflexed in age, with patent, eglandular hairs 1-1.5 mm long and short, patent, eglandular and glandular hairs 0.2-0.5 mm long; stipules 4-6 mm long, 1.5-2 mm wide, lanceolate (sometimes with a short bifid apex),

free, papery, brown, with eglandular hairs on abaxial surface, glabrous adaxially. *Inflorescence* a monochasial cyme; cymules 2-flowered, solitary [ratio cymule length/leaf length = 4.7-5.4]; peduncles 10-48 mm long, with patent, eglandular hairs ca. 1 mm long and short, patent, eglandular and glandular hairs 0.2-0.5 mm long; bracteoles 3-4 mm long, 0.5-1 mm wide, lanceolate, sometimes lobed, whorled; pedicels 10-40 mm long, with patent, eglandular hairs 1-1.5 mm long and short patent, eglandular and glandular hairs 0.2-0.5 mm long. Flowers actinomorphic. *Sepals* 6-9 mm long, 2.5-3.6 mm wide, lanceolate, smooth, not accrescent, nerves 3, mucro 0.3-0.6 mm long [ratio mucro length/sepal length = 0.09-0.10], with patent, eglandular hairs 1-1.3 mm long and patent, eglandular and glandular hairs 0.2-0.5 mm long on the abaxial surface, glabrous adaxially. *Petals* 12-14 mm long, 8-9 mm wide, erect-patent, emarginate (notch 1 mm deep), without claw, bright purple, glabrous on both surfaces, ciliate on the basal margin, with hairs 0.2-0.5 mm long. *Stamens* 10, both whorls bearing anthers; filaments 5-6 mm long, lanceolate, pale pink, pilose on the abaxial surface, ciliate on the proximal half, with hairs 0.1-0.2 mm long; anthers 1.5-1.6 mm long, dark blue. Nectaries 5, hemispheric, with a tuft of hairs at the top, dorsally glabrous. *Gynoecium* 6-7 mm long, pink purple. *Fruit* 15-17 mm long, erect, discharge of carpel-projection type, inoperative; mericarps 6-7 mm long, 3-3.5 mm wide, without a strand of fibers, not compressed at the apex, with 3-4 transverse ribs and a longitudinal crest, without basal beak, without a basal callus, without a basal prong, brown, with appressed, eglandular hairs 0.3-0.8 mm long, not ciliate at the base; rostrum 9-10 (0.4-0.6 mm wide at the base) mm long, without a narrowed apex, not twisted, with erect-patent, eglandular and glandular hairs 0.1-0.2 mm long; stigmatic remnants 1-2 mm long, with 5 hairy lobes. *Seeds* 2.8-3 mm long, 1.8-1.9 mm wide, smooth, uniformly colored, brown, glabrous. Cotyledons with with a notch on each side margin. Figs. 710, 711.

Pollen. *Geranium*-type (Bortenschlager 1967: 431; Gagnepain 1903: 87).

Chromosome number. 2*n* = 20, 28?

Phenology. Collected in flower from May to July.

Distribution. This species ranges from eastern Georgia through Armenia and Azerbaijan to northern Iran (Fig. 712).

Habitat. Meadows, stony places, and forest edges; 100-2600 m.

Representative specimens examined. **Armenia.** Nagorno Karabaj: Karabakh, Askeran, c. 4 km W Stepanakert, Archinkhar, 39°48'N, 46°42'E, 5 June 2010, *Vitek & al. 10-0097* (MA); Karabakh, Askeran, c. 21 km NNW Stepanakert, 2.5 km NW Khachen, 40°0'N, 46°40'E, 8 June 2006, *Vitek & al. 10-0590* (MA). Syunik, pr. Nerkin Hand vil-

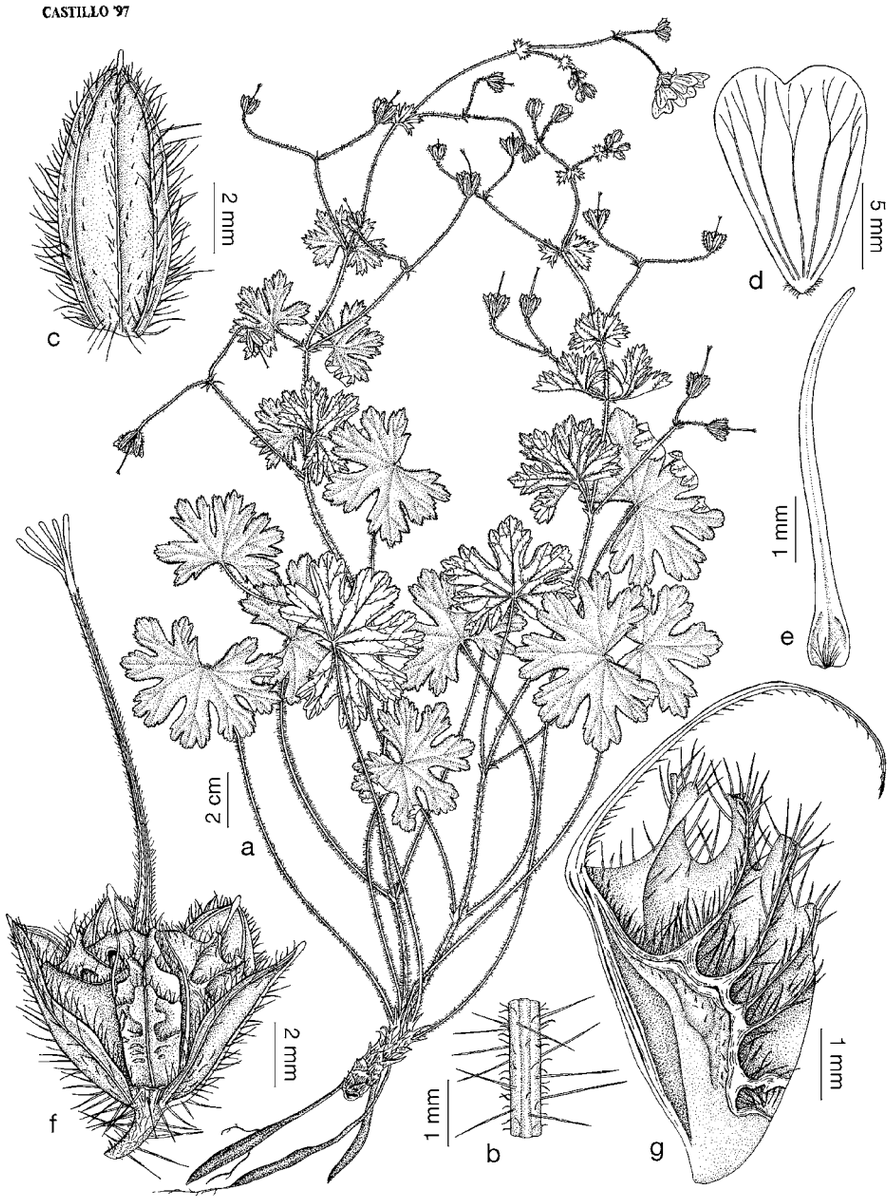


Fig. 710. *Geranium albanum.* a. Habit. b. Peduncle. c. Sepal. d. Petal. e. Stamen. f. Fruit and sepals. g. Mericarp. (Based on: a-e, *Kalm s.n., 1838,* G; f, g, *Schmid* 6636, C).

Fig. 711. *Geranium albanum* (Based on: *Aedo 3864,* MA).

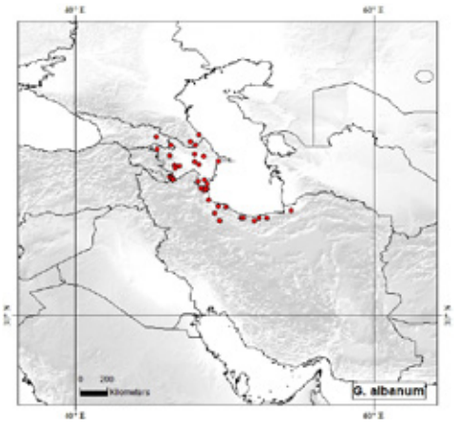


Fig. 712. Distribution of *Geranium albanum*.

lage, 39°3'N, 46°31'E, 26 June 2005, *Gonzalo & al. 266* (MA); Syunik, pr. Chakaten, 39°8'N, 46°27'E, 26 June 2005, *Gonzalo & al. 251* (MA); Syunik, Kapan, 1 km from turn off to Kapan to Vahanavank Monastery, 39°13'N, 46°20'E, 13 May 2004, *Rico & al. 1736* (MA); Kafanskij rajon, 39°15'N, 46°20'E, 30 May 1980, *[illegible] 313* (LE); Sjunik prov., Kapan distr., around Jeritzavank, 39°16'N, 46°28'E, 20 June 2004, *Vitek & al. 04-0944* (MA, MSB, W). **Azerbaijan.** Absheron: Baku, Schemacha, inter Ach-Su et urb. Schemacha, 40°3'N, 48°17'E, 2 May 1928, *Sachokia s.n.* (LE); Astanly Lenkoransk, Bakinsk, 40°17'N, 49°37'E, 2 May 1907, *Schelkovnikov s.n.* (LE); Baku, Schemacha, pr. Müdshi, 40°37'N, 48°38'E, 31 July 1900, *Alexeenko s.n.* (LE). Aran: steppa Shirvan, 40°14'N, 48°0'E, 1 May 1930, *Sachokia s.n.* (LE). Ganja-Qazakh: Elisabethpol, Schuscha, pr. Chan-Kendy, 40°40'N, 46°21'E, July, *Fedossejew s.n.* (LE). Kalbajar-Lachin: Zangelanskij ray., Razadara, 39°5'N, 46°34'E, 10 May 1948, *Grossheim & al. s.n.* (LE). Lankaran: prope Lankoran, 38°45'N, 48°50'E, 1836, *Hohenacker s.n.* (W, FI-W); Yardyumpinskij rajon, 14 km SW Yardyumpyu, 38°55'N, 48°15'E, 21 July 1977, *[illegible] 781/95* (LE); Talig, Dygya-Palaban, 39°3'N, 48°39'E, 13 July 1894, *[illegible] s.n.* (LE); Lenkoran, pr. pag. Alexejevka, 41°4'N, 45°31'E, 12 May 1939, *Zakarjan s.n.* (LE). Mountainous Shirvan: Geokzai, ad p. Ivanovka, 40°44'N, 48°1'E, 16 Apr. 1902, *Alexeenko 7496* (LE). Upper Karabakh: Gandzha, distr. Agdam, steppa Karabach inter urb. Agdam et Chinziristan, 39°58'N, 47°0'E, 4 May 1928, *Prilipko s.n.* (LE). **Georgia.** Kagkag, Merab, 3 June 1918, *[illegible] 1189* (W); prope Schuscha Georg. dauc., 1838, *Hohenacker s.n.* (K); Georg. Cauc., m. Wilnser, 1838, *Kalm s.n.* (G). Kakheti: Georgia Orient., Steppa Shiraki, m. Schavi-mta, 41°21'N, 46°27'E, 8 May 1940, *Sachokia s.n.* (MA); in dumosis circa Telav, Kachetia, 41°55'N, 45°29'E, 20 June 1918, *Pastuchov s.n.* (K); Tiflis, pr. Telan, 41°55'N, 45°28'E, 13 June 1918, *Pastuchov s.n.* (W); in dumosis circa Telav, Kachetia, 41°55'N, 45°29'E, 20 June 1918, *Pastuchov s.n.* (LE). **Iran.** Ardabil: prov. Talysh et Korabach, m. Kohenaker, 38°29'N, 48°27'E, 1838, *Kalm s.n.* (G). East Azerbaijan: W side of Hasi Amir Pass, on Russian border, 28 km NE of Ardebil, 38°25'N, 48°33'E, 21 July 1964, *Grant 16299* (MO). Gilan: around the village Damash-east of Rudbar, 36°48'N, 49°23'E, 21 May 1975, *Ala 17143G* (W); Deylaman to Siahkal, 37°13'N, 50°6'E, 7 June 2011, *Noroozi 2348* (MA); Persia borealis, in dumetis pr. Rasht, 37°16'N, 49°35'E, 28 Apr. 1902, *Bornmüller 6507* (BM, G, K, W); Assalem to Khalkhal, 37°42'N, 48°57'E, 29 May 1978, *Wendelbo 27765* (GB); in collibus 10-20 km W Astara, ad viam versus Heyran ducentem, 38°24'N, 48°46'E, 17 May 1971, *Rechinger 39902* (B, G, W); Ardabil a Astara, 38°20'N, 48°40'E, 12 May 1967, *Abai 12287* (W); Arbadil to Astara, 10 mi from Caspian shore on Caspian slopes, 38°20'N, 48°40'E, 6 June 1962, *Furse 2470* (K, W); Ardabil-Astara, 38°24'N, 48°52'E, 10 June 1963, *Bowles Scholarship Bot. Exped. 2312* (K). Golestān: Gorgan, 37°0'N, 54°30'E, *Sharif 545* (W). Mazenderan: Gozlu, 15 July 1940, *Koelz 16221* (W); Haraz valley, Karehsang, 36°18'N, 52°0'E, 7 May 1959, *Wendelbo 584* (W); 59 km S of Shahi, 36°27'N, 52°51'E, 30 June 1962, *Furse 2979* (K, W); Ostan 2, entre Amol et Siavicheh, 36°27'N, 52°20'E, 21 May 1956, *Schmid 5853* (G, W); Ostan 2, Dimelo, sommet du versant caspien, peu

en dessous de la crête, 36°27'N, 52°20'E, 4 June 1956, *Schmid 5985* (G, W); Sirga, 36°28'N, 51°15'E, 6 May 1960, *Roques 8549* (P, W); Ostan 1, Hassankif, 36°29'N, 51°9'E, 6 Oct. 1956, *Schmid 6636* (G). Qazvin: Persia borealis, Elburz, Kandaran, 36°16'N, 49°42'E, 1939, *Gauba 1453* (B); Persia borealis, Elburz, Pole-Zangulé, 36°16'N, 49°42'E, 1939, *Gauba 1553* (B). **Russia.** Dagestan: Kurinskij, pr. st. Diviczi, 41°35'N, 47°45'E, 6 Apr. 1902, *Alexeenko 7428* (LE); pr. urb. Derbent, 42°3'N, 48°17'E, 15 May 1901, *Alexeenko 7437* (LE).

Discussion. Geranium albanum is a perennial species endemic to northern Iran and the Caucasus. It has a singular mericarp, with a very thick wall and a well-developed dorsal crest. Features shared with *G. divaricatum* are the inoperative discharge mechanism and the ribbed mericarp. The chromosome number in this species is not fully clarified. Warburg (1938a: 145) and Van Loon (1984a: 276) have given different numbers, with only that of the first author matches with data for *G. divaricatum*.

281. Geranium divaricatum Ehrh., Beitr. Naturk. 7: 164. 1792. *Geranium winterlii* Roth, Catal. Bot. 2: 78. 1800, nom. illeg., ["winterli"]. Type locality: "Hungaria. J.J. Winterl, Prof. ... Geranium novum. Winterl. ind.". Type: Hungary. *Ehrhart Plant. Select. 69* (lectotype, designated by Aedo 1998: 620, M!; isolectotype, GOET-004058 image!).

Geranium divaricatum var. *ambiguum* Rochel ex Schult., Oestr. Fl. ed. 2, 2: 285. 1814. *Geranium divaricatum* [B] *ambiguum* (Rochel ex Schult.) Graebn. in Asch. & Graebn., Syn. Mitteleur. Fl. 7(1): 51. 1913. Type locality: "An den Weingärten um Ofen and im Baranyer Com., selten". Type: Cultivated, *A. Rochel 292* (neotype, designated by Aedo & al. 1998: 621, M!; isolectotype, W!).

Annual herbs, 20-50 cm tall. *Stem* erect, leafy, with long patent, eglandular hairs 1-3 mm long and short, patent, glandular and eglandular hairs 0.2-0.5 mm long. *Basal leaves* in a ± persistent rosette, cauline leaves alternate; leaf laminas 2.5-7 cm long, 3.1-7.9 cm wide, not peltate, palmatifid [ratio main-sinus length/middle segment length = 0.65-0.85], polygonal in outline, base cordate, not coriaceous, with nerves not projected, with ± appressed, eglandular and glandular hairs on both surfaces; segments 5(7), in 1 plane, middle segment rhombic, 4-9 mm wide at the base [ratio segment width at the base/middle segment length = 0.18-0.21], 7-12(15)-lobed in distal half [ratio secondary sinus length/middle segment length = 0.16-0.26]; petioles up to 15 cm long, without abscission zone, terete, not swollen, not deflexed in age, with patent, eglandular hairs 1-2.8 mm long and short, patent, eglandular and glandular hairs 0.2-0.5 mm long; stipules 4-7 mm long, 1-2 mm wide, lanceolate, free, papery, brown, with eglandular and glandular hairs on abaxial surface, glabrous adaxially. *Inflorescence* a monochasial cyme; cymules 2-flowered, solitary [ratio cymule length/leaf length = 1.2-1.3]; peduncles 6-35 mm long, with patent, eglandular hairs 1-3.5 mm long and short, patent, eglandular and glandular hairs 0.1-0.5 mm long; bracteoles 3-4 mm long, 0.5-1 mm wide, lanceolate, whorled; pedicels 10-28 mm long, with patent, eglandular hairs 1-2.5 mm long and short, patent, eglandular and glandular hairs 0.2-0.5 mm long. Flowers actinomorphic. *Sepals* 4-4.5 mm long, 1.8-2 mm wide, lanceolate, smooth, not accrescent, nerves 3, mucro 0.7-1 mm long [ratio mucro length/sepal length = 0.10-0.22], with patent, eglandular hairs 0.2-0.8 mm long and patent, glandular hairs 0.3-0.7 mm long on the abaxial surface, glabrous adaxially. *Petals* 4-6.5 mm long, 2.5-3 mm wide, erect-patent, emarginate (notch ca. 1 mm deep), without claw, bright purple, glabrous on both surfaces, sometimes ciliate on the basal margin, with hairs 0.1-0.2 mm long. *Stamens* 10, both whorls bearing anthers; filaments 1-2.5 mm long, lanceolate, white, pilose on the abaxial surface, ciliate on the proximal half, with hairs 0.1-0.2 mm long; anthers 0.4-0.6 mm long, purple. Nectaries 5, hemispheric, glabrous. *Gynoecium* 3-3.5 mm long, pale pink. *Fruit* 7-11 mm long, erect, discharge of carpel-projection type, inoperative; mericarps 2.8-3.5 mm long, 2-1.8 mm wide, without a strand of fibers, not compressed at the apex, with 3-4 transverse ribs, without a longitudinal crest, without basal beak, without a basal callus, without a basal prong, brown, with ± appressed, eglandular hairs 0.2-0.5 mm long, not ciliate at the base; rostrum 5-8 (0.5-0.6 mm wide at the base) mm long, without a narrowed apex, not twisted, with erect-patent, eglandular and glandular hairs 0.1-0.2 mm long; stigmatic remnants 0.5-1 mm long, with 5 hairy lobes. *Seeds* 2.4-2.6 mm long, 1.3-1.4 mm wide, smooth, uniformly colored, brown, glabrous. Cotyledons with with a notch on each side margin. Figs. 713, 714.

Pollen. *Geranium*-type (Velasco 1992b: 58).

Chromosome number. 2*n* = 26.

Phenology. Collected in flower from April to August.

Distribution. This species ranges from Spain, through central and eastern Europe and western Asia to western Himalayas, China and central Siberia (Fig. 715).

Habitat. Waste places, meadows, stony dry slopes, field margins, and shady wood borders; 50-2550 m.

Representative specimens examined. **Afghanistan.** Faryab: Faisabad district, 36°17'N, 64°49'E, 21 May 1964, *Furse 6230* (K). Jowzjan: N Afghanistan, Mazar-I Sharif, 21 km SE Tashkurghan, 36°44'N, 67°41'E, 7 May 1967, *Rechinger 34034* (W). **Armenia.** Syunik, pr. Zorats Karer, 39°33'N, 46°1'E, 25 June 2005, *Gonzalo & al. 16* (MA). Vayots Dzor: pr. Ger-Ger, 39°47'N, 45°32'E, 24 June 2005, *Herrero & al. 2869* (MA). **Austria** Lower Austria: Niederösterreich, Donautal, Hainburger Berge, 48°9'N, 16°56'E, 4 June 2004, *Barta 2004-475* (MA). Tyrol: Lienz, Tirolis, 46°46'N, 12°46'E, 19 May 1869, *Gander s.n.* (K). **Azerbaijan.** Kalbajar-Lachin: Kurdistan pr. lac Alagod, 39°44'N, 46°0'E, 13 Aug. 1932, *Heydeman & Isaev s.n.* (K). Nakhchivan: Nakhichevanskaja Autonomous SSR, Nakhichevansk rajon, Aznabjurt, 39°26'N, 45°16'E, 8 June 1947, *Gross-*

heim & al. s.n. (LE). **Belorussiya.** Minsk: Khojni, Mozyrskago, 53°54'N, 27°34'E, 1902, *Bordzilowski s.n.* (LE). **Bulgaria.** Smolyan: Rhodopes centrales, a 5 kms de Smolyan, 41°37'N, 24°40'E, 30 June 2004, *Herrero & al. 2207* (MA). Central Rhodope Mts., pr. Kosovo, 41°54'N, 24°42'E, 29 June 2004, *Aedo & al. 10336* (MA). **China.** Xinjiang: Tian-Shan occid., ad fluv. [?]bulak, TschtkalDobrogea, N von Costinesti, 6 Apr. 1981, *Skvovtsov s.n.* (M); in montibus Bogdo Ola, Ozun-ava, 43°35'N, 89°40'E, 7 June 1928, *Hummel 177* (S). **Czech Republic.** South Moravian: bei Brunn, 49°12'N, 16°38'E, 1860, *Makonsky s.n.* (W). Olomouc: rupibus prope Engelhans, Bohemia, 50°6'N, 17°6'E, *Fenzl s.n.* (W). **France.** Occitanie: Cerdagne, Puigmal, 42°22'N, 2°7'E, July, *Braun-Blanquet s.n.* (MPU); Ariège, Quérigur, 42°42'N, 2°5'E, 3 Aug. 1857, *Loret s.n.* (P). **Georgia.** Samtskhe-Javakheti: Javakheti, Distr. Bogdanivka, 41°20'N, 43°55'E, 15 July 1955, *Zanitazadze s.n.* (MA). Shida Kartli: Tiflis, Gori-Vollis, fl. Tana, pr. Ateni, 41°55'N, 44°6'E, 24 May 1910, *Woronow s.n.* (LE). **Germany.** Brandenburg: pr. Francfort-sur-l'Oder, 52°20'N, 14°32'E, 27 June 1847, *Buek s.n.* (K, RO). Saxony: Dresden, b. Dohna, 51°2'N, 13°44'E, 4 July 1879, *Poscharsky s.n.* (W). **Greece.** Central Macedonia: Thessalonikis, ep. Lagada, 1 km W of Sokos, N of the road, 40°49'N, 23°20'E, 27 May 1993, *Snogerup 10139* (LD). West Macedonia: Pisoderion, Macedonia, 40°47'N, 21°14'E, 23 June 1932, *Alston & Sandwith 970* (K). **Hungary.** Pest: arenisis siccies Rákos Budae-Pestini, 47°30'N, 19°5'E, 2 July 1891, *Borbás s.n.* (W); ab flumen Duna, in mt. Szentmihályhegy, a Nagymaros, 47°47'N, 18°57'E, 17 June 1961, *Zertova s.n.* (PR). **India.** Himachal Pradesh: Gaon, Bashahr, NW Himalaya, 31°35'N, 78°25'E, 7 May 1891, *Lace 882* (K); Chumba, W Himalaya, 32°34'N, 76°7'E, May, *Watt 2067* (K). Jammu-Kashmir: Preslang near Pahlgam, Kashmir, 33°1'N, 75°25'E, 10 Aug. 1945, *Stewart 21676* (K). **Iran.** Tehran: prope Teheran, 35°42'N, 51°25'E, *Kotschy 866* (W). West Azerbaijan: Azerbaijan occid., SE Shahpur versus lacum Rezaiyeh, Urmia, 39°38›N, 46°30'E, 12 June 1971, *Rechinger s.n.* (W). **Iraq.** Nineveh: Jebel Sinjar, Mosul liwa, 36°19'N, 41°40'E, 26 May 1948, *Gillett 11134* (K). Sulaymaniyah: Suleimania, supra oppido Penjwin, 35°37'N, 45°56'E, 26 May 1961, *Hadac 4910* (PR). **Italy.** Lombardy: Ponte di Legno, 46°16'N, 10°31'E, Aug. 1879, *Parlatore s.n.* (FI). Piedmont: Oulx, ad saepes secundum viam quae est inter Borgata superiore di Oulx et S. Marco, Torino, 45°2'N, 6°50'E, 25 June 1906, *Ferrari & Vallino 603* (K, RO). **Kazakhstan.** Almaty: Tian-shan, montes Zailijski Alatau, distr. lembekshi-kazakhski, in valle fluminis Issyk, 43°4'N, 76°54'E, 31 May 1974, *Vašák s.n.* (W); Dschetysu gub., Taldy-Kurgan distr., Verkhob'ya karamala, 45°0'N, 78°24'E, 2 July 1928, *Schipczinsky 650* (LE). South Kazakhstan: Turkestania, Wernoje, 43°17'N, 68°16'E, 24 Sep. 1876, *Kuschakewitz s.n.* (K). **Kyrgyzstan.** Osh: Oblast Dppipag-Abadakaga, Badar-Kurgans rajon, 40°4'N, 72°35'E, 21 July 1955, *Kamel s.n.* (LE); Turkestania, prov. Fergana, distr. Osch. pr. Gulcza, 40°21'N, 73°26'E, 30 May 1900, *Tranzschel s.n.* (LE). **Moldova.** Anenii Noi: Kalfa, Pulbokeskij rajon, 46°54'N, 29°25'E, 27 May 1956, *Kopopov s.n.* (LE). Briceni: Bessarabii, Khotinsk, uezda, mest. Lipkany, 48°15'N, 26°48'E, 1898, *Kejkhel s.n.* (LE). **Poland.** Lower Silesian: Breslau, Ransern, Hecken, 51°5'N, 17°0'E, 1867, *Engler s.n.* (K). **Romania.** Nord-Vest: Transsilvania, Cluj, loco Hajongarl, 46°46'N, 23°36'E, 8 July 1925, *Nyárády s.n.* (K, RO). Sud-Vest Oltenia: Oltenia, Dolj, pr. Tîmburesti, 44°2'N, 23°56'E, 9 May 1971, *Cîrtu & Cîrtu s.n.* (MA). **Russia.**

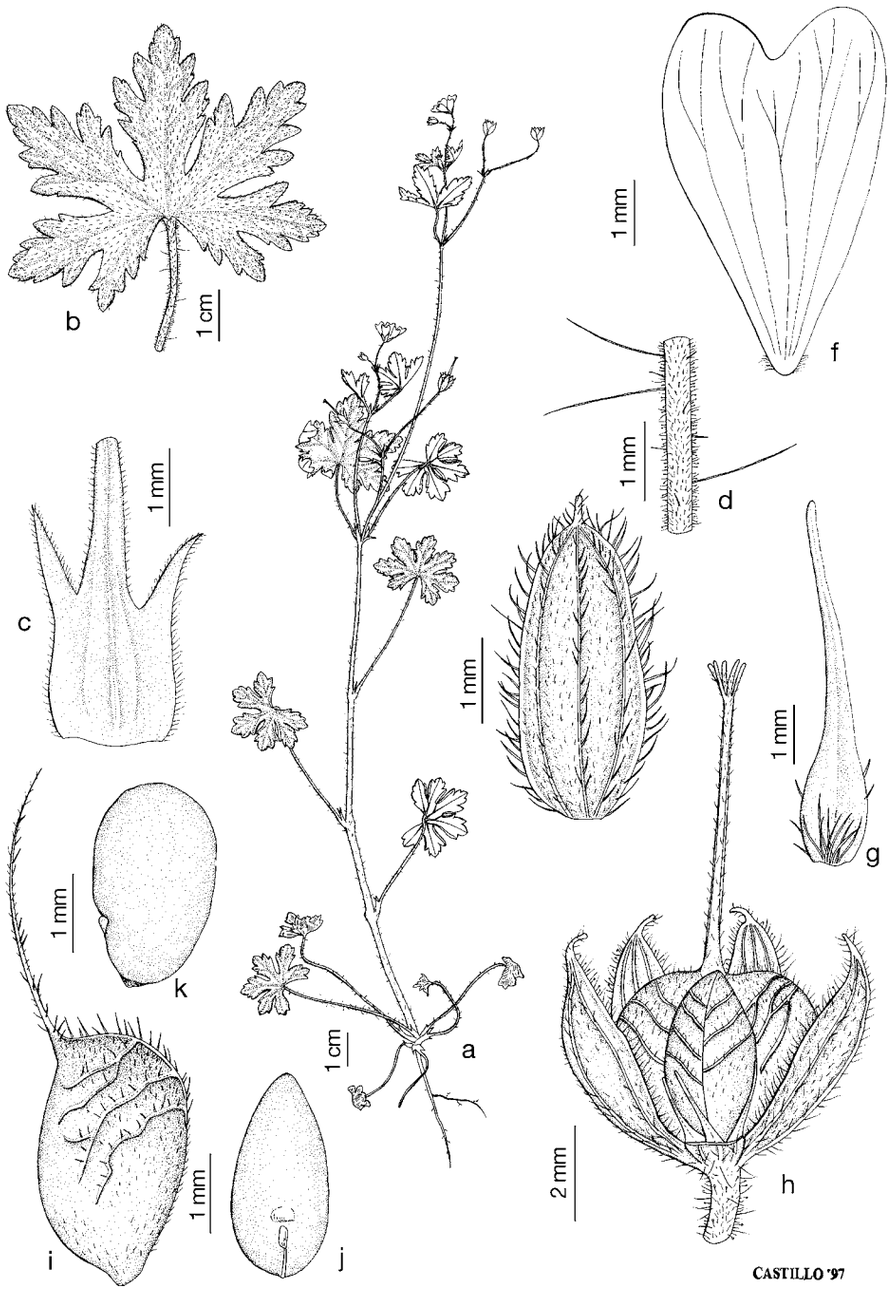


Fig. 713. *Geranium divaricatum.* a. Habit. h. Leaf. c. Stipule. d. Peduncle. e. Sepal. f. Petal. g. Stamen. h. Fruit and sepals. i. Mericarp. j, k. Seeds. (Based on: a, c-g, *Popov* & *Vvedensky s.n.,* MA-71170; b, *Fritzsche s.n.,* BC-825281; h-k, *Koch 46/348,* MA).

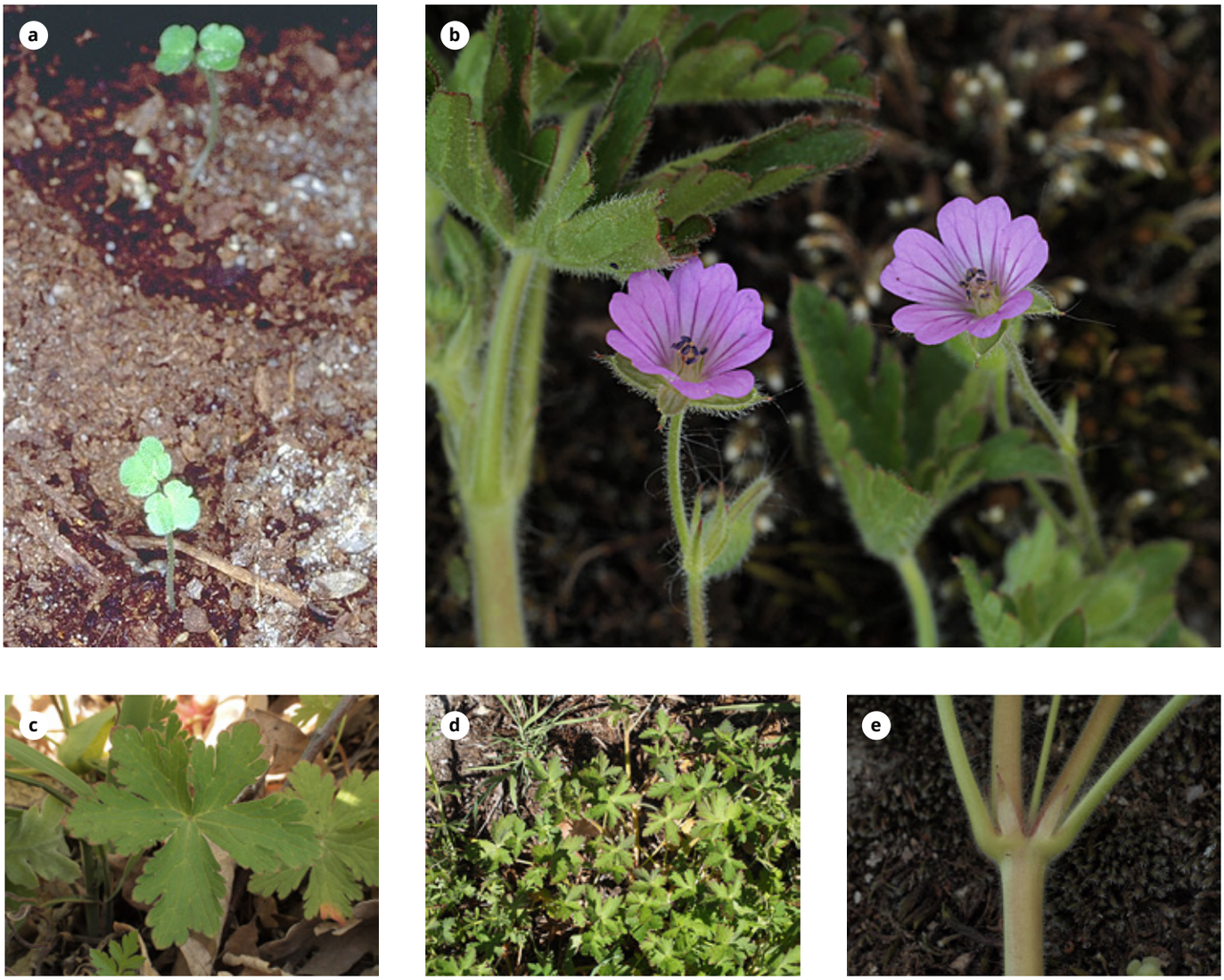


Fig. 714. *Geranium divaricatum* (Based on: a, *Aedo 4681,* MA; b-e, *Aedo & al. 23703*, MA).

Bashkiriya: Zilairskij rajon, Useganskaya, 54º0'N, 56º0'E, 21 June 1928, *Grebner 241* (LE). Belgorod: Kursk, Bielgorod, 50º38'N, 36º36'E, 5 June 1900, *Sukachev s.n.* (LE). Chita: Tarbagatai, 51º10'N, 109º5'E (P). Dagestan: Dargi, pr. Murguk, 42º15'N, 47º41'E, 7 July 1898, *Alexeenko s.n.* (LE). Kabardino-Balkaria: Caucasus centralis, distr. Baksan, in declivibus rivi Irik ad pedes montis Gubasanty, 43º41'N, 44º4'E, 17 Aug. 1978, *Vašák s.n.* (W). Karachayevo-Cherkasskaiya: Kaukasus, Dschmagat-Tal nordöstlich Teberda, 43º28'N, 41º46'E, 5 July 1975, *Stohr 9* (B). Krasnodar: Kuban, 45º6'N, 40º7'E, 2 June 1907, *Endaurowa s.n.* (LE). Krym: Krymea (LE). Rostov: Millerovo, 46º39'N, 40º30'E, 20 June 1939, *Nurljuskin s.n.* (LE). Saratov: Razboyshchina, 51º34'N, 45º49'E, 8 July 1912, *[illegible] s.n.* (LE). Stavropol: Terek, Pjatigorsk, Mt. Mashuka, behind the Proval (Abyss), 44º2'N, 43º3'E, 15 July 1912, *Gordiagin s.n.* (MA). Volvograd: Sarepta, 48º31'N, 44º29'E, 1 June 1894, *Becker s.n.* (M). West Siberia: Omsk ob., Frunzenskij raj., Alajskogo khebet, 54º59'N, 73º22'E, 28 Mar. 1963, *Ajderova & al. s.n.* (LE). **Slovakia.** Bratislava: Presburg, 48º9'N, 17º7'E, 10 June 1875, *Eschfaeller s.n.* (W). Nitra: in Mt. Zobor, Nitriam, 48º21'N, 18º7'E, 1836, *Láng s.n.* (K). **Spain.** Ávila: Navarredonda de Gredos, 40º22'N, 5º8'W, 16 Aug. 1984, *Sánchez Mata s.n.* (MAF). Granada: Convento de San Jerónimo, 37º5'N, 3º24'W, 17 July 1998, *Aedo & al. 4681* (MA). Guadalajara: El Cardoso de la Sierra, dehesa de Cardoso, 14 May 2016, *Galán s.n.* (MA). Lérida: Sant Clement de Tarill, valle de Boi, 11 July 1979, *Carrillo & Ninot s.n.*

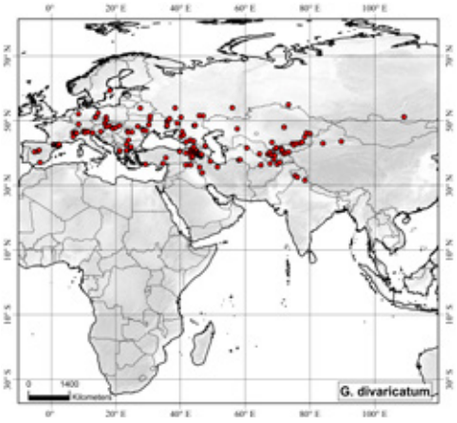


Fig. 715. Distribution of *Geranium divaricatum*.

(BCN). Madrid: Bustarviejo, Dehesa Vieja, 29 June 2013, *Baonza s.n.* (MA). **Sweden.** Södermanland: Nacka, 59°18'N, 18°10'E, 4 Sep. 1915, *Vestergren s.n.* (W). **Switzerland.** Graubünden: Grisons, Engadine, ruine Steinsberg Ardez, 46°30'N, 10°0'E, 22 July 1933, *Huber s.n.* (BC, MA). Valais: supra Stalden, 46°13'N, 7°53'E, 26 July 1878, *Vetter s.n.* (BC). **Tajikistan.** Khatlon: pr. Gissaf, 38°5'N, 68°54'E, 5 May 1933, *Zaprjagaev 188* (LE); Artucz, 39°20'N, 68°7'E, 6 May 1892, *Komarov s.n.* (LE). **Turkey.** Erzurum: Pasinler, ruinas del castillo Hassen Kale, 39°59'N, 41°40'E, 30 June 2001, *Herrero & al. 1825* (MA). Kars: Gölebert-Haçuvan, 40°35'N, 43°5'E, 30 June 1957, *Davis & Hedge 39457* (BM). **Turkmenistan.** Ahal: Kopet-Dag, 37°50'N, 58°0'E, 24 May 1924, *Czerniakowska 17* (LE); Ashabad, in angustiis Karanky, 37°58'N, 58°24'E, 6 May 1898, *Litvinov 1129* (G, W). **Ukraine.** Cherkasy: pr. opp. Umanj, 48°45'N, 30°10'E, 21 June 1904, *Czernous 3430* (G, K, LE, W); Kiew, pr. Kitajewskaja Pustin, 50°26'N, 30°31'E, 22 June 1902, *Rakoczi 1607* (G). **Uzbekistan.** Bukhara: Paba, Bucharia, 39°46'N, 64°25'E, 21 May 1906, *Rosheviz 778* (LE). Tashkent: pr. Tashkent, 41°16'N, 69°13'E, *Kuschakewitz s.n.* (K, P).

Discussion. The most distinctive feature of this annual species is the transversely ribbed mericarp, which has thin walls and no longitudinal crest. The eastern limit of *Geranium divaricatum* is not well established, because it is quite difficult to obtain material from Russian herbaria. In Asia, this species reaches the central Siberia (109°E) and the western Himalayas to 76°E. It is known from Sweden by only one collection, which could be an introduction; the nearest locality is in Germany, almost 1000 km southward.

IVc. Geranium sect. **Trilopha** Yeo, Bot. J. Linn. Soc. 89: 13. 1984. *Geraniopsis* Chrtek, Nov. Bot. Univ. Carol. Prag. 1967: 9. 1968. Type: *Geranium trilophum* Boiss. (art. 10.8).

Annual herbs. *Flowers* actinomorphic. *Petals* rounded, without claw. *Pollen* of *Erodium*-type. *Fruit* of carpel-projection type, operative; mericarps transversely wrinkled or with wings; rostrum twisted distally. *Cotyledons* with entire margins.

282. Geranium trilophum Boiss., Diagn. Pl. Orient. ser. 1, 6: 30. 1846. *Geraniopsis trilophum* (Boiss.) Chrtek, Novit. Bot. Delect. Seminum Horti Bot. Univ. Carol. Prag. 1967: 9. 1967. Type locality: "Geranium trilophum Boiss. in pl. Kotsch. Pers. Febr. 1845... Hab. in rupestribus montanis prope Dalechi et gere Persiae australis Kotschy No. 222". Type: Iran. Fars, Gere, inter Abuschir et Schiras, 29°36'N, 52°32'E, 18 Mar. 1842, *T. Kotschy 222* (lectotype, designated by Schönbeck-Temesy 1970: 33, W!; isolectotypes, BM-000796358!, FI-006226!, G-BOIS-00402164!, K-000729278!, LE!, MO-176175!, P-00757934!, PR-375704!).

Geranium trilophum var. *maculatum* Bornm., Mitth. Thüring. Bot. Vereins 6: 53. 1894. Type locality: "exs. 145... von Buschir". Type: Iran. Faristan, Buschir, 28°58'N, 50°50'E, 17 Mar. 1893, *J. Bornmüller 145* (lectotype, designated by Aedo & al. 2016: 359, W!; isolectotypes, BM!, CAS!, FI!, HBG-517276 image!, K!, LE!, LD!, MPU-018546!, P-00757941!, US image!, WU!).

Annual herbs, 19-51 cm tall. *Stem* erect or ascending, leafy, with short retrorse, not appressed, eglandular hairs 0.1-0.3 mm long, patent, eglandular hairs 1.4-2.1 mm long and, usually, scattered, patent, glandular hairs 0.4-0.5 mm long. *Basal leaves* in a deciduous rosette, cauline leaves opposite (rarely alternate in middle of shoot, 1-2 nodes); leaf laminas (3.9)4.6-5.1(5.3) cm long, 4.6-6.3 cm wide, not peltate, palmatifid [ratio main-sinus length/middle segment length = (0.58)0.67-0.73], polygonal in outline, base cordate, not coriaceous, with nerves not projected, pilose, with ± appressed, eglandular hairs and plane eglandular hairs on the adaxial surface and ± appressed, eglandular hairs abaxially; segments 5, in 1 plane, middle segment rhombic, 9.4-11.8 mm wide at the base [ratio segment width at the base/middle segment length = 0.29-0.38], 9-11(12)-lobed in distal half [ratio secondary sinus length/middle segment length = (0.13)0.18-0.20(0.22)]; petioles up to 14 cm long, without abscission zone, terete, not swollen, not deflexed in age, with retrorse, not appressed, eglandular hairs 0.1-0.3 mm long, patent, eglandular hairs 0.6-1.9 mm long and, rarely, patent, glandular hairs 0.2-0.4 mm long; stipules 1.8-4.1 mm long, 0.6-2.2 mm wide, lanceolate, free, papery, green, with eglandular hairs on abaxial surface and on the margin, usually glabrous adaxially. *Inflorescence* a monochasial cyme; cymules (1)2-flowered, solitary, sometimes grouped at nodes with short or no pedicels [ratio cymule length/leaf length = 0.4-3.9]; peduncles 15-46 mm long, with retrorse, not appressed, eglandular hairs 0.1-0.3 mm long, usually patent, eglandular hairs 1.1-1.6 mm long and patent, glandular hairs 0.4-0.7 mm long; bracteoles 1.8-2.9 mm long, 0.4-0.6 mm wide, lanceolate, whorled; pedicels absent or 4.8-22 mm long, with retrorse, not appressed, eglandular hairs 0.1-0.3 mm long, sometimes patent, eglandular hairs 1-1.6 mm long and patent, glandular hairs 0.3-0.8 mm long. Flowers actinomorphic. *Sepals* 5-6.1(6.2) mm long, 2.5-3.1 mm wide, broadly ovate, smooth, accrescent (6.7-8.9 mm long, 5.5-6.4 mm wide in fruit), nerves 3, mucro 0.5-1.1 mm long [ratio mucro length/sepal length = 0.10-0.22], with ± appressed, eglandular hairs 0.2-0.3 mm long, sometimes also patent, eglandular hairs 1.1-2.3 mm long and usually patent, glandular hairs 0.5-0.7 mm long on the abaxial surface, glabrous adaxially. *Petals* (8.8)9-9.8(11.2) mm long, 4.9-7.9 mm wide, erect-patent, rounded, without claw, purple with a dark basal spot, glabrous on both surfaces, ciliate on the basal margin, with hairs 0.1-0.3 mm long. *Stamens* 10, both whorls bearing anthers; filaments 2.7-4.4 mm long, lanceolate, black except the base, glabrous; anthers 1.2-1.3 mm long, purple. Nectaries 5, hemispheric, glabrous. *Gy-*

noecium 4-6.2 mm long, dark purple. *Fruit* (17.8)18.4-20.8(21.4) mm long, erect, discharge of carpel-projection type, operative; mericarps 5-5.8(6.5) mm long, 2.4-3.4 mm wide, without a strand of fibers, not compressed at the apex, with two longitudinal toothed wings bent dorsally to form a trough-like structure and with an evident ridge in the middle, protruding beyond the trough-like structure, without horns, without basal beak, without a basal callus, without a basal prong, brown, with appressed, eglandular hairs 0.1-0.2 mm long; rostrum 10.4-14.2 mm long, without a narrowed apex, twisted distally, with patent, eglandular hairs 0.3-0.8 mm long and, usually, a group of patent, eglandular hairs 0.6-1.1 mm long towards the apex; stigmatic remnants 0.3-0.6 mm long, with 5 glabrous lobes. *Seeds* 2.2-2.7 mm long, 1.1-1.3 mm wide, smooth, uniformly colored, brownish red, glabrous. Cotyledons with entire margin. Fig. 716.

Pollen. *Erodium*-type (Aedo & al. 2016: 356).

Chromosome number. Unknown.

Phenology. Collected in flower from March to April.

Distribution. This species ranges from southern Iran to Oman (Fig. 717).

Habitat. Open scrublands, grassland plains, cliffs or tops of escarpments, under shaded bushes and disturbed areas; 0-2300 m.

Additional specimens examined. **Iran.** Bushehr: Bushehr, 28°45'N, 51°30'E, 14 Apr. 1885, *Stapf 496* (WU); Borghmani, Bushehr, 28°56'N, 51°6'E, 13 Mar. 1937, *Köie 934* (C); Fars, Kharg Island, 29°14'N, 50°18'E, 25 Feb. 1965, *Grant 17035* (W); Borazjan, 29°16'N, 51°13'E, *Stapf 495* (WU); Fars, Naphtaguelle b. Dalaki, 29°17'N, 50°54'E, *Stapf 497* (WU); Fars, Bushehr, Naphtha Quellum, Dalaki, 29°17'N, 50°54'E, 26 Apr. 1885, *Stapf 498* (WU); supra rivum Rud Dalki, 30 km ab oppido Borazjan (Dashtestan), 29°28'N, 51°20'E, 18 Apr. 1977, *Sokák s.n.* (PR); ad fontes petroleum fundentes pr. Dalechi, 29°29'N, 51°23'E, Mar. 1842, *Kotschy 222b* (P). Hormozgan: Chahestan, 27°30'N, 56°43'E, *Gabriel 127* (W). Khuzestan: Pazanan, 30°34'N, 50°0'E, *Gauba 751* (W); SE Masjid-Soleiman, montagne Asmari, 31°40'N, 49°39'E, 21 Apr. 1959, *Pabot s.n.* (G); 60 km NO von Dizful, 32°46'N,

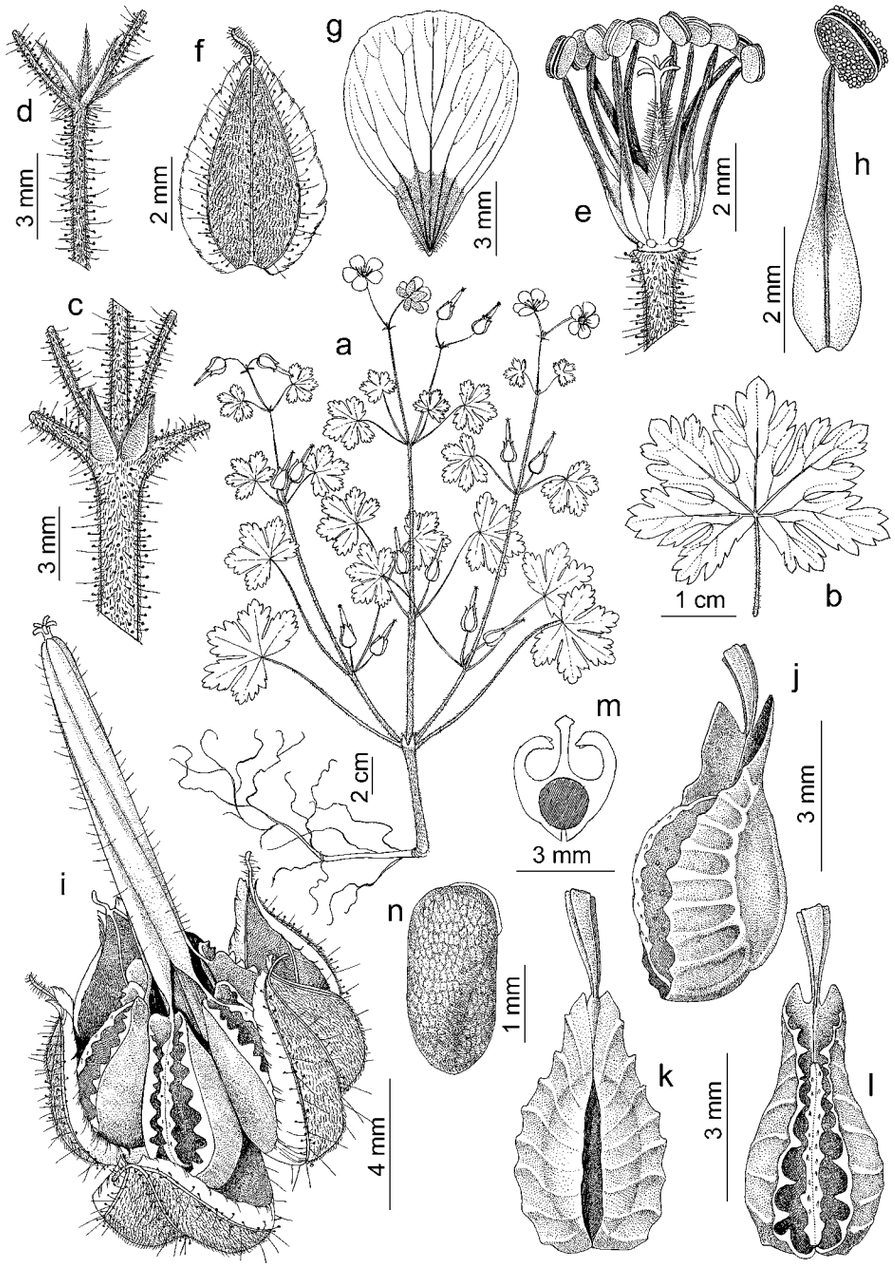


Fig. 716. *Geranium trilophum* a. Habit. b. Leaf. c. Stipules. d. Bracteoles. e. Flower without petals and sepals. f. Sepal. g. Petal. h. Stamen. i. Fruit. j-l. Mericarps. m. Transverse section of a mericarp. n. Seed. (Based on: a-i, n, *Bornmüller 659*, LD; j-m, *Jacobs 6442*, L).

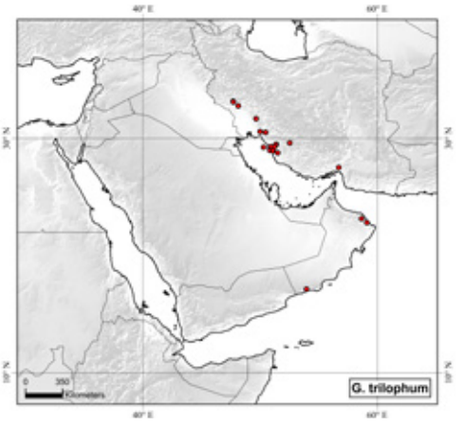


Fig. 717. Distribution of *Geranium trilophum*.

48º8'E, 17 Apr. 1937, *Köie 942* (C). Kohgiluyeh and Boyer-Ahmad: 30 km E Behbahan, gorges de Maroun, 30º30'N, 50º28'E, 15 Apr. 1959, *Pabot 531* (G). Lorestan: S Lorestan-Sheshom, 33º6'N, 47º43'E, 28 Apr. 1963, *Jacobs 6442* (L, W); Lorestan, near Po-le Dokhtar, 110 km from Khorramabad on road to Andimeshk, 33º9'N, 47º42'E, 5 May 1975, *Wendelbo & Assadi 16602* (W). **Oman.** Ash Sharqiyah North: Jaylah, Jebel Beni Jabir, to end of Wadi Shab, 22º48'N, 59º8'E, 28 Apr. 1996, *Ghazanfar 227* (OBG). Dhofar: prima di Ghadow, venendo da Salalah, 17º7'N, 53º58'E, 26 Sep. 2001, *Raffaelli & al. 663* (FT). Muscat: Jabal Aswad, near Siya, 23º8'N, 58º40'E, 21 Mar. 1992, *Collenette 8001* (E).

Discussion. Geranium trilophum is erect or ascending, with basal leaves in a deciduous rosette and cauline leaves opposite, rarely alternate towards the basal third of the stem, and a monochasial inflorescence. It is easily identified by its purple petals with a dark basal spot, its accrescent and very wide sepals and its singular mericarps. Mericarps of *G. trilophum* have two longitudinal toothed wings bent dorsally to form a trough-like structure with an evident ridge in the middle, protruding from the trough-like structure. The indumentum of *G. trilophum* is composed of short, ± uncinate, eglandular hairs on stems, leaves and inflorescence, and usually glandular, patent hairs and long, eglandular, patent hairs. Some specimens of *G. trilophum* have 2-flowered cymules with well-developed peduncle and pedicels in some nodes and cymules or aggregates of cymules without pedicels in other nodes. In other specimens only the second type of cymule is found. According to Schönbeck-Temesy (1970) *G. trilophum* frequently produces cleistogamous flowers. *Geranium trilophum* is an endemic plant of the north side of the Persian Gulf. Knuth (1912) also included plants from Yemen and adjacent areas of northeast Africa in *G. trilophum*. Schönbeck-Temesy (1970), Kokwaro (1971a), Thulin (1993), Alfarhan & Thomas (2001), and Patzelt (2007) concurred with Kunth. However, plants from those areas are easily distinguished from *G. trilophum* by their shorter petals and sepals. Additionally they have a mericarp with a much smaller ridge which is covered by the trough-like structure. Those plants were described by Deflers (1889) as *G. yemense*, a name that has been misapplied frequently (see discussion under *G. yemense* and *G. biuncinatum*).

283. Geranium yemense Deflers, Voy. Yemen: 118. 1889. *Geraniopsis yemense* (Deflers) Chrtek, Novit. Bot. Delect. Seminum Horti Bot. Univ. Carol. Prag. 1969: 9. 1969. Type locality: "Hab. ad montem Kahel, prope Menâkhah; alt. 2400 m. (Exs. 296.)". Type: Yemen. Gebel Kahel, pr. Menâkhah, 15°04'N, 43°44'E, 10 May 1887, *A. Deflers 296* (lectotype, designated by Kokwaro 1971a: 641, P-00757939!; isolectotypes, MA-699071!, MPU-018613!).

Geranium omphalodeum Lange in Weilbach & Lange, Index Sem. Hort. Haun.: 27. 1866. Type locality: "Ex horto Berolinensi nomine Geranii columbini acceptum". Type: Cultivated at Copenhagen Botanic Garden, 16 Aug. 1865, *J. Lange s.n.* (lectotype, designated by Hansen & al. 1997: 19, C-10012695!).

Annual herbs, 8-62 cm tall. *Stem* erect or ascending, leafy, with short retrorse, not appressed, eglandular hairs 0.1-0.3 mm long (rarely also, patent, eglandular hairs 1.5-1.7 mm long) and, sometimes, scattered, patent, glandular hairs 0.4-0.9 mm long. *Basal leaves* in a deciduous rosette, cauline leaves opposite (rarely alternate in middle of shoot, 1-2 nodes); leaf laminas (2.1)3.4-4.9(6.4) cm long, 2.8-7.9 cm wide, not peltate, palmatifid [ratio main-sinus length/middle segment length = (0.59)0.66-0.77(0.86)], polygonal in outline, base cordate, not coriaceous, with nerves not projected, with ± appressed, eglandular hairs and plane eglandular hairs on the adaxial surface and ± appressed, eglandular hairs abaxially; segments 5, in 1 plane, middle segment rhombic, 6-14.9 mm wide at the base [ratio segment width at the base/middle segment length = (0.27)0.29-0.37(0.39)], (7)8-17(26)-lobed in distal half [ratio secondary sinus length/middle segment length = (0.18)0.22-0.28(0.34)]; petioles up to 16 cm long, without abscission zone, terete, not swollen, not deflexed in age, with retrorse, not appressed, eglandular hairs 0.1-0.3 mm long, sometimes also patent, eglandular hairs 1-2.9 mm long and, rarely, patent, glandular hairs 0.5-0.7 mm long; stipules 1.7-3.2 mm long, 0.5-1.9 mm wide, lanceolate, free, papery, green, with eglandular hairs on abaxial surface and on the margin, usually glabrous adaxially. *Inflorescence* a monochasial cyme; cymules (1)2-flowered, solitary, sometimes grouped at nodes with short or no pedicels [ratio cymule length/leaf length = 0.2-5]; peduncles 3-25 mm long, with retrorse, not appressed, eglandular hairs 0.1-0.3 mm long and, usually patent, glandular hairs 0.4-0.7 mm long; bracteoles 1.7-2.9 mm long, 0.5-0.7 mm wide, lanceolate, whorled; pedicels absent or 3.9-23.7 mm long, with retrorse, not appressed, eglandular hairs 0.1-0.3 mm long, sometimes patent, eglandular hairs 1-1.2 mm long and, usually, patent, glandular hairs 0.3-0.6 mm long. Flowers actinomorphic. *Sepals* (3.3)3.6-4.2(4.8) mm long, 1.6-2.7 mm wide, broadly ovate, smooth, accrescent (5.2-7.5 mm long, 3.3-5.1 mm wide in fruit), nerves 3, mucro 0.5-1.3 mm long [ratio mucro length/sepal length = 0.12-0.40], with ± appressed, eglandular hairs 0.2-0.3 mm long, sometimes also patent, eglandular hairs 1.4-2.9 mm long and usually patent, glandular hairs 0.4-1 mm long on the abaxial surface, glabrous adaxially. *Petals* (4.8)6.1-8.1(8.7) mm long, 3.1-5.2 mm wide, erect-patent, rounded, without claw, purple with a dark basal spot, glabrous on both surfaces, ciliate on the basal margin, with hairs 0.1-0.2 mm long. *Stamens* 10, both whorls bearing anthers; filaments 2.1-3.6 mm long, lanceolate, black except the base, glabrous or with scattered cilia 0.1-0.2 mm long

on the margin; anthers 0.7-1.1 mm long, purple. Nectaries 5, hemispheric, glabrous. *Gynoecium* 2.6-3.7 mm long, dark purple. *Fruit* (14.1)15.9-17.4(18.6) mm long, erect, discharge of carpel-projection type, operative; mericarps 3.7-4.6(4.8) mm long, 1.9-3.4 mm wide, without a strand of fibers, not compressed at the apex, with two longitudinal toothed wings bent dorsally to form a trough-like structure and with a small ridge in the middle, inside the trough-like structure, without horns, without basal beak, without a basal callus, without a basal prong, brown, with appressed, eglandular hairs 0.1-0.2 mm long; rostrum 8.8-12.6 mm long, without a narrowed apex, twisted distally, with erect-patent, eglandular hairs 0.1-0.4 mm long; stigmatic remnants 0.2-0.6 mm long, with 5 glabrous lobes. *Seeds* 2.1-2.4 mm long, 1-1.2 mm wide, smooth, uniformly colored, brownish red, glabrous. Cotyledons with entire margin. Fig. 718.

Pollen. *Erodium*-type (Aedo & al. 2016: 356).

Chromosome number. Unknown.

Phenology. Collected in flower from January to May.

Distribution. This species ranges through Jordan, eastern Egypt and Sudan, western Yemen, Socotra, Djibouti, Eritrea, northern Ethiopia and Somalia (Fig. 719).

Habitat. In shade of small trees on limestone escarpments, coffee terraces and other cultivated areas; 600-2850 m.

Additional specimens examined. **Djibouti.** côte Française des Somalis, Gemedda, 1 Apr. 1959, *Chedeville 1274* (FT, P). Obock: côte Française des Somalis, versant meridionale des Mts. Mabla, piste de Obok a Sismo, 11°56'N, 43°2'E, Feb. 1938, *Aubert de la Rüe s.n.* (P). **Egypt.** Red Sea: Gebl Elba, Wadi Kansisrob, 23°45'N, 35°24'E, Jan. 1933, *Drar 166* (S); Gebl Elba, Wadi Kansisrob, 23°45'N, 35°24'E, Jan. 1932, *Drar 268* (S); Gebel Elba, Wadi Kansisrob, 23°45'N, 35°24'E, 23 Jan. 1929, *Täckholm s.n.* (S). **Eritrea.** Northern Red Sea: Mensa, 14°53'N, 40°18'E, 15 Jan. 1893, *Terracciano & Pappi 2102* (FT); Assaorta, monte Fatta, 15°22'N, 39°18'E, 19 Mar. 1893, *Pappi 3084* (FT); Ghinda, 15°26'N, 39°5'E, 24 Feb. 1916, *Baldrati 659* (FT); Hamasen, valle de Ghinda, 15°26'N, 39°5'E, 12 Mar. 1902, *Pappi*

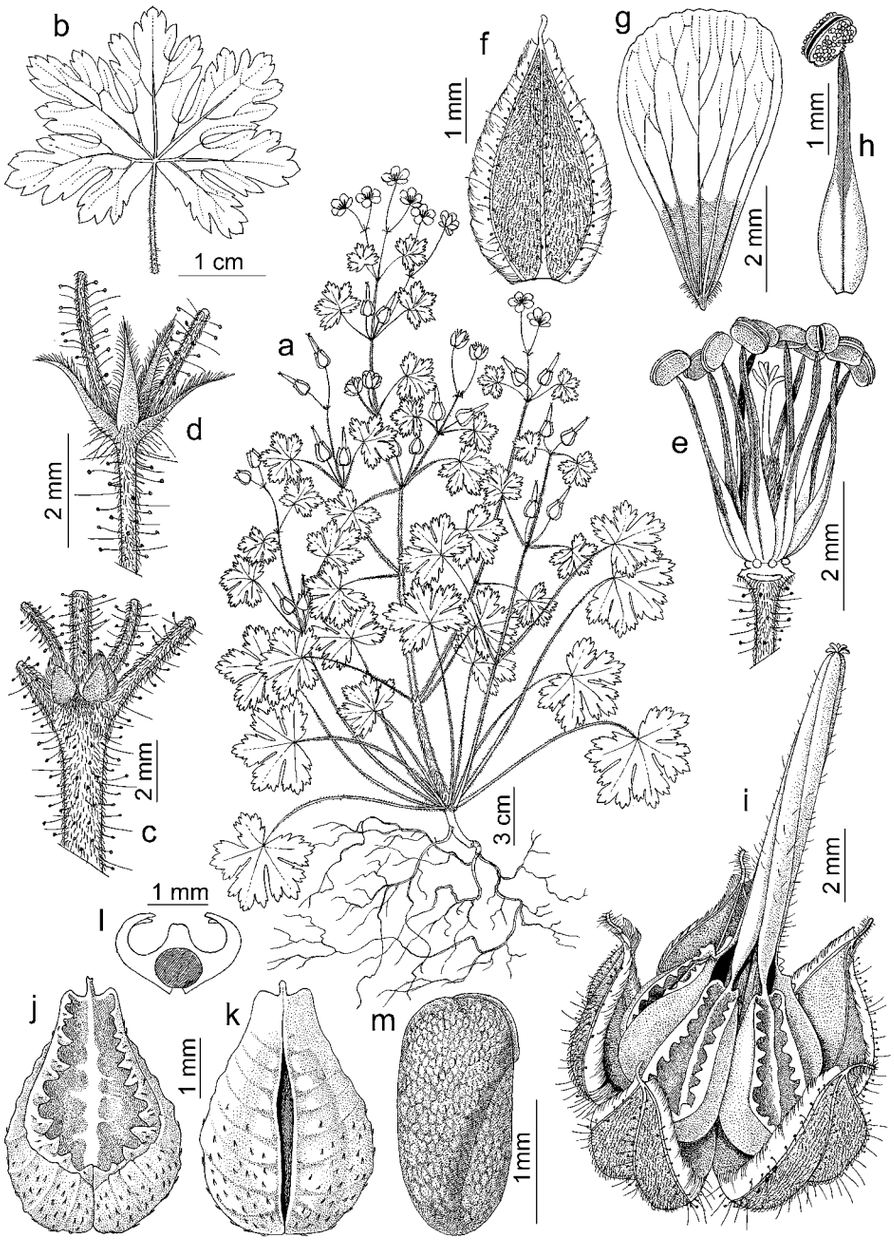


Fig. 718. *Geranium yemense* a. Habit. b. Leaf. c. Stipules. d. Bracteoles. e. Flower without petals and sepals. f. Sepal. g. Petal. h. Stamen. i. Fruit. j, k. Mericarps. l. Transverse section of a mericarp. m. Seed. (Base on: a, *Baldrati 659*, A; b-i, m, *Wood 73/67*, BM; j-l: *Fiori 1168*, FT).

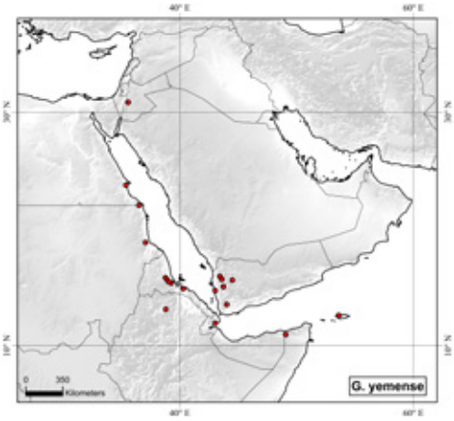


Fig. 719. Distribution of *Geranium yemense*.

4044 (BM, FT); Hamasen, Tilfil, 15º38'N, 38º56'E, 31 Mar. 1909, *Fiori 1168* (FT); Geleb, 15º49'N, 38º47'E, 11 Apr. 1891, *Schweinfurth 1318* (M). **Ethiopia.** Amhara: Wollo, Dschadscha, 13º7'N, 38º48'E, 4 Sep. 1854, *Schimper 2490* (S, RO). **Jordan.** Madaba: W Tafilah, S mare morto, 30º50'N, 35º35'E, 22 Mar. 1908, *Aaronson & Oppenheimer 5405* (HUJ). **Somalia.** Bari: Galgallo, 64 km SSW of Bosaso, at eastern end of Al Mado Range, 10º57'N, 49º4'E, 10 Jan. 1973, *Bally & Melville 15746* (MO, FT); W of Galgallo, 10º57'N, 49º4'E, 10 Jan. 1973, *Lavranos 10218* (E). **Sudan.** Red Sea: Red Sea Hills district, in vicinity of Erkowit, 18º50'N, 37º4'E, 3 Mar. 1932, *Aylmer 221* (BM); Ssoturba Gebirges an der Nubische Küste, jebel Shellal, 22º1'N, 36º31'E, 1865, *Schweinfurth 2397* (P, BM, G). **Yemen.** Azal: Jebel Shibam, Menackho, 15º3'N, 43º44'E, 2 June 1977, *Wood 1693* (BM); Asir, 15º37›N, 44º30›E, 1983, *Abulfatih 36* (BM). Janad: Djennati, 13º32'N, 44º1'E, 1837, *Botta s.n.* (P). Socotra**:** 16 km SE of Salansiyah, 12º36'N, 53º36'E, 24 Jan. 1994, *Thulin & Gifri 8713* (UPS). Tahama: Uossil, 14º43'N, 43º2'E, 5 Feb. 1889, *Schweinfurth 1129* (US); Westliches Randgebirge, W'Hänge des Passes 38 km W Alram an der Strasse nach Hajjah, 15º41'N, 43º36'E, 4 Oct. 1981, *Podlech 36356* (M); Mahabishah, 15º56'N, 43º26'E, 11 Mar. 1973, *Wood 73/67* (BM).

Discussion. Geranium yemense shares with *G. trilophum* a similar inflorescence structure, annual habit, indumentum, accrescent sepals, and petal color. However, in *G. yemense* the sepals, the petals, the fruits, and the seeds are shorter than in *G. trilophum*. Additionally, *G. yemense* has leaves with more lobes per segment, but with a substantial overlap. The mericarp of *G. yemense* has a small ridge which is covered by the trough-like structure, while *G. trilophum* has an evident ridge protruding beyond the trough-like structure. The species are separated by more than 1000 km. Knuth (1912) misapplied the name *G. yemense* to the plants here recognized as *G. biuncinatum*, as noted Kokwaro (1971a). Knuth (1912) used 'Valvulae apice unguibus duobus ornatae' to key out *G. yemense*; however this is an unequivocal feature of *G. biuncinatum*. Additionally, he included both specimens with horns and without horns in the material studied of *G. yemense* (i.e. *Deflers 296*, which is the type of *G. yemense*). At the same time Knuth (1912) included within *G. trilophum* specimens from Yemen and adjacent areas that should be considered to be *G. yemense*. Kokwaro (1971a), rightly separated specimens with horns on the mericarp as *G. biuncinatum*, but considered *G. yemense* to be a synonym of *G. trilophum*. Zohary (1972) recorded *G. trilophum* from Jordan (Moav and Edom regions). Considering that these areas are close to the area of *G. yemense* in Jordan, it seems feasible that such records should be attributed to *G. yemense*. Such is the case of the Egyptian specimen *Täckholm s.n.* (S) that Täckholm & Chrtek (1968: 140) considered as *G. trilophum,* and probably that of the remaining specimens cited by these authors.

Geranium omphalodeum was described by Lange (1866) from seeds of unknown origin cultivated at the Copenhagen Botanic Garden. Knuth (1912) included this name under the synonymy of *G. ocellatum*. Laundon (1961) suggested that *G. omphalodeum* is a synonym of *G. trilophum* while Kokwaro (1971a) did not address this problem. Yeo (2002a) tentatively accepted this taxon considering that its recognition might lead to its rediscovery in nature. The last author considered that *G. omphalodeum* can be distinguished from *G. trilophum* by its small mericarps and its deeply dissected leaves. It should be noted that Yeo did not differentiate *G. yemense* from *G. trilophum*, even though the mericarps of *G. yemense* are shorter than those of *G. trilophum*. The type of *G. omphalodeum* fits very well with *G. yemense*, although the leaves are a bit more deeply divided. Consequently, it has been included in the synonymy of *G. yemense*.

284. Geranium biuncinatum Kokwaro, Webbia 25(2): 639. 1971. Type locality: "Somali republic, Northern Region, Sugli Al Hills at 4700-6000 ft, 15 Nov. 1929, Collenette 289 (K!, holotype)... Eritrea: Hamasen: Ghinda, 23 Feb. 1916, Baldrati 2624 (FI!). Sudan: Erkowit Jabel Taatala, Andrews 3528 (K!). Yemen: Au-dessus de Menacha at 2300-2600 m, 23 Feb. 1889, Schweinfurth 1944 (BR!, K!, FI!, P!), K sheet pro parte". Type: Somalia. Northern Region, Sugli Al Hills, 10°58'N, 48°53'E, 15 Nov. 1929, *C.L. Collenette 289* (holotype, K-000417204!).

Annual herbs, 12-62 cm tall. *Stem* erect or ascending, leafy, with short retrorse, not appressed, eglandular hairs 0.2-0.3 mm long (sometimes also patent, eglandular hairs 1.2-1.9 mm long) and scattered, patent, glandular hairs 0.4-0.6 mm long. *Basal leaves* in a deciduous rosette, cauline leaves opposite; leaf laminas (2.6)4-4.5(5.8) cm long, 3-6.8 cm wide, not peltate, palmatifid [ratio main-sinus length/middle segment length = (0.68)0.72-0.77(0.78)], polygonal in outline, base cordate, not coriaceous, with nerves not projected, with ± appressed, eglandular hairs and plane eglandular hairs on the adaxial surface and ± appressed, eglandular hairs and scattered glandular hairs abaxially; segments 5, in 1 plane, middle segment rhombic, 6.2-10.9 mm wide at the base [ratio segment width at the base/middle segment length = (0.23)0.26-0.29(0.33)], (5)10-15(18)-lobed in distal half [ratio secondary sinus length/middle segment length = (0.16)0.22-0.26(0.30)]; petioles up to 12 cm long, without abscission zone, terete, not swollen, not deflexed in age, with retrorse, not appressed, eglandular hairs 0.2-0.3 mm long, sometimes also patent, eglandular hairs 1.1-1.5 mm long and, usually, patent, glandular hairs 0.4-0.7 mm long; stipules 1.4-3.1 mm long, 0.6-1.6 mm wide, lanceolate, free, papery, green, with eglandular hairs on abaxial surface and on the margin, glabrous adaxially. *Inflorescence* a monochasial cyme; cymules (1)2-flowered, solitary, sometimes grouped at nodes with short or no pedicels [ratio cymule length/leaf

length = 0.2-0.9(2)]; peduncles 10-27 mm long, with retrorse, not appressed, eglandular hairs 0.2-0.3 mm long, sometimes also patent, eglandular hairs 1-1.2 mm long and patent, glandular hairs 0.3-0.7 mm long; bracteoles 1.3-2.6 mm long, 0.5-0.9 mm wide, lanceolate, whorled; pedicels absent or 3-19 mm long, with retrorse, not appressed, eglandular hairs 0.2-0.3 mm long, sometimes also patent, eglandular hairs 1-1.2 mm long and, usually, patent, glandular hairs 0.3-0.6 mm long. Flowers actinomorphic. *Sepals* 4.6-5.1(6) mm long, 2.4-3.4 mm wide, broadly ovate, smooth, accrescent (6.2-7.9 mm long, 3.7-5.5 mm wide in fruit), nerves 3, mucro 0.5-0.9 mm long [ratio mucro length/sepal length = 0.10-0.17], with ± appressed, eglandular hairs 0.2-0.3 mm long, sometimes also patent, eglandular hairs 1-1.6 mm long and usually patent, glandular hairs 0.5-0.8 mm long on the abaxial surface, glabrous adaxially. *Petals* 7.5-9.3 mm long, 4.9-5.6 mm wide, erect-patent, rounded, without claw, purple with a dark basal spot, glabrous on both surfaces, ciliate on the basal margin, with hairs 0.1-0.2 mm long. *Stamens* 10, both whorls bearing anthers; filaments 2.1-3.6 mm long, lanceolate, black except the base, glabrous or with scattered cilia 0.1-0.2 mm long on the margin; anthers 0.8-1 mm long, yellow. Nectaries 5, hemispheric, glabrous. *Gynoecium* 2.7-3.9 mm long, dark purple. *Fruit* (15.7)17-19.5(20.3) mm long, erect, discharge of carpel-projection type, operative; mericarps (4.9)5.4-6.8(7.1) mm long, 2.5-3.4 mm wide, without a strand of fibers, not compressed at the apex, with two longitudinal toothed wings bent dorsally to form a trough-like structure, continued at the top into a hook 3.9-4.8 mm long on either side looking like a pair of horns, and with a small ridge in the middle, inside the trough-like structure, without basal beak, without a basal callus, without a basal prong, brown, with appressed, eglandular hairs 0.1-0.2 mm long; rostrum 9.5-12.3 mm long, without a narrowed apex, twisted distally, with antrorse, not appressed, eglandular hairs 0.1-0.3 mm long and usually a group of patent, eglandular hairs 0.8-1.1 mm long towards the apex; stigmatic remnants 0.2-0.4 mm long, with 5 glabrous lobes. *Seeds* 2-2.5 mm long, 0.9-1.1 mm wide, smooth, uniformly colored, brownish red, glabrous. Cotyledons with entire margin. Figs. 720, 721.

Pollen. *Erodium*-type (Aedo & al. 2016: 356).

Chromosome number. Unknown.

Phenology. Collected in flower from February to July.

Distribution. This species ranges from northeastern Oman, through

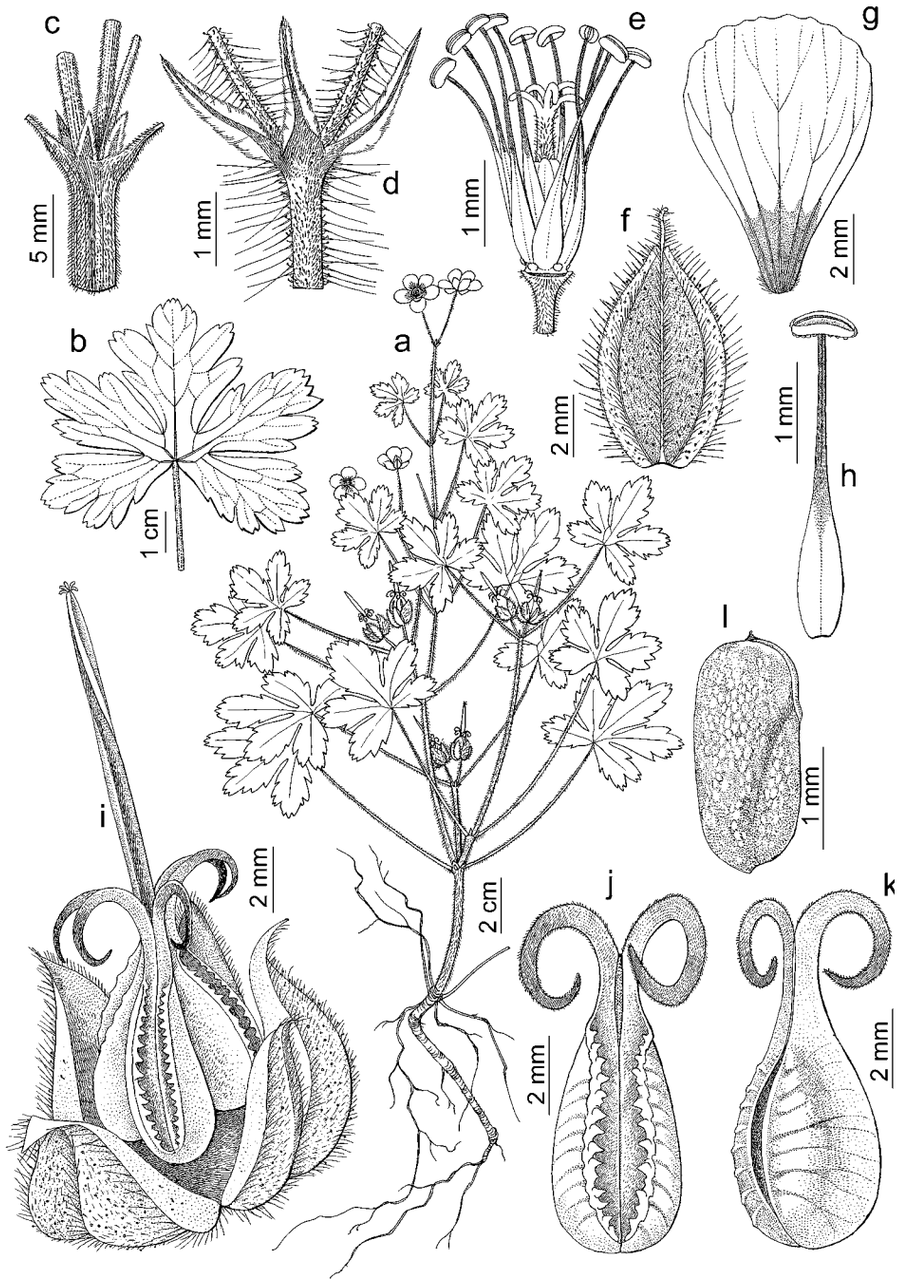


Fig. 720. *Geranium biuncinatum*. a. Habit. b. Leaf. c. Stipules. d. Bracteoles. e. Flower without petals and sepals. f. Sepal. g. Petal. h. Stamen. i. Fruit. j, k. Mericarps. l. Seed. (Based on: a-d, i-l, k, BM; e-h, *Spellenberg 7281*, NY).

Yemen and eastern Sudan, to Somalia and Eritrea (Fig. 722).

Habitat. Mountain slopes in evergreen bushland, open scrubs, shade of boulders, rocky ravines and coffee terraces; 200-2300 m.

Additional specimens examined. **Eritrea.** Northern Red Sea: Ghinda, 15°26'N, 39°5'E, 23 Feb. 1916, *Baldrati 2624* (FT). **Oman.** Dhofar: sopra Tawi Attayr, 17°7'N, 54°35'E, 25 Sep. 2001, *Raffaelli 489* (FT). Musandam: Musandam Peninsula, Birkat al-Khalidiyah, near Salalah, 26°2'N, 56°22'E, 28 Feb. 1979, *Mandeville 7348* (BM). **Sudan.** Red Sea: Tahasha, Erkowit, Jebel Taatala, 18°46'N, 37°6'E, *Andrews 3528* (K). **Yemen.** cultivated in the Botanical Garden, Helsinki, from seeds from Yemen, 22 Sep. 1984, *Alanko 49122* (H); Purkissa 3 kk kasvanut yksilö Englannissa yms. kasvatettu kanta, voi olla kleistokaaminen tai normaali, 15 May 1996, *Uronen 86-1* (H). Azal: Menacha, 15°4'N, 43°44'E, 23 Feb. 1889, *Schweinfurth 1944* (FT, P). Hadhramaut: Jebel Burá, between Hilla and Attuba [cultivated in the Real Jardín Botánico from seeds in 1986], 14°56'N, 45°51'E, 3 Apr. 2001, *Wood 3126* (MA); Jebel Burá, between Hilla and Attuba, 14°56'N, 45°51'E, 15 Feb. 1980, *Wood 3126* (BM). Janad: below Hasavan, Jebel Sabir, 13°30'N, 44°3'E, 12 Feb. 1977, *Wood 1540* (BM); Djennati, 13°32'N, 44°1'E, 1837, *Botta s.n.* (P); Ibb Governate, 2 mi W of Ibb, near Acama, SW slopes, 13°56'N, 44°10'E, 12 July 1983, *Spellenberg 7281* (NY). Socotra: Socotra, 12°30'N, 54°0'E, Aug. 1880, *Balfour 242* (LE).

Fig. 721. *Geranium biuncinatum* (Based on: *Wood 3126,* MA).

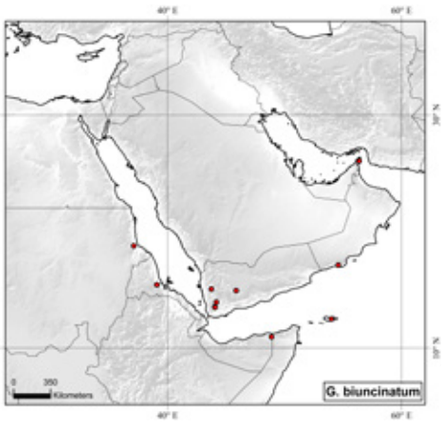


Fig. 722. Distribution of *Geranium biuncinatum*.

Discussion. Geranium biuncinatum is an annual with opposite leaves, more or less covered by eglandular and usually glandular hairs. It is easily identified by its purple petals with a dark basal spot, its accrescent and very wide sepals and its singular mericarps. Mericarps of *G. biuncinatum* have toothed wings continuing in a pair of recurved horns which is a unique condition in the genus. *Geranium trilophum* and *G. yemense* have similar mericarps but without horns. The indumentum of *G. biuncinatum* is composed of short, ± uncinate, eglandular hairs on stems, leaves and inflorescence, and sometimes glandular hairs also. In some specimens, long, patent hairs are mainly on the sepals and cymules. The sepals grow during mericarp maturation to cover the mericarps, except the horns. Sepals in fruit are very unequal, the two inner being smaller. The measurements in the descriptions correspond to the external sepals. *Geranium biuncinatum* shares with *G. trilophum* and *G. yemense* the previously mentioned sepal features. Sepals and petals of *G. biuncinatum* are intermediate in length between *G. trilophum* and *G. yemense*. Mericarps, excluding the horns, are longer than in *G. yemense* and similar to *G. trilophum*. Plants grown at Madrid Botanical Garden during spring of 2001 from seeds kindly provided by P. Yeo (*Woods 3126*), showed cleistogamous flowers (vouchers: MA-648734, MA-657456). Those flowers never opened but matured into fertile fruits. Knuth (1912) misapplied the name *G. yemense* to the plants here recognized as *G. biuncinatum* as was noted by Kokwaro (1971a) (see the discussion under *G. yemense*). Chrtek (1968) proposed the genus *Geraniopsis* to segregate the species with mericarps with two longitudinal toothed wings bent dorsally to form a trough-like structure. Yeo (1973a) concurs with Schönbeck-Temesy (1970) in considering *Geraniopsis* unjustified. *Geranium biuncinatum* has been reported from Saudi Arabia (Alfarhan & Thomas 2001). Unfortunately, I did not see the voucher for this record. Reports for Ethiopia (Kokwaro 1971a) probably refer to Eritrea (Gilbert & Voster 2000).

285. Geranium favosum Hochst. in G. W. Schimp., Iter Abyssinicum Sect. II n.º 806. 1842, in sched., cum descr. Type locality: "Schimperi iter Abyssinicum/Setio secunda/806. Geranium favosum Hochst./(pericarpium plicis dentato-flexuosis transversis quasi favosum)/U.i. 1842. prope Gafta Sept. 1838" [according to BM label]; "Geranium favosum Hochst., in pl. Schimp. Abyss., sect. II, n° 806... Crescit frequens in convalle fluvii Taccacé (Quartin Dillon); in provincia Ouodgerate (Ant. Petit), et prope Güendepta, in provincia Tigré (Schimper)" [cf. A. Rich., Tent. Fl. Abyss. 1: 117. 1847]. Type: Ethiopia. Tigré, prope Gafta, 11°50'N, 38°02'E, Sep. 1838, *G.W. Schimper 806* (lectotype, designated by Kokwaro 1971a: 645, P-00086010!; isolectotypes, BM!, BR-0000008367778 image!, FI!, G-00402156!, K-000417207!, MO!, S-09-13825 image!, TUB-001713 image!, W!).

Annual herbs, 12-50 cm tall. *Stem* erect or ascending, leafy, with short retrorse, not appressed, eglandular hairs 0.2-0.4 mm long (rarely also, patent, eglandular hairs 1.2-1.9 mm long) and, sometimes, scattered, patent, glandular hairs 0.4-0.7 mm long. *Basal leaves* in a deciduous rosette, cauline leaves alternate and upper opposite; leaf laminas (2)2.4-3.3(5.9) cm long, 2.2-6.3 cm wide, not peltate, deeply palmatifid [ratio main-sinus length/middle segment length = (0.80)0.86-0.89(0.90)], polygonal in outline, base cordate, not coriaceous, with nerves not projected, with ± appressed, eglandular hairs and plane eglandular hairs on the adaxial surface and ± appressed, eglandular hairs abaxially; segments 5, in 1 plane, middle segment rhombic, 2-3.6 mm wide at the base [ratio segment width at the base/middle segment length = (0.09)0.11-0.20(0.22)], (5)8-11(14)-lobed in distal half [ratio secondary sinus length/middle segment length = (0.25)0.27-0.33(0.34)]; petioles up to 10 cm long, without abscission zone, terete, not swollen, not deflexed in age, with short retrorse, not appressed, eglandular hairs 0.2-0.4 mm long, sometimes also, patent, eglandular hairs 1.1-1.8 mm long and, usually, patent, glandular hairs 0.2-0.5 mm long; stipules 1.9-5.1 mm long, 0.5-1.4 mm wide, lanceolate, free, papery, white, with eglandular hairs on abaxial surface and on the margin, glabrous adaxially. *Inflorescence* a monochasial cyme; cymules (1)2-flowered, solitary, sometimes grouped at nodes with short or no pedicels [ratio cymule length/leaf length = 0.3-3.2]; peduncles 4-31 mm long, with retrorse, not appressed, eglandular hairs 0.2-0.4 mm long, rarely patent, eglandular hairs 1.3-2.2 mm long and, usually, patent, glandular hairs 0.2-0.8 mm long; bracteoles 2.2-3.8 mm long, 0.3-0.5 mm wide, lanceolate, whorled; pedicels absent or 4-21 mm long, with retrorse, not appressed eglandular hairs 0.2-0.3 mm long, rarely patent, eglandular hairs 1.3-2.3 mm long and patent, glandular hairs 0.3-1 mm long. Flowers actinomorphic. *Sepals* (3)3.5-4.4(4.6) mm long, 1.2-2.3 mm wide, ovate, smooth, accrescent (4-6.5 mm long, 2.5-3.8 mm wide in fruit), nerves 3, mucro 0.4-1.2 mm long [ratio mucro length/sepal length = 0.13-0.32], with ± appressed, eglandular hairs 0.2-0.3 mm long, patent, eglandular hairs 1-2.5 mm long and patent, glandular hairs 0.4-0.8 mm long on the abaxial surface, glabrous adaxially. *Petals* (6.2)6.7-7.5(8.2) mm long, 2.6-5.6 mm wide, erect-patent, rounded, without claw, purple, without a basal spot, glabrous on both surfaces, ciliate on the basal margin, with hairs 0.1-0.2 mm long. *Stamens* 10, both whorls bearing anthers; filaments 2.2-3.3 mm long, lanceolate, black except the base, glabrous; anthers 0.7-0.9 mm long, yellow. Nectaries 5, hemispheric, glabrous. *Gynoecium* 2-3.1 mm long, dark purple. *Fruit* (10.4)11.5-13.2(18.4) mm long, erect, discharge of carpel-projection type, operative; mericarps (2)2.1-2.6(2.8) mm long, 1-1.7 mm wide, without a strand of fibers, not compressed at the apex, transversely wrinkled, with 4-5 prominent ribs, separated by furrows ca. 0.3 mm deep, 0.3-0.5 mm wide, without wings, without basal beak, without a basal callus, without a basal prong, brown to black, with appressed, eglandular hairs 0.1 mm long, mainly on the ribs; rostrum 7.5-14.2 mm long, without a narrowed apex, twisted distally, with erect-patent, eglandular hairs 0.1-0.3 mm long; stigmatic remnants 0.2-0.4 mm long, with 5 glabrous lobes. *Seeds* 1.6-2.1 mm long, 0.8-1 mm wide, smooth, uniformly colored, brownish red, glabrous. Cotyledons with entire margin. Fig. 723.

Pollen. *Erodium*-type (Aedo & al. 2016: 356).

Chromosome number. 2*n* = 50.

Phenology. Collected in flower from January to October.

Distribution. This species ranges from Sudan to Eritrea and Ethiopia (Fig. 724).

Habitat. Damp or swampy places, damp crevices, rocky slopes, small streams, open semi-evergreen bushlands and cultivated slopes with shrub vegetation; 1500-3250 m.

Additional specimens examined. **Eritrea.** Mai Ciaet, Aug. 1916, *Baldrati 2620* (FT). Anseba: Paese dei Bogos, Abita, Keren, sul Monte Deban, 15º46'N, 38º27'E, Aug. 1870, *Beccari 267* (FI). Northern Red Sea: Assaorta, Soyra Mts, monte Mamahot verso il torrente Arigot, 14º44'N, 39º30'E, 23 Aug. 1902, *Pappi 1237* (BM, MO); Amasen, alle Porte del Diavolo, 15º30'N, 39º11'E, 1 Jan. 1902, *Pappi 5023* (FT). Southern: Saraè, Gaza Gobó, 14º50'N, 38º30'E, 10 Oct. 1902, *Pappi 159* (FT). **Ethiopia.** Ouedjerale, *Quartin-Dillon & Petit s.n.* (W); Amogai, 19 Sep. 1862, *Schimper 250* (US); Abysinia, *Schimper s.n.* (P). Amhara: 10 km S Debre zeit, near Green Lake, 10º28'N, 37º48'E, 22 Mar. 1969, *Noréhn s.n.* (LD); Amhara-Dembià, valle Scintia sopra Asoso, 11º30'N, 38º30'E, 26 Aug. 1909, *Chiovenda 1659* (FT); Memsa, 12º2'N, 39º6'E, *Quartin-Dillon 18* (P); Amhara-Dembià, Gondar, 12º36'N, 37º28'E, 16 Aug. 1909, *Chiovenda 1412* (FT); Dschadscha, 13º7'N, 38º47'E, May 1867, *Schimper 147* (FI); Terr. Agow, pr. Dschadscha, 13º7'N, 38º47'E, 4 Sep. 1854, *Schimper 2253* (B, BM, LD, MA, P, RO, S, W); Begemder province, Semian mountains, valley going down to main valley between Geech and Ambaras, 13º13'N, 38º5'E, 20 Sep. 1969, *De Wilde 118* (MO). Oromia: Chiré, bords du Baccazzé, 8º12'N, 39º49'E, Aug. 1840, *Petit 124* (P); near bridge crossing Awash-River about 20 km S of Nazareth, 8º33'N, 39º16'E, 8 Sep. 1965, *De Wilde 7948* (M, MO); Oromiya, Hara lake, Debu Zeit, 8º46'N, 38º59'E, Aug. 1971, *Hovda s.n.* (UPS); foresta di Mamagania, 9º0'N, 39º0'E, 7 Oct. 1937, *Giordano 1678* (FT); torrente Doukan, 9º0'N, 39º0'E, 7 Sep. 1937, *Senni 1475* (FT); slopes of the Mugur valley, 30 mi N of Addis Ababa, 9º25'N, 38º48'E, 31 July 1934, *Sandford s.n.* (BM). Tigray: Tigre province, 17 km S of Maichew along the road to Dessie, 12º40'N, 39º32'E, 3 Sep. 1970, *De Wilde 6940* (LD, M, MO); Chamsinegja, 13º10'N, 39º20'E, 7 Aug. 1852, *Schimper 468* (P); Tigray, c. 12 km NW of Wukro along road to Hawzen, 13º50'N, 39º31'E, 24 Sep. 2001, *Friis & al. 10453* (C); Tigray, c. 20 km NW of Wukro along road to Hawzen, 13º51'N, 39º29'E, 25 Sep. 2001, *Friis & al. 10463* (C); Shiré, 14º7'N, 38º23'E, *Quartin-Dillon 124* (P); Addi Dschoa, 14º11'N, 38º59'E, 10 Oct. 1862, *Schimper s.n.* (BM). **Sudan.** Central Darfur: Jebel Marra Mts., about 120 km E

of Zalingei, 12º58'N, 24º13'E, 19 Jan. 1967, *De Wilde 5360* (BR, MO, P).

Discussion. Geranium favosum is an annual herb, erect or ascending, with basal leaves in a deciduous rosette and a monochasial inflorescence. The leaves of the distal part of the stem and inflorescence are opposite while those of the middle and base of the stem are alternate. As in the remaining species of the section, the indumentum of *G. favosum* is composed of short, ± uncinate, eglandular hairs on stems, leaves and inflorescence, and usually glandular, patent hairs. Long eglandular hairs also appear in many individuals. Cymules of *G. favosum* are usually 2-flowered, with well-developed peduncle and pedicels, but in some nodes umbel-like aggregates with short or absent pedicels appear. *Geranium favosum* is quite similar to *G. mascatense* in general appearance. Both species share alternate leaves on the middle and base of the stem and a mericarp with almost the same ornamentation. The mericarps are transversely wrinkled, with prominent ribs, separated by furrows ca. 0.3 mm deep, 0.3-0.5 mm wide, and usually with transverse ribs connecting the main ribs. In both species, small, appressed hairs occur mainly on the ribs. The mericarps of *G. favosum* are smaller than those of *G. mascatense* usually have fewer transverse ribs, but there is a significant overlap in these features. The mericarps of *G. brevipes* resemble those of *G. favosum* but have slightly prominent ribs and, consequently shallow furrows ca. 0.1 mm deep. Petals of *G. favosum* are consistently without a dark basal spot, while in *G. brevipes* and *G. mascatense* this spot has been observed in most individuals. In contrast, in all species of the section, including *G. favosum*, the staminal filaments are blackish except for the base and the stigma is dark purplish. The leaves of *G. favosum* are quite different from those of the remaining species of the section because they are deeply divided: the middle segment has a narrower base,

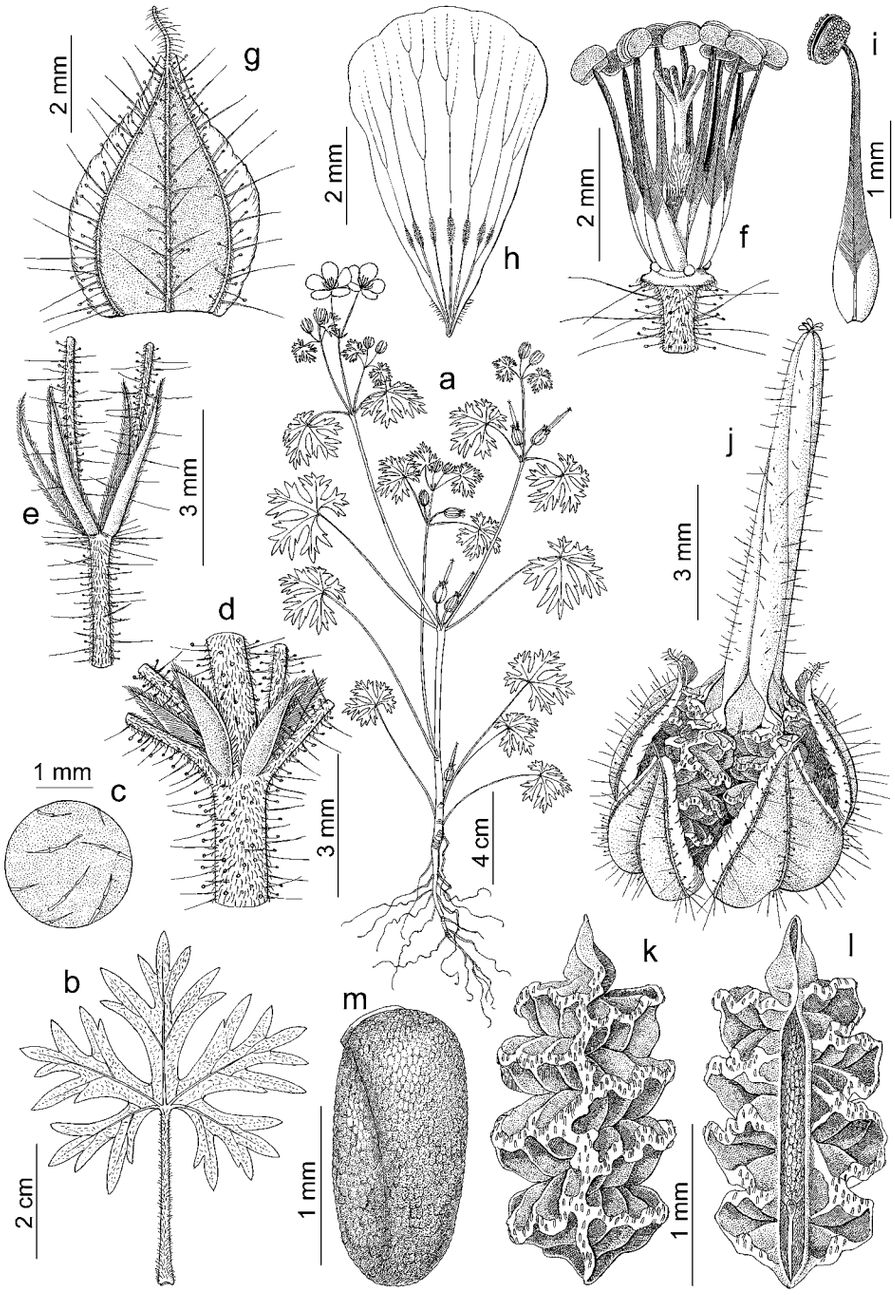


Fig. 723. *Geranium favosum*. a. Habit. b. Leaf. c. Detail of leaf indumentum. d. Stipules. e. Bracteoles. f. Flower without petals and sepals. g. Sepal. h. Petal. i. Stamen. j. Fruit. k, l. Mericarps. m. Seed. (Based on: a, d, e, h, j-l, *De Wilde 6940*, LD; b, c, f, g, i, *Schimper 2253*, B; m, *Pappi 5023*, FT).

Fig. 724. Distribution of *Geranium favosum*.

and the main sinus and the secondary sinus of the middle segment are deeper. Kokwaro (1971a) reported *G. favosum* from Djibouti on the basis of three specimens. Two of them (*Denis 184*, P; *De la Rue s.n.*, P) are *G. mascatense* while *Anla 90* (K) has not been examined. Thus, the presence of *G. favosum* in Djibouti should be confirmed.

286. Geranium mascatense Boiss., Diagn. Pl. Orient. ser. 1, 1: 59. 1843. Type locality: "Hab. in monte Gebel Akader regni Mascate. Aucher pl. exs. N° 4303". Type: Oman. Al Batinah, monte Gebel Akader, 23°10'N, 57°25'E, *P.M. Aucher-Éloy 4303* (lectotype, designated by Schönbeck-Temesy 1970: 34, G-BOIS-00330439!; isolectotypes, BM-000796382!, FI-006225!, K-000729279!) [two duplicates at P are *G. rotundifolium* L.].

Geranium mascatense var. *persicum* Pau in Pau & C. Vicioso, Trab. Mus. Nac. Ci. Nat., Ser. Bot. 14: 18. 1918. Type locality: "Habit. Gotvend". Type: Iran. Gotvend, río Karum, 32°14'N, 48°48'E, June 1899, *F. Martínez de la Escalera s.n.* (lectotype, designated by Aedo & al. 2016: 367, MA-71302!; isolectotypes, BM-000796381 image!, K!).

Annual herbs, 12-58 cm tall. *Stem* erect or ascending, leafy, with short retrorse, not appressed, eglandular hairs 0.2-0.6 mm long, patent, eglandular hairs 1.1-3 mm long and, usually, scattered, patent, glandular hairs 0.2-0.6 mm long. *Basal leaves* in a deciduous rosette, cauline leaves alternate and upper opposite; leaf laminas (2.2)2.5-5.2(6.5) cm long, 2.6-7.4 cm wide, not peltate, palmatifid [ratio main-sinus length/middle segment length = (0.63)0.66-0.74(0.81)], polygonal in outline, base cordate, not coriaceous, with nerves not projected, with ± appressed, eglandular hairs and plane eglandular hairs on the adaxial surface and ± appressed, eglandular hairs abaxially; segments 5, in 1 plane, middle segment rhombic, 4.7-13.4 mm wide at the base [ratio segment width at the base/middle segment length = (0.24)0.30-0.35(0.41)], (6)7-15(22)-lobed in distal half [ratio secondary sinus length/middle segment length = (0.13)0.18-0.24(0.29)]; petioles up to 14 cm long, without abscission zone, terete, not swollen, not deflexed in age, with short retrorse, not appressed, eglandular hairs 0.2-0.4 mm long, usually, patent, eglandular hairs 1.1-2.1 mm long and, usually, patent, glandular hairs 0.2-0.5 mm long; stipules 1.1-3 mm long, 0.4-1.3 mm wide, lanceolate, free, papery, green, with eglandular hairs on abaxial surface and on the margin, glabrous adaxially. *Inflorescence* a monochasial cyme; cymules (1)2-flowered, solitary, sometimes grouped at nodes with short or no pedicels [ratio cymule length/leaf length = 0.2-5.3]; peduncles 1-21 mm long, with retrorse, not appressed, eglandular hairs 0.2-0.5 mm long, rarely patent, eglandular hairs 1.3-1.5 mm long and, usually, patent, glandular hairs 0.2-0.6 mm long; bracteoles 1.2-2.7 mm long, 0.3-0.7 mm wide, lanceolate, whorled; pedicels absent or 4-21.3 mm long, with retrorse, not appressed eglandular hairs 0.2-0.7 mm long, rarely patent, eglandular hairs 1.4-2.2 mm long and, usually, patent, glandular hairs 0.3-0.7 mm long. Flowers actinomorphic. *Sepals* (3.4)3.5-4(4.1) mm long, 1.6-2.3 mm wide, ovate, smooth, accrescent (4.3-6 mm long, 1.9-5.4 mm wide in fruit), nerves 3, mucro 0.3-1.5 mm long [ratio mucro length/sepal length = 0.14-0.22], with ± appressed, eglandular hairs 0.2-0.3 mm long, patent, eglandular hairs 1.3-2.4 mm long and patent, glandular hairs 0.3-0.8 mm long on the abaxial surface, glabrous adaxially. *Petals* (4.4)6.3-7.5(8.9) mm long, 1.8-5.6 mm wide, erect-patent, rounded, without claw, purple, usually with a dark basal spot, glabrous on both surfaces, ciliate on the basal margin, with hairs 0.1-0.2 mm long. *Stamens* 10, both whorls bearing anthers; filaments 2.4-3.8 mm long, lanceolate, black except the base, glabrous; anthers 0.8-1.2 mm long, purple. Nectaries 5, hemispheric, glabrous. *Gynoecium* 2.6-4.3 mm long, dark purple. *Fruit* (9.3)11.8-14(14.6) mm long, erect, discharge of carpel-projection type, operative; mericarps (2.5)2.7-3.5 mm long, 1.1-1.8 mm wide, without a strand of fibers, not compressed at the apex, transversely wrinkled, with 4-6 prominent ribs, separated by furrows ca. 0.3 mm deep, 0.3-0.5 mm wide, without wings, without basal beak, without a basal callus, without a basal prong, brown or grey, with appressed, eglandular hairs 0.1 mm long, mainly on the ribs; rostrum 5.8-10.7 mm long, without a narrowed apex, twisted distally, with erect-patent, eglandular hairs 0.1-0.4 mm long; stigmatic remnants 0.2-0.6 mm long, with 5 glabrous lobes. *Seeds* 1.8-2.6 mm long, 0.8-1.4 mm wide, smooth, uniformly colored, brownish red, glabrous. Cotyledons with entire margin. Figs. 725, 726.

Pollen. *Erodium*-type (Aedo & al. 2016: 356).

Chromosome number. Unknown.

Phenology. Collected in flower from January to September.

Distribution. This species ranges from Israel, Iran, Oman and Yemen to Egypt, Sudan, Djibouti, Eritrea and Somalia (Fig. 727).

Habitat. Shaded areas, rocky slopes with large boulders, cliff and shady banks, forest edges and cultivated fields; 50-2000 m.

Additional specimens examined. **Djibouti.** Obock: cote française des Somalis, monts Mabla, piste de Obock à Sismo, 11°56'N, 43°2'E, 18 Feb. 1938, *Aubert de la Rüe s.n.* (P). Tadjourah: cote française des Somalis, Day, 11°46'N, 42°39'E, 27 Feb. 1956, *Chedeville 1483* (P); Daï, 11°46'N, 42°39'E, 17 Feb. 1956, *Denis 184* (P). **Egypt.** Red Sea: Gebel Elba, SE corner of Egypt, Wadi Kansisrob, 23°45'N, 35°24'E, 23 Jan. 1929, *Täckholm s.n.* (S). **Eritrea.** Central: Nefasit, 15°19'N, 39°0'E, 7 Mar. 1916, *Baldrati 658* (FT); Hamasen, colle Lessa, 15°20'N, 39°2'E, 20 Jan. 1909, *Fiori 1165* (FI). Northern Red Sea: Assaorta, Sorgenti di Masciabo, 15°12'N, 39°19'E, 20 Mar. 1893, *Pappi 3190* (FT). **Iran.** Fars: 10-15 km NE of Kazerun, 29°37'N, 51°39'E, 26 Mar. 1974, *Davis & Bokhari 55858* (MO). Hormozgan: insula Qeshm, 26°46'N, 55°48'E, 21 Feb. 1893, *Bornmüller 146* (W);

Kermán, in vicinitate pagi Isin, montium Kuhháye Genú, 27º19'N, 56º17'E, 12 May 1973, *Sokák 4689* (PR). Ilam: 20 km E of Qir, 32º41'N, 47º19'E, 2 Apr. 1974, *Davis & Bokhari 56335* (MO). Kerman: Garmsir pr. Bandar Abbas, 28º19'N, 56º33'E, 1937, *Gabriel 120* (W); Dar Guan, 29º36'N, 57º22'E, 1937, *Gabriel 85* (W). Sistan and Balochistan: Baluchistan, Tis, pr. Chahrbahar, 25º21'N, 60º37'E, *Gauba 747* (W); Baluchestan, in vicinitate vici Tis, 25º31'N, 60º37'E, 6 Apr. 1973, *Sokák 1380* (PR); Baluchestan, pr. viam Níkshshr-Espakeh, 16 km SE a Tang-e Sarhe, 26º29'N, 60º2'E, 10 Apr. 1973, *Sokák 1616* (PR). **Israel.** Jerusalem: Hulda, 31º49'N, 34º52'E, 2016, *Beitelman s.n.* (HUJ). **Oman.** Ad Dakhiliyah: Wadi al Ma'aqil, 23º3'N, 57º42'E, 16 Mar. 1972, *Mandeville 3478* (BM); Muscat: Jabal al-Aswad, summit, 23º10'N, 58º37'E, 23 Apr. 1975, *Mandeville 6783* (BM). Al Batinah North: vicinity of an-Nid, 23º13'N, 57º19'E, 8 Apr. 1975, *Mandeville 6344* (BM, OBG). Ash Sharqiyah North: Jabal Bani Jabir, Salma plateau, around 7th Hole, 22º51'N, 59º7'E, 20 Feb. 2013, *Patzelt & al. 4343* (OBG). Dhofar: Khadrafi, Sarfait area, 16º42'N, 53º10'E, 26 Sep. 1976, *Mandeville 6946* (BM); Dhofar, Jabal Qara, near the track between Raysut and Qaftawt, 17º3'N, 53º54'E, 3 Oct. 1998, *Hein 5208* (B); Dhofar, Jabal Qara, Salalah to Thamrait Rd., 1 km S of raven's Roots, 17º3'N, 53º54'E, 8 Sep. 1985, *Miller 7540* (OBG); Dhofar, strada Salalah-Mirbat Bivio sulla sinistra per Tawi Attayr Dai Baobad all'al-

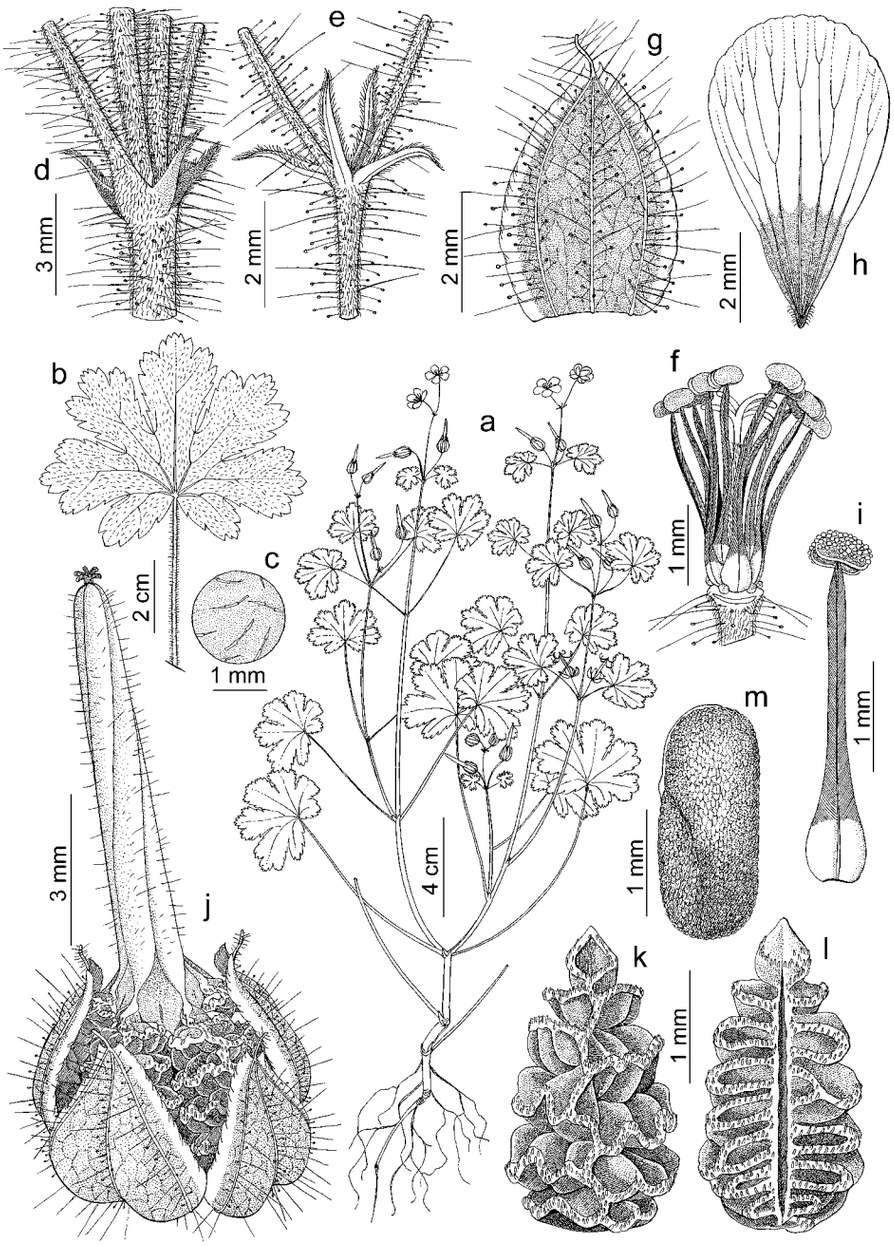


Fig. 725. *Geranium mascatense*. a. Habit. b. Leaf. c. Detail of leaf indumentum. d. Stipules. e. Bracteoles. f. Flower without petals and sepals. g. Sepal. h. Petal. i. Stamen. j. Fruit. k, l. Mericarps. m. Seed. (Based on: a-c, g, h, j-m, *Kilian & al. 772*, B; d-f, i, *Baldrati 658*, FT).

Fig. 726. *Geranium mascatense* (Based on: *Gallagher 6398/12,* MA).

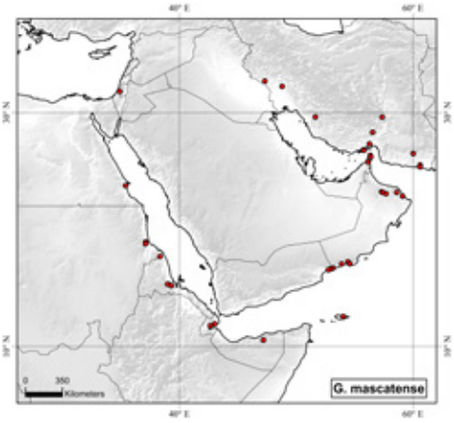


Fig. 727. Distribution of *Geranium mascatense*.

tiplano di Tawi Attayr, 17º4'N, 54º36'E, 6 Sep. 2002, *Raffaelli & al. 459* (FT); Dhofar, altiplano di Jibjat, 17º14'N, 54º26'E, 27 Sep. 2001, *Raffaelli & al. 697* (FT). Musandam: El Khorram, 25º45'N, 56º10'E, Feb. 1952, *Lee-Oldfield 121* (BM); al-Maksar isthmus, 26º12'N, 56º24'E, 24 Feb. 1979, *Mandeville 7165* (BM); Goat Is. [cultivated at MA, from seeds colected in 1982], 26º21'N, 56º21'E, 3 Apr. 2001, *Gallagher 6398/12* (MA). **Somalia.** Sanaag: Darra as, 10º33'N, 47º12'E, 2 Feb. 1895, *Phillips s.n.* (K). **Sudan.** Red Sea: Has Has, Karora hills, 17º42'N, 38º21'E, Feb. 1923, *Crowfoot s.n.* (K); Kassala province, Erkowit, 18º46'N, 37º6'E, 1928, *Maffey 9* (K); Hor Tamanib, near Suakin, 18º56'N, 37º7'E, 27 Feb. 1869, *Lord s.n.* (K). **Yemen.** Hadhramaut: Al-Mahra gov., Hawf Mts, pr. Shah'rut, 16º33'N, 52º46'E, 3 Oct. 2001, *Kilian & al. 772* (B, C); Al-Mahra gov., Hawf Mts, Uteq, 16º38'N, 52º57'E, 29 Sep. 2001, *Hein & al. 473* (C, B); Al-Mahra gov., Hawf Mts, Uteq, 16º38'N, 52º57'E, 29 Sep. 2001, *Hein & al. 494* (B, C); Al-Mahra gov., Hawf Mts, NE of Uteq, 16º38'N, 52º57'E, 28 Sep. 2001, *Kilian & al. 417* (B); Al-Mahra gov., Hawf Mts, Uteq, 16º38'N, 52º57'E, 29 Sep. 2001, *Kilian & al. 511* (B). Socotra: Socotra, Jibal Hagher S of Hadibu, former road between Hadibu and Dimele Pass, 12º34'N, 54º1'E, 16 Jan. 1994, *Beyhl & al. 368* (B, M).

Discussion. Geranium mascatense is quite similar to *G. favosum* in general appearance. Both species share a similar mericarp and alternate leaves on the base of the stem. *Geranium mascatense*, however, can be easily distinguished by its less divided leaves and its petals which usually have a basal spot. *Geranium mascatense* has been sometimes confused with *G. brevipes*, a partially sympatric species. Both share leaves of similar appearance and petals with a basal dark spot. *Geranium mascatense* is recognized by its distinctive mericarps with strongly prominent ribs and, consequently, deep furrows (usually ca. 0.3 mm deep). According to Schönbeck-Temesy (1970: 34) *G. mascatense* frequently produces cleistogamous flowers. Knuth (1912) included *G. mascatense* under *G. ocellatum*. In contrast, *G. mascatense* has been widely accepted in the regional literature as a distinct species (Alfarhan & Thomas 2001; Gilbert & Voster 2000; Kokwaro 1971a; Laundon 1961; Schönbeck-Temesy 1970). Nasir (1983) recorded *G. mascatense* from southern Pakistan and Alfarhan & Thomas (2001) from southwestern Saudi Arabia. Unfortunately I did not see vouchers for these reports.

287. Geranium ocellatum Cambess. in Jacquem., Voy. Inde 4: 33, Tab. 38. 1841. Type locality: "Rarius in nemoribus propè pagum Sera in Pentapotamide. Floret Aprili... collegit Victor Jacquemont". Type: India. Jammu & Kashmir, Pentapotamide, pagum Sera, 33°38'N, 73°58'E, 26-27 Apr. 1831, *V. Jacquemont s.n.* (lectotype, designated by Kokwaro 1971a: 643, P!; isolectotypes, K!, MPU!).

Geranium ocellatum var. *himalaicum* R. Knuth in Engl., Pflanzenr. IV.129 (Heft 53): 62. 1912. *Geranium mascatense* var. *himalaicum* (R. Knuth) Babu ex Raizada, Suppl. Duthie's Fl. Upper Gangetic Plain 4: 36. 1976. Type locality: "Himalaya, oft in die Ebene hinabsteigend: Von Kaschmir und der Salt Range bis Nepal, so in Garwhal (Falconer n. 321!), im Nordwest-Himalaya 330-2000 m (Thomson in Herb. Ind. or. Hooker f. et Thomson!), ohne Standort (Griffith n. 940-941!), bei Simla (Herb. Schlagintweit n. 5008!). Hügel des Pendjab. Behar, auf dem Gipfel des Parusnath (Andersson nach Hooker). Munipur (Watt n. 6313!)". Type: India. Manipur, Khongui valley, 24°48'N, 93°56'E, *G. Watt 6313* (lectotype, designated by Aedo & al. 2016: 369, P!; isolectotypes, E!, K!).

Geranium ocellatum var. *yunnanense* R. Knuth in Engl., Pflanzenr. IV.129 (Heft 53): 62. 1912. *Geranium mascatense* var. *yunnanense* (R. Knuth) Raizada, Suppl. Duthie's Fl. Upper Gangetic Plain 4: 36. 1976. *Geranium tapintzense* C.C. Huang, Notes Roy. Bot. Gard. Edinburgh 42(2): 326. 1985. Type locality: "Yunnan: Auf Feldern bei Tapin-tze (Delavay a. 1883-1885, n. 2491!)". Type: China. Yunnan, bei Tapin-tze, 25°34'N, 100°14'E, 1883-1885, *P.J. Delavay 2491* (holotype, B destroyed; isotypes, BM!, E!, G-00402159!, MPU!, P!) (the sheet from P has an original handwritten label by Delavay with no number (only "Delavay 1") and dated 8 March 1883; the sheets at BM and E have a typewritten label with the number 2491 and the date 26 Feb. 1883 added by hand, which suggest a mistake in the labeling transcription, otherwise they seems to be isotypes).

Geranium kweichowense C.C. Huang, Notes Roy. Bot. Gard. Edinburgh 42(2): 325. 1985. Type locality: "CHINA: Kweichow province, Lo-fou, iii 1909, fleur rouge, J. Cavalerie 3615 (holo. E), and 3619 (E)". Type: China. Guizhou, Kweichow province, Lo-fou, 27°00'N, 107°00'E, Mar. 1909, *J. Cavalerie 3615* (holotype, E-00216575 image!; isotypes, K!, P!) [According to Yeo 1992: 203, the specimen cited by Huang as *Cavalerie 3619* is actually numbered *3615*].

Geranium indicum Hurrah & V. Wagh, Nordic J. Bot. 2021: 2, 3 fig. 2, 4 fig. 3, 6 fig. 5. 2021. Type locality: "India, Himachal Pradesh, Solan, Kumarhatii, Kasauli, on the way to monkey top, 30°53'05.09"N, 76°58'30.98"E, 1927 m a.s.l., 10 Oct 2017, Imtiyaz A. Hurrah 311045 A (holotype LWG) and 311045 B (isotype LWG)". Type: India. Himachal Pradesh, Solan, Kumarhatii, Kasauli, 30°53'05.09"N, 76°58'30.98"E, 10 Oct. 2017, *I.A. Hurrah s.n.* (holotype, LWG-311045A; isotype, LWG-311045B).

Geranium ocellatum var. *albiflorum* Hurrah, Bagri & V. Wagh, Phytotaxa 530(3): 272, 273 fig. 2. 2022. Type locality: "India, Uttarakhand, Garhwal, Tehri, Kandi Bagriyonki, 15 April 2020, 30º12'47.87'´N, 78º34'58.66"E, 1608 m, Ajendra Singh Bagri & Ankit Singh, 320297 (holotype LWG! isotype LWG!)". Type: India. Uttarakhand, Garhwal, Tehri, Kandi Bagriyonki, 30º12'47"N, 78º34'56"E, 15 Apr. 2020, *A.S. Bagri & A. Singh s.n.* (holotype, LWG; isotype, LWG).

Annual herbs, 9-43 cm tall. *Stem* erect or ascending, leafy, with short retrorse, not appressed, eglandular hairs 0.1-0.4 mm long, patent, eglandular hairs 1.4-2.9 mm long and, usually, scattered, patent, glandular hairs 0.2-0.4 mm long. *Basal leaves* in a ± persistent rosette, cauline leaves opposite (rarely alternate in middle of shoot, 1-2 nodes); leaf laminas (1.4)2.1-3.2(6.7) cm long, 1.9-7.4 cm wide, not peltate, palmatifid [ratio main-sinus length/middle segment length = (0.63)0.73-0.77(0.84)], polygonal in outline, base cordate, not coriaceous, with nerves not projected, with ± appressed, eglandular hairs (rarely with plane eglandular hairs) on the adaxial surface and ± appressed, eglandular hairs abaxially; segments 5, in 1 plane, middle segment rhombic, 3-11.6 mm wide at the base [ratio segment width at the base/ middle segment length = (0.17)0.22-

0.29(0.34)], (3)7-16(19)-lobed in distal half [ratio secondary sinus length/ middle segment length = (0.15)0.21-0.24(0.26)]; petioles up to 16 cm long, without abscission zone, terete, not swollen, not deflexed in age, with retrorse, not appressed, eglandular hairs 0.1-0.5 mm long, patent, eglandular hairs 1.2-2.7 mm long and, usually, patent, glandular hairs 0.2-0.4 mm long; stipules 2-7.6 mm long, 0.4-1.6 mm wide, lanceolate, free, papery, brownish red, with eglandular hairs on abaxial surface and on the margin, usually glabrous adaxially. *Inflorescence* a monochasial cyme; cymules (1)2-flowered, solitary, sometimes grouped at nodes with short or no pedicels [ratio cymule length/leaf length = 1.1-4.5]; peduncles 10-94 mm long, with retrorse, not appressed, eglandular hairs 0.1-0.3 mm long, sometimes patent, eglandular hairs 1-1.4 mm long and patent, glandular hairs 0.3-0.6 mm long; bracteoles 2.2-4.2 mm long, 0.3-1 mm wide, lanceolate, whorled; pedicels absent or 5-23 mm long, with retrorse, not appressed, eglandular hairs 0.1-0.4 mm long and patent, glandular hairs 0.3-0.5 mm long. Flowers actinomorphic. *Sepals* (3.4)4-4.5(4.9) mm long, 1.6-3 mm wide, ovate, smooth, not accrescent, nerves 3, mucro 0.2-0.7 mm long [ratio mucro length/sepal length = 0.05-0.22], with ± appressed, eglandular hairs 0.1-0.4 mm long, sometimes also patent, eglandular hairs 1.1-2.1 mm long and, usually, patent, glandular hairs 0.3-0.5 mm long on the abaxial surface, glabrous adaxially. *Petals* (3.1)6.8-7.4(8.5) mm long, 1.7-7.7 mm wide, erect-patent, rounded, without claw, purple with a dark basal spot, glabrous on both surfaces, ciliate on the basal margin, with hairs 0.1-0.4 mm long. *Stamens* 10, both whorls bearing anthers; filaments 2-3.3 mm long, lanceolate, black except the base, glabrous; anthers 0.6-1.3 mm long, dark purple. Nectaries 5, hemispheric, glabrous. *Gynoecium* 2.4-3.7 mm long, dark purple. *Fruit* (10.4)12.7-13.9(17.5) mm long, erect, discharge of carpel-projection type, operative; mericarps (1.7)2-2.3(2.8) mm long, 0.8-1.4 mm wide, without a strand of fibers, not compressed at the apex, transversely wrinkled, with 8-14 slightly prominent ribs, separated 0.2-0.3 mm, without wings, without basal beak, without a basal callus, without a basal prong, grey, brown or glaucous, glabrous; rostrum 7.5-13.8 mm long, without a narrowed apex, twisted distally, with erect-patent, eglandular hairs 0.1-0.3 mm long; stigmatic remnants 0.2-0.6 mm long, with 5 glabrous lobes. *Seeds* 1.3-2.2 mm long, 0.8-1.1 mm wide, smooth, uniformly colored, brownish red, glabrous. Cotyledons with entire margin. Fig. 728.

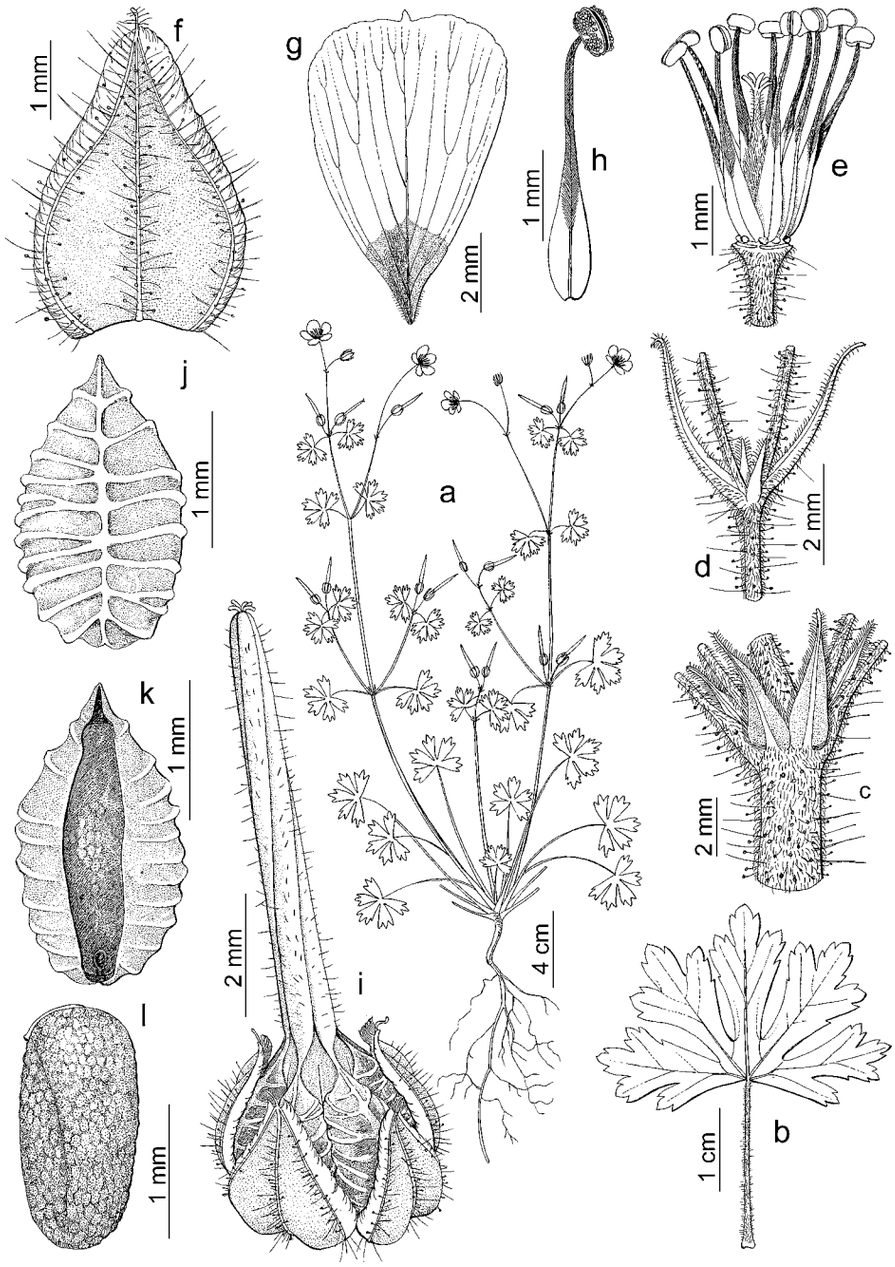


Fig. 728. *Geranium ocellatum*. a. Habit. b. Leaf. c. Stipules. d. Bracteoles. e. Flower without petals and sepals. f. Sepal. g. Petal. h. Stamen. i. Fruit. j, k. Mericarps. l. Seed. (Based on: a-d, f, g, i, *Fleming 356*, C; e, h, l, *Kingdon Ward 10308*, BM; j, k, *Chaudhuri s.n.*, *July 1936*, GH).

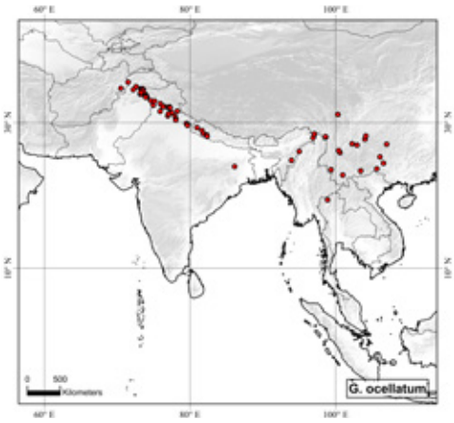


Fig. 729. Distribution of *Geranium ocellatum*.

Pollen. *Erodium*-type (Aedo & al. 2016: 356).

Chromosome number. Unknown.

Phenology. Collected in flower from February to December.

Distribution. This species ranges from Afghanistan, through Pakistan, China, India and Nepal to Thailand (Fig. 729).

Habitat. Meadows, grassy and rocky banks, edge of forests, cultivated fields, and roadsides; 600-3000 m.

Representative specimens examined. **Afghanistan.** Laghman: Nuristan, Gusalak, 34°40'N, 70°30'E, 30 Apr. 1948, *Edelberg 2120a* (C). Nuristan: Netshingel, 35°30'N, 71°30'E, 15 July 1949, *Edelberg 1699* (C). **China.** Guangxi: Kwangsi prov., Loh Hoh Tsuen, Ling Yün Hsien, 24°24'N, 106°34'E, 18 Mar. 1933, *Steward & Cheo 33* (P, GH, NY, S, W). Guizhou: Wangmo co., roadside 1-2 km S of Bi Jiao San, 25°16'N, 106°5'E, 18 Mar. 1996, *Tsi & al. 110* (K). Sichuan: Pai Kuo Wan to Mo So Ying, 27°4'N, 102°15'E, 1 Apr. 1914, *Schneider 652* (P, G). Xizang: Rima, 28°25'N, 97°4'E, 27 Mar. 1950, *Kingdon Ward 19251* (BM). Yunnan: Szemao, 22°47'N, 100°58'E, *Henry 12882* (MO, US); Kiao Kia, Kao Chan Se, 26°53'N, 102°56'E, 28 Feb. 1909, *Ducloux & Tén 1098* (E); Mo Tsou, 26°53'N, 102°56'E, 1906, *Maire s.n.* (E); Gongshan Drungzu Nuzu Zizhixian, Binzhougluo Xiang, Shuangla, E side of Gaoligong Shan road from Beyendjing, 28°8'N, 104°8'E, 1 Mar. 1916, *Tén 380* (P, W); infra vicum Hsinlung trans flumen Pudu-ho ad N urbis Yünnafu, pr. vicum Dadji, 31°5'N, 100°18'E, 9 Mar. 1914, *Handel-Mazzetti 480* (WU, W). **India.** Arunachal Pradesh: Assam frontier, Lohit Valley, from Minzong to Walong, 27°53'N, 96°54'E, 21 Apr. 1933, *Kingdon Ward 10308* (E, GH). Himachal Pradesh: Punjab, pr. Kasauli, ad montes Suvalicos, 30°53'N, 76°57'E, 3 Apr. 1885, *Drummond 3117* (P); Punjab,15th mile Dalhousia road, 32°33'N, 75°56'E, 14 Feb. 1917, *Stewart 1165* (MO, S). Jammu-Kashmir: cultivated at MA from seeds from Udhampur, Jammu, 32°55'N, 75°8'E, 18 Oct. 2001, *Aedo 6719* (MA, W); Punjab, Mt. Tilla, 32°58'N, 74°37'E, 5 Jan. 1917, *Stewart 785* (MO). Jharkhand: Perisnalt, Behar, 23°57'N, 86°7'E, 21 Dec. 1877, *Watt 61* (E); Chutia Nagpur, Perisnalt, 23°57'N, 86°7'E, *Watt 8251* (E). Nagaland: Naga Hills, gorge of the Tizu river, S of Saramati, near Runa, in the Lohit valley and Mushmi Hills, 26°0'N, 95°0'E, 15 Mar. 1935, *Kingdon Ward 11297* (E). Punjab: Hoshiarpur district, 31°31'N, 75°54'E, July 1936, *Chaudhuri s.n.* (GH). Uttaranchal: Almora, 29°35'N, 79°39'E, 15 Apr. 1948, *Koelz 20001* (NY); NW Himalaya, distr. Jaunsar, Mandáli, 30°49'N, 77°56'E, 12 May 1893, *Duthie 12969* (MPU). **Nepal.** Karnali: Lawamjula, 28°18'N, 82°16'E, 29 Mar. 1952, *Polunin & al. 676* (BM, E, GH); Jum Khola, 28°27'N, 81°50'E, 13 Apr. 1974, *Dobremez 2480* (BM); bei Pokhara, 28°53'N, 81°38'E, 7 Mar. 1974, *Schwabe s.n.* (B). Lumbini: Balle, NW of Bijauri, 28°6'N, 82°20'E, 26 Mar. 1952, *Polunin & al. 3688* (BM, E, GH). Sudurpashchim: Doti-Siligarhi, 29°16'N, 80°58'E, 1 Apr. 1967, *Ecker-Racz 32* (US). **Pakistan.** Azad Jammu and Kashmir: Nakal beyond Kotli, 33°26'N, 73°54'E, 20 Apr. 1954, *Stewart 27409* (W); Bhatta valley, 34°29'N, 73°34'E, Mar. 1915, *Anderson s.n.* (E). Khyber Pakhtunkhwa: Ghora Gali, Murree Hills, 33°52'N, 73°20'E, 30 Apr. 1978, *Stewart s.n.* (MO); above Kohala, Murree Rd., 33°52'N, 73°11'E, 13 Apr. 1954, *Stewart s.n.* (GH); Abbottabad, 34°9'N, 73°13'E, Apr. 1934, *Stewart 14113c* (NY); Swat, Mingora, 34°28'N, 72°13'E, 12 Apr. 1954, *Ali 25993* (BM); Swat, inter Khawazakhiela et Shangla, 34°53'N, 72°36'E, 2 June 1965, *Rechinger 30625* (M). Punjab: Marara, 32°21'N, 74°56'E, *Jacquemont 574* (K, P). **Thailand.** Chiang Mai: NW slope of Doi Chiang Dao, 19°23'N, 98°53'E, 1 Dec. 1984, *Koyama & al. 39750* (GH); Doi Chiengdao, 19°23'N, 98°53'E, 21 Dec. 1931, *Put 4463* (C, GH, P).

Discussion. Geranium ocellatum is an annual herb, erect or ascending, with basal leaves in a ± persistent rosette, usually opposite on the stem, and a monochasial inflorescence. It is easily identified by its purple petals with a dark basal spot and its glabrous mericarps, transversely wrinkled with 8-14 ribs. The ribs are slightly prominent, usually parallel, sometimes forked, and separated by a shallow sinus 0.2-0.3 mm wide. There are no transverse veins or ribs connecting the main ribs. The indumentum of *G. ocellatum* is composed of short, ± uncinate, eglandular hairs on stems, leaves and inflorescence, and usually glandular, patent hairs. Long eglandular hairs also appear in many individuals. Cymules of *G. ocellatum* are usually 2-flowered, with well-developed peduncles and pedicels, but in some nodes umbel-like aggregates with short or absent pedicels appear. Knuth (1912: 62) had a broad concept of *G. ocellatum* that included plants from the Himalayas, Arabian Peninsula and Africa. His opinion was shared by Laundon (1961: 68) and Kokwaro (1971a: 643). In contrast, Gilbert & Voster (2000: 367) and Yeo (2002a: 165) indicated that there may be differences between the plants from the Himalayas and those from Arabia and Africa. I followed the criteria of the latter authors and separated the plants from Arabia and Africa as a different species, under the name *G. brevipes*. Mericarps of *G. brevipes* have appressed, eglandular hairs 0.1 mm long, mainly on the ribs. Additionally, the ribs are fewer (usually 4-6), separated by wider sinuses (0.3-0.4 mm wide) and connected by veins or small ribs. The two species are allopatric and their ranges are separated by some 3,000 km. According to Yeo (2002a: 165) *G. ocellatum* frequently produces cleistogamous flowers. These cleistogamic forms have been recently described as *G. indicum* (Hurrah & al. 2021).

288. Geranium brevipes Hutch. & Dalziel, Fl. W. Trop. Afr. 1: 138. 1927, nom. nov. *Geranium favosum* var. *sublaevis* Oliv., Fl. Trop. Afr. 1(1): 292. 1868. *Geranium mascatense* var. *sublaevis* (Oliv.) Urb., Jahrb. Königl. Bot. Gart. Berlin 3: 241. 1884. *Geranium ocellatum* var. *sublaevis* (Oliv.) Milne-

Redh., Kew Bull. 1948: 453. 1948. Type locality: Type: Cameroon. Cameroons mountain, 4°9'N, 9°14'E, Dec. 1861, *G. Mann 1261* (lectotype, designated by Laundon 1961: 69, K-000094362!).

Geranium ocellatum var. *africanum* R. Knuth in Engl., Pflanzenr. IV.129 (Heft 53): 62. 1912. *Geranium mascatense* var. *africanum* (R. Knuth) Raizada, Suppl. Duthie's Fl. Upper Gangetic Plain 4: 36. 1976. Type locality: Type: Tanzania. Kilimandscharo, Marangu, 3°17'S, 37°31'E, June 1893, *G.L. Volkens 421* (lectotype, designated by Aedo & al. 2016: 372, BM-000796973!; isolectotype, K!).

Geranium ocellatum var. *camerunense* R. Knuth in Engl., Pflanzenr. IV.129 (Heft 53): 63. 1912. *Geranium mascatense* var. *camerunense* (R. Knuth) Raizada, Suppl. Duthie's Fl. Upper Gangetic Plain 4: 36. 1976. Type locality: Type: Cameroon. Buea, 4°09'N, 9°14'E, 1891, *P. Preuss 983* (lectotype, designated by Aedo & al. 2016: 373, HBG-517298 image!; isolectotype, BM!).

Annual herbs, 16-62 cm tall. *Stem* erect or ascending, leafy, without vegetative stems, with short retrorse, not appressed, eglandular hairs 0.1-0.4 mm long, usually, patent, eglandular hairs 1.4-2.8 mm long and, usually, scattered, patent, glandular hairs 0.3-0.9 mm long. *Basal leaves* in a deciduous rosette, cauline leaves opposite (sometimes alternate in middle of shoot, 1-2 nodes); leaf laminas (1.4)2.7-4.6(6.2) cm long, 1.7-7.9 cm wide, not peltate, palmatifid [ratio main-sinus length/middle segment length = (0.63)0.66-0.74(0.80)], polygonal in outline, base cordate, not coriaceous, with nerves not projected, with ± appressed, eglandular hairs and plane eglandular hairs on the adaxial surface and ± appressed, eglandular hairs abaxially; segments 5, in 1 plane, middle segment rhombic, 2.7-14.9 mm wide at the base [ratio segment width at the base/middle segment length = (0.20)0.28-0.34(0.42)], (7)10-15(20)-lobed in distal half [ratio secondary sinus length/middle segment length = (0.16)0.19-0.24(0.30)]; petioles up to 16 cm long, without abscission zone, terete, not swollen, not deflexed in age, with retrorse, not appressed, eglandular hairs 0.1-0.4 mm long, usually patent, eglandular hairs 1.1-2.5 mm long and, usually, patent, glandular hairs 0.3-0.8 mm long; stipules 1.8-4.3 mm long, 0.6-1.6 mm wide, lanceolate, free, papery, green, with eglandular hairs on abaxial surface and on the margin, glabrous adaxially. *Inflorescence* a monochasial cyme; cymules (1)2-flowered, solitary, sometimes grouped at nodes with short or no pedicels [ratio cymule length/leaf length = 0.1-5.3]; peduncles 5.9-32 mm long, with retrorse, not appressed, eglandular hairs 0.1-0.3 mm long, sometimes patent, eglandular hairs 1-2.1 mm long and, usually, patent, glandular hairs 0.2-0.9 mm long; bracteoles 1.7-4.4 mm long, 0.4-0.8 mm wide, lanceolate, whorled; pedicels absent or 3.3-18 mm long, with retrorse, not appressed, eglandular hairs 0.1-0.3 mm long, sometimes patent, eglandular hairs 1-2.1 mm long and patent, glandular hairs 0.3-1 mm long. Flowers actinomorphic. *Sepals* 3.5-4.2(4.9) mm long, 1.4-2.2 mm wide, ovate, smooth, slightly accrescent (4.4-5.7 mm long, 2-3.7 mm wide in fruit), nerves 3, mucro 0.4-1.2 mm long [ratio mucro length/sepal length = 0.13-0.29], with ± appressed, eglandular hairs 0.2-0.3 mm long, sometimes also patent, eglandular hairs 1.4-2.9 mm long and patent, glandular hairs 0.3-0.9 mm long on the abaxial surface, glabrous adaxially. *Petals* (5.8)6.3-7.1(8.8) mm long, 2.5-5.1 mm wide, erect-patent, rounded, without claw, purple, usually with a dark basal spot, glabrous on both surfaces, ciliate on the basal margin, with hairs 0.1-0.2 mm long. *Stamens* 10, both whorls bearing anthers; filaments 2.5-3.8 mm long, lanceolate, black except the base, glabrous; anthers 0.8-1.1 mm long, dark purple. Nectaries 5, hemispheric, glabrous. *Gynoecium* 2.5-3.8 mm long, dark purple. *Fruit* (10.4)12-14.2(14.5) mm long, erect, discharge of carpel-projection type, operative; mericarps (2)2.2-2.8(3) mm long, 1.1-1.6 mm wide, without a strand of fibers, not compressed at the apex, transversely wrinkled, with 4-6 slightly prominent ribs, separated 0.3-0.4 mm, without wings, without basal beak, without a basal callus, without a basal prong, brown or glaucous, with appressed, eglandular hairs 0.1 mm long, mainly on the ribs; rostrum 7.5-10.8 mm long, without a narrowed apex, twisted distally, with erect-patent, eglandular hairs 0.1-0.3 mm long; stigmatic remnants 0.2-0.5 mm long, with 5 glabrous lobes. *Seeds* 1.4-2.4 mm long, 0.8-1.3 mm wide, smooth, uniformly colored, brownish red, glabrous. Cotyledons with entire margin. Fig. 730.

Pollen. *Erodium*-type (Aedo & al. 2016: 356).

Chromosome number. 2*n* = 56.

Phenology. Collected in flower from January to December.

Distribution. This species ranges from southwestern Saudia Arabia and Yemen, through Djibouti and Cameroon to Angola and Zimbabwe (Fig. 731).

Habitat. Shaded areas, grassy slopes, meadows, slopes of ravines with scattered boulders and bushes, rock ledges, open bushlands, forest edges, walls and cultivated fields; 1200-3000 m.

Additional specimens examined. **Angola.** Huila: 10 mi NW of Sa da Bandeira, on road to Turnevala, 14º55'S, 13º30'E, 20 Apr. 1968, *Kers 3298* (S). **Cameroon.** Cameroon Mt., Masake Camp, 3 Dec. 1930, *Maitland 811* (B). Adamawa: Tchabal Mbabo, Hama Aoudi, 7º16'N, 12º9'E, 3 Nov. 1967, *Jacques-Felix 9035* (BR, P). North: Poli, du col de Béré au Vokré, 8º29'N, 13º15'E, 3 Oct. 1967, *Félix 8485* (P). Northwest: Bamenda, near Ndu, mile 82 from Bamenda, 6º24'N, 10º46'E, 5 Jan. 1951, *Keay & Russell 28437* (P). Southwest: Cameroon Mt., Buea, 4º8'N, 9º14'E, Dec. 1924, *[illegible] 811* (K). **Djibouti.** Tadjourah: Day, 11º46'N, 42º39'E, May 1964, *Chedeville 2582* (FT). **Eritrea.** Anseba: Bassopiano orientale Faghenà, 15º34'N, 38º52'E, 21 Apr. 1948, *Nastasi 28* (FT); Mensa, Mt. Ira, 15º41'N, 38º44'E, 9 Feb. 1893, *Terracciano & Pappi 1420* (FT); Gheleb, Amba, 15º49'N, 38º44'E, 16 Apr. 1891, *Schweinfurth 1351* (M). Central: 10 km S of Nefasit, 15º15'N, 39º2'E, 2 Feb. 1969, *De Wilde 4499* (MO). Southern: Ocule Cusai, Addi Cajè, 14º50'N, 39º22'E, 14 Sep. 1902, *Pappi 1895* (FT).

Ethiopia. Amhara: Wofasha, near Debra Sina, Shoa, 9°44'N, 39°48'E, 27 Apr. 1959, *Mooney 7857* (FT); Tossa mountain, 1 km W of Desse, 11°7'N, 39°37'E, 11 May 1969, *Sutherland 242* (MO). Oromia: Mega, 4°3'N, 38°18'E, 13 Sep. 1939, *Corradi 7262* (FT); 8 km SW of Shashamane, 7°12'N, 38°36'E, 20 Oct. 1965, *De Wilde 8318* (B, C, H, P); Harar, 15 km NW of Harar College area, golf course, NE of lake Alemaya, 9°24'N, 42°1'E, 14 Sep. 1961, *Burger 931* (C, FT). Somali: Harar, 124 km E of Awash station on mountain road to Dire Dawa via Meisso, Checher mountains, 9°30'N, 41°3'E, 30 Aug. 1974, *Ash 2553* (MO). **Kenya.** Laikipia: Nanyuki, 0°1'N, 37°4'E, *Ashby s.n.* (BM). Nandi: Tinderet Farm, 0°4'S, 35°21'E, July 1936, *Davoli 21* (FT). Nakuru: près d'Eburru, 0°35'S, 36°14'E, Aug. 1929, *Humbert 9059* (P); S side of lake Naivasha, 0°48'S, 36°17'E, 12 July 1909, *Mearns 706* (BM, NY). Taita–Taveta: in Dabida hills, 3°24'S, 38°17'E, 1907, *Skene 123* (G). Trans-Nzoia: Kitale, 1°0'N, 35°0'E, 13 July 1950, *Wiltshire 26* (FT). **Malawi.** Central: Kantorongonda and Kasungu mts, Nyika, NW lake Nyassa, 13°2'S, 33°28'E, Oct. 1893, *Craswshay s.n.* (BM); Dedza district, Chincherere Hills, N of Dedza, 14°17'S, 34°15'E, 3 Apr. 1990, *Goldblatt 9088* (MO). Northern: Chitipa district, Misuku Hills, Mughesse rain forest, 9°40'S, 33°33'E, 6 July 1973, *Pawek 7044* (MO). **Mozambique.** Manica: Manika e Sofala, Chimanimani mountains, plateau above Mevumoze, 19°52'S, 33°6'E, 17 Apr. 1960, *Goodier 994* (BM). **Saudi Arabia.** Asir: Dalaghan National Park, 30 km SE Abha, 18°3'N, 42°44'E, 1 Mar. 1981, *Hillcoat 66* (BM); Al Mahmoud, 35 km N of Abha, 10 km below Jabal Al-Sooda, 18°12'N, 42°30'E, 21 May 1980, *Boulos 14137* (BM); Al Sawdah, 18°16'N, 42°22'E, 5 Apr. 1979, *Nasher 10P* (BM); Al Taif, Al-Shafa, 21°6'N, 40°19'E, 12 Apr. 1986, *Fayed 1272* (M); Sawdah, Shaaf, 22°46'N, 39°29'E, 10 Mar. 1968, *Mosnier 3910* (P). **Somalia.** Bari: W of Galgallo, 10°57'N, 49°4'E, 10 Jan. 1973, *Lavranos 10218* (E). Sanaag: Meid [Mayhd], Serrut Gebirge, 10°48'N, 47°19'E, Apr. 1875, *Hildebrandt 1379* (BM). **South Sudan.** Eastern Equatoria: Imatong Mountains, between Gilo and Icibol, 4°1'N, 32°51'E, 11 Nov. 1980, *Friis & Vollsesen 156* (C). **Sudan.** Central Darfur: Darfur, Nyuringya, on W side of Marra Mts., 12°58'N, 24°13'E, 5 Jan. 1934, *Dandy 131* (BM); Kassala province, Gedain, Red Sea Hills, 16°27'N, 36°53'E, 12 Apr. 1953, *Jackson 2938* (B). **Tanzania.** Arusha: Arumeru district, Uwanja wa Mbogo, 3°15'S, 36°45'E, 16 Aug. 1997, *Mkeya 887* (MO). Iringa: Mufindi, valle del Fuaghi, 8°36'S, 35°17'E, 15 Jan. 1933, *Balbo 468* (FT); Mufindi, 8°36'S, 35°17'E, 29 Apr. 1969, *Paget-Wilkes 497* (MO). Ruvuma: Songea district, Matengo Hills, 10.5 km N

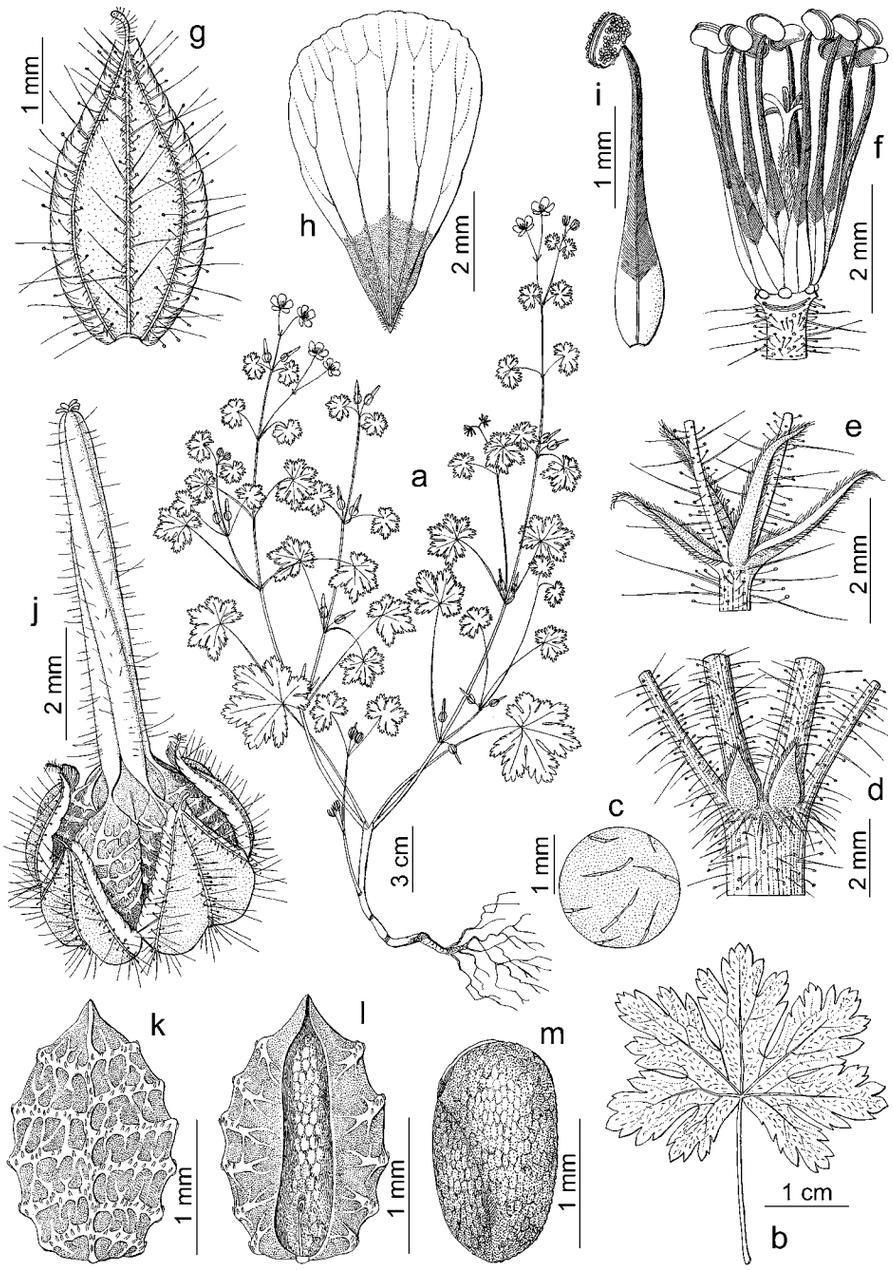


Fig. 730. *Geranium brevipes*. a. Habit. b. Leaf. c. Detail of leaf indumentum. d. Stipules. e. Bracteoles. f. Flower without petals and sepals. g. Sepal. h. Petal. i. Stamen. j. Fruit. k, l. Mericarps. m. Seed. (Based on: a-i, m, *Matzen s.n., 3 Aug. 1963*, C; j-l, *Schweinfurth 1351*, M).

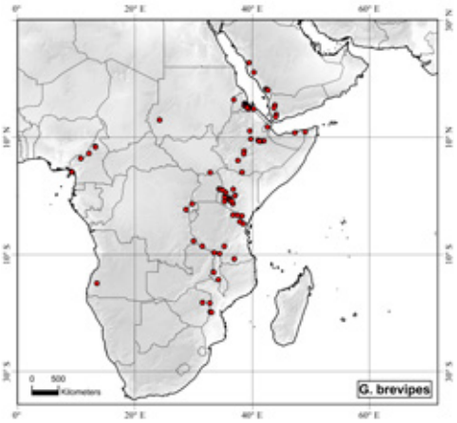


Fig. 731. Distribution of *Geranium brevipes*.

of Miyau, 10º45'S, 36º58'E, 22 May 1956, *Milne-Redhead & Taylor 10408* (B). Tanga: Usambara, bei Kuroi, 4º45'S, 38º30'E, 20 Aug. 1909, *Brunnthaler 290* (WU). **Uganda.** Eastern: Butandiga, Mt. Elyon, 1º12'N, 34º22'E, 20 Oct. 1916, *Snowden 425* (BM). Western: Kigezi district, Mabungo to lake Chahafi, 1º21'S, 29º47'E, 12 Jan. 1933, *Rogers 349* (BR). **Yemen.** Azal: cultivated in the Real Jardín Botánico from seeds from Yemen, Shibam, 15º3'N, 43º44'E, 25 May 2001, *Miller & Long 3372* (MA); between Shibam and Kawkaban, 15º30'N, 43º54'E, 1 June 1977, *Wood 1671* (BM). Janad: Taizz, at foot of Jebel Sabir, 13º30'N, 44º3'E, 11 Dec. 1937, *Scott & Britton 310* (BM); Djennati, 13º32'N, 44º1'E, 1837, *Botta s.n.* (P); Jibla, 13º55'N, 44º8'E, 10 Dec. 1972, *Wood 141* (BM). **Zaire.** South Kivu: Kalonge, 2º19'S, 28º43'E, July 1932, *Hauman 164bis* (BR); Tanganyika: Marungu-Sampwe, 7º42'S, 30º0'E, Apr. 1944, *Dobois 1053* (BR). **Zimbabwe.** Manicaland: Nyanga, NE point Hill Fort Rhodes, 18º17'S, 32º47'E, 19 Apr. 1953, *Chase 4910* (BM, MO); Melsetter, Skyline road, 19º48'S, 32º52'E, 20 Sep. 1960, *Phipps 2843* (BM). Mashonaland East: Marandella, 18º12'S, 31º33'E, 26 Feb. 1943, *Dehn 749* (M).

Discussion. Geranium brevipes is quite similar to *G. ocellatum* in general appearance. Both species are annual herbs, with cauline, usually opposite leaves, and they share a monochasial inflorescence and purple petals with a dark basal spot. However, *G. brevipes* can be easily distinguished by its mericarps which have short and appressed hairs (glabrous in *G. ocellatum*), and fewer ribs (see more details under *G. ocellatum*). Additionally, *G. brevipes* is more robust and has longer leaves, accrescent sepals with longer mucro and longer mericarps and seeds than *G. ocellatum*. The leaves of *G. brevipes* are usually shallowly divided. However, three collections appear with deeply divided leaves: *Chapman 1239* (NY) from Malawi, *Dandy 131* (BM) from Sudan, and *Gilli 261* from Tanzania. Otherwise, they fall well within the range of variability of *G. brevipes*. According to Kers (1971) *G. brevipes* (sub *G. ocellatum*) frequently shows cleistogamous flowers. *Geranium brevipes* occurs from Yemen and Saudi Arabia to Zimbabwe, through the highlands of East Africa. It is also present on the plateaus of Angola and in the Cameroon mountains. Since Knuth (1912), it has been considered that these plants should be included in *G. ocellatum*, a Himalayan species, sometimes at varietal rank. However, the indumentum and ornamentation of the mericarp are consistent in plants from Arabian Peninsula and Africa, but are not found in the Himalayan individuals. Consequently, this endemic form deserves specific status, for which two specific epithets were available, *G. brevipes* being the oldest.

IVd. Geranium sect. **Polyantha** Reiche in Engl. & Prantl, Nat. Pflanzenfam. 3(4): 8. 1890. Type: *Geranium polyanthes* Edgew. & Hook. f. (art. 10.8).

Geranium sect. *Strigosa* C.C. Huang & L.R. Xu, Fl. Reipubl. Pop. Sin. 43(1): 47. 1998. Type: *Geranium strictipes* R. Knuth (designated by Xu & al. 1998: 47).

Perennial herbs. *Flowers* actinomorphic. *Petals* usually rounded, without claw. *Pollen* of *Erodium*-type. *Fruit* of carpel-projection type, operative; mericarps reticulate; rostrum not twisted. *Cotyledons* with entire margins.

Geranium hispidissimum, *G. strictipes*, and *G. wardii* share an inflorescence with a dichasial structure and opposite leaves. In contrast, the group comprising *G. polyanthes, G. umbelliforme,* and *G. moupinense* has a monochasial inflorescence and alternate leaves (at least in the middle of the shoot). *Geranium nakaoanum* is somewhat intermediate, having a monochasial inflorescence but leaves usually opposite. This species is also the only one in the section showing some other features, e.g., usually 1-flowered cymules, scarce indumentum, and staminal filament shape.

289. Geranium hispidissimum (Franch.) R. Knuth in Engl., Pflanzenr. IV. 129 (Heft 53): 183. 1912. *Geranium strigosum* var. *hispidissimum* Franch., Pl. Delavay.: 113. 1889. Type locality: "Yun-nan, ad collum montis Hee-chan-men; 15 jul. 1887 (Delavay)". Type: China. Yunnan, ad collum montis Hee-chan-men, 26º06'N, 99º57'E, 15 July 1887, *P.J. Delavay s.n.* (lectotype, designated by Yeo 1992: 199, P-00712092!; isolectotype, B destroyed, K-000380191!, LE).

Geranium strigosum var. *platylobum* Franch., Pl. Delavay.: 113. 1889. *Geranium platylobum* (Franch.) R. Knuth in Engl., Pflanzenr. IV. 129 (Heft 53): 183. 1912. Type locality: "In silvis montis Che-tcho-tze, supra Tapin-tze. alt. 2000 m.; 6 aug. 1887 (Delavay, n. 2756)". Type: China. Yunnan, montis Che-tcho-tze, supra Tapin-tze, 25º34'N, 100º14'E, 6 Aug. 1887, *P.J. Delavay 2756* (lectotype, designated by Kunth 1912: 183, P-00712095!; isolectotype, K-000380192!).

Perennial herbs, 16-72 cm tall. *Rootstock* 6-16 mm in diameter, ± vertical, not tuberculate, not turnip-shaped, without thickened roots. *Stem* erect or ascending, leafy, not rooting at nodes, stolons absent, without vegetative stems, with uncinate, eglandular hairs 0.1-0.3 mm long, patent, eglandular hairs 0.5-3.3 mm long (sometimes lacking) and patent, glandular hairs 0.3-3.5 mm long. *Basal leaves* in a ± persistent rosette, cauline leaves opposite; leaf laminas (2.4)3.5-4.4(5.3) cm long, 3.2-8.4 cm wide, not peltate, palmatifid [ratio main-sinus length/middle segment length = (0.55)0.68-0.77(0.81)], polygonal in outline, base cordate, not coriaceous, with nerves not projected, with ± appressed, eglandular hairs and plane glandular hairs on both surfaces; segments 5, in 1 plane, middle segment obtriangular, 4.8-11.7 mm wide at the base [ratio segment width at the base/middle segment length = (0.23)0.27-0.38(0.48)], 9-16-lobed in distal half [ratio secondary sinus length/middle segment length = (0.14)0.16-0.24(0.28)]; petioles up to 15 cm long, without abscission zone, terete, not swollen, not deflexed in age, with uncinate, eglandular hairs 0.1-0.3 mm long, patent, eglandular hairs

0.4-3.1 mm long (sometimes lacking) and patent, glandular hairs 0.4-3.2 mm long; stipules 3.9-13.2 mm long, 0.9-3.1 mm wide, lanceolate, free, herbaceous, green, with scattered, eglandular hairs on abaxial surface and on the margin, glabrous adaxially. *Inflorescence* a dichasial cyme with monochasial branches; cymules 2-flowered, solitary [ratio cymule length/leaf length = 1.1-3.9]; peduncles (11)69-129(145) mm long, with uncinate eglandular hairs 0.1-0.3 mm long, patent, eglandular hairs 0.5-3.2 mm long (sometimes lacking) and patent, glandular hairs 1.2-2.4 mm long; bracteoles 4.5-6.6 mm long, 0.5-1.1 mm wide, lanceolate, whorled; pedicels (8.1)0.3-22(31.8) mm long, with uncinate, retrorse eglandular hairs 0.1-0.3 mm long, patent, eglandular hairs 0.2-2.2 mm long (sometimes lacking) and patent, glandular hairs 0.6-2 mm long. Flowers actinomorphic. *Sepals* (4.9)5.2-6.4(7.3) mm long, 2.1-3 mm wide, lanceolate, smooth, not accrescent, nerves 3, mucro 0.8-2.4 mm long [ratio mucro length/sepal length = 0.17-0.35], with ± patent, eglandular hairs 0.1-0.5 mm long and patent, glandular hairs 1-3.4 mm long on the abaxial surface, glabrous adaxially. *Petals* (8.6)9-9.8(10.6) mm long, 3.9-7.3 mm wide, erect-patent, rounded, without claw, white to purple, hairy on the base of the adaxial surface, usually glabrous on the abaxial surface, ciliate on the basal margin, with hairs 0.4-0.6 mm long. *Stamens* 10, both whorls bearing anthers; filaments 3.8-5.1 mm long, lanceolate, white, pilose on the abaxial surface, ciliate on the proximal half, with hairs 0.2-0.9 mm long; anthers 1.2-1.7 mm long, unknown color. Nectaries 5, hemispheric, with a tuft of hairs at the top, dorsally glabrous. *Gynoecium* 3.1-5.9 mm long, pink. *Fruit* 23-28 mm long, erect, discharge of carpel-projection type, operative; mericarps 3.7-4.7 mm long, 1.2-1.8 mm wide, without a strand of fibers, not compressed at the apex, reticulate, without basal beak, without a basal callus, without a basal prong, brown, with ± appressed, eglandular hairs 0.1-0.2 mm long; rostrum 16-20 mm long, without a narrowed apex or with a narrowed apex 0.5-1 mm long, not twisted, with patent, eglandular hairs 0.1-0.2 mm long and patent, scattered, glandular hairs 0.1-0.7 mm long; stigmatic remnants 1.5-2.4 mm long, with 5 glabrous lobes. *Seeds* 2.2-3.3 mm long, 1-1.5 mm wide, smooth, uniformly colored, brown, glabrous. Cotyledons not studied. Fig. 732.

Pollen. *Erodium*-type (Aedo 2016: 615).

Chromosome number. Unknown.

Phenology. Collected in flower from May to November.

Distribution. This species ranges from Sichuan to Yunnan, in southern China (Fig. 733).

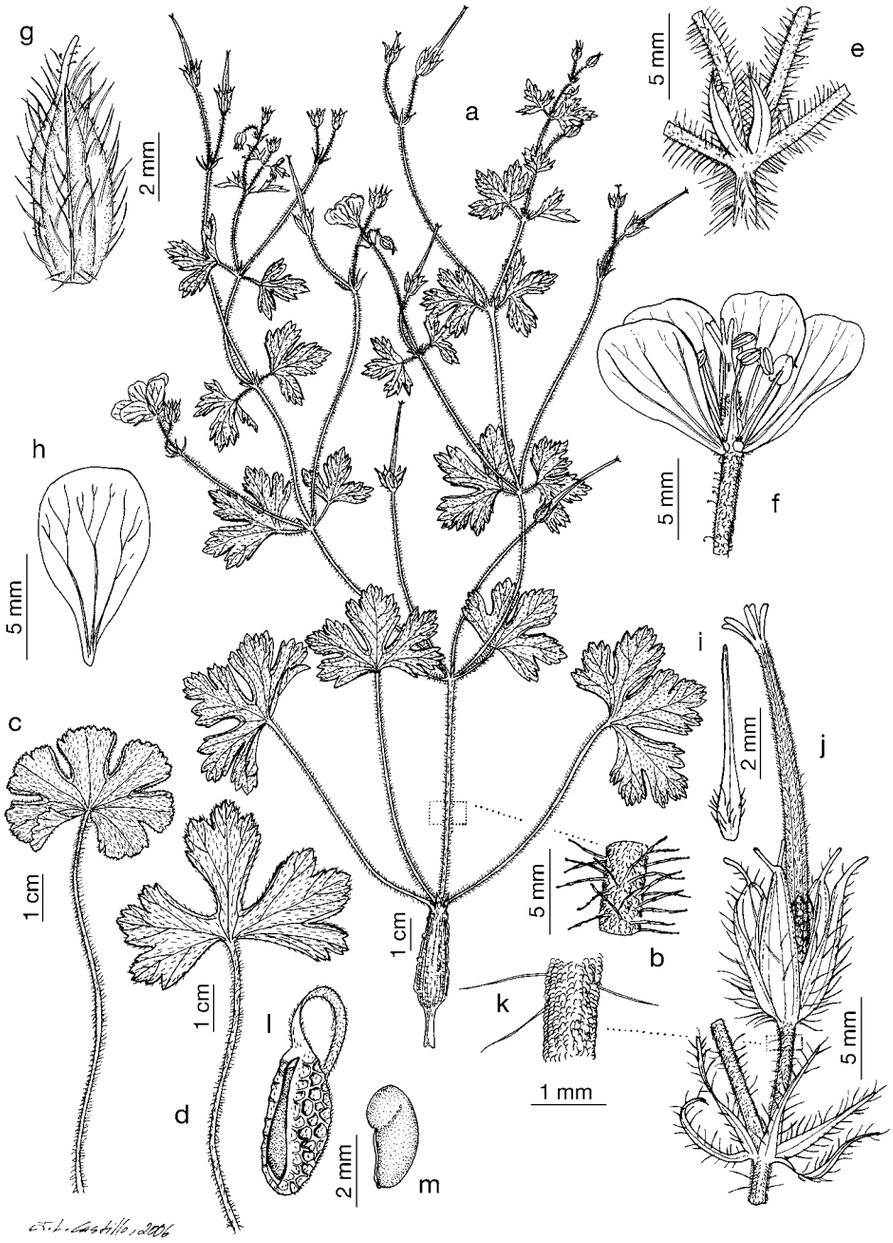


Fig. 732. *Geranium hispidissimum.* a. Habit. b. Stem indumentum. c, d. Leaves. e. Stipules. f. Flower without sepals. g. Sepal. h. Petal. i. Staminal filament. j. Fruit. k. Peduncle indumentum. l. Mericarp. m. Seed. (Based on: a-d, f-h, l, m, *Qin 23372*, PE; i-k, *Maire 2577*, E; e, *Maire s.n.,* E-216867).

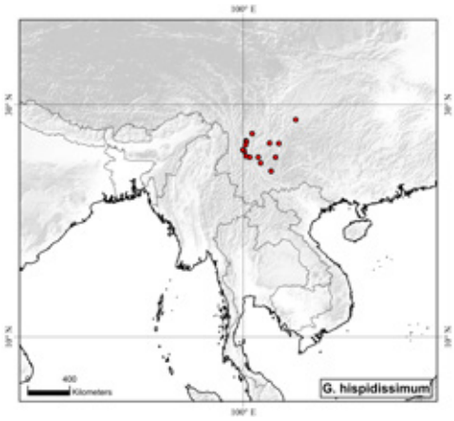


Fig. 733. Distribution of *Geranium hispidissimum*.

Habitat. Meadows, among shrubs in open rocky slopes, and in forest edges of *Pinus* L. or mixed deciduous broad-leaved, evergreen and conifers; 2000-3200 m.

Additional specimens examined. **China.** Sichuan: Huei-li Hsien, 26°41'N, 102°15'E, 17 Sep. 1932, *Yü 1541* (GH). Yunnan: Ta Kai plateau, 1913, *Maire s.n.* (E); Yunnan, 1935, *Wang 70873* (A); Yunnan, prope urbem Yungbei, inter vic. Dschaoping et Boloti, 24°16'N, 102°23'E, 30 June 1914, *Handel-Mazzetti 3358* (W, WU); ad orientem urbis Lidjiang (Likiang) supra vicum Duinaoko, 24°58'N, 101°29'E, 4 July 1914, *Handel-Mazzetti 3461* (W, WU); Yun-nan-sen, 25°28'N, 100°33'E, Sep. 1897, *Bélard 15* (P); entre Yun-nan-sen et Nang-tzé, 25°28'N, 100°33'E, Aug. 1897, *Bélard s.n.* (P); Yunnan sen, 25°28'N, 100°33'E, 1 Sep. 1897, *Ducloux 432* (P); Yun-nan sen, 25°28'N, 100°33'E, Nov. 1906, *Maire 2577* (E); Yun-nan sen, 25°28'N, 100°33'E, Nov. 1906, *Maire 884* (BM); Lou Pou mountains, 25°28'N, 101°17'E, June, *Maire s.n.* (P); Songmoing Xian, in the vicinity of Longtan, 59 km N of Kunming, 25°28'N, 102°46'E, 27 July 1984, *Sino-Amer. Bot. Exped. 1349* (A, CAS, E, K); Chien Chuan to Sung Kwei pass, 25°59'N, 100°5'E, Sep. 1902, *Forrest 132* (E); col du Hee-chan-men, 26°6'N, 99°57'E, 23 July 1886, *Delavay 4827* (MA, P); distrito Dali, población He Qing, montaña Ma Er Shan, 26°31'N, 100°11'E, 25 Aug. 1929, *Qin 23372* (E, PE); Dongchouan, 26°39'N, 103°3'E, July, *Maire s.n.* (P, BM, E); Ahsi NW Likiang-Snow range on Yangtze, 26°48'N, 100°16'E, 20 June 1939, *Ching 20787* (A, PE); Li-kiang Hsien, 26°53'N, 100°14'E, July 1935, *Wang 71296* (A); near Ta-tsang-kai, 27°30'N, 100°45'E, 26 May 1921, *Kingdon Ward 3971* (E); ad viam Yunnanfu-Suifu, 28°42'N, 104°30'E, 4 Sep. 1914, *Mell s.n.* (W).

Discussion. Geranium hispidissimum shares with *G. strictipes* an erect habit, stout, vertical rootstock, opposite leaves, and inflorescence in dichasial cyme with monochasial branches. *Geranium hispidissimum* is, however, easy to identify from its less deeply divided leaves and its shorter petals. It also has shorter sepals, staminal filaments, anthers, fruit, rostrum narrowed apex and seeds. These features overlap to some degree. The indumentum of *G. hispidissimum* is also variable but is usually denser than in *G. strictipes*, especially on the leaves. *Geranium hispidissimum* and *G. strictipes* share with *G. moupinense* sepals with longer mucro. In these species the sepal mucro is green; in the remaining species of the section it is purple. The ranges of *G. hispidissimum* and *G. strigosum* overlap, and they occur sometimes in the same locality. Knuth (1912) recognized *G. platylobum* but did not indicate any difference from *G. strictipes* to key it out. According to Yeo (1992), *G. platylobum* is an extreme case with unusual rounded leaf segments and obtuse lobes. The study of the type material shows that *G. platylobum* has short petals and leaves that are not as deeply divided as in *G. hispidissimum*.

290. Geranium moupinense Franch., Nouv. Arch. Mus. Hist. Nat. ser. 2, 8(2): 208. 1885. Type locality: "Moupine, in locis umbrosis. Jun. 1869". Type: China. Sichuan, Moupine, 30°23'N, 102°50'E, June 1869, *A. David s.n.* (lectotype, designated by Aedo 2016: 620, P!; isotype, MA-628480!).

Geranium ascendens Z.M. Tan, Bull. Bot. Res., Harbin 10(1): 23, tab. 1. 1990. Type locality: "Sichuan: Yaan, Chengdu College of Tradttional Chinese Medicine Exped. 102 (Type, CTMC)". Type: China. Sichuan, Yaan, 29°59'N, 103°05'E, 1988, *Chengdu College of Traditional Chinese Medicine Exped. 102* (holotype, SZ image!; the type was originally at CDCM).

Perennial herbs, 12-25 cm tall. *Rootstock* 3-5 mm in diameter, ± vertical, not tuberculate, not turnip-shaped, without thickened roots. *Stem* erect, leafy, not rooting at nodes, stolons absent, without vegetative stems, with uncinate, eglandular hairs 0.1-0.3 mm long and patent, glandular hairs 0.7-1.1 mm long. *Basal leaves* in a ± persistent rosette, cauline leaves alternate; leaf laminas 3.6-5.8 cm long, 4.6-5.5 cm wide, not peltate, palmatifid [ratio main-sinus length/middle segment length = 0.76-0.81], polygonal in outline, base cordate, not coriaceous, with nerves not projected, with ± appressed, eglandular hairs and plane glandular hairs on both surfaces; segments 5, in 1 plane, middle segment obtriangular, 3.7-6.9 mm wide at the base [ratio segment width at the base/middle segment length = 0.26-0.35], 3-7-lobed in distal half [ratio secondary sinus length/middle segment length = 0.14-0.18]; petioles up to 12 cm long, without abscission zone, terete, not swollen, not deflexed in age, with uncinate, eglandular hairs 0.1-0.2 mm long and patent, glandular hairs 0.8-1.1 mm long; stipules 4.9-5.1 mm long, 1.5-1.6 mm wide, broadly lanceolate, free, papery, brown, with scattered, eglandular hairs on abaxial surface and on the margin, glabrous adaxially. *Inflorescence* a monochasial cyme; cymules 2-flowered, solitary [ratio cymule length/leaf length = 2.3-2.9]; peduncles 48-72 mm long, with uncinate, retrorse, eglandular hairs 0.2-0.3 mm long and patent, glandular hairs 0.8-1.6 mm long; bracteoles 5-6.6 mm long, 1-1.2 mm wide, lanceolate, whorled; pedicels 25-28 mm long, with uncinate, retrorse, eglandular hairs 0.2-0.3 mm long and patent, glandular hairs 0.7-1.1 mm long. Flowers actinomorphic. *Sepals* 7.9-8.9 mm long, 1.8-4.3 mm wide, lanceolate, smooth, not accrescent, nerves 3, mucro 1.7-1.8 mm long [ra-

tio mucro length/sepal length = 0.19-0.22], with ± patent, eglandular hairs 0.1-0.3 mm long and patent, glandular hairs 1.4-1.8 mm long on the abaxial surface, glabrous adaxially. *Petals* 12-12.2 mm long, 5.3-7.7 mm wide, erect-patent, rounded, without claw, purple, hairy on the base of both surfaces, ciliate on the basal margin, with hairs ca. 0.2 mm long. *Stamens* 10, both whorls bearing anthers; filaments 2.7-4 mm long, lanceolate, white, pilose on the abaxial surface, ciliate on the proximal half, with hairs 0.4-1 mm long; anthers 1.6-1.7 mm long, unknown color. Nectaries 5, hemispheric, with a tuft of hairs at the top, dorsally glabrous. *Gynoecium* 5-5.5 mm long, unknown color. *Fruit* 20-23 mm long, erect, discharge of carpel-projection type, operative; mericarps 3-3.2 mm long, 1-1.1 mm wide, without a strand of fibers, not compressed at the apex, reticulate, without basal beak, without a basal callus, without a basal prong, brown, with ± appressed, eglandular hairs 0.1-0.2 mm long; rostrum 16.5 mm long, with a narrowed apex 1.5-1.7 mm long, not twisted, with patent, eglandular hairs 0.2-0.3 mm long; stigmatic remnants 1.8-2 mm long, with 5 glabrous lobes. *Seeds* 2-2.1 mm long, 0.9-1 mm wide, smooth, uniformly colored, brown, glabrous. Cotyledons not studied. Fig. 734.

Pollen. *Erodium*-type (Aedo 2016: 614).

Chromosome number. Unknown.

Phenology. Collected in flower in June.

Distribution. This species is endemic to Sichuan, in southwestern China (Fig. 735).

Habitat. Shaded areas; unknown altitude.

Discussion. Geranium moupinense is an erect perennial herb that shares the feature of alternating leaves on the stem with *G. polyanthes* and *G.*

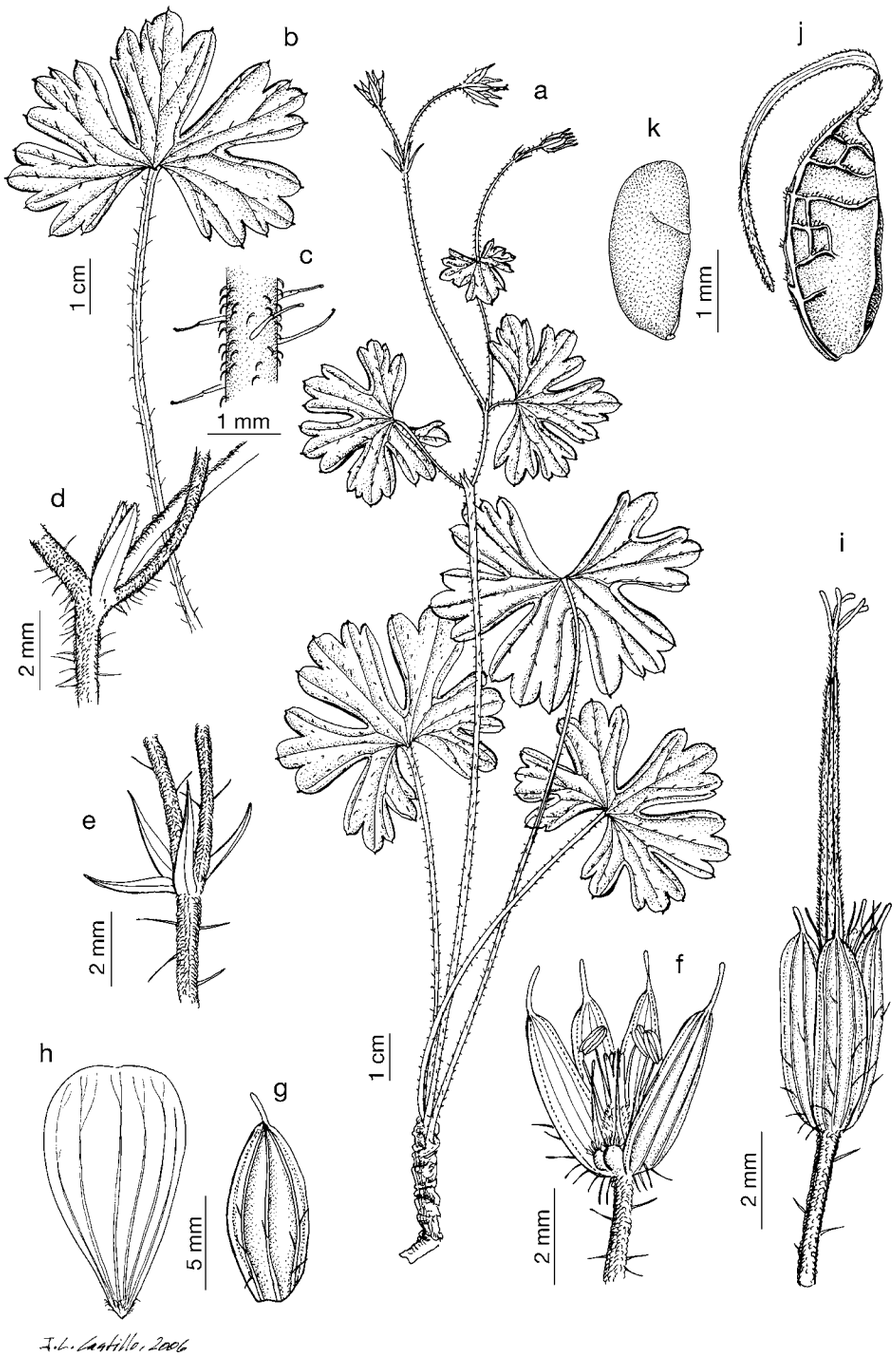


Fig. 734. *Geranium moupinense*. a. Habit. b. Leaf. c. Petiole indumentum. d. Stipules. e. Bracteoles. f. Flower without petals. g. Sepal. h. Petal. i. Fruit. j. Mericarp. k. Seed. (Based on: *David s.n.*, MA-628480).

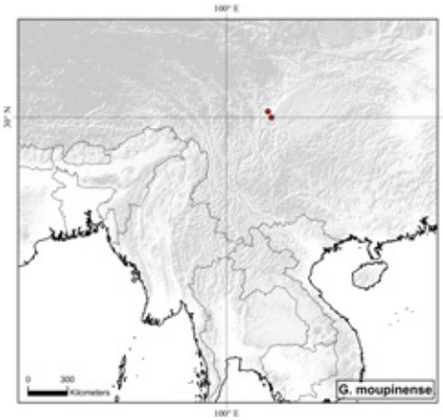


Fig. 735. Distribution of *Geranium moupinense*.

umbelliforme. It is easily differentiated from these species by its solitary cymules (not in umbel-like aggregates) with well-developed peduncles and pedicels. *Geranium moupinense* also has noticeably longer sepals, mucro, and nectaries, with a tuft of hairs at the top (not glabrous). Additionally, the leaves of *G. moupinense* have fewer lobes per segment. The bracteoles, sepals, and anthers are longer, and the eglandular hairs on the inflorescence are shorter. These features overlap to some degree. *Geranium moupinense* shares with *G. umbelliforme* a fruit rostrum with a well-developed narrowed apex. Unfortunately, among the few available collections, the fruits and underground parts are poorly represented. Thus, more collections may help to clarify the degree of character variation in both rootstock and fruits within this species.

Geranium moupinense is a rare species only known from three herbarium sheets, two at P and one at MA, which seems to be part of the same gathering. They bear a similar printed label with the date "1870". According to Franchet (1885), the collection by A. David was made in June 1869. Other species from the "Plantae Davidianae" have the same inconsistency (e.g., *Meliosma cuneifolia* Franch. [P-00732482], with a printed label dated 1870). Fortunately, in some cases the original handwritten label was kept (e.g., *Deutzia longifolia* Franch. [P-00709448], which shows that 1869 was changed to 1870 on the printed label). Yeo (1992) studied the specimens at P but considered the type as "not found". The present data strongly suggest that these specimens with only a printed label are original material, and consequently a lectotype was proposed. Yeo (1992) accepted *Geranium ascendens* in his treatment of Chinese geraniums, although he examined neither the type nor the other specimens. On the basis of the protologue he considered *G. ascendens* to be related to *G. moupinense* and *G. wardii* but only pointed out its differences in regard to the latter. Xu & al. (1998) and Xu & Aedo (2008) considered *G. ascendens* a synonym of *G. moupinense*. An image of the type of *G. ascendens* fits well with *G. moupinense* because of its alternate cauline leaves, leaf lamina not deeply divided, and solitary cymules. These reasons support retaining *G. ascendens* in the synonymy of *G. moupinense*, at least until new evidence appears.

---

291. Geranium nakaoanum H. Hara, Acta Phytotax. Geobot. 16: 1. 1954. Type locality: "Nepal: Chaikia to Kalun 4000 m. (S. Nakao, Jul. 2, 1953--Typus in Herb. Univ. Kyoto); Manaslu alt. 3700 m (S. Nakao, Jun. 7, 1953)". Type: Nepal. Chaikia to Kalun, 28º35'N, 81º37'E, 2 July 1953, *S. Nakao s.n.* (holotype, KYO!).

Perennial herbs, 7-27 cm tall. *Rootstock* 3.2-15.4 mm in diameter, ± vertical, not tuberculate, not turnip-shaped, without thickened roots. *Stem* erect or ascending, leafy, not rooting at nodes, stolons absent, without vegetative stems, glabrous. *Basal leaves* in a ± persistent rosette, cauline leaves opposite (rarely alternate in middle of shoot, first node); leaf laminas (1.2)1.6-2.2(2.5) cm long, 1.5-3.1 cm wide, not peltate, palmatifid [ratio main-sinus length/middle segment length = (0.66)0.77-0.82(0.84)], polygonal in outline, base cordate, not coriaceous, with nerves not projected, with ± uncinate, eglandular hairs and plane glandular hairs on the adaxial surface and glabrous abaxially; segments 5, in 1 plane, middle segment obtriangular, 1.4-2.9 mm wide at the base [ratio segment width at the base/middle segment length = (0.15)0.17-0.22(0.28)], 3-8-lobed in distal half [ratio secondary sinus length/middle segment length = (0.15)0.26-0.37(0.43)]; petioles up to 18 cm long, without abscission zone, terete, not swollen, not deflexed in age, usually glabrous, sometimes with scattered, eglandular hairs 0.1-0.2 mm long; stipules 2.9-4 mm long, 1.3-2 mm wide, ovate, obtuse, free, papery, brown, with scattered, eglandular hairs on abaxial surface and on the margin, glabrous adaxially. *Inflorescence* a monochasial cyme; cymules 1(2)-flowered, solitary [ratio cymule length/leaf length = 1.1-2.8]; peduncles 28-69(106) mm long, with uncinate, retrorse, eglandular hairs 0.1-0.3 mm long; bracteoles 2.7-4.9 mm long, 0.9-1.5 mm wide, lanceolate, obtuse, subopposite; pedicels 21-44(65) mm long, with uncinate, retrorse, eglandular hairs 0.2-0.3 mm long. Flowers actinomorphic. *Sepals* (5.5)6.1-7(8.2) mm long, 2.6-3.3 mm wide, lanceolate, smooth, not accrescent, nerves 3, mucro 0.4-0.6 mm long [ratio mucro length/sepal length = 0.07-0.11], with uncinate, antrorse, eglandular hairs 0.1-0.4 mm long on the abaxial surface, glabrous adaxially. *Petals* (11.5)13.1-15.9(16.1) mm long, 7-10.9 mm wide, erect-patent, rounded, without claw, purple, hairy on the base of the adaxial surface, glabrous abaxially, ciliate on the basal margin, with hairs 0.3-0.7 mm long. *Stamens* 10, both whorls bearing anthers; filaments 3.5-4.6 mm long, lanceolate with an abruptly narrowed apex, white, ciliate, with eglandular hairs 0.3-1.4 mm long; anthers 0.8-1 mm long, yellow. Nectaries 5, hemispheric, glabrous. *Gynoecium* 3.7-4.3 mm long, yellow. *Fruit* 14.5-22.9 mm long, erect, discharge of carpel-projection type, operative; mericarps 4-4.3 mm long, 1.6-1.9 mm wide, without a strand of fibers, not compressed at the apex, reticulate, without basal beak, without a basal callus, without a basal prong, brown, glabrous; rostrum 8.1-15.8 mm long, without a narrowed apex or with a narrowed apex 0.5-0.8 mm long, not twisted, glabrous; stigmatic remnants 0.5-1.9 mm long, with 5 glabrous lobes. *Seeds* 3-3.1 mm long, 1.3-1.4 mm wide, smooth, uniformly colored, brown, glabrous. Cotyledons not studied. Fig. 736.

Pollen. *Erodium*-type (Aedo 2016: 614).

Chromosome number. Unknown.

Phenology. Collected in flower from February to August.

Distribution. This species ranges from central Nepal to Bhutan, plus a locality in northern Burma (Fig. 737).

Habitat. Meadows, on open grassy or rocky slopes, and along trails; 3100-5000 m.

Additional specimens examined. **Bhutan.** Bumthang: Pangotang, Tsampa, 27°55'N, 90°45'E, 14 June 1949, *Ludlow & Sherriff 19132* (BM, US). **Burma.** Kachin: Paijawng Bum, 26°10'N, 98°30'E, 31 July 1919, *Kingdon Ward 3438* (E). **India.** Sikkim: Bikbari campsite at the end of valley below HMI base camp, 27°32'N, 88°8'E, 30 June 1983, *Starling & al. 245* (K). **Nepal.** Bagmati: Dobhan, 27°32'N, 85°13'E, 17 Aug. 1932, *Sharma E439* (BM); Bhuanjene, 27°55'N, 85°30'E, 8 Aug. 1974, *Haas 2118* (BM); Bhairaukunda, 27°58'N, 85°52'E, 14 July 1972, *Maire 81* (E); C Nepal, Bagmati Zone, Rasuwa District, Gosain Kund-Bhairab Kund, 28°5'N, 85°25'E, 28 July 1955, *Hoshino & al. 9531084* (A); Ganesh Himal, 28°10'N, 85°10'E, May 1974, *Yon 192* (E); C Nepal, Bagmati Zone, Rasuwa District, around Jaisuli Kund, 28°11'N, 85°11'E, 1 Aug. 1994, *Miyamoto & al. 9410140* (E); Langsisa Kharka, 28°12'N, 85°34'E, 15 June 1949, *Polunin 414* (BM); C Nepal, Bagmati Zone, Rasuwa District, Pabil Kharka-pass-Kharka, near Seto Kund, 28°15'N, 85°7'E, 7 Aug. 1994, *Miyamoto & al. 9410228* (A, E). Gandaki: Mailey Khiba, Central Nepal, 28°27'N, 83°38'E, 26 June 1975, *Stainton 7384* (BM); Rambong, Lamjung Himal, 28°29'N, 84°11'E, 28 June 1954, *Stainton & al. 5991* (BM); NW of Gurjakhani, 28°36'N, 83°13'E, 13 June 1954, *Stainton & al. 3101* (A, BM, E); Taglung, S of Tukucha, Kali Gandaki, 28°42'N, 83°38'E, 12 July 1954, *Stainton & al. 1782* (BM); Mukinath, 28°49'N, 83°52'E, 26 June 1954, *Stainton & al. 1454* (A, BM, E). Province No. 1: Hongu Khola, 27°30'N, 86°45'E, 2 July 1964, *McCosh 354* (A, BM); E Nepal, Sagarmatha Zone, Solukhumbu District, Gnaula-Pike, 27°33'N, 86°27'E, 22 July 1995, *Miyamoto & al. 9580047* (A); E Nepal, Sagarmatha Zone, Solukhumbu District, Sete-Lamjura La-Taktor, 27°34'N, 86°26'E, 30 July 1997, *Wakabayashi & al. 9720053* (A); E Nepal, Sagarmatha Zone, Solukhumbu District, Chalem Khar-

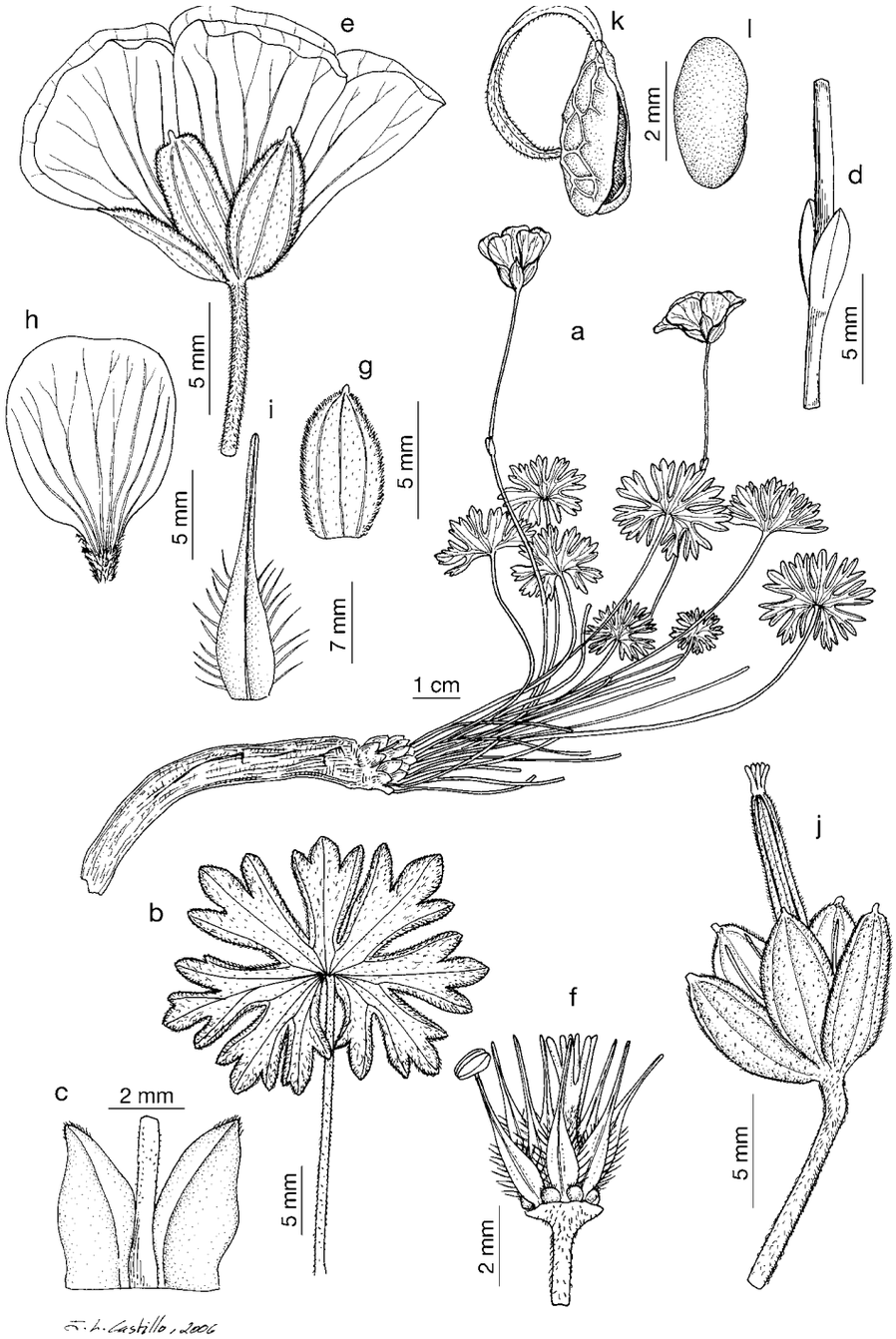


Fig. 736. *Geranium nakaoanum*. a. Habit. b. Leaf. c. Stipules. d. Bracteoles. e. Flower. f. Flower without petals and sepals. g. Sepal. h. Petal. i. Staminal filament. j. Fruit. k. Mericarp. l. Seed. (Based on: a, b, d-f, *Nakao s.n.*, *2 July 1953*, KYO; c, *McCosh 354*, BM; g-i, *Stainton 7384*, BM; j-l, *Wigram 31*, K).

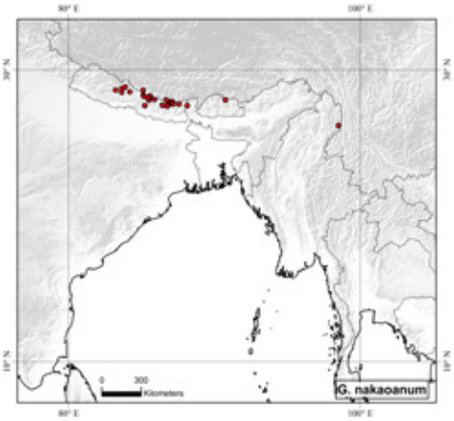


Fig. 737. Distribution of *Geranium nakaoanum*.

ka-Panch Pokhari-Khola Kharka, 27°35'N, 86°50'E, 5 Aug. 1997, *Wakabayashi & al. 9730142* (A); E Nepal, Sagarmatha Zone, Solukhumbu District,Khola Kharka-Rangdu Kharka, 27°36'N, 86°50'E, 8 Aug. 1997, *Wakabayashi & al. 9730163* (A); Topke Gola, 27°38'N, 87°34'E, 9 July 1971, *Beer 8310* (BM); E Nepal, Khosi Zone, Sankhuwa Sabha District, Sano Birke-Jaggu Danda, 27°38'N, 87°9'E, 24 Aug. 1997, *Noshiro & al. 9760340* (A); E Nepal, Khosi Zone, Sankhuwa Sabha District, around Cha Ding Kharka, 27°40'N, 87°10'E, 8 Aug. 1990, *Minaki & al. 90* (A, E); E Nepal, Khosi Zone, Sankhuwa Sabha District,Cha Ding Kharka-Tutu La- Thulo Pokhari-Shipton Pass-Khongma, 27°40'N, 87°10'E, 30 July 1988, *Suzuki & al. 8821951* (E); E Nepal, Khosi Zone, Sankhuwa Sabha District, around Makalu Base Camp, 27°50'N, 87°5'E, 25 July 1988, *Suzuki & al. 8820875* (A, E); Maccherma, 27°54'N, 86°43'E, 7 July 1970, *Dobremez 360* (BM).

Discussion. Geranium nakaoanum is a small herb, with a vertical rootstock shortly branched at the apex and with short, erect, or ascending stems not rooting at the nodes. Basal leaves are arranged in a rosette, which is overtopped by the cymules. Cauline leaves are usually opposite, but in some individuals they are alternate in the middle of the shoot and opposite toward the apex. The cymules are borne on the short stem or, sometimes, on the rootstock. They are usually 1-flowered, although exceptionally some 2-flowered cymules occur in some predominantly 1- flowered individuals. The indumentum of the peduncles and pedicels consists of short, retrorsely appressed eglandular hairs. Both stems and petioles are glabrous, but some scattered, appressed, eglandular hairs were observed on the petioles of some individuals. Petals are long, with small hairs on the basal margin and on the base of the adaxial surface. The staminal filaments have a distinctive narrowed apex and conspicuous ciliae. The variability of *G. nakaoanum* fruits should be checked with more fruiting material because only two mature fruits have been studied. *Geranium nakaoanum* seems to be close to *G. polyanthes*, *G. umbelliforme*, and *G. moupinense* because of its monochasial inflorescence. It differs, however, from this group by its usually opposite leaves. *Geranium nakaoanum* shows singular characters in the section, e.g., its usually 1-flowered cymules, the scarce indumentum, and the staminal filaments with a narrowed apex. According to Ikeda (*pers. comm.*), the description of *Geranium nakaoanum* was published in October 1954 (Hara 1954) and later copied in Flora and Fauna of Nepal (Hara 1955).

292. Geranium polyanthes Edgew. & Hook. f. in Hook. f., Fl. Brit. India 1: 431. 1874. Type locality: "Temperate Himalaya, Kumaon, Blinkworth; Inner valleys of Sikkim, alt. 9-12,000 ft., in grassy places, J. D. Hooker". Type: India. Uttaranchal, Kumaon, 29°24'N, 79°30'E, *R. Blinkworth 8564* (lectotype, designated by Yeo 1992: 192, K-000380195!; isolectotypes, G-00402162 image!, P!, W!).

Perennial herbs, 7-64 cm tall. *Rootstock* 4-10 mm in diameter, ± vertical, not tuberculate, not turnip-shaped, with thickened roots along the rootstock. *Stem* erect, leafy, not rooting at nodes, stolons absent, without vegetative stems, subglabrous or with a variable indumentum composed by uncinate, eglandular hairs 0.1-0.3 mm long and, sometimes, patent, eglandular hairs 0.8-2.2 mm long and patent, glandular hairs 0.2-1.3 mm long. *Basal leaves* in a ± persistent rosette, cauline leaves alternate in middle of shoot and upper opposite; leaf laminas (1.9)2.8-4.9(5.6) cm long, 2.7-6.5 cm wide, not peltate, palmatifid [ratio main-sinus length/middle segment length = (0.61)0.71-0.76(0.81)], polygonal in outline, base cordate, not coriaceous, with nerves not projected, with ± appressed, eglandular hairs and plane glandular hairs on both surfaces; segments 5, in 1 plane, middle segment obtriangular, 3.4-8.9 mm wide at the base [ratio segment width at the base/middle segment length = (0.20)0.25-0.30(0.33)], 3-10-lobed in distal half [ratio secondary sinus length/middle segment length = (0.12)0.17-0.22(0.32)]; petioles up to 32 cm long, without abscission zone, terete, not swollen, not deflexed in age, subglabrous or with a variable indumentum composed by uncinate eglandular hairs 0.1-0.3 mm long and, sometimes, patent, eglandular hairs 0.4-1.9 mm long and patent, glandular hairs 0.5-1.2 mm long; stipules 4.9-8.3 mm long, 1.5-4.8 mm wide, ovate, obtuse, free, papery, brown, with scattered, eglandular hairs on abaxial surface and on the margin, glabrous adaxially. *Inflorescence* a monochasial cyme; cymules 2(3)-flowered, in dense umbels-like aggregates at the top of each branch [ratio cymule length/leaf length = 1.4-3.4]; peduncles 5-73 mm long, with patent, eglandular hairs 0.6-0.7 mm long; bracteoles 2.3-5.6 mm long, 0.5-1.6 mm wide, lanceolate, obtuse, whorled; pedicels absent or (1.9)3.2-17(25) mm long, with uncinate, retrorse, eglandular hairs 0.2-0.3 mm long, patent, eglandular hairs 1-2.3 mm long and, usually, patent, glandular hairs 0.4-0.7 mm long. Flowers actinomorphic. *Sepals* (4.9)5.7-6.9(8.2) mm long, 1.7-3.9 mm wide, lanceolate, smooth, not accrescent, nerves 3, mucro 0.4-0.9 mm long [ratio mucro length/sepal length = 0.06-0.16], with ± patent, eglandular hairs 0.2-2.6 mm long and patent, glandular hairs 0.4-1.1 mm long on the abaxial surface, glabrous adaxially. *Petals* (7.8)9.3-11.8(14.1) mm long, 5.1-9.1 mm wide, erect-patent, rounded or retuse, without claw, purple, hairy on the base of the adaxial surface, glabrous abaxially, ciliate on the basal margin, with hairs 0.4-0.7 mm long. *Stamens* 10, both whorls bearing anthers; filaments 2.6-4.6 mm long, lanceolate, white, pilose on the abaxial surface, ciliate on the proximal half, with hairs 0.3-0.7 mm long; anthers 0.6-1.1 mm long, yellow. Nectaries 5, hemispheric, glabrous. *Gynoecium* 3.2-4.9 mm long, pink. *Fruit* 13-21.7 mm long, erect, discharge of carpel-projection type, operative;

mericarps 3.1-4.7 mm long, 1.2-1.7 mm wide, without a strand of fibers, not compressed at the apex, reticulate, without basal beak, without a basal callus, without a basal prong, brown, with ± appressed, eglandular hairs 0.1-0.2 mm long; rostrum 9.2-16.3 mm long, without a narrowed apex or with a narrowed apex 0.5-1 mm long, not twisted, with patent, eglandular hairs 0.2-0.5 mm long and, sometimes, scattered, patent, glandular hairs 0.2-0.3 mm long; stigmatic remnants 0.7-1.7 mm long, with 5 glabrous lobes. *Seeds* 1.9-2.8 mm long, 0.9-1.4 mm wide, smooth, uniformly colored, brown, glabrous. Cotyledons with entire margin. Fig. 738.

Pollen. *Erodium*-type (Aedo 2016: 615; Bortenschlager 1967: 456).

Chromosome number. 2*n* = 28.

Phenology. Collected in flower from January to September.

Distribution. This species ranges from Uttaranchal in northern India to Yunnan in southwestern China (Fig. 739).

Habitat. Alpine meadows, moist fields, grassy slopes, damp banks, amongst boulders, and on edge of *Abies* Mill., *Juniperus* L., *Picea* A. Dietr., and *Rhododendron* L. forests; 2000-4600 m.

Representative specimens examined. **Bhutan.** Gasa: Upper Mo Chu District, between Gasa and Pari La, 27º56'N, 89º47'E, 16 Sep. 1984, *Sinclair & Long 5052* (E). Punakha: Phajudin [Pajoding] Juipu, 27º31'N, 89º52'E, 13 July 1914, *Cooper 2548* (E). Thimphu: above Motithang, 27º29'N, 89º36'E, 19 July 1979, *Grierson & Long 2742* (E). Trongsa: Tsonga, 27º30'N, 90º30'E, 3 Oct. 1914, *Cooper 2286* (E). Wangdue Phodrang: Nabi to Hinglai-La, 27º30'N, 90º0'E, 6 July 1938, *Gould 844* (K). **Burma.** Kachin: Seinghku Wang, 28º3'N, 97º35'E, 29 June 1926, *Kingdon Ward 7013* (K). **China.** Xizang: Tha Chu valley, 16 July 1950, *Kingdon Ward 19651* (BM); distrito Nie La Mu, pueblo Quxiang, 28º4'N, 85º59'E, 1 Sep. 1981, *Liao Lian Rong 1911* (PE); Nielamu Xian, Qu Xiang, 28º6'N, 85º59'E, 15 Sep. 2006, *Tibet-MacArthur 756* (US); upper Kiubiang Valley, Chulung, Chialohmuto to Tsugum Mt., 28º18'N, 89º12'E, *Yü s.n.* (KUN); Mt. Kenichunpo and region of Champutong, Salween-Irrawadi watershed, 28º30'N,

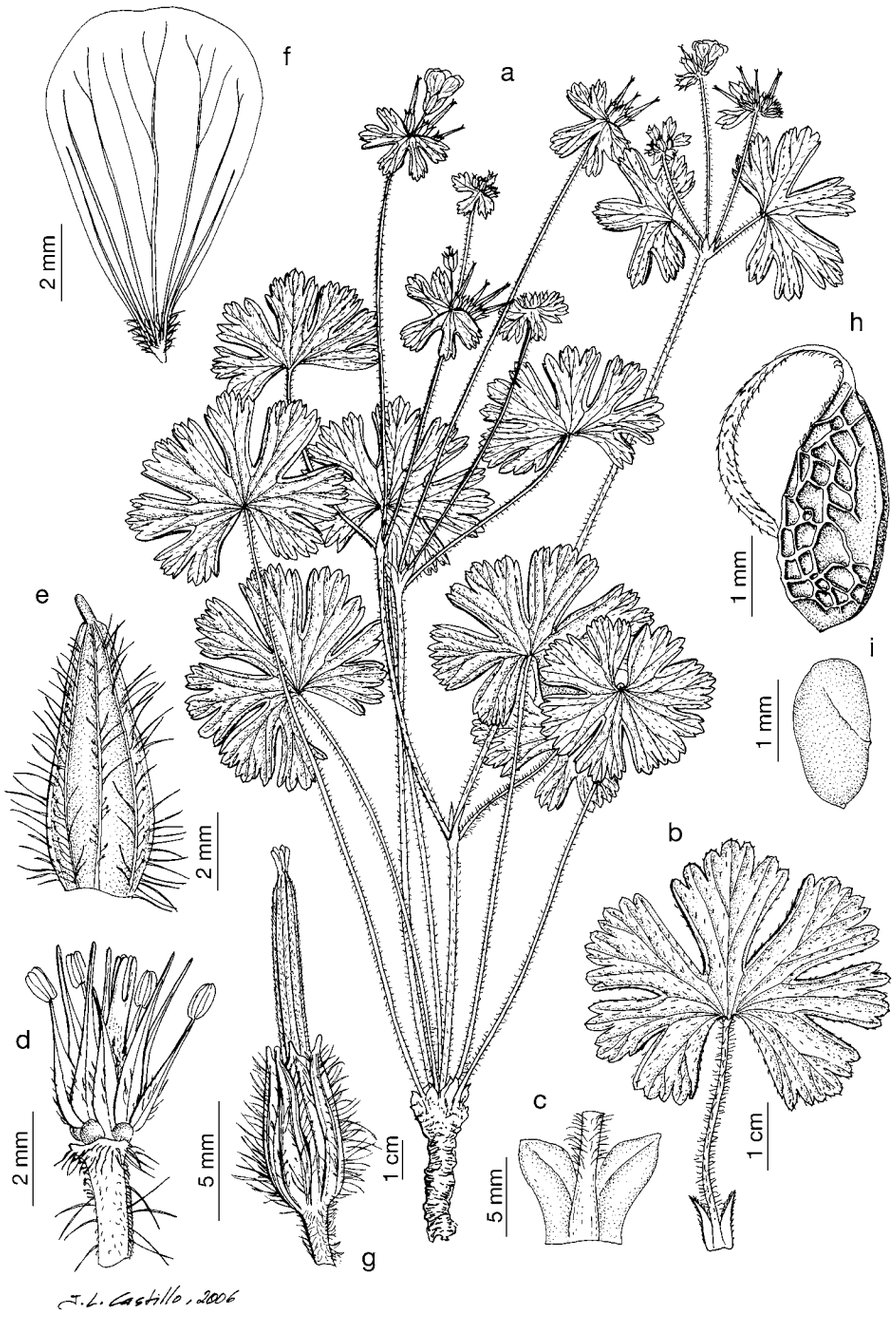


Fig. 738. *Geranium polyanthes*. a. Habit. b. Leaf. c. Stipules. d. Flower without petals and sepals. e. Sepal. f. Petal. g. Fruit. h. Mericarp. i. Seed. (Based on: a, c-i, *Ludlow & al. 5225* (BM); b, *Yü s.n.*, KUN-280350).

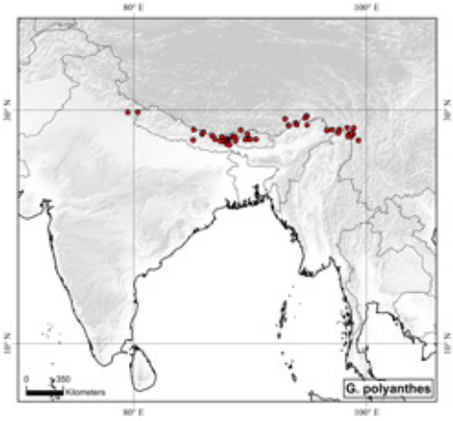


Fig. 739. Distribution of *Geranium polyanthes*.

98°20′E, *Rock 10188* (E, US); Senguti, Tsari, 28°40′N, 93°20′E, 21 Aug. 1936, *Ludlow & Sherriff 2467* (BM); Tsari, 28°42′N, 93°18′E, 12 June 1936, *Ludlow & Sherriff 2124* (BM); distrito Motuo, pueblo Nage, 28°44′N, 94°53′E, 31 July 1974, *Qinghai-Tibet Exped. 74-3802* (PE); Langong, 28°45′N, 94°0′E, 9 June 1938, *Ludlow & Sherriff 5504* (BM); Lo La Chu, near Molo, 28°55′N, 93°55′E, 25 June 1936, *Ludlow & Sherriff 1867* (BM); Kongbo, Doshong La, 29°31′N, 94°51′E, 13 July 1938, *Ludlow & al. 5225* (A, BM). Yunnan: Gongshan, Cikai, about 1.2 km SSE of the Heipa Pass tunnel on the new road from Gongshan to the Dulong Jiang valley, 27°45′N, 98°27′E, 13 Aug. 2006, *Gaoligong Shan Biod. Survey 32158* (CAS); Gongshan, Cikai, near Yipsaka lake, 2.1 km SSE of Heipa Pass tunnel on the new road from Gongshan to the Dulong Jiang valley, E side of Gaoligong Shan, 27°45′N, 98°27′E, 13 Aug. 2006, *Gaoligong Shan Biod. Survey 32220* (CAS, GH, MA); Si-Kang, Chi-na-tung, Tsawa-rung, 27°45′N, 98°42′E, Aug. 1935, *Wang 65221* (A); Gongshan Xian, Cikai Zheng, Labadi, along a branch of the Pula He on the road from Gongshan to Kongdang, E side of Gaoligong Shan, 27°48′N, 98°29′E, 4 Oct. 2002, *Gaoligong Shan Biod. Survey 16972* (CAS, GH); Gongshan, Bingzhongluo, SW of Fucai, between Niwalo and Chukuai lake along N side of Nianwaluo He, 12.4 km WSW of Bingzhongluo, E side of Gaoligong Shan, 27°59′N, 98°30′E, 1 Sep. 2006, *Gaoligong Shan Biod. Survey 32907* (CAS, GH, MA); jugi Schöndsu-la inter fluvios Lu-djiang (Salween) et Landsang-djiang (Mekong), 28°4′N, 98°44′E, 10 July 1916, *Handel-Mazzetti 8253* (WU); sources of the Irrawaddy, Adung valley, 28°20′N, 97°40′E, 11 July 1931, *Kingdon Ward 9783* (BM); Tsekou, 28°29′N, 98°54′E, June 1905, *Bulley s.n.* (K); distrito Deqin, rivera del río Cangjiang, montaña Yongzi, 28°29′N, 98°54′E, 9 Aug. 1940, *Feng 6449* (PE); Tsekou, 28°29′N, 98°54′E, June 1905, *Manberg s.n.* (K). **India.** Assam: Dolei valley, 28°15′N, 96°35′E, 24 Sep. 1928, *Kingdon Ward 8667* (K). Sikkim: Damphibkei, 27°16′N, 88°2′E, 12 Aug. 1913, *Lepcha & Ribu 1088* (E); Kapup, 27°22′N, 88°44′E, 3 Sep. 1913, *Cooper 761* (E); West District, Chhurong, Chhu valley between Jamlinghang and Bikbari, 27°29′N, 88°9′E, 11 July 1992, *Long & al. 238* (E); Sikkim, Lachung valley, 27°41′N, 88°44′E, Aug. 1892, *Gammie s.n.* (P, US, W); Eantso La, 27°45′N, 88°30′E, 1906, *Cave 1212* (WRSL); Jolumbo, 27°45′N, 88°30′E, 24 Oct. 1875, *Clarke 25608* (K). Uttaranchal: Kumaon, Jimba, on way from Bonato to Darma Vy, 29°51′N, 80°21′E, 3 July 1948, *Koelz 20970* (NY). West Bengal: Darjiiling, 27°2′N, 88°15′E, 12 Sep. 1875, *Clarke 27598* (K); Singalila Ridge, Sandakphu, 27°6′N, 88°0′E, 19 July 1981, *Rai 312* (B). **Nepal.** Bagmati: Chuwar, 27°26′N, 85°6′E, 14 Aug. 1932, *Sharma 421* (E); Jhade, Ghopte, 27°26′N, 85°7′E, 9 Sep. 1965, *Shrestha & Shakya 3758* (US); Central Region, Bagmati Zone, Sindhupalchok District, Phunboche Danda, S Bhairab Kund, 27°57′N, 85°53′E, 16 Sep. 2011, *Watson & al. 219* (E); Ganesh Himal, 28°20′N, 85°10′E, Apr. 1974, *Yon 426* (E). Province No. 1: Mechi Zone, Taplejung District, Lamo Pokhari-Dobate- Hike Kharka, 27°20′N, 87°28′E, 6 Aug. 1999, *Omori & al. 9920037* (E); Taplejung, Ghunsa, Yonpma Khola valley above Phole, 27°21′N, 87°40′E, 22 Sep. 1985, *Gray 31* (K); Milke Dobaye, 27°23′N, 87°29′E, 20 Aug. 1972, *Dobremez 1582* (BM, E); Iswa Khola, 27°30′N, 87°0′E, 21 Sep. 1975, *Beer 25495* (BM); Yimbua Yuola, 27°32′N, 87°57′E, 23 June 1969, *Williams 824* (BM); Topke Gola, 27°42′N, 87°35′E, 25 Aug. 1972, *Dobremez 1722* (E); Mahalangur Himal, Khumbu, Paugpoche, 27°47′N, 86°45′E, 30 Sep. 1962, *Poelt 6329* (M).

Discussion. Geranium polyanthes is an erect perennial herb with a more or less vertical rootstock with thickened roots, leaves alternate in the middle of the shoot and opposite at the apex, and with a monochasial inflorescence. It is easy to identify by its distinctive dense aggregate of cymules at the apex of each branch. The cymules usually lack pedicels, have short peduncles, and are subtended by sessile or short petiolate leaves. Exceptionally, some solitary, peduncled cymules occur in individuals with cymules predominantly in umbel-like aggregates. Stipules are ovate, obtuse, and conspicuously wide. *Geranium polyanthes* is close to *G. umbelliforme*, since both share a similar inflorescence structure and alternate cauline leaves. Nonetheless, *G. umbelliforme* has cymules in loose umbel-like aggregates usually with well-developed peduncles and pedicels and narrower stipules. According to Yeo (2002a), some of the flowers of *G. polyanthes* are cleistogamous.

293. Geranium strictipes R. Knuth in Engl., Pflanzenr. IV. 129 (Heft 53): 581. 1912. Type locality: "Nordwest-Yunnan: Hichiang-Kette, auf dem östlichen Hange um 3000-3300 m, an trockenen steinigen Orten in buschigem Gestrüpp (Forrest a. 1906 n. 2369 -- Typus in herb. Edinburgh!).-- Blüchend und Fruchtend Juni". Type: China. Yunnan, eastern flank of the Lichiang range, 27°20′N, 100°08′E, June 1906, *G. Forrest 2369* (holotype, E-00216882!; isotypes, BM-000796466!, K-000380193!, P-00757917!).

Geranium strigosum Franch., Bull. Soc. Bot. France 33: 442. 1887, nom. illeg., non Burm. f. 1768. *Geranium strigosum* var. *gracile* Franch., Pl. Delavay.: 113. 1889 (Yeo 1992: 197, designated the type of *Geranium strigosum* var. *gracile*; for more details see discussion). Type locality: "Yun-nan, in dumetis Pe-ngay-tze, supra Houang-kia-pin; fl. fr. 4 sept. (Delav. n.)". Type: China. Yunnan, montis Pe-ngay-tze, supra Houang-kia-pin, 25°34′N, 100°08′E, 4 Sep. 1882, *P.J. Delavay Geranium, n. 2* (lectotype, designated by Aedo 2016: 629, P-00757910!).

Geranium strigosum var. *grandiflorum* Franch., Pl. Delavay.: 113. 1889. *Geranium strictipes* var. *grandiflorum* (Franch.) C.Y. Wu ex H.W. Li, Vasc. Pl. Hengduan Mount. 1: 1026. 1993. Type locality: "In pascuis ad collum Hee-chan-men, alt. 3000 m.; 14 jun. 1887 (Delavay); Hokin, in silvis ad collum Koua-la-po, alt. 3000 m.; 13 jul. 1886 (Delavay, n. 2165)". Type: China. Yunnan, collum Koua-la-po, Hee-chan-men, 26°06′N, 99°57′E, 14 June 1887, *P.J. Delavay s.n.* (lectotype, designated by Aedo 2016: 629, P-00757916!; isolectotypes, K-000729358!, NY!).

Perennial herbs, 20-76 cm tall. *Rootstock* 6-28 mm in diameter, ± vertical, not tuberculate, not turnip-shaped, without thickened roots. *Stem* erect or ascending, leafy, not rooting at nodes, stolons absent, without vegetative stems, with patent, eglandular hairs 0.2-2.2 mm long and, usually, patent, glandular hairs 0.4-3.4 mm long, sometimes subglabrous. *Basal leaves* in a deciduous rosette, cauline leaves opposite; leaf laminas (1.8)2.5-3.6(4.9) cm long, 2.8-5.9 cm wide, not peltate, palmatifid [ratio main-sinus length/middle segment length = (0.70)0.80-0.86(0.89)], polygonal in outline, base cordate, not coriaceous, with nerves not projected, with ± appressed, eglandular hairs and plane glandular hairs on both

surfaces; segments 5, in 1 plane, middle segment rhombic, 3.2-10.6 mm wide at the base [ratio segment width at the base/middle segment length = (0.20)0.22-0.24(0.32)], 8-16-lobed in distal half [ratio secondary sinus length/middle segment length = (0.24)0.29-0.36(0.47)]; petioles up to 15 cm long, without abscission zone, terete, not swollen, not deflexed in age, with uncinate, eglandular hairs 0.1-0.3 mm long, patent, eglandular hairs 0.4-2 mm long and, usually, patent glandular hairs 0.2-2.7 mm long; stipules 3.8-10 mm long, 0.5-2.3 mm wide, lanceolate, free, herbaceous, green, with scattered, eglandular hairs on abaxial surface and on the margin, glabrous adaxially. *Inflorescence* a dichasial cyme with monochasial branches; cymules 2-flowered, solitary [ratio cymule length/leaf length = 1.3-3.9]; peduncles (40)51-82(109) mm long, with uncinate, eglandular hairs 0.1-0.3 mm long, patent, eglandular hairs 0.3-2.3 mm long, and patent, glandular hairs 0.4-1.7 mm long; bracteoles 3.1-8.9 mm long, 0.4-1.2 mm wide, lanceolate, whorled; pedicels (4.6)9.7-21.9(25) mm long, with uncinate, retrorse, eglandular hairs 0.2-0.3 mm long, patent, eglandular hairs 0.2-1.9 mm long and patent, glandular hairs 0.4-1.7 mm long. Flowers actinomorphic. *Sepals* (5.5)6.1-7.3(7.8) mm long, 2.2-3.3 mm wide, lanceolate, smooth, not accrescent, nerves 3, mucro 0.8-2.3 mm long [ratio mucro length/sepal length = 0.12-0.35], with patent, eglandular hairs 0.2-1.9 mm long and patent, glandular hairs 0.8-2.8 mm long on the abaxial surface, glabrous adaxially. *Petals* (10.2)12-13.2(14.9) mm long, 4.1-10.1 mm wide, erect-patent, rounded or slightly emarginate (notch 0.5-1 mm deep), without claw, purple, hairy on the base of both surfaces, ciliate on the basal margin, with hairs 0.3-1 mm long. *Stamens* 10, both whorls bearing anthers; filaments 3.7-6.2 mm long, lanceolate, yellow, pilose on the abaxial surface, ciliate on the proximal half, with hairs 0.2-0.8 mm long; anthers 1-2.7 mm long, yellow. Nectaries 5, hemispheric, with a tuft of hairs at the top, dorsally glabrous. *Gynoecium* 4.8-6.6 mm long, yellow. *Fruit* 26-46.2 mm long, erect, discharge of carpel-projection type, operative; mericarps 5-5.6 mm long, 1.1-2.4 mm wide, without a strand of fibers, not compressed at the apex, reticulate, without basal beak, without a basal callus, without a basal prong, brown, with ± appressed, eglandular hairs 0.1-0.2 mm long; rostrum 19-37 mm long, with a narrowed apex 1-2.6 mm long, not twisted, with patent, eglandular hairs 0.1-0.4 mm long and, sometimes, scattered, patent, glandular hairs 0.1-0.4 mm long; stigmatic remnants 1.9-2.7 mm long, with 5 glabrous lobes. *Seeds* 3.3-4.4 mm long, 1.3-1.9 mm wide, smooth, uniformly colored, brown, glabrous. Cotyledons not studied. Fig. 740.

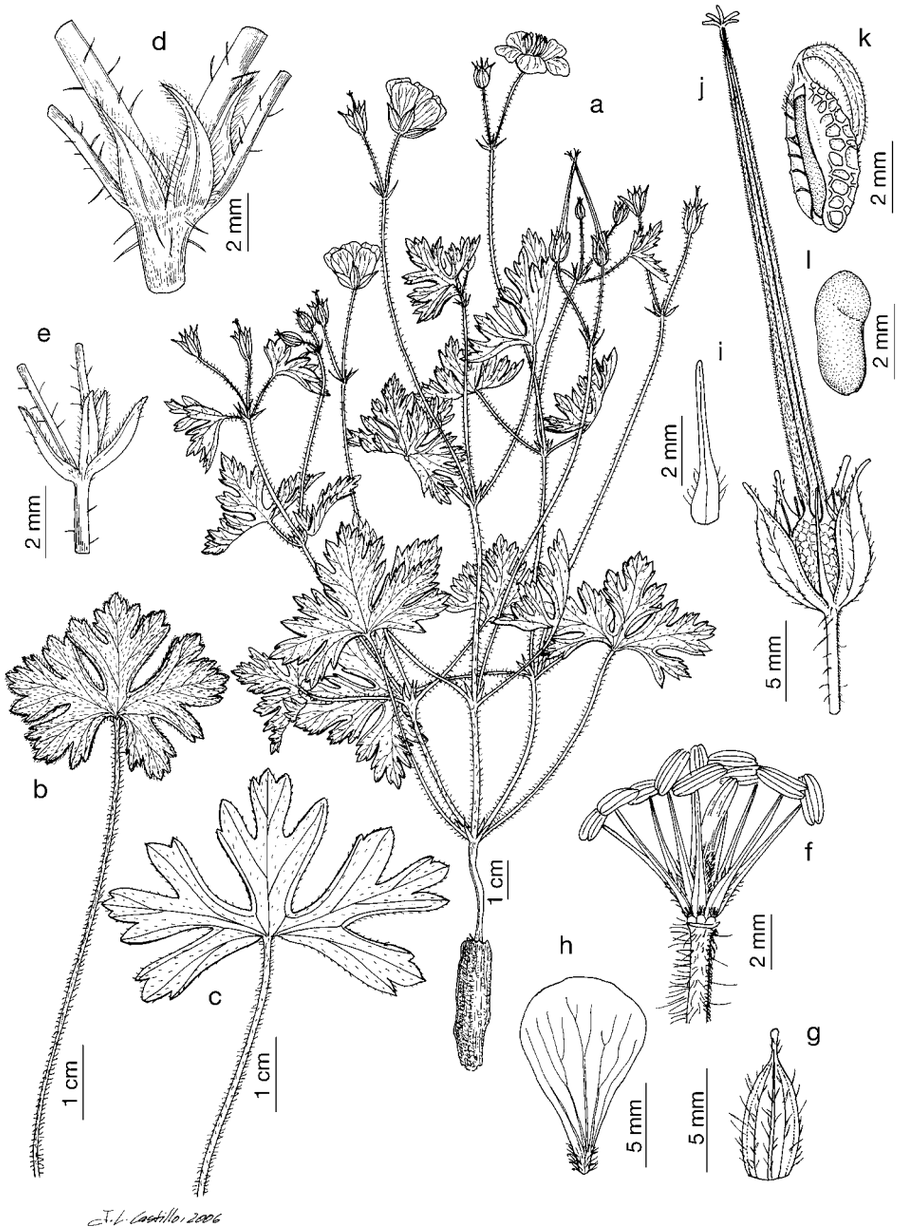


Fig. 740. *Geranium strictipes*. a. Habit. b. Leaves. d. Stipules. e. Bracteoles. f. Flower without petals and sepals. g. Sepal. h. Petal. i. Staminal filament. j. Fruit. k. Mericarp. l. Seed. (Based on: a, c-i, *Forrest 2369*, BM; b, *Zhong Dian Expedition 606*, PE; j-l, *Forrest 6113*, E).

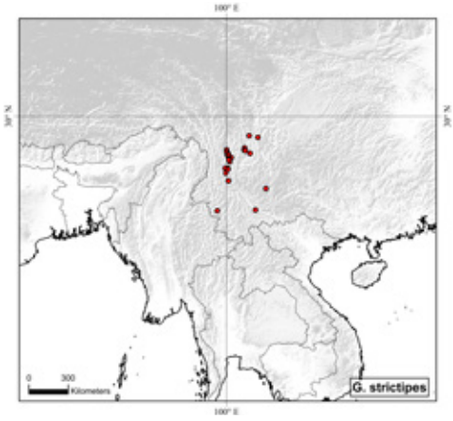


Fig. 741. Distribution of *Geranium strictipes*.

Pollen. *Erodium*-type (Aedo 2016: 615; Tan & al. 1996: 212).

Chromosome number. Unknown.

Phenology. Collected in flower from April to November.

Distribution. This species ranges through Sichuan and Yunnan, in southwestern China (Fig. 741).

Habitat. Meadows, amongst scrub and on stony banks at edge of *Quercus* L. and *Pinus* L. forests; 1600-3650 m.

Additional specimens examined. **China.** Sichuan: ad oppidum Yenyüen regione, in steppis ad vic Schuitangdse, 27°27'N, 101°38'E, 4 June 1914, *Handel-Mazzetti 2830* (WU); ad oppidum Yenyüen regione, inter vicos Dnörlliandgse et Hungga, 27°27'N, 101°38'E, 12 June 1914, *Handel-Mazzetti 2888* (WU); inter oppidum Yenyüen et flumen Yalung, 27°38'N, 101°18'E, 30 Sep. 1914, *Handel-Mazzetti 5410* (W, WU); Szechuan asutral inter Yenyuan hsien et Yung ming, pr. pagum Hunka, 27°38'N, 101°18'E, 12 June 1914, *Schneider 1171* (G, GH, US); Muli Xian, border of Muli Xian and Yanyuan Xian on E side road (highway 216), 27°41'N, 101°13'E, 10 Aug. 2010, *Boufford & al. 42801* (MA); Muli Xian, on the way from Yanyuan to Muli, near the pass, 27°41'N, 101°13'E, 3 Aug. 2007, *Tibet-MacArthur 1687* (US); Muli, 27°50'N, 101°15'E, 10 June 1921, *Kingdon Ward 4040* (E); Muli, 27°50'N, 101°15'E, 28 June 1921, *Kingdon Ward 4279* (E); Kientchang, Mienming, 28°33'N, 102°10'E, 2 Nov. 1911, *Legendre 1425* (P); Jiulong Xian, between city Jiulong and Yalong Jiang, right side highway going toward Yalong Jiang, 28°40'N, 101°34'E, 16 July 2005, *Boufford & al. 33029* (GH, MA). Yunnan: Yunnan, *Yü 6670* (GH); Yunnan, *Yü 7491* (IBSC); Keng-Ma, 23°31'N, 99°22'E, Apr. 1936, *Wang 72927b* (GH); cerca del Jardin Botanico de Lijiang, 23°34'N, 102°0'E, 8 Aug. 1962, *Zhong Dian Exped. 606* (PE); Kunmin, near Hua-ji-gou, 25°2'N, 102°43'E, 11 Oct. 1979, *Murata & Yamazaki 9251* (MO); col de Yen-tze-hay, 26°21'N, 100°6'E, *Delavay s.n.* (K, P); col de Koua-la-po, 26°26'N, 100°6'E, 13 July 1886, *Delavay 2165* (P, K); distrito Dali, población Jian Chuan, en el camino del pueblo Dian Nan al pueblo Ma Deng, 26°26'N, 99°55'E, 17 July 1984, *Xiangko Exp. 243* (KUN); Li-kiang Hsien, 26°53'N, 100°14'E, June 1935, *Wang 70555* (A); Li-kiang Hsien, 26°53'N, 100°14'E, July 1935, *Wang 70934* (A); ciudad Lijaing, 26°53'N, 100°14'E, July 1935, *Wang 71658* (IBSC); Li-kiang Hsien, 26°53'N, 100°14'E, July 1935, *Wang 79873* (KUN); on Ma Huang Paddok, bank of Nguluke, Lichiang Snow range, 27°0'N, 100°10'E, 12 June 1922, *Rock 4352* (E, US); Lichiang ad pagum Ugu leh keh, 27°0'N, 100°10'E, 18 July 1914, *Schneider 1864* (G, GH, US); prope Linkiang, 27°0'N, 100°10'E, 18 July 1914, *Schneider 1869* (K, G, GH); Jade Dragon mountain, 27°5'N, 100°10'E, 6 July 1999, *Hu & Kong Y080* (A); Lijiang Co., Yuhu, Xuesong Cun, Beisha Xiang, foot of Mt. Yulongxue, 27°7'N, 100°10'E, 14 Sep. 1993, *Konta & Koyama 2469* (A); ciudad Lijiang, montaña Yulong, 27°7'N, 100°10'E, 20 July 1962, *Zhang 100312* (KUN); pr. urbem Lidjiang (Likiang) in monte Yülung-schan, 27°10'N, 100°20'E, 1914, *Handel-Mazzetti 3798* (W, WU); Lijiang Co., Yulong Shan, above Gao Shan Zhi Yu Yan, 27°10'N, 100°20'E, 9 June 1987, *Sino-Brit. Lijian Exped. 1256* (K); Lijiang Co., Yulong Shan, above Gao Shan Zhi Yu Yan, 27°10'N, 100°20'E, 9 June 1987, *Sino-Brit. Lijian Exped. 1266* (E); Yunnan Findspot, Lijiang, Yulong Shan, Ganghoba [cultivado en Wakehurst], 27°10'N, 100°20'E, 10 June 1987, *Sino-Brit. Lijian Exped. 603* (MA); ciudad Lijiang, pueblo Xuesong, 27°10'N, 100°20'E, 18 July 1937, *Yü 15323* (PE); W flank of Haba Snow range, 27°20'N, 100°4'E, 23 June 1939, *Feng 1367* (GH); Yangtze watershed, Likiang, E slopes of Likiang Snow Range, 27°20'N, 100°8'E, June 1922, *Rock 4443* (E, GH, NY, P, US); Lichiang range, 27°25'N, 100°8'E, 1910, *Forrest 10340* (BM); Lichiang range, 27°25'N, 100°8'E, July 1913, *Forrest 10370* (BM, E, GH); hills forming the E boundary of the Lichiang valley, 27°25'N, 100°8'E, July 1910, *Forrest 6113* (BM, E, P); Zhongdian, road to Haba Shan, 27°33'N, 100°1'E, 14 June 1994, *Alpine Garden Soc. Exped. 247* (E); Diqing pref., between Zhongdian and Jiulong, 27°42'N, 100°1'E, 14 June 1993, *Aldén & al. 1268* (E).

Discussion. Geranium strictipes is an erect herb with a very stout, more or less vertical rootstock, opposite leaves, and inflorescence a dichasial cyme with monochasial branches. According to Yeo (1992), *G. strictipes* is apparently the closest relative of *G. hispidissimum*. Their leaves, however, differ significantly. Leaves of *G. strictipes* are more deeply divided because the main and second sinuses are deeper. In addition, the main segment is narrower at the base in *G. strictipes*. The middle segment of the leaf lamina is rhombic in *G. strictipes*; in *G. hispidissimum* the middle segment is obtriangular. *Geranium strictipes* has longer petals, with more dense indumentum on the abaxial base, than in *G. hispidissimum*. The indumentum of *G. strictipes* varies, with some individuals subglabrous on stem and petioles, to others covered by a quite dense indumentum. The glandular hairs are sometimes absent on the stem and the petioles and vary greatly in density on the inflorescence. According to Yeo (1992), the glandular hairs of *G. strictipes* have distinctly small swollen heads, while in *G. hispidissimum* they have minute terminal cells, occasionally swollen but usually not. This feature seems to be constant in *G. strictipes* but varies in *G. hispidissimum*. In the latter, both glandular hairs with a minute or distinct head appear, which limits its taxonomic use. Franchet (1887: 442) described *Geranium strigosum* as a species without infraspecific taxa from "Yun-nan, in dumetis Pe-ngay-tze, supra Houangkia-pin; fl. fr. 4 sept. (Delav. n.)". Two years later Franchet (1889) recognized under his *G. strigosum* four varieties: α *hispidissimum*, ß *grandiflorum*, γ *gracile*, and δ *platylobum*. Two of these are currently separated as *G. hispidissimum* (varieties α and δ) (Yeo, 1992). Neither of the remaining two have the epithet "*strigosum*", which corresponds to the typical variety. However, γ *gracile* is described from two collections, the first being the same as *G. strigosum*: "In dumetis Pe-ngay-tze, supra Houang-kia-pin; fl. fr. 4 sept. 1882 (Delavay, Geranium, n. 2; in monte

Che-tcho-tze (id)". This strongly suggests that Franchet considered such variety as the typical, as Knuth (1912) indicated. Therefore, I lectotypified *G. strigosum* on *Delavay Geranium n. 2*. The result is that *G. stigosum* var. *gracile*, typified by Yeo (1992) on the same specimen, becomes homotypic of *G. strigosum*. Yeo (1992) was aware of this coincidence of localities but considered the type of *G. strigosum* as *non vidi*. Wu (1984) proposed the combination *Geranium strictipes* var. *grandiflorum*, which is not validly published according to article 41.5 of the ICN, because he cited the basionym and its author but without reference to its place of valid publication.

294. Geranium umbelliforme Franch., Bull. Soc. Bot. France 33: 443. 1887. Type locality: "Yun-nan, in silvis ad juga Koua-la-po, supra Hokin, alt. 3000 m.; fl. 4 aug. 1885 (Delav. n. 1944)". Type: China. Yunnan, in silvis ad juga Koua-la-po, supra Hokin, 26º31'N, 100º11'E, 4 Aug. 1885, *P.J. Delavay 1944* (lectotype, designated by Yeo 1992: 194, P-00757972!).

Perennial herbs, 28-45 cm tall. *Rootstock* 6-11 mm in diameter, ± vertical, not tuberculate, not turnip-shaped, without thickened roots. *Stem* erect, leafy, not rooting at nodes, stolons absent, without vegetative stems, with patent, eglandular hairs 0.3-3.9 mm long and patent, glandular hairs 0.7-1.8 mm long. *Basal leaves* in a ± persistent rosette, cauline leaves alternate in middle of shoot and upper opposite; leaf laminas (3.7)4.1-6.9(8.4) cm long, 4.9-9.9 cm wide, not peltate, palmatifid [ratio main-sinus length/middle segment length = (0.66)0.67-0.73], polygonal in outline, base cordate, not coriaceous, with nerves not projected, with ± appressed, eglandular hairs and plane glandular hairs on both surfaces; segments 5, in 1 plane, middle segment obtriangular, 8-14 mm wide at the base [ratio segment width at the base/middle segment length = (0.24)0.27-0.42(0.43)], 7-15-lobed in distal half [ratio secondary sinus length/middle segment length = (0.15)0.16-0.18(0.19)]; petioles up to 20 cm long, without abscission zone, terete, not swollen, not deflexed in age, with patent, eglandular hairs 0.4-3.9 mm long and patent, glandular hairs 0.6-1.8 mm long; stipules 4.5-8.7 mm long, 1.2-2.6 mm wide, ovate, obtuse, free, papery, brown, with scattered, eglandular and glandular hairs on abaxial surface and on the margin, glabrous adaxially. *Inflorescence* a monochasial cyme; cymules (2)3-4-flowered, in loose umbels-like aggregates at the top of each branch [ratio cymule length/leaf length = 1.3-2.4]; pedun-

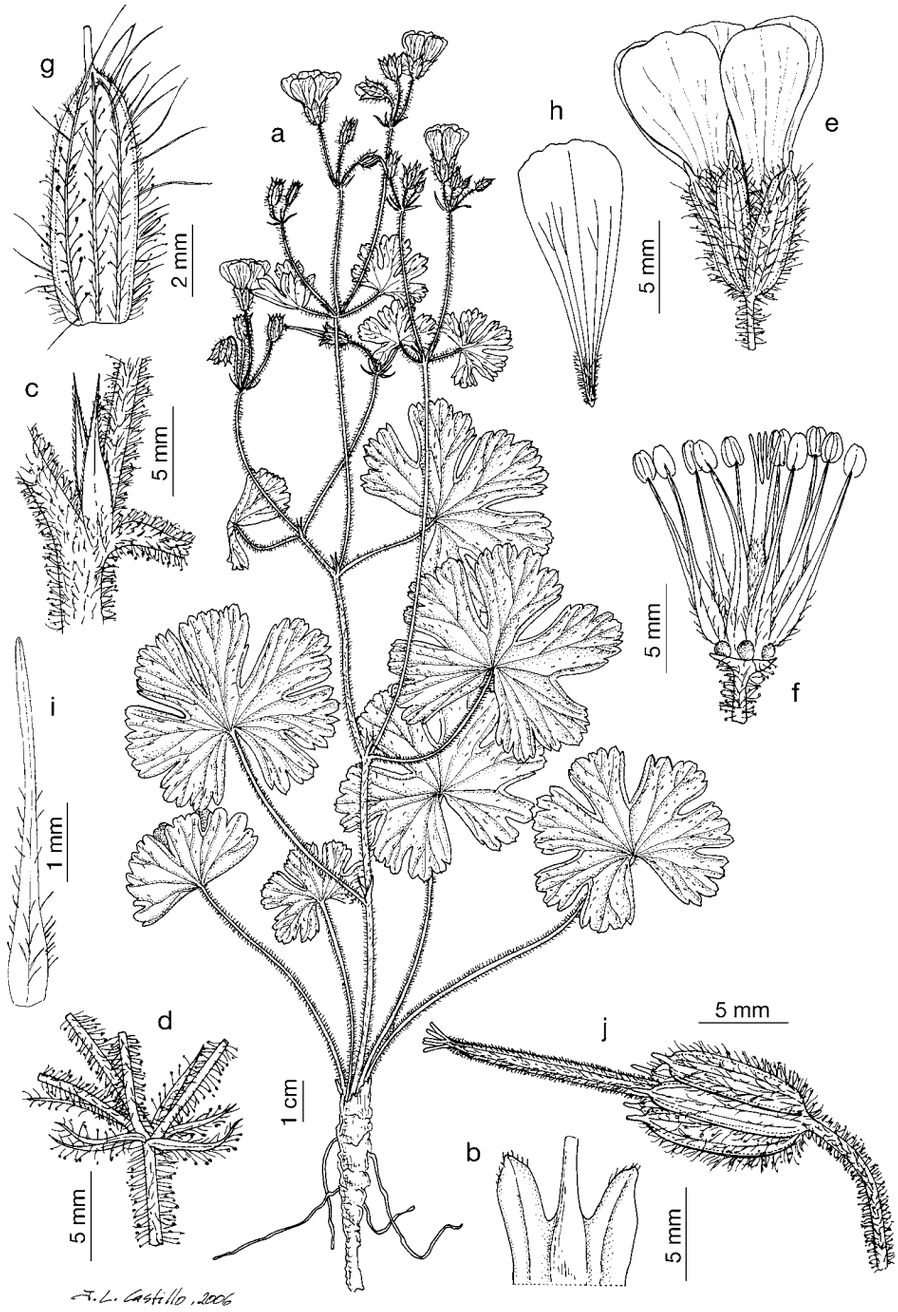


Fig. 742. *Geranium umbelliforme*. a. Habit. b, c. Stipules. d. Bracteoles. e. Flower. f. Flower without petals and sepals. g. Sepal. h. Petal. i. Staminal filament. j. Fruit. (Based on: *Forrest 6195*, E).

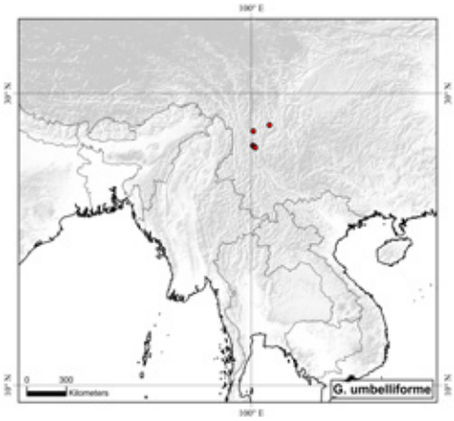


Fig. 743. Distribution of *Geranium umbelliforme*.

cles 25-67 mm long, with patent, eglandular hairs 0.5-3 mm long and patent, glandular hairs 0.6-1.8 mm long; bracteoles 3.4-6 mm long, 0.3-0.7 mm wide, linear-lanceolate, whorled; pedicels (5)12-34(35) mm long, with patent, eglandular hairs 0.4-3.5 mm long and patent, glandular hairs 0.6-1.8 mm long. Flowers actinomorphic. *Sepals* 6.1-6.7(7.6) mm long, 1.7-2.7 mm wide, lanceolate, smooth, not accrescent, nerves 3, mucro 0.5-1.4 mm long [ratio mucro length/sepal length = 0.09-0.18], with patent, eglandular hairs 0.3-3.3 mm long and patent, glandular hairs 0.6-1.9 mm long on the abaxial surface, glabrous adaxially. *Petals* (13.1)13.8-15.2(16.8) mm long, 5-9 mm wide, erect-patent, rounded or retuse, without claw, purple, hairy on the base of both surfaces, mainly on adaxial surfaces, ciliate on the basal margin, with hairs 0.4-1 mm long. *Stamens* 10, both whorls bearing anthers; filaments 3.9-6.7 mm long, lanceolate, white, pilose on the abaxial surface, ciliate on the proximal half, with hairs 0.3-0.9 mm long; anthers 0.9-1.6 mm long, unknown color. Nectaries 5, hemispheric, glabrous. *Gynoecium* 4.3-6.2 mm long, red. *Fruit* 18.2-21.5 mm long, erect, discharge of carpel-projection type, operative; mericarps 2.8-3.4 mm long, 0.8-1.4 mm wide, without a strand of fibers, not compressed at the apex, reticulate, without basal beak, without a basal callus, without a basal prong, brown, with ± appressed, eglandular hairs 0.1-0.2 mm long; rostrum 12.3-15.9 mm long, with a narrowed apex 2-2.1 mm long, not twisted, with patent, eglandular hairs 0.3-0.4 mm long and, sometimes, scattered, patent, glandular hairs 0.2-0.3 mm long; stigmatic remnants 1.1-1.5 mm long, with 5 glabrous lobes. *Seeds* unknown. Cotyledons not studied. Fig. 742.

Pollen. *Erodium*-type (Aedo 2016: 615; Bortenschlager 1967: 456; Tan & al. 1996: 211).

Chromosome number. Unknown.

Phenology. Collected in flower from July to August.

Distribution. This species ranges through Sichuan and Yunnan, in southwestern China (Fig. 743).

Habitat. Meadows and forest edges amongst the limestone cliffs; 3000-3400 m.

Additional specimens examined. **China.** Sichuan: Muli, 27º50'N, 101º15'E, 22 July 1921, *Kingdon Ward 4543* (E); Muli, mountains of Kulu, 27º50'N, 101º15'E, July 1929, *Rock 18042* (E, GH). Yunnan: prefectura Dali, Henqing, pueblo Machang Baishanmu, 26º17'N, 100º16'E, 1 Aug. 1929, *Ching 23481* (PE); prefectura Dali, Henqing, pueblo Songgui, montaña Maer Shan Yanzidong, 26º22'N, 100º13'E, 21 July 1963, *Jinshajiang Exped. 4759* (KUN); au col de Koua-la-po, point culminant de la route de Ta-li à Hokin, 26º26'N, 100º6'E, 24 July 1883, *Delavay s.n.* (P); E flank of Lichiang Range, 27º25'N, 100º8'E, July 1910, *Forrest 6195* (BM, E, K, P).

Discussion. In its general aspect *Geranium umbelliforme* is similar to *G. polyanthes*. They share a similar inflorescence structure and alternate cauline leaves. Nonetheless, *G. umbelliforme* has cymules with usually well-developed peduncles and longer pedicels, resulting in a lax inflorescence. Petals of *G. umbelliforme* are longer and narrower than those of *G. polyanthes* and the narrowed apex of the fruit rostrum is longer. Additionally, the leaves of *G. umbelliforme* are longer and with more lobes per segment, bracteoles are narrower, sepal mucro is longer, and staminal filaments and anthers are longer. These features overlap to some degree. Among the few available collections, the underground parts are poorly represented. Nevertheless, *Geranium umbelliforme* appears to have a more or less vertical rootstock. Only two specimens had fruits and the seeds are unknown because these fruits were immature. Thus, more collections may help to clarify the degree of character variation in both rootstock and fruits within this species. The ranges of these species do not overlap but are close; *Geranium polyanthes* occurs in the Himalayas in a zone about 2000 km from Uttaranchal in North India to Yunnan Province in China, whereas *G. umbelliforme* appears easternmost, in Yunnan and Sichuan Provinces.

295. Geranium wardii Yeo, Notes Roy. Bot. Gard. Edinburgh 34(2): 195. 1975. Type locality: "West Central Burma. Mount Victoria: common on turf slopes, mostly in young fruit, 2560 m, 26 x 1956, Kingdon-Ward 22760 (holo. BM!; iso. CGG!)". Type: Burma. Chin, West Central Burma, Mt. Victoria, 21º14'N, 93º55'E, 26 Oct. 1956, *F. Kingdon-Ward 22760* (holotype, BM-000796458!; isotypes, CGG, GB-0047721 image!).

Perennial herbs, 23-30 cm tall. *Rootstock* and roots unknown. *Stem* erect or ascending, leafy, not rooting at nodes, stolons absent, without vegetative stems, with scattered, patent, eglandular hairs 0.2-0.9 mm long. *Basal leaves* in a deciduous rosette, cauline leaves opposite; leaf laminas 2.2-3.3 cm long, 2.7-4.7 cm wide, not peltate, palmatifid [ratio main-sinus length/middle segment length = 0.57-0.60], polygonal in outline, base cordate, not coriaceous, with nerves not projected, with ± appressed, eglandular hairs and plane glandular hairs on both surfaces; segments 5, in 1 plane, middle segment obtriangular, 5.4-7.7 mm wide at the base [ratio segment width at the base/middle segment

length = 0.33-0.38], 7-8-lobed in distal half [ratio secondary sinus length/ middle segment length = 0.17-0.18]; petioles up to 6 cm long, without abscission zone, terete, not swollen, not deflexed in age, with patent, eglandular hairs 0.3-0.4 mm long and patent glandular hairs 0.7-1 mm long; stipules 2.8-5.5 mm long, 1.7-2.4 mm wide, ovate, obtuse, free, papery, brown, with eglandular and glandular hairs on the margin. *Inflorescence* a dichasial cyme with monochasial branches; cymules 2-flowered, solitary [ratio cymule length/leaf length = 2-3.5]; peduncles 29-64 mm long, with uncinate, retrorse, eglandular hairs 0.2-0.3 mm long and patent, glandular hairs 0.4-0.8 mm long; bracteoles 4-4.5 mm long, 0.9-1.2 mm wide, broadly lanceolate, obtuse, whorled; pedicels 18-38 mm long, with uncinate, retrorse, eglandular hairs 0.2-0.3 mm long and patent glandular hairs 0.7-0.8 mm long. Flowers actinomorphic. *Sepals* 6.6-11 mm long, 3.4-4 mm wide, lanceolate, smooth, not accrescent, nerves 3, mucro 1.1-1.2 mm long [ratio mucro length/sepal length = 0.10-0.18], with ± patent, eglandular hairs 0.2-0.3 mm long and patent, glandular hairs 1-1.3 mm long on the abaxial surface, glabrous adaxially. *Petals* 12.6-13.4 mm long, 7.8-8.3 mm wide, erect-patent, rounded, without claw, purple, hairy on the base of the adaxial surface, glabrous abaxially, ciliate on the basal margin, with hairs 0.3-0.5 mm long. *Stamens* 10, both whorls bearing anthers; filaments 3.3-4 mm long, lanceolate, purple, pilose on the abaxial surface, ciliate on the proximal half, with hairs 0.3-0.5 mm long; anthers 1.4-1.5 mm long, purple. Nectaries 5, hemispheric, glabrous. *Gynoecium* 4.4-5 mm long, unknown color. *Fruit* 23-26 mm long, erect, discharge of carpel-projection type, operative; mericarps 3.4-5.2 mm long, 1.2-1.9 mm wide, without a strand of fibers, not compressed at the apex, reticulate, without basal beak, without a basal callus, without a basal prong, brown, with ± appressed, eglandular hairs 0.2-0.3 mm long; rostrum 16-16.5 mm long, without a narrowed apex, not twisted, with patent, eglandular hairs 0.2-0.3 mm long; stigmatic remnants 1.9-2.5 mm long, with 5 glabrous lobes. *Seeds* 2.7-2.8 mm long, 1.5-1.6 mm wide, smooth, uniformly colored, brown, glabrous. Cotyledons not studied. Fig. 744.

Pollen. *Erodium*-type (Aedo 2016: 615).

Chromosome number. Unknown.

Phenology. Collected in flower in October.

Distribution. This species is endemic to central Burma (Fig. 745).

Habitat. Turf slopes; 2550-2800 m.

Discussion. Geranium wardii is only known from the type, a flowering and fruiting collection. However, the specimens lack the rootstock and roots.

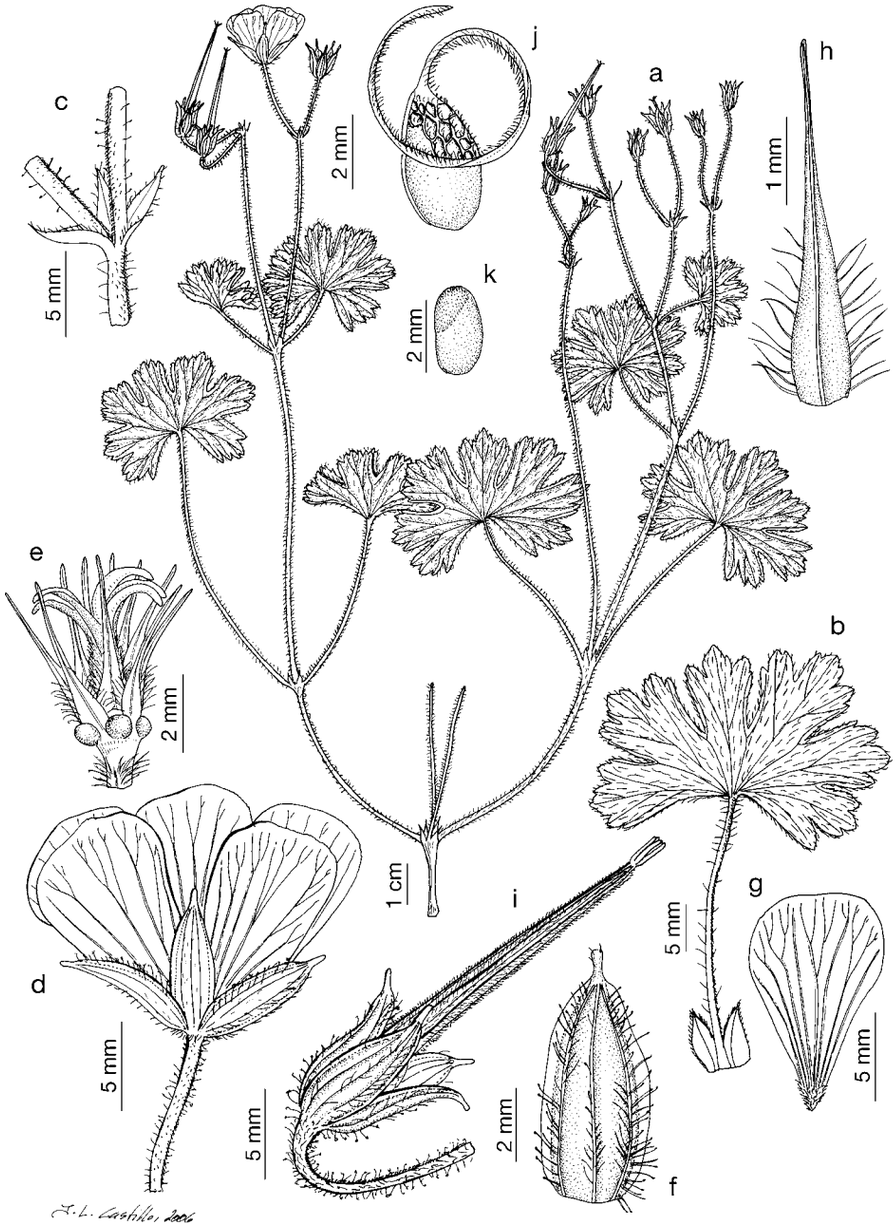


Fig. 744. *Geranium wardii*. a. Habit. b. Leaf. c. Bracteoles. d. Flower. e. Flower without petals and sepals. f. Sepal. g. Petal. h. Staminal filament. i. Fruit. j. Mericarp. k. Seed. (Based on: *Kingdon-Ward 22760,* BM).

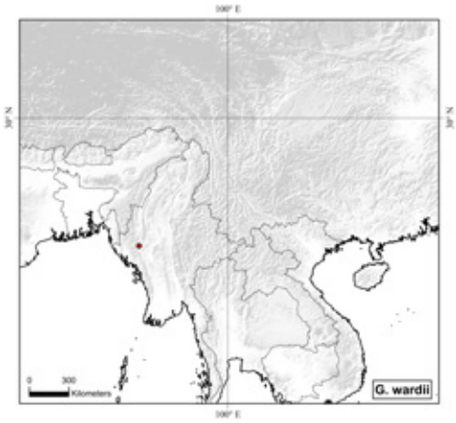


Fig. 745. Distribution of *Geranium wardii*.

Geranium wardii shares with *G. strictipes* and *G. hispidissimum* opposite leaves and inflorescence in dichasial cyme, with monochasial branches. The leaves of *G. hispidissimum* are similar to those of *G. wardii* in the degree of division but have more lobes per segment and a denser indumentum. The petals of *G. wardii* and *G. strictipes* are longer than those of *G. hispidissimum*. In contrast, the sepal mucro of *G. wardii* is shorter than that of *G. strictipes* or *G. hispidissimum*, and the nectaries are glabrous (with a tuft of hairs in *G. strictipes* and *G. hispidissimum*). The stipules of *G. wardii* are ovate with an obtuse apex and resemble those of *G. nakaoanum*, *G. polyanthes*, and *G. umbelliforme*; in *G. strictipes* and *G. hispidissimum* the stipules are lanceolate.

IVe. Geranium sect. **Ruberta** Dumort., Fl. Belg.: 112. 1827. *Robertium* Picard, Mém. Soc. Agric. Boulogne-sur-Mer 1: 134. 1837. *Geranium* sect. *Robertium* (Picard) Godr. in Gren. & Godr., Fl. France 1: 306. 1847, nom. illeg. *Geranium* [§] *Robertiana* Boiss., Fl. Orient. 1: 871. 1867, nom. illeg. *Geranium* sect. *Robertiana* Boiss. ex Reiche in Engl. & Prantl, Nat. Pflanzenfam. 3(4): 9. 1908, nom. illeg. *Robertiella* Hanks in Hanks & Small, N. Amer. Fl. 25: 3. 1907, nom. illeg. Type: *Geranium robertianum* L. (art. 10.8).

Geranium sect. *Lucida* R. Knuth in Engl., Pflanzenr. IV.129 (Heft 53): 44, 60. 1912. Type: *Geranium lucidum* L. (art. 10.8).

Geranium sect. *Anemonifolia* R. Knuth in Engl., Pflanzenr. IV. 129 (Heft 53): 98. 1912. Type: *Geranium anemonifolium* L'Hér. (art. 10.8).

Annual or perennial herbs. *Flowers* predominantly actinomorphic. *Petals* rounded, with claw bicarinate. *Pollen* of *Geranium*-type. *Fruit* of carpel-projection type, operative; mericarps reticulate; rostrum not twisted. *Cotyledons* with entire margins.

Geranium lucidum, the type of section *Lucida*, has a distinctive calyx, with sepals having lengthwise keels and transverse flaps between these, and mericarps with cristate ribs clothed with hooked, small hairs. Those characters become blurred in *G. lasiopus* and *G. glaberrimum*; the sepals have nerves thickened into longitudinal ribs and, sometimes, with weak and incomplete transverse connections, and the mericarps are reticulate, sometimes with eglandular, not hooked hairs. Yeo (2004) recognized section *Lucida* as comprising the last three species despite the fact that he stated that there are links among all species (of sect. *Lucida* and sect. *Ruberta*). Consequently, the question arises as to whether it is necessary to have two sections, without clear boundaries, to accommodate 10 species. I preferred to recognize a broader and better characterized section *Ruberta*, which includes section *Lucida*, instead of separating these species into two sections following the previously mentioned proposal by Yeo (2004).

296. Geranium glaberrimum Boiss. & Heldr. in Boiss., Diagn. Pl. Orient. ser. 1 8: 116. 1849. Type locality: "Geranium glaberrimum Boiss. et Heldr. in pl. Anat. 1846... Hab. in fissuris rupium montis Gheidagh Tauri Isaurici suprà Alaya alt. 5500-6000'. Julio. (Heldreich.)". Type: Turkey. Gheidagh Tauri Isaurici, 36°50'N, 32°15'E, 9 July 1845, *T.H. Heldreich 1042* (lectotype, designated by Aedo 2017b: 417, G-BOIS-00330437!; isolectotypes, BM-000796353!, COI!, E-00438411!, FI!, GOET-004064 image!, H-1293420!, JE- 00010354 image!, K-00729294!, LE!, MA-617382!, P-00712084!, PR-881495!, RO!, W-0051535!, WAG-0004341 image!).

Perennial herbs, 8-43 cm tall. *Rootstock* 6-14 mm in diameter, ± horizontal, not tuberculate, not turnip-shaped, without thickened roots. *Stem* erect, leafy, not rooting at nodes, stolons absent, without vegetative stems, glabrous. *Basal leaves* in a ± persistent rosette, cauline leaves opposite; leaf laminas (1.8)2.3-4.6(6.4) cm long, 2-7.8 cm wide, not peltate, palmatifid [ratio main-sinus length/middle segment length = (0.63)0.66-0.77(0.83)], polygonal in outline, base cordate, not coriaceous, with nerves not projected, glabrous; segments 5, in 1 plane, middle segment obtriangular to rhombic, 3.5-16.4 mm wide at the base [ratio segment width at the base/middle segment length = (0.24)0.28-0.35(0.41)], (3)4-8(12)-lobed in distal half [ratio secondary sinus length/middle segment length = (0.12)0.15-0.18(0.27)]; petioles up to 17 cm long, without abscission zone, terete, not swollen, not deflexed in age, glabrous; stipules (1.6)2.3-3.6(7.4) mm long, 0.7-2.6 mm wide, ovate, obtuse, free, papery, brown, glabrous. *Inflorescence* a dichasial cyme with monochasial branches; cymules 2-flowered, solitary or, rarely in aggregates at the top of each branch [ratio cymule length/leaf length = 1-3.5]; peduncles 14-41(64) mm long, glabrous; bracteoles 1-2.3 mm long, 0.4-0.9 mm wide, lanceolate, obtuse, whorled; pedicels 8-20(40) mm long, glabrous. Flowers actinomorphic. *Sepals* (5.3)5.6-6.7(7.1) mm long, 2.2-3.8 mm wide, lanceolate, the three outer with 2-3 longitudinal ribs sometimes with incomplete transverse connections and the inner smooth, not accrescent,

nerves 3, mucro (0.5)0.6-1.1(1.2) mm long [ratio mucro length/sepal length = (0.09)0.10-0.19], glabrous. *Petals* (11.2)13.2-15.1(18.8) mm long, (4)4.7-6.9(9) mm wide, patent, rounded, with claw 3.2-9.1 mm long (bicarinated), purple, usually glabrous on the adaxial surface, hairy on the base of abaxial surface, ciliate on the basal margin, with hairs 0.2-0.4 mm long. *Stamens* 10, both whorls bearing anthers; filaments (8.7)11.2-12.7(13.9) mm long, linear-lanceolate, pink, usually glabrous, rarely with some cilia 0.2-0.3 mm long on the base or on the distal half; anthers (1.1)1.4-1.6 mm long, reddish. Nectaries 5, hemispheric, glabrous. *Gynoecium* 9-14.3 mm long, deep pink. *Fruit* (18.7)21-24(27) mm long, erect, discharge of carpel-projection type, operative; mericarps 2.7-4.8 mm long, 1.1-1.8 mm wide, without a strand of fibers, not compressed at the apex, reticulate, with the thin ridges slightly branched, without basal beak, without a basal callus, without a basal prong, brown, glabrous or scarcely hairy with short and usually hooked eglandular hairs 0.1-0.2 mm long; rostrum 12.7-20.7 mm long, with a narrowed apex 6.3-11.2 mm long, not twisted, glabrous; stigmatic remnants 0.9-1.4 mm long, with 5 glabrous lobes. *Seeds* 2.3-3.4 mm long, 1-1.2 mm wide, smooth, uniformly colored, brownish red, glabrous. Cotyledons with entire margin. Fig. 746.

Pollen. *Geranium*-type (Aedo 2017: 412).

Chromosome number. 2*n* = 30.

Phenology. Collected in flower from May to July.

Distribution. This species ranges through southern Turkey (Fig. 747).

Habitat. At the top of small, nearly vertical limestone cliffs; 950-2100 m.

Additional specimens examined. **Turkey.** Antalya: 20 km NE Mahmutlat, Alanya, 36º34'N, 32º17'E, 2 May 2000, *Ulrich s.n.* (B); Antalya, Geyik Dağlari, Akdaği, 36º53'N, 32º10'E, 19 July 1999, *Döring & al. 745* (B); Antalya, südliche Dedegöl Dağlari, Nordflanke des Derme Tepe, c. 13 km NO Beşkonak, 37º14'N, 31º20'E, 10 July 1992, *Hein A-43-D* (B, P); Antalya, Gebiz (Pisidia), Bozburun dag at Tasli, 37º17'N, 31º2'E, 25 July 1949, *Davis 15551* (W); Isparti, 46

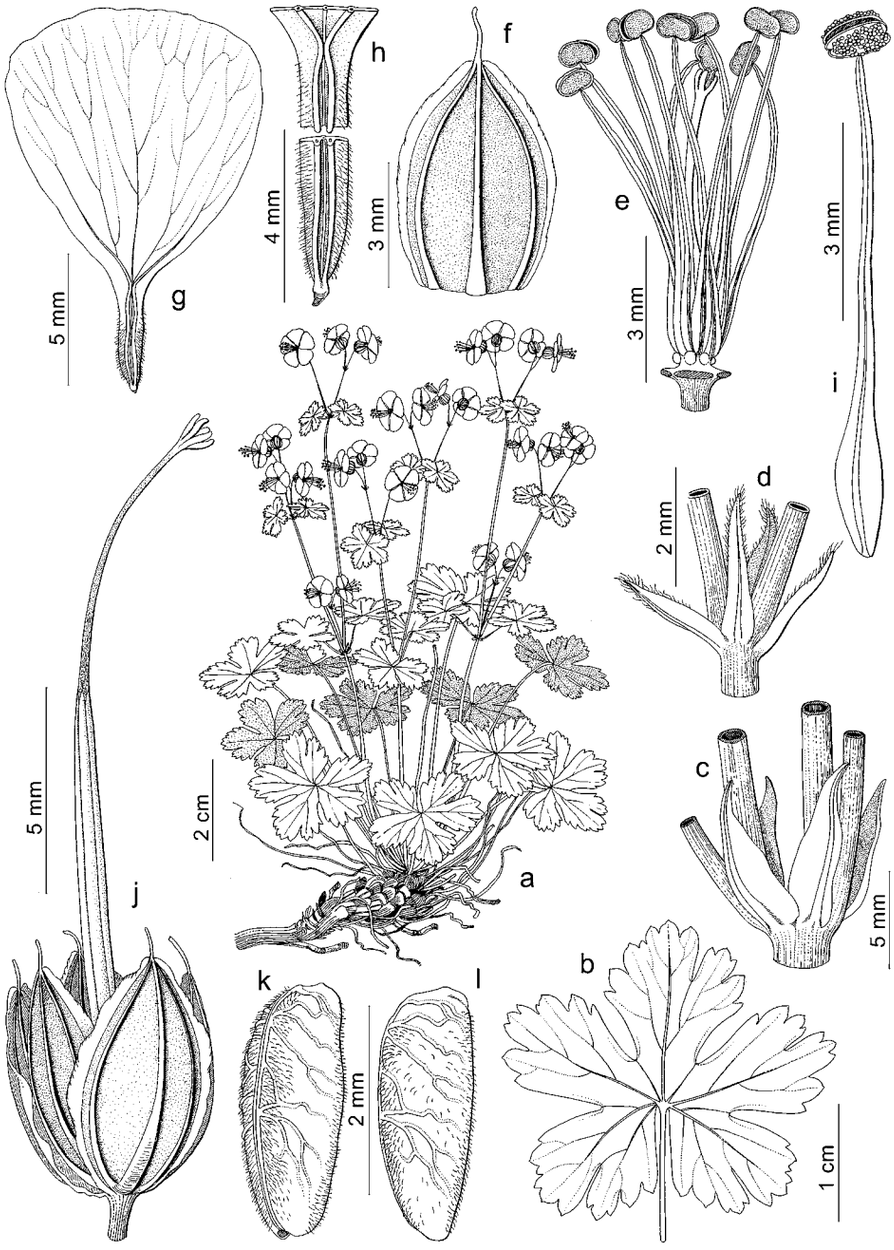


Fig. 746. *Geranium glaberrimum*. a. Habit. b. Leaf. c. Stipules. d. Bracteoles. e. Flower without petals. f. Outer sepal. g. Petal. h. Petal claw. i. Stamen. j. Fruit. k, l. Mericarps. (Based on: a-i, *Sorger 67-5-62,* W; j-l, *Sorger 73-13-32*, W).

Fig. 747. Distribution of *Geranium glaberrimum*.

km from Begsehir on the road to Akseki, 37°18'N, 31°50'E, 2000, *Yeo CA 5255* (MA); Antalya, Akseki, 37°26'N, 31°38'E, 9 June 1970, *Pamukcuoglu & Quezel s.n.* (HUB). Kahramanmaraş: Maras, 10 km N Andirin, 37°34'N, 36°21'E, 1 June 1973, *Sorger 73-13-32* (W); Maras, Hobek Dagi, Kaya iizerleri, 37°48'N, 36°20'E, 10 May 1999, *Ilçim 450* (MA). Konya: 30 mi N Akseki, 100 mi SW Konya, Toros Daglari, 37°26'N, 31°38'E, 2 June 1961, *Stutz 1484* (W); Dedegöldag, W Beysehirsee, 37°39'N, 31°17'E, 3 July 1965, *Sorger 65-43-32* (W). Mersin: entre Anamur et Ermanek vers Saray Mahallesi, pres du village Kozagaçi, 36°18'N, 33°0'E, *Guittonneau 73062603* (MA). Isparta: Cicekdag, 37°51'N, 31°18'E, 17 June 1967, *Sorger 67-5-62* (W).

Discussion. Geranium glaberrimum is a perennial herb with a robust, more or less horizontal rootstock that shows some stipules and the petiole base. This species is almost completely glabrous. Some hairs, however, usually appear on the petal claw and on the mericarp surface and rarely on the staminal filament. The inflorescence is a dichasial cyme with monochasial branches. In each node, there is a pair of opposite leaves and a 2-flowered cymule. At the apex of each branch appears a solitary 2-flowered cymule or groups of several cymules. These groups are distinct, that is, with well-developed peduncles and pedicels. The flowers are actinomorphic. The outer sepals have the nerves thickened into longitudinal ribs and, sometimes, with weak and incomplete transverse connections. Yeo (2004: 412, 423) suggested that these features would indicate a link with *G. lucidum*. The stamens are a bit shorter than the petals, but they seem exserted because the petal blade is spreading. The staminal filaments and style are straight, not curved as in *G. macrorrhizum*, linear-lanceolate, without an expanded base, and usually glabrous. In some individuals, scattered cilia appear on the base (*Sorger 73-13-32*, W) or toward the apical half (*Sorger 65-43-32*, W; *Sorger 67-5-62*, W). When the fruit is still immature, the staminal filaments remain appressed to the rostrum, protruding from the sepals, as in *G. macrorrhizum* and *G. dalmaticum*. The mericarps usually have a small number of short and usually hooked, eglandular hairs. These types of hairs are similar to those found in the mericarp of *G. lucidum*. One specimen has an unusual densely hairy mericarp (*Ilçim 450*, MA), but otherwise it is very similar to *G. glaberrimum*. The mericarps usually have unelevated veins, slightly branched and with a veinless zone toward the ventral margin. One individual has raised ribs extending nearly to the ventral margin (*Ulrich s.n.*, B) as was already noted by Yeo (2004: 423), but it matches *G. glaberrimum* otherwise. *Geranium glaberrimum* may be most closely allied with *G. lasiopus*; see under *G. lasiopus* for a discussion of the relation between the two species.

297. Geranium lasiopus Boiss. & Heldr. in Boiss., Diagn. Pl. Orient. ser. 1, 8: 117. 1849. Type locality: "Geranium lasiopus Boiss. et Heldr. in pl. Anat. exs. 1846 ... Hab. in fissuris rupium Lycaoniae inter Ghelindost et Karagatch Jun. (Heldreich.)". Type: Turkey. Isparta, inter Ghelindost et Karagatch, 38°11'N, 31°13'E, 9 June 1845, *T.H. Heldreich s.n.* (lectotype, designated by Aedo 2017b: 419, G-BOIS-00330438!; isolectotypes, BM-000796352!, CGE image!, FI!, LE!, K-000729292!, P-00712112!, W-1889-0001477!).

Perennial herbs, 7-18 cm tall. *Rootstock* 4-13 mm in diameter, ± horizontal, not tuberculate, not turnip-shaped, without thickened roots. *Stem* erect, leafy, not rooting at nodes, stolons absent, without vegetative stems, with patent, eglandular hairs 0.3-0.9 mm long and, sometimes, scattered, patent, glandular hairs 0.3-0.9 mm long. *Basal leaves* in a ± persistent rosette, cauline leaves opposite; leaf laminas (1.4)1.6-3.5(4.1) cm long, 1.6-4.7 cm wide, not peltate, palmatifid [ratio main-sinus length/middle segment length = (0.50)0.61-0.73(0.77)], polygonal in outline, base cordate, not coriaceous, with nerves not projected, with appressed, eglandular and sometimes glandular hairs on both surfaces; segments 5, in 1 plane, middle segment obtriangular, 3.3-9.1 mm wide at the base [ratio segment width at the base/middle segment length = (0.19)0.31-0.35(0.47)], 3-9-lobed in distal half [ratio secondary sinus length/middle segment length = (0.07)0.11-0.19(0.22)]; petioles up to 9 cm long, without abscission zone, terete, not swollen, not deflexed in age, with patent, eglandular hairs 0.2-0.8 mm long and, sometimes, patent glandular hairs 0.3-0.5 mm long; stipules (2.5)4-4.9(5.1) mm long, 0.7-1.4 mm wide, lanceolate, free, papery, brownish red, with eglandular hairs on the abaxial surface and margin, glabrous adaxially. *Inflorescence* a dichasial cyme with monochasial branches; cymules 2-flowered, solitary [ratio cymule length/leaf length = 1.5-3.7]; peduncles (8)11-31(82) mm long, with patent, eglandular hairs 0.2-0.7 mm long and, sometimes, patent, glandular hairs 0.1-0.2 mm long; bracteoles 1.3-5.8 mm long, 0.4-1.1 mm wide, lanceolate, whorled; pedicels (8.2)8.7-18(23) mm long, with patent, eglandular hairs 0.2-0.7 mm long and, sometimes, patent, glandular hairs 0.2-0.7 mm long. Flowers actinomorphic. *Sepals* (4.5)5.2-6.5(6.6) mm long, 2.3-3.6 mm wide, lanceolate, the three outer with 2-3 longitudinal ribs and the inner smooth, not accrescent, nerves 3, mucro (0.3)0.5-0.7(1.1) mm long [ratio mucro length/sepal length = (0.07)0.11-0.16(0.18)], with ± patent, eglandular hairs 0.3-0.7 mm long and rarely, patent, glandular hairs 0.2-0.5 mm long on the abaxial surface, glabrous adaxially. *Petals* (10)10.5-14.9(16.8) mm long, (4.6)4.8-8(8.9) mm wide, patent, rounded, with claw 2.4-7.3 mm long (bicarinated), purple, glabrous on the adaxial surface, glabrous or hairy on the base of the

abaxial surface, ciliate on the basal margin, with hairs 0.2-0.3 mm long. *Stamens* 10, both whorls bearing anthers; filaments (7)8.7-11.7(15.6) mm long, linear-lanceolate, deep pink, glabrous; anthers 1.5-2.1 mm long, reddish. Nectaries 5, hemispheric, glabrous. *Gynoecium* 7.9-10.2 mm long, deep red. *Fruit* 16-17 mm long, erect, discharge of carpel-projection type, operative; mericarps 4.3-4.5 mm long, 1.3-1.5 mm wide, without a strand of fibers, not compressed at the apex, reticulate, with the thin ridges slightly branched and with a veinless zone towards the ventral margin, without basal beak, without a basal callus, without a basal prong, brown, densely hairy with short and usually hooked eglandular hairs 0.1-0.2 mm long; rostrum 12-13 mm long, with a narrowed apex 8-9 mm long, not twisted, with patent, eglandular hairs 0.3-0.4 mm long restricted to the narrowed apex; stigmatic remnants 1.1-1.2 mm long, with 5 glabrous lobes. *Seeds* 2.4-3.2 mm long, 8.8-1.1 mm wide, smooth, uniformly colored, brownish red, glabrous. Cotyledons not studied. Fig. 748.

Pollen. *Geranium*-type (Aedo 2017: 412).

Chromosome number. 2*n* = 48.

Phenology. Collected in flower from April to June.

Distribution. This species ranges through southern Turkey (Fig. 749).

Habitat. Vertical to slightly overhung limestone cliffs; 1400-1700 m.

Additional specimens examined. **Turkey.** Isparta: Dedegöldag, 37°39'N, 31°17'E, 15 June 1966, *Sorger 66-46-61* (W); Isparta, Egridir, 37°53'N, 30°49'E, 28 Apr. 1974, *Peşmen & Güner 1258* (HUB); Isparta, S Karaagag, Kizildag Milli Park, Kuçuksivri, 38°4'N, 31°24'E, 25 June 1994, *Mutlu 848* (HUB). Konya: Eregli, Aydos Dagi, Kayasaray, Kuaçli, 37°22'N, 34°15'E, 22 June 1977, *Erik 2272* (HUB); Konya, Caramania, in fisuris rupium Karagatch Pisidiae, 37°35'N, 32°49'E, May 1845, *Heldreich s.n.* (K, P). Muğla: Badadag above Fethiye, 36°32'N, 29°9'E, June 2002, *Eren 5158* (B); Mugla, Badadag, SE of Fethiye, N slope, 36°32'N, 29°9'E, 17 May 1990, *Turland 354* (BM).

Discussion. Geranium lasiopus is similar to *G. glaberrimum*. As Yeo (2004) stated, both species are alike

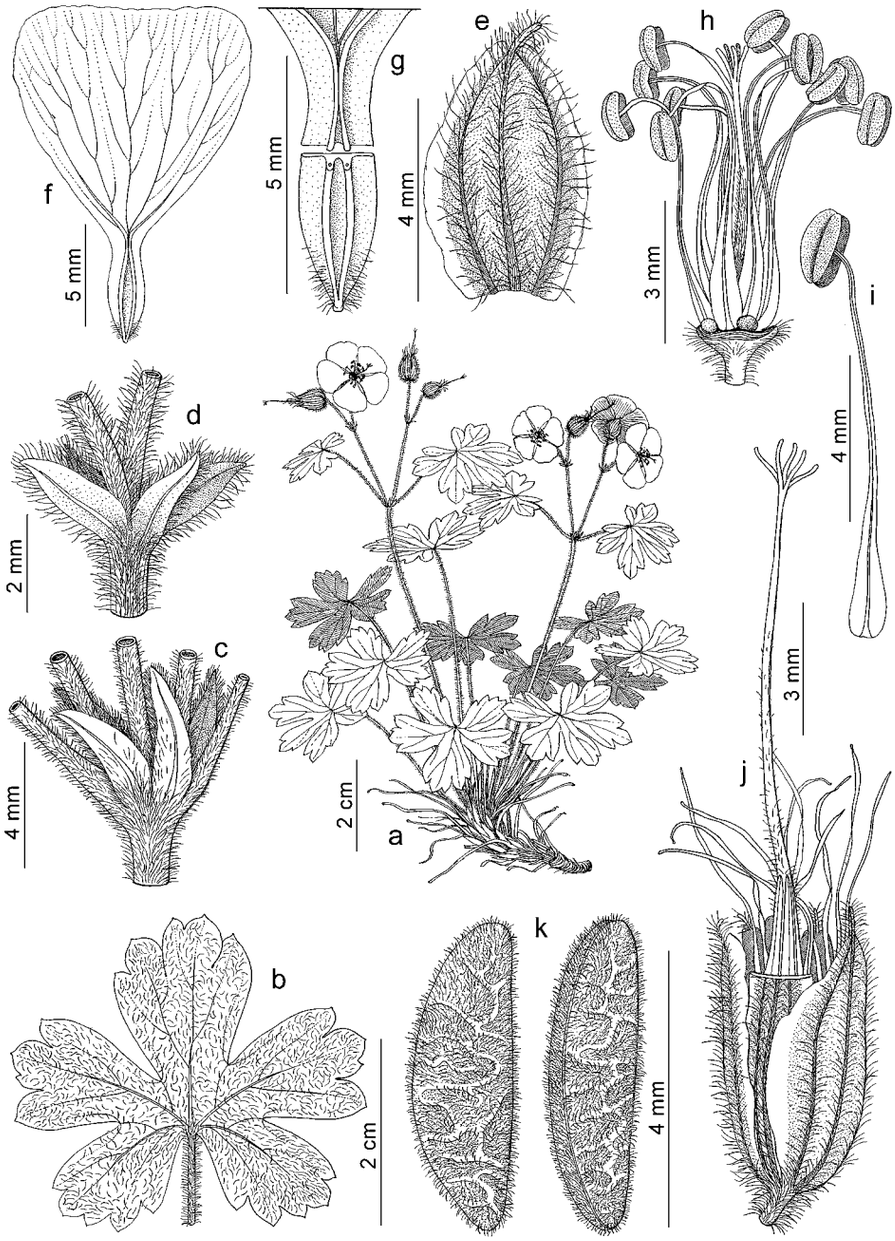


Fig. 748. *Geranium lasiopus*. a. Habit. b. Leaf. c. Stipules. d. Bracteoles. e. Sepal. f. Petal. g. Petal claw. h. Flower without sepals and petals. i. Stamen. j. Fruit. k. Mericarps. (Based on: a, c-i, *Erik 2272*, W; b, j, k, *Sorger 06-46-61*, W).

Fig. 749. Distribution of *Geranium lasiopus*.

in habit, flower, and leaf shape. They also share outer sepals with the nerves thickened into longitudinal ribs, a bicarinate petal claw, and the presence of hooked, eglandular hairs on the mericarps. In contrast, *G. lasiopus* is easily distinguished from *G. glaberrimum* because its dense indumentum on the stem and leaves is mainly comprised of eglandular hairs. *Geranium lasiopus* has an unusual fruit with the narrowed apex much longer than the basal part of the rostrum. Unfortunately, *Geranium lasiopus* has been collected only a few times, and some aspects of its variability, such as the previously mentioned rostrum, remain unknown. The sepal longitudinal ribs and mericarp indumentum suggest that *G. lasiopus* is also close to *G. lucidum*. However, the latter has some important differences: annual life span, outer sepals with lengthwise keels, and transverse flaps between these, and smaller petals and mericarps with longitudinal cristate ribs. Davis (1967: 454) did not make a formal proposal of type for *Geranium lasiopus*. He only indicated a list of herbaria with original material of this species.

298. Geranium lucidum L., Sp. Pl.: 682. 1753. *Robertium lucidum* (L.) Picard, Mém. Soc. Agric. Boulogne-sur-Mer 1: 134. 1837. *Geranium saxatile* Thal ex Bubani, Fl. Pyren. 3: 316. 1901, nom. illeg. Type locality: "Habitat in Europae rupibus umbrosis". Type: "Habitat in Europae rupibus umbrosis" (lectotype, designated by Ghafoor 1978: 43, LINN-858.72 image!).

Geranium lucens Hocq., Fl. Jemmape: 205. 1814. Type locality: "Vers Chimay et Marienbourg". Syntypes: Belgium. Vers Chimay, 50°03'N, 4°19'E, *L. F. Hocquart s.n.*; Marienbourg, 50°06'N, 4°30'E, *L.F. Hocquart s.n.* (no original material located).

Geranium lucidum var. *montanum* N. Terracc., Annuario Reale Ist. Bot. Roma 4: 82. 1891. Type locality: "In rupibus umbrosis montosis.- Pollino alle Neviere a 1500 m". Type: Italy. Pollino, Neviere, 39°55'N, 16°11'E, July 1887, *N. Terracciano s.n.* (lectotype, here designated, RO!).

Annual herbs, 5-39 cm tall. *Stem* erect, leafy, glabrous. *Basal leaves* in a persistent rosette, cauline leaves opposite (sometimes alternate in middle of shoot, 1-2 nodes); leaf laminas (1.2)2.2-3.3(3.8) cm long, 1.3-4.8 cm wide, not peltate, palmatifid [ratio main-sinus length/middle segment length = (0.46)0.56-0.66(0.73)], orbicular in outline, base cordate, not coriaceous, with nerves not projected, with scattered, ± appressed, plane glandular hairs on the adaxial surface and glabrous abaxially; segments 5, in 1 plane, middle segment obtriangular, 3.3-10 mm wide at the base [ratio segment width at the base/middle segment length = (0.26)0.31-0.35(0.40)], 3-7(8)-lobed at the apex [ratio secondary sinus length/middle segment length = (0.08)0.10-0.16(0.23)]; petioles up to 11 cm long, without abscission zone, terete, not swollen, not deflexed in age, glabrous or, more rarely, with some uncinate, antrorse, eglandular hairs 0.2-0.3 mm long; stipules (1.3)2.4-3.5(6.1) mm long, 0.4-1.8 mm wide, lanceolate, free, papery, hyaline, glabrous. *Inflorescence* a dichasial cyme with monochasial branches; cymules 2-flowered, solitary [ratio cymule length/leaf length = (0.7)1.1-5.1]; peduncles (6.5)17-26(78) mm long, with uncinate, antrorse, eglandular hairs 0.2-0.4 mm long or, more rarely, glabrous; bracteoles 0.5-2.4 mm long, 0.2-0.9 mm wide, lanceolate, whorled; pedicels (4)5-11(22) mm long, with uncinate, antrorse, eglandular hairs 0.2-0.4 mm long. Flowers actinomorphic. *Sepals* (5.2)5.6-6.2(6.7) mm long, 2.1-4.1 mm wide, lanceolate, the three outer with lengthwise keels and transverse flaps between these, the two inner ± smooth, not accrescent, nerves 3, mucro (0.4)0.5-0.7(1) mm long [ratio mucro length/sepal length = (0.07)0.09-0.12(0.20)], glabrous. *Petals* (7.1)7.5-9.7(11.7) mm long, (1.1)1.7-2.2(2.7) mm wide, patent, rounded, with claw 3.9-6 mm long (bicarinated), purple, glabrous. *Stamens* 10, both whorls bearing anthers; filaments (5.3)6.4-7.3(7.6) mm long, linear-lanceolate, white, glabrous; anthers (0.2)0.3-0.4(0.5) mm long, yellow. Nectaries strongly reduced. *Gynoecium* 5-9.1 mm long, pink. *Fruit* (13.2)15-16(17.5) mm long, erect, discharge of carpel-projection type, operative; mericarps 1.8-2.8 mm long, 0.9-1.6 mm wide, without a strand of fibers, not compressed at the apex, reticulate, with 4-6 prominent, cristate, apical keels, thin lateral ridges slightly branched and a veinless zone towards the ventral margin, without basal beak, without a basal callus, without a basal prong, brown, glabrous on most of the surface, with hooked, eglandular hairs 0.1-0.2 mm long on the margin and on the keels; rostrum 6.3-13.2 mm long, with a narrowed apex 4-6.4 mm long, not twisted, glabrous in the proximal half, with erect-patent, eglandular hairs 0.1-0.2 mm long in the distal half; stigmatic remnants 0.6-1.1 mm long, with 5 glabrous lobes. *Seeds* 1.6-2.1 mm long, 0.9-1.2 mm wide, smooth, uniformly colored, brownish red, glabrous. Cotyledons with entire margin. Figs. 750, 751.

Pollen. *Geranium*-type (Aedo 2017: 412; Bortenschlager 1967: 455; Perveen & Gaiser 1999: 267; Stafford & Blackmore 1991: 76; Velasco 1992b: 58).

Chromosome number. 2*n* = 20, 40, c. 40, 42, 40-44, 60.

Phenology. Collected in flower from March to August.

Distribution. This species ranges from Europe to western Himalayas and northern Africa and it is introduced in western U.S.A. (Fig. 752).

Habitat. Open forests, clearings of scrubs, rocky areas, shady ledges, meadows, and roadsides; 0-3300 m.

Representative specimens examined. **Albania.** Vlorë: Saranda, 39º52'N, 20º0'E, 23 Apr. 1987, *Bellingham s.n.* (BM). **Algeria.** Tlemcen: Ghar Rouban, 34º36'N, 1º46'W, *Pomel s.n.* (MPU). **Armenia.** Syunik: pr. Nerkin Hand village, 39º3'N, 46º31'E, 26 June 2005, *Gonzalo & al. 313* (MA). **Azerbaijan.** Lankaran: Talysh, Hyrkanisches Waldreservat Qirkan qorugu, W des Stausees Xanbulaq, 38º40'N, 48º45'E, 26 May 2001,

Schneeweiss & Tribsch 6770 (W). **Belgium.** Wallonia: Liège, Huy, 50°32'N, 5°14'E, 26 May 1997, *Lambinon 97-38* (MA). **Bulgaria.** Plovdiv: Central Rhodope Mts., pr. Assenovgrad, 41°59'N, 24°52'E, 29 June 2004, *Aedo & al. 10184* (MA). **Croatia.** Primorje-Gorski Kotar: Istria, Tersato bei Fiume, 45°19'N, 14°28'E, 19 May 1887, *Richter s.n.* (COI). **Cyprus.** Nicosia: bajo el pico Tripylos, 35°0'N, 32°40'E, 17 Apr. 2019, *Aedo & al. 26474* (MA). **Denmark.** Hovedstaden: Bornholm, Helligdommen, 55°10'N, 15°0'E, 10 July 1864, *Baagoe s.n.* (COI). **Estonia.** Saare: Livonia, insula Osilia, Kaugatoma-Pank, peninsulae Sworbe, 58°23'N, 21°51'E, 30 June 1900, *Kupffer 11627* (LE). **Finland.** Åland: Alandia, par. Saltvik, insula Haraldsbyholmen, 60°17'N, 20°3'E, June, *Granberg s.n.* (MA). **France.** Corse: Solenzara, 41°51'N, 9°24'E, 20 Apr. 1935, *Aellen 3293* (MO). île-de-France: Seine et Marne, Saint-Pierre-lès-Nemours, 48°16'N, 2°40'E, 14 June 1916, *Hibon s.n.* (P). **Georgia.** Tbilisi: Dabahane gorge, 41°42'N, 44°45'E, 30 June 1959, *Davis 33877* (K). **Germany.** Brandenburg: Potsdam, 52°23'N, 13°4'E, 5 June 1904, *Gallopf s.n.* (MA). **Great Britain.** England: above Malham Tarn 6 m NE of Settle, Yorkshire, 54°4'N, 2°16'W, 23 June 1956, *Clarke s.n.* (MA). **Greece.** Kriti: Rethymo, Anoguia, Psiloritis mountain, 35°12'N, 24°49'E, 25 June 2018, *Riera & al. 8921* (MA). Peloponnese: Achaia, Kalavrita, Mts. Chelmos, Mt. Avgho, 38°1'N, 22°10'E, 21 June 2007, *Aedo & al. 14197* (MA). **Hungary.** Pest: Hungaria centr., Johannisberg ad Budam, 47°31'N, 18°57'E, *Kerner s.n.* (COI, P). **India.** Himachal Pradesh: Punjab, Bashahr, Shimla, Gahan, 31°10'N, 77°35'E, 6 May 1928, *Parker 2796* (LE). Uttaranchal: Gurhwal, 30°15'N, 79°20'E, 1864, *Falconer 319* (LE, P, W). **Iran.** Fars: Talimansur, Bakhtiari, 28°57'N, 53°15'E, 28 Apr. 1940, *Koelz 15095* (W). **Iraq.** Sulaymaniyah: near Derbendikhan Dam, Sulaimaniya Liwa, 35°6'N, 45°41'E, 26 Apr. 1963, *Al-Ani & al. 144A* (W). **Ireland.** Leinster: Dublin, 53°25'N, 6°15'W, *Ball s.n.* (P). **Israel.** Northern: Upper Galilee, meron to bet Jahn, 32°59'N, 35°24'E, 5 May 1926, *Naftolsky s.n.* (FI). **Italy.** Puglia: pr. Monte Sant'Angelo, 41°42'N, 15°57'E, 9 Apr. 2015, *Aedo 22481* (MA). Sardegna: Nouro, Bolotana, Badde Salghes, Mularza Noa, 40°20'N, 8°54'E, 2 June 2003, *Aedo & al. 9162* (MA). Sicilia: Palermo, La Pizzuta, pr. Portella della Páglia, 37°59'N, 13°15'E, 30 May 2000, *Aedo & al. 5772* (MA). **Jordan.** Jerash: E of Suf, 32°19'N, 35°50'E, 4 May 1911, *Meyers & Dinsmore 1748* (K). **Lebanon.** Beqaa: Zahlé, 33°50'N, 35°54'E, 6 Apr. 1930, *Gombault 1151* (P). **Libya.** Derna: Cirenaica, Lamluda, 32°46'N, 22°8'E, 9 Apr. 1933, *Pampanini 4446* (FI). **Montenegro.** Kotor: Dalmazia, Cattaro, 42°25'N, 18°46'E, June 1882, *Marchesetti s.n.* (FI). **Morocco.** Tanger-Tetouan-Al Hoceima: Xauen, Jbel Lakra, Hauta-el-Kasdir, 35°6'N, 5°7'W, 22 June 1997, *Aedo & al. 4118* (MA). **Netherlands.** North Brabant: Dorp, 51°39'N, 4°46'E, 12 June 2012, *Reijerse s.n.* (L). **North Macedonia.** Pelagonia: montes Galicica, E lacum Prespa, supra vicum Leskovec, 40°54'N, 21°1'E, 27 June 1937, *Klásterský s.n.* (PR). **Norway.** Nordland: Breivikdalen i ei urd, Breivik, Velfjord, 65°3'N, 12°14'E, 24 July 1932, *Strompdal 372* (O). **Pakistan.** Khyber Pakhtunkhwa: Changla Gali, Murree Hills, 33°59'N, 73°23'E, June, *Siddiqi s.n.* (F). **Poland.** Masovian: Warschau, 52°15'N, 21°0'E, 6 May 1884 (LE). **Portugal.** Madeira: Faja da Nogueira, 32°44'N, 16°54'W, 26 June 2000, *Navarro 3070* (MA). Minho: pr. Monçao, 42°4'N, 8°28'W, 20 Apr. 2008, *Aedo 15582* (MA). **Romania.** Sud-Muntenia: Arges, Gorges de Dimbovicioara, 45°27'N, 25°13'E, 9 July 1998, *Güemes & Bacchetta 2442* (MA). **Russia.** Dagestan: Dagestan,

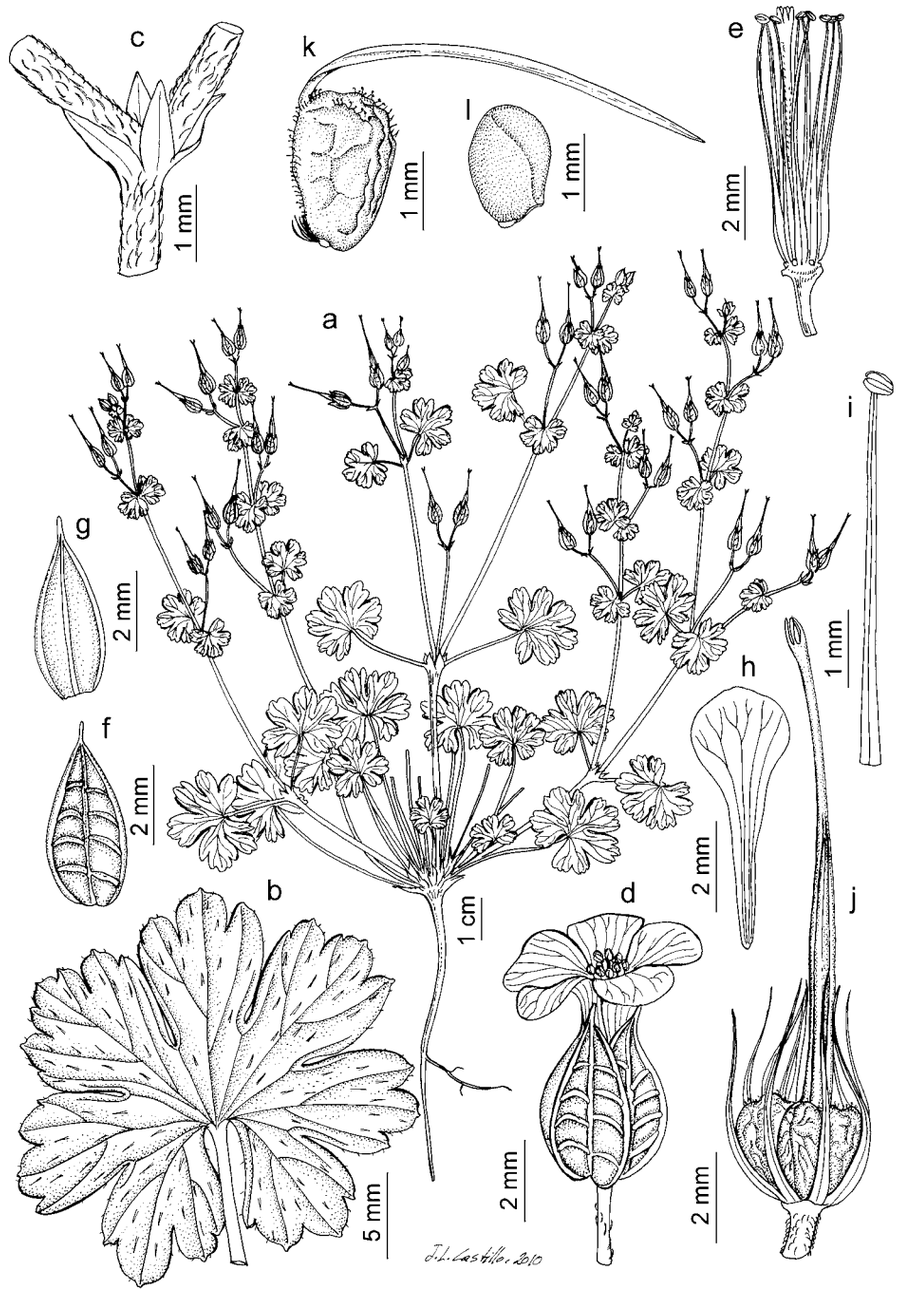
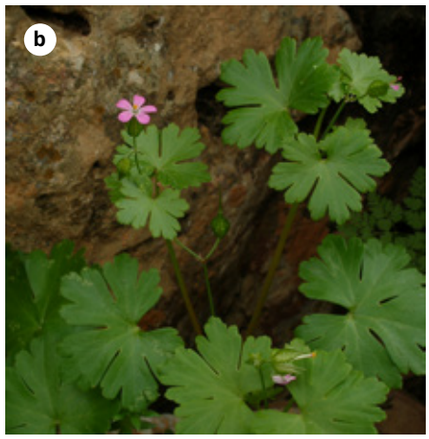


Fig. 750. *Geranium lucidum*. a. Habit. b. Leaf. c. Bracteoles. d. Flower. e. Flower without petals. f. Outer sepal. g. Inner sepal. h. Petal. i. Stamen. j. Fruit. k. Mericarp. l. Seed. (Based on: a-c, j-l, *Ladero & al. s.n.,* MA-252484; d-i, *Vicioso s.n.,* MA-71244).



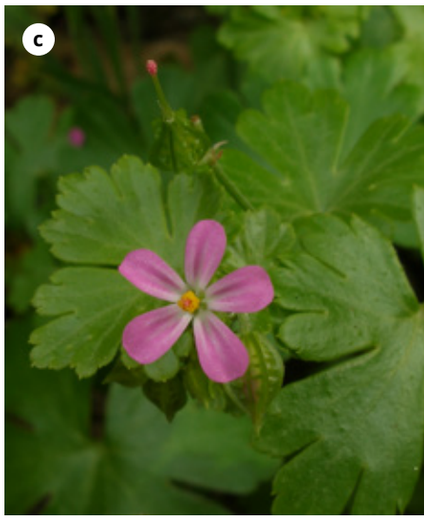


Fig. 751. *Geranium lucidum* (Based on: a-c, *Aedo 12586,* MA; d, e, without voucher, cultivated at *Real Jardín Botánico de Madrid*).

pr. Derbent, 42°4'N, 48°17'E, 16 May 1901, *Alexeenko 7440* (LE). Krasnodar: Circassiae, Tschernomore, 44°59'N, 41°10'E, 3 June 1924, *Steup s.n.* (LE). Krym: Yalta, above Nikita, 44°30'N, 34°14'E, 2 June 1959, *Davis 33344* (LE). Stavropol: Terek, Pjatigorsk, 44°2'N, 43°3'E, 28 July 1912, *Gordiagin s.n.* (LE). **Saudi Arabia.** Makkah: Jabal Ibrahim, off the Taif- Al Baha road, 21°30'N, 40°50'E, 20 Mar. 1987, *Collenette 6129* (K). **Serbia.** Šumadija and Western Serbia: in agro vrajano, 44°10'N, 20°50'E, May 1895, *Adamovic s.n.* (P). **Slovakia.** Bratislava: Slovakia austro-occidentalis, Malacky, montes Malé Karpaty, 48°26'N, 17°1'E, 25 June 1933, *Domin s.n.* (MA). **Spain.** Baleares: Mallorca, Lluc, 39°49'N, 2°51'E, 5 May 1947, *Ferrer s.n.* (MA). Cantabria: Hermandad de Campoo de Suso, Riaño, 43°0'N, 4°17'W, 25 July 1992, *Aedo 2409* (MA). **Sweden.** Kalmar: Öland, Borgholm, 56°53'N, 16°39'E, June, *Ringselle s.n.* (MO). **Switzerland.** Neuchâtel: Saint-Aubin, 46°53'N, 6°46'E, June, *Payot 965* (MO). **Syria.** Homs: Al Hikir, 34°53'N, 36°18'E, 5 May 2007, *Rico 2252* (MA). **Tunisia.** Jendouba: Ghardimaou, La Roche, 36°29'N, 8°18'E, 30 Mar. 2009, *Quintanar & al. 3197* (MA). **Turkey.** Balikesir: Bandirma, Erdek, monte Malya Tepeler, 40°27'N, 27°50'E, 12 May 2000, *Castroviejo 15209* (MA). Karabük: Zonguldak, Safranbolu, cañón Incekaya, 41°16'N, 32°41'E, 19 June 2001, *Aedo & al. 6354* (MA). **Turkmenistan.** Ahal: pr. Ashabad, in montibus ad scaturigines pr. Chan-Jaila (pr. Firyuza), 37°55'N, 58°3'E, 18 July 1897, *Litvinov 1136* (LE). **Ukraine.** Ivano-Frankivsk: Fischair-Dubki, 48°46'N, 25°27'E, 6 June 1900, *Golde s.n.* (LE). **USA.** California: Alameda Co., Strawberry Canyon in Berkeley Hills, 37°52'N, 122°14'W, 13 July 1996, *Ertter 15979* (MA). Oregon: Yamhill Co., Carlton, 45°17'N, 123°10'W, 23 May 1985, *Halse 3009* (UC). Washington: Pierce Co., near junction of Route 507 and Rice Kandle Road, 47°34'N, 122°20'W, 16 May 2017, *Zika 28716* (MA).

Discussion. Geranium lucidum is a small annual with a basal rosette and a more or less branched, erect stem. Cauline leaves are usually similar in shape to the basal leaves, becoming progressively shorter toward the shoot apex. The cauline leaves are alternate in the middle of the shoot (one to two nodes) and opposite toward the apex. The inflorescence is a dichasial cyme with monochasial branches. However, small or not well-developed individuals may show a monochasial inflorescence. This species is almost totally glabrous, although some hairs usually appear on the leaf, peduncles, and pedicels as well as the fruit. *Geranium lucidum* has a distinctive calyx because the three outer sepals have lengthwise keels and transverse flaps between these. The stamens are shorter than the petals, but they seem exserted because the petal blade is spread. The staminal filaments and style are straight, not curved as in *G. macrorrhizum*, linear-lanceolate, without an expanded base, and glabrous. The nectaries are strongly reduced, but nectar

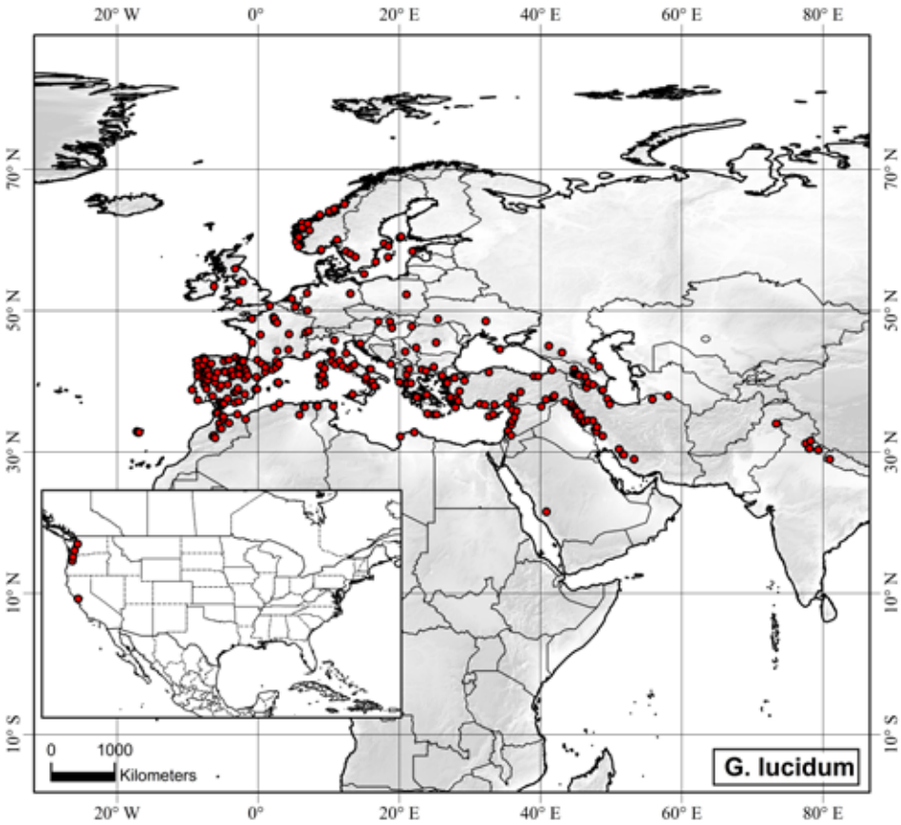


Fig. 752. Distribution of *Geranium lucidum*.

production has been documented by Yeo (2004: 421). The mericarps of *G. lucidum* are also unique in the genus because of their longitudinal cristate ribs with hooked small hairs. The fruit rostrum has a narrowed apex fully hairy. According to Yeo (2004), *G. lucidum* is close to *G. glaberrimum* because of its leaf shape and keeled calyx. Both species also share the presence of hooked glandular hairs on the mericarp, although they are not constant in *G. glaberrimum*.

Geranium lucidum is native to Europe, Central Asia (up to western Himalayas), and northern Africa. It is perhaps introduced in some areas of northern Europe. For instance, according to Weeda (1992) this species is introduced in the Netherlands. It is well documented as recently introduced in the western United States. Its presence in New Zealand, is based on a specimen at CHR could not be studied.

299. Geranium purpureum Vill., Hist. Pl. Dauphiné 1: 272. 1786. *Geranium robertianum* var. *purpureum* (Vill.) DC. in Lam. & DC., Fl. Franç. ed. 3 4(2): 853. 1805. *Geranium robertianum* var. *atropurpureum* Hagenb., Tent. Fl. Basil. 2: 190. 1834, nom. illeg. *Geranium robertianum* var. *parviflorum* Webb & Berthel., Hist. Nat. Îles Canaries: 22. 1836, nom. illeg. *Robertium vulgare* var. *purpureum* (Vill.) Picard, Mém. Soc. Agric. Boulogne-sur-Mer 1: 137. 1837. *Geranium villarsianum* Jord., Cat. Jard. Grenoble 1849: 16. 1849, nom. illeg. *Robertium purpureum* (Vill.) Fourr., Ann. Soc. Linn. Lyon ser. 2, 16(2): 351. 1868. *Geranium robertianum* subsp. *purpureum* (Vill.) Nyman, Consp. Fl. Eur. 1: 138. 1878. *Geranium purpureum* var. *villarsianum* Rouy in Rouy & Foucaud, Fl. France 4: 97. 1897, nom. illeg. *Geranium purpureum* [a] *villarsianum* Graebn. in Asch. & Graebn., Syn. Mitteleur. Fl. 7(1): 64. 1913, nom. illeg. Type locality: "au Pont de Claix, sur les rochers" [45°07'N, 5°43'E]. Type: France. *D. Villars s.n.* (lectotype, designated by Aedo 2017b: 433, B-W-12583-02-0 image!).

Geranium robertianum var. *parviflorum* Viv., Fl. Libyc. Spec.: 39. 1824. *Geranium parviflorum* (Viv.) Evers, Verh. K.K. Zool.-Bot. Ges. Wien 46: 69. 1896, nom. illeg., non Curtis, 1782. Type locality: "H. in Cyrenaicâ". Type: Libya. Cyrenaicâ, *D. Viviani s.n.* (no original material located).

Geranium robertianum var. *incisa* A. St.-Hil., Fl. Bras. Merid. 1: 102. 1825. Type locality: "Inveni in apricis propè oppidum S. Theresae". Type: Brazil. Rio Grande do Sul, Santa Teresa, 28°46'S, 53°25'W, *A. Saint-Hilaire 2044* (lectotype, designated by Aedo 2012: 440, P-00758013!).

Geranium robertianum var. *parviflorum* Peterm., Fl. Lips. Excurs. 508. 1838, nom. illeg., non Viv. 1824. Type locality: "... in silvis Rosenthal, Streitholz, ad pagum Anger, ad collem Bienitz etc". Syntypes: Germany. Thüringen, Streitholz, 51°25'N, 10°05'E, *W.L. Petermann s.n.*; Germany. Sachsen, Rosenthal, 51°08'N, 14°04'E, *W.L. Petermann s.n.*; Germany. Sachsen, Anger, 51°31'N, 13°01'E, *W.L. Petermann s.n.*; Germany. Sachsen, Bienitz, 51°21'N, 12°16'E, *W. L. Petermann s.n.* (no original material located).

Geranium modestum Jord., Cat. Jard. Grenoble 1849: 16. 1849, nom. illeg., non Dum.- Cours. 1811. *Robertium modestum* Jord. ex Fourr., Ann. Soc. Linn. Lyon ser. 2, 16 (2): 351. 1868. *Geranium robertianum* var. *modestum* (Jord. ex Fourr.) Nyman, Consp. Fl. Eur.: 138. 1878. *Geranium purpureum* var. *modestum* (Jord. ex Fourr.) Hausskn., Mitth. Thüring. Bot. Vereins 5: 66. 1893. *Geranium robertianum* f. *modestum* (Jord. ex Fourr.) F.N. Williams, Prodr. Fl. Britann. 9: 501. 1912. *Geranium purpureum* [a] *modestum* (Jord. ex Fourr.) Graebn. in Asch. & Graebn., Syn. Mitteleur. Fl. 7(1): 65. 1913. *Geranium robertianum* subvar. modestum (Jord. ex Fourr.) Litard. in Briq., Prodr. Fl. Corse 2(2): 13. 1936. Type locality: "Hab. in umbrosis rupium calcarearum, ad sepes: Crémieu! propè Lyon, Hyères (Var), etc". Type: France. Var, Hyèeres, 43°07'N, 6°07'E, 1848, *A. Jordan s.n.* (lectotype, designated by Aedo 2017b: 433, MPU-018536!; isolectotypes, BM!, K-000729303!, MO-2102632!, P-00834375!, W-1889-0061869!).

Geranium mediterraneum Jord., Mém. Acad. Roy. Sci. Lyon, Sect. Sci. ser. 2, 1: 251. 1851. *Geranium robertianum* var. *mediterraneum* (Jord.) Nyman, Consp. Fl. Eur.: 138. 1878. *Geranium purpureum* var. *mediterraneum* (Jord.) Rouy in Rouy & Foucaud, Fl. France 4: 98. 1897. *Geranium purpureum*

[b] *mediterraneum* (Jord.) Graebn. in Asch. & Graebn., Syn. Mitteleur. Fl. 7(1): 65. 1913. *Geranium robertianum* subvar. *mediterraneum* (Jord.) Litard. in Briq., Prodr. Fl. Corse 2(2): 13. 1936. Type locality: "Hab. in umbrosis, ad rupes calcareas Galliae praesertim mediterraneae, circà Toulon, Marseille, etc., ubi eum legi.-- Fl. maio" . Type: France. Cultivated at Lyon [from seeds from Marseille, 1838], May-June 1860, *A. Jordan s.n.* (neotype, designated by Aedo 2017b: 433, MPU-018481!; isoneotype, P-00834371!).

Geranium minutiflorum Jord., Mém. Acad. Roy. Sci. Lyon, Sect. Sci. ser. 2, 1: 250. 1851. *Robertium minutiflorum* (Jord.) Fourr., Ann. Soc. Linn. Lyon ser. 2, 16(2): 351. 1868. *Geranium robertianum* var. *minutiflorum* (Jord.) Nyman, Consp. Fl. Eur.: 138. 1878. *Geranium purpureum* var. *minutiflorum* (Jord.) Loret & Barrandon, Fl. Montpellier ed. 2: 92. 1886. *Geranium purpureum* [2] *minutiflorum* (Jord.) Graebn. in Asch. & Graebn., Syn. Mitteleur. Fl. 7(1): 65. 1913. *Geranium robertianum* f. *minutiflorum* (Jord.) Merino, Brotéria, Sér. Bot. 11: 116. 1913. Type locality: "Hab. in rupestribus calcareis Rhodano proximis montium Beugesi, ubi eum legi.-- Fl. maio junio". Type: France. Rhône-Alpes, Serrières-de-Briord, 45°56'N, 05°25'E, 17 May 1868, *A. Jordan s.n.* (neotype, designated by Aedo 2017b: 433, MPU-018482 image!).

Geranium lebelii Boreau, Fl. Centre France ed. 3, 2: 130. 1857. *Geranium robertianum* var. *lebelii* (Boreau) Nyman, Consp. Fl. Eur.: 138. 1878. Type locality: "Lieux frais. R.-Bourges.-Orléans.-Angers". Type: France. Pays-de-la- Loire, Angers, 47°28'N, 0°32'W, 1 June 1849, *A. Boreau s.n.* (lectotype, designated by Aedo 2017b: 433, ANG image!).

Geranium semiglabrum Jord. ex Boreau, Fl. Centre France ed. 3, 2: 130. 1857. *Robertium semiglabrum* (Jord. ex Boreau) Fourr., Ann. Soc. Linn. Lyon ser. 2, 16(2): 351. 1868 [28 Dec. 1868]. *Geranium robertianum* var. *semiglabrum* (Jord. ex Boreau) Nyman, Consp. Fl. Eur.: 138. 1878. *Geranium purpureum* var. *semiglabrum* (Jord. ex Boreau) Rouy in Rouy & Foucaud, Fl. France 4: 97. 1897. *Geranium purpureum* [b] *semiglabrum* (Jord. ex Boreau) Graebn. in Asch. & Graebn., Syn. Mitteleur. Fl. 7(1): 65. 1913. Type locality: "Lieux pierreux. R.-Creus. St-Sulpice-le-Guérettois (De Cessac)". Type: France. Limoges, Creuse, Saint-Sulpice-le- Guéréttois, 46°12'N, 1°49'E, 28 Aug. 1855, *P. Cessac s.n.* (lectotype, designated by Aedo 2017b: 433, ANG image!).

Geranium robertianum subvar. *scopulicolum* Jord. ex Rouy in Rouy & Foucaud, Fl. France 4: 97. 1897. Type locality: "Billot, nº 3549... Manche: falaises de Granville (Lebel)". Type: France. Basse-Normandie, Manche, cultive de graines des falaieses de Granville, 48°50'N, 1°35'W, 20 June 1860, *A. Jordan s.n.*, *Fl. Exsicc. Billot 3549* (lectotype, designated by Aedo 2017b: 433, P!; isolectotype, MA-170891!).

Geranium simile Jord., Bull. Soc. Bot. France 7: 606. 1862. *Geranium purpureum* var. *simile* (Jord.) Rouy in Rouy & Foucaud, Fl. France 4: 97. 1897. *Robertium simile* (Jord.) Fourr., Ann. Soc. Linn. Lyon ser. 2, 16(2): 351. 1868. *Geranium purpureum* [b] *simile* (Jord.) Graebn. in Asch. & Graebn., Syn. Mitteleur. Fl. 7(1): 65. 1913. Type locality: "... du Gard et de l'Hérault... ". Type: France. Languedoc-Roussillon, Hérault, 43°40'N, 3°30'E, *A. Jordan s.n.* (lectotype, designated by Aedo 2017b: 433, BM-00751354!; isolectotype, Z).

Geranium robertianum var. *parviflorum* Parl., Fl. Ital. 5: 201. 1873, nom. illeg., non Viv. 1824. Type locality: "La varietà ß è anche comune". Type: Italy. Sicily, Palermo, 38°05'N, 13°18'E, Apr. 1835, *F. Parlatore s.n.* (lectotype, designated by Aedo 2017b: 433, FI-3086-B image!).

Geranium modestum var. *album* Chast., Bull. Soc. Bot. France 24: 248. 1878. *Geranium purpureum* [1] *album* (Chast.) Graebn. in Asch. & Graebn., Syn. Mitteleur. Fl. 7(1): 65. 1913. Type locality: "Hab.- Les rochers de schiste talqueux, de formation primitive, et surtout sur les désagrégations de ces rochers. dans le vallée du Dourdou, à Conques. Fleurit en mai et juin (découvert le 11 mai 1875)". Type: France. Midi-Pyrénées, Aude, vallée du Dourdou, à Conques, 44°35'N, 2°23'E, 11 May 1875, *G. Chastaingt s.n.* (no original material located).

Geranium purpureum var. *eriosepalum* Hausskn., Mitth. Thüring. Bot. Vereins 5: 66. 1893. *Geranium purpureum* [2] *eriosepalum* (Hausskn.) Graebn. in Asch. & Graebn., Syn. Mitteleur. Fl. 7(1): 65. 1913. Type locality: "hab. in m. Hymetto ad Akropolin Athenarum, in m. Kerata supra Eleusin, ad Akrokorinthum, in m. Palamidi supra Naupliam". Type: Greece. Peloponnesus, m. Palamidi supra Naupliam, 37°34'N, 22°48'E, 1885, *H.C. Haussknecht s.n.* (lectotype, designated by Aedo 2017b: 433, JE-00007526!; isolectotype, BM- 000751357!).

Geranium purpureum var. *leiosepalum* Hausskn., Mitth. Thüring. Bot. Vereins 5: 66. 1893. *Geranium purpureum* [1] *leiosepalum* (Hausskn.) Graebn. in Asch. & Graebn., Syn. Mitteleur. Fl. 7(1): 65. 1913, ["liosepalum"]. Type locality: "hab. in rupinis Akrokorinthi". Type: Greece. Peloponnesus, Akrokorinthi, 37°56'N, 22°57'E, 1885, *H.C. Haussknecht s.n.* (lectotype, designated by Aedo 2017b: 433, JE-00007534!).

Geranium robertianum var. *tenuisectum* Albov, Prodr. Fl. Colchic.: 47. 1895. Type locality: "Circassia: fontes fl. Lasha ad rupes, 2140 m. (N.A. 1894; m. Fisht, 1900 m. (N.A. 1893, nos 516, 558). Abchasia: jugum Bzybicum totum, 6500 p. (N.A. 1890); loc. Ashoempydzh, alt. 2100 m. (N.A. 1894). Mingrelia: loc. Kernakhoni, 6500 p. (N.A. 1893, nos 89, 190c); m. Kwira 1980 m. (N.A. n° 61)". Type: Russia. Distr. Tschernomorsky, Mt. Fichte, 43°57'N, 39°54'E, 18 Sep. 1893, *N. Alboff 558* (lectotype, designated by Aedo 2017b: 434, LE!).

Geranium parviflorum var. *succulenta* Evers, Verh. K.K. Zool.- Bot. Ges. Wien 46: 69. 1896. *Geranium purpureum* [b] *succulentum* (Evers) Graebn. in Asch. & Graebn., Syn. Mitteleur. Fl. 7(1): 65. 1913. Type locality: "Trient, Muralta etc., Mori, Slavini di S. Marco, Lenzima etc. (Auch in den Abruzzen bei Oronton von Felsen gesammelt.)". Syntypes: Italy. Trient, 46°04'N, 11°08'E, *G. Evers s.n.*; Muralta, 46°04'N, 11°07'E, *G. Evers s.n.*; Mori, 45°50'N, 10°58'E, *G. Evers s.n.*; Slavini di San Marco, 45°50'N, 11°00'E, *G. Evers s.n.*; 45°52'N, 10°59'E, Lenzima, *G. Evers s.n.*; Abruzzen bei Oronton, *G. Evers s.n.* (no original material located).

Geranium purpureum subvar. *albiflorum* Rouy in Rouy & Foucaud, Fl. France 4: 98. 1897. Type locality: "Çà et là, rare". Type: France. Without precise locality, *G. Rouy s.n.* (no original material located).

Geranium purpureum var. *intricatum* Gren. ex Rouy in Rouy & Foucaud, Fl. France 4: 97, 98. 1897. *Geranium purpureum* [a] *intricatum* (Gren. ex Rouy) Graebn. in Asch. & Graebn., Syn. Mitteleur. Fl. 7(1): 65. 1913. *Geranium robertianum* f. *intricatum* (Gren. ex Rouy) Merino, Brotéria, Sér. Bot. 11: 116. 1913. Type locality: "Gren. in litt et in herb. Mus. Paris. - Vaucluse: source de Vaucluse (Grenier); Hérault: montagne de Cette (Grenier)". Type: France. Vaucluse, source de Vaucluse, 43°55'S, 5°07'E, 29 July 1846, *J.C.M. Grenier s.n.* (lectotype, designated by Aedo 2017b: 434, P!).

Geranium robertianum var. *insigne* Lojac., Malpighia 20: 195. 1906. Type locality: "Villarosa Tin.!". Type: Italy. Sicily, Villarosa, 37°35'N, 14°10'E, 28 Apr. 1877, *M. Lojacono s.n.* (neotype, designated by Aedo 2017b: 434, PAL!).

Geranium eginense Hausskn. & Sint. ex R. Knuth in Engl., Pflanzenr. IV. 129 (Heft 53): 61. 1912. Type locality: "Türkisch-Armenien: Egin am Euphrat (Sintenis, It. orient. a. 1890, n. 2480!)". Type: Turkey. Egin am Euphrat, 39°15'N, 38°29'E, 1 June 1890, *P. Sintenis 2480* (lectotype, designated by Aedo 2017b: 434, P-00712073!; isolectotypes, BR-510 895 image!, JE-00010355 image!, LD-1015493 image!, W-1887-0000469!, WU-3924!).

Geranium robertianum var. *hispidum* Druce, Bot. Soc. Exch. Club Brit. Isles 4: 406. 1917. Type locality: "Cliffs of Berry Head, S. Devon, June 1916". Type: Great

Britain. England, South Devon, Berry Head, 50°24'S, 3°29'W, June 1916, *G.C. Druce s.n.* (lectotype, designated by Aedo 2017b: 434, OXF-00005897T image!).

Geranium purpureum var. *forsteri* Wilmott, J. Bot. 59: 95. 1921. *Geranium purpureum* subsp. *forsteri* (Wilmott) H.G. Baker, Watsonia 3(3): 165. 1955. Type locality: "Hearing that Mr. J. E. Little had gathered a peculiar plant at Middleton in Sussex, and remembering Bon'er's note, I immediately wondered if the long-lost G. purpureum of Forster had turned up again. I was able to visit the spot in 1919, when, on the bare shingle, I found two patches of plants identical with Forster's figure, the one about twenty yards long consisting of few specimens, the second, fifty yards long, with hundreds of plants...". Type: Great Britain. England, Sussex, near Middleton, 50°47'N, 0°37'W, 1919, *A.J. Wilmott s.n.* (lectotype, designated by Yeo 2003: 534, BM-000037827!).

Geranium robertianum f. *subeglandulosum* H. Lindb., Acta Soc. Sci. Fenn., Ser. B, Opera Biol. 1(2): 94. 1932. Type locality: "H., Sierra Morena, Santa Eléna, in dumetis in colle juxta pagum". Type: Spain. Jaén, Santa Elena, 38°20'S, 3°32'W, 4 Apr. 1926, *H. Lindberg 208* (lectotype, designated by Väre 2012: 47, H-1368525 image!).

Geranium robertianum var. *villosulum* Pau, Bol. Soc. Ibér. Ci. Nat. 33: 97. 1934, nom. illeg., non Murr, 1923. Type locality: "Abdelkader". Type: Morocco. Sidi-Abdelkader, Beni-Sicar, 35°19'N, 3°2'W, *A. Pardo s.n.* (lectotype, designated by Aedo 2017b: 434, MA-71374!).

Geranium elamellatum Kokwaro, Kew Bull. 23: 527, fig. 1. 1969. Type locality: "Kenia. Kinangop Escarpment, Knight's Gorge, 2340 m., Sept. 1934, Albrechtsen in Napier 2763, C.M. 6687 (K, holotype; BR, EA, isotypes)". Type: Kenya. Knight's Gorge, on slope of Kinangop Escarpment, 0°37'S, 36°42'E, Sep. 1934, *Albrechtsen 6687* (holotype, K-00417216!; isotypes, BR- 624 593 image!, EA).

Geranium alboroseum Bomble, Jahrb. Bochum. Bot. Vereins 8: 57. 2017. Type locality: "Germany, Aachen: 5202/23 – Zollamtstraße, ruderaler Gebüschrand, Bomble 16052502, MSTR-173567 – leg. F. W. Bomble 25.05.2016.". Type: Germany, Aachen, 54º46'N, 6º05'E, 25 May 2016, *F.W. Bomble 16052502* (holotype, MSTR-173567 image!).

Geranium urbanum Bomble, Jahrb. Bochum. Bot. Vereins 8: 54. 2017. Type locality: "Germany, Aachen: 5202/12 – Schinkelstraße, Gebüschrand, Bomble 16052801, MSTR-173559 – leg. F. W. Bomble 28.05.2016". Type: Germany, Aachen, 54º46'N, 6º05'E, 28 May 2015, *F.W. Bomble s.n.* (holotype, MSTR-173559 image!).

Annual, sometimes biennial herbs, 8-56 cm tall. *Stem* erect or prostrate, leafy, with ± patent, glandular hairs 0.3-2.6 mm long, sometimes with uncinate, eglandular hairs 0.2-1.3 mm long, rarely glabrous. *Basal leaves* in a persistent rosette, cauline leaves opposite (sometimes alternate in middle of shoot, 1-2 nodes); leaf laminas (0.9)2.3-5.7(7.1) cm long, 1.2-9.2 cm wide, not peltate, palmatisect, polygonal in outline, base cordate, not coriaceous, with nerves not projected, with ± uncinate, eglandular hairs (mainly on the nerves) and plane glandular hairs on both surfaces; segments (3)5, in 1 plane, middle segment rhombic, 0.3-1.1 mm wide at the base [ratio segment width at the base/middle segment length = 0.01-0.03(0.08)], 5-20(38)-lobed in distal half [ratio secondary sinus length/middle segment length = (0.23)0.30-0.35(0.51)]; petioles up to 16 cm long, without abscission zone, terete, not swollen, somewhat deflexed in age, with patent, eglandular hairs 0.2-1 mm long and ± patent, glandular hairs 0.4-2.9 mm long; stipules (0.7)1.2-2.4(5.3) mm long, 0.3-2.6 mm wide, ovate, obtuse, free, papery, green, with glandular hairs on abaxial surface and on the margin, glabrous adaxially. *Inflorescence* a dichasial cyme with monochasial branches; cymules 2-flowered, solitary [ratio cymule length/leaf length = (0.7)1.1-2.2(6.4)]; peduncles (6.2)16.5-34.2(83) mm long, with uncinate, retrorse, eglandular hairs 0.2-0.5 mm long and ± patent, glandular hairs 0.2-2.2 mm long; bracteoles 0.4-1.6 mm long, 0.2-1.1 mm wide, ovate, whorled; pedicels (3.4)6.7-10.2(13.5) mm long, with uncinate, retrorse, eglandular hairs 0.2-0.4 mm long and ± patent, glandular hairs 0.2-1.5 mm long. Flowers actinomorphic. *Sepals* (3.7)4.9-6.3(7.9) mm long, 1.6-3.4 mm wide, lanceolate, smooth, not accrescent, nerves 3, mucro (0.4)0.8-1.2(2) mm long [ratio mucro length/sepal length = (0.08)0.14-0.20(0.43)], with ± patent, glandular hairs 0.2-2.4 mm long and, usually scattered, patent, eglandular hairs 0.2-0.5 mm long on the abaxial surface, glabrous adaxially. *Petals* (5.3)6.3-8.4(9.9) mm long, (0.8)1.5-2(2.6) mm wide, erect-patent, rounded (rarely retuse), with claw 3.2-6 mm long (bicarinated), purple, glabrous. *Stamens* 10, both whorls bearing anthers; filaments (3.7)5.2-6(6.6) mm long, linear-lanceolate, pink, glabrous; anthers (0.2)0.3-0.4(0.7) mm long, yellow. Nectaries 5, hemispheric, glabrous. *Gynoecium* 4.2-7.3 mm long, pink. *Fruit* (16.2)17.9-20.8(23.2) mm long, erect, discharge of carpel-projection type, operative; mericarps 1.9-3.2 mm long, 1-2.6 mm wide, usually with a strand of fibers derived from the beak attached near the apex on either side, not compressed at the apex, reticulate, with thick ridges dense throughout or sometimes thin and sparce in the basal half and forming 1-4 overlapping collars or contiguous circumferential ridges at apex, without basal beak, without a basal callus, without a basal prong, brown, glabrous or with eglandular hairs 0.1-0.2 mm long; rostrum 10-17.5 mm long, with a narrowed apex 4-8.3 mm long, not twisted, glabrous on the proximal half, and with patent, eglandular hairs 0.1-0.4 mm long and scattered, patent, glandular hairs 0.1-0.3 mm long restricted to the narrowed apex; stigmatic remnants 0.7-1.2 mm long, with 5 glabrous lobes. *Seeds* 1.5-2.3 mm long, 0.8-1.3 mm wide, smooth, uniformly colored, brownish red, glabrous. Cotyledons with entire margin. Figs. 753-755, 757 k-o.

Pollen. *Geranium*-type (Aedo 2017: 412; Stafford & Blackmore 1991: 76; Velasco 1992b: 60; Verhoeven & Marais 1990: 167).

Chromosome number. 2*n* = 32.

Phenology. Collected in flower from January to December.

Distribution. This species ranges through Europe, western Asia (to northern Iran) and northern and eastern Africa and it is introduced in California, southern South America, Korea, Australia, New Zealand and South Africa (Fig. 756).

Habitat. Roadsides, clearings and disturbed areas, dunes, rocky and shruby areas and forests; 0-3100 m.

Representative specimens examined. **Albania.** Vlorë: Valona, Saranda, sistema degli islotti costieri di Ksamil, islotto sudoccidentale, 39º46'N, 19º59'E, 9 May 2017, *Cecchi s.n.* (FI). **Algeria.** Blida: Chiffa, 36º27'N, 2º44'E, 9 May 1937, *Maire s.n.* (MPU). **Argentina.** Buenos Aires: Punta Lara, La Plata, 34º49'S, 57º58'W, 1 Nov. 1929, *Cabrera 1239* (GH, MA). **Armenia.** Lori: 12.5 km WSW of Stepanan, 6.5 km SW of Urasar, 40º58'N, 44º14'E, 30 Aug. 2012, *Vitek & al. 12-0326* (MA, W). **Australia.** South Australia: Southern Lofty, along River Onkaparinga near Hahndorf, 35º2'S, 138º47'E, Oct. 1999, *Bates*

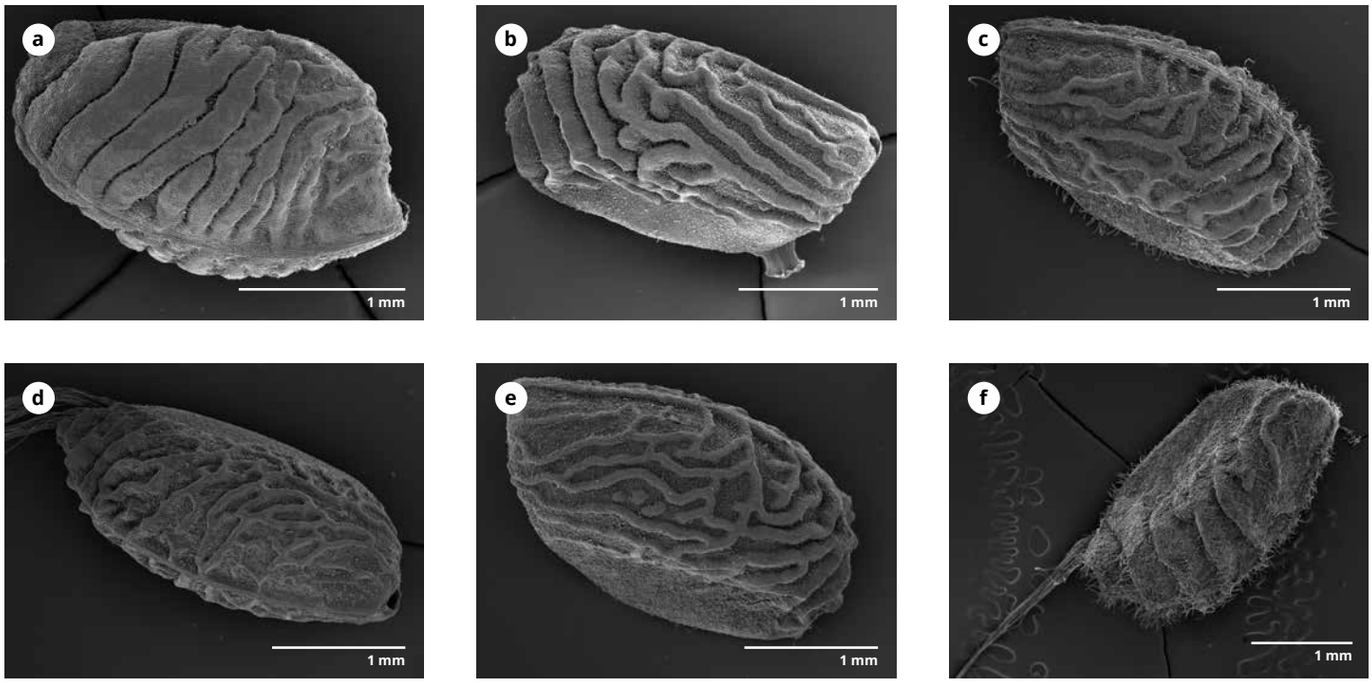


Fig. 753. SEM photographs showing the variability of the mericarps of *Geranium purpureum*. (Based on: a, *Vitek 99-445,* MA; b *Navarro & al. 4406,* MA; c, *Castroviejo 15211*, MA; d, *Rico 2262*, MA; e, *Rechinger 23009*, MA; f, *Aedo 6758*, MA).

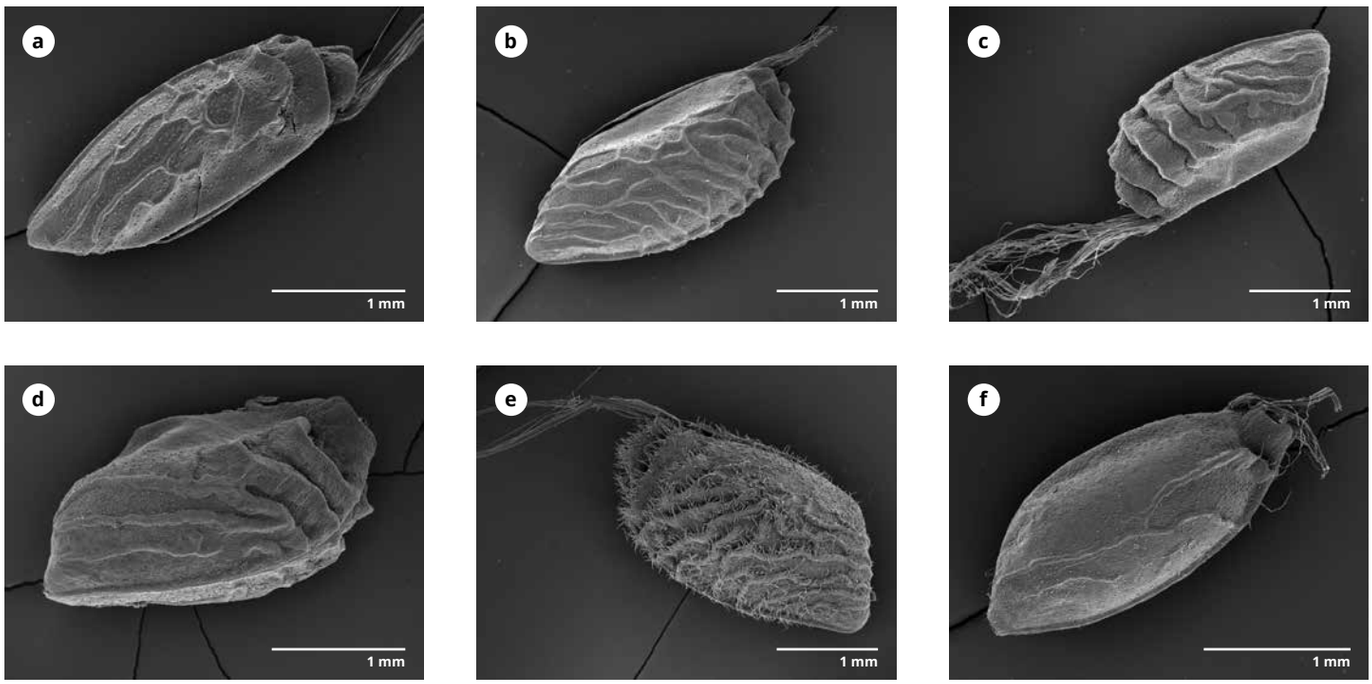


Fig. 754. SEM photographs showing the variability of the mericarps of *Geranium purpureum*. (a, *Navarro & al. 7035*, MA; b, *Prokes s.n.*, *6 July 2013*, W; c, *Castroviejo 18171*, MA; d, *Calvo 5805*, MA; e, *Aedo 19458*, MA; f, *Vitek 12-0326*, W).

54893 (AD). **Austria.** Burgerland: NW Uefr, 47°56'N, 16°44'E, 11 May 2006, *Barta s.n.* (MA). **Azerbaijan.** Lankaran: Talysh, at the reserved Girkan forest edge, 38°33'N, 48°43'E, 26 Apr. 1971, *Belyanina s.n.* (W). **Belgium.** Wallonia: Liège, Visé, 50°44'N, 5°42'E, 9 May 2002, *Lambinon 02/B/18* (MA). **Brazil.** Rio Grande do Sul: Veranópolis, 28°57'S, 51°33'W, Nov., *Grazziotin 2150* (MA, R). Santa Catarina: Rio do Peixe, Lacerdópolis, Rod. SC-303, 27°27'S, 51°54'W, 17 Sep. 1994, *Hatschbach 61086* (UB). **Bulgaria.** Burgas: E Stara Planina, 15 km WSW Dalgopol, Chudnite skali, 42°58'N, 27°17'E, 1 June 1999, *Gussev & al. 33-4-280* (MA). **Chile.** Biobío: pr. Concepción, mirador Alemán, 36°50'S, 73°2'W, 4 Nov. 2001, *Aedo 6726* (MA). Valparaíso: Olmué, 32°59'S, 71°11'W, 8 Nov. 2001, *Aedo 6758* (MA). **Croatia.** Split-Dalmatia: montibus Biokovo supra oppidum Makarska, 43°18'N, 17°1'E, 10 June 1967, *Soják s.n.* (PR). **Cyprus.** Limassol: pr. Amiantos, 34°55'N, 32°56'E, 15 Apr. 2019, *Aedo & al. 26275* (MA). **Czech Republic.** Moravian-Silesian: Nový Jičín, Kopřivnice, main railway station, 49°35'N, 18°8'E, 10 May 2011, *Kocián s.n.* (BRNU). **Eritrea.** Gash-Barka: Hamasen, mt. Tagena presso Mochi, 14°25'N, 37°33'E, 1 Apr. 1909, *Fiori 1164* (FT). **France.** Auvergne-Rhône-Alpes: Isère, Grenoble, pr. Fontaine, 45°11'N, 5°41'E, 31 May 2011, *Aedo 18406* (MA). **Georgia.** Abkhazia: Transcaucasia occid., près de Soukhoum-Kalé, Bouchure de Dzekhwta, 43°1'N, 40°59'E, 8 May 1909, *Woronow 121* (MPU). **Germany.** Baden-Württemberg: Stuttgart, Untertürkheim, Hafengelände, an der Ostseite von Hafenbecken 2, 48°47'N, 9°16'E, 26 Apr. 2011, *Joßberger s.n.* (STU). **Great Britain.** England: Hampshire, Stokes Bay, 50°46'N, 1°10'W, 1829, *Borrer s.n.* (BM). **Greece.** Kriti: Samarias gorge, 35°18'N, 23°56'E, 22 June 2018, *Medina & al. 9783* (MA). Peloponnese: Achaia, Kalavrita, Koto Lousoi, 37°59'N, 22°9'E, 24 June 2007, *Navarro & al. 7035* (MA). **Iran.** Mazandaran: Chalus, Caspian Sea, 36°38'N, 51°24'E, 13 Apr. 1963, *Bowles Scholarship Bot. Exped. 775* (LE). **Iraq.** Sulaymaniyah: E of Durbendikhan Dam, Sulaimaniya Liwa, 35°6'N, 45°41'E, 17 Apr. 1964, *Hussein & Barkley 7720* (NY). **Israel.** Haifa: Mt. Carmel, 32°43'N, 35°3'E, 10 May 2015, *Fragman-Sapir s.n.* (STU). **Italy.** Campania: pr. Castellbate, monte Licosa, 40°15'N, 14°56'E, 13 Apr. 2015, *Aedo 22589* (MA). Sardegna: Nouro, Seui-Ussassai, monte Arbu, 39°54'N, 9°23'E, 4 June 2003, *Navarro & al. 4406* (MA). Sicilia: subida al Etna, 37°42'N, 14°51'E, 30 May 1998, *Castroviejo & al. 14751* (MA). **Kenya.** Nyandarua: 3 km SE of Shamata Forest Station, 0°13'S, 36°33'E, Oct. 1970, *Mabberley 368* (K). **Lebanon.** Mount Lebanon: dans la vallée du Nahr ed Samour, 33°42'N, 35°26'E, 11 Mar. 1931, *Gombault 1149* (P). **Libya.** Marj: Cyrenaica, supra Barcem, 32°30'N, 20°54'E, 21 Apr. 1938, *Maire & Weiller 340* (MPU). **Malawi.** Northern: Rumphi distr., Nyika Plateau, 10°47'S, 33°48'E, 23 Apr. 1976, *Pawek s.n.* (MO). **Malta.** Malta Is.: insula Malta, 35°55'N, 14°26'E, 1 May 1907, *Sommier s.n.* (FI). **Montenegro.** Kotor: NW Kotor, 42°26'N, 18°46'E, 25 June 1988, *Krendl s.n.* (MA, W). **Morocco.** Béni Mellal-Khénifra: carretera de Afourer a Azilal, 32°11'N, 6°30'W, 9 Apr. 2000, *Cano & al. s.n.* (MA). **New Zealand.** New Zealand

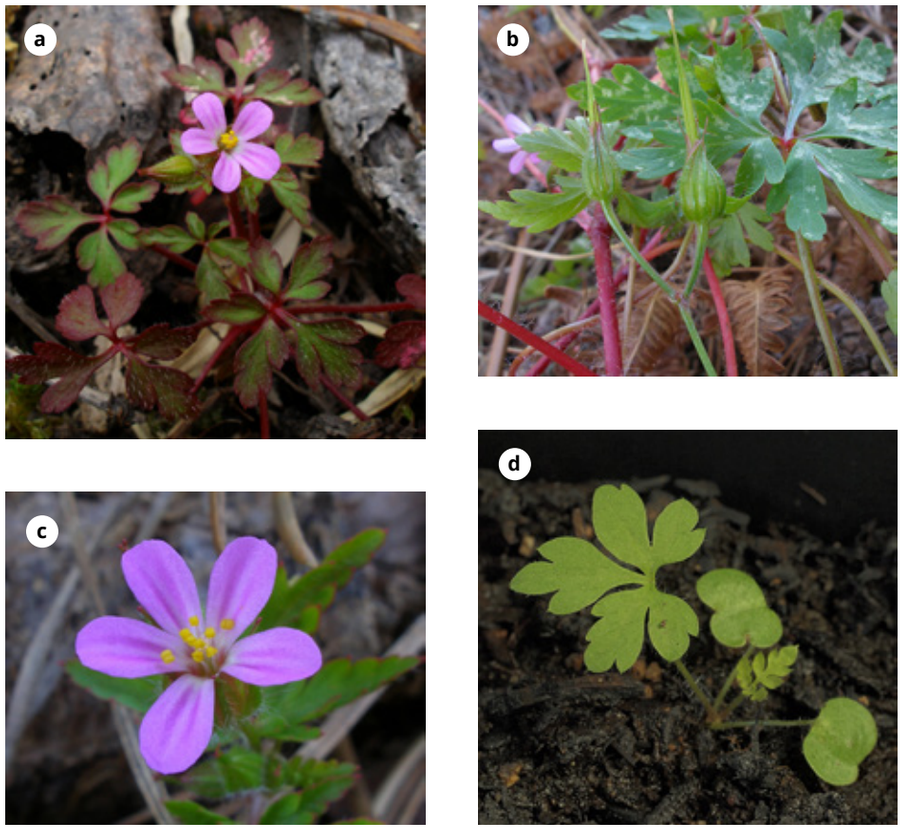


Fig. 755. *Geranium purpureum* (Based on: a, *Aedo 13629,* MA; b, c, *Aedo 17166,* MA; d, *Aedo 18406,* MA).

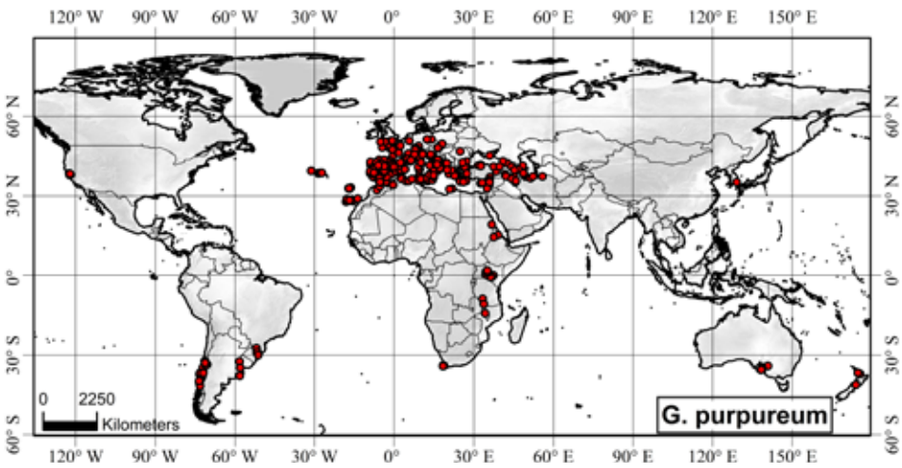


Fig. 756. Distribution of *Geranium purpureum*.

South Is.: Marlborough, Picton, Victoria Domain, 41°17'S, 174°0'E, 18 Dec. 2011, *Calvo 5805* (MA). **Portugal.** Azores: Flores, lagoa dos Patos, 39°26'N, 31°14'W, 9 Aug. 2012, *Aedo 19458* (MA). Beira Baixa: pr. Alcongosta, 40°6'N, 7°28'W, 3 May 2009, *Aedo 16406* (MA). Madeira: pr. Porto Novo, 32°39'N, 16°48'W, 17 Mar. 2007, *Aedo & al. 13629* (MA). **Romania.** Sud-Vest Oltenia: ad cataracta danubii pr. Orsova, Banatus, 44°43'N, 22°23'E, 5 June 1887, *Degen s.n.* (FI). **Russia.** Krym: peninsula Kercz, 45°11'N, 36°0'E, 6 May 1906, *Klopotow s.n.* (LE). **South Africa.** Western Cape: on the Cape Flats half way between Wynberg and Faure, 34°1'S, 18°44'E, 26 Aug. 1953, *Parker 4903* (K). **South Korea.** Busan: Busanjin-gu, Beomcheon-dong, 35°8'N, 129°3'E, 26 Apr. 2017, *Park 170001* (KH). **Spain.** Albacete: pr. Villapalacios, 38°35'N, 2°40'W, 25 Apr. 2008, *Aedo 15611* (MA). Baleares: Mallorca Almedrá a Tossals Verds, 39°46'N, 2°49'E, 4 June 1998, *Aedo & al. 4549* (MA). Canarias: Gran Canaria, Cruz de Tejeda, Degollada de las Palomas, 28°1'N, 15°36'W, 6 Apr. 2010, *Aedo 17166* (MA). **Sudan.** Red Sea: Kassala province, Gedain, red sea hills, 19°11'N, 36°50'E, 12 Apr. 1953, *Jackson 2961* (K). **Switzerland.** Solothurn: Banhof Dulliken bei Olten, 47°21'N, 7°54'E, 2 June 1991, *Huber 12952* (ZT). **Syria.** Latakia: Qardaha, Jobet Barghal, 35°6'N, 35°54'E, 8 May 2007, *Rico 2262* (MA). **Tanzania.** Mbeya: Mbeya range, Tanganyika territory, 8°50'S, 33°20'E, 16 Mar. 1960, *Kerfoot 1652* (K). **Tunisia.** Kef: entre Sidi Merzoug y Aïn Limghaassel, 36°17'N, 8°47'E, 28 Mar. 2009, *Calvo & al. 3377* (MA). **Turkey.** Karabük: Zonguldak, Safranbolu, cañón Incekaya, 41°16'N, 32°41'E, 19 June 2001, *Aedo & al. 6376* (MA). **Uganda.** Eastern: Sebei, eastern province, half a mile above the bridge [maishu] mountain road, 1°20'N, 34°35'E, Aug. 1971, *Tweedie 4091* (K). **Uruguay.** Paysandu: Concepción, 32°29'S, 58°14'W, Oct. 1875, *Lorentz 274* (CORD). **USA.** California: Alameda Co., Berkeley, 37°52'N, 122°14'W, 25 Mar. 2001, *Ertter 17574* (MA).

Discussion. Geranium purpureum is an annual that facultatively behaves as a biennial if it is sown in summer (Yeo 1973a: 291). It usually has an erect habit, although some plants from exposed habitats may be prostrate. The leaves are palmatisect, with a distinctly petiolulate main segment. The cauline leaves are alternate occasionally at one or two middle nodes but become opposite toward the inflorescence. The flowers are small, actinomorphic, with the petals a little longer than the sepals. The petal size and color of the anthers are always quite sufficient to distinguish *G. purpureum* from *G. robertianum*, at least in the living state. The petal length of *G. purpureum* [(5.3)6.3-8.4(9.9) mm] shows a small degree of overlap with that of *G. robertianum* [(8.5)10.5-12.5(14.2) mm]. The petal width, which is measured on the blade, also shows a minimum overlap [(0.8)1.5-2(2.6) mm in *G. purpureum*, (2.1)2.6-4.5(6.1) mm in *G. robertianum*]. The anthers of *G. purpureum* are yellow, while those of *G. robertianum* are purple. In some taxonomic accounts there has been confusion between anther color and pollen color of these species (i.e., Carolin 1965: 331; Webb & Ferguson 1968: 194), and "orange pollen" has been attributed to *G. robertianum*. Both species, however, have yellow pollen. The variability of mericarp indumentum and sculpture of *Geranium purpureum* is considerable and this has led to the description of a number of minor variants as species. Baker (1955, 1957) and Yeo (1973a) analyzed this variability, concluding that it has little taxonomic significance. The mericarps of *G. purpureum* vary from glabrous to densely hairy, with short eglandular hairs. As Yeo (1973a) pointed out, this variability can be occasionally found on the same individual. During this study it has been corroborated, for instance, in a specimen from Turkey (*Castroviejo 15211*, MA), which has glabrous mericarps (mature and immature), some with few hairs and others more or less densely hairy. The sculpture of the mericarp varies in the presence of one to four overlapping apical collars, the thickness of the ridges, and the density of the reticulum. Some mericarps have apical collars in a variable number and others none; some have thick and contiguous ridges, with no space between them; and others have thin ridges with wide gaps between them. In some cases, the ridges occur throughout the surface of the mericarps, while in others they are sparse or lacking in the basal half. In some herbarium specimens, it has been observed that mature mericarps have thick and contiguous ridges, while immature mericarps show thin ridges with wide gaps between them (i.e., *Castroviejo 15211*, MA; *Rechinger 23009*, MA). These findings corroborate Yeo's (1973a) statement that the sparser and more slender ribbing may also be partially connected with immaturity. Yeo (2004) also mentioned that the weakness of the sculpture in mericarps may be related to maturation in adverse summer weather. In some areas, like Macaronesia, Caucasia, or East Tropical Africa, herbarium specimens with thick and contiguous ridges are rare or lacking. This should be further investigated. However, it seems difficult that the sculpture and mericarp indumentum can be consistently used to segregate any taxon from *G. purpureum*. It also should be noted that some herbarium specimens that lack flowers and have mericarp with thin and sparse ridges are impossible to assign with certainty to *G. purpureum* or to *G. robertianum*. Figures 753 and 754 show the variability of mericarp sculpture in *G. purpureum*.

Baker (1955) accepted *Geranium purpureum* subsp. *forsteri* as an endemic to South England, based mainly on its prostrate habit. Yeo (2003) grew plants from seeds and found that some individuals can have an erect habit. Yeo (2003) expressed doubt about a more acceptable rank for this entity, but concluded that it can be maintained as a subspecies. Finally, subsp. *forsteri* is mentioned but is not formally recognized by Yeo (2004). Considering the previously mentioned variation of the habit, and the fact that no relevant additional character has been found, the subspecies *forsteri* was synonymized to *G. purpureum*.

Davis (1967: 452, 458) recognized *Geranium eginense* as a distinct species endemic to Turkey and only known from the type gathering. According to this author, *G. eginense*

can be distinguished from *G. purpureum* and *G. robertianum* by its leaf segments 2- to 3-lobed and obtusely crenate-dentate. Schönbeck-Temesy (1970: 38) suggested, however, that *G. eginense* is quite similar to some specimens of *G. purpureum* and is very difficult to distinguish from it. An examination of the type of *G. eginense* shows a plant like *G. purpureum* in habit but reduced in size, with short petals and mericarps with prominent ridges. The only feature that could support the recognition of *G. eginense* is the lack of fibers derived from the rostrum and attached near the apex of the mericarp. Yeo (1973a: 343) mentioned a similar case of a plant with these characters cultivated at Cambridge from seeds received from *Jardim Botânico da Universidade do Porto*. I have found these characters widespread among herbarium specimens (i.e., from Cyprus, Iter Medit. IV 1592, MA-495364; Montenegro, *Krendl s.n.,* 25 June 1988, W; and Tunisia, *Walter 549*, W); even on the same individual (i.e., *Castroviejo 15211*, MA). All these plants showed no noticeable variation in other characters, which suggests that the occasional lack of fibers is of minor taxonomic significance.

Geranium elamellatum is described by Kokwaro (1969) as an endemic species from eastern Africa. The main distinction from *G. purpureum* proposed by Kokwaro (1969: 528) is the sculpture of the mericarp, with thin ridges, sparse and scarcely anastomosing in the basal half. As stated before, this pattern is found to be widespread through where *G. purpureum* is found, from Armenia (*Vitek 12-0326*, W) to the Azores (*Aedo 19458*, MA).

I visited the *Muséum d'histoire naturelle de Grenoble*, where Villars' herbarium is kept, to locate the original material of *Geranium purpureum*. I also searched for this material at G, MPU, and P, where some of Villars' duplicates can be found. Unfortunately, the search yielded no positive results. Some specimens, however, have been found in Willdenow's herbarium (B). The folder B-W-12583, which includes three sheets, has a small label on the inner side written in Schlechtendal's hand indicating "Villars. W." According to R. Vogt and P. Hiepko (*in litt.*), this label means that these specimens were provided by Villars to Willdenow. The three sheets were annotated as "G. robertianum var. purpureum" by R. Knuth and are in accordance with the current concept of *G. purpureum*. The sheet selected as lectotype (B-W-12583-02-0) shows a fruiting plant plus a fragment, with some cymules in flower. Unfortunately, there is no indication of the exact geographic origin of this collection. In the protologue, Villars (1786: 272) mentioned only one locality, near Grenoble: "au Pont de Claix, sur les rochers", 45°07'N, 5°43'E, and later states: "Je l'ai trouvée au Buis [45°26'N, 05°02'E], sous les rochers, à Grenoble près le pont de Claix & ailleurs" (Villars 1789: 375). When Lojacono (1906) described *Geranium robertianum* var. *insigne*, he indicated the locality and the collector: "Villarosa Tin.!" According to G. Domina (*in litt.*), the specimen selected as type was collected by Tineo and relabeled by Lojacono (Lojacono 1906); thus, to avoid any uncertainty, it is chosen as neotype instead of lectotype.

A detailed account of the life history of *G. purpureum* is provided by Tofts (2004b).

300. Geranium robertianum L., Sp. Pl.: 681. 1753. *Geranium graveolens* Stokes, Bot. Mat. Med. 2: 495. 1812, nom. illeg. *Robertium vulgare* Picard, Mém. Soc. Agric. Boulogne-sur-Mer 1: 134. 1837. *Geranium palmatisectum* Dulac, Fl. Hautes- Pyrénées: 240. 1867, nom. illeg. *Robertiella robertianum* (L.) Hanks in Underw. & Britton (eds.), N. Amer. Fl. 25(1): 3. 1907. Type locality: "Habitat in Europae borealis rupibus". Type: "Habitat in Europae borealis rupibus" (lectotype, designated by Ghafoor 1978: 44, LINN-858.70 image!).

Geranium rubellum Moench, Suppl. Meth.: 95. 1802. Type locality: [not indicated]. Type: Unknown locality and collector (according to Stafleu & Cowan 1981: 536, Moench's herbarium is lost).

Geranium robertianum var. *mosquense* Goldb. ex DC., Prodr. 1: 644. 1824. *Geranium robertianum* [δ] *mosquense* (Goldb. ex DC.) Graebn. in Asch. & Graebn., Syn. Mitteleur. Fl. 7 (1): 61. 1913. *Geranium robertianum* f. *mosquense* (Goldb. ex DC.) Gams in Hegi, Ill. Fl. Mitt.-Eur. 4(3): 1714. 1924. Type locality: "in paludosis circa Mosquam. Goldbach mem. soc. mosq. 5. p. 133. (v.s.)". Type: Russia. Circa Mosquam, 55°45'N, 37°36'E, 1819, *C.L. Goldbach s.n.* (lectotype, designated by Aedo 2017b: 443, G-DC-00212107 image!).

Geranium robertianum var. *inodorum* DC., Prodr. 1: 644. 1824. *Geranium inodorum* (DC.) G. Don, Gen. Hist. 1: 721. 1831. *Geranium robertianum* [2] *inodorum* (DC.) Graebn. in Asch. & Graebn., Syn. Mitteleur. Fl. 7(1): 62. 1913. *Geranium robertianum* f. *inodorum* (DC.) Gams in Hegi, Ill. Fl. Mitt.-Eur. 4(3): 1714. 1924. Type locality: "New York to Virginia" [sec. Pursh, Fl. Amer. Sept. 2: 449 (1814)]. Type: U.S.A. New York to Virginia, *F.T. Pursh s.n.* (no original material located).

Geranium robertianum var. *rubrum* Lej., Rev. Fl. Spa: 147. 1824. Type locality: "Se trouve sur les rochers ombragés, dans les environs de Verviers, Ensival, Limbourg, etc" [sec. Lejeune, Fl. Spa: 85. 1811]. Syntypes: Belgium. Verviers, 50°35'N, 5°52'E, *A.L. Lejeune s.n.*; Ensival, 50°34'N, 5°51'E, *A.L. Lejeune s.n.*; Limbourg, 50°37'N, 5°56'E, *A. L. Lejeune s.n.* (no original material located).

Geranium raii Lindl., Syn. Brit. Fl.: 57. 1829. *Geranium lucidum* var. *raii* (Lindl.) Nyman, Consp. Fl. Eur.: 138. 1878. Type locality: "On the sea-coast in the south of England". Type: Great Britain. On the sea-coast in the S of England, *J. Lindley s.n.* (lectotype, designated by Aedo 2017b: 443, CGE-05775 image!).

Geranium robertianum var. *albiflorum* G. Don, Gen. Hist. 1: 721. 1831. *Geranium robertianum* f. *albiflorum* (G. Don) House, Bull. New York State Mus. Nat. Hist. 243-244: 54. 1923. Type locality: "Native of England, on rocks near Bristol". Type: Great Britain. England, near Bristol, 51°27'N, 2°35'E, *G. Don s.n.* (no original material located).

Geranium robertianum var. *maritimum* G. Don, Gen. Hist. 1: 721. 1831. Type locality: "Native of Britain, near the sea in Dorsetshire, Selsy Island, Sussex". Type: Great Britain. England, Dorsetshire, Selsy Island, Sussex, 50°43'N, 0°47'W, *G. Don s.n.* (no original material located).

Geranium robertianum var. *leucanthum* Dumort. ex Rchb., Fl. Germ. Excurs.:

777. 1832. *Geranium robertianum* [1] *leucanthum* (Dumort. ex Rchb.) Graebn. in Asch. & Graebn., Syn. Mitteleur. Fl. 7(1): 61. 1913. Type locality: [not indicated]. Type: Germany? *H.G.L. Reichenbach s.n.* (no original material located).

Geranium robertianum var. *rubricaule* Hornem., Fors. Oecon. Plantel. ed. 3, 2: 226. 1835. *Geranium robertianum* [b] *rubricaule* (Hornem.) Graebn. in Asch. & Graebn., Syn. Mitteleur. Fl. 7(1): 61. 1913. Type locality: [not indicated]. Type: Denmark. *J W. Hornemann s.n.* (no original material located).

Geranium lindleyanum Royle, Ill. Bot. Himal. Mts. 2, tab. 27. 1834; 1: 150. 1835. Type locality: "... which I found at Urukta in flower in May". Type: India. Himachal Pradesh, Urukta, 31°03'N, 77°35'E, *J.F. Royle s.n.* (lectotype, designated by Aedo 2017b: 443, LIV-8053!). [for dates of Royle's illustrations see Sprague 1933].

Geranium robertianum var. *albiflorum* Gaudin ex Babey, Fl. Jurass. 1: 324. 1845, nom. illeg., non G. Don, 1831. Type locality: "Poligny, le long d'une haie, dans un chemin de vigne, au pied de la montagne.--Bâle, sur les monts Wasserfall (J. Bauh.) et Wallemberg (Hagenb.)". Syntypes: France. Poligny, 46°48'N, 5°45'E, *C.F. Hagenbach s.n.*; Switzerland. Bâle, sur les monts Wasserfall, 47°34'N, 7°36'E, *J.J. Bauhin s.n.*; Switzerland. Wallemberg, *C.F. Hagenbach s.n.* (no original material located).

Geranium robertianum var. *maritimum* Bab., Man. Brit. Bot. ed. 3: 62. 1851, nom. illeg., non G. Don, 1831. *Geranium robertianum* subsp. *maritimum* Bab. ex H. G. Baker, Watsonia 3: 272. 1956. Type locality: "Southern sea-coast". TYPE. Great Britain. England, West Sussex, Shoreham, 50°49'N, 0°18'W, 16 June 1835, *C.C. Babington s.n.* (lectotype, designated by Aedo 2017b: 443, CGE-05779 image!).

Geranium robertianum var. *albiflorum* Van Heurck & Wesm., Prodr. Fl. Brabant: 23. 1861, nom. illeg., non G. Don, 1831. Type locality: "Fossés de la campagne de M. Dekerkhove près Louvain". Type: Belgium. Campagne de M. Dekerkhove près Louvain, 50°40'N, 4°37'E, *H.F. Van Heurck s.n.* (no original material located).

Geranium robertianum var. *graniticarum* Martrin-Donos, Pl. Crit. Tarn: 17. 1862. *Geranium robertianum* [a] *graniticarum* (Martrin-Donos) Graebn. in Asch. & Graebn., Syn. Mitteleur. Fl. 7(1): 62. 1913. *Geranium robertianum* f. *graniticarum* (Martrin-Donos) Gams in Hegi, Ill. Fl. Mitt.-Eur. 4(3): 1714. 1924. Type locality: "Terrain granitique à La Cabarède". Type: France. Tarn, La Cabarède, 43°26'N, 2°34'E, Aug. 1853, *J.V. Martrin-Donos s.n.* (lectotype, designated by Aedo 2017b: 443, MPU!).

Geranium robertianum f. *subglabrum* Grognot, Mém. Hist. Nat. Soc. Eduenne: 139. 1865. Type locality: "... que nous avons trouvée près Mâcon". Type: France. Borgogne, Mâcon, 46°18'N, 4°49'E, *C. Grognot s.n.* (no original material located).

Geranium robertianum var. *laciniatum* Beckh. ex F. Wilms & Beckh., Jahres-Ber. Westfal. Prov.-Vereins Wiss. 1878: 178. 1879. Type locality: "Höxter (Bk.)". Type: Germany, Westfalia, Höxter, 51°46'N, 9°22'E, ca. 1870, *C. Beckhaus s.n.* (lectotype, designated by Aedo 2017b: 443, MSTR image!).

Geranium robertianum f. *leucantha* Lange, Haandb. Danske Fl. ed. 4: 726. 1887, nom. illeg., non Dumort. ex Rchb. 1832. Type locality: "F. Skove ved Skaarup (19); J. Anlaeget ved Randers! Almind So v. Silkeborg (Baagoe)!". Syntypes: Denmark. Skove ved Skaarup, 56°59'N, 8°35'E, *J. Lange s.n.*; Anlaeget ved Randers, 56°28'N, 10°02'E, *J. Lange s.n.*; Almind So v. Silkeborg, 55°33'N, 9°28'E, *J.S. Baagøe s.n.* (no original material located).

Geranium robertianum var. *dasycarpon* Beck, Fl. Nieder-Österreich.: 561. 1892. Type locality: "ß auf dem Sonnwendstein". Type: Austria. Sonnwendstein, 47°37'N, 15°51'E, 29 June 1875, *G. Beck s.n.* (lectotype, designated by Aedo 2017b: 443, PRC-455569!).

Geranium neapolitanum A. Terracc., Prodr. Fl. Luc. 1: 90. 1893. Type locality: "Luoghi umidi ed ombrosi a Balvano (Barb., l.c.), ma con dubbio.--Io lo raccolsi sulla cima di Montocchio, e lo trovai, col nome di G. delicatulum, nell'erbario della R. Scuola tecnica di Potenza, raccolto a mte Arioso". Syntypes: Italy. Montocchio, 43°32'N, 10°43'E, *A. Terracciano s.n.*; m. Arioso, 40°29'N, 15°45'E, *A. Terracciano s.n.* (no original material located).

Geranium robertianum var. *crassicaule* Rouy in Rouy & Foucaud, Fl. France 4: 95. 1897. *Geranium robertianum* [γ] *crassicaule* (Rouy) Graebn. in Asch. & Graebn., Syn. Mitteleur. Fl. 7(1): 61. 1913. *Geranium robertianum* f. *crassicaule* (Rouy) Gams in Hegi, Ill. Fl. Mitt.-Eur. 4(3): 1714. 1924. Type locality: "var. [γ], dans les lieux humides". Type: France. Unknown locality and collector (no original material located).

Geranium purpureum var. *littorale* Rouy in Rouy & Foucaud, Fl. France 4: 98. 1897. *Geranium purpureum* [1] *littorale* (Rouy) Graebn. in Asch. & Graebn., Syn. Mitteleur. Fl. 7 (1): 65. 1913. *Geranium robertianum* f. *littorale* (Rouy) Merino, Brotéria, Sér. Bot. 11: 116. 1913. *Geranium littorale* (Rouy) A.W. Hill, Index Kew., suppl. 6: 91. 1926. Type locality: "Exsicc.: Soc. Dauph., n° 1564.-Somme: galets maritimes entre Cayeux et le Hourdel (bot. mult.; Rouy)". Type: France. Somme, entre Cayeux et le Hourdel, 50°12'N, 1°31'E, 24 July 1877, *E. Bonnet & B. Verlot s.n., Exsicc. Soc. Dauph. 1564* (lectotype, designated by Aedo 2017b: 443, P-00375656!).

Geranium robertianum f. *dasycarpum* Woronow in Kusn., N. Busch & Fomin, Fl. Cauc. Crit. 3(7): 76. 1908. *Geranium robertianum* var. *dasycarpum* (Woronow) Gams in Hegi, Ill. Fl. Mitt.-Eur. 4(3): 1714. 1924, nom. illeg., non Beck, 1892. Type locality: "Hab. in silvaticis lapidosis et rupestribus umbrosis Tauriae, Cis- et Transcaucasiae, 0—7000'. — [Kerchensky peninsula. Mount Opuz near the Black Sea. Lime rocks. 22.V.06. fl. fr. Klopotov! Near Shabanovskaya village, meadow in oak forest. 7.VI.88. fl. fr. Kuznets.[ov]! Near Abadzekhskaya village, in wet oak forests. 21.VI.88. fl. fr. Kuznets.[ov]! Zheleznovodsk. Gryaznushka. 21.V.87. fl. fr. Akinf. [iev]! Zheleznaya Gora. 20.VI.26. fr. Geffet! Pyatigorsk. Mashuka. 27.VI.26 fl. fr. Geffet! Mount Beshta near Pyatigorsk. 4.VII.43. n° 647. fl. fr. Kolenati! Khasav-Ujrtovsky distr. Salatau. Between Chirkey and Khonzagoi. 1000—3000'. 28.VII.97. n° 7291. fl. fr. Alex.[eenko]! Between Temir-Khan-Shura and Erpeli. 1700—1900'. 19.VI.99. n° 7292. fl. fr. Alex.[eenko]! Between Kodorsky mountain pass and Khupro village. Upper border of pinwood zone. 18.VII.04. fr. Busch! Chatyrdagh, yaila (mountain steppe). 5.VI.87. fr. Zelen.! The same place. VI.88. fr. Pachosky! Baidarskaya valley. 30.VI.76. fl. fr. Litvinov! Lambat-Babugan, yaila (mountain steppe). 7.VIII.86. fl. fr. Zelen. n.v. Kozmodamian-Babugan-Yalta. 25.VI.87. fr. Zelen. n.v. Between Kozmodamianovsky cloister and Beshui village. Forest. 1.VI.05. fl. fr. Busch! Oreanda. Shadowy place near stream. 29.V.98. fr. Golde! Cherkessiya. near Vardane. Shadowy places in the forest. 26.V.01. fl. fr. Grinev.! Petskirskoye canyon (Madzhara river), on stony slopes and wet rocks. V. and VI.03. fl. fr. Between Sukhumi and Azhary. 30.VII.—3.VIII. fl. fr. Busch! Mtskhet. Left bank of Kura river. 18.V.08. fl. fr. Pagirev! Borzhom. 2400—3180'. 11.VI.65. fl. Radde! The same place, shadowy places. 24.VI.92. fr. Medvedev! The same place. Road to "Zelenaya Gryada", shadowy places. 26.VI.96. fl. fr. Medvedev! Manglis. On wet rocks. 6.VIII.05. fl. Sosnovsky! Near Elisabethtal. In woods. V. n° 623. fr. Frick! Everywhere in Western Karabakh and near Shusha. Hohenack. [er]! Western Karabakh. Dipsui. n° 537. fl. fr. Hohenack.[er]! Karabakh. Mount Eshken-Maidan. VII. fl. fr. Owerin! Talysh. Mineralnye vody. In the wood. 2.VI.94. fr. Lomak.! Near Gelglov. 3.VIII.27. n° 7293. fr. Alex.[eenko]! Lyrik. 28.V.70. fl. fr. Radde! In Caucasus provices. n° 50. fl. fr. Radde!]" [in Russian]. Type: Russia. Caucasus, Zheleznovodsk, Gryaznushka, 44°19'N,

40°40′E, 21 May 1887, *I. Akinfiev s.n.* (lectotype, designated by Aedo 2017b: 444, LE!).

Geranium eriophorum H. Lév., Bull. Soc. Agric. Sarthe 59: 319. 1904. *Geranium robertianum* var. *eriophorum* (H. Lév.) H. Lév., Fl. Kouy-Tchéou: 175. 1914-1915. Type locality: "Kouy-Tchéou: murs de la ville de Gan-pin; fleurs rouges; tiges et feuilles rougeâtres, 28 avril 1897; no. 1575 (Em. Bodinier)". Type: China. Yunnan, Kouy-Tchéou, ville de Gan-pin, 26°38′N, 106°37′E, 28 Apr. 1897, *E. Bodinier 1575* (lectotype, designated by Lauener 1967: 266, E- 00216573!; isolectotype, P-00712169!).

Geranium robertianum f. *umbraticum* C.G. Westerl., Bot. Not. 1904: 14. 1904. *Geranium robertianum* [b] *umbraticum* (C.G. Westerl.) Graebn. in Asch. & Graebn., Syn. Mitteleur. Fl. 7(1): 62. 1913. Type locality: "Alingsås, Ängabo". Type: Sweden. Alingsås, Ångabo, 57°55′N, 12°32′E, 10 July 1903, *C.G. Westerlund s.n.* (lectotype, designated by Aedo 2017b: 444, S-22572 image!).

Geranium robertianum f. *commune* F.N. Williams, Prodr. Fl. Brit. 9: 501. 1912. Type locality: "Shingly beaches in the South of England and the West of Ireland (-te Irish plants does not exactly match)". Type: Great Britain. *F.N. Williams s.n.* (no original material located).

Geranium robertianum var. *macropetalum* Briq. ex R. Knuth in Engl., Pflanzenr. IV.129 (Heft 53): 67. 1912. *Geranium robertianum* f. *macropetalum* (Briq. ex R. Knuth) Gams in Hegi, Ill. Fl. Mitt.-Eur. 4(3): 1714. 1924. Type locality: "Korsica, 450-650 (Briquet a. 1907)". Type: France. Corse, montagne de Caporalino, pr. Corté, 42°22′N, 09°11′E, 11 May 1907, *J. Briquet s.n.* (lectotype, designated by Aedo 2017b: 444, G-00414715!).

Geranium robertianum [b] *alpinum* Gaudin ex Graebn. in Asch. & Graebn., Syn. Mitteleur. Fl. 7(1): 62. 1913. *Geranium robertianum* f. *alpinum* (Gaudin ex Graebn.) Gams in Hegi, Ill. Fl.Mitt.-Eur. 4(3): 1714. 1924. Type locality: "γ *alpinum*. Schleich. exs. ... in Alpibus" [sec. Gaudin, Fl. Helv. 4: 417. 1829]. Type: Switzerland. *J.C. Schleicher s.n.* (no original material located).

Geranium robertianum var. *villosulum* Murr, Neu. Übers. Bl.-Pfl.Vorarlberg Jahr. Land. Ver.: 186. 1923. *Geranium robertianum* f. *villosulum* (Murr) Gams in Hegi, Ill. Fl. Mitt.-Eur. 4(3): 1714. 1924. Type locality: "Tosters". Type: Austria. Tosters, 47°14′N, 9°34′W, *J. Murr s.n.* (no original material located).

Geranium robertianum var. *trilobatum* H. Takeda, Bot. Soc. Exch. Club Brit. Isles 4: 192. 1916. Type locality: "About the middle of May 1913, I noticed in a lane at Ottery St Mary, Devon, a specimen... ". Type: Great Britain. England, Devon, Ottery Saint Mary, 50°45′N, 3°16′W, May 1913, *H. Takeda s.n.* (no original material located).

Geranium robertianum subsp. *celticum* Ostenf., Bot. Soc. Exch. Club Brit. Isles 5: 551. 1920. *Geranium robertianum* var. *celticum* (Ostenf.) Wilmott, J. Bot. 59: 99. 1921. Type locality: "Habitat: Hibernia occid. in saxis calcareis ad Ballyvaghan". Type: Ireland. Galway Co., Clifden rocks, 53°29′N, 10°04′W, 21 Aug. 1911, *C.E. Ostenfeld 353* (lectotype, designated by Aedo 2017b: 444, C-10021739 image!).

Geranium robertianum var. *intermedium* Wilmott, J. Bot. 59: 98, 99. 1921. Type locality: "I have seen it from Dorset (Chesil beach, Riddelsdell, 1912, see B. E. C. 1912, Rep. 240): Somerset (Porlock, E. S. Marshall, 3174; Devonshire (Lynton Foreland) and Glamorgan (Barry)". Type: Great Britain, Chesil Beach, 50°34′N, 2°28′W, 17 July 1912, *H.J. Riddelsdell s.n.* (lectotype, designated by Aedo 2017b: 444, BM-001185457!).

Geranium robertianum var. *glabrinux* Petrova & Kožuharov in Jordanov, Fl. Rep. Pop. Bulg. 7: 492. 1979. Type locality: "m. Pirin septentrionalis, in Pineto l.d. Markovo branište 1100 m s. m. 2. VII. 1972. Leg. A. Petrova (SOM-130339)". Type: Bulgaria. Pirin septentrionalis, Markovo, pr. Bansko 41°50′N, 23°29′E, 2 July 1972, *A. Petrova s.n.* (holotype, SOM-130339!).

Biennial, sometimes annual herbs, 10-67 cm tall. *Stem* erect or prostrate, leafy, with ± patent, glandular hairs 0.7-2.8 mm long, sometimes with uncinate, eglandular hairs 0.2-0.7 mm long. *Basal leaves* in a persistent rosette, cauline leaves opposite; leaf laminas (3.5)4.4-7(10) cm long, 3.2-10.1 cm wide, not peltate, palmatisect, polygonal in outline, base cordate, not coriaceous, with nerves not projected, with ± uncinate, eglandular hairs (mainly on the nerves) and plane glandular hairs on both surfaces; segments (3)5, in 1 plane, middle segment rhombic, 0.2-1.4 mm wide at the base [ratio segment width at the base/middle segment length = 0.01-0.02(0.04)], 16-37(49)-lobed in distal half [ratio secondary sinus length/middle segment length = (0.18)0.29-0.35(0.42)]; petioles up to 19 cm long, without abscission zone, terete, not swollen, deflexed, appressed to the soil in age, with retrorse, not appressed, eglandular hairs 0.2-0.6 mm long and patent, glandular hairs 0.3-3.1 mm long; stipules (1.6)2-4.1(4.9) mm long, 0.8-2.5 mm wide, ovate, obtuse, free, papery, green, with glandular hairs on abaxial surface and on the margin, glabrous adaxially. *Inflorescence* a dichasial cyme with γ monochasial branches; cymules 2-flowered, solitary [ratio cymule length/leaf length = (0.6)0.9-2.2(5.5)]; peduncles (13)27-54(94) mm long, with uncinate, retrorse, eglandular hairs 0.1-0.5 mm long and ± patent, glandular hairs 0.3-2.9 mm long; bracteoles 0.6-1.8 mm long, 0.2-1 mm wide, ovate, whorled; pedicels (3.4)5.9-12.1(19.6) mm long, with uncinate, retrorse, eglandular hairs 0.2-0.4 mm long and ± patent, glandular hairs 0.2-2.2 mm long. Flowers actinomorphic. *Sepals* (5)5.6-6.5(7.2) mm long, 1.6-3.9 mm wide, lanceolate, smooth, not accrescent, nerves 3, mucro (0.9)1.2-1.8(2.6) mm long [ratio mucro length/sepal length = (0.14)0.22-0.31(0.44)], with ± patent, glandular hairs 0.4-3.5 mm long and, usually scattered, patent, eglandular hairs 0.1-0.5 mm long on the abaxial surface, glabrous adaxially. *Petals* (8.5)10.5-12.5(14.2) mm long, (2.1)2.6-4.5(6.1) mm wide, erect-patent, rounded, with claw 3.1-5.9 mm long (bicarinated), purple, glabrous. *Stamens* 10, both whorls bearing anthers; filaments (4.5)6.1-7.3(8) mm long, linear-lanceolate, pink, glabrous; anthers (0.4)0.5-0.6(0.7) mm long, purple. Nectaries 5, hemispheric, glabrous. *Gynoecium* 5.5-8.6 mm long, pink. *Fruit* (17.4)20.2-22.6(24.4) mm long, erect, discharge of carpel-projection type, operative; mericarps 2.1-3.2 mm long, 1-1.5 mm wide, with a strand of fibers derived from the beak attached near the apex on either side, not compressed at the apex, reticulate, with few thin ridges and scarcely anastomosing in the basal half but more abundant distally and forming 1-2(3) overlapping, collar-like keels at the apex, without basal beak, without a basal callus, without a basal prong, brown, glabrous or with eglandular hairs 0.1-0.2 mm long; rostrum 13.2-18.2 mm long, with a narrowed

apex 4.4-7.2 mm long, not twisted, glabrous on the proximal half, and with patent, eglandular hairs 0.1-0.3 mm long and scattered, patent, glandular hairs 0.1-0.3 mm long restricted to the narrowed apex; stigmatic remnants 0.9-1.9 mm long, with 5 glabrous lobes. *Seeds* 1.3-2.3 mm long, 0.8-1.4 mm wide, smooth, uniformly colored, brownish red, glabrous. Cotyledons with entire margin. Figs. 757 a-j, 758, 759.

Pollen. *Geranium*-type (Aedo 2017: 412; Bortenschlager 1967: 425; Park & Kim 1997: 312; Perveen & Gaiser 1999: 267; Stafford & Blackmore 1991: 74; Tan & al. 1996: 210; Velasco 1992b: 60; Weber 1996: 196).

Chromosome number. 2*n* = 32?, 52?, 54?, 56?, 64.

Phenology. Collected in flower from January to December.

Distribution. This species ranges through Europe, western and central Asia and northern Africa and perhaps on some parts of eastern U.S.A. and it is introduced in southwestern Canada, western U.S.A., Bermuda, southern South America, China, Taiwan, Réunion, Japan and New Zealand (Fig. 760).

Habitat. Disturbed areas, mossy rocks, dunes, pastures, and deciduous or mixed forests; 0-3500 m.

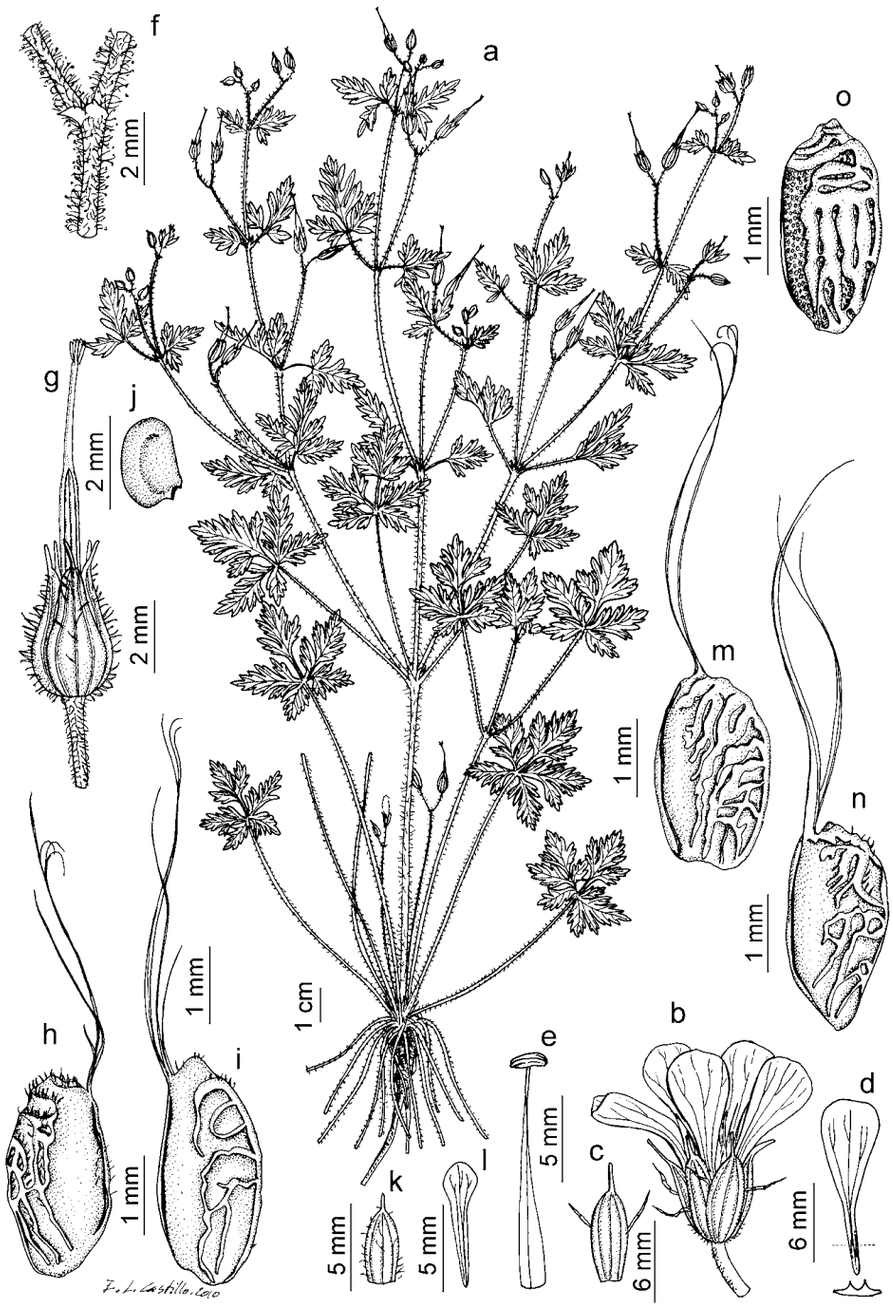


Fig. 757. *Geranium robertianum*. a. Habit. b. Flower. c. Sepal. d. Petal and petal transverse section. e. Stamen. f. Bracteoles. g. Fruit. h, i. Mericarps. j. Seed. (Based on: a, f-h, *Nieto & al. 3117,* MA; b-e, *Aedo 2034,* MA; i, *Aedo 16811*, MA). *Geranium purpureum.* k. Sepal. l. Petal. m-o. Mericarps. (Based on: k, l, o, *Aedo 2058*, MA; m, *Aedo 15694*, MA; n, *Aedo 9699,* MA).

Representative specimens examined. **Andorra**. San Julià de Lòria: hacia la borda del Germà, 42°27'N, 1°28'E, 1 June 2007, *Aedo & al. 13909* (MA). **Argentina.** Buenos Aires: Balcarce, Estancia la Constancia, 37°50'S, 58°15'W, 12 Oct. 1943, *Hunziker 3896* (MO, NY). **Armenia.** Syunik: pr. Vil. Tandzatap and Ahavni, 39°21'N, 46°17'E, 25 June 2005, *Gonzalo & al. 124* (MA). **Austria.** Carinthia: Kärnten, Lesachtal SW von Liesing, 46°41'N, 12°48'E, 6 July 1995, *Sonderegger & Vitek 95-222* (MA). **Azerbaijan.** Absheron: Baku, pr. Schemscha, 40°38'N, 48°38'E, 28 July 1900, *Alexeenko 6775* (LE). **Belorussiya.** Gomel: Tijineckaya vopost, 52°26'N, 30°58'E, 15 Aug. 1923, *Savicz 528* (LE). **Bermuda.** Southampton, 32°20'N, 64°40'W, 12 Mar. 1929, *Kennedy 131* (NY). **Brazil.** Rio Grande do Sul: Cambará, pr. São Francisco de Paula, 29°1'S, 50°9'W, Feb. 1948, *Rambo s.n.* (PACA). **Bulgaria.** Smolyan: Central Rhodope Mts., pr. Kosovo, 41°54'N, 24°42'E, 29 June 2004, *Aedo & al. 10356* (MA). **Canada.** British Columbia: Victoria, The Gorge, 48°26'N, 123°21'W, 11 June 1939, *Eastham 4143* (QFA). Newfoundland Is.: Saint Pierre, 46°0'N, 56°0'W, *Arsène (frère) 292* (NY). Ontario: Essex Co., Sheridon Pt., 41°49'N, 82°41'W, 30 June 1979, *Darbyshire 823* (CAN). Québec: Missisquoi Co., Philipsburg, 45°2'N, 73°5'W, 24 May 1930, *Marie-Victorin (frère) & Rolland (frère) 34 137* (DAO). **Chile.** La Araucanía: Cautín, Temuco, Cerro Ñielol, 38°40'S, 72°38'W, 30 Sep. 1957, *Montero 5608* (CONC). Los Lagos: Valdivia, 39°48'S, 73°14'W, *Philippi s.n.* (W). Santiago: Santa Rita, 33°28'S, 71°50'W, Oct., *Philippi s.n.* (SGO). **China.** Guizhou: ciudad Zunyi, distrito Daozhen, montaña Baijishan, 27°35'N, 106°42'E, 5 Oct. 1990, *Liu Zhengyu 20858* (MO). Sichuan: ciudad Chngqing,

distrito Nanchuan, montaña Jinfoshan, Xian Nudong, 29º1'N, 107º10'E, 6 Sep. 1994, *Liu Zhengyu 14408* (MO). Xinjiang: in montibus Bogdo Ola, in abiegno ad flumen San-Go infra lacum Haitze, 43º35'N, 89º40'E, 5 Sep. 1928, *Hummel 925* (S). Xizang: Bomi Xian, W city Bomi on highway 318 along Palongzang Bu, 29º58'N, 95º21'E, 1 Aug. 2000, *Boufford & al. 29857* (MA). Yunnan: Nieou ko chay, region de Pin tchouan, 25º51'N, 100º33'E, 26 July 1911, *Ducloux & Py 7093* (P). **Croatia.** Istria: Senj, 45º21'N, 13º54'E, 2 June 1966, *Petermann s.n.* (LE). **Czech Republic.** Hradec Králové: Jičín, Zebia Hol, 50º27'N, 15º22'E, 7 Sep. 2000, *Castroviejo 15649* (MA). **Denmark.** Syddanmark: Midskov, E Kolding, 55º30'N, 10º36'E, 24 June 1983, *Larsen & al. 38504* (MA). **Dominican Republic.** Pedernales: "carretera internacional" al norte de Pedernales y al sur de Los Arroyos, 18º13'N, 71º44'W, 12 June 2006, *Greuter 26622* (B). **Estonia.** Saare: Osilia, Filsand, 58º23'N, 21º51'E, 21 June 1900, *Klinge s.n.* (LE). **Finland.** Southwest Finland: Varsinais-Suomi, Korppoo, Korpolandet, Rumar district, 60º7'N, 21º39'E, 21 Aug. 1976, *Alava & Alho s.n.* (MA). **France.** Auvergne-Rhône-Alpes: Auvergne, Puy-de-Dôme, 45º46'N, 2º59'E, 10 Aug. 2002, *Aedo 8393* (MA). Corse: Vivario, Monte d'Oru, Casc. des Anglais, 42º10'N, 9º10'E, 20 Aug. 1996, *Serra & Bort 4911* (MA). Normandie: Basse-Normandie, Manche, Carteret, 49º22'N, 1º47'W, 31 May 1888, *Corbière s.n.* (MA). Réunion**:** Salarie, Santier de Belouve, 21º2'S, 55º33'E, Dec., *Friedmann 2024* (P). **Georgia.** Samtskhe-Javakheti: village Azhuri, Oshor ridge, near Azhur, 41º37'N, 43º14'E, 20 July 1926, *Meffert 440* (MA). **Germany.** Bavaria: Bayern, Oberbayern, von München an Mauern, 48º47'N, 11º44'E, 23 June 1902, *Dihm s.n.* (MA). **Great Britain.** England: Gloucester, Leckhamtom, 52º51'N, 2º5'W, 21 Aug. 1970, *Castroviejo s.n.* (MA). **Greece.** Kriti: La Cancé, rochers de Malaxa pr. Khania, 35º27'N, 24º24'E, 1845, *Raulin 567* (P). Peloponnese: Lakonia, Taigetos Mts., Ladagha gorge, 37º4'N, 22º17'E, 24 June 2007, *Aedo & al. 14262* (MA). **Hungary.** Pest: Budapest, 47º30'N, 19º5'E, 7 June 1877, *[illegible] s.n.* (P). **Iceland.** Reykjavík: Reykjavik, 64º8'N, 21º55'W, Sep. 1950, *Dadídsson s.n.* (ICEL). **India.** Jammu-Kashmir: Pahlgam, Kashmir, 34º0'N, 75º19'E, 20 Aug. 1925, *Stewart 8321* (MO). **Iran.** Mazandaran: Gorgan, Nahar Khuran, 35º55'N, 52º18'E, May 1948, *Sharif 550* (W). **Ireland.** Munster: Clare Co., Poulsallagh, 53º3'N, 9º21'W, 1 June 1965, *Dickinson s.n.* (MA). **Italy.** Lazio: pr. Tolfa, 42º8'N, 11º56'E, 11 Apr. 2011, *Calvo & Quintanar 4326* (MA). Sardegna: Nouro, Bolotana, Badde Salghes, Mularza Noa, 40º20'N, 8º54'E, 2 June 2003, *Aedo & al. 9175* (MA). Sicilia: Palermo, Riserva di Bosco della Ticuzza (Busambra), 37º51'N, 13º25'E, 31 May 2000, *Castroviejo & al. 15544* (MA). **Japan.** Honshū: Western Honsu, Shiga, Gongendani, N Mt. Nabejiri-yama, Taga-cho, Inukami-gun, 35º12'N, 136º20'E, 3 May 1967, *Fukuoka & Wakabayashi 1012* (MO, NY). **Kazakhstan.** Almaty: Semirbciensk obl., Okr g. Vbrnago, 43º15'N, 76º55'E, 24 July 1898, *Killomanz s.n.* (LE). **Kyrgyzstan.** Talas: Isdekucidh, Koruman-cas, 42º11'N, 71º23'E, 24 July 1972 (LE). **Lebanon.** North: Libanon, in reg. Arz Libnan, Ehden, 34º16'N, 35º58'E, 11 June 1933, *Samuelsson 5922* (MO). **Lithuania.** Fluck, 3 June 1894 (LE). **Moldova.** Nisporeni: Kalarachskiy, Cioreşti, 47º10'N, 28º13'E, 15 June 1966, *Vitko s.n.* (LE). **Morocco.** Fès-Meknès: 27 km SSW of Taza, Gouffre de Friouato, 34º6'N, 4º5'W, 22 June 1987, *Jury & al. 8552* (MA). **Netherlands.** Utrecht: between Utrecht and Rhijnauwen, 52º4'N, 5º10'E, 29 June 1960, *Berg s.n.* (MA). **New Zealand.** New Zealand North Is.: Bay of Islands, Russell State Forest, 4.5 km SE of Waikare, 35º22'S, 174º16'E, 30 Nov. 1972, *Orchard 3779* (AD). **Norway.** Vestfold og Telemark: Akershus Co., Baerum, Haslum, 58º48'N, 9º23'E, 19 June 2007, *Sunding s.n.* (MA). **Poland.** Lesser Poland: Cracovia, inter pagum Tyniec et vicum Podgórki, 50º0'N, 19º48'E, 11 June 1970, *Piekós s.n.* (MO, LE). **Portugal.** Azores: Pico, Lajes, above Silveira, 38º22'N, 28º15'W, 6 June 1964, *Dansereau & al. 439* (COI). Beira Baixa: pr. Alcongosta, 40º6'N, 7º28'W, 3 May 2009, *Aedo 16408* (MA). **Portugal.** Madeira: riberia da Fonte do Louro, 32º47'N, 16º55'W, 31 Aug. 2003, *Aedo 9704* (MA). **Romania.** Sud-Muntenia: Prahova, pr. Sinaia, Mt. Paduchiosul, 45º19'N, 25º30'E, 9 Aug. 2009, *Aedo 16811* (MA). **Russia.** Altay: Altai, Kibesen, 51º52'N, 87º14'E, 10 Apr. 1901, *Krylov s.n.* (LE). Dagestan: Dagestania superior montosa ad fl. Ilan-chewi, 43º0'N, 47º0'E, 17 Aug. 1860, *Ruprecht s.n.* (LE). Kaliningrad: Kaliningrad, Primorsk, 54º32'N, 20º3'E, 12 June 1949, *Pobedimova & al. 282* (LE). Kaluga: in valle fluv. Ugra inter Juchnov et Tovarkovo, ad ostium fl. Tetscha, 54º40'N, 35º56'E, 20 July 1978, *Skvortsov s.n.* (MO). Karelia: Lajdenpoja, 61º30'N, 30º12'E, 10 July 1961, *Pobedimova & Gladkova 239* (LE). Kostroma: Nerejm, 57º25'N, 40º45'E, 6 Aug. 1912, *Kossinvky 816* (LE). Krasnodar: Sochi, Vostochny Dagomys river, 1 km to the N of Baranovka village, 43º42'N, 39º41'E, 22 June 2006, *Naumenko & al. s.n.* (MA). Krym: Yalta-Oreanda, 44º30'N, 34º10'E, 11 Apr. 1900, *Puring s.n.* (LE). Moscow: Mosqua, Naro-Fominsk, ad fluv. Nara, 55º25'N, 36º45'E, 20 Aug. 1978, *Skvortsov s.n.* (MO). Murmansk: in Tannia circa Helpinggford, Aug. 1840, *Trautvertter s.n.* (LE). Novgorod: Borovicskiy obs., Dolina rbki Mstni, Opesenskago, Egluy,

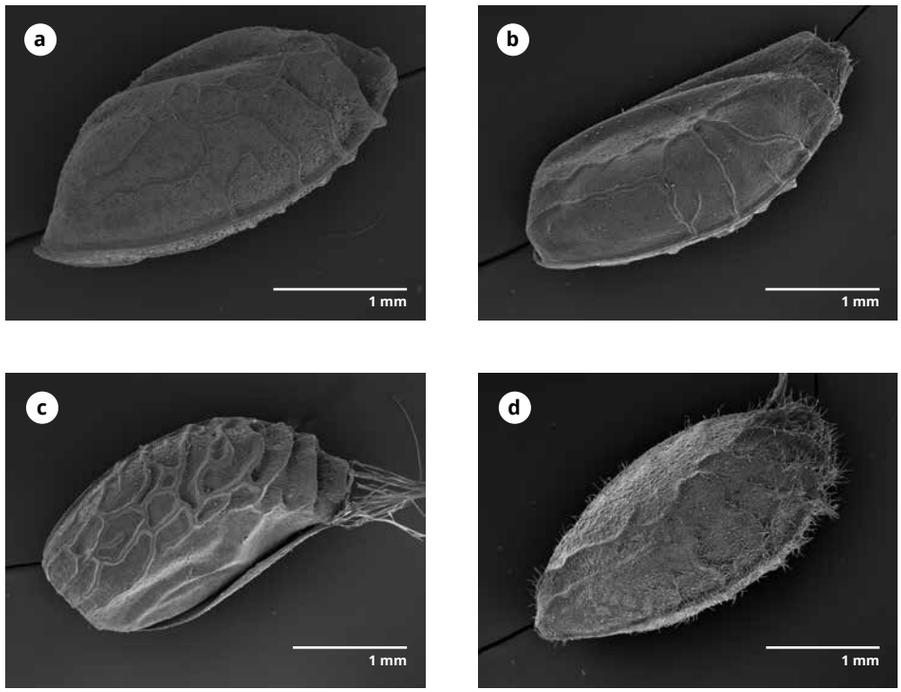


Fig. 758. SEM photographs showing the variability of the mericarps of *Geranium robertianum*. (Based on: a, *Steiner 64*, W; b, *Aedo 16811*, MA; c, *Navarro 3369*, MA; d, *Gonzalo 34*. MA).

Fig. 759. *Geranium robertianum* (Based on: a, b, *Aedo 15748,* MA; c, *Aedo 21941,* MA; d, e, *Aedo 21953,* MA; f, without voucher, cultivated at *Real Jardín Botánico de Madrid*; g, without voucher, from Madeira, Portugal, photo: M. Sequeira).

58°30'N, 34°0'E, 22 July 1915, *Komarov s.n.* (LE). Voronezh: Yoronezh, Bobrovskij, Jrenovskoy, 58°6'N, 62°9'E, 11 June 1923, *Ditmer s.n.* (LE). West Siberia: Kemerovskaya obl., Kuzedeevo, 53°19'N, 87°12'E, 13 Aug. 1974, *Dashinsky & al. 456* (LE). **Saudi Arabia.** Asir: Raidah escarpment, below assihab Park, 12 km NW of Abha, 18°12'N, 42°24'E, 20 Feb. 1986, *Collenette 5624* (E). **Slovakia.** Bratislava: Presov, Kezmarok, Cerveny Klastor, 49°24'N, 20°25'E, 16 Aug. 2013, *Barberá 943* (MA). **Slovenia.** Upper Carniola: Bled, garganta de Vintgar, 46°23'N, 14°5'E, 9 Aug. 2017, *Aedo 25232* (MA). **Spain.** Cantabria: Serna, 43°1'N, 4°12'W, 28 June 2008, *Aedo 15760* (MA). **Sweden.** Stockholm: Uppland, Djurö, insula Runmarö, Nore, 59°17'N, 18°46'E, 11 July 1929, *Vestergren 1117* (LE). **Switzerland.** Valais: Corcelles-près-Concise, 46°51'N, 6°57'E, 12 May 1988, *Theurillat 5899* (MA). **Taiwan.** Taichung Co.: Chihyuanshanchuang, 23°44'N, 120°58'E, 13 Apr. 1985, *Tang 1263* (TAI). **Tajikistan.** Gorno-Badakhshan: Severnuiy sklon Seravshanskogo jr., Spusk po reke Dajshtiv, Fal'mout, 39°07'N, 73°11'E, 19 July 1960,

Egorova 1983 (LE). **Turkey.** Karabük: Zonguldak, puerto de Ahmetusta, 41°22'N, 32°42'E, 20 June 2001, *Aedo & al. 6498* (MA). **Turkmenistan.** Ahal: Ashabad, 37°56'N, 58°22'E, 1874, *[illegible] 4371* (LE). **Ukraine.** Cherkasy: pr. Umanj, 48°44'N, 30°14'E, 23 June 1904, *Tyranovez 3436* (MO, ILL). **Uruguay.** Florida: Arroyo Mansavillagra, Picada Castro, Estancia Rincón de Santa Elena, 33°26'S, 55°54'W, Sep. 1946, *Gallinal 5761* (SP). **USA.** Alaska: Kodiak, 57°47'N, 152°24'W, 25 June 1970, *Willians 2550* (ALA). California: Los Angeles Co., Brentwood, 34°3'N, 118°28'W, 3 June 1958, *Roos s.n.* (OBI). Maine: York Co., Limerick, 43°42'N, 70°48'W, 24 July 1947, *Moldenke 18937* (NY). Maryland: Talbot Co., Longwoods, 38°51'N, 76°4'W, 6 July 1947, *Earle 4353* (PH). Michigan: Leelanau Co., North Manitou Is., 42°5'N, 86°7'W, 29 July 1886, *Wislizenus 476* (MO). New Hampshire: Rockingham Co., Duck I'd, Isles of Shoals, 42°59'N, 70°36'W, 3 July 1887, *Churchill s.n.* (MO). Oregon: Curry Co., Cape Ferrelo, 42°6'N, 124°21'W, 20 May 1996, *Stansell 3074* (OSC). Washington: Clallam Co., Olympic Nat. Park, road along Hurricane ridge, 28 Aug. 1969, *Riggins 783* (OBI). West Virginia: Wayne Co., Wilsondale, 37°57'N, 82°19'W, 4 June 1909 (NY). **Uzbekistan.** Samarkand: Samarkandskaya gub., Okr kish, Ak-say, 39°21'N, 66°59'E, *Butkov 204* (LE).

Discussion. Geranium robertianum is a facultative biennial, occasionally lasting longer in protected conditions or sometimes annual (Bertin, 2001; Tofts, 2004a; Yeo, 1973a). It is quite similar to *G. purpureum* in general appearance, leaf outline, inflorescence structure, and flower and fruit morphology; however, *G. robertianum* has longer and wider petals and purple anthers as stated before. Moreover, the sepal mucro and anthers are longer in *G. robertianum* than in *G. purpureum* although with some overlap. In contrast with *G. purpureum*, the mericarp sculpture of *G. robertianum* is less variable. These mericarps have scarce and thin ridges anastomosing in the basal half but are more abundant distally and form one to two (or three) overlapping, collar-like keels at the apex. This type of sculpture is also found in some specimens of *G. purpureum*, which make it difficult to assign some herbarium specimens without flowers to either species. Figure 758 shows the variability of mericarp sculpture in *G. robertianum*. Baker (1956) accepted *Geranium robertianum* subsp. *maritimum* based on its prostrate habit and lack of indumentum, and *G. robertianum* subsp. *celticum* based on its pale leaves and flowers. Yeo (1973a, 2004) has reservations as to the distinctness and constancy of these taxa and does not formally recognize them. I agree with this opinion, and, considering that no relevant additional characters have been found, these subspecies were synonymized to *G. robertianum*. Yeo (1992, 2004) reported the smaller flower size of *G. robertianum* from China and the Far East (in relation to the European populations), which has been corroborated in this study. Otherwise, they fall well within the range of variability of *G. robertianum*. According to the cytological observations by Baker, Yeo (1973a: 314) reported that the triploid hybrid of *Geranium purpureum* × *G. robertianum* formed *n* univalents and *n* bivalents at the first division of meiosis. Consequently, Yeo (1973a: 314) proposed an allopolyploid origin for *G. robertianum* with *G. purpureum* and an unknown species as parents.

A detailed account of the life history of *G. robertianum* is provided by Tofts (2004a) and Bertin (2001). Sexton & al. (1983) studied the abscission process of the petals of *G. robertianum*.

Geranium robertianum is widely distributed in the temperate northern hemisphere and is naturalized in southern South America, Réunion, and New Zealand (Aedo 2012). Its status in North America is subject to controversy: it is naturalized in southwestern Canada and the western United States, but is perhaps native to eastern Canada and the eastern United States, where its presence was documented at an early date (Pursh 1814). *Geranium robertianum* appears to be introduced in eastern Asia and Japan, but Nishida & al. (2012) suggested that some Japanese populations could be native. *Geranium robertianum* was recorded from Singapore (Knuth 1912: 66) based on a collection by J. C. Ploem from 1867, probably kept at B. Unfortunately, no voucher of this record has been located. It was not possible to locate the type of *Geranium robertianum* var. *rubricaule* Hornem. According to Wilmott (1921: 98), no original specimens are at C, where Hornemann's herbarium is kept.

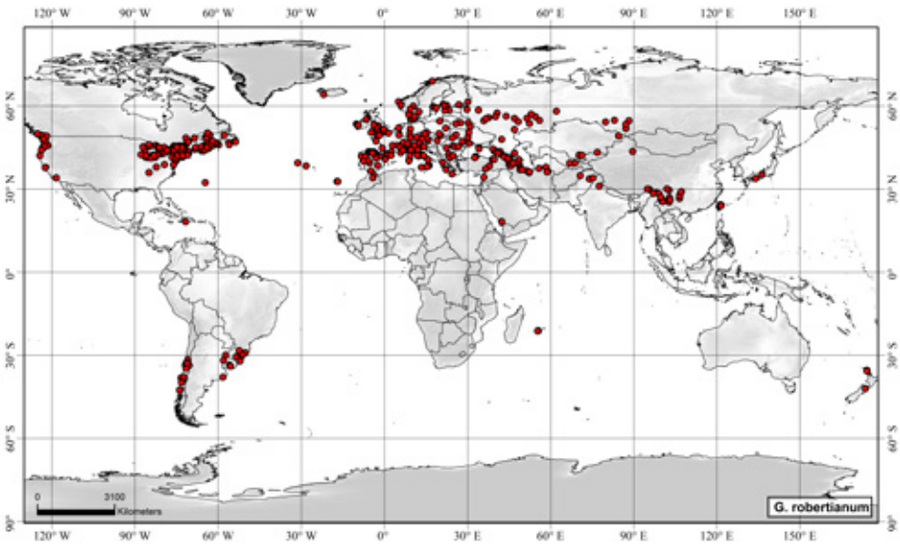


Fig. 760. Distribution of *Geranium robertianum*.

301. Geranium yeoi Aedo & Muñoz Garm., Kew Bull. 52(3): 727. 1997. *Geranium rubescens* W.D. Jacks. ex Yeo, Bol. Mus. Munic. Funchal 23: 31. 1969, [replaced synonym], nom. illeg., non Andrews, 1805. Type locality: "G. rubescens W. Jackson ined. (1957, p. 87)... R. do Seixal, 1500 ft., June 1865, F.M. Norman, as G. robertianum var. maritimum". Type: Portugal. Madeira, Riberia do Seixal, 32°46'N, 17°06'W, June 1865, *F.M. Norman s.n.* (holotype, CGE-00058 image!).

Biennial herbs, 35-80(100) cm tall. *Stem* erect, leafy, usually with scattered, uncinate, eglandular hairs 0.2-0.7 mm long and ± patent, glandular hairs 0.4-1.6 mm long, sometimes glabrous. *Basal leaves* in a deciduous rosette, cauline leaves opposite; leaf laminas (5)6.1-11.7(18.8) cm long, 5.8-17.3 cm wide, not peltate, palmatisect, polygonal in outline, base cordate, not coriaceous, with nerves not projected, with ± uncinate, eglandular hairs (mainly on the nerves) and plane glandular hairs on both surfaces; segments 5, in 1 plane, middle segment rhombic, 0.9-2.4 mm wide at the base [ratio segment width at the base/middle segment length = 0.01-0.02(0.04)], (35)39-61(96)-lobed in distal half [ratio secondary sinus length/middle segment length = (0.26)0.36-0.42(0.46)]; petioles up to 25 cm long, without abscission zone, terete, not swollen, deflexed, appressed to the soil in age, usually with scattered, retrorse, not appressed, eglandular hairs 0.2-0.5 mm long and ± patent, glandular hairs 0.6-2.8 mm long, sometimes glabrous; stipules (3)4.8-6.4(7.4) mm long, 1.8-3.8 mm wide, ovate, obtuse, free, papery, green to dark reddish, glabrous on both surfaces and with glandular hairs on the margin, sometimes ± tomentose abaxially. *Inflorescence* a dichasial cyme with monochasial branches; cymules (1)2-flowered, solitary [ratio cymule length/leaf length = (1.3)2.4-3.6(9)]; peduncles (23)34-52(69) mm long, with uncinate, retrorse, eglandular hairs 0.2-0.6 mm long and patent, glandular hairs 0.6-2.2 mm long; bracteoles 1.2-3.4 mm long, 0.5-2.1 mm wide, lanceolate, whorled; pedicels (3.7)9.2-19.4(34.7) mm long, with uncinate, retrorse, eglandular hairs 0.2-0.6 mm long and patent, glandular hairs 0.3-1.9 mm long. Flowers actinomorphic. *Sepals* (6)6.9-8.3(9.4) mm long, 2-3.8 mm wide, lanceolate, smooth, not accrescent, nerves 3, mucro (1.3)1.6-2.2(3.1) mm long [ratio mucro length/sepal length = (0.18)0.22-0.30(0.40)], with ± patent, glandular hairs 0.3-3.1 mm long and, usually scattered, patent, eglandular hairs 0.2-0.6 mm long on the abaxial surface, glabrous adaxially. *Petals* (14.9)16.2-19.3(20.7) mm long, (4.6)6.5-8.3(9.4) mm wide, erect-pat-

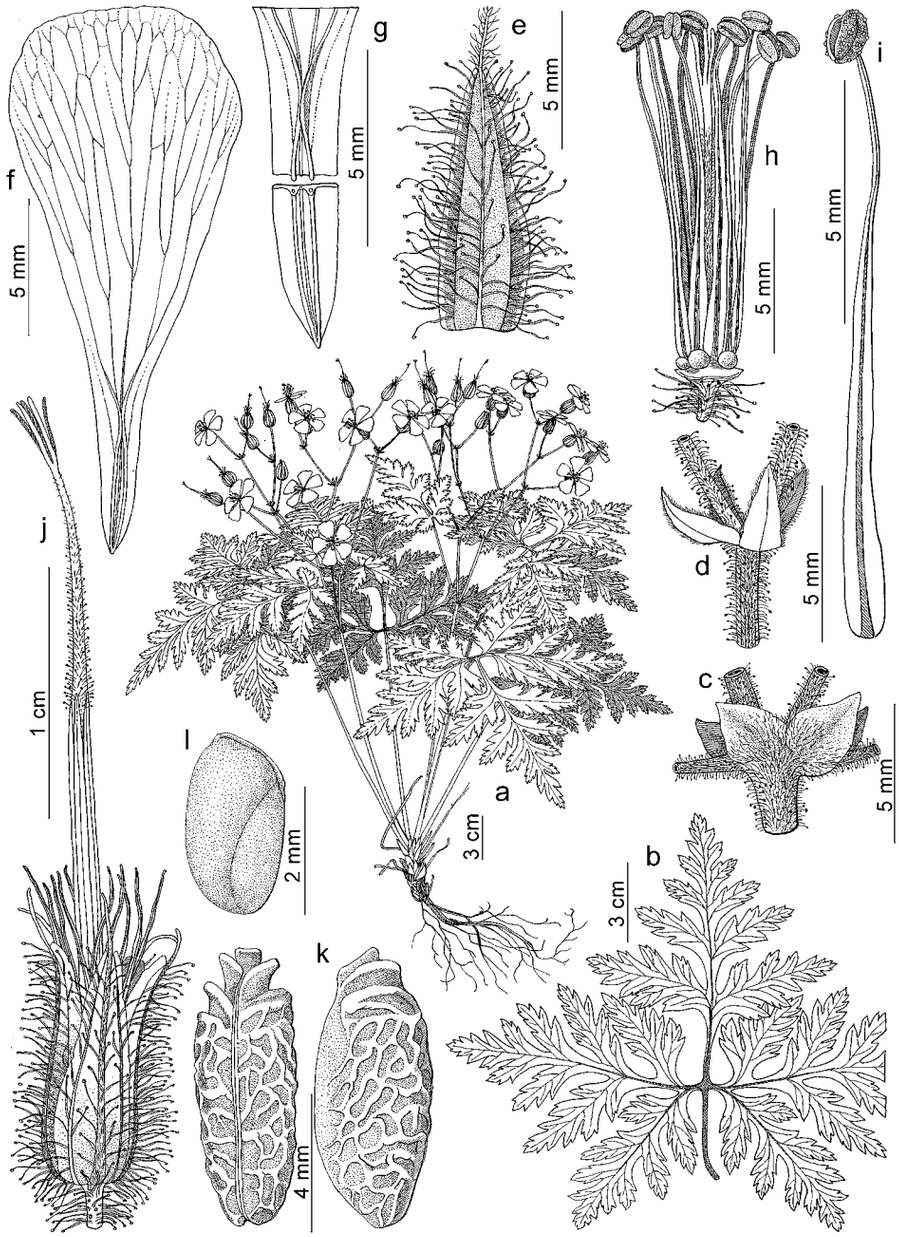


Fig. 761. *Geranium yeoi*. a. Habit. b. Leaf. c. Stipules. d. Bracteoles. e. Sepal. f. Petal. g. Detail of petal claw. h. Flower without sepals and petals. i. Stamen. j. Fruit. k. Mericarps. l. Seed. (Based on: a, c-l, *Jardim 8920*, MADJ; b, *Navarro 3098*, MA).

ent, rounded (rarely retuse), with claw 5.8-8.1 mm long (bicarinated), purple, glabrous. *Stamens* 10, both whorls bearing anthers; filaments (8.7)9.6-11.3(12.8) mm long, linear-lanceolate, white or pink, glabrous; anthers (0.8)0.9-1.1(1.2) mm long, yellow with red lines. Nectaries 5, hemispheric, glabrous. *Gynoecium* 8.6-13.4 mm long, dark purple. *Fruit* (27)29-33(34) mm long, erect, discharge of carpel-projection type, operative; mericarps 3.1-4 mm long, 1.2-2 mm wide, usually without a strand of fibers, not compressed at the apex, reticulate, with thin ridges scarcely anastomosing and forming 1(2) annular keels at the apex, without basal beak, without a basal callus, without a basal prong, brown, glabrous; rostrum 21.2-27 mm long, with a narrowed apex (7.4)8.3-10.3(11.1) mm long, not twisted, glabrous on the proximal half, with erect-patent, eglandular hairs 0.2-0.4 mm long and scattered, patent, glandular hairs 0.1-0.4 mm long restricted to the narrowed apex; stigmatic remnants 1.5-2.6 mm long, with 5 glabrous lobes. *Seeds* 2.3-2.9 mm long, 1.1-1.6 mm wide, smooth, uniformly colored, brown, glabrous. Cotyledons with entire margin. Figs. 761, 762.

Pollen. *Geranium*-type (Aedo 2017: 412).

Chromosome number. 2*n* = 128.

Phenology. Collected in flower from January to December.

Distribution. This species is endemic to Madeira and it is introduced or garden-escaped in France, Australia, New Zealand and California (Fig. 763).

Habitat. Cloud forests and grassy roadbanks; 10-1000 m.

Fig. 762. *Geranium yeoi* (without voucher, from Madeira, Portugal, photo: M. Sequeira).

Additional specimens examined. **Australia.** South Australia: Southern Lofty, roadside scrub near Mt. Lofty, 34°59'S, 138°43'E, 19 Dec. 1981, *Bates 2145* (AD); Southern Lofty, Adelaide Hills, on exit from Crafers, 34°59'S, 138°42'E, 16 Dec. 2010, *Brodie & Cunningham 1932* (MA); Southern Lofty, Bridgewater, 35°0'S, 138°45'E, 28 Oct. 1975, *Bailey s.n.* (MA); Southern Lofty, roadside NW of Stirling, 35°0'S, 138°42'E, 3 Mar. 1996, *Bates 42516* (AD); Southern Lofty, Adelaide Hills, Stirling to Aldgate Road, 35°0'S, 138°43'E, 2 Dec. 2011, *Brodie & Lang 3867* (MA); Southern Lofty, Crafers-Stirling woodland walk, 35°1'S, 138°43'E, Aug. 2004, *Bates 63299* (AD); Southern Lofty, at Mylor, 35°3'S, 138°45'E, 26 Jan. 1989, *Bates 17416* (AD); Southern Lofty region, Bald Hill road, Bull Creek, 35°14'S, 138°46'E, Oct. 2010, *Bell s.n.* (MA). Tasmania: 17 Keen Court, Kingston, 42°59'S, 147°18'E, 18 Nov. 2002, *Morris 86773* (MA). **France.** Provence-Alpes-Côte d'Azur: Avignon, 19

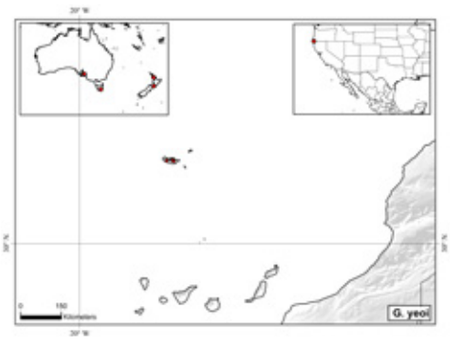


Fig. 763. Distribution of *Geranium yeoi*.

May 1886, *Delacour 5206* (CAS, FI). **New Zealand.** New Zealand North Is.: Auckland Ecological region, Tamaki Ecological district, S of Whenuapai, 80 Trig Road, 36º49'S, 174º35'E, 22 Nov. 1991, *Cameron 6609* (AD); Wellington, Karori, Victory Avenue, 41º16'S, 174º43'E, 14 Dec. 1979, *Brownsey s.n.* (AD). **Portugal.** Madeira: Ribeiro Frio, 32º44'N, 16º53'W, 19 Sep. 1961, *Coleridge 141* (BM); Rabaçal, levada das 25 Fontes, 32º45'N, 17º7'W, 3 Aug. 1974, *Christensen 5342* (C); Santana, forest station, 32º46'N, 16º53'W, 13 Sep. 1988, *[illegible] s.n.* (C); Queimadas de Santa Ana, 32º46'N, 16º54'W, 21 Oct. 2006, *Castroviejo & Sequeira 18209* (MA); Queimadas, 32º46'N, 16º56'W, 17 Aug. 1961, *Coleridge 1* (BM); to the top of Pico Ruivo, 32º46'N, 16º57'W, Mar. 1827, *Lowe 358* (BM); Santa Anna, 32º46'N, 16º54'W, July, *Mandon 47* (C, P, RO); Santana, carretera al Pico das Pedras, 32º46'N, 16º53'W, 26 June 2000, *Navarro 3098* (MA); levada do Caldeirão from Queimadas rest house to Caldeirão Verde, 32º46'N, 16º56'W, 7 June 1985, *Press 833* (BM); riberia da Fonte do Louro, 32º47'N, 16º55'W, 31 Aug. 2003, *Aedo 9701* (MA); riberia da Fonte do Louro, 32º47'N, 16º55'W, 31 Aug. 2003, *Aedo 9702* (MA); along road to Queimadas, 32º47'N, 16º54'W, 19 Apr. 1998, *Alanko 95380* (H); Queimadas, 32º47'N, 16º54'W, 2 July 1998, *Jardim 8920* (MA, MADJ); Queimadas, 32º47'N, 16º54'W, 24 June 1966, *Sjögren 1213a* (MA); Queimadas, Taborda, 32º47'N, 16º54'W, 26 Feb. 1965, *Sjögren 266a* (MO). **USA.** California: Del Norte Co., Ocean View Drive 0.1 road mile S of North Indian Road, N of Smith River mouth, 41º57'N, 124º12.1'W, 19 Oct. 2008, *Zika 24223* (MA).

Discussion. Geranium yeoi is a robust biennial herb with a simple taproot with thin secondary roots. It is an unique endemic species from Madeira without a well developed caudex. According to Yeo (1973a: 289), cultivated plants form magnificient overwintering rosettes. *Geranium yeoi* is extremely similar to *G. robertianum* but larger in all its parts. It is easy to distinguish, however, by its longer petals with a longer claw, longer staminal filaments, and longer fruits. According to Yeo & Widler-Kiefer (1990: 11) the "nectar of *G. yeoi* [as *G. rubescens*], contains exactly the same amino-acids as that of *G. robertianum*, as indeed we would expect if it was an autopolyploid of the latter". *Geranium yeoi* is also characterized by the lack of fibers derived from the rostrum and attached near the apex of the mericarp. In some specimens (i.e., *Jardim s.n.*, MADJ-8920), however, vestigial fibers have been found at the apex of the mericarp, which reinforces the close relationship between *G. yeoi* and *G. robertianum*. Although *Geranium yeoi* is more similar in life cycle to *G. robertianum* than *G. palmatum*, it may be difficult to differentiate from *G. palmatum* when the basal part of the plant is not collected. *Geranium yeoi* has, however, shorter and narrower petals, but with a larger claw, than *G. palmatum*. The staminal filaments, anthers, and fruit rostrum apex are also shorter in *G. yeoi* than in *G. palmatum* with little overlap. Additionally, *G. yeoi* may be distinguished by its lack of a purplish pigment in the stalk of the glandular hairs of the inflorescence.

Geranium yeoi, a restricted endemic from the northern slopes of Madeira Island, has been used often in gardens (Yeo 2002a: 178). It is naturalized or garden-escaped in Great Britain (Stace 2010), France and in several remote places, such as in California, Australia, and New Zealand.

---

302. Geranium cataractarum Coss., Notes Pl. Crit.: 99. 1851. *Geranium cataractarum* subsp. *cossonii* Maire, Bull. Soc. Hist. Nat. Afrique N. 15: 98. 1924, nom. illeg. Type locality: "Florens et vix fructiferum 30ª die Julii 1850 lectum. In rupibus madidis cataractarum los Choros dictarum in monte Sierra de Segura regni Murcici (E. Bourgeau)". Type: Spain. Albacete, Sierra de Segura, Los Chorros, 38°27'N, 2°25'E, 30 June 1850, *E. Bourgeau s.n.* (lectotype, designated by Aedo 2017b: 414, P-00375661!; isolectotype, LE!).

Geranium cataractarum var. *tomentosum* Porta, Veg. Itin. Iber.: 17. 1892. Type locality: "Reg. Murc. in rupium rimis montium inter Segura et Puebla de don Fedrique, sol. cal.alt. 1400-2000 m.". Type: Spain. Jaén, inter Segura et Puebla de don Fadrique, 38°02'N, 2°28'E, 1890, *P. Porta s.n.* (no original material located).

Geranium occitanicum Batt. & Pit. in Pit., Contr. Fl. Maroc: 8. 1918. *Geranium cataractarum* var. *occitanicum* (Batt. & Pit.) Font Quer, Cavanillesia 4: 89. 1931. Type locality: "Maroc central: Djebel Outa, près Anoceur (1800 m.) Fisures de rochers exposés au nord". Type: Morocco. Djebel Outa, pr`es Anoceur, 33°40'N, 4°51'E, Oct. 1913, *M. Mouret 1955* (lectotype, designated by Aedo 2017b: 414, P-00390201!).

Geranium cataractarum subsp. *pitardii* Maire, Bull. Soc. Hist. Nat. Afrique N. 15: 96, fig. 2. 1924. *Geranium cataractarum* var. *pitardii* (Maire) Font Quer, Cavanillesia 4: 89. 1931. Type locality: "Hab. in fissuris rupium calcarearum subalpinarum Atlantis Medii, ad alt. 1.600-2.300 m., ubi junio et julio floret. Moyen Atlas: Djebel Outa près Anoceur, 1.800 m., fissures des rochers exposés au N. (Mouret). Rochers calcaires exposés au N.-W. à Timhadit, 1.850-1.900 m.; dans la gorge de Ras-el-Ma, 1.600 m.; sur l'Ari-Hayan, 2.200-2.300 m.; au Tizi-Ali-ou-Mansour, près Bekrit, 2.000 m.; sur l'Ari-Benij, 2.300-2.400 m.; dans le Kheneg Merzoul, 1.900 m. (Maire)". Type: Morocco. Moyen Atlas, Azrou, Ras-el-Ma, 33°26'N, 5°13'E, 19 June 1923, *R. Maire s.n.* (lectotype, designated by Aedo 2017b: 414, MPU-001574!).

Perennial herbs, 19-33 cm tall. *Rootstock* 5-11 mm in diameter, ± horizontal, not tuberculate, not turnip-shaped, without thickened roots. *Stem* erect, leafy, not rooting at nodes, stolons absent, without vegetative stems, with scattered, patent, eglandular hairs 0.2-0.3 mm long and patent, glandular hairs 0.3-2.4 mm long. *Basal leaves* in a persistent rosette, cauline leaves opposite; leaf laminas (2.1)3.8-5.1(7.9) cm long, 2.6-7.5 cm wide, not peltate, palmatisect, polygonal in outline, base cordate, not coriaceous, with nerves not projected, with ± appressed, eglandular hairs and plane glandular hairs on the adaxial surface and with eglandular hairs and glandular hairs abaxially; segments 5, in 1 plane, middle segment rhombic, 0.6-2.3 mm wide at the base [ratio segment width at the base/middle segment length = (0.01)0.02-0.05(0.07)], 12-31-lobed in distal half [ratio secondary sinus length/middle segment length = (0.25)0.34-0.39(0.51)]; petioles up to 19 cm long, without abscission zone,

terete, not swollen, not deflexed in age, with scattered, patent, eglandular hairs 0.2-0.3 mm long and ± patent, glandular hairs 0.3-2.2 mm long; stipules (1.7)2.3-4(4.6) mm long, 0.7-2.3 mm wide, lanceolate, free, papery, green, with glandular hairs on abaxial surface and on the margin, glabrous adaxially. *Inflorescence* a dichasial cyme; cymules 2-flowered, solitary [ratio cymule length/leaf length = 1.1-2.9]; peduncles (9)23-41(60) mm long, with patent, eglandular hairs 0.1-0.3 mm long and patent, glandular hairs 0.2-1.1 mm long; bracteoles 0.8-2.9 mm long, 0.3-1 mm wide, lanceolate, whorled; pedicels (7)9-14(21) mm long, with patent, eglandular hairs 0.1-0.3 mm long and patent, glandular hairs 0.3-1.1 mm long. Flowers ± actinomorphic. *Sepals* (4.8)5.3-6.2(6.3) mm long, 2.3-3.7 mm wide, lanceolate, smooth, not accrescent, nerves 3, mucro 0.4-0.7(0.8) mm long [ratio mucro length/sepal length = (0.07)0.08-0.13(0.17)], with patent, glandular hairs 0.8-2.3 mm long on the abaxial surface, glabrous adaxially. *Petals* (12)12.5-14.8(17.7) mm long, (4.5)5.2-7.4(8.2) mm wide, patent, rounded, with claw 3.8-6.3 mm long (bicarinated), purple, glabrous. *Stamens* 10, both whorls bearing anthers; filaments (5.8)7.7-9.1(10) mm long, linear-lanceolate, pink, glabrous; anthers (1.1)1.2-1.6(1.8) mm long, orange. Nectaries 5, hemispheric, glabrous. *Gynoecium* 7-10 mm long, pink. *Fruit* (14.3)15-17(20.3) mm long, erect, discharge of carpel-projection type, operative; mericarps 2.8-3.3 mm long, 1.1-1.5 mm wide, without a strand of fibers, not compressed at the apex, reticulate, with thin ridges scarcely anastomosing, without basal beak, without a basal callus, without a basal prong, brown, glabrous, rarely with scattered, eglandular hairs 0.1-0.2 mm long; rostrum 9.8-15 mm long, with a narrowed apex 4.4-6.4 mm long, not twisted, glabrous or with patent, glandular hairs 0.1-0.2 mm long restricted to the basal half of the narrowed apex; stigmatic remnants 0.8-1.5 mm long, with 5 glabrous lobes. *Seeds* 1.8-2.6 mm long, 0.8-1.3 mm wide, smooth, uniformly colored, brownish red, glabrous. Cotyledons with entire margin. Figs. 764, 765.

Pollen. *Geranium*-type (Aedo 2017: 412; Velasco 1992b: 60).

Chromosome number. 2*n* = 36.

Phenology. Collected in flower from June to July.

Distribution. This species ranges from southeastern Spain to central Morocco (Fig. 766).

Habitat. Fissures, crevices, and screes of limestone rocks; 1300-2300 m.

Additional specimens examined. **Morocco.** Béni Mellal-Khénifra: Beni-Mellal, Jab Tassemit au-dessus de Beni-Mellal,

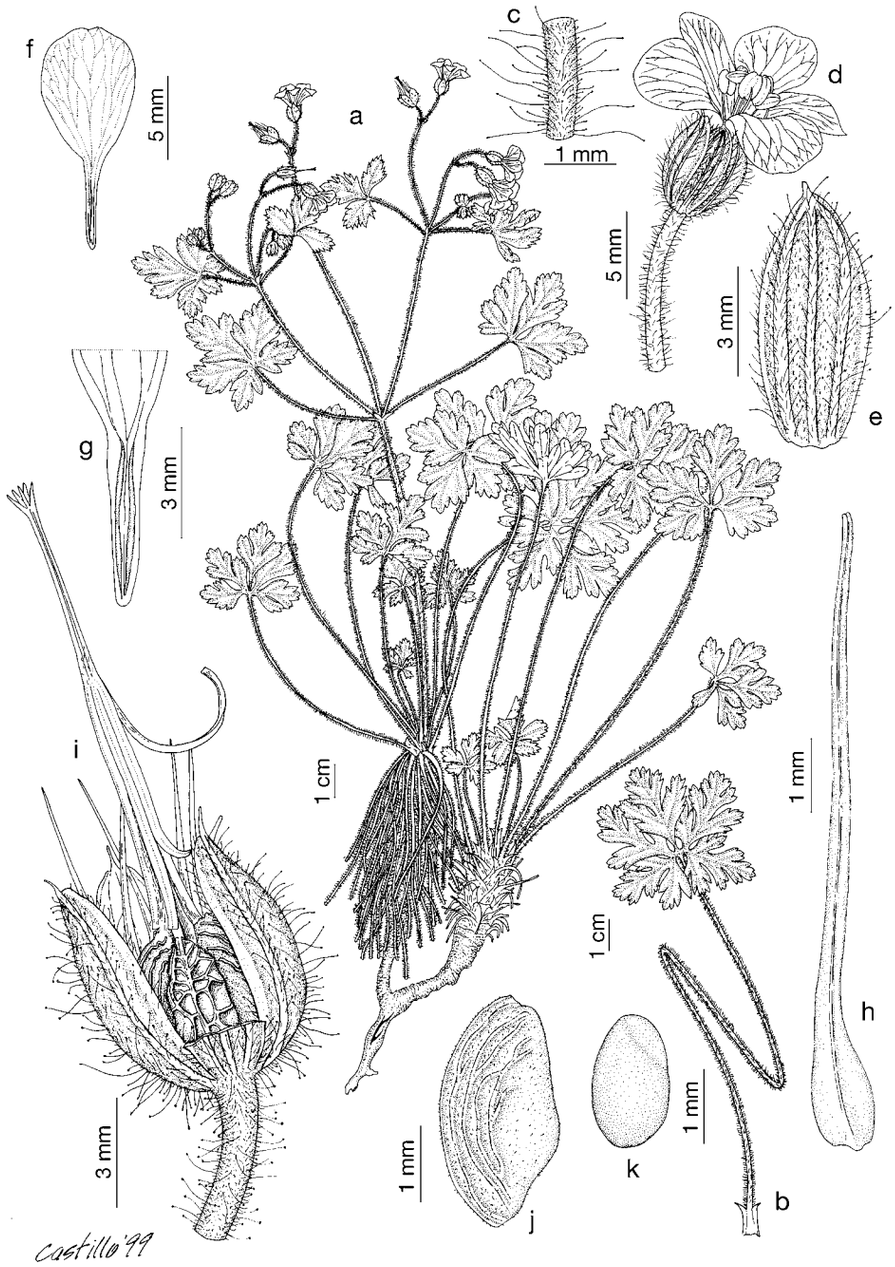


Fig. 764. *Geranium cataractarum*. a. Habit. b. Leaf. c. Peduncle. d. Flower. e. Sepal. f. Petal. g. Detail of petal claw. h. Staminal filament. i. Fruit. j. Mericarp. k. Seed. (based on: a, *Soriano 1190*, MA; b-g, *Muñoz Garmendia & Soriano 3193*, MA; h-k, *González Rebollar & al. 3192,* MA).

Fig. 765. *Geranium cataractarum* (Based on: *Aedo 16117*, MA).

32°18'N, 6°15'W, 5 June 1980, *Charpin & al. MAR 602* (MA); Beni Mellal, El Ksiba, 32°30'N, 6°0'W, 5 July 2006, *Quintanar & al. 2037* (MA); Moyen Atlas, Ari Hayan, 33°19'N, 5°47'W, 26 June 1923, *Maire s.n.* (MPU). Fès-Meknès: Moyen Atlas, fôret de Bikrit, 33°1'N, 5°15'W, 4 July 1996, *Cirujano & al. R-10199* (MA); Moyen Atlas, Bekrit, 33°5'N, 5°13'W, 1 June 1924, *Jahandiez 507* (MA); Atlas Medio, S de Timhadit, 33°9'N, 5°4'W, 26 June 1997, *Aedo & al. 4234* (MA); gorges du Guigon, Foum Kheneg, 33°9'N, 5°3'W, 18 June 1953, *Sauvage 11600* (MPU); Middel Atlas, Timahdite, 33°12'N, 5°4'W, 12 June 1992, *Valdés & al. 170708* (B); Timhadit, 33°14'N, 5°3'W, 26 July 1921, *Maire s.n.* (MPU); Moyen-Atlas, Timhadit, 33°14'N, 5°3'W, 26 July 1921, *Maire s.n.* (P, PR); Moyen Atlas, Timhadit, 33°14'N, 5°3'W, 5 Aug. 1920, *Powell s.n.* (MPU); 2 km SE of Maison Forestiere d'Ain Kahla, 12 km SE of Ain Leuh, 33°16'N, 5°20'W, 23 July 1968, *Elsley 61/68* (SEV); Middle Atlas, Azrou, 11 km along track to Ain-Kahla from main Azrou-Midelt road at Jbel Hebri, 33°16'N, 5°11'W, 14 July 1997, *Jury 17962* (MA); Moyen Atlas, forêt Boutrouba, au Kef, 33°25'N, 5°12'W, 18 June 1923, *Jahandiez 557* (BC, LD, MPU); Atlas medium, Ras-el-Ma pr. Azrou, 33°26'N, 5°13'W, 24 June 1926, *Lindberg 4359* (MPU, LD); Moyen Atlas, supra Tizi-n-Treten pr. Ifrane, 33°31'N, 5°7'W, 16 June 1936, *Maire s.n.* (MPU); Djebel Outa, 33°40'N, 4°51'W, Aug. (MPU); Moyen Atlas, Djebel Barkeoli pres Bou Idris, S de Taza, 34°0'N, 4°0'W, 12 June 1931, *[illegible] s.n.* (MPU); Moyen Atlas, près d'Aïn Kalaa, 34°1'N, 5°45'W, 11 July 1938, *Faurel s.n.* (MPU); Taza, de Bab-Ou-Idir au Dj Tazzeka, 34°4'N, 4°11'W, 14 June 1980, *Charpin & al. 979* (MA). Tanger-Tetouan-Al Hoceima: Rif Mountains, Jbel Tassaot, 35°16'N, 5°8'W, 25 June 1992, *Valdés & al. 61-2075* (B). **Spain.** Albacete: Sierra de Alcaraz, Los Chorros al Calar de Mundo, 38°27'N, 2°26'W, 9 July 1923, *Cuatrecasas s.n.* (MA); Los Chorros, 38°27'N, 2°26'W, 20 July 1934, *González Albo s.n.* (MA); Los Chorros, 38°27'N, 2°26'W, 20 July 1934, *González Albo s.n.* (MA); Sierra de Alcaraz, Riópar, Los Chorros, 38°27'N, 2°26'W, 9 Sep. 1954, *Heywood s.n.* (MA); Los Chorros, Riópar, 38°27'N, 2°26'W, *Heywood s.n.* (MA); Sierra de Alcaraz, Padrón de Bienservida, 38°30'N, 2°31'W, 4 July 1923, *Cuatrecasas s.n.* (MA); Granada: Huéscar, arroyo Montaño, 38°4'N, 2°32'W, 2 June 2015, *Sánchez & al. s.n.* (MA); Jaén: Sierra de Segura, subida al pico Cabañas, 37°50'N, 2°59'W, 20 July 1977, *Castroviejo & Valdés Bermejo s.n.* (MA); Quesada, cañada de las Fuentes, 37°50'N, 2°58'W, 20 June 1975, *González Rebollar & al. 3190* (MA); Sierra de Cazorla, 37°50'N, 2°58'W, 14 June 1927, *Lacaita s.n.* (MA); Sierra de Cazorla, fuentes

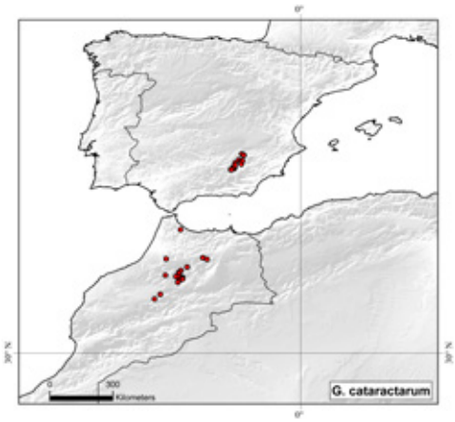


Fig. 766. Distribution of *Geranium cataractarum*.

del Guadalquivir, 37º50'N, 2º58'W, 24 June 1971, *Morales & Fernández Casas s.n.* (MA); Sierra de Cazorla, fuentes del Guadalquivir, 37º50'N, 2º58'W, 6 Aug. 1968, *Segura Zubizarreta s.n.* (MA); Cazorla, Nava de San Pedro, 37º52'N, 2º53'W, 18 June 1975, *González Rebollar & al. 3191* (MA); Nava de San Pedro, 37º52'N, 2º53'W, 25 June 1971, *Morales & Fernández Casas s.n.* (MA); Nava de San Pedro, 37º52'N, 2º53'W, 6 May 1977, *Segura Zubizarreta s.n.* (MA); Cazorla, Nava de San Pedro, 37º52'N, 2º52'W, 18 June 1975, *Soriano 1190* (MA); Sierra de la Cabrilla, hacia el Barranco de Guadaletin, 37º54'N, 2º49'W, 12 July 1926, *Cuatrecasas s.n.* (BC); La Iruela, sobre el salto de los Órganos, 37º56'N, 2º53'W, 30 May 1976, *Muñoz Garmendia & Soriano 3193* (MA); Santiago de la Espada, sierra de Banderillas, 38º1'N, 2º48'W, 21 July 1975, *González Rebollar & al. 3192* (MA); Pontones, sierra de Lagunillas, supra La Cabañuela, 38º7'N, 2º48'W, 22 July 1975, *Muñoz Garmendia & Soriano 3194* (MA); Sierra de Cazorla en La Maleza, Puntal del Aire, 38º13'N, 2º29'W, 15 June 1928, *Cuatrecasas s.n.* (BC); Santiago de la Espada, Calar del Cobo, 38º13'N, 2º32'W, 20 July 1985, *Pajarón 1679* (MA); Sierra de Cazorla, Puntal del Aire, 38º13'N, 2º29'W, 15 June 1928, *Pau s.n.* (FI); Sierra de Segura, ad cacumen Yelmo de Segura, 38º15'N, 2º39'W, 12 June 1975, *Fernández Piqueras & Fernández Casas 334* (MA).

Discussion. Geranium cataractarum is a perennial herb with a branching rootstock that bears several rosettes. The erect aerial stem ends in a dichasial inflorescence with distinct 2-flowered cymules. The leaves are opposite and palmatisect, and quite similar to those of *G. robertianum* in shape and the degree of division. The flowers show the two upper petals with a divergent petal blade; otherwise they are actinomorphic. The petals are glabrous and have a bicarinate claw, but they are not arranged together with the stamens to form five nectar passages. The staminal filaments are narrow and shorter than the petals, but they seem exserted because the petal blade is spreading. When the fruits are still immature, the staminal filaments remain appressed to the rostrum, protruding from the sepals, but considerably less than in *G. macrorrhizum*. The indumentum consists predominantly of long glandular hairs in a variable density. Scattered, eglandular hairs are also found, especially on the peduncles and pedicels. Mericarps are usually glabrous, with a reticulate surface, with two to three more prominent longitudinal, parallel veins that are connected by small transversal ones. The rostrum may be glabrous or, more frequently, with scattered, short glandular hairs restricted to the basal half of the narrowed apex. *Geranium cataractarum* was classified into section *Unguiculata* by Knuth (1912: 89) with some doubts, which was later accepted by Yeo (1984). Van Loon (1984b: 287) remarked on the morphological affinities and chromosomic relation among *G. cataractarum*, *G. robertianum*, and *G. purpureum* and placed *G. cataractarum* into *Geranium* sect. *Ruberta*, which is also recognized by Yeo (2004). The actinomorphic flower and bicarinate petal claw strongly support the latter classification.

303. Geranium maderense Yeo, Bol. Mus. Munic. Funchal 23: 26, 31, plate 2. 1969. Type locality: "Paul da Serra, [Levada do Moiro (Mouro)], 4000 ft. Apr. 1960. Plant very large; span 6 feet. Flowers purple. Major C. H. C. Pickering, K (two sheets, one bearing a leaf and one with part of an inflorescence, constitute the type specimen)". Type: Portugal. Madeira, Paul da Serra, Levada do Moiro, 32°44'N, 17°02'W, Apr. 1960, *C.H.C. Pickering s.n.* (holotype, K-000417202!).

Perennial, monocarpic herbs, 60-180(200) cm tall. *Rootstock* 20-25(60) mm in diameter, ± vertical, not tuberculate, not turnip-shaped, without thickened roots. *Stem* simple or sparingly branched, each axis terminating in a rossete, erect, leafy, not rooting at nodes, stolons absent, without vegetative stems, usually glabrous, sometimes with scattered, patent, glandular hairs 0.7-0.9 mm long. *Basal leaves* in a persistent rosette, cauline leaves opposite; leaf laminas (16)20-30(45) cm long, 17-48 cm wide, not peltate, palmatisect, polygonal in outline, base cordate, not coriaceous, with nerves not projected, with eglandular hairs on the nerves of the adaxial surface and glabrous abaxially; segments 5, in 1 plane, middle segment rhombic, 1.2-2.5 mm wide at the base [ratio segment width at the base/middle segment length = 0.01-0.02], (145)209-260(460)-lobed in distal half [ratio secondary sinus length/middle segment length = (0.37)0.42-0.50(0.59)]; petioles up to 39 cm long, without abscission zone, terete, with swollen base, deflexed and reamining turgid after lamina death, glabrous or with scattered, patent, glandular hairs 0.1-0.2 mm long; stipules (5.2)5.5-11.5(11.8) mm long, 2.4-5.2 mm wide, ovate, obtuse, free, papery, brownish red, with scattered, eglandular and glandular hairs on abaxial surface and on the margin, glabrous adaxially. *Inflorescence* a dichasial cyme; cymules 2-flowered, solitary [ratio cymule length/leaf length = 2.6-4.2]; peduncles (40)70-88(173) mm long, with patent, glandular hairs 0.4-2.9 mm long; bracteoles 0.8-5.4 mm long, 0.3-1.3 mm wide, lanceolate, whorled; pedicels (53)59-75(121) mm long, with patent, glandular hairs 0.4-3.9 mm long. Flowers actinomorphic. *Sepals* (7.2)7.9-8.8(10.5) mm long, 2.4-3.8 mm wide, lanceolate, smooth, not accrescent, nerves 3, mucro (0.5)1-1.4(2.3) mm long [ratio mucro length/sepal length = (0.07)0.12-0.17(0.26)],

with ± patent, glandular hairs 0.3-2.4 mm long and, usually, patent, eglandular hairs 0.1-0.3 mm long on the abaxial surface, glabrous adaxially. *Petals* (16.9)18.3-20.2(22.5) mm long, (8.5)11.4-14.5(19.9) mm wide, erect-patent, rounded, with claw 0.8-3.1 mm long (bicarinated), purplish pink with a darker basal spot, glabrous. *Stamens* 10, both whorls bearing anthers; filaments (5.5)7.8-9(10.3) mm long, linear-lanceolate, purple to dark red, glabrous; anthers (1.1)1.2-1.4(1.6) mm long, dark red. Nectaries 5, hemispheric, glabrous. *Gynoecium* 6.4-9.8 mm long, dark purple. *Fruit* (26)29-36(39) mm long, erect, discharge of carpel-projection type, operative; mericarps 3.8-4.7 mm long, 1.3-2.3 mm wide, without a strand of fibers, not compressed at the apex, reticulate, with thin ridges scarcely anastomosing and forming 0-1 overlapping, collar-like keels at the apex, without basal beak, without a basal callus, without a basal prong, brown, glabrous; rostrum 17-29 mm long, with a narrowed apex (6.2)7-7.8(9.4) mm long, not twisted, with scattered, patent, eglandular hairs 0.1-0.2 mm long and patent, glandular hairs 0.1-0.3 mm long restricted to the basal half of the narrowed apex; stigmatic remnants 2.8-4.2 mm long, with 5 glabrous lobes. *Seeds* 2.8-4.1 mm long, 1.4-2 mm wide, finely reticulate, uniformly colored, brown, glabrous. Cotyledons with entire margin. Figs. 767, 768.

Pollen. *Geranium*-type (Aedo 2017: 412).

Chromosome number. 2*n* = 68.

Phenology. Collected in flower from April to September.

Distribution. This species is endemic to Madeira (Fig. 769).

Habitat. Maritime cliffs or in the shade of laurel forests; 50-1450 m.

Additional specimens examined. **Portugal.** Madeira: Boaventura, Prazo Cerrao, entre el pueblo y el cementerio, 21 Oct. 2006, *Castroviejo & Sequeira 18205* (MA); Boaventura, Prazo Cerrao, entre el pueblo y el cementerio, 25 Mar. 2007, *Castroviejo & al. 18258* (MA); Calheta-Achada de Cima, 2 Apr. 2001, *Gonçalves s.n.* (MADJ); São Vicente-Miradouro, 10 Apr. 2001, *Gonçalves s.n.* (MADJ); Ponta do Sol-Canhas-Levada do Poiso, 2 Apr. 2001, *Gonçalves s.n.* (MADJ); Calheta-Lombo do Doutor, 2 Apr. 2001, *Gonçalves s.n.* (MADJ); Jardín Botánico de Funchal, 1998, *Güemes s.n.* (MA); cultivated in Major C.H. Pickering's garden, Funchal, 5 Apr. 1973, *Hansen 494* (C); Canhas, cultivada en casa de M. Sequeira, 25 June 2003, *Medina 2448* (MA); cultivated from seeds collected on the Paul da Serra at the Quinta São Roque, 6 May 1966, *Pickering 22* (BM); cultivated at Quinta de Santo Antonio, 23 May 2002, *Quinn & Silva s.n.* (MADM); levada de Casa do Lombo do Mouro, 32º44'N, 17º2'W, 28 June 2000, *Navarro 3396* (MA); Porto da Cruz, Larano, na escarpa da vereda Larano-Boca do Risco, 32º45'N, 16º47'W, 6 May 2016, *Jardim*

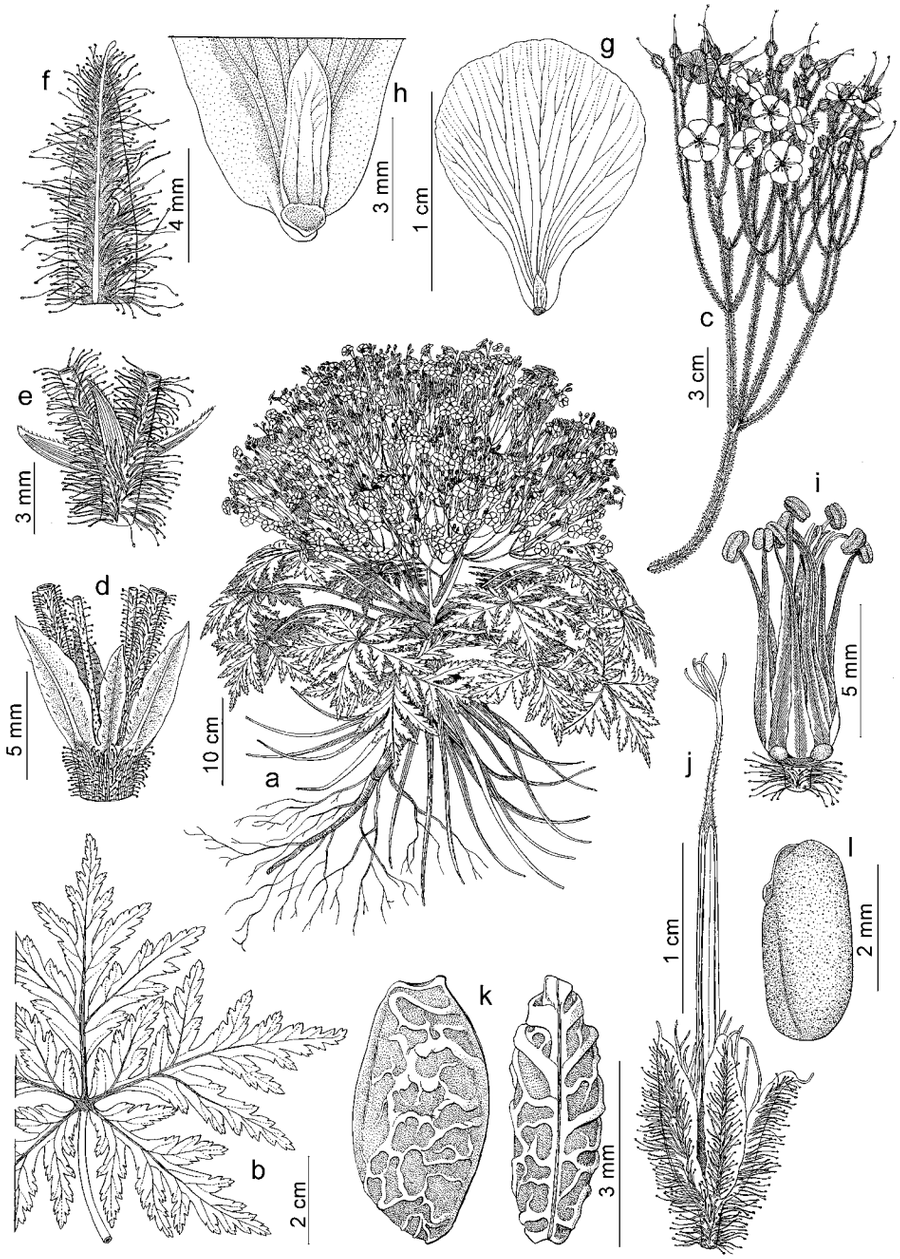


Fig. 767. *Geranium maderense*. a. Habit. b. Leaf. c. Partial inflorescence. d. Stipules. e. Bracteoles. f. Sepal. g. Petal. h. Detail of petal claw. i. Flower without sepals and petals. j. Fruit. k. Mericarps. l. Seed. (Based on: a-c, *Navarro 3396*, MA; d, e, *Gonçalves s.n.*, MADJ-9688; f-i, *Navarro 3396*, MA; j-l, *Costa s.n.,* MADM-490; the habit is partially based on Yeo 1969, plate 2).

Fig. 768. *Geranium maderense* (Based on: a, without voucher, cultivated at the *Jardim Botânico de Lisboa,* Portugal; b, c, *Aedo 2332*, MA; d-f, without voucher, from Madeira, Portugal, photo: M. Sequeira).

Fig. 769. Distribution of *Geranium maderense*.

& Sequeria 6429 (MA); Encumeada, levada forestal, exp. N antes do segundo tunel no sentido este/oeste, 32º45'N, 17º0'W, 29 May 2014, *Sequeira & Góis-Marques 7961* (MA); São Vicente-Cardais, 32º48'N, 17º2'W, 6 May 2016, *Jardim & Sequeria 6432* (MA); Achadas da Cruz, 32º51'N, 17º12'W, May 1934, *Costa s.n.* (C, MADM).

Discussion. Geranium maderense is similar to *G. palmatum* and *G. reuteri*. They share a pachycaul habit, giant inflorescences, and dissected leaves. *Geranium maderense* is differentiated by its massive caulescent habit and its immense inflorescence. According to Yeo (1973a), the monocarpic *G. maderense* has one extended internode terminating the central axis and four to eight crowded inflorescence branches at the apex, as well as a terminal flower vestige, while *G. palmatum* and *G. reuteri* continue to produce leaves on the central axis above the origin of the inflorescence branches. As commented in *G. palmatum* and *G. reuteri*, the rootstock of *G. maderense* has marked petiole scars and reflexed petioles toward the apex that provide support to the plants. Similarly, it also has a predominantly glandular indumentum with a purple-tinted stalk. *Geranium maderense* is easily distinguished from *G. palmatum* and *G. reuteri* by its shorter staminal filaments, usually as long as the sepals, and by its shorter, narrowed apex of the rostrum. The peduncles, pedicels, mericarps, and seeds of *G. maderense* are longer than those in *G. palmatum* and *G. reuteri*, and the petal claw is shorter, in all cases with some overlap. *Geranium maderense* and *G. palmatum* share wider petals than *G. reuteri*, and a rostrate narrowed apex with glandular hairs on the basal half. The rostrum of the fruit of *G. maderense* and *G. palmatum* is shorter than that in *G. reuteri* and the stigmatic remnants are longer. *Geranium maderense* and *G. reuteri* share longer sepals with a shorter mucro than in *G. palmatum*, and in both cases with some overlap. Additionally, it should be mentioned that *G. palmatum* has tomentose stipules, while those of *G. maderense* and *G. reuteri* have scattered hairs. Wilder-Kiefer & Yeo (1987: 287) reported that the hybrid of *Geranium maderense* × *G. cataractarum* formed ca. 16 univalents and ca. 18 bivalents at the first division of meiosis, which strongly suggests an allopolyploid origin for *G. maderense*, with *G. cataractarum* and an unknown species as parents.

Geranium maderense is widely cultivated in Madeira, in gardens, and is naturalized near cities. It is, however, very rare in the wild. *Geranium maderense* was first discovered by Costa in 1934 (Pereira 1967). This author collected the plant "...nas rochas escarpadas do litoral das Achadas da Cruz..." in the northwestern part of the island. In Pereira (1967) it was recognized as "nova espécie" described in Portuguese and photographed, but, unfortunately, no epithet was provided. Yeo (1969) formally described *G. maderense* from plants collected by Major C.H.C. Pickering, a British resident in Madeira. This collector located a wild population on Levada do Moiro, a mountain place (1200 m) far from coastal cliffs. According to R. Jardim (*in litt.*), an expert local botanist, this population would be of anthropic origin. The species has also been observed and recently collected by R. Jardim and M. Sequeira on the craggy coastal cliffs east to Porto da Cruz, Larano; this seems the only native locality extant today. *Geranium maderense* is widely used in gardens. Its presence in New Zealand, probably as garden-escape, is based on a specimen at AK that could not be studied.

304. Geranium palmatum Cav., Diss. 4: 216, tab. 84 fig. 2. 1787 [Aug. 1787]. *Geranium anemonifolium* L'Hér. in Aiton, Hort. Kew. 2: 432. 1789, nom. illeg. *Geranium rutilans* Ehrh., Beitr. Naturk. 7: 164. 1792, nom. illeg. *Robertium anemonifolium* Picard, Mém. Soc. Agric. Boulogne-sur-Mer 1: 134. 1837, nom. illeg. Type locality: "Habitat..... Habui floridum mensibus iunio, iulio et augusto. Colitur in R.H.P.". Type: Cultivated at Paris Royal Botanic Garden, *A.J. Cavanilles s.n.* (lectotype, designated by Aedo 2001b: 61, MA-475746!).

Geranium anemonifolium var. *laevigatum* Bolle, Index Sem. Hort. Berol. 1861: 11. 1862. Type locality: "Haec formma illa est hortensis ex Aiton hort. Kew. 1778 a Masson e Madera introducta = G. laevigatum hort. Icones in Botanical Magazine 206 (1792) et Sweet Geran. t. 244 eam spectant... locus natalis specialior ignotus, sed certe, nisi forsan planta e cultura diuturna nata varietas, in Madera quaerendus. Rev. Lowe in opere suo de hujus insulae Flora tractante sub paragrapho Geranii anemonifolii nihil dicit de hujus formis nisi: Varies much in smoothness". Type: Bot. Mag. 6, tab. 206. 1792 (lectotype, designated by Aedo 2017b: 428).

Perennial herbs, 30-75(120) cm tall. *Rootstock* 3.6-25 mm in diameter, ± vertical, not tuberculate, not turnip-shaped, without thickened roots. *Stem* simple or with several short branches, each axis terminating in a rossete, erect, leafy, not rooting at nodes, stolons absent, without vegetative stems, glabrous or with uncinate, eglandular hairs 0.1-0.3 mm long and scattered, patent, glandular hairs 0.3-1.3 mm long. *Basal leaves* in a persistent rosette, cauline leaves opposite; leaf laminas (6.5)9.2-15.5(24.8) cm long, 7.3-25 cm wide, not peltate, palmatisect, polygonal in outline, base cordate, not coriaceous, with nerves not pro-

jected, with ± appressed, eglandular hairs and plane glandular hairs on the adaxial surface and glabrous or with scattered, eglandular and glandular hairs abaxially; segments 5, in 1 plane, middle segment rhombic, 1.1-2.9 mm wide at the base [ratio segment width at the base/middle segment length = (0.01)0.02-0.05], (33)63-180(250)-lobed in distal half [ratio secondary sinus length/middle segment length = (0.33)0.39-0.45(0.53)]; petioles up to 31 cm long, without abscission zone, terete, with swollen base, deflexed and reamining turgid after lamina death, glabrous or with scattered, patent, glandular hairs 0.4-1.6 mm long; stipules (3)5.3-8.5(15.2) mm long, 2.2-14.5 mm wide, ovate, obtuse, free, rarely connate, papery, green, tomentose on both surfaces, sometimes also with scattered glandular hairs on the margin. *Inflorescence* a dichasial cyme; cymules (1)2(4)-flowered, solitary [ratio cymule length/leaf length = 1.2-7.1]; peduncles (11)27-48(65) mm long, with uncinate, retrorse, eglandular hairs 0.1-0.3 mm long and patent, glandular hairs 0.3-1.8 mm long; bracteoles 0.7-4 mm long, 0.3-1.4 mm wide, lanceolate, whorled; pedicels (9)15-27(36) mm long, with uncinate, retrorse, eglandular hairs 0.1-0.3 mm long and patent, glandular hairs 0.4-1.6 mm long. Flowers slightly zygomorphic. *Sepals* (5.1)6-7.2(8.2) mm long, 2.3-3.6 mm wide, lanceolate, smooth, not accrescent, nerves 3, mucro (1.3)1.7-2.5(3.3) mm long [ratio mucro length/sepal length = (0.20)0.26-0.35(0.50)], with ± patent, glandular hairs 0.2-3.1 mm long and, usually, patent, eglandular hairs 0.1-0.3 mm long on the abaxial surface, glabrous adaxially. *Petals* (18.5)21-22.5(24.2) mm long, (9.3)10.3-14.4(15.8) mm wide, ± patent, rounded, with claw 2.8-4.8 mm long (bicarinated), purple, glabrous. *Stamens* 10, both whorls bearing anthers; filaments (12.7)15.4-16.6(19) mm long, linear-lanceolate, pink, glabrous; anthers (1.3)1.4-1.8(2) mm long, orange. Nectaries 5, hemispheric, glabrous. *Gynoecium* 11.19 mm long, purple. *Fruit* (26)29-32(34) mm long, erect, discharge of carpel-projection type, operative; mericarps 3.2-3.9 mm long, 1.2-1.9 mm wide, without a strand of fibers, not compressed at the apex, reticulate, with thin ridges scarcely anastomosing and forming 1(2) overlapping, collar-like keels at the apex, without basal beak, without a basal callus, without a basal prong, brown, glabrous; rostrum 17-26 mm long, with a narrowed apex (10.4)12.1-14.6(16) mm long, not twisted, with scattered, patent, eglandular hairs 0.1-0.2 mm long and patent, glandular hairs 0.1-0.3 mm long restricted to the basal half of the narrowed apex; stigmatic remnants 2.1-4.7 mm long, with 5 glabrous lobes. *Seeds* 2.4-2.9 mm long, 1-1.5 mm wide, finely reticulate, uniformly colored, brown, glabrous. Cotyledons with entire margin. Figs. 770, 771.

Pollen. *Geranium*-type (Aedo 2017: 412; Bortenschlager 1967: 427 [sub *G. anemonifolium*]).

Chromosome number. 2*n* = 68.

Phenology. Collected in flower from January to October.

Distribution. This species is endemic to Madeira and it is occasionally introduced in western U.S.A. (Fig. 772).

Habitat. Rock cliffs or in open cloud forests, and in moist shady places near streams; 500-1650 m.

Representative specimens examined. **Portugal.** Madeira: Porto da Cruz, along the first 2.5 km of the levada between Ribeiro Frio and Portela, 32°43'N, 16°52'W, 30 May 1994, *Anderberg & al. 220* (S); pico Grande, Serra d'Agoa, 32°43'N, 17°1'W, 19 Apr. 1900, *Bornmüller 379* (LD); from Ribeiro Frio to Balcões, 32°43'N, 16°55'W, 30 July 1981, *Hampshire 66* (BM); von Ribeiro Frio entlang der Levada oberhalb Faja da Nogueira,vorbei an Balcões, 32°43'N, 16°55'W, 10 Sep. 1986, *Hertel 33615* (M); NW Boca do Cerro zum Encumeada Pass, 32°43'N, 16°59'W, 24 Apr. 1998, *Kourgli & Vitek 98-30* (W); zwischen Eira do Serrado und Curral sas Freiras, ca 300 m vor dem 2 Strassentunnel, 32°43'N, 16°58'W, 13 June 1997, *Nordt & Parolly 97-34* (B); Ribeiro Frio, 32°43'N, 16°52'W, 10 Sep. 2012, *Thiv & al. 5076* (STU); along the levada from Ribeiro Frio to Portela, c. 3 km E of Ribeiro Frio, 32°43'N, 16°52'W, 6 Oct. 2005, *Väre 16572* (H); Faja da Nogueira, near the power station, 32°44'N, 16°54'W, 9 June 1976, *[illegible] 2080* (C); pico das Torres, 32°44'N, 16°56'W, 27 Aug. 2003, *Aedo 9693* (MA); levada do Ribeiro Frio N of the tunnel, 32°44'N, 16°53'W, 31 July 1974, *Christensen & Dalgaard 5259* (C); levada W of Encumeada before the first tunnel, 32°44'N, 17°4'W, 2 Sep. 1983, *Dalgaard & Dalgaard 13196* (C); Poiso och Ribeiro Frio, 32°44'N, 16°53'W, 1 May 1952, *Een 52* (S); le long de la route descendant du col de Ribeiro Frio, Poiso, 32°44'N, 16°53'W, 11 July 1977, *Jacques 10676* (MA); S of Ribeiro Frio, 3 km N of Poiso, 32°44'N, 16°53'W, 31 July 1979, *Jarvis & al. 814* (MO); Poiso-Ribeiro Frio, 32°44'N, 16°53'W, 20 May 1969, *Maas s.n.* (C); levada Serra, entre o Ribeiro Frio e os Balcões na margem da levada, 32°44'N, 16°52'W, 14 June 1957, *Malato-Beliz & Santos s.n.* (MADJ); levada an der Nordseite des Pico do Cedro westlich Boca da Encumeada, 32°44'N, 17°2'W, 23 June 1981, *Metlesics s.n.* (WU); levada de Casa do Lombo do Mouro, 32°44'N, 17°2'W, 28 June 2000, *Navarro 3390* (MA); straße Funchal-Santana über den Poso-Pass, 1 km S Riberio Frio, 32°44'N, 16°53'W, 14 June 1997, *Nordt & Parolly 97-43* (B); W of Ribeiro Frio, along the levada on the N-slope of Rocha da Moitada, 32°44'N, 16°54'W, 27 May 1978, *Rustan 225* (MADM); Ribeiro Frio, along levada do Furada, near Lanceiros Waterhouse, 32°44'N, 16°53'W, 28 May 1988, *Short 196* (BM); levada dos Vinhaticos, 32°44'N, 17°1'W, 28 July 1902, *Vahl s.n.* (C); pico Arieiro, 32°44'N, 16°55'W, 26 June 2000, *Velayos & al. 9801* (MA); c. 200 m above Ribeiro Frio, 32°44'N, 16°53'W, 20 July 2010, *Vitek & al. 10-1628* (MA, W); Ribeiro Frio, levada do Lamaceiro, 32°44'N, 16°53'W, 3 July 1965, *Wänsjö 1247* (LD); levada de Bica da Cana, 32°45'N, 17°3'W, 29 Aug. 2003, *Aedo 9696* (MA); levada de Rabaçal, 32°45'N, 17°7'W, 30 Aug. 2003, *Aedo 9697* (MA); Boca das Torrinhas, 32°45'N, 16°58'W, 23 July 1900, *Bornmüller 380* (WU); São Vicente-Encumeada-levada Norte, 32°45'N, 17°1'W, 16 July 2001, *Gonçalves & al. s.n.* (MADJ); between Lapinhas and Torrinhas Pass, 32°45'N, 16°58'W, 5 June 1952, *Persson 231* (S); caminho da Porta de Encumeada da Rocha Negra, 32°45'N, 17°1'W, June, *Ramos 67* (MA); Levada de Norte, second tunnel, 32°45'N, 17°10'W, 9 Sep. 2012, *Thiv & al. 5067* (STU); Levada do Risco, 32°45'N, 17°7'W, 11 Sep. 2012, *Thiv & al. 5109* (STU); Encumeada, levada Norte, 32°45'N, 17°1'W, 25 June 2000, *Velayos & al. 9699* (MA); levada between Casa dos Queimadas and Caldeirao, 32°46'N,

16º56'W, 14 Aug. 1973, *Dalgaard 4540* (C); Ribeira de São Jorge, próximo do Caldeirão do Inferno, 32º46'N, 16º56'W, 17 June 1957, *Hansen s.n.* (MADJ); pr. Santa Anna, 32º46'N, 16º55'W, July 1866, *Mandon 46* (BM, C, FI, NY, RO, S); E facing São Vicente valley, 32º46'N, 17º1'W, 28 July 1954, *Moore & al. s.n.* (BM); at the origin of Ribeira do Inferno at the levada from Caramujo, 32º46'N, 16º56'W, 30 June 1952, *Persson 232* (S); path to Curral from Boa Ventura, 32º46'N, 16º58'W, 14 July 1956, *Pickering 19* (BM); levada do Caldeirao between Queimadas rest house and EN101-5, 32º46'N, 16º56'W, 6 June 1985, *Press 802* (BM); riberia da Fonte do Louro, 32º47'N, 16º55'W, 31 Aug. 2003, *Aedo 9700* (MA); along levada between Queimadas and Pico das Pedras, 32º47'N, 16º54'W, 2 Aug. 2001, *Alanko 109383* (H); Cerco acima dos Lamaceiros-Fajã do Penedo, na encosta acima do Furado, 32º47'N, 16º58'W, 28 June 1957, *Hansen s.n.* (MADJ); Ribeira Grande, 32º49'N, 16º54'W, 13 May 1952, *Een & Persson 156* (S); Punta Delgada, 32º49'N, 16º59'W, 12 July 1828, *Holl s.n.* (MO, LD); Ribeira do Tristão, 32º51'N, 17º12'W, Aug. 1934, *Costa s.n.* (MADM). **USA.** California: San Francisco Co., Golden Gate Park, road above de Laveaga Dell, 37º46'N, 122º28'W, 14 June 1990, *McClintock s.n.* (JEPS).

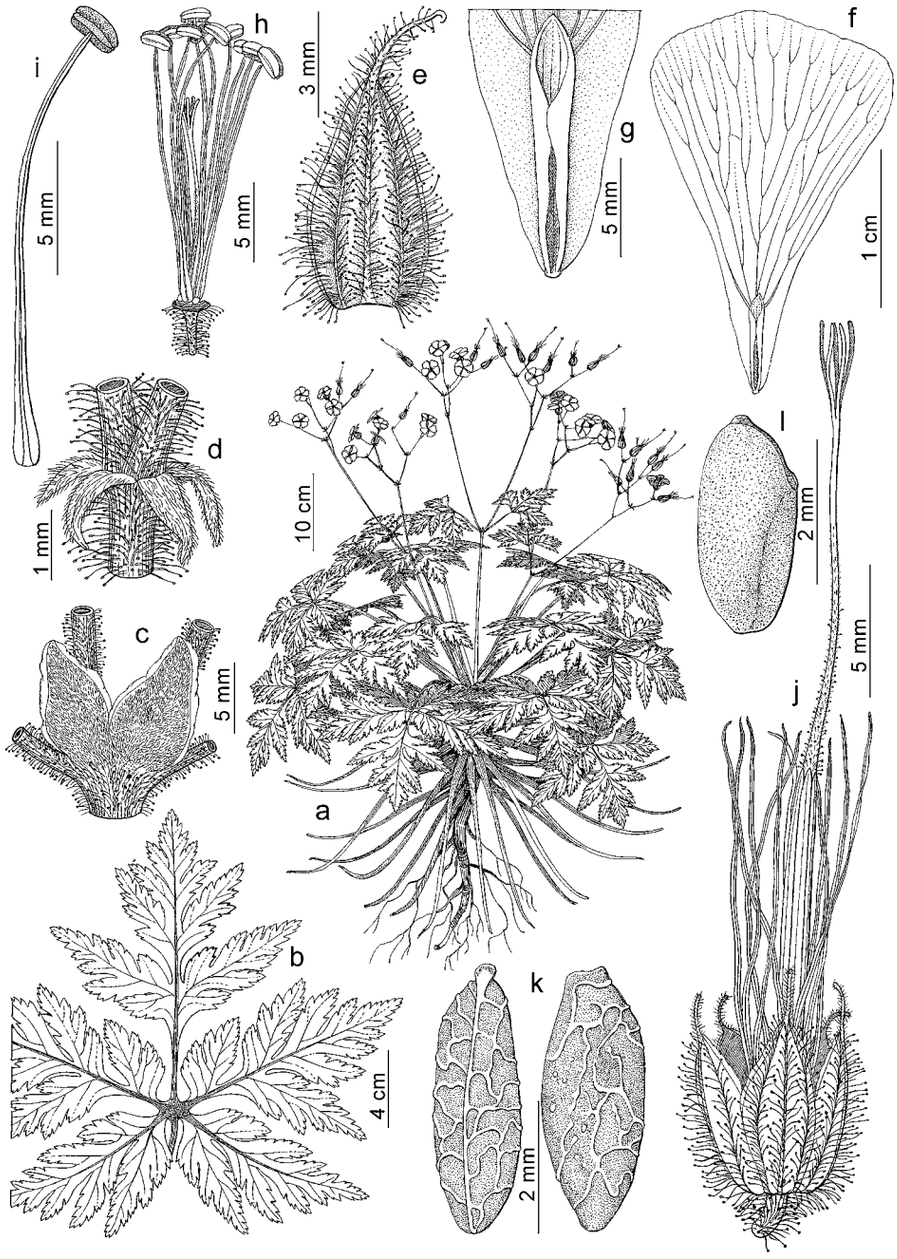


Fig. 770. *Geranium palmatum*. a. Habit. b. Leaf. c. Stipules. d. Bracteoles. e. Sepal. f. Petal. g. Detail of petal claw. h. Flower without sepals and petals. i. Stamen. j. Fruit. k. Mericarps. l. Seed. (Based on: a, *Navarro 3390,* MA; b, d-f, j-l, *Velayos 9699*, MA; c, h-i, *Vitek & al. 10-1628,* MA).

Discussion. Geranium palmatum is similar to *G. reuteri*. They share a pachycaul habit, giant inflorescences, and dissected leaves. The rootstock also has marked petiole scars and reflexed petioles toward the apex that provide support to the plants. *Geranium palmatum* growth continues after flowering by the production of rosette leaves above the inflorescence branches. The inflorescence is basically dichasial with 2-flowered cymules, but the suppression of internodes, the absence of growth in certain axes, and the abortion of flowering peduncles combine to display a complex inflorescence with numerous flowers together. The indumentum of *G. palmatum* also consists predominantly of long glandular hairs, with a purple-tinted stalk, variable in density, although some eglandular hairs are also found, especially on the peduncles, pedicels, and leaf nerves. The color of the hair stalks is sometimes difficult to appreciate in dry specimens. The most noticeable differences in relation to *Geranium reuteri*, as already mentioned, are the wider petals of *G. palmatum* and its glandular hairs on the fruit rostrum. Additionally, *G. palmatum* has tomentose stipules, while *G. reuteri* has stipules with scattered hairs. The fruit of *G. palmatum* is shorter but with longer stigmatic remnants, in both cases with some overlap. The lectotype of *Geranium palmatum* consists of a fragment of inflorescence and a leaf. The middle leaf segment is clearly petiolulate, the stipules are tomentose, and the petals are 11-12 mm wide, which fit very well in the current concept of this species. The fruit rostrum, however, has only eglandular hairs. Because it is an old specimen, glan-

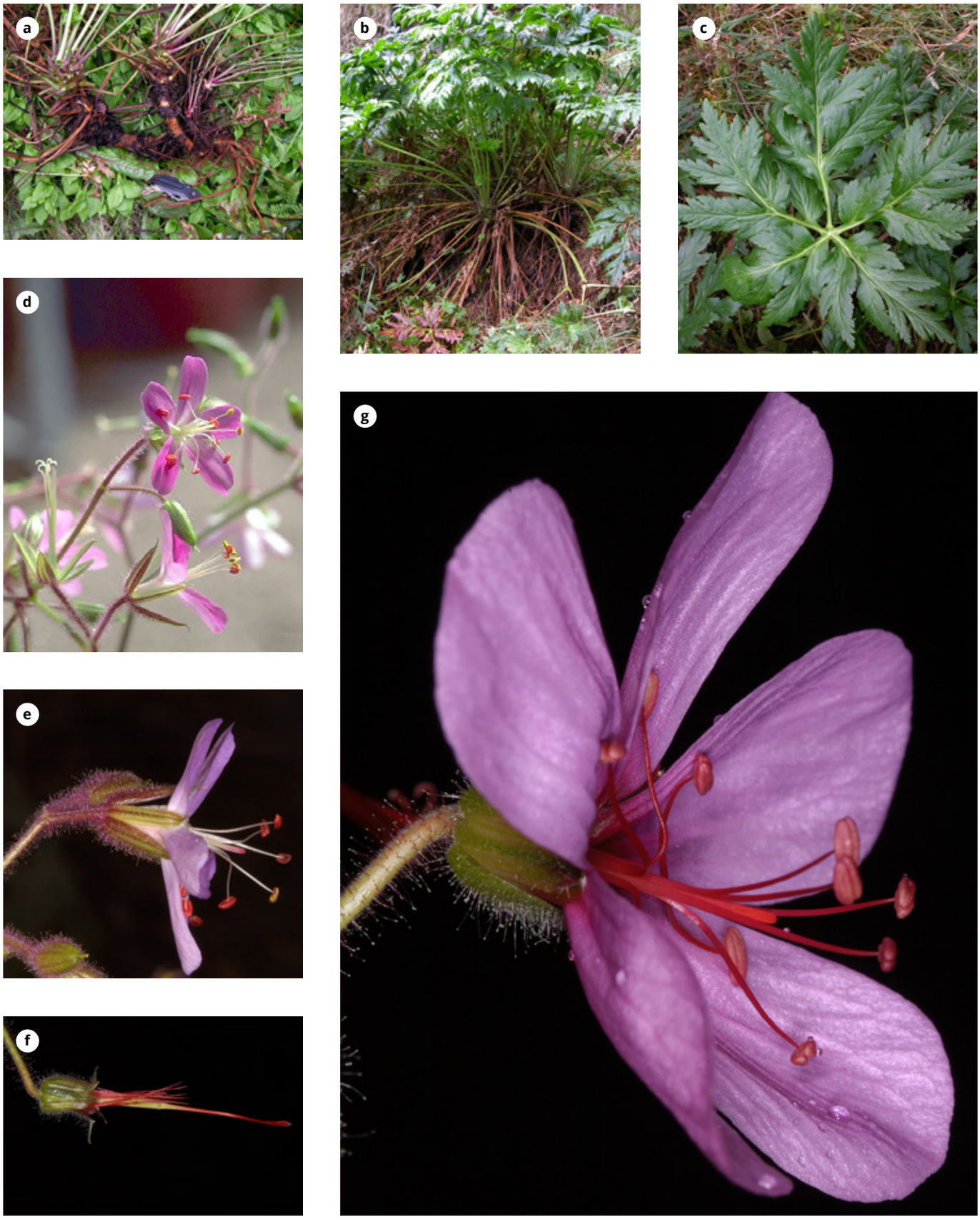


Fig. 771. *Geranium palmatum* (Based on: a-d, *Aedo 9697,* MA; e-g, without voucher, from Madeira, Portugal, photo: M. Sequiera).

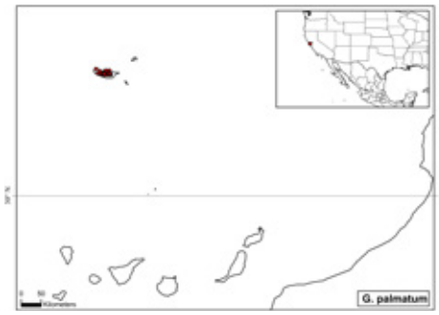


Fig. 772. Distribution of *Geranium palmatum*.

dular hairs could have been lost or, alternatively, it may be an exception to the normal glandular rostrum indumentum of this species.

Geranium palmatum, a restricted endemic from Madeira Island, has been used often in gardens (Yeo 2002a). It is occasional in California (Aedo 2012: 5).

305. Geranium reuteri Aedo & Muñoz Garm., Kew Bull. 52(3): 726. 1997. *Geranium canariense* Reut., Cat. Grain. Jard. Bot. Genève 1857: 4. 1858, [replaced synonym], nom. illeg., non (Willd.) Poir., 1812. *Geranium anemonifolium* var. *canariense* Reut. ex Bolle, Index. Sem. Hort. Berol. 1861: 11. 1862. Type locality: "Hab. in Teneriffa, Webb, Bourgeau pl. exsicc.! G. anemonefolium Webb Phyt. can. I p. 20; Bourg. pl. exsicc. n° 1251 non L'Hér." [According to Yeo (1973a: 332), Reuter's citation of the number 1251 was an error for 1271]. Type: Spain. Tenerife, Las Mercedes, 28°31'N, 16°17'W, 11 Apr. 1855, *E. Bourgeau 1271* (lectotype, designated by Aedo 2017b: 439, MA-169679!; isolectotypes, B-100591748!, C!, COI!, CGE, F-1528829!, G-00402166!, K!, MPU!, P-00389435!, RO!, S!, W-1889-0001456!).

Geranium anemonifolium var. *major* Pit., Index Sem in Pit. & Proust, Iles Canaries 1: 140. 1909. Type locality: "Le type décrit par W.B. Pl. Canarienses, n° 443. Ténérife: La Mina (800m), Las Mércédès (800m), Vueltas de Taganama (500 à 700m), Agua Garcia (800m). Palma: Fayana de la Plata, sur Los Sauces (600m). Hierro: Miradero, à la Fuente Tinco (800m), Riscos de Tivataje et de Jinama (600 à 800m)". Type: Spain. Tenerife, La Mina, 28°33'N, 16°17'W, Apr. 1906, *C.J.M. Pitard 443* (lectotype, designated by Aedo 2017b: 439, P-05126236!; isolectotypes, G-00402169!, L-2011935!, MO-1891039!).

Geranium anemonifolium var. *minor* Pit. in Pit. & Proust, Iles Canaries 1: 140. 1909. Type locality: "Pl. Canarienses, n° 10. Gomera: Cumbre de Valle Hermoso, sous Laguna Grande (800 à 900m)". Type: Spain. Gomera, cumbre de Valle Hermoso, sous Laguna Grande, 28°08'N, 17°16'W, 13 Apr. 1905, *C.J.M. Pitard 10* (lectotype, designated by Aedo 2017b: 439, P-05126232!; isolectotypes, G-00402165!, L-2011930!, MO-1891040!).

Perennial herbs, 23-51(150) cm tall. *Rootstock* 4.5-17.4 mm in diameter, ± vertical, not tuberculate, not turnip-shaped, without thickened roots. *Stem* simple or with several short branches, each axis terminating in a rossete, erect, leafy, not rooting at nodes, stolons absent, without vegetative stems, usually glabrous, sometimes with with uncinate, eglandular hairs 0.3-0.4 mm long and scattered, patent, glandular hairs 0.9-1.4 mm long. *Basal leaves* in a persistent rosette, cauline leaves opposite; leaf laminas (7)8-21(27) cm long, 7-28 cm wide, not peltate, palmatisect, polygonal in outline, base cordate, not coriaceous, with nerves not projected, with ± appressed, eglandular hairs and plane glandular hairs on the adaxial surface and glabrous or with scattered, eglandular and glandular hairs abaxially; segments 5, in 1 plane, middle segment rhombic, 1.7-4.2 mm wide at the base [ratio segment width at the base/middle segment length = (0.01)0.02-0.04], 33-104(270)-lobed in distal half [ratio secondary sinus length/middle segment length = (0.35)0.36-0.51(0.57)]; petioles up to 32 cm long, without abscission zone, terete, with swollen base, deflexed and reamining turgid after lamina death, usually with patent, glandular 0.3-1.6 mm long, sometimes with uncinate, retrorse, eglandular hairs 0.2-0.5 mm long, rarely glabrous; stipules (1.5)3-6.8(11) mm long, 1.9-7.7 mm wide, broadly lanceolate to ovate, obtuse, free, papery, green, with eglandular and glandular hairs on abaxial surface and margin, glabrous adaxially. *Inflorescence* a dichasial cyme; cymules (1)2(4)-flowered, solitary [ratio cymule length/leaf length = 1.1-2.8]; peduncles (18)36-47(87) mm long, with uncinate, retrorse, eglandular hairs 0.2-0.5 mm long and patent, glandular hairs 0.4-1.6 mm long; bracteoles 0.5-2.4 mm long, 0.4-1.7 mm wide, ovate, whorled; pedicels (2)11-25(39) mm long, with uncinate, retrorse, eglandular hairs 0.2-0.5 mm long and patent, glandular hairs 0.4-1.7 mm long. Flowers actinomorphic. *Sepals* (7.3)7.4-8.3(9.3) mm long, 2.2-3.7 mm wide, lanceolate, smooth, not accrescent, nerves 3, mucro (0.7)1.2-1.7(3) mm long [ratio mucro length/sepal length = (0.09)0.16-0.21(0.41)], with ± patent, glandular hairs 0.4-1.6 mm long and, usually, patent, eglandular hairs 0.2-0.5 mm long on the abaxial surface, glabrous adaxially. *Petals* (12.1)14.4-19.4(21) mm long, (2.8)5.4-5.9(6.4) mm wide, ± patent, rounded (rarely retuse), with claw 4.2-7.1 mm long (bicarinated), purple, glabrous. *Stamens* 10, both whorls bearing anthers; filaments (14.8)16-19(19.6) mm long, linear-lanceolate, white or deep red, glabrous; anthers (1.1)1.6-1.7(2.4) mm long, maroon to scarlet. Nectaries 5, hemispheric, glabrous. *Gynoecium* 12-23 mm long, pink. *Fruit* (27)33-38(41) mm long, erect, discharge of carpel-projection type, operative; mericarps 3.9-4 mm long, 1.2-1.6 mm wide, without a strand of fibers, not compressed at the apex, reticulate, with thin ridges scarcely anastomosing and forming 0-1 overlapping, collar-like keels at the apex, without basal beak, without a basal callus, without a basal prong, brown, glabrous or with eglandular hairs 0.1-0.2 mm long at apex; rostrum 26-34 mm long, with a narrowed apex 14-21 mm long, not twisted, with scattered, patent, eglandular hairs 0.1-0.3 mm long restricted to the basal half of the narrowed apex; stig-

matic remnants 1.3-3 mm long, with 5 glabrous lobes. *Seeds* 2.3-3 mm long, 0.9-1.4 mm wide, smooth, uniformly colored, brown, glabrous. Cotyledons with entire margin. Figs. 773, 774.

Pollen. *Geranium*-type (Aedo 2017: 412).

Chromosome number. 2*n* = 128.

Phenology. Collected in flower from January to December.

Distribution. This species is endemic to Canary Island (Fig. 775).

Habitat. In the shade of cloud forests and Erica L. formations; 200-1600 m.

Representative specimens examined. **Spain.** Canarias: El Hierro, Frontera, fuente de Mencafete, 27º44'N, 18º2'W, 2 Jan. 2013, *Aedo 19663* (MA); El Hierro, Fuente Tincos, 27º45'N, 17º59'W, Mar., *Pitard 1257* (P); Gran Canaria, Valsendero, La Virgin, 28º2'N, 15º35'W, 17 Mar. 1966, *Kunkel 8813* (B); Gran Canaria, Tamadaba, 28º2'N, 15º41'W, 27 Oct. 1985, *Suárez s.n.* (TFC); Gran Canaria, pr. Moya, barranco de los Laureles, 28º5'N, 15º35'W, 8 Apr. 2010, *Aedo 17220* (MA); Gran Canaria, Los Tiles, 28º5'N, 15º35'W, 31 Mar. 1921, *Børgesen 811* (C); Gran Canaria, barranco Oscuro, Moya, 28º7'N, 15º33'W, 18 Mar. 1980, *Suárez s.n.* (TFC); Gomera, mirador del Rejo, 28º7'N, 17º12'W, 16 Aug. 2001, *Aedo 6701* (MA); Gomera, la Zarzita, 28º7'N, 17º10'W, 8 May 1968, *Maesen 410* (MA); Gomera, Chorros de Epina, 28º9'N, 17º17'W, 17 Aug. 2001, *Aedo 6704* (MA); Gomera, just after turning to Epina on road from Vallehermoso to Valle Gran Rey, 28º9'N, 17º17'W, 7 Mar. 1973, *Aldridge 1076* (MO); Gomera, Apartacamino, 28º9'N, 17º18'W, 16 June 1947, *Ceballos & al. s.n.* (MA); Gomera, Vallehermoso, 28º9'N, 17º17'W, 1 May 1915, *Knoche 1221* (CAS); Tenerife, Icod, camino forestal La Corona, 28º19'N, 16º41'W, 17 June 1973, *Acebes s.n.* (TFC); Tenerife, 1.5 km westich von Erjos, 28º19'N, 16º48'W, 16 Mar. 1971, *Bot. Inst. München 1971 8* (M); Tenerife, ladera W del pico de los Villanos, 28º20'N, 16º50'W, 12 Aug. 2001, *Aedo 6694* (MA, W); Tenerife, La Orotava, Agua Mansa, Los Órganos, 28º20'N, 16º29'W, 4 Jan. 1993, *Alanko 74103* (H); Tenerife, monte de los Silos, 28º20'N, 16º47'W, 22 Aug. 1974, *Arco s.n.* (TFC); Tenerife, Icod de los Vinos, La Vega, 28º20'N, 16º44'W, 17 Feb. 1984, *Ardévol s.n.* (TFC); Tenerife, Icod, Los Márquez, 28º20'N, 16º42'W, 8 May 1988, *Ardévol s.n.* (TFC); Tenerife, La Orotava, Aguamansa, Los Órganos, 28º20'N, 16º29'W, 30 Mar. 1987, *Kilian 1395* (B); Tenerife, barranco del Majuelo above los Silos, 28º21'N, 16º49'W, 13 Apr. 1961, (BM); Tenerife, Aguamansa, área recreativa de La Caldera, 28º21'N, 16º30'W, 27 Sep. 2007, *Medina & Sequeira 4244* (MA); Tenerife, Santa Úrsula, de la zona recreativa del Rincón 1 km hacia la Caldera de La Orotava, 28º25'N, 16º28'W, 1 May 1997, *Panero & Ortega 6942* (MA); Tenerife, Agua García, pr. Tacoronte, 28º27'N, 16º24'W, June 1904, *Burchard 139* (M); Tenerife, Esperanza, 28º27'N, 16º21'W, Oct. 1897, *Cook 1092* (NY); Tenerife, Agua García, Madre del Agua, 28º27'N, 16º24'W, 27 June 1980, *Wilpredt & García Gallo s.n.* (TFC); Tenerife, Las Mercedes, 28º31'N, 16º17'W, 4 May 1933, *Asplund 1092* (S); Tenerife, Anaga, sendero entre Pico del Inglés y Cabeza del Viento, barranco de Tahodio, 28º31'N, 16º15'W, 10 Apr. 1999, *Becher & Himstedt s.n.* (TFC); Tenerife, Anaga, EL Pijaral, 28º33'N, 16º11'W, 2 Jan. 2015, *Aedo 22246* (MA); Tenerife, Sierra Anaga, above Almáciga, 28º33'N, 16º10'W, 28 Jan. 1973, *Aldridge 582* (BM,

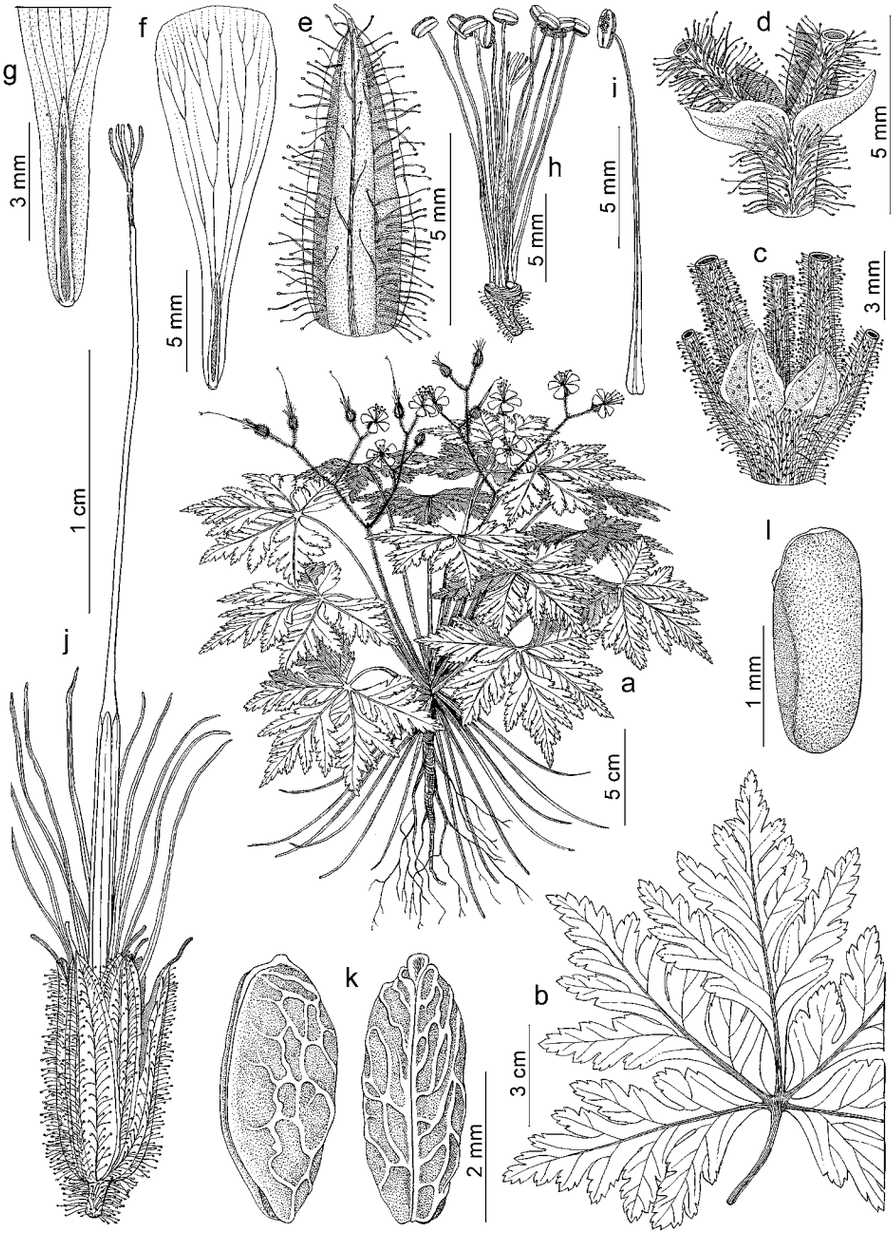


Fig. 773. *Geranium reuteri*. a. Habit. b. Leaf. c. Stipules. d. Bracteoles. e. Sepal. f. Petal. g. Detail of petal claw. h. Flower without sepals and petals. i. Stamen. j. Fruit. k. Mericarps. l. Seed. (Based on: a, d-g, *Aedo 6694,* MA; b, c, h, i, k, l, *Aedo 6704*, MA; j, *Aedo 6686*, MA).

FI, MO); Tenerife, Sierra Anaga, El Bailadero de San Andrés, 28º33'N, 16º13'W, 23 Jan. 1969, *Bramwell 599* (MO); Tenerife, Cabezo del Tejo, 28º34'N, 16º10'W, 10 Aug. 2001, *Aedo 6686* (MA, W); Tenerife, 4 km Taganana, 28º34'N, 16º13'W, 4 Apr. 2001, *Kämäräinen 2001-33* (H); Tenerife, vueltas de Taganana, 28º34'N, 16º13'W, Feb., *Pitard 1256* (P); La Palma, zona recreativa de Pared Vieja, 28º38'N, 17º49'W, 31 July 2000, *Aedo 5909* (MA); La Palma, Breña Alta, Guairin, 28º38'N, 17º48'W, 7 July 1947, *Ceballos & al. s.n.* (MA); La Palma, Cumbre Nueva, near the road-tunnel, 28º39'N, 17º49'W, 3 Sep. 1972, *Hansen 198* (C); La Palma, Cubo, 28º45'N, 17º46'W, 18 May 1936, *Brooke s.n.* (BM); La Palma, pr. Los Franceses, 28º47'N, 17º51'W, 10 Apr.

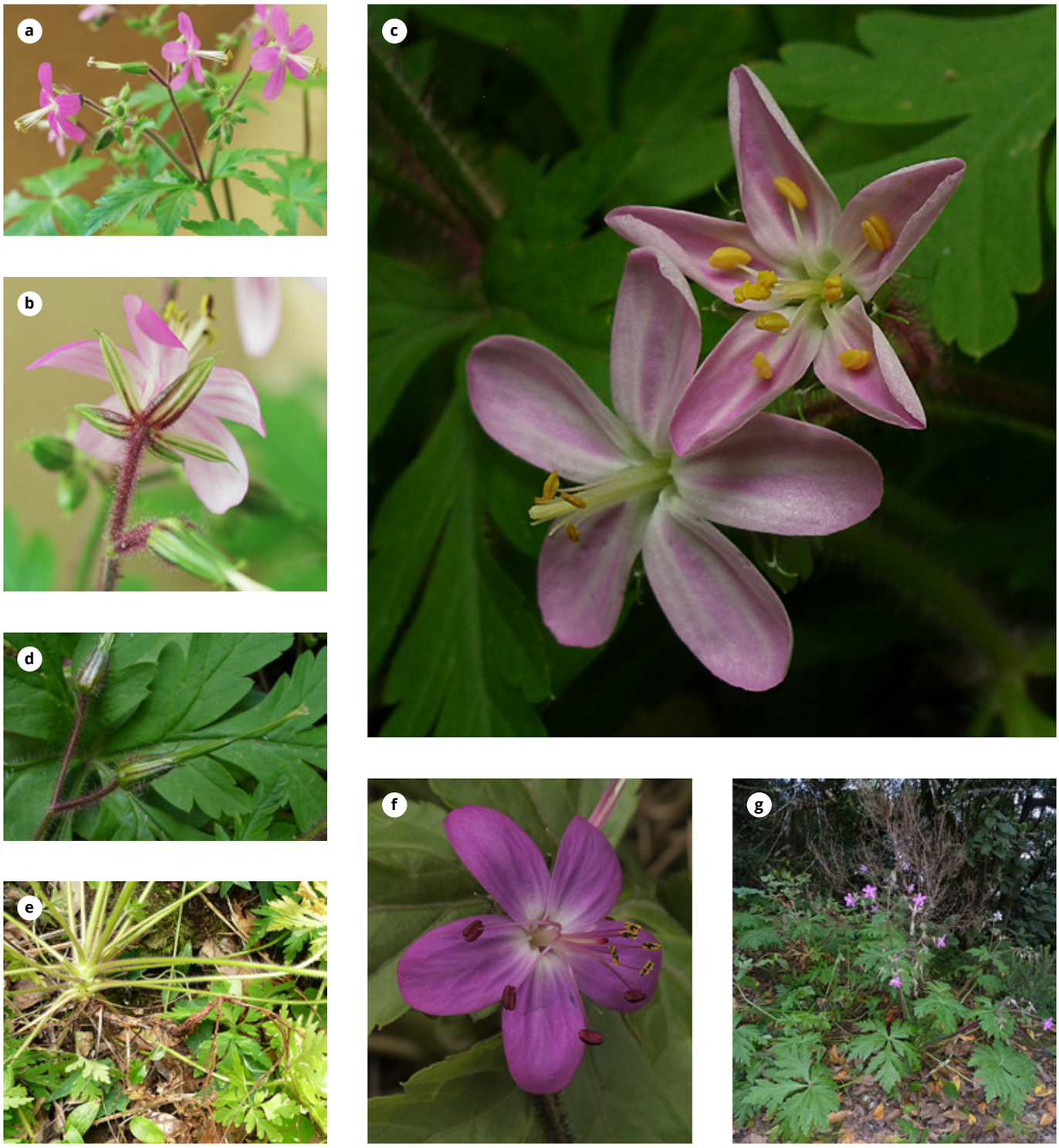


Fig. 774. *Geranium reuteri* (Based on: a, b, *Aedo 5096,* MA; c-e, *Aedo 17220,* MA; f, g, *Aedo 22246* MA).

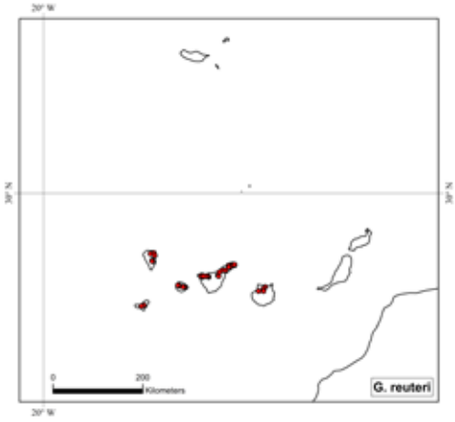


Fig. 775. Distribution of *Geranium reuteri*.

1980, *Fernández Casas 3068* (B, MA, MO); La Palma, Los Sauces, barranco del Agua, 28º48'N, 17º47'W, 28 July 2000, *Aedo 5888* (MA); La Palma, barranco de los Gallegos, 28º48'N, 17º50'W, 18 Apr. 1977, *Jarvis & al. 327* (BM).

Discussion. Geranium reuteri is a perennial with a rootstock terminating in a rosette. The rootstock, which is tapered toward the base, has marked petiole scars and petiole remaining toward the apex (this apical part is unburied). The reflexed petioles provide support to the plants as in other related species. According to Yeo (1973a: 291), *G. reuteri* continued its growth after flowering by the production of rosette leaves above the inflorescence branches. *Geranium reuteri* produces a terminal inflorescence with axillary branches arising from the uppermost rosette leaves. The production of a terminal whorl of inflorescence branches is followed by the death of the subtending rosette. The plant normally survives by producing a few axillary rosettes from the lowest internodes of the stem. Yeo (1973a: 292) indicated that the inflorescence is basically dichasial with 2-flowered cymules, but the suppression of internodes, the absence of growth in certain axes, and the abortion of flowering peduncles combine to display a complex inflorescence with numerous flowers together. *Geranium reuteri* has a perfectly actinomorphic flower with narrow, spreading petal limbs, long stamens, and a style exserted far beyond the petals. The indumentum of *G. reuteri* consists predominantly of long glandular hairs, with a purple-tinted stalk, variable in density. Scattered eglandular hairs are also found, particularly on the peduncles, pedicels, and leaf nerves. According to Yeo (1973a: 294), *Geranium reuteri* shows a continuous ring of sclerenchyma in the petiole, while in other species of the group (species 299-301, 303-304) this ring is interrupted. Yeo (1973a: 322) distinguished *G. reuteri* because its leaves have a sessile middle leaf segment, in contrast to the petiolulate middle leaf segment of *G. palmatum* and *G. maderense*. In *G. reuteri* the middle segment narrows progressively toward the base, and in some cases it is difficult to ascertain whether there is a short petiolule. *Geranium palmatum* and *G. maderense*, however, have a middle segment that narrows abruptly into a distinct petiolule. *Geranium reuteri* is similar to *G. palmatum* in having very long stamens exserted far beyond the throat. However, in *G. reuteri* the corollas are perfectly actinomorphic, whereas in *G. palmatum* they are slightly zygomorphic. Although they have some overlap, the sepals are longer in *G. reuteri* than in *G. palmatum* but with a shorter mucro. Petals are also shorter but with a longer claw. The best features to differentiate between the two species, however, are petal width and rostrum indumentum. Petals are clearly wider in *G. palmatum* than in *G. reuteri*. The narrowed apex of the rostrum of *G. reuteri* has short eglandular hairs mainly on the basal half, whereas *G. palmatum* has glandular and eglandular ones. When Reuter (1858) described *Geranium canariense*, he indicated only the locality and the collector: "Hab. in Teneriffa, Webb, Bourgeau pl. exsicc.! G. anemonefolium Webb Phyt. can. I p. 20; Bourg. pl. exsicc. n° 1251 non L'H´er." According to Yeo (1973a: 332), Reuter's citation of the number 1251 was an error for 1271.

IVf. Geranium sect. Unguiculata

(Boiss.) Reiche in Engl. & Prantl, Nat. Pflanzenfam. 3(4): 8. 1890. *Geranium* [§] *Unguiculata* Boiss., Fl. Orient. 1: 869. 1867. *Geranium* subg. *Pelargoniastrum* Tzvelev, Novosti Sist. Vyssh. Rast. 29: 95. 1993. Type: *Geranium macrorrhizum* L. (designated by Knuth 1912: 45).

Perennial herbs. *Flowers* zygomorphic. *Petals* rounded, with claw smooth. *Pollen* of *Geranium*-type. *Fruit* of carpel-projection type, operative; mericarps reticulate; rostrum not twisted. *Cotyledons* with entire margins.

306. Geranium macrorrhizum

L., Sp. Pl.: 680. 1753. *Geranium lugubre* Salisb., Prodr. Stirp. Chap. Allerton: 309. 1796, nom. illeg. *Robertium macrorrhizum* (L.) Picard, Mém. Soc. Agric. Boulogne-sur-Mer 1: 134. 1837. Type locality: "Habitat... ". Type: "Habitat..." (lectotype, designated by Aedo in Jarvis 2007: 538, herb. Clifford 343, Geranium 4, BM-000646405 image!).

Geranium balkanum N. Taylor in L.H. Bailey, Stand. Cycl. Hort.: 1332. 1915. Type locality: [not indicated].Type: unknown locality and herbarium (no original material located).

Geranium macrorrhizum var. *kellereri* Stef. & Jordanov, Izv. Bulg. Bot. Druzh. 4: 32. 1931. Type locality: "Auf dem Gipfel Tasboas, im Juni 1927 von S. M. Boris III König der Bulgaren, entdeckt". Type: Bulgaria. Rhodope centralis, Tas-Bois supra pagum Batak, 41°26'N, 24°13'E, 21 June 1926, *Tzar Boris III s.n.* (lectotype, designated by Aedo 2017b: 455, SOM!; choice made by A. Petrova & S. Kozuharov, in sched.).

Geranium macrorrhizum f. *acutilobum* Şerb., Bull. Sect. Sci. Acad. Roumaine 24: 619 fig. 9. 1942. Type locality: "Feldberge in Baden; herb. Iter Albanicum Alterum-Mt. Tisca versus distr. Dalvino". Type: Albania. Dalvino, Mt. Tisca, 39°57'N, 20°06'E, 1 Aug. 1894, *A. Baldacci 216* (lectotype, designated by Aedo 2017b: 455, P-01001766!; isolectotype, FI!).

Geranium macrorrhizum var. *angustilobum* Şerb., Bull. Sect. Sci. Acad. Roumaine 24: 619 fig. 8. 1942. Type locality:

"Herb. Franciscus Xaver Ebenhoch Koronczo Com. Strigoniensis Hungaria, cultivée dans le jardin botanique de Vienne; herb. Flora exsiccata Austro-Hungarica-in ditione Illirico littorali. In saxosis Modreae prope Tolminum". Type: Slovenia. Tolminum, Modreae, 46°22'N, 13°34'E, *C. Marchesetti 2838* (lectotype, designated by Aedo 2017b: 455, P!; isolectotype, C!).

Geranium macrorrhizum f. *brachidentatum* Şerb., Bull. Sect. Sci. Acad. Roumaine 24: 619, fig. 10. 1942. Type locality: "Herb. Elisée Reverchon-Alpes Maritimes, montagne de Nanan sur Fontan". Type: France. Alpes Maritimes, montagne de Nanan sur Fontan, 44°09'N, 7°33'E, *E. Reverchon s.n., Pl. France 110* (lectotype, designated by Aedo 2017b: 455, P-00375480!).

Geranium macrorrhizum var. *hirsutum* Şerb., Bull. Sect. Sci. Acad. Roumaine 24: 618 fig. 5. 1942. Type locality: "Herb. Zach. C. Panţu-Predeal, distr. Prahova; herb. Simonkai L.-Băile Herculane, distr. Mehedinţi. Plante cultivée dans le jardin botanique de Bucarest et provenant de Predeal". Syntypes: Romania. Cultivated in Bucarest Botanical Garden from Predeal, 45°31'N, 25°34'E, *I.* Şerbănescu *s.n.*; Prahova, Predeal, *Z.C. Panţu s.n.*; Mehedinţi, Băile Herculane, 44°52'N, 22°23'E, *L. Simonkai s.n.* (no original material located).

Geranium macrorrhizum f. *longidentatum* Şerb., Bull. Sect. Sci. Acad. Roumaine 24: 620 fig. 11. 1942. Type locality: "Herb. Eihelbaum-Berlin Univers. Garten". Syntype: Germany. Berlin University Garten, *Eihelbaum s.n.* (no original material located).

Geranium macrorrhizum var. *parvifolium* Şerb., Bull. Sect. Sci. Acad. Roumaine 24: 619, fig. 7. 1942. Type locality: "Herb. Th. Tichler-Carinthia Gailthal Plecken; herb. Flora v. Carinthia, Ratki Gailthal Plecken; herb. Iter Thessalicum P. Sintenis, Phaliki mt. Plaka; herb. Pontafel et Baldany-Alpes; herb. Hoffmann-Giessen Chiusa". Type: Greece. Chaliki, subalpium mont Plaka, 39°40'N, 21°08'E, *P. Sintenis 677* (lectotype, designated by Aedo 2017b: 455, W-3283!; isolectotype, P-00375655!).

Geranium macrorrhizum var. *paucidentatum* Şerb., Bull. Sect. Sci. Acad. Roumaine 24: 619. 1942. Type locality: [not indicated]. Syntype: Romania. Unknown locality, *I.* Şerbănescu *s.n.* (no original material located).

Geranium macrorrhizum var. *rotundilobum* Şerb., Bull. Sect. Sci. Acad. Roumaine 24: 619, fig. 6. 1942. Type locality: "Herb. Dominicus Bilimek, cultivée dans le jardin botanique de Vienne; herb. Thielens Tirlemont-Roly, Namur Belge (cultivée)". Syntypes: Austria. Cultivated at Wien Botanical Garden, *D. Bilimek s.n.*; Belgium. Namur, 50°07'N, 4°31'E, *T. Tirlemont s.n.* (no original material located).

Geranium kikianum Kit Tan & Vold, Nordic J. Bot. 29: 2 fig. 1, fig. 2A. 2011. Type: locality: "Greece. Nomos Messinas, Eparchia Kalamon, foothills of Mt Taigetos, Kefalovrisi to Plataniki, wet places by stream in Pinus nigra forest, schistose rock, 1400-1450 m a.s.l., 21 Jun 2008, Kit Tan and G. Vold 29696 (holotype, C; isotypes, ATH, LD, herb. Kit Tan)". Type: Greece. Nomos Messinas, Eparchia Kalamon, foothills of Mt. Taigetos, Kefalovrisi to Plataniki, 37°20'N, 21°50'E, 21 June 2008, *Kit Tan & G. Vold 29696* (holotype, C-10012690!; isotypes, ATH, LD-1592132 image!, herb. Kit Tan).

Ger*anium lucarinii* Venanzoni & Wagens., Phytotaxa 489(3): 253, 255 fig. 3. 2021. Type: locality: "ITALY. Umbria: Terni, nei pressi della Cascata delle Marmore, parete di roccia calcarea, 42°33'N, 12°42'E, 200 m, 07 June 2019, R. Venanzoni et R.P. Wagensommer s.n. (holotype CAME!, isotypes: FI! and BI!)". Type: Italy. Umbria, Terni, nei pressi della Cascata delle Marmore, 42°33'N, 12°42'E, 7 June 2019, *R. Venanzoni & R.P. Wagensommer s.n.* (holotype, CAME image!; isotypes, BI, FI).

Perennial herbs, 21-52 cm tall. *Rootstock* 4.7-10.6 mm in diameter, ± horizontal, not tuberculate, not turnip-shaped, without thickened roots. *Stem* erect, leafy, not rooting at nodes, stolons absent, without vegetative stems, with uncinate, eglandular hairs 0.1-0.3 mm long and, usually, scattered, patent, glandular hairs 0.2-1 mm long. *Basal leaves* in a persistent rosette, cauline leaves opposite; leaf laminas (4.4)5.2-8.7(10.8) cm long, 4.7-10.7 cm wide, not peltate, palmatifid [ratio main-sinus length/middle segment length = (0.70)0.74-0.81(0.85)], polygonal in outline, base cordate, not coriaceous, with nerves not projected, with ± appressed, eglandular hairs and plane glandular hairs on the adaxial surface and with uncinate, eglandular hairs and glandular hairs abaxially; segments 5, in 1 plane, middle segment rhombic, 5.3-15.4 mm wide at the base [ratio segment width at the base/middle segment length = (0.16)0.17-0.26(0.33)], (8)10-34-lobed in distal half [ratio secondary sinus length/middle segment length = (0.11)0.16-0.21(0.27)]; petioles up to 23 cm long, without abscission zone, terete, not swollen, not deflexed in age, with a variable indumentum composed by uncinate, antrorse, eglandular hairs 0.1-0.2 mm long and, usually, scattered, patent, glandular hairs 0.3-1.5 mm long; stipules (2.3)3.3-4.2(6.5) mm long, 1.3-3.4 mm wide, lanceolate, free, papery, brownish red, with eglandular hairs on the abaxial surface and margin, glabrous adaxially. *Inflorescence* a dichasial cyme; cymules 2-flowered, solitary or in aggregates at the top of each branch [ratio cymule length/leaf length = 1-2.8]; peduncles (2.5)13-32(90) mm long, with uncinate, antrorse, eglandular hairs 0.2-0.3 mm long and, usually, patent, glandular hairs 0.3-0.9 mm long; bracteoles 1.2-4.2 mm long, 0.7-2 mm wide, lanceolate, obtuse, whorled; pedicels absent or (2.5)6.5-11.2(18) mm long, with uncinate, antrorse, eglandular hairs 0.1-0.3 mm long and, usually, patent, glandular hairs 0.3-0.6 mm long. Flowers zygomorphic. *Sepals* (6.4)6.8-8.2(8.5) mm long, 2.8-5.3 mm wide, lanceolate, smooth, not accrescent, nerves 3, mucro (1.4)2-3.2(4.2) mm long [ratio mucro length/sepal length = (0.22)0.29-0.34(0.46)], with uncinate, eglandular hairs 0.1-0.3 mm long and ± scattered, patent, glandular hairs 0.2-1.2 mm long on the abaxial surface, glabrous adaxially. *Petals* (10)13.3-14.7(16.7) mm long, (5.1)7.1-7.9(9.3) mm wide, patent, rounded, with claw 3.7-6.9 mm long, purple, hairy on the base on both adaxial and abaxial surface, ciliate on the basal margin, with hairs 0.2-0.4 mm long. *Stamens* 10, both whorls bearing anthers; filaments (15)16.8-19.9(21) mm long, linear-lanceolate, sometimes with a pair of teeth very near the base, purple, glabrous or with some cilia 0.2-0.3 mm long on the base; anthers (1.7)1.9-2.1(2.5) mm long, reddish. Nectaries 5, hemispheric, glabrous. *Gynoecium* 16-33 mm long, red. *Fruit* (33)37-44(49) mm long, erect, discharge of carpel-projection type, operative; mericarps 2.2-3.2 mm long, 1-1.6 mm wide, without a strand of fibers, not compressed

at the apex, reticulate, with the thin transversal ridges weakly branched, without basal beak, without a basal callus, without a basal prong, brown, glabrous; rostrum 27-42 mm long, with a narrowed apex 13-26 mm long, not twisted, with patent, eglandular hairs 0.1-0.3 mm long and, rarely, patent, glandular hairs 0.1-0.2 mm long restricted to the basal half of the narrowed apex; stigmatic remnants 1.3-2.2 mm long, with 5 glabrous lobes. *Seeds* 2-2.7 mm long, 1.1-1.5 mm wide, finely reticulate, uniformly colored, brown, glabrous. Cotyledons with entire margin. Figs. 776, 777.

Pollen. *Geranium*-type (Aedo 2017: 412; Bortenschlager 1967: 425; Gagnepain 1903: 86; Stafford & Blackmore 1991: 68).

Chromosome number. 2*n* = 46, ca. 46, 87-93, 92.

Phenology. Collected in flower from April to September.

Distribution. This species ranges from southern France to Bulgaria and Greece and it is introduced in Belgium, Germany, Great Britain, Canada and U.S.A. (Fig. 778).

Habitat. Rocky ledges, open forests, and meadows, on limestones, serpentines or siliceous soils; 50-2850 m.

Representative specimens examined. **Albania.** Vlorë: Cika, vetta principale salendo dal passo Llogarasa, 40°12'N, 19°38'E, 9 July 2012, *Conti & Manilla s.n.* (APP). **Austria.** Carinthia: pr. Pleckenerhaus, 46°36'N, 12°56'E, July 1875, *Ball s.n.* (NY). Lower Austria: Niederösterreich, Marchfeld, 2.5 km SSE Eisenbahn, 48°18'N, 16°30'E, 21 May 2004, *Borba s.n.* (W); Niederösterreich, Marchtal, S von Dürnkrut, 0.2 km N-NNE der Kirche von Stillfried, 48°24'N, 16°50'E, 4 June 2014, *Barta 3871* (MA). **Belgium.** Wallonia: Roly, Namur, 50°7'N, 4°31'E, 31 May 1973, *Duvigneaud 73B382* (MA). Meuse, 50°41'N, 5°39'E, 19 June 1913, *Mairlot s.n.* (MA). **Bosnia-Herzegovina.** Stolac, 43°5'N, 17°57'E, 25 July 1897, *Fiala s.n.* (FI); Livno, 43°49'N, 17°0'E, 20 July 1904, *Stadlmann & Faltis s.n.* (FI). **Bulgaria.** Blagoevgrad: carretera Nova Lovcha a Koprivlen, 41°28'N, 23°45'E, 6 July 2004, *Quintanar & al. 1278* (MA). Smolyan: Central Rhodope Mts., pr. Kosovo, 41°54'N, 24°42'E, 29 June 2004, *Aedo & al. 10351* (MA). **Canada.** Québec: Montréal, 45°32'N, 73°41'W, 30 May 2013, *Calvo 6223* (MA). **Croatia.** Lika-Senj Hrvatska, Velebit, road Jablanac-Krasno, w-facing 1 km S of the summit of the road, Veliki Alan, 44°32'N, 15°14'E, 25 June 1983, *Frost-Olsen 5202* (MA). Split-Dalmatia: Velebit, Velika Paklenica bei Starigrad, 43°10'N, 16°36'E, 21 Apr. 1979, *Vitek s.n.* (W). **France.** Provence-Alpes-Côte d'Azur: Alpes-Maritimes, valleé de la Gordolasque, entre le Pont du Ray et Saint Grat, 44°0'N, 7°19'E, 30 June 1921, *Le Brun s.n.* (MPU); Alpes-Maritimes, au pont de la Gordolasque, au dessus du Belvédère, 44°1'N, 7°20'E, 11 July 1912, *Arbost 2109* (MPU). **Germany.** Hesse: Giessen, alte Mauern im Dorfe Vetzberg, 50°37'N, 8°34'E, 18 June 1924, *Freiberg s.n.* (MA). **Great Britain.** England: South Devon, Dartmoor, 50°35'N, 3°55'W, May 1892, *Lomax s.n.* (ABS). **Greece.** East Macedonia and Thrace: Dramas, W Rhodopi, 5 km N of the forest station Zagradenia, area called Likolakka, 41°25'N, 24°37'E, 9 Aug. 1979, *Strid & Papanicolaou 16451*

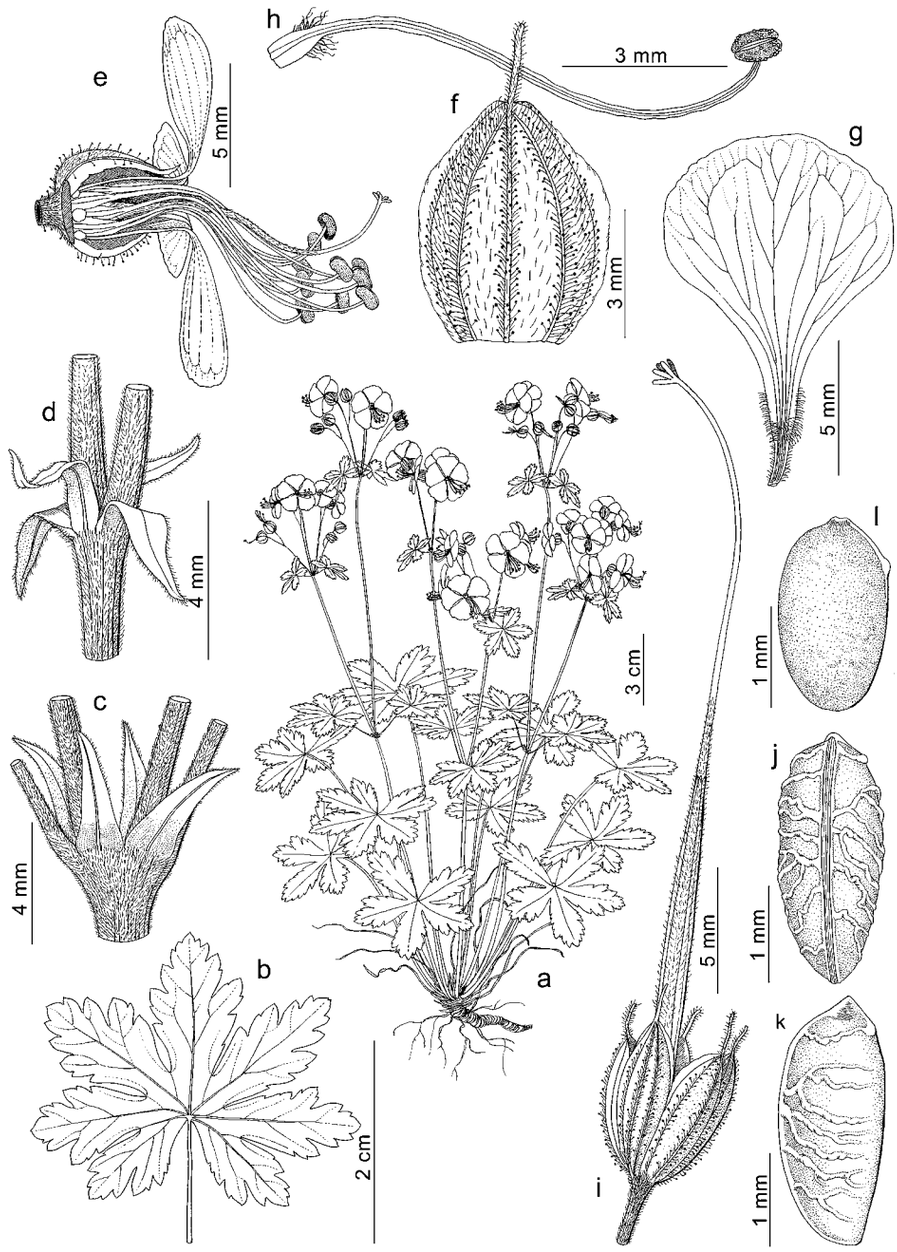


Fig. 776. *Geranium macrorrhizum*. a. Habit. b. Leaf. c. Stipules. d. Bracteoles. e. Flower. f. Sepal. g. Petal. h. Stamen. i. Fruit. j, k. Mericarps. l. Seed. (Based on: a-c, e-g, *Korb s.n.*, *30 July 1907*, W; d, *Hartvig & Franzen 9071*, C; h-l, *Strid & Tan 31643*, C).

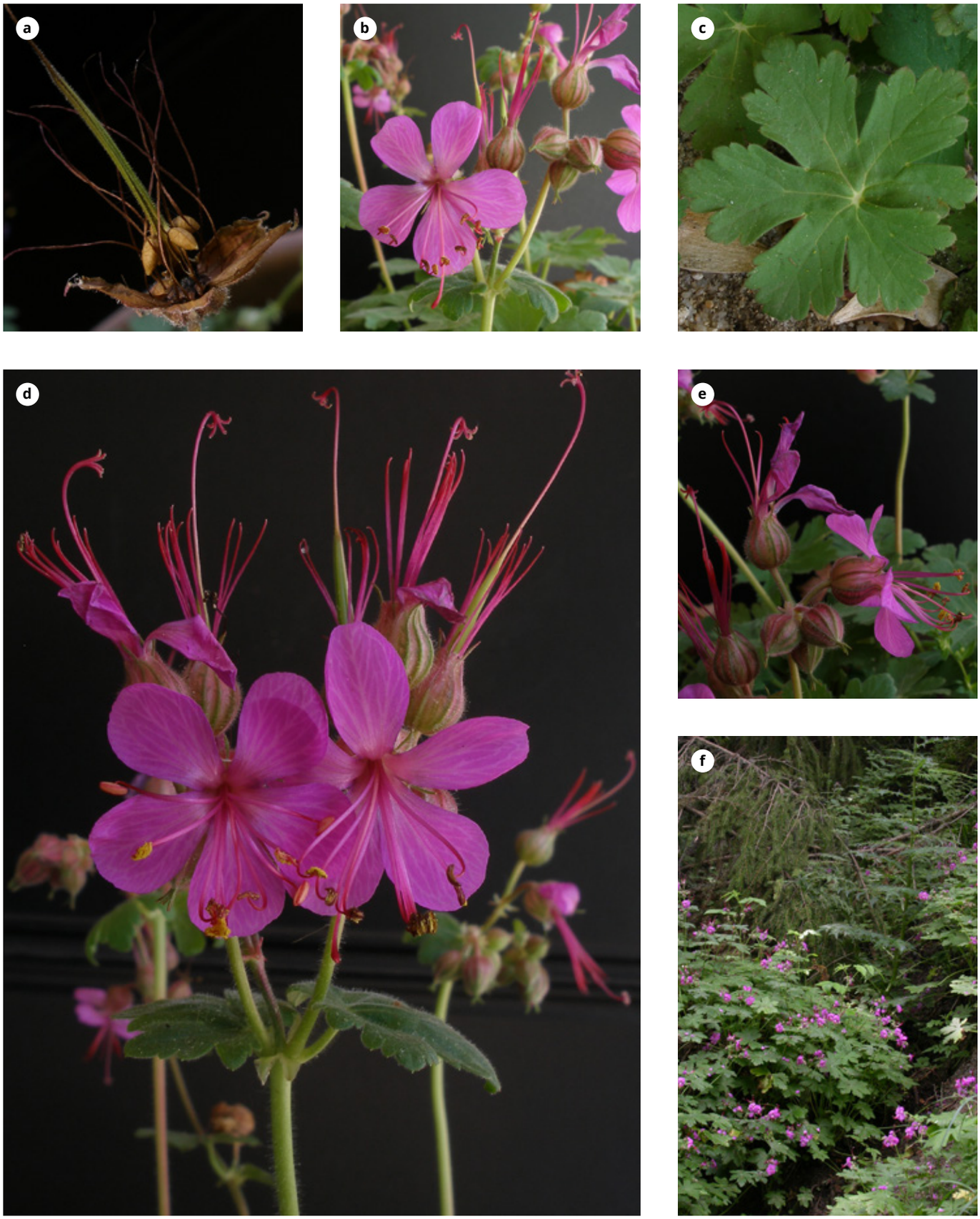


Fig. 777. *Geranium macrorrhizum* (Based on: a-e, *Aedo 10531*, MA; f, *Quintanar & al. 1349*, MA).

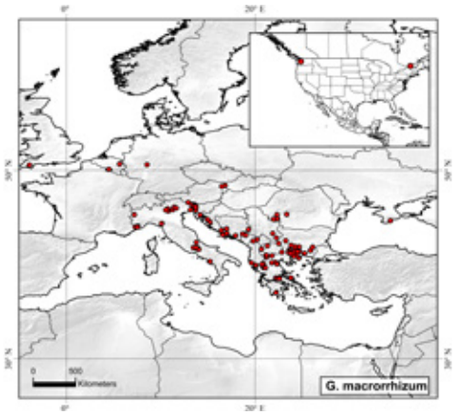


Fig. 778. Distribution of *Geranium macrorrhizum*.

(C). Epirus: pr. Megha Peristeri, 39°43'N, 21°3'E, 30 June 2007, *Castroviejo & al. 18516* (MA). Peloponnese: Lakonia, Taigetos Mts., Ladagha gorge, 37°4'N, 22°17'E, 24 June 2007, *Aedo & al. 14276* (MA). Thessaly: Pieria, Mt. Olympo, 40°5'N, 22°24'E, 3 July 2007, *Aedo & al. 14349* (MA). **Italy.** Campania: Gole del Fiume Calore, Felitto, 40°21'N, 15°15'E, 20 June 2002, *Salerno s.n.* (FI). Veneto: Monte Baldo, 45°41'N, 10°49'E, 16 July 1976, *Grünweis s.n.* (W). **Kosovo.** Peja: Rugovo canyon, W Pec, 42°40'N, 20°15'E, 17 June 1969, *Roessler 6829* (M). **Montenegro.** Plav: Mt. Prokletije, Kucke Prokletije, Katun Mokro, 42°30'N, 19°50'E, 18 July 2003, *Lakušić & al. s.n.* (APP). Plužine: montis Morglic, pr. lacum Volnjak, 43°15'N, 18°43'E, Aug. 1888, *Beck 174* (LE). **North Macedonia.** Pelagonia: Mt. Pelister, 41°0'N, 21°11'E, 31 July 1862, *Orphanides s.n.* (P). Polog: Kosmet, Sar Planina, S Breovica, NE of Bistra, at Shara, along the stream W of Shara, 41°39'N, 20°43'E, 11 July 1979, *Frost-Olsen 2235* (C, MA). **Romania.** Vest: Caras-Severin, Piriul Jelerau, 44°50'N, 22°0'E, 8 May 1966, *Goga s.n.* (COI). Sud-Vest Oltenia: Transsilvania, Ciuc, Bicaz, montis Surduc inter Dealu Glodului et Piatra Ciuhei, 45°20'N, 23°23'E, 8 July 1932, *Gusuleac & Topa s.n.* (P, C). **Russia.** Krym: pr. Alushta, in via trajectum Ishutshel, 44°40'N, 34°24'E, 18 June 1938, *Yuzepchuk s.n.* (LE). **Serbia.** Southern and Eastern Serbia: in the Vlasina valley N of lake Vlasina, 4 km N of Brod, 42°50'N, 22°17'E, 4 July 1984, *Frost-Olsen 6207* (MA); Nis, 43°19'N, 21°54'E, 1968, *Weber s.n.* (PR). **Slovenia.** Gorizia: pr. Bovec, Slap Boka, 46°19'N, 13°29'E, 10 Aug. 2017, *Aedo 25244* (MA); Triglav National Park, inter Predel et Bovec, pr. Log, 46°21'N, 13°35'E, 27 May 2010, *Calvo 4688* (MA). **USA.** Washington: King Co., 0.4 km WNW Lake Boren, Newcastle, 47°31'N, 122°9'W, 24 Apr. 2016, *Zika 27771* (MA).

Discussion. Geranium macrorrhizum is a perennial herb with a robust, more or less horizontal rootstock that shows some stipules and the petiole base. The aerial stem has quite a long naked portion up to the inflorescence. The inflorescence has one or two nodes with a pair of opposite leaves, the first shortly petiolate and the second almost sessile. The groups of 2-flowered cymules at the end of each branch can be distinct, that is, with well-developed peduncles, or with short or null pedicels and in umbel-like aggregates. The flowers are modified, being horizontal at anthesis and zygomorphic. The petals have a distinct, smooth claw, without the double keel of species of section *Ruberta*. The stamens are a bit shorter than the petals, but they seem exserted because the petal blade is spread. Staminal filaments are displaced to the lower side of the flower and slightly turned up at the tips and the style is displaced and curved like the stamens. The staminal filaments are linear-lanceolate, with an expanded base usually with some cilia. When the fruit is still immature, the staminal filaments remain appressed to the rostrum, protruding from the sepals. The indumentum, which consists of glandular and eglandular, usually uncinate, hairs, varies considerably. In some individuals, one of the two types of hairs is almost completely lacking. The density of glandular and eglandular hairs varies sometimes on the same sheet.

Geranium macrorrhizum is quite similar to *G. dalmaticum* in general appearance and inflorescence structure. Both species share zygomorphic flowers, exserted staminal filaments, fruit rostrum with a long, narrowed apex, and reticulate mericarps. Leaves of *G. macrorrhizum* are longer than those in *G. dalmaticum* and with more lobes per segment, even in small individuals. Additionally, *G. macrorrhizum* has a sepal mucro noticeably longer than that of *G. dalmaticum*. The stamens have an expanded, triangular base that abruptly narrows into the linear staminal filaments. In some rare individuals the expanded base has a pair of auricles, one on each side, as in *G. dalmaticum*. Although with some overlap, bracteoles, sepals, and staminal filaments are longer in *G. macrorrhizum* than in *G. dalmaticum*.

Şerbănescu (1942) analyzed the variability of *Geranium macrorrhizum* and proposed a division of this species in six varieties and three additional forms. The basis of these groups is the degree of division of the leaves and the variation of the indumentum. These features are highly variable, however, even within the same gathering, which advises against its taxonomic use. Unfortunately, some of the types of these names remain unknown. Tan & al. (2011) described *G. kikianum*, a new species endemic to the Taigetos Mountains in the Peloponnese. It is differentiated by its narrow petals (5.5-7 mm wide) in contrast to those of *G. macrorrhizum* (11-14 mm wide), with a narrow claw. I have found great variation in petal size in *G. macrorrhizum* across its area, which suggests that *G. kikianum* may be a local variation without taxonomic significance. Wagensommer & Venanzoni (2021) described *G. lucarinii*, as a closely related species to *G. macrorrhizum*, based on its longer peduncles, pedicels and sepal mucro and the persistence of basal leaves with segments that often overlapping on the margin. All these characters fall into the variability of *G. macrorrhizum* and thus *G. lucarinii* is here considered conspecific. When Stefanoff & Jordanov (1931) described *Geranium macrorrhizum* var. *kellereri*, they indicated that the original material was collected in "Juni 1927." The date of the lectotype is not exactly as it is in the protologue (21 June 1926), which may be an erratum.

García-Aloy & al. (2017, table S8) recorded *G. macrorrhizum* from "France, Pyrenees; Aldasoro s.n."; so far no herbarium voucher has been found for this amazing locality.

307. Geranium dalmaticum (Beck) Rech. f., Magyar Bot. Lapok 33: 28. 1934. *Geranium macrorrhizum* var. *dalmaticum* Beck, Verh. K.K. Zool.-Bot. Ges. Wien 46: 266. 1896. *Geranium macrorrhizum* [B] *dalmaticum* (Beck) Graebn. in Asch. & Graebn., Syn. Mitteleur. Fl. 7(1): 58. 1913. Type locality: "Dalmatia: In monte Vipera penninsulae Sabioncello in fissuris et glareis rupium calcearum altid. 700-850 m s.m. Florens legit mens. Junio 1894 G. de Beck". Type: Croatia. Dalmatia, Sabioncello, monte Vipera, 42°59'N, 17°10'E, 12 June 1894, *G. Beck s.n.* (lectotype, designated by Aedo 2017b: 449, PRC-450807 image!).

Geranium macrorrhizum subsp. *microrhizum* Freyn, Mém. Herb. Boissier 13: 4. 1900, ["microrhizon"]. *Geranium microrhizum* (Freyn) O. Schwarz, Repert. Spec. Nov. Regni Veg. 40: 352. 1936. Type locality: "Dalmatia australis, Ragusa: in cacumine montis dicto Monte Vipere 960 m supra mare dia 18. Julio 1899 leg. Brandis". Type: Croatia. Dalmatia, Ragusa, monte Vipera, 42°59'N, 17°10'E, 18 July 1899, *E.S.J. Brandis s.n.* (lectotype, designated by Aedo 2017b: 450, BRNM image!).

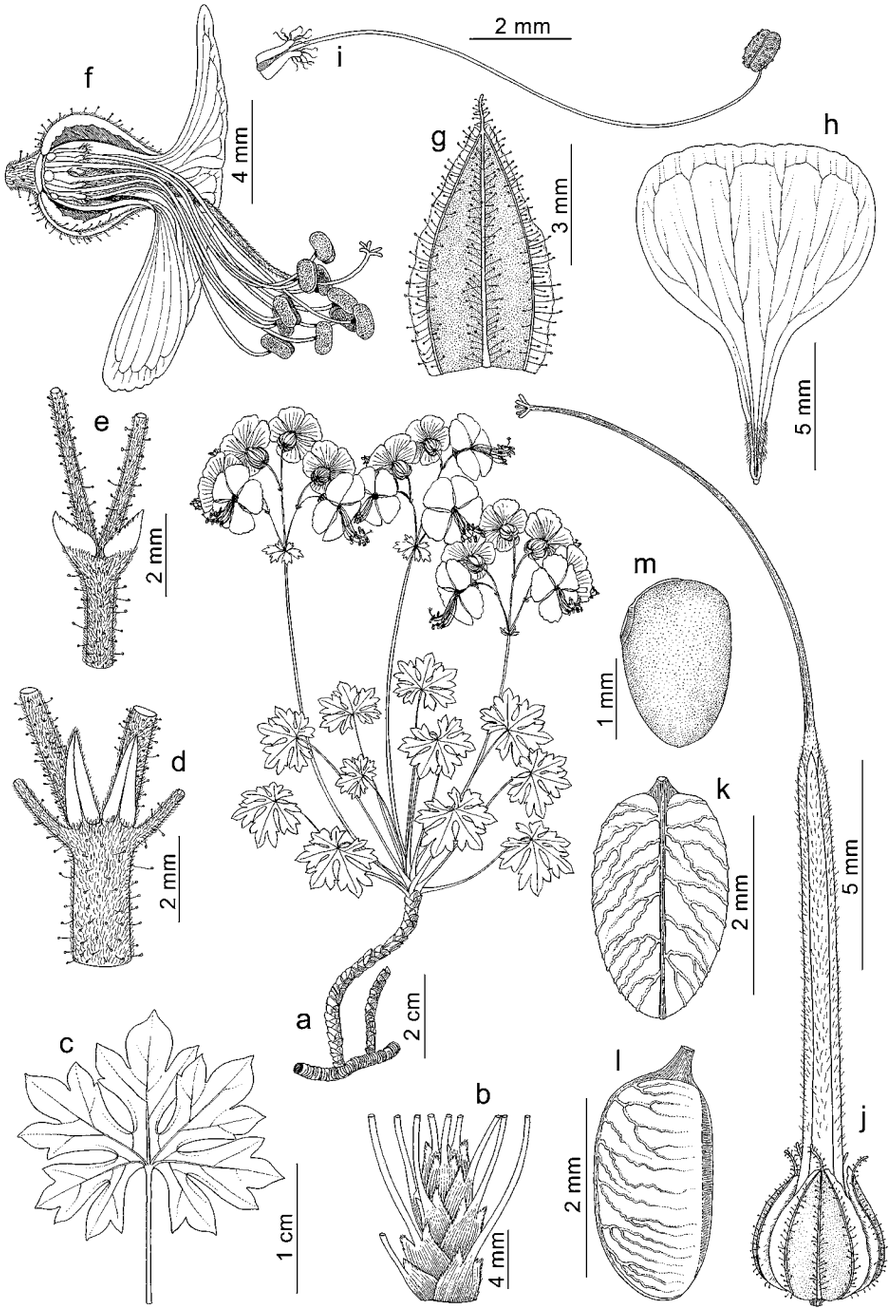


Fig. 779. *Geranium dalmaticum*. a. Habit. b. Detail of the leaf insertion on the stem. c. Leaf. d. Stipules. e. Bracteoles. f. Flower. g. Sepal. h. Petal. i. Stamen. j. Fruit. k, l. Mericarps. m. Seed. (Based on: a-g, j-m, *Baldacci 110*, BM; h, i, *Alanko 1359*, H).

Perennial herbs, 8-23 cm tall. *Rootstock* 2.7-4.3 mm in diameter, ± horizontal, not tuberculate, not turnip-shaped, without thickened roots. *Stem* erect, leafy or scapiform, not rooting at nodes, stolons absent, without vegetative stems, with abundant uncinate, eglandular hairs 0.1-0.2 mm long and, sometimes, scattered, patent, glandular hairs 0.1-0.2 mm long. *Basal leaves* in a persistent rosette, cauline leaves usually absent, sometimes 1 pair of small, opposite leaves; leaf laminas (2)2.1-3.2(3.6) cm long, 2.2-4.2 cm wide, not peltate, palmatifid [ratio main-sinus length/middle segment length = (0.78)0.82-0.86(0.88)], polygonal in outline, base cordate, not coriaceous, with nerves not projected, with uncinate, eglandular hairs on nerves of the adaxial surface and margin, glabrous or with scattered eglandular hairs abaxially; segments 5, in 1 plane, middle segment rhombic, 1.6-5.4 mm wide at the base [ratio segment width at the base/middle segment length = (0.13)0.15-0.21(0.22)], 3-5(6)-lobed in distal half [ratio secondary sinus length/middle segment length = (0.15)0.21-0.25(0.26)]; petioles up to 13 cm long, without abscission zone, terete, not swollen, not deflexed in age, with uncinate, antrorse, eglandular hairs 0.1-0.3 mm long; stipules (2.2)2.4-3.9(4.8) mm long, 0.7-1.5 mm wide, lanceolate, free, papery, brownish red, with eglandular hairs on the abaxial surface and margin, glabrous adaxially. *Inflorescence* a dichasial cyme;

cymules 2-flowered, solitary or in aggregates at the top of each branch [ratio cymule length/leaf length = 0.4-6.6]; peduncles 2.2-16(98) mm long, with uncinate, antrorse, eglandular hairs 0.1-0.2 mm long and sometimes patent, glandular hairs 0.3-0.4 mm long; bracteoles 1-1.8 mm long, 0.5-0.8 mm wide, lanceolate, obtuse, whorled; pedicels (2.5)5.1-7.6(9.2) mm long, with uncinate, antrorse, eglandular hairs 0.1-0.3 mm long and, usually, patent, glandular hairs 0.3-0.5 mm long. Flowers zygomorphic. *Sepals* (5.5)6-6.6(7.3) mm long, 3-4.3 mm wide, lanceolate, smooth, not accrescent, nerves 3, mucro (0.9)1.1-1.6(1.7) mm long [ratio mucro length/sepal length = (0.16)0.20-0.22(0.31)], with uncinate, eglandular hairs 0.2-0.3 mm long and ± patent, glandular hairs 0.5-1.9 mm long on the abaxial surface, glabrous adaxially. *Petals* (12.4)14-16.7(18.1) mm long, (7.7)9.3-12.2(13.8) mm wide, patent, rounded, with claw 3.4-6.7 mm long, purple, hairy on the base on both adaxial and abaxial surface, ciliate on the basal margin, with hairs 0.2-0.6 mm long. *Stamens* 10, both whorls bearing anthers; filaments (10.8)13.9-15(16.5) mm long, linear-lanceolate, with a pair of teeth very near the base, pink, glabrous except on the basal teeth, with hairs 0.2-0.6 mm long; anthers 1.7-1.9(2) mm long, reddish. Nectaries 5, hemispheric, glabrous. *Gynoecium* 11-24 mm long, red. *Fruit* 31-45 mm long, erect, discharge of carpel-projection type, operative; mericarps 2.6-3.4 mm long, 1.2-1.3 mm wide, without a strand of fibers, not compressed at the apex, reticulate, with thin transversal ridges slanting and occasionally forking or merging, without basal beak, without a basal callus, without a basal prong, brown, glabrous; rostrum 26-38 mm long, with a narrowed apex 14-15.8 mm long, not twisted, with patent, eglandular hairs 0.1-0.2 mm long and, sometimes, patent, glandular hairs 0.1-0.2 mm long restricted to the basal half of the narrowed apex; stigmatic remnants 1.4-2 mm long, with 5 glabrous lobes. *Seeds* 2-2.2 mm long, 0.9-1.3 mm wide, finely reticulate, uniformly colored, brown, glabrous. Cotyledons not studied. Fig. 779.

Pollen. *Geranium*-type (Aedo 2017: 412).

Chromosome number. 2*n* = 46.

Phenology. Collected in flower from May to August.

Distribution. This species ranges from southern Croatia to Montenegro and northern Albania and it is ocasionally introduced in northwestern U.S.A. (Fig. 780).

Habitat. Fissures, crevices and screes of limestone rocks; 300-950 m.

Fig. 780. Distribution of *Geranium dalmaticum*.

Additional specimens examined. **Albania.** Shkodër: Skala Rapsa, Holti, 42º24'N, 19º29'E, 26 June 1900, *Baldacci 8* (M, W); Skala Rapsa, Holti, 42º24'N, 19º29'E, 26 June 1900, *Baldacci s.n.* (P); felsen in der Schlucht des Flusses Cem, an der Strasse Shkodër-Vermosh, 40 km N Shkodër, Bezirk Shkodër (cultivated at ETH Zürich), 42º25'N, 19º30'E, 5 Aug. 1982, *Baltisberger & Lenherr 11073* (ZT); felsen in der Schlucht des Flusses Cem, an der Strasse Shkodër-Vermosh, 40 km N Shkodër, Bezirk Shkodër (cultivated at ETH Zürich), 42º25'N, 19º30'E, 5 Aug. 1982, *Baltisberger & Lenherr 83/1001* (ZT); felsen in der Schlucht des Flusses Cem, an der Strasse Shkodër-Vermosh, 40 km N Shkodër (cultivated at ETH Zürich), 42º25'N, 19º30'E, 5 Aug. 1982, *Baltisberger & Lenherr 83/1002* (ZT). **Croatia.** Sabioncello [cultivated in Weimar], July 1941, *Bornmüller s.n.* (B); Dalmatia, Sabioncello, monte Vipera [cult. in Steiermark], 17 June 1937, *Korb s.n.* (W). **Montenegro.** Podgorica: ad Trijepsi versus distric. Kuci, 42º26'N, 19º27'E, 3 July 1898, *Baldacci 110* (BM, FI, M, WU); ad Trijepsi, 42º26'N, 19º27'E, 3 July 1898, *Baldacci 40* (LE, P). **USA.** Washington: Pierce Co., MacKaye Marsh trail, SW Sequalitchew lake, 47º6'N, 122º37'W, 24 May 2019, *Dunwiddie & al. 19-121* (MA).

Discussion. Geranium dalmaticum is a small perennial herb with a more or less horizontal and branched rootstock. The aerial stem is usually naked except for a pair of leaves below the inflorescence. Sometimes these leaves are just vestigial, giving the appearance of a subscapose habit. In well-developed individuals, the inflorescence comprises three 2-flowered cymules arranged dichasially. In contrast, in other specimens the inflorescence may be reduced to a single 2-flowered cymule. Bracteoles are usually arranged on the junction of the peduncle and pedicel, but sometimes some supplementary bracteoles can be found on the pedicel. The flowers are zygomorphic, like those of *G. macrorrhizum*. The staminal filaments are linear-lanceolate, with an expanded base that has hairy-tipped auricles on each side. These auricles have been found in all individuals examined.

Geranium dalmaticum is an endemic restricted to a few localities in southern Croatia, Montenegro, and northern Albania. It seems that in this area there are no collections of *G. macrorrhizum*. The differences between G. *macrorrhizum* and *G. dalmaticum* are indicated under *G. macrorrhizum*. Since most of these differences are related to size, *G. dalmaticum* could simply be considered a reduced form of *G. macrorrhizum.* However, its geographic isolation as well as the fact that these differences are maintained in cultivation, strongly support its recognition as an independent species.

Geranium dalmaticum is used occasionally in gardens and recently found, probably not well-established yet, in northwestern U.S.A.

MISCELLANEOUS DOUBTFUL AND NOT VALIDLY PUBLISHED NAMES

Between square brackets is indicated the name of the taxa which is usually attributed the name, if possible. Between brackets are indicated the articles of the Shenzhen Code, if necessary.

Geranium sect. *Batrachia* L., in Murray, Syst. Veg. ed. 13: 513. 1774. nom. inval., includes the type of the name of the genus but does not repeat the generic name (art. 22.2).

Geranium sect. *Batrachia* W.D.J. Koch, Syn. Fl. Germ. Helv. 1: 137. 1835. nom. inval., includes the type of the name of the genus but does not repeat the generic name (art. 22.2).

Geranium sect. *Eugeranium* Godr. in Gren. & Godr., Fl. France 1: 297. 1847, nom. inval., because the use of the prefix *Eu* (art. 21.3).

Geranium sect. *Geranotypus* Dumort., Fl. Belg.: 112. 1827, nom. inval., includes the type of the name of the genus but does not repeat the generic name (art. 22.2).

Geranium sect. *Perennia* Boiss., Diagn. Pl. Orient. ser. 2, 1: 111. 1854, nom. nud.

Geranium sect. *Sylvatica* Bubani, Fl. Pyren. 3: 307. 1901, nom. inval., includes the type of the name of the genus but does not repeat the generic name (art. 22.2).

Geranium series *Ambigua* H.E. Moore, Contr. Gray Herb. 146: 24. 1943, nom. inval., without Latin description (art. 39.1).

Geranium series *Atropurpurea* H.E. Moore, Contr. Gray Herb. 146: 45. 1943, nom. inval., without Latin description (art. 39.1).

Geranium series *Bella* H.E. Moore, Contr. Gray Herb. 146: 48. 1943, nom. inval., without Latin description (art. 39.1).

Geranium series *Campanulatae* Paray, Bol. Soc. Bot. México 16: 25. 1954, nom. inval., without Latin description (art. 39.1).

Geranium series *Caroliniana* H.E. Moore, Contr. Gray Herb. 146: 102. 1943, nom. inval., without Latin description (art. 39.1).

Geranium series *Crenata* H.E. Moore, Contr. Gray Herb. 146: 37. 1943, nom. inval., without Latin description (art. 39.1).

Geranium series *Deltoidea* H.E. Moore, Contr. Gray Herb. 146: 62. 1943, nom. inval., without Latin description (art. 39.1).

Geranium series *Lata* H.E. Moore, Contr. Gray Herb. 146: 26. 1943, nom. inval., without Latin description (art. 39.1).

Geranium series *Nivea* H.E. Moore, Contr. Gray Herb. 146: 17. 1943, nom. inval., without Latin description (art. 39.1).

Geranium series *Repentia* H.E. Moore, Contr. Gray Herb. 146: 77. 1943, nom. inval., without Latin description (art. 39.1).

Geranium series *Resima* H.E. Moore, Contr. Gray Herb. 146: 35. 1943, nom. inval., without Latin description (art. 39.1).

Geranium series *Trolliifolia* H.E. Moore, Contr. Gray Herb. 146: 16. 1943, nom. inval., without Latin description (art. 39.1).

Geranium series *Vulcanicola* H.E. Moore, Contr. Gray Herb. 146: 82. 1943, nom. inval., without Latin description (art. 39.1).

Geranium subsect. *Eusylvatica* R. Knuth in Engl., Pflanzenr. IV. 129 (Heft 53): 108. 1912, nom. inval., because the use of the prefix *Eu* (art. 21.3).

Geranium [trib.] *Columbina* Fr., Novit. Fl. Suec. alt.: 211. 1828, nom. inval., the rank is denoted by a misplaced term (art. 37.6).

Geranium [trib.] *Sylvatica* Fr., Novit. Fl. Suec. alt.: 211. 1828, nom. inval., the rank is denoted by a misplaced term (art. 37.6).

Geranium [§] *Batrachia* Boiss., Fl. Orient. 1: 869. 1867 nom. inval., includes the type of the name of the genus but does not repeat the generic name (art. 22.2).

Geranium abaicum Schweinf. ex R. Knuth in Engl., Pflanzenr. IV.129 (Heft 53): 61. 1912, nom. nud., pro syn. [*G. trilophum*].

Geranium acaule Phil. ex R. Knuth in Engl., Pflanzenr. IV.129 (Heft 53): 83. 1912, nom. nud., pro syn. [*G. sessiliflorum*].

Geranium aconitifolium Eichw. ex B. D. Jacks., Index Kew. 2: 1017. 1893, nom. inval., not accepted by its author (art. 36.1) [*G. rivulare*].

Geranium aconitifolium Knaf ex Nyman, Consp.: 137. 1878, nom. nud., pro syn. [*G. rivulare*].

Geranium aconitifolium [*] *venosum* Pers., Syn. Pl. 2: 235. 1806, nom. inval.? (Greuter 1968: 92) [*G. sylvaticum*].

Geranium agavacense Kunth in Humb., Bonpl. & Kunth, Nov. Gen. Sp. 5: 231. 1822, [var. ortho., recorded in Knuth's (1912) monograph & IPNI] [*G. ayavacense*].

Geranium aionium L. ex B.D. Jacks., Proc. Linn. Soc. London Suppl. 1912: 79. 1912, nom. inval., not accepted by its author (art. 36.1).

Geranium akovense Bojer ex R. Knuth in Engl., Pflanzenr. IV.129 (Heft 53): 203. 1912, nom. nud., pro syn. [*G. arabicum*].

Geranium alatavicum Popov ex Bobrov in Kom. & al., Fl. URSS 14: 44. 1949, nom. nud. [*G. collinum*].

Geranium albicans var. *glanduliferum* Hieron., nom. nud., in sched. (CORD!) [*G. fallax*].

Geranium albiflorum var. *grandiflorum* Reverd. & Vylzan., Fl. Krasnoyarsk. 7-8: 5. 1977, nom. inval., sine descr. (art. 39.1) [*G. albiflorum*].

Geranium albiflorum var. *lilacinum* Krylov ex Malyschev in Malyschev & Peschkova (eds.), Fl. Prebaikal: 27. 1978, nom. nud. [*G. albiflorum*].

Geranium albiflorum f. *lilacinum* Krylov ex Bobrov in Kom. & al. (eds.), Fl. URSS 14: 28. 1949, nom. inval., sine descr. (art. 39.1) [*G. albiflorum*].

Geranium albiflorum f. *lilacinum* Krylov ex Malyschev, Vysok. Fl. Vost. Sayan.: 181. 1965, nom. inval., without type (art. 40.1) [*G. albiflorum*].

Geranium album Picard ex B.D. Jacks., Index Kew. 2: 1017. 1893, nom. inval., not accepted by its author (art. 36.1) [*G. molle*].

Geranium alpestre Schur, Verh. Mitth. Siebenbürg. Vereins Naturwiss. Hermannstadt 1851: 176. 1851, nom. nud. [*G. sylvaticum*].

Geranium altaicum G. Don ex Loudon, Hort. Brit. 276. 1830, nom. nud.

Geranium altaicum Patrin, nom. nud., in sched. [*G. pratense*].

Geranium andrewsiana Gower, nom. nud., in sched. (K!) [*G. sylvaticum*].

Geranium anemonifolium var. *grandiflorum* Bolle, Index. Sem. Hort. Berol. 1861: 11. 1862. Type locality: "Hanc Madera gignit magna copia". Type: Portugal. Madeira, *C.A. Bolle s.n.* (no original material located) [*G. palmatum*].

Geranium anemonioides, nom. nud., in sched. (BM!, E!, G!) [*G. subcaulescens*].

Geranium angelina Nois. ex Steud., Nomencl. Bot. 1: 364. 1821, nom. nud.

Geranium angustifolium Gilib., Fl. Lit. Inch. 2: 176. 1782, nom. inval., suppressed work (art. 34.1) [*G. dissectum*].

Geranium argenteum Bory & Chaub. ex B.D. Jacks., Index Kew. 2: 1018. 1893, nom. inval., not accepted by its author (art. 36.1) [*G. subcaulescens*].

Geranium argenteum Geners., Fl. Scepusiensis Elench.: 52. 1798, nom. nud. [*G. sylvaticum*].

Geranium argenteum var. *purpureum* Ingw., Genus Geranium: 4. 1946, nom. inval., without Latin description (art. 39.1) [*G. argenteum*].

Geranium aristisepalum var. *typicum* H.E. Moore, Contr. Gray Herb. 146: 64. 1943, nom. inval., epithet indicating the taxon containing the type of the name of the next higher-ranked taxon (art. 24.3) [*G. hernandesii*].

Geranium armenum var. *albowii* Lipsky ex Woronow in Kusn., N. Busch & Fomin,

Fl. Cauc. Crit. 3(7): 40. 1908, nom. nud., pro syn. [*G. psilostemon*].

Geranium aschenborianum Aschenborn ex R. Knuth in Engl., Pflanzenr. 129. IV (Heft 53): 194. 1912, nom. nud. [*G. hernandesii*].

Geranium asphodeloides Bory & Chaub. ex B.D. Jacks., Index Kew. 2: 1018. 1893, nom. inval., not accepted by its author (art. 36.1) [*G. peloponnesiacum*].

Geranium asphodeloides Sm. ex B.D. Jacks., Index Kew. 2: 1018. 1893, nom. inval., not accepted by its author (art. 36.1) [*G. subcaulescens*].

Geranium asphodeloides var. *genuinum* Boiss., Fl. Orient. 1: 878. 1867, nom. inval., epithet indicating the taxon containing the type of the name of the next higher-ranked taxon (art. 24.3) [*G. asphodeloides*].

Geranium asphodeloides var. *hispidum* Zelen. ex R. Knuth in Engl., Pflanzenr. IV.129 (Heft 53): 155. 1912, nom. nud., pro syn. [*G. asphodeloides*].

Geranium asphodeloides f. *parviflora* Sint. ex R. Knuth in Engl., Pflanzenr. IV.129 (Heft 53): 156. 1912, nom. nud., pro syn. [*G. asphodeloides*].

Geranium atropurpureum var. *cowenii* (Rydb.) Dorn, Vasc. Pl. Wyoming: 180, 304. 1988, nom. inval., combination proposed without reference to basionym (art. 41.5) [*G. caespitosum*].

Geranium aureum Rose ex R. Knuth in Engl., Pflanzenr. IV.129 (Heft 53): 169. 1912, nom. nud., pro syn. [*G. lozanoi*].

Geranium austriacum Wiesb. ex R. Knuth in Engl., Pflanzenr. IV.129 (Heft 53): 130. 1912, nom. nud., pro syn. [*G. phaeum*].

Geranium austrosinense C.C. Huang, nom. nud., in sched. (PE!) [*G. ocellatum*].

Geranium ayavacense Steud. ex B.D. Jacks., Index Kew. 2: 1018. 1893, nom. inval., not accepted by its author (art. 36.1) [*G. ayavacense*].

Geranium backhousianum Boiss. ex Woronow in Kusn., N. Busch & Fomin, Fl. Cauc. Crit. 3(7): 41. 1908, nom. nud., pro syn. [*G. psilostemon*].

Geranium barcinonense Sennen, nom. nud., in sched. (BC!) [*G. robertianum*].

Geranium batrachioides Bubani ex R. Knuth in Engl., Pflanzenr. IV.129 (Heft 53): 127. 1912, nom. nud., pro syn. [*G. pratense*].

Geranium batrachioides Cav., Diss. 3: [186]. Feb 1787, nom. nud. [*G. pratense*].

Geranium batrachioides Hochst. & Steud. in Steud., Nomencl. Bot. ed. 2, 1: 677. 1840, nom. nud. [*G. endressii*].

Geranium batrachioides Hocq., Fl. Jemmape: 205. 1814, nom. inval., not accepted by its author (art. 36.1) [*G. sylvaticum*].

Geranium baumgartenianum Schur, Sert. Fl. Transs.: 16. 1853, nom. nud. [*G. dissectum*].

Geranium baumgartenianum Schur, Enum. Pl. Transsilv.: 138. 1866, nom. inval., not accepted by its author (art. 36.1) [*G. dissectum*].

Geranium berteroanum var. *philippi* (J.F. Macbr.) L.E. Navas, Fl. Cuenca Santiago Chile 2: 230. 1976, comb. superfl., ["berteranum"] [*G. skottsbergii*].

Geranium bicolor Royle, Ill. Bot. Himal. Mts.: 149. 1835, nom. inval., without description (art. 38.1) [*G. ocellatum*].

Geranium bifidum Ehrenb. ex R. Knuth in Engl., Pflanzenr. IV.129 (Heft 53): 152. 1912, nom. nud., pro syn. [*G. pyrenaicum*].

Geranium bifolium Maxim. ex B.D. Jacks., Index Kew. 2: 1018. 1893, nom. inval., not accepted by its author (art. 36.1) [*G. dahuricum*].

Geranium bifolium Turcz. ex Bobrov, Fl. U.R.S.S.: 14: 29. 1949, nom. nud., pro syn. [*G. pseudosibiricum*].

Geranium bigosa Nois. ex Steud., Nomencl. Bot. 1: 364. 1821, nom. nud.

Geranium blucher Nois. ex Steud., Nomencl. Bot. 1: 364. 1821, nom. nud.

Geranium bohemicum Krock. ex B.D. Jacks., Index Kew. 2: 1018. 1893, nom. inval., not accepted by its author (art. 36.1) [*G. divaricatum*].

Geranium bosniacum Sendtn., nom. nud., in sched. (G!) [*G. phaeum*].

Geranium brevipes L'Hér. ex DC., Prodr. 1: 639. 1824, nom. nud., pro syn. [*G. sessiliflorum*].

Geranium briceanum Sweet, Hort. Brit.: 74. 1826, nom. nud. [*G. robertianum*].

Geranium brotherusianum Trautv. ex R. Knuth in Engl., Pflanzenr. IV.129 (Heft 53): 109 (1912), nom. nud., pro syn. [*G. renardii*].

Geranium bulbosum Opiz ex Steud., Nomencl. Bot. ed. 2, 1: 677. 1840, nom. nud.

Geranium caeruleum Gilib., Fl. Lit. Inch. 2: 174. 1782, nom. inval., suppressed work (art. 34.1) [*G. pratense*].

Geranium caeruleum Lam., Encycl. 2: 654. 1788, nom. nud., pro syn. [*G. rotundifolium*].

Geranium caeruleo-purpureum Gilib., Fl. Lit. Inch. 2: 175. 1782, nom. inval., suppressed work (art. 34.1) [*G. sylvaticum*].

Geranium caespitosum var. *eremophilum* (Wooton & Standl.) W.C. Martin & C.R. Hutchins, Fl. New Mexico 1: 1121. 1980, nom. inval., combination proposed without reference to basionym (art. 41.5) [*G. caespitosum*].

Geranium caespitosum var. *fremontii* (Torr. ex A. Gray) Dorn, Vasc. Pl. Wyoming: 180, 304. 1988, nom. inval., combination proposed without reference to basionym (art. 41.5) [*G. caespitosum*].

Geranium caffroides R. Knuth, Bot. Jahrb. Syst. 32: 214. 1903, nom. nud. [*G. incanum*].

Geranium calabricum, nom. nud., in sched. (K!) [*G. asphodeloides*].

Geranium calabrum Ten., nom. nud., in sched. (NAP!) [*G. molle*].

Geranium camaense C.C. Huang in C. Y. Wu, Fl. Xizangica 3: 10. 1986, nom. inval., without type (art. 40.1).

Geranium camaense C.C. Huang in S. Y. Jin, Cat. Type Spec. Herb. China: 301. 1994. Type locality: "Xizang: Dinggyê, Cama River, alt. 4000m, in slip of rock". Type: China. Xizang, Dinggyê, Cama River, 28°18'N, 88°06'E, *Pu 826* (holotype, PE).

This species is only known from the type collected in Xizang (Dinggye Xian). According to the original description, it is similar to *G. lucidum* L. (subg. *Robertium*) but differs in having leaves and flowers glabrous. *Geranium lucidum* is a European species that reaches the W Himalayas and Nepal. It is an annual and very easy to recognize by its calyx with lengthwise keels and transverse flaps between these. Unfortunately, it has not been possible to examine the type specimen of *G. camaense*.

Geranium campestre Schangin in Pall., Neueste Nord. Beytr. Phys. Geogr. Erd-Völkerbeschreib. 6: 112. 1793, nom. nud. [*G. pseudosibiricum*].

Geranium carmineum R. Knuth in Engl., Pflanzenr. IV.129 (Heft 53): 119. 1912. Type locality: "Mexiko: Prov. Oaxaca, im Distrikt Nochistlan bei Cuauhtlilla (C. u. Ed. Seler, Pl. mexic. a. 1895 n. 1517 sub nom. G. Hernandezii DC. vel aff.? in Bull. Herb. Boiss. 2. Ser. III. [1903] 94!); bei San Miguel Quilitongo (C. et Ed. Seler, Pl. mexic. a. 1895 n. 1448! sub nom. G. mexicanum H.B.K. p.p. in Bull. Herb. Boiss. 2. Ser. III (1903) 94). Ohne Standortsangabe (Uhde n. 1190!). — Blühend und fruchtend November". Syntypes: Mexico. Oaxaca, im Distrikt Nochistlan bei Cuauhtlilla, 17°28'N, 97°14'W, 1895, *C. Seler & E. Seler 1517* (no original material located); San Miguel Quilitongo, 17°27'N, 97°10'W, 1895, *C. Seler & E. Seler 1448* (no original material located); unknown locality, *C.A. Uhde 1190* (no original material located).

The original description of *G. carmineum* fits well with *G. seemannii*; however, no original material of *G. carmineum* has been located, and the name cannot be fixed with certainty. Moore (1943: 103) also considered *G. carmineum* as a "doubtful" name.

Geranium carolinianum var. *lanuginosum* Nicolas, nom. nud., in sched. (K!) [*G. seemannii* subsp. *seemannii*].

Geranium carolinum Burm. f., Spec. Bot. Geran.: 27. 1759, [var. ortho., recorded

in Knuth's (1912) monograph & IPNI] [*G. carolinianum*].

Geranium carolinum Crantz, Inst. Rei Herb. 2: 156. 1766, [var. ortho., recorded in the IPNI] [*G. carolinianum*].

Geranium cataractarum var. *cazorlense* Pau, nom. nud., in sched. (K!, MA-71402!, FI!) [*G. cataractarum*].

Geranium catarractarum Simonk. ex Kanitz, Pl. Roman.: 28. 1879, nom. nud., pro syn.

Geranium choorense Royle, Ill. Bot. Himal. Mts.: 150. 1835, nom. inval., without description (art. 38.1) [*G. ocellatum*].

Geranium choorense var. *favosum* Hochst. ex Chiov., nom. nud., in sched. (MO-1602967!) [*G. favosum*].

Geranium choorense var. *mascatense* Boiss. ex Chiov., nom. nud., in sched. (W-9188!) [*G. mascatense*].

Geranium cinereum Boiss. & Reut. ex R. Knuth in Engl., Pflanzenr. IV.129 (Heft 53): 95. 1912, nom. nud., pro syn. [*G. subargenteum*].

Geranium cinereum subsp. *cazorlense* (Heywood) Malag., Sin. Fl. Ibér. 45: 714. 1976, nom. inval., combination proposed without reference to basionym (art. 41.5) [*G. cazorlense*].

Geranium cinereum subsp. *dolomiticum* (Rothm.) Malag., Sin. Fl. Ibér. 45: 714. 1976, nom. inval., combination proposed without reference to basionym (art. 41.5) [*G. dolomiticum*].

Geranium cinereum subsp. *subargenteum* (Lange) Borja, Anales Inst. Bot. Cavanilles 10(2): 402. 1953, nom. inval., combination proposed without reference to basionym (art. 41.5) [*G. subargenteum*].

Geranium cinereum subsp. *subargenteum* (Lange) Malag., Sin. Fl. Ibér. 717. 1976, nom. inval., combination proposed without reference to basionym (art. 41.5) [*G. subargenteum*].

Geranium cinereum var. *subacutum* (Boiss.) P.H. Davis & J. Roberts, Notes Roy. Bot. Gard. Edinburgh 22: 23. 1955, comb. superfl. [*G. subacutum*].

Geranium cinereum var. *typicum* R. Knuth in Engl., Pflanzenr. IV.129 (Heft 53): 92. 1912, nom. inval., epithet indicating the taxon containing the type of the name of the next higher-ranked taxon (art. 24.3) [*G. cinereum*].

Geranium cinereum f. *genuinum* R. Knuth in Engl., Pflanzenr. IV.129 (Heft 53): 92. 1912, nom. inval., epithet indicating the taxon containing the type of the name of the next higher-ranked taxon (art. 24.3) [*G. subcaulescens*].

Geranium clandestinum L'Hér., nom. nud., in sched. (MPU-682435!) [*Erodium sp.*].

Geranium coelestinum Schur, Enum. Pl. Transsilv.: 136. 1866, nom. nud., pro syn. [*G. caeruleatum*].

Geranium coeruleatum Schur in Nyman, Consp. Fl. Eur.: 137. 1878, var. ortho. [*G. caeruleatum*].

Geranium collinum var. *darvasicum* Kinzik. in Ovcz., Fl. Tadzhiksk. SSR 6: 687. 1981, nom. inval., without type (art. 40.1) [*G. collinum*].

Geranium coloratum C.V. Morton, nom. nud., in sched. (NY!) [*G. durangense*].

Geranium columbinum Garsault, Fig. Pl. Méd.: 181, pl. 287. 1764, nom. inval., suppressed work (art. 34.1) [*G. rotundifolium*].

Geranium columbinum var. *album* Humn. ex Nyman, Consp. Fl. Eur. Suppl. 2(1): 77. 1889, nom. nud. [*G. columbinum*].

Geranium columbinum var. *mariolense* Rigual, Fl. Alicante: 317. 1972, nom. inval., without Latin description (art. 39.1) [*G. columbinum*].

Geranium columbinum f. *corsicum* Chabert, nom. nud., in sched. (FI!) [*G. columbinum*].

Geranium columbinum f. *longiaristatum* Pau, nom. nud., in sched. (MA-71034!) [*G. columbinum*].

Geranium combretii Ludlow & Sherriff, nom. nud., in sched. (BM!).

Geranium compar R. Br. in Salt, Voy. Abyss.: lxv. 1814, nom. nud., in sched. (BM!) [*G. arabicum*].

Geranium core Kostel., Allg. Med.-Pharm. Fl.: 1900. 1836. Type locality: "Feuill. 3. t. 16) eine in Chili...". Type: Feuillée, Journal des Observationes Physiques, Mathematiques et Botaniques 3: tab. 16. 1725 (lectotype, designated by Aedo 2012: 446).

Knuth (1912) considered *G. core* a synonym of *G. rotundifolium* L. Dr. J. Hadinec kindly searched Kosteletzky's herbarium material of *Geranium* and informed me that there is no specimen at PRC that could serve as type material of *G. core* Kostel. The name is not listed in the first list of PRC holdings prepared after incorporation of Kosteletzky's herbarium. Thus, the drawing by Feuillée remains the only original element. This drawing shows a perennial species with a turnip-shaped rootstock that may be related to species allied with *G. berteroanum*; however, there is no other character that permits determination to species.

Geranium cucullatum var. *typicum* R. Knuth, Bot. Jahrb. Syst. 37: 568. 1906, nom. inval., epithet indicating the taxon containing the type of the name of the next higher-ranked taxon (art. 24.3) [*G. sibbaldioides*].

Geranium cuneatum var. *"sinclair"* R. Knuth in Engl., Pflanzenr. IV.129 (Heft 53): 217. 1912, nom. nud., pro syn. [*G. hillebrandii*].

Geranium cuneatum var. *hillebrandii* R. Knuth in Engl., Pflanzenr. IV.129 (Heft 53): 217. 1912, nom. nud. [*G. hillebrandii*].

Geranium dahuricum var. *alpinum* Bar. & Skv. in Liou & al., Clav. Pl. Chin. Bor.-orient.: 196. 1959, nom. inval., without Latin description (art. 39.1) [*G. dahuricum*].

Geranium declinatum Moench, Suppl. Meth.: 97. 1802. Type locality: [not indicated]. Type: Unknown locality and collector (no original material located). According to Stafleu & Cowan (1981: 536) the herbarium and types no longer extant.

Geranium diffusum Picard ex B.D. Jacks., Index Kew. 2: 1019. 1893, nom. inval., not accepted by its author (art. 36.1) [*G. columbinum*].

Geranium diffusum var. *genuinum* Briq., Annuaire Conserv. Jard. Bot. Genève 11-12: 189. 1908, nom. inval., epithet indicating the taxon containing the type of the name of the next higher-ranked taxon (art. 24.3) [*G. diffusum*].

Geranium diffusum var. *grandiflorum* Hieron. ex R. Knuth in Engl., Pflanzenr. IV.129 (Heft 53): 211. 1912, nom. nud., pro syn. [*G. diffusum*].

Geranium dissectum Gay ex R. Knuth in Engl., Pflanzenr. IV.129 (Heft 53): 71. 1912, nom. nud., pro syn. [*G. berteroanum*].

Geranium dissectum var. *alba* A. Huet ex Nyman, Consp. Fl. Eur. 1: 138. 1878, nom. nud., pro syn. [*G. dissectum*].

Geranium dissectum var. *baumgarteniánum* Schur ex Nyman, Consp. Fl. Eur.: 138. 1878, nom. nud. [*G. dissectum*].

Geranium dissectum var. *latilobum* Sennen, nom. nud., in sched. (BC!) [*G. dissectum*].

Geranium dissectum var. *marianica* Rivas Goday & Bellot, nom. nud., in sched. (MAF-25271!) [*G. dissectum*].

Geranium dissectum var. *nanum* Gaudin, Fl. Helv. 4: 412. 1829, nom. nud. [*G. dissectum*].

Geranium dissectum var. *procumbens* Sennen, nom. nud., in sched. (MPU!) [*G. dissectum*].

Geranium dissectum var. *tuberosum* F. Muell. ex R. Knuth in Engl., Pflanzenr. IV.129 (Heft 53): 75. 1912, nom. nud., pro syn. [*G. solanderi*].

Geranium dissectum var. *typicum* R. Knuth in Eng, Pflanzenr. IV.129 (Heft 53): 51. 1912, nom. inval., epithet indicating the taxon containing the type of the name of the next higher-ranked taxon (art. 24.3) [*G. dissectum*].

Geranium divaricatum Loisel. ex B.D. Jacks., Index Kew. 2: 1019. 1893, nom. inval., not accepted by its author (art. 36.1) [*G. bohemicum*].

Geranium divaricatum var. *tenuisectum* Sennen, Pl. Espagne 1916 n.° 2575.

1916, nom. nud., in sched. (BC-825282!) [*G. pusillum*].

Geranium donianum Hook. f. & Thomson ex Edgew. & Hook. f. in Hook. f., Fl. Brit. India 1: 431. 1874, nom. nud., pro syn. [*G. polyanthes*].

Geranium donianum Wall. ex R. Knuth in Engl., Pflanzenr. IV.129 (Heft 53): 185. 1912, nom. nud., pro syn. [*G. collinum*].

Geranium durangensis Rose ex R. Knuth in Engl., Pflanzenr. IV.129 (Heft 53): 201. 1912, nom. nud. [*G. wislizeni*].

Geranium durieui Spach, nom. nud., in sched. (LE!) [*G. rotundifolium*].

Geranium eginense Hausskn. & Sint. ex R. Knuth, Bot. Jahrb. Syst. 32: 217. 1903, nom. nud. [*G. purpureum*].

Geranium ehrenbergianum Schltdl. ex R. Knuth in Engl., Pflanzenr. IV.129 (Heft 53): 171, 620. 1912, nom. nud. [*G. bellum*].

Geranium elatum Picard ex B.D. Jacks., Index Kew. 2: 1019. 1893, nom. inval., not accepted by its author (art. 36.1) [*G. pusillum*].

Geranium emirnense Hils. & Bojer, J. Proc. Linn. Soc., Bot. 6: 6. 1862, nom. nud., pro syn. [*G. arabicum*].

Geranium emirnense Hils. & Bojer ex Hook. f., J. Proc. Linn. Soc., Bot. 7: 185. 1864, nom. nud., pro syn. [*G. arabicum*].

Geranium erectum Trautv. ex Regel, Trudy Imp. S.-Peterburgsk. Bot. Sada 5: 253. 1877, ortho. mistake; according to Bobrov (1949: 30): "calami lapsu" [*G. rectum*].

Geranium erianthum A. Gray ex R. Knuth in Engl., Pflanzenr. IV.129 (Heft 53): 181. 1912, nom. nud., pro syn. [*G. yesoense*].

Geranium erianthum Lindl. ex B.D. Jacks., Index Kew. 2: 1029. 1893, nom. inval., not accepted by its author (art. 36.1) [*G. oreganum*].

Geranium erianthum Torr. ex R. Knuth in Engl., Pflanzenr. IV.129 (Heft 53): 117. 1912, nom. nud., pro syn. [*G. oreganum*].

Geranium erianthum f. *communis* Kom., Fl. Kamtschatka 2: 294. 1929, nom. inval., epithet indicating the taxon containing the type of the name of the next higher-ranked taxon (art. 24.3) [*G. erianthum*].

Geranium erianthum f. *pallescens* Nakai, Tennenkinenbutsu Chosa Hokoku 12: 50 (1930), nom. nud. [*G. erianthum*].

Geranium eriostemon D. Don ex B.D. Jacks., Index Kew. 2: 1019. 1893, nom. inval., not accepted by its author (art. 36.1) [*G. lambertii*].

Geranium eriostemon var. *pallidum* Sweet, Geraniaceae 2, tab. 197b. 1824. *Geranium pallidum* (Sweet) Steud., Nomencl. Bot. ed. 2, 1: 679. 1840, nom. inval., not accepted by its author (art. 36.1). Type locality: "About the same time we received a plant in fine flower from Sir R.C. Hoare, who informed us that he had raised it from seeds given him by A.B. Lambert, Esq. but he knew not from whence they procured... From the habit of the plant we suspected it to be a native of Nepaul; and we have since been informed by Mr. D. Don that it is a native of that country, and specimens of it are preserved in Mr. Lambert's Herbarium". Type: Nepal? *A.B. Lambert s.n.* (no original material located).

The illustration mentioned in the protologue is a simple detail of a flower which is not enough to clarify the identity of this name. According to Sweet (1824) the plant was raised from seed given by Lambert, probably from Nepal.

Geranium eritreae R. Knuth in Engl., Pflanzenr. IV.129 (Heft 53): 61. 1912. Type locality: "Eritrea: Schlucht von Gua bei Saganeiti (Schweinfurth, Col. Eritr. a. 1892, n. 1276!)". Type: Eritrea. Schlucht von Gua bei Saganeiti, 15°03'N, 39°11'E, 1892, *G.A. Schweinfurth 1276* (no original material located).

Kokwaro (1971a: 649) indicated that he was not able to locate the type (or any other material) of *G. eritreae* in the following herbaria: BM, BR, EA, FI, K, KAW, LD, LINN, MHU, O, P, S, and UPS. Additionally, a search in B, C, E, G, L, LE, M, NY, US, W, and WU has also been negative. It is probable that it was lost during the destruction of the Berlin Herbarium during World War II. Kokwaro (1971a) suggested that *G. eritreae* may be a synonym of *G. favosum*. Gilbert & Voster (2000) considered that the description of the mericarps fits those of *G. favosum* or *G. mascatense* but the leaves are more comparable to those of *G. favosum*.

Geranium erlangerianum Engl. ex R. Knuth in Engl., Pflanzenr. IV.129 (Heft 53): 206. 1912, nom. nud., pro syn. [*G. arabicum*].

Geranium escalonense R. Knuth, Repert. Spec. Nov. Regni Veg. 34: 145. 1933. Type locality: "Bolivia: Cuesta del Escalon, Matten, 2900 m (Troll a. 1927 n. 485 — Typus in herb. Berol.!). — Blühend November". Type: Bolivia. Chuquisaca, Cuesta del Escalón, 19°28'S, 64°11'W, 1927, *C. Troll 485* (holotype, B destroyed).

The original description fits well with *G. rupicola*, except for the 2-flowered cymules. No duplicates of the holotype were located, but two specimens of *Troll 484* were found. Both were collected in "Cuesta del Escalon", but have 1-flowered cymules. The label of the specimen at B gives the date "24.11.1927" and the altitude "2900 m"; on the label of the duplicate at JE the date is "29.11.1927" and the altitude "2200 m." Because the specimen at B lacks Knuth's annotation label, it is likely that it was acquired after the destruction of the Berlin Herbarium during World War II and not seen by Knuth.

Geranium europaeum Popov ex Bobrov in Kom. & al., Fl. URSS 14: 59. 1949, nom. nud. [*G. sibiricum*].

Geranium exile Standl. ex R. Knuth, Repert. Spec. Nov. Regni Veg. 40: 220. 1936, nom. nud., pro syn. [*G. azorelloides*].

Geranium fagrigii W.M. Brooke, nom. nud., in sched. (BM!).

Geranium flexuosum E. Mey. ex R. Knuth in Engl., Pflanzenr. IV.129 (Heft 53): 165. 1912, nom. nud., pro syn. [*G. baurianum*].

Geranium foetidum Gilib., Fl. Lit. Inch. 2: 178. 1782, ["faetidum"], nom. inval., suppressed work (art. 34.1) [*G. robertianum*].

Geranium forsan Hohen., Enum. Pl. Talysch: 158. 1838, nom. inval., sine descr. (art. 38.1).

Geranium fremontii Macoun ex R. Knuth in Engl., Pflanzenr. IV.129 (Heft 53): 117. 1912, nom. nud., pro syn. [*G. oreganum*].

Geranium frigidum Hochst. ex A. Rich., Tent. Fl. Abyss. 1: 116. 1847, nom. nud., pro syn. [*G. arabicum*].

Geranium furcatum Kanitz, Linnaea 32: 567. 1864, nom. inval., not accepted by its author (art. 36.1).

Geranium furcatum Schur ex B.D. Jacks., Index Kew. 2: 1020. 1893, nom. inval., not accepted by its author (art. 36.1) [*G. dissectum*].

Geranium fusiforme Yeo, Edinburgh J. Bot. 49(2): 155. 1992, nom. nud., pro syn. [*G. rosthornii*].

Geranium gardi Sennen, nom. nud., in sched. (BC!) [*G. robertianum*].

Geranium geissei R. Knuth in Engl., Pflanzenr. IV. 129 (Heft 53): 70. 1912. Type locality: "Chile: Ohne genauere Standortsangabe (Geisse — Typus in herb. Berol.!)". Type: Chile. [without locality], *R. Geisse s.n.* (holotype, B destroyed; photos, F!, G!, GH!, NY!).

The holotype is no longer extant, and no duplicates were located. None of the Geisse collections at SGO can be associated with this name. The photographs of the holotype are not sufficiently detailed to permit accurate identification, but suggest that the name may be a synonym of *G. berteroanum*.

Geranium geminatum Ehrenb. ex R. Knuth in Engl., Pflanzenr. IV.129 (Heft 53): 97 (1912), nom. nud., in sched. [*G. tuberosum*].

Geranium gerardi André, Rev. Hort. ser. 4, 63: 350. 1891, nom. nud. [*G. psilostemon*].

Geranium grandiflorum Gilib., Fl. Lit. Inch. 2: 174. 1782, nom. inval., suppressed work (art. 34.1) [*G. sanguineum*].

Geranium grandiflorum Gueldenst., Reis. Russland 1: 426. 1787, nom. nud. [*G. ibericum*].

Geranium gratissimum Nois. ex Steud., Nomencl. Bot. 1: 364. 1821, nom. nud.

Geranium gypsum Bobrov in Kom. & al., Fl. URSS 14: 60 (1949), nom. nud. [*G. bohemicum*].

Geranium haemanthum Willd. ex Spreng., Syst. Veg. 3: 74 (1826), nom. nud., pro syn. [*G. asphodeloides*].

Geranium halepense Steud., nom. nud., in sched. (K!, FI-W-006223!, P!, W!) [*G. tuberosum*].

Geranium hastatum Rose ex R. Knuth in Engl., Pflanzenr. IV.129 (Heft 53): 194. 1912, nom. nud. [*G. hernandesii*].

Geranium heldreichii N. Taylor in L.H. Bailey, Stand. Cycl. Hort.: 1332. 1915. Type locality: [not indicated]. Type: no original material located.

Geranium hernandezii Trel. ex R. Knuth in Engl., Pflanzenr. IV.129 (Heft 53): 196. 1912, nom. nud., pro syn. [*G. mexicanum*].

Geranium herrerae R. Knuth in Herrera, Chlor. Cuzco.: 151. 1926, nom. nud. [*G. core-core*].

Geranium heterotrichon Sm. ex Royle, Ill. Bot. Himal. Mts.: 150. 1835, nom. inval., sine descr. (art. 38.1).

Geranium holosericeum var. *typicum* R. Knuth in Engl., Pflanzenr. IV.129 (Heft 53): 105. 1912, nom. inval., epithet indicating the taxon containing the type of the name of the next higher-ranked taxon (art. 24.3) [*G. holosericeum*].

Geranium humifusum R. Knuth, Bot. Jahrb. Syst. 32: 211. 1903, nom. nud. [*G. collinum*].

Geranium hungaricum Wiesb ex R. Knuth in Engl., Pflanzenr. IV.129 (Heft 53): 130. 1912, nom. nud., pro syn. [*G. phaeum*].

Geranium hydnocarpum Steud., nom. nud., in sched. (P!) [*G. favosum*].

Geranium impar R. Br. ex Steud., Nomencl. Bot. ed. 2, 1: 678. 1840, nom. nud. [*G. arabicum*].

Geranium incanum E. Mey. ex R. Knuth in Engl., Pflanzenr. IV.129 (Heft 53): 162. 1912, nom. nud., pro syn. [*G. harveyi*].

Geranium incanum var. *typicum* R. Knuth in Engl., Pflanzenr. IV.129 (Heft 53): 164. 1912, nom. inval., epithet indicating the taxon containing the type of the name of -the next higher-ranked taxon (art. 24.3) [G. incanum].

Geranium incisum Nutt. ex Torr. & A. Gray, Fl. N. Amer. 1: 206. 1838, nom. nud., pro syn. [*G. oreganum*].

Geranium intermedium Bertero ex R. Knuth in Engl., Pflanzenr. IV.129 (Heft 53): 77. 1912, nom. nud., pro syn. [*G. berteroanum*].

Geranium intricatum Gren. ex H.G. Baker, Watsonia 3(3): 161. 1955, nom. nud., pro syn. [*G. purpureum*].

Geranium javanicum Zoll., nom. nud., in sched. (P!) [*G. ardjunense*].

Geranium keiske, nom. nud., in sched. (LE!) [*G. dahuricum*].

Geranium knollii Brittinger ex Rchb., Fl. Germ. Excurs. 2: 778. 1832, nom. nud., pro syn. [*G. sylvaticum*].

Geranium laevigatum Burm. f. ex DC., Prodr. 1: 640. 1824, nom. nud., pro syn. [*G. palmatum*].

Geranium laevigatum Royle, Ill. Bot. Himal. Mts.: 150. 1835, nom. inval., without description (art. 38.1) [*G. palmatum*].

Geranium lambertii Sweet, Hort. Brit.: 492. 1826, nom. nud. [*G. lambertii*].

Geranium leucanthum Andrz. ex Trautv., Trudy Imp. S.-Peterburgsk. Bot. Sada 8: 177. 1883, nom. nud. [*G. pratense*].

Geranium linearifolium R. Knuth, Jahresber. Schles. Ges. Vaterl. Cult. 81, II. Abt. Nat. b: 17. 1904, [ortho. mistake for *G. linearilobum* R. Knuth, recorded in the IPNI] [*G. vagans*].

Geranium linearilobum R. Knuth, Bot. Jahrb. Syst. 32: 214. 1903, nom. nud. [*G. vagans*].

Geranium londetii Fisch. ex Schrank, Pl. Nov.: 67. 1828, [var. ortho., recorded in Knuth's (1912) monograph & IPNI] [*G. collinum*].

Geranium longipedatum St.-Lag. ex B.D. Jacks., Index Kew. 2: 1020. 1893, nom. inval., not accepted by its author (art. 36.1) [*G. collinum*].

Geranium lowei G. Nicholson, Ill. Dict. Gard. 4, suppl.: 548. 1888, ["lowii"]. Type locality: [not indicated]. Type: no original material located (Yeo 1973a: 328) [*G. yeoi*]

Geranium lowei Reut., nom. nud., in sched. (BM!, P!) [*G. yeoi*].

Geranium lucidum var. *opacum* Marcet, Bol. Real Soc. Esp. Hist. Nat., Secc. Biol. 51: 107. 1954, nom. inval., without Latin description (art. 39.1) [*G. lucidum*].

Geranium ludovicianum Raf., Fl. Ludov.: 89. 1817. Type locality: [not indicated]. Type: U.S.A. Louisiana (no original material located).

Rafinesque (1817: 89) translated into Latin and English a description provided by Robin (1807: 477) for an unnamed species of *Geranium*. This text is not sufficiently detailed to determine the species that Robin treated.

Geranium macrocalyx Franch., nom. nud., in sched. (P!) [*Geranium sp.*].

Geranium macrorrhizum subsp. *eu-macrorrhizum* Hayek, Repert. Spec. Nov. Regni Veg. Beih. 30: 575. 1925, nom. inval., epithet indicating the taxon containing the type of the name of the next higher-ranked taxon (art. 24.3) [*G. macrorrhizum*].

Geranium macrorrhizum var. *illyricum* Beck ex R. Knuth in Engl., Pflanzenr. IV.129 (Heft 53): 90. 1912, nom. nud., pro syn. [*G. dalmaticum*].

Geranium macrorrhizum var. *perrugosum* Rohlena, nom. nud., in sched. (BC!, BM!, K!) [*G. macrorrhizum*].

Geranium macrorrhizum var. *typicum* Şerb., Bull. Sect. Sci. Acad. Roumaine 24: 617. 1942, nom. inval., epithet indicating the taxon containing the type of the name of the next higher-ranked taxon (art. 24.3) [*G. macrorrhizum*].

Geranium maculatum Ledeb. ex R. Knuth in Engl., Pflanzenr. IV.129 (Heft 53): 122. 1912, nom. nud., pro syn. [*G. erianthum*].

Geranium maculatum var. *albiflorum* Raf., Med. Fl. 1: 217. 1828, nom. nud. [*G. maculatum*].

Geranium maculatum var. *diphyllum* Raf., Med. Fl. 1: 217. 1828, nom. nud. [*G. maculatum*].

Geranium maculatum var. *humile* Raf., Med. Fl. 1: 217. 1828, nom. nud. [*G. maculatum*].

Geranium maculatum var. *macrophyllum* Raf., Med. Fl. 1: 217. 1828, nom. nud. [*G. maculatum*].

Geranium maculatum var. *viride* Raf., Med. Fl. 1: 217. 1828, nom. nud. [*G. maculatum*].

Geranium magellanicum De Wild. ex R. Knuth in Engl., Pflanzenr. IV.129 (Heft 53): 74. 1912, nom. nud., pro syn. [*G. berteroanum*].

Geranium magellanicum var. *typicum* R. Knuth in Engl., Pflanzenr. IV.129 (Heft 53): 70. 1912, nom. inval., epithet indicating the taxon containing the type of the name of the next higher-ranked taxon (art. 24.3) [*G. magellanicum*].

Geranium magnificum Nois. ex Steud., Nomencl. Bot. 1: 364. 1821, nom. nud.

Geranium malvaceum Wahlenb. ex B.D. Jacks., Index Kew. 2: 1020. 1893. nom. inval., not accepted by its author (art. 36.1) [*G. rotundifolium*].

Geranium malvifolium Baumg. ex R. Knuth, Pflanzenr. IV.129 (Heft 53): 51. 1912, nom. nud., pro syn. [*G. dissectum*].

Geranium malvifolium Lam. ex R. Knuth in Engl., Pflanzenr. IV.129 (Heft 53): 48. 1912, nom. nud., pro syn. [*G. pusillum*].

Geranium malvifolium Schleich. ex B.D. Jacks., Index Kew. 2: 1020. 1893, nom. inval., not accepted by its author (art. 36.1) [*G. molle*].

Geranium mandonii A.W. Hill, nom. nud., in sched. (K!) [*G. weddellii*].

Geranium mascatense var. *himalaicum* (R. Knuth) Babu, Herb. Fl. Dehra Dun: 101. 1977, comb. superfl. [*G. ocellatum*].

Geranium mediterraneum var. *nigricaule* Sennen, nom. nud., in sched. (BC!) [*G. purpureum*].

Geranium melananthos Steven ex Rupr., Mém. Acad. Imp. Sci. Saint Pétersbourg ser. 7 15(2): 301. 1869, nom. nud., pro syn. [*G. pratense*].

Geranium mexicanum Fisch., C.A. Mey. & Avé-Lall. ex B.D. Jacks., Index Kew. 2: 1019. 1893, nom. inval., not accepted by its author (art. 36.1) [*G. nepalense*].

Geranium mexicanum var. *typicum* H.E. Moore, Contr. Gray Herb. 146: 36. 1943, nom. inval., epithet indicating the taxon containing the type of the name of the next higher-ranked taxon (art. 24.3) [*G. mexicanum*].

Geranium microphyllum Briq., Annuaire Conserv. Jard. Bot. Genève 11-12: 183. 1908, nom. nud. [*G. crassipes*].

Geranium minimum Picard ex B.D. Jacks., Index Kew. 2: 1020. 1893, nom. inval., not accepted by its author (art. 36.1) [*G. dissectum*].

Geranium mobile Gewez?, nom. nud., in sched. (P!) [*G. carolinianum*].

Geranium moldavicum Fisch. ex Bobrov in Kom. & al., Fl. URSS 14: 39. 1949, nom. nud., pro syn. [*G. phaeum*].

Geranium molle Gaertn., B. Mey. & Scherb. ex B.D. Jacks., Index Kew. 2: 1020. 1893, nom. inval., not accepted by its author (art. 36.1) [*G. pyrenaicum*].

Geranium molle subsp. *brutium* (Gasp.) P.H. Davis, Notes Roy. Bot. Gard. Edinburgh 28: 35. 1967, comb. superfl. [*G. molle*].

Geranium molle subsp. *normale* A. Terracc., Malpighia 4: 202. 1890, nom. inval., epithet indicating the taxon containing the type of the name of the next higher-ranked taxon (art. 24.3) [*G. molle*].

Geranium molle subsp. *stipulare* (Kunze) Dostál, Folia Mus. Rerum Nat. Bohemiae Occid., Bot. 21: 9. 1984, comb. superfl. [*G. molle*].

Geranium molle subsp. *stipulare* (Kunze) Soó, Acta Bot. Acad. Sci. Hung. 17: 125. 1972, comb. superfl. [*G. molle*].

Geranium molle var. *abortivum* (De Not. ex Ces.) Ces., Pass. & Gibelli, Comp. Fl. Ital.: 752. 1883, comb. superfl. [*G. molle*].

Geranium molle var. *caucasicum* Regel ex Woronow in Kusn., N. Busch & Fomin, Fl. Cauc. Crit. 7(3): 66. 1909, nom. nud., pro syn. [*G. molle*].

Geranium molle var. *diffusum* Ten. ex A. Terracc., Malpighia 4: 202. 1890, nom. nud. [*G. molle*].

Geranium molle var. *elatum* Ten. ex A. Terracc., Malpighia 4: 202. 1890, nom. nud. [*G. molle*].

Geranium molle var. *graecum* A. Terracc., Malpighia 4: 202. 1890, nom. nud. [*G. molle*].

Geranium molle var. *lucanum* Gasp. ex Nyman, Consp. Fl. Eur. 1: 138. 1878, nom. nud., pro syn. [*G. molle*].

Geranium molle var. *maioriflorum* Borbás, Oesterr. Bot. Z. 40: 382. 1890, nom. nud. [*G. molle*].

Geranium molle var. *maritimum* Lojac., Malpighia 20: 194. 1906, nom. nud., pro syn. [*G. molle*].

Geranium molle var. *montanum* A. Terracc., Malpighia 4: 202. 1890, nom. nud. [*G. molle*].

Geranium molle var. *supinum* Foucaud & Jousset, nom. nud., in sched. (BC!, P!) [*G. molle*].

Geranium molle var. *typicum* Posp., Fl. Oesterr. Küstenl. 2: 31. 1898, nom. inval., epithet indicating the taxon containing the type of the name of the next higher-ranked taxon (art. 24.3) [*G. molle*].

Geranium molle var. *vulcanicum* A. Terracc., Malpighia 4: 202. 1890, nom. nud. [*G. molle*].

Geranium molle f. *albiflorum* R. Uechtr., Jahresber. Schles. Ges. Vaterl. Cult. 60: 254. 1883, ["albiflora"], nom. nud. [*G. molle*].

Geranium molle f. *corymbiferum* Just. ex Christiansen, Fl. Schleswig-Holstein: 322. 1953, nom. inval., without Latin description (art. 39.1) [*G. molle*].

Geranium molle [f.] *glabrata* A. Terracc., Malpighia 4: 202. 1890, nom. inval., the rank is denoted by a misplaced term (art. 37.6) [*G. molle*].

Geranium molle [f.] *pygmaea* A. Terracc., Malpighia 4: 202. 1890, nom. inval., the rank is denoted by a misplaced term (art. 37.6) [*G. molle*].

Geranium molle [f.] *sepincola* A. Terracc., Malpighia 4: 202. 1890, nom. inval., the rank is denoted by a misplaced term (art. 37.6) [*G. molle*].

Geranium molle [f.] *tenuisecta* A. Terracc., Malpighia 4: 199-200, 202. 1890, nom. inval., the rank is denoted by a misplaced term (art. 37.6) [*G. molle*].

Geranium molle [f.] *trivialis* A. Terracc., Malpighia 4: 199-200, 202. 1890, nom. inval., the rank is denoted by a misplaced term (art. 37.6) [*G. molle*].

Geranium molle [f.] *villosissima* A. Terracc., Malpighia 4: 202. 1890, nom. inval., the rank is denoted by a misplaced term (art. 37.6) [*G. molle*].

Geranium molle [subf.] *abortiva* (De Not. ex Ces.) A. Terracc., Malpighia 4: 202. 1890, nom. inval., the rank is denoted by a misplaced term (art. 37.6) [*G. molle*].

Geranium molle [a] *triviale* A. Terracc. ex Gortani & M. Gortani, Fl. Friulana 2: 300. 1906, nom. nud. [*G. molle*].

Geranium montanum J.F. Gmel. ex B.D. Jacks., Index Kew. 2: 1020.1893, nom. inval., not accepted by its author (art. 36.1) [*G. ibericum*].

Geranium montanum J. König ex O. Müll., Nova Acta Phys.-Med. Acad. Caes. Leop.-Carol. Nat. Cur. 4: 209. 1770, nom. nud.

Geranium montanum Pourret, nom. nud., in sched. (MAF-Pourret!) [*G. dolomiticum*].

Geranium moranense Benth., nom. nud., in sched. (W!) [*G. seemannii* subsp. *seemannii*]. I have found no connection between this name and *Erodium moranense* Willd. ex Kunth in Humb., Bonpl. & Kunth, Nov. Gen. Sp. 5: 229. 1822, which is a heterotypic synonym of *E. cicutarium* (L.) L'Hér. ex Aiton.

Geranium mosquense Goldb. ex B.D. Jacks., Index Kew. 2: 1020. 1893, nom. inval., not accepted by its author (art. 36.1) [*G. robertianum*].

Geranium multiceps var. *fimbriosum* Vareschi, nom. nud., in sched. (VEN-32447!) [*G. multiceps*].

Geranium multiceps var. *glabrum* Vareschi, nom. nud., in sched. (VEN-102088!) [*G. multiceps*].

Geranium multiceps var. *pilosum* Vareschi, nom. nud., in sched. (VEN-5318!) [*G. multiceps*].

Geranium multiflorum Lang ex Schur, Oesterr. Bot. Z. 18: 317. 1868, nom. nud., pro syn. [*G. pusillum*].

Geranium multiflorum var. *typicum* R. Knuth in Engl., Pflanzenr. IV.129 (Heft 53): 219. 1912, nom. inval., epithet indicating the taxon containing the type of the name of the next higher-ranked taxon (art. 24.3) [*G. multiflorum*].

Geranium multipartitum var. *typicum* R. Knuth, Bot. Jahrb. Syst. 37: 566. 1906, nom. inval., epithet indicating the taxon containing the type of the name of the next higher-ranked taxon (art. 24.3) [*G. humboldtii*].

Geranium nanum Coss., nom. nud., in sched. (BR-0000013347079 image!, FI!, G-00018762!, K-000417201!, LE!, MPU-009258!, P-00084486!, Z) [*G. nanum*].

Geranium napellifolium Schur, Enum. Pl. Transsilv.: 136. 1866, nom. nud., pro syn. [*G. pratense*].

Geranium nasirii Y.J. Nasir, Pakistan J. Bot. 14(Abs.): 46. 1982, nom. nud.

Geranium navieri Jord. ex Gren., nom. nud., in sched. (P!) [*G. dissectum*].

Geranium nebrodense Tineo, nom. nud., in sched. (RO!) [*G. pyrenaicum* subsp. *pyrenaicum*].

Geranium neesianum Carolin in Jessop, List Vasc. Pl. South Australia: 35. 1983, nom. nud. [*G. retrorsum*].

Geranium nemorale var. *bicknellii* (Britton) Fernald, Rhodora 43: 35. 1941, comb. superfl., includes the type of a name that ought to have been adopted under

the rules (art. 52.1), but it has a basionym (art. 52.4) [*G. bicknellii*].

Geranium neopumilum Aedo & Muñoz Garm., Kew Bull. 52(3): 726. 1997. *Geranium pumilum* R. Knuth in Engl., Pflanzenr. IV. 129 (Heft 53): 88. 1912, non (Willd.) Poiret, 1812. Type locality: "Ecuador: Páramos del Cerro Antisana, 4056 m (Stuebel, Fl. Aeq. a. 1871 n. 185e — Typus in Herb. Berlin!).— Blüh. Oktober". Type: Ecuador. Pichincha, páramos del Cerro Antisana, 0°30'S, 78°10'W, 1871, *A. Stuebel 185e* (holotype, B destroyed).

The original description does not permit a conclusive interpretation of this taxon. The type was collected at the same locality as that of *G. antisanae*, and date and altitude are also the same. Knuth's description fits with *G. antisanae*, except for the glabrous leaves.

Geranium neapolitanum Nyman, Consp. Fl. Eur. Suppl. 1: 949. 1884, nom. nud., pro syn. [*G. pratense*].

Geranium nepalense f. *albiflora* T.H. Chung ex W.T. Lee, J. Korean Pl. Taxon. 12(2): 85. 1982, nom. inval., without type (art. 40.1) [*G. thunbergii*].

Geranium neglectum Kar. & Kir., nom. nud., in sched. (LE!) [*G. collinum*].

Geranium nodosum Eichw. ex R. Kunth in Engl., Pflanzenr. IV. 129 (Heft 53): 190. 1912. nom. nud., pro syn. [*G. gracile*].

Geranium novum Winterl, Index Hort. Bot. Univ. Hung. without page number, fig. 2. 1788, nom. inval., word not intended as a specific epithet (art. 23.6) [*G. divaricatum*].

Geranium ocellatum var. angustisectum Engl. ex R. Knuth in Engl., Pflanzenr. IV.129 (Heft 53): 207. 1912, nom. nud., pro syn., in sched. [*G. vagans*].

Geranium occitanum Batt. & Pit. in Pit., Contr. Fl. Atl.: 15. 1919, [var. ortho., recorded in the IPNI] [*G. cataractarum*].

Geranium ornatum A. Nelson ex R. Knuth in Engl., Pflanzenr. IV.129 (Heft 53): 117. 1912, nom. nud., pro syn. [*G. viscosissimum*].

Geranium pallidum Royle in Hook. f., Fl. Brit. India 1: 431. 1874, nom. nud., pro syn. [*G. nepalense*].

Geranium palmatum Cav., Diss. 3: [186]. 1787, nom. nud. [Feb. 1787] [*G. palmatum*].

Geranium palmatum Picard ex B.D. Jacks., Index Kew. 2: 1020. 1893, nom. inval., not accepted by its author (art. 36.1) [*G. dissectum*].

Geranium palustre Edgew. & Hook. f. ex R. Knuth in Engl., Pflanzenr. IV.129 (Heft 53): 128. 1912, nom. nud., pro syn. [*G. saxatile*].

Geranium palustre Thunb. ex R. Knuth in Engl., Pflanzenr. IV.129 (Heft 53): 192. 1912. nom. nud., pro syn. [*G. thunbergii*].

Geranium palustre var. *minus* Ledeb. ex R. Knuth in Engl., Pflanzenr. IV.129 (Heft 53): 176, 1912, nom. nud., pro syn. [*G. palustre*].

Geranium panormitanum Lojac., nom. nud., in sched. (FI!) [*G. molle*].

Geranium partitum Willd. ex Kunth in Humb., Bonpl. & Kunth, Nov. Gen. Sp. 5: 231. 1822, nom. nud., pro syn. [*G. ayavacense*].

Geranium parvulum Ten. ex R. Knuth in Engl., Pflanzenr. IV.129 (Heft 53): 59. 1912, nom. nud. [*G. molle*].

Geranium patens Royle in Hook. f., Fl. Brit. India 1: 431. 1874, nom. nud., pro syn. [*G. nepalense*].

Geranium patulum Sol. in G. Forst., Fl. Ins. Austr.: 91. 1786, nom. nud. [*G. retrorsum*].

Geranium pedatum Raf., Herb. Raf.: 60. 1833, nom. nud.

Geranium pedatum Raf., New Fl. 2: 34. 1837. Type locality: "Glades and Prairies of West Kentucky and Illinois". Type: U.S.A. West Kentucky and Illinois (no original material located).

Geranium pedunculatum Royle, Ill. Bot. Himal. Mts.: 150. 1835, nom. inval., sine descr. (art. 38.1).

Geranium perrugosum Borbás ex Kanitz, Pl. Roman.: 28. 1879, nom. nud.

Geranium persianum Pau, nom. nud., in sched. (BC-12682!) [*G. mascatense*].

Geranium persicum Pau, nom. nud., in sched. (MA-71303!) [*G. mascatense*].

Geranium phaeum Sebast. & Mauri ex B.D. Jacks., Index Kew. 2: 1020. 1893, nom. inval., not accepted by its author (art. 36.1) [*G. reflexum*].

Geranium phaeum Siev. ex B.D. Jacks., Index Kew. 2: 1020. 1893, nom. inval., not accepted by its author (art. 36.1) [*G. platyanthum*].

Geranium phaeum subsp. *normale* A. Terracc., Malpighia 4: 219. 1890, nom. inval., epithet indicating the taxon containing the type of the name of the next higher-ranked taxon (art. 24.3) [*G. phaeum*].

Geranium phaeum var. *vulgatius* DC., Prodr. 1: 641. 1824, nom. inval., epithet indicating the taxon containing the type of the name of the next higher-ranked taxon (art. 24.3) [*G. phaeum*].

Geranium phaeum subvar. *genuinum* Rouy in Rouy & Foucaud, Fl. France 4: 82. 1897, nom. inval., epithet indicating the taxon containing the type of the name of the next higher-ranked taxon (art. 24.3) [*G. phaeum*].

Geranium phaeum f. *austriacum* Wiesb., Natur Offenbarung 41: 636. 1895, nom. inval., not accepted by its author (art. 36.1) [*G. phaeum*].

Geranium phaeum f. *hungaricum* Wiesb., Natur Offenbarung 41: 636. 1895, nom. inval., not accepted by its author (art. 36.1) [*G. phaeum*].

Geranium phaeum [f.] *baldensis* A. Terracc., Malpighia 4: 219. 1890, nom. nud. [G. phaeum].

Geranium phaeum [f.] *gallica* A. Terracc., Malpighia 4: 219. 1890, nom. nud. [*G. phaeum*].

Geranium phaeum [f.] *helvetica* A. Terracc., Malpighia 4: 219. 1890, nom. nud. [*G. phaeum*].

Geranium phaeum [f.] *pyrenaica* A. Terracc., Malpighia 4: 219. 1890, nom. nud. [*G. phaeum*].

Geranium phaeum [subf.] *fuscum* (L.) A. Terracc., Malpighia 4: 219. 1890, nom. inval., the rank is denoted by a misplaced term (art. 37.6) [*G. phaeum*].

Geranium phaeum [subf.] *patula* (Vill.) A. Terracc., Malpighia 4: 219. 1890, nom. inval., the rank is denoted by a misplaced term (art. 37.6) [*G. phaeum*].

Geranium phaeum [subf.] *planipetalum* (Chaix) A. Terracc., Malpighia 4: 219. 1890, nom. inval., the rank is denoted by a misplaced term (art. 37.6) [*G. phaeum*].

Geranium phaeum [*] *lividum* (L'Hér.) Pers., Syn. Pl. 2: 235. 1806, nom. inval.?, see Greuter (1968: 92) [*G. phaeum*].

Geranium pilgerianum R. Knuth in Engl., Pflanzenr. IV. 129 (Heft 53): 106. 1912. Type locality: "Columbien, bei Cundinamarca: Páramo de Pasca, 3700-3800 m (Stuebel n. 146 p. p.)". Type: Colombia. Cundinamarca, Páramo de Pasca, 4°18'N, 74°18'W, *A. Stuebel 146 p.p.* (holotype, B destroyed; photos, F!, G!, GH!, NY!).

Neither the photograph of the type nor the original description permit a conclusive interpretation of this taxon; the two fragments shown in the photo do not display clearly the diagnostic inflorescence characters. No other collection from Páramo de Pasca seen during this study could be assigned to *G. pilgerianum.*

Geranium pilosum Sol. in G. Forst., Fl. Ins. Austr.: 91. 1786, nom. nud. [*G. solanderi*].

Geranium pinetophilum R. Knuth, Notizbl. Bot. Gart. Berlin-Dahlem 14: 352. 1939. Type locality: "Nanga-Parbat-Gebiet, Rakhiot-Tal: Nadelwälder, den Unterwuchs, Beherrschend, 3300 m (blühend 29. Juni 1937 — C. Troll n. 7637, Typus!); Jalipur-Tal: Nadelwälder, 2800-3200 m (blühend 1. Juli 1937 — C. Troll n. 7678); Rupal-Tal: Tarshing, steinige Triften im bewässerten Land, 2900 m (blühend 11. Juni 1937 — C. Troll n. 7388)". Type: Pakistan. Nanga-Parbat-Gebiet, Rakhiot-Tal, 35°15'N, 74°35'E, 29 June 1937, *C. Troll 7637* (holotype, B destroyed).

Geranium pinnatifidum Picard ex B.D. Jacks., Index Kew. 2: 1021. 1893, nom.

inval., not accepted by its author (art. 36.1) [*G. rotundifolium*].

Geranium platypetalum Fisch. & C.A. Mey. ex Hohen., Bull. Soc. Imp. Naturalistes Moscou 6: 246. 1833, nom. nud. [*G. platypetalum*].

Geranium platyrenifolium Z.M. Tan, Bull. Bot. Res., Harbin 6(2): 52, 61 tab. 4. 1986. Type locality: "Sichuan: Muli, Hetaowan, June 28, 1978, Muli Exped. 260 (Type, fl. ICD)". Type: China. Sichuan, Muli, Hetaowan, 27º25'N, 102º30'E, 28 June 1978, *Muli Exped. 260* (holotype, SM).

According the original description this species has roots bearing one or two tubers at distances up to several cm from their origin, opposite leaves deeply divided, free stipules, cymules 2-flowered, petals 15-18 mm long with rounded apex and hairy base, and eglandular indumentum. It is found in meadows of SW Sichuan. Unfortunately, it has been not possible to examine any specimen belonging to this species.

Geranium potentilloides Bonpl. ex Wedd., Chlor. Andina 2: 284. 1861, nom. nud., pro syn. [*G. humboldtii*].

Geranium potentilloides Willd. ex Spreng., Syst. Veg. 3: 70. 1826, nom. nud., pro syn. [*G. humboldtii*].

Geranium potentilloides var. *alpestre* Ridl. in G.S. Hope, Equatorial Glaciers New Guinea: 161. 1976, nom. inval., combination proposed without reference to basionym (art. 41.5) [*G. papuanum*].

Geranium praealpinum Beck, Fl. Nieder-Österreich. 2: 560. 1892, nom. nud., pro syn. [*G. sylvaticum*].

Geranium pratense Jinuma ex R. Knuth in Engl., Pflanzenr. IV.129 (Heft 53): 181. 1912, nom. nud., pro syn. [*G. soboliferum*].

Geranium pratense subsp. *stewartianum* Y.J. Nasir, Fl. Pakistan 149: 18 fig. 4, 19. 1983. *Geranium pratense* var. *stewartianum* Y.J. Nasir, Fl. Pakistan 149: 21. 1983. Type locality: "Tilel Vy., ± 9000', R.R. & I.D. Stewart 18569 (holo. RAW), as to left hand specimen only". Type: Pakistan. Tilel Vy., 35°36'N, 75°00'E, *R.R. Stewart & I.D. Stewart 18569* (holotype, RAW, now at KUH, fragment image!).

The fragment examined does not permit a conclusive identification.

Geranium pratense subsp. *typicum* Woronow ex R. Knuth in Engl., Pflanzenr. IV.129 (Heft 53): 128. 1912, nom. nud., pro syn. [*G. pratense*].

Geranium pratense var. *affine* (Ledeb.) C.C. Huang & L.R. Xu, Fl. Reipub. Pop. Sin. 43(1): 59. 1998, comb. superfl. [*G. pratense*].

Geranium pratense var. *albiflorum* Opiz, Seznam: 47. 1852, nom. nud. [*G. pratense*].

Geranium pratense var. *laciniatum* Ten., Index Sem. Hort. Bot. Neapol.: 4. 1825, nom. nud. [*G. pratense*].

Geranium pratense var. *napellifolium* Schur ex Nyman, Consp. Fl. Eur.: 137. 1878, nom. nud. [*G. pratense*].

Geranium pratense var. *parviflorum* Opiz, Seznam: 47. 1852, nom. nud. [*G. pratense*].

Geranium pratense var. *semiplenum* Lindm., Bot. Soc. Exch. Club Brit. Isles 7: 765. 1925, nom. nud. [*G. pratense*].

Geranium pratense var. *typicum* Krylov in Serg., Sist. Zametki Mater. Gerb. Krylova Tomsk. Gosud. Univ. Kujbyševa 1: 3. 1934, nom. inval., epithet indicating the taxon containing the type of the name of the next higher-ranked taxon (art. 24.3) [*G. pratense*].

Geranium pratense f. *lanigera* Coste ex Sennen, Pl. Espagne 1916 n.° 2572. 1916, nom. nud., in sched. (BC-12444!, BM!, MA!, MAF-58797!, MAF-58795!) [*G. pratense*].

Geranium proximum Bertero ex Steud., Nomencl. Bot. ed. 2, 1: 679. 1840, nom. inval., without description (art. 38.1) [*G. berteroanum*].

Geranium pseudosibiricum Maxim. ex B.D. Jacks., Index Kew. 2: 1021. 1893, nom. inval., not accepted by its author (art. 36.1) [*G. dahuricum*].

Geranium pseudosibiricum var. *typicum* Regel, Tent. Fl.-Ussur.: 41. 1861, nom. inval., epithet indicating the taxon containing the type of the name of the next higher-ranked taxon (art. 24.3) [*G. pseudosibiricum* J. Mayer].

Geranium pseudotuberosum Boiss. & Reuter, nom. nud., in sched. (P!) [*G. malviflorum*].

Geranium pseudovillosum Schur, Enum. Pl. Transsilv. 921. 1866, ["pseudo-villosum"], nom. nud., pro syn. [*G. molle*].

Geranium ptychocarpum Hochst., nom. nud., in sched. (RO!, S!).

Geranium pubescens Willd. in Humb., Bonpl. & Kunth, Nov. Gen. Sp. 5: 231. 1822, nom. nud., pro syn. [*G. chilloense*].

Geranium pumilum R. Knuth in Engl., Pflanzenr. IV.129 (Heft 53): 88. 1912, nom. illeg., non (Willd.) Poir. 1812. *Geranium neopumilum* Aedo & Muñoz Garm., Kew Bull. 52(3): 726. 1997. Type locality: "Ecuador: Páramos del Cerro Antisana, 4056 m (Stuebel, Fl. Aeq. a. 1871 n. 185e — Typus in Herb. Berlin!).— Blüh. Oktober". Type: Ecuador. Páramos del Cerro Antisana, 0°30'S, 78°10'W, 1871, *A. Stuebel 185e* (holotype, B destroyed).

The original description does not permit a conclusive interpretation of this taxon. The type was collected at the same locality as that of *G. antisanae*, and date and altitude are also the same. Knuth's description fits with *G. antisanae*, except for the glabrous leaves.

Geranium purpureum Boucher ex R. Knuth in Engl., Pflanzenr. IV. 129 (Heft 53): 67. 1912, nom. nud., pro syn. [*G. purpureum*].

Geranium purpureum Gilib., Fl. Lit. Inch. 2: 175. 1782, nom. inval., suppressed work (art. 34.1) [*G. palustre*].

Geranium purpureum var. *genuinum* Rouy in Rouy & Foucaud, Fl. France 4: 97. 1897, nom. inval., epithet indicating the taxon containing the type of the name of the next higher-ranked taxon (art. 24.3) [*G. purpureum*].

Geranium purpureum var. *minutiflorum* (Jord.) Rouy in Rouy & Foucaud, Fl. France 4: 98. 1897, comb. superfl. [*G. purpureum*].

Geranium purpureum var. *minutiflorum* (Jord.) Murb., Acta Univ. Lund. 27(5): 151.1891, comb. superfl. [*G. purpureum*].

Geranium purpureum var. *modestum* (Jord. ex Fourr.) Rouy in Rouy & Foucaud, Fl. France 4: 97. 1897, comb. superfl. [*G. purpureum*].

Geranium purpureo-caeruleum Gilib. ex Ledeb., Fl. Ross. 1(2): 465. 1842, nom. nud., pro syn. sphalm. [*G. sylvaticum*].

Geranium pusillulum A.M. Jiménez, Fl. Cochabamba: 178. 1984, nom. inval., without Latin description (art. 39.1).

Geranium pusillum Labram & Hegetschw. ex R. Knuth, Pflanzenr. IV.129 (Heft 53): 51. 1912, nom. nud., pro syn. [*G. dissectum*].

Geranium pusillum subsp. *normale* A. Terracc., Malphigia 4: 212. 1890, nom. inval., epithet indicating the taxon containing the type of the name of the next higher-ranked taxon (art. 24.3) [*G. pusillum*].

Geranium pusillum var. *affine* Bertero ex R. Knuth in Engl., Pflanzenr. IV.129 (Heft 53): 76. 1912, nom. inval., not accepted by its author (art. 36.1) [*G. core-core*].

Geranium pusillum var. *albiflorum* Opiz, Seznam: 47. 1852, nom. nud. [*G. pusillum*].

Geranium pusillum var. *album* Lindm., Bot. Soc. Exch. Club Brit. Isles 7: 766. 1925, nom. nud. [*G. pusillum*].

Geranium pusillum var. *humile* (Cav.) Steud., Nom. 1: 365. 1821, comb. superfl. [*G. pusillum*].

Geranium pusillum var. *humile* (Cav.) DC., Prodr. 1: 643. 1824, comb. superfl. [*G. pusillum*].

Geranium pusillum var. *humile* (Cav.) A. Terracc., Malphigia 4: 212. 1890, comb. superfl. [*G. pusillum*].

Geranium pusillum f. *humile* Bueck ex Prahl, Krit. Fl. Schlesw.-Holst. 2: 37. 1889, nom. nud., pro syn. [*G. pusillum*].

Geranium pusillum [f.] *major* A. Terracc., Malphigia 4: 212. 1890, nom. inval., the

rank is denoted by a misplaced term (art. 37.6) [*G. pusillum*].

Geranium pusillum [f.] *minor* A. Terracc., Malphigia 4: 212. 1890, nom. inval., the rank is denoted by a misplaced term (art. 37.6) [*G. pusillum*].

Geranium pusillum [subf.] *humifusa* A. Terracc., Malphigia 4: 212. 1890, nom. inval., the rank is denoted by a misplaced term (art. 37.6) [*G. pusillum*].

Geranium pusillum [α] *genuinum* Graebn. in Asch. & Graebn., Syn. Mitteleur. Fl. 7(1): 41. 1913, nom. inval., epithet indicating the taxon containing the type of the name of the next higher-ranked taxon (art. 24.3) [*G. pusillum*].

Geranium pyrenaicum Bubani ex R. Knuth in Engl., Pflanzenr. IV.129 (Heft 53): 152. 1912, nom. nud., pro syn. [*G. pyrenaicum*].

Geranium pyrenaicum subsp. *normale* A. Terracc., Malpighia 4: 211. 1890, nom. inval., epithet indicating the taxon containing the type of the name of the next higher-ranked taxon (art. 24.3) [*G. pyrenaicum*].

Geranium pyrenaicum var. *diffusum* Ten. ex A. Terracc., Malpighia 4: 211. 1890, nom. nud., pro syn.

Geranium pyrenaicum var. *grandiflorum* Schur, Verh. Naturf. Vereins Brünn 15: 161. 1877, nom. nud. [*G. pyrenaicum*].

Geranium pyrenaicum var. *heterotrichum* Sennen, nom. nud., in sched. (PH!) [*G. pyrenaicum*].

Geranium pyrenaicum var. *malvaceum* Beauverd, Bull. Soc. Bot. Genève 11: 138. 1920, nom. nud. [*G. pyrenaicum*].

Geranium pyrenaicum var. *minae* (Tineo) A. Terracc., Malpighia 4: 211. 1890, comb. superfl. [*G. pyrenaicum*].

Geranium pyrenaicum var. *parviflorum* Schur, Verh. Naturf. Vereins Brünn 15: 161. 1877, nom. nud. [*G. pyrenaicum*].

Geranium pyrenaicum var. *subtrilobum* G. Camus, nom. nud., in sched. (P!) [*G. pyrenaicum*].

Geranium pyrenaicum var. *trilobum* G. Camus & fr. Adorateur-Henri, nom. nud., in sched. (P!) [*G. pyrenaicum*].

Geranium pyrenaicum var. *typicum* Woronow in Kusn., N. Busch & Fomin, Fl. Cauc. Crit. 3(7): 56. 1908, nom. inval., epithet indicating the taxon containing the type of the name of the next higher-ranked taxon (art. 24.3) [*G. pyrenaicum*].

Geranium pyrenaicum var. *velutinum* Buhse, Aufzähl. Transkauk.: 48. 1860, nom. nud. [*G. pyrenaicum*].

Geranium pyrenaicum [f.] *algeriensis* A. Terracc., Malpighia 4: 211. 1890, nom. inval., the rank is denoted by a misplaced term (art. 37.6) [*G. pyrenaicum*].

Geranium pyrenaicum [f.] *maior* A. Terracc., Malpighia 4: 211. 1890, nom. inval., the rank is denoted by a misplaced term (art. 37.6) [*G. pyrenaicum*].

Geranium pyrenaicum [f.] *minor* A. Terracc., Malpighia 4: 208. 1890, nom. inval., the rank is denoted by a misplaced term (art. 37.6) [*G. pyrenaicum*].

Geranium pyrenaicum [f.] *sicula* A. Terracc., Malpighia 4: 211. 1890, nom. inval., the rank is denoted by a misplaced term (art. 37.6) [*G. pyrenaicum*].

Geranium pyrenaicum [a] *typicum* Woronow ex Graebn. in Asch. & Graebn., Syn. Mitteleur. Fl. 7(1): 33. 1913, nom. inval., epithet indicating the taxon containing the type of the name of the next higher-ranked taxon (art. 24.3) [*G. pyrenaicum*].

Geranium raimondii R. Knuth, Repert. Spec. Nov. Regni Veg. 28: 9. 1930. *Geranium canescens* Wedd., Chlor. Andina 2: 286. 1861, nom. illeg., non L'Hér. ex Aiton, 1789. Type locality: "Hab. Pérou: Cordillères centrales, entre Cajamarca et Chachapoyas !, au-dessus de 3600 mètres (Raimondi)". Type: Peru. Cajamarca-Amazonas, Cordillères centrales, entre Cajamarca et Chachapoyas, 1861, *A. Raimondi s.n.* (lectotype, designated by Aedo 2012: 449: P!).

The lectotype is the only original material that could be located. It is a fragment that cannot be determined to species but may belong to one of the taxa allied with *G. diffusum*.

Geranium reflexum var. *latisepalum*, nom. nud., in sched. (SOM!) [*G. reflexum*].

Geranium reflexum var. *subreflexum* A. Terracc., Malpighia 4: 219. 1890, nom. nud. [*G. reflexum*].

Geranium reflexum [f.] *catriensis* A. Terracc., Malpighia 4: 219. 1890, nom. nud. [*G. reflexum*].

Geranium reflexum [f.] *graeca* A. Terracc., Malpighia 4: 219. 1890, nom. nud. [*G. reflexum*].

Geranium reflexum [f.] *serbica* A. Terracc., Malpighia 4: 219. 1890, nom. nud. [*G. reflexum*].

Geranium richardsonii S. Watson ex R. Knuth in Engl., Pflanzenr. IV.129 (Heft 53): 118. 1912, nom. nud., pro syn. [*G. viscosissimum*].

Geranium rivale Vill., Hist. Pl. Dauphiné 3, pl. 40. 1789, [ortho. mistake for *G. rivulare* Vill., recorded in the IPNI] [*G. rivulare*].

Geranium robertianum subsp. *eurobertianum* Briq., Prodr. Fl. Corse 2(2): 10. 1936, nom. inval., epithet indicating the taxon containing the type of the name of the next higher-ranked taxon (art. 24.3) [*G. robertianum*].

Geranium robertianum subsp. *purpureum* (Vill.) Murb., Contr. Fl. Nord-Ouest Afrique 1: 52. 1897, comb. superfl. [*G. purpureum*].

Geranium robertianum var. *albo* Gaudin ex R. Knuth in Engl., Pflanzenr. IV. 129 (Heft 53): 626. 1912, nom. nud. [*G. robertianum*].

Geranium robertianum var. *album* Weston, Bot. Univ. 2: 352. 1771. Type locality: [not indicated]. Type: Unknown locality and collector. According to Stafleu & Cowan 1988: 216, the herbarium and types of Weston are unknown [*G. robertianum*].

Geranium robertianum var. *alpinum* Gaudin, Fl. Helv. 4: 417. 1829, nom. nud. [*G. robertianum*].

Geranium robertianum var. *baeticum* Gand. & E. Rev., nom. nud., in sched. (MA-71403!, P!) [*G. robertianum*].

Geranium robertianum var. *bernettii* A.F. Schwarz ex Gams in Hegi, Ill. Fl. Mitt.-Eur. 4(3): 1714. 1924. Type locality: [not indicated]. Type: Unknown locality and collector (no original material located) [*G. robertianum*].

Geranium robertianum var. *genuinum* Godr. in Gren. & Godr., Fl. France 1: 306. 1847, nom. inval., epithet indicating the taxon containing the type of the name of the next higher-ranked taxon (art. 24.3) [*G. robertianum*].

Geranium robertianum var. *grandiflorum* Strobl, Oesterr. Bot. Z. 36: 93. 1886, nom. nud. [*G. robertianum*].

Geranium robertianum var. *latisectum* Schur, Verh. Naturf. Vereins Brünn 15: 163. 1877, nom. nud., pro syn. [*G. robertianum*].

Geranium robertianum var. *leucanthon* Dumort., Fl. Belg.: 112. 1827, nom. nud. [*G. robertianum*].

Geranium robertianum var. *littorale* Pylaie, nom. nud., in sched. (P!) [*G. robertianum*].

Geranium robertianum var. *lucidum* Weston, Bot. Univ. 2: 352. 1771. Type locality: [not indicated]. Type: Unknown locality and collector. According to Stafleu & Cowan (1988: 216) the herbarium and types of Weston are unknown. [*G. robertianum*].

Geranium robertianum var. *minutiflorum* (Jord.) Strobl, Oesterr. Bot. Z. 36: 93. 1886, comb. superfl. [*G. purpureum*].

Geranium robertianum var. *purpureum* Mill. ex Nyman, Consp. Fl. Eur.: 138. 1878. nom. nud. [*G. purpureum*].

Geranium robertianum var. *purpureum* Schur, Verh. Naturf. Vereins Brünn 15: 163. 1877, nom. nud., pro syn. [*G. purpureum*].

Geranium robertianum var. *purpureum* (Vill.) Pauquy, Statist. Bot. Somme: 76. 1831, comb. superfl. [*G. purpureum*].

Geranium robertianum var. *romanum* A. Terrac., nom. nud., in sched. (MPU!, PH!) [*G. robertianum*].

Geranium robertianum var. *rubens* Weston, Bot. Univ. 2: 352. 1771. Type

LOCALITY: [not indicated]. TYPE: Unknown locality and collector. According to Stafleu & Cowan (1988: 216), the herbarium and types of Weston are unknown. [*G. robertianum*].

Geranium robertianum var. *scopulicolum* Jord. ex Nyman, Consp. Fl. Eur.: 138. 1878, nom. nud. [*G. purpureum*].

Geranium robertianum var. *tenuisectum* Schur, Verh. Naturf. Vereins Brünn 15: 163. 1877, nom. nud., pro syn. [*G. robertianum*].

Geranium robertianum var. *terebinthinaceum* Schur, Enum. Pl. Transsilv.: 138. 1866, nom. nud., pro syn. [*G. robertianum*].

Geranium robertianum var. *typicum* Beck, Fl. Nieder-Österreich.: 561. 1892, nom. inval., epithet indicating the taxon containing the type of the name of the next higher-ranked taxon (art. 24.3) [*G. robertianum*].

Geranium robertianum subvar. *leucanthum* Maire, nom. nud., in sched. (MPU!) [*G. robertianum*].

Geranium robertianum f. *adenophorum* R. Keller ex Gams in Hegi, Ill. Fl. Mitt.-Eur. 4(3): 1714. 1924. TYPE: Unknown locality and collector (no original material located) [*G. robertianum*].

Geranium robertianum f. *albidum* Wiesb. ex Murr, Neu. Übers. Bl.-Pfl. Vorarlberg: 186. 1923, nom. inval., without description (art. 38.1) [*G. robertianum*].

Geranium robertianum f. *denserugosum* Strobl, Oesterr. Bot. Z. 36: 93. 1886, nom. nud. [*G. purpureum*].

Geranium robertianum f. *euodoratum* Borza, Bul. Grăd. Bot. Univ. Cluj 25: 260. 1945, ["eu-odoratum"], nom. inval., epithet indicating the taxon containing the type of the name of the next higher-ranked taxon (art. 24.3) [*G. robertianum*].

Geranium robertianum f. *glabrescens* A. Blytt, nom. nud., in sched. (COI!) [*G. robertianum*].

Geranium robertianum f. *glabrum* R. Knuth in Engl., Pflanzenr. IV. 129 (Heft 53): 67. 1912, ["glabra"], nom. nud., pro syn. [*G. robertianum*].

Geranium robertianum f. *gracile* Stäge ex Gams in Hegi, Ill. Fl. Mitt.-Eur. 4(3): 1714. 1924. TYPE LOCALITY: [not indicated]. TYPE: Unknown locality and collector (no original material located) [*G. robertianum*].

Geranium robertianum f. *inciso-pallens* Stäge ex Gams in Hegi, Ill. Fl. Mitt.-Eur. 4(3): 1714. 1924. TYPE LOCALITY: [not indicated]. TYPE: Unknown locality and collector (no original material located) [*G. robertianum*].

Geranium robertianum f. *inciso-rubrum* Stäge ex Gams in Hegi, Ill. Fl. Mitt.-Eur. 4(3): 1714. 1924. TYPE LOCALITY: [not indicated]. TYPE: Unknown locality and collector (no original material located) [*G. robertianum*].

Geranium robertianum f. *parcerugosum* Strobl, Oesterr. Bot. Z. 36: 93. 1886, nom. nud. [*G. purpureum*].

Geranium robertianum f. *robusta* R. Knuth in Engl., Pflanzenr. IV. 129 (Heft 53): 626. 1912, nom. nud. [*G. robertianum*].

Geranium robertianum f. *rubescens* Rouy ex R. Knuth in Engl., Pflanzenr. IV. 129 (Heft 53): 67. 1912, nom. nud. [*G. purpureum*].

Geranium robertianum [f.] *purpureum* (Vill.) Rouy in Rouy & Foucaud, Fl. France 4: 96. 1897, nom. inval., the rank is denoted by a misplaced term (art. 37.6) [*G. purpureum*].

Geranium roivania Nois. ex Steud., Nomencl. Bot. 1: 365. 1821, nom. nud.

Geranium romanum [?] *versicolor* John Parkinson. ex R. Knuth in Engl., Pflanzenr. IV.129 (Heft 53): 189. 1912. nom. nud., pro syn. [*G. versicolor*].

Geranium roseo-caeruleis Gilib., Fl. Lit. Inch. 2: 176. 1782, nom. inval., suppressed work (art. 34.1) [*G. columbinum*].

Geranium roseum L'Hér. ex Dum. Cours., Bot. Cult. ed. 2, 5: 38. 1811, nom. nud.

Geranium roseum L'Hér. ex Steud., Nomencl. Bot. 1: 365. 1821, nom. nud. [*G. reflexum*].

Geranium rotundifolium Gay ex R. Knuth, in Engl., Pflanzenr. IV.129 (Heft 53): 76. 1912, nom. nud., pro syn. [*G. core-core*].

Geranium rotundifolium Ledeb. ex B.D. Jacks., Index Kew. 2: 1021. 1893, nom. inval., not accepted by its author (art. 36.1) [*G. sibiricum*].

Geranium rotundifolium Pollich ex B.D. Jacks., Index Kew. 2: 1021. 1893, nom. inval., not accepted by its author (art. 36.1) [*G. pusillum*].

Geranium rotundifolium var. *arenicolum* Sennen, Pl. Espagne n.° 3667. 1918, nom. nud., in sched. (BC-12583!, BM!, MA-71154!, W!) [*G. rotundifolium*].

Geranium rotundifolium var. *davidovii*, nom. nud., in sched. (SOM!) [*G. rotundifolium*].

Geranium rotundifolium var. *elongatum* Sennen, Pl. Espagne n.° 2993. 1917, nom. nud., in sched. (BC-12587, MA-71155!, K!, W!) [*G. rotundifolium*].

Geranium rotundifolium var. *genuinum* Rouy in Rouy & Foucaud, Fl. France 4: 91. 1897, nom. inval., epithet indicating the taxon containing the type of the name of the next higher-ranked taxon (art. 24.3) [*G. rotundifolium*].

Geranium rotundifolium var. *minor* Bertero ex R. Knuth in Engl., Pflanzenr. IV.129 (Heft 53): 76. 1912, nom. inval., not accepted by its author (art. 36.1) [*G. core-core*].

Geranium rotundifolium var. *viscossisimum* Heldreich, nom. nud., in sched. (BM!) [*G. rotundifolium*].

Geranium rotundifolium [a] *genuinum* Graebn. in Asch. & Graebn., Syn. Mitteleur. Fl. 7(1): 49. 1913, nom. inval., epithet indicating the taxon containing the type of the name of the next higher-ranked taxon (art. 24.3) [*G. rotundifolium*].

Geranium rotundifolium f. *sennenii* Pau, nom. nud., in sched. (MA-71157!) [*G. rotundifolium*].

Geranium rotundifolium f. *umbellatum* R. Berger, Allg. Bot. Z. Syst. 20: 15. 1915, nom. nud. [*G. rotundifolium*].

Geranium rubellum Wender., Schriften Ges. Beförd. Gesammten Naturwiss. Marburg 2: 259. 1831, nom. illeg., non Moench 1802. TYPE LOCALITY: [not indicated]. TYPE: cultivated at Marburg botanical garden (no original material located). According to Stafleu & Cowan (1988: 178) Wenderoth's herbarium may be considered lost.

Geranium rubescens W.D. Jacks., Bol. Mus. Munic. Funchal 23: 31. 1969, nom. inval., pro syn. [*G. yeoi*].

Geranium rupestre Rafin., nom. nud., in sched. (P!) [*G. robertianum*].

Geranium saltuense Schltdl. ex R. Knuth in Engl., Pflanzenr. IV.129 (Heft 53): 101. 1912, nom. nud. [*G. crenatifolium*].

Geranium sanguineum var. *angustilobum* Sennen, Pl. Espagne 1921-23 n.° 4253. 1922, nom. nud., in sched. (BC!, BM!, MA-71570!, W!) [*G. sanguineum*].

Geranium sanguineum var. *asperifolium* Sennen, nom. nud., in sched. (BC-12374!) [*G. sanguineum*].

Geranium sanguineum var. *genuinum* Godr. in Gren. & Godr., Fl. France 1: 302. 1847, nom. inval., epithet indicating the taxon containing the type of the name of the next higher-ranked taxon (art. 24.3) [*G. sanguineum*].

Geranium sanguineum var. *haematodes* Burm. f. ex R. Knuth in Engl., Pflanzenr. IV.129 (Heft 53): 139. 1912, nom. nud., pro syn. [*G. sanguineum*].

Geranium sanguineum var. *lancastriense* (Mill.) G. Nicholson, Ill. Dict. Gard. 2: 64. 1885, comb. superfl. [*G. sanguineum*].

Geranium sanguineum var. *majus* Maxim. ex Syr. & Petunn. in Syr., Ill. Fl. Mosk. Gub. 2: 326. 1907, nom. nud., pro syn. [*G. sanguineum*].

Geranium sanguineum var. *monstrosum* Scheppig ex R. Knuth in Engl., Pflanzenr. IV.129 (Heft 53): 139. 1912, nom. nud. [*G. sanguineum*].

Geranium sanguineum var. *prostratum* (Cav.) Dum. Cours., Bot. Cult. 3: 6. 1802, comb. supefl. [*G. sanguineum*].

Geranium sanguineum var. *prostratum* (Cav.) Pers., Syn. Pl. 2: 234. 1806, comb. supefl. [*G. sanguineum*].

Geranium sanguineum var. *subnudicaulix*, nom. nud., in sched. (SOM!) [*G. sanguineum*].

Geranium sanguineum var. *vulgare* Čelak., Prodr. F. Böhmen 3: 530. 1875, nom. inval., epithet indicating the taxon containing the type of the name of the next higher-ranked taxon (art. 24.3) [*G. sanguineum*].

Geranium sanguineum [b] *dubium* Rochel, Bot. Reise Banat: 55. 1838, nom. nud. [*G. sanguineum*].

Geranium sanguineum [c] *latilobum* Rochel, Bot. Reise Banat: 55. 1838, nom. nud. [*G. sanguineum*].

Geranium scabiosiafolium J.F. Villiers, nom. nud., in sched. (P!) [*G. arabicum*].

Geranium scopulicolum Jord., nom. nud, in sched. (K!) [*G. purpureum*].

Geranium semiorbiculare Rchb., Fl. Germ. Excurs.: 778. 1832, nom. nud., pro syn. [*G. rotundifolium*].

Geranium senneni Pau, nom. nud., in sched. (BC-825306!) [*G. rotundifolium*].

Geranium sericeum var. *typicum* Wedd. ex R. Knuth in Engl., Pflanzenr. IV.129 (Heft 53): 80. 1912, nom. inval., epithet indicating the taxon containing the type of the name of the next higher-ranked taxon (art. 24.3) [*G. sericeum*].

Geranium sessiliflorum Cav., Diss. 3: [186]. 1787, nom. nud. [Feb. 1787] [*G. sessiliflorum*].

Geranium sessiliflorum var. *typicum* R. Knuth, Bot. Jahrb. Syst. 37: 565. 1906, nom. inval., epithet indicating the taxon containing the type of the name of the next higher-ranked taxon (art. 24.3) [*G. sessiliflorum*].

Geranium sessiliflorum f. *albiflorum* Kuntze, Revis. Gen. Pl. 3(3): 33. 1898, nom. nud., in sched. (NY!) [*G. sessiliflorum*].

Geranium sibiricum Miq. ex R. Knuth in Engl., Pflanzenr. IV.129 (Heft 53): 192. 1912, nom. nud., pro syn. [*G. nepalense*].

Geranium sibiricum subsp. *eusibiricum* Gams in Hegi, Ill. Fl. Mitt.-Eur. 4(3): 1695. 1924, nom. inval., epithet indicating the taxon containing the type of the name of the next higher-ranked taxon (art. 24.3 [*G. sibiricum*].

Geranium solitarium Z.M. Tan, Acta Phytotax. Sin. 33(6): 608, 609 fig. 1. 1995. Type locality: "Sichuan...: Pingwu..., Huya..., alt. 4500 m, 1978-07-21, Pingwu Exped. 636 (typus, SM)". Type: China. Sichuan, Pingwu, 32º24'N, 104º31'E, 21 July 1978, *Pingwu Exped. 636* (holotype, SM).

According to the original description, this species has roots long and thickened, opposite leaves not deeply divided, stipules distinct, cymules 1-flowered, petals ca. 1.8 cm, with rounded apex and basally with hairs, and eglandular indumentum. The fruit and seed are unknown. It is found in alpine habitats of N Sichuan. Unfortunately, it has not been possible to examine any specimens belonging to this species.

Geranium somalense Sprage, nom. nud., in sched. (K!) [*G. biuncinatum*].

Geranium sonderianum Turcz. ex Müll. Berol. in Walp., Ann. Bot. Syst. 7: 485. 1869, nom. nud. [*G. holosericeum*].

Geranium sonorae C.V. Morton, nom. nud., in sched. (NY!) [*G. charucanum*].

Geranium stewartianum Y.J. Nasir, Pakistan J. Bot. 14(Abs.): 46. 1982, nom. nud.

Geranium stewartianum subsp. khillanmargensis Y.J. Nasir, Pakistan J. Bot. 14(Abs.): 46. 1982, nom. nud.

Geranium stewartianum var. chorwanianus Y.J. Nasir, Pakistan J. Bot. 14(Abs.): 46. 1982, nom. nud.

Geranium stewartianum var. schmidii Y.J. Nasir, Pakistan J. Bot. 14(Abs.): 46. 1982, nom. nud. [*G. schmidii*].

Geranium striatum Clairv. ex B.D. Jacks., Index Kew. 2: 1021. 1893, nom. inval., not accepted by its author (art. 36.1) [*G. rivulare*].

Geranium strictipes var. *grandiflorum* (Franch.) C.Y. Wu, Index Fl. Yunnan 1: 297. 1984, nom. inval., combination proposed without reference to basionym (art. 41.5) [*G. strictipes*].

Geranium strictum Picard ex B.D. Jacks., Index Kew. 2: 1021. 1893, nom. inval., not accepted by its author (art. 36.1) [*G. rotundifolium*].

Geranium stroblii Hay., nom. nud., in sched. (W!).

Geranium subcaulescens var. *genuinum* Boiss., Fl. Orient. 1: 872. 1867, nom. inval., epithet indicating the taxon containing the type of the name of the next higher-ranked taxon (art. 24.3) [*G. subcaulescens*].

Geranium subcaulescens var. *palmatipartitum* Hausskn., nom. nud., in sched. [*G. palmatipartitum*].

Geranium subcaulescens f. *glabrescens* Boiss., Fl. Orient. Suppl.: 141. 1888, nom. nud. [*G. ponticum*].

Geranium subcaulescens f. *pallidiflora* Freyn ex R. Knuth in Engl., Pflanzenr. IV.129 (Heft 53): 94. 1912, nom. nud. [*G. subacutum*].

Geranium subcaulescens f. *pallidiflora* Freyn, nom. nud., in sched. (BM!, E!, G!, JE!, LD!, LE!) [*G. subacutum*].

Geranium subcaulescens f. *purpureo-violacea* Freyn, nom. nud., in sched. (B!, BM!, E!, G!, JE!, LD!, LE!) [*G. subacutum*].

Geranium subcaulescens [ß] *parviflorum* Boiss., nom. nud., in sched. (BM!) [*G. subacutum*].

Geranium subdivaricatum Schur, Verh. Naturf. Vereins Brünn 15: 160. 1877, nom. inval., not accepted by its author (art. 36.1) [*G. divaricatum*].

Geranium subincanum Lange ex Guinea, Anales Jard. Bot. Madrid 7: 343. 1947, nom. nud. [*G. subargenteum*].

Geranium sylvaticum Saulcy & Michon ex B.D. Jacks., Index Kew. 2: 1021. 1893, nom. inval., not accepted by its author (art. 36.1) [*G. libani*].

Geranium sylvaticum Ucria ex B.D. Jacks., Index Kew. 2: 1021. 1893, nom. inval., not accepted by its author (art. 36.1) [*G. versicolor*].

Geranium sylvaticum var. *alpestre* (Schur) Hayek, Fl. Steiermark 1: 630. 1909, nom. superfl. [*G. sylvaticum*].

Geranium sylvaticum var. *alpestre* (Schur) Thaiss. ex Domin & Podp. in Polívka, Domin & Podp., Klic Uplne Kvetene Rep. Ceskoslovenske ed. 2: 111. 1928, nom. superfl. [*G. sylvaticum*].

Geranium sylvaticum var. *argenteum* Geners. ex Steud., Nomencl. Bot. 1: 365. 1821, nom. nud. [*G. sylvaticum*].

Geranium sylvaticum var. *argenteum* Geners. ex Wahlenb., Fl. Carp.: 208. 1814, nom. nud., pro syn. [*G. sylvaticum*].

Geranium sylvaticum var. *batrachioides* (Cav.) DC., Prodr. 1: 641. 1824, comb. superfl. [*G. pratense*].

Geranium sylvaticum var. *parviflorum* Brittinger, Verh. K.K. Zool.-Bot. Ges. Wien 12: 1117. 1862, nom. nud. [*G. sylvaticum*].

Geranium sylvaticum var. *ranunculifolium* Schur ex Nyman, Consp. Fl. Eur. 1: 137. 1878, nom. nud., pro syn. [*G. sylvaticum*].

Geranium sylvaticum var. typicum Rupr., Mém. Acad. Imp. Sci. Saint Pétersbourg ser. 7, 15(2): 272. 1869, nom. inval., epithet indicating the taxon containing the type of the name of the next higher-ranked taxon (art. 24.3). [*G. sylvaticum*].

Geranium sylvaticum subvar. *subhirsutum* Beck ex Gams in Hegi, Ill. Fl. Mitt.-Eur. 4(3): 1685. 1924, nom. nud. [*G. sylvaticum*].

Geranium sylvaticum f. *albiflorum* Murr, Neu. Übers. Bl.-Pfl. Vorarlberg: 187. 1923, nom. nud. [*G. sylvaticum*].

Geranium sylvaticum f. *lilacinum* Murr, Neu. Übers. Bl.-Pfl. Vorarlberg 187. 1923, nom. nud. [*G. sylvaticum*].

Geranium sylvaticum f. *pallidiflorum* Üksip ex Talts, Eesti Nsr Flora 3: 320. 1959, nom. nud. [*G. sylvaticum*].

Geranium sylvaticum f. *parviflorum* Brittinger ex Nyár., Kolozsvár Fl. 5: 338. 1943. nom. inval., sine descr. (art. 39.1) [*G. sylvaticum*].

Geranium sylvaticum f. *purpureum* Murr, Neu. Übers. Bl.-Pfl. Vorarlberg 187. 1923, nom. nud. [*G. sylvaticum*].

Geranium sylvaticum f. *roseum* Murr, Neu. Übers. Bl.-Pfl. Vorarlberg 187. 1923, nom. nud. [*G. sylvaticum*].

Geranium sylvaticum [*] *batrachioides* (Cav.) Pers., Syn. Pl. 2: 235. 1806, nom. inval.? (Greuter 1968) [*G. pratense*].

Geranium sylvaticum [α] *glandulosum* Strobl, Jahres-Ber. Obergymn. Melk 32: 49. 1882, nom. nud. [*G. sylvaticum*].

Geranium sylvestre Olafsen & Povelsen ex Bab., J. Linn. Soc., Bot. 11: 300. 1871, nom. nud. [*G. sylvaticum*].

Geranium tenessicum Raf., Herb. Raf.: 60. 1833, nom. nud.

Geranium terminale Z.M. Tan, Bull. Bot. Res., Harbin 6(2): 53, 63 tab. 6. 1986. Type locality: "Sichuan: Xide, Tuanjie Commune, Wajiliangzi, alt. 2800 m, July 13, 1979, Xide Exped. 586 (Type, fl. ICD)". Type: China. Sichuan, Xide, Tuanjie Commune, Wajiliangzi, 28º01'N, 102º10'E, 13 July 1979, *Xide Exped. 586* (holotype, SM). According the original description this species has short horizontal rootstock with thickened roots, opposite leaves deeply divided, ± connate stipules, cymules 2-flowered, petals c. 15 mm long with rounded apex and hairy base, and glandular indumentum. Unfortunately, it has been not possible to examine any specimen belonging to this species.

Geranium thunbergii Siebold & Zucc., Abh. Mat.-Phys. Cl. Königl. Bayer. Akad. Wiss. 4(2): 28. 1845, nom. nud. [*G. thunbergii*].

Geranium thunbergii var. *pallidum* Nakai, Kôryô-Shikenrin-no-ippan: 41. 1932, nom. nud. [*G. thunbergii*].

Geranium thunbergii var. *roseum* Nakai, Kôryô-Shikenrin-no-ippan: 41. 1932, nom. nud. [*G. thunbergii*].

Geranium thunbergii f. *albiflora* T.H. Chung, Ill. Enc. Fauna & Flora Kor. 5(App.): 89 fig. 142. 1970, nom. inval., without Latin description (art. 39.1) [*G. thunbergii*].

Geranium transbaicalicum var. *genuinum* Serg., Sist. Zametki Mater. Gerb. Krylova Tomsk. Gosud. Univ. Kiybyševa 1934(1): 4. 1934. nom. inval., epithet indicating the taxon containing the type of the name of the next higher-ranked taxon (art. 24.3) [*G. pratense*].

Geranium trifoliatum Z.M. Tan, Bull. Bot. Res., Harbin 14(3): 231, 234 tab. 1. 1994, nom. illeg., non Andrews (1805). *Geranium tanii* Aedo & Muñoz Garm., Novon 6: 229. 1996. Type locality: "Sichuan: Xide County, Shengou Country, Beimu Mount, on the grassland, June 30, 1979, Xide Exped. 0526 (Type, ICD)". Type: China. Sichuan, Xide County, Shengou County, Beimu Mount, 29º30'N, 105º05'E, 30 June 1979, *Xide Exped. 0526* (holotype, SM).
According the original description this species has short horizontal rootstock with thickened roots, opposite leaves deeply divided, ± connate stipules, cymules 2-flowered, petals c. 15 mm long with rounded apex and hairy base, and glandular indumentum. Unfortunately, it has been not possible to examine any specimen belonging to this species.

Geranium tuberosum Boiss. ex B.D. Jacks., Index Kew. 2: 1022. 1893, nom. inval., not accepted by its author (art. 36.1) [*G. malviflorum*].

Geranium tuberosum subsp. *eu-tuberosum* Hayek in Repert. Spec. Nov. Regni Veg. Beih. 30: 575 (1925), nom. inval., epithet indicating the taxon containing the type of the name of the next higher-ranked taxon (art. 24.3) [*G. tuberosum*].

Geranium tuberosum subsp. *linearilobum* (DC.) Krylov in Krylov & al., Fl. Zap. Sibir. 8: 1822. 1935, comb. superfl. [*G. linearilobum*].

Geranium tuberosum subsp. *linearilobum* (DC.) Malag., Subsp. Var. Geogr.: 12. 1973, comb. superfl. [*G. linearilobum*].

Geranium tuberosum subsp. *macrostylum* (Boiss.) Malag., Subsp. Var. Geogr.: 12. 1973, comb. superfl. [*G. macrostylum*].

Geranium tuberosum var. *alpina* Siehe, nom. nud., in sched. (JE!) [*G. tuberosum*].

Geranium tuberosum var. *genuinum* Boiss., Fl. Orient. 1: 873 (1867), nom. inval., epithet indicating the taxon containing the type of the name of the next higher-ranked taxon (art. 24.3) [*G. tuberosum*].

Geranium tuberoso proximum Bertero ex R. Knuth in Engl., Pflanzenr. IV.129 (Heft 53): 71. 1912, nom. nud., pro syn. [*G. berteroanum*].

Geranium ulassovianum Fisch. ex Rchb., Icongr. Bot. Exot. 1: 19, pl. 27. 1824, [it seems to be a ortho. mistake because it is correctly indicated as "vlassovianum" at the index. The name is recorded by the IPNI. [*G. wlassovianum*].

Geranium urosepalum Aschenborn ex R. Knuth in Engl., Pflanzenr. IV.129 (Heft 53): 194. 1912, nom. nud. [*G. hernandesii*].

Geranium valde-pilosum Schur, Enum. Pl. Transsilv.: 137. 1866, nom. nud., pro syn. [*G. pratense*].

Geranium variegatum Wender. ex Steud., Nomencl. Bot. ed. 2, 1: 680. 1840, nom. nud. [*G. pratense*].

Geranium venosum Pers. ex B. Jacks., Index Kew. 2: 1022. 1893, nom. inval., not accepted by its author (art. 36.1) [*G. sylvaticum*].

Geranium versicolor Turcz. ex Bobrov in Kom. & al., Fl. URSS 14: 27. 1949, nom. nud., pro syn. [*G. albiflorum*].

Geranium villosum var. *gracile* Sennen, Pl. Espagne n.° 2994. 1917, nom. nud., in sched. (BM!) [*G. molle*].

Geranium virescens Jord., nom. nud., in sched. (P!) [*G. robertianum*].

Geranium virginianum, nom. nud., in sched. (MO!) [*G. texanum*].

Geranium viscicum, nom. nud., in sched. (MO!) [*G. californicum*].

Geranium viscosum Gilib., Fl. Lit. Inch. 2: 177. 1782, nom. inval., suppressed work (art. 34.1) [*G. rotundifolium*].

Geranium vvedenskyi Bobrov in Kom. & al., Fl. URSS 14: 62 (1949), nom. inval., not accepted by its author (art. 36.1) [*G. linearilobum*].

Geranium vulgare Gueldenst. ex B.D. Jacks., Index Kew. 2: 1022. 1893, nom. inval., not accepted by its author (art. 36.1).

Geranium walpersianum Hieron. ex R. Knuth in Engl., Pflanzenr. IV.129 (Heft 53): 88. 1912, nom. nud., pro syn. [*G. antisanae*].

Geranium wilfordii var. *stellarifolium* H. Hara, nom. nud., in sched. [*G. wilfordii*].

Geranium wilfordii f. *grandiflorum* Hiyama, nom. nud., in sched. [*G. wilfordii*].

Geranium wlassovianum f. *incana* Maxim., Prim. Fl. Amur.: 70. 1859, nom. inval. (art. 36.1) [*G. maximowiczii*].

Geranium wlassovianum f. *incana* Maxim. ex R. Knuth in Engl., Pflanzenr. IV.129 (Heft 53): 170, 1912, nom. nud., pro syn. [*G. maximowiczii*].

Geranium wlassovianum f. *setosopilosa* Maxim., Prim. Fl. Amur.: 70. 1859, nom. inval. (art. 36.1) [*G. maximowiczii*].

Geranium wlassovianum f. *setosopilosa* Maxim. ex R. Knuth in Engl., Pflanzenr. IV.129 (Heft 53): 170, 1912, nom. nud., pro syn. [*G. maximowiczii*].

Geranium xinjiangense C.Y. Yang, Claves Pl. Xinjiang. 3: 218. 1983, nom. inval., without Latin description (art. 39.1).

Geranium yaanense Z.M. Tan, Acta Phytotax. Sin. 33(6): 611, 610 fig. 2. 1995. Type locality: "Sichuan...: Yaan..., Xiatian..., alt. 1500 m, 1978-09-19, Yaan Exped. 1130 (typus, SM)". Type: China. Sichuan, Yaan, Xiatian, 29º52'N, 102º12'E, 19 Sep. 1978, *Yaan Exped. 1130* (holotype, SM).
According to the original description, this species has opposite leaves not deeply divided, stipules distinct, cymules 2-flowered, petals ca. 9 mm, with rounded apex and basally with hairs, and glandular indumentum. It has been considered a synonym of *Geranium moupinense*, a species of the subg. *Robertium*. However, the latter has alternate leaves and reticulate mericarps. Unfortunately, it has not been possible to examine any specimens belonging to this species.

Geranium yesoense var. *genuina* Tatew., Trans. Sapporo Nat. Hist. Soc. 14: 263. 1936, nom. inval., epithet indicating the taxon containing the type of the name of the next higher-ranked taxon (art. 24.3) [*G. yesoense*].

HYBRIDS

Hybridization experiments in *Geranium* have been carried out with species of subg. *Geranium* (Dahlgren 1923; Sansome 1936) and subg. *Robertium* (Van Loon 1984a; Wilder-Kiefer & Yeo 1987). Yeo (2002a: 38, 212) summarized the impressive work of artificial hybridisation carried out by Alan Bremmer, which otherwise remains unpublished, and provided a list of the hybrids that have flowered using the hybrid formulas.

In the following list I have compiled hybrids with a binomial name, that have been recorded in nature, have been found to grow spontaneously in gardens or have been artificially obtained. Exceptionally names with only hybrid formulas have been listed to discuss some different aspects.

G. argenteum × G. cinereum
Geranium × *intermedium* Sünd., Allg. Bot. Z. Syst. 12: 91. 1906, nom. nud. *Geranium* × *intermedium* Sünd. ex R. Knuth in Engl., Pflanzenr. IV.129 (Heft 53): 220. 1912. Type locality: "Kulturhybride. – Von Sündermann in Lindau gezüchlet". Type: Germany. Cultivated in Lindau, *F. Sündermann s.n.* (no original material located).

G. argenteum × G. subcaulescens
Geranium × *lindavicum* Sünd. ex R. Knuth in Engl., Pflanzenr. IV.129 (Heft 53): 220. 1912. Type locality: "Kulturhybride. – Von Sündermann in Lindau gezüchlet". Type: Germany. Cultivated in Lindau, *F. Sündermann s.n.* (no original material located).

G. asphodeloides × G. bohemicum
Geranium × *decipiens* Hausskn., Mitth. Thüring. Bot. Vereins 5: 65. 1893. Type locality: "Hab. in derelictis pr. ruinas castelli turcici supra mon. Korona, parentibus consociatum". Type: Greece. Agrapha, monasterium Korona, 39º45'N, 21º30'E, 20-28 June 1885, *C. Haussknecht s.n.* (lectotype, here designated, JE image!).
According to Hayek (1927: 571) this hybrid results from the cross *G. asphodeloides* and *G. lanuginosum*.

G. bohemicum× G. lanuginosum
This hybrid was found by Dahlgren (1949) in a culture of *G. lanuginosum,* among seedlings from southern Sweden. Apparently it never has been formally described. Previously it has been obtained by Dahlgren (1923) artificially. Bohlin (1997) indicated the first report of this hybrid in nature.

G. dahuricum × G. pratense
Geranium × *bergianum* C.E. Lundstr., Acta Horti Berg. 5(3): 69, Taf. 3 Fig. 2. 1914. Type locality: [not indicated]. Type: probably cultivated at Bergius Botanic Garden, *C.E. Lundström s.n*. (no original material located).

G. dalmaticum × G. macrorrhizum
Geranium × *cantabrigiense* Yeo, Hardy Geraniums: 153, 188, fig. 9.90C, pl. 34. 1985. Type locality: "Cult. Hort. Bot. Univ. Cantab., no. 232-74 Kiefer, sub nomine G. dalmaticum x G. macrorrhizum culta, 22. vi. 1983 lecta et in foliis herbarii tribus (holotypus et duo isotypi) conservatur (CGG)". Type: Cultivated. Botanical Garden Univ. Cambridge, 22 June 1983, *H. Wilder-Kiefer 232-74* (holotype, CGG).

G. endressii × G. traversii
Geranium × *riversleaianum* Yeo, Hardy Geraniums: 67, 187, fig. 9.3, pl. 3. 1985. Type locality: "Cult. Hort. Bot. Univ. Cantab., no. 172-74 G.S. Thomas, sub nomine Geranium 'Russell Prichard', 30. vii. 1975 lecta (CGG)". Type: Cultivated at Hort. Bot. Univ. Cantab., 30 July 1975, *G.S. Thomas 172-74* (holotype, CGG).

G. endressii × G. versicolor [sometimes as *G. striatum*]
Geranium × *oxonianum* Yeo, Hardy Geraniums: 65, 187, fig. 9.2, pl. 2. 1985. Type locality: "Cult. Hort. Bot. Univ. Cantab., no. 24-74 G.S. Thomas, sub nomine Geranium endressii x G. versicolor: 'Claridge Druce', 30. vi. 1974 lecta et in foliis herbarii duobus conservatur (CGG)". Type: Cultivated at Cambridge Botanical Garden, 30 June 1974, *P. Yeo s.n.* (holotype, CGG).
Both species are allopatric, but hybrids of garden origin are widely cultivated (Van Loon 1984a: 167) and occasionally naturalized (McClintock 1975: 191). Marschall (1911: 551) indicated a spontaneous specimen of this hybrid growing in a garden.

G. ibericum × G. platypetalum
Geranium × *magnificum* Hyl., Lustgården 42: 114, fig. 1. 1961. Type locality: "In hortis (saltem plerumque s.n. G. platypetali) pro ornamento colitur; a me in Anglia, Norvegia et Suecia visa.-Typus in UPS (H. Upsaliensis, sub divo cult., leg. I. Nordin 17. VI. 1960)". Type: Sweden. cultivated at Upsala Botanical Garden, 17 June 1960, *I. Nordin s.n.* (holotype, UPS color slide!).
Geranium ibericum var. *talyshense* E.F. Warb., New Phytol. 38: 144. 1938, nom. nud.

G. lividum [=*G. phaeum*] × **G. phaeum**
Geranium × *phaeoides* Fritsch ex Jenčič, Oesterr. Bot. Z. 50: 43. 1900, nom. nud.

G. lucidum × G. robertianum
Geranium × *hybridum* W. Allen ex C. Bailey in F. Lees, Bot. Loc. Rec. Club 3: 118. 1887, nom. illeg., non L., 1767. Type locality:: "On old walls, 'Mill in Hole,' Bridgnorth, Salop; W. Allen". Type: Great Britain, Bridgnorth, 52º32'N, 2º25'W, *W. Allen s.n.* (no original material located).
According to McClintock (1975: 192) it is known from a couple of localities from England, but no specimens has been traced.

G. molle × G. pyrenaicum
Geranium × *luganense* Chenevard, Bull. Herb. Boissier ser. 2, 3: 427. 1903. Type locality: "Crocefisso, Mt S. Giorgio". Type: Switzerland. Tessin, Crocefisso, Mt S. Giorgio, 45º54'N, 8º57'E, *P. Chenevard s.n.* (no original material located).
According to Van Loon (1984a: 167) this hybrid has been found only once in wild. *Geranium oenense*, sometimes considered an hybrid between *G. molle* and *G. pusillum* has been synonymized to *G. molle*.

G. phaeum [var. *lividum*] × **G. reflexum**
Geranium × *monacense* nothovar. *anglicum* Yeo, Hardy Geraniums: 188. 1985. Type locality: "Cult. Hort. Bot. Univ. Cantab., no. 281-81 Forty, primo ex Hurst Green, east Sussex, a P. Ropero lecta, exsicata sub nomine G. phaeum var. lividum 4. vi. 1982 lecta et in foliis herbarii duobus conservatur (CGG)". Type: Cultivated at Cambridge Botanical Garden, 4 June 1982, *P. Yeo s.n.* (holotype, CGG).

G. phaeum [var. *phaeum*] × **G. reflexum**
Geranium × *monacense* Harz, Mitt. Bayer Bot. Ges. 4(1): 7. 1921. Type locality: "Wörthsee (Oberbayern)". Type: Germany, Oberbayern, Wörthsee, 48º05'N, 11º11'E, *K. Harz s.n.* (no original material located).

G. phaeum [var. *lividum*] × **G. sylvaticum**
Geranium × *zermattense* Wolf ex Gams in Hegi, Ill. Fl. Mitt.-Eur. 4(3): 1715. 1924, nom. nud.
Gams (1924: 1715) did not provided any description and indicated that this taxa was "very doubtful".

G. pratense × G. robertianum
A hybrid between these species was reported by Drabble & Drabble (1908: 301) in England. According to McClin-

tock (1975: 190) no specimens has been traced, and the existence of such hybrid seems very unlikely.

G. pusillum × **G. pyrenaicum**

Geranium hybridum Hausskn., sometimes considered an hybrid between *G. pusillum* and *G. pyrenaicum,* has been here considered as synonym of *G. pusillum*.

G. rivulare × **G. sylvaticum**

Geranium × *besseanum* Gams in Hegi, Ill. Fl. Mitt.-Eur. 4(3): 1715. 1924, nom. nud. Gams (1924: 1715) did not provide any description to this taxa.

G. sessiliflorum [subsp. *novaezelandiae*] × **G. traversii** [var. *elegans*]

Geranium × *antipodeum* Yeo, Hardy Geraniums ed. 2: 211. 2002. Type locality: "cult. University Botanic garden, Cambridge, accession no. 1998.0471 Beckett, 2.xi.1979 (K) (from K. and G. Beckett...". Type: Cultivated at Cambridge Botanical Garden, 2 Nov. 1979, *P. Yeo s.n.* (holotype, K-000729507 image!).

ACKNOWLEDGMENTS

Many individuals have helped in the elaboration and completion of this study, but I am especially grateful to Santiago Castroviejo (1946-2009), who provided support for this project both personally and professionally, and who, in many ways, made its completion possible. Sadly, he did not live to see the publication. I also owe a special thanks to M.J. Cano since without her insistence I would never have collected my articles on *Geranium* in a monograph and for her accurate criticism of each of its sections that she has reviewed with invaluable dedication and effort. My friends Carmen Navarro and Félix Muñoz Garmendia actively supported my work in its many aspects, as did Lourdes Rico, Kew Botanical Gardens, and Carmen Ulloa, Missouri Botanical Garden. I am indebted to the curators and staff of the herbaria mentioned in *Material and methods* for kindly providing specimens and other material for study. The collectors given special recognition because their effort for more than 200 years, often in inhospitable or dangerous areas, has made this work possible. I also extend my appreciation to the journals, editors and anonymous reviewers of the previous papers on which this work is partly based for their critical reviews and for their helpful suggestions during the editing process. I would like to thank specially to the journals: *Annals of the Missouri Botanical Garden*, *Israel Journal of Botany*, *Systematic Botany*, *and Systematic Botany Monographs* for granting permission to use in this publication some of the plates previously published in these journals.

I wish to record my sincere thanks to Y. Abraham, G. Alessia, P.J. Alexander, M. Amadio, N. Askoy, C. Aupic, G. Aymard, G.G. Aymonin, G. Baillargeon, H. Balslev, M. Baltisberger, P. Barberá, G. Barboza, C. Bartram, C. Benedí, T. Block, K. Boardman, A. Bogaerts, D. Boufford, C. Brodie, R. Brummitt, P. Buek, A. Buira, P. Bures, V. Byalt, S. Cafferty, J. Calvo, E. Cameron, P. Catalán, D. Chabard, A. Charpin, F. Chiang, F. Conti, M.B. Crespo, S. D'Acunto, C.E. Darigo, P.N. Davies, J. de Lange, J. Delavie, A. Diamond, D. Dixon, A. Donatelli, R. Drinkwater, D. Dubovik, R. Duno, B. Estébanez, J. Estrada, M. Estrella, D. Fabijan, A. Fayard, J.L. Fernández, T. Flynn, N. Fumeaux, F. Ganders, Xinfen Gao, K. García, L.M. Gardiner, R. Gauthier, L. Gautier, M. Gibby, G. Guignard, A. Granda, W. Greuter, J. Güemes, G.G. Guittonneau, J. Hadinec, S. Halloy, A. Harbottle, P. Heenan, B.J. Hellenthal, P. Hiepko, M. Hjertson, A. Hölzer, J. Hosking, L. Iharlegui, H. Ikeda, R. Jardim, C.E. Jarvis, D.M. Johnson, T. Khmil, H. Kim, J. Klackenberg, O. Korniyenko, J. Kuijt, H.W. Lack, M. Laínz, D. Langel, I. Lin, N. Lederer, G.P. Lewis, M. Lock, G. López, S. Marner, M.P. Martín, J. McNeill, L. Medina, R. Mill, P. Milne, A. Mora, R. Morales, P. Mráz, P. Muñoz-Rodríguez, J.G. Murrell, C. Nepi, S. Nishida, M. Novoselova, M. Niketić, P. Otto, J. Paiva, J. Pandalayil, F. Pando, Y.R. Paneru, J. Pedrol, P. Pelser, M. Peña, P. Perret, L. Perrie, V. Petronela, L. Pignotti, J. Pizarro, H.N. Qin, A. Quintanar, R.K. Rabeler, L. Raenko, D. Ranatunga, T. Ranker, P. Raven, G. Reid, A. Rhoads, E. Rico, R. Riina, Y. Roskov, Z. Rogers, T. Rouillard, C. Roux, J. Rukseniene, O. Ryding, M. Salas, A. Santangelo, F. Schmid, I. Schonberger, P. Schönfelder, F. Schuhwerk, M. Sequeira, A. Shimizu, D.-H. Son, M. Sosef, J. Stepanek, A. Stepanova, K. Sutorý, H. Takahashi, W. Takeuchi, M.T. Tellería, B. Tenbergen, G. Thijsse, M. Thulin, N. Turland, J. Valdés, M. Velayos, J. Veldkamp, D. Victor, E. Vitek, R. Vogt, H. Vonow, N. Walsh, J.J. van der Walt, Chiu-Mei Wang, S. Welsh, P. Yeo, T. Zanoni and Libing Zhang, for their helpful suggestions and very useful advice in many aspects.

P. Alexander, A. Buira, J. Calvo, A. Diamond, M.Á. García, A. Grau, J. Pedrol, A. Prunell, R. Riina, P. Sklenář, M. Sequeira and C. Ulloa have kindly allowed me to use their photographs of some species.

I am grateful to C. Aldana, P. Amorim, S. Beck, P. Cãmara, A. Cano, M.J. Cano, L. Domínguez, A. Galán de Mera, M.T. Gallego, J.R. Grande, J. Guerra, L. Gutiérrez, J.A. Jiménez, S. Leiva, C. Marticorena, D. Minga, R. Rodríguez, N. Sanjines, G. Suárez, and M. Zapata for their kind assistance during field trips in Argentina, Bolivia, Brazil, Chile, Ecuador, Peru, and Venezuela, and also A. Bornia, A. Martín Ciudad, J.J. Quirós, J. Reyes and Y. Ruiz for their technical support. Xinying and Anne Martin kindly revised and corrected the English text.

Most of the drawings were made by J. Castillo and R. García Mora, plus some that were made by M. Cartañá, M. Chirino, E. Ortúñez and J. Pizarro.

This work was partly financed by the Spanish Government of the research projects (AMB1999-1290-E, REN2000-2093-E/GLO, PB91-0070-C03-00, PR2001-0342, REN2002-04634-C05-05, REN2003-00982/GLO, CGL2004-00172/BOS, CLG2007-60184/BOS, CGL2010-19747, CGL2011-28613-C03-01, CGL2014-52787-C3-1-P and CGL2017-85204-C3-1-P) and by the European Union through the COLPARSYST program.

LITERATURE CITED

Abraham, Y. & Elbaum, R. 2013. Hygroscopic movements in Geraniaceae: the structural variations that are responsible for coiling or bending. *New Phytol.* 199: 584-594.

Abrams, M.D. & Dickmann, D.I. 1984. Apparent heat stimulation of buried seeds of *Geranium bicknellii* on jack pine sites in northern lower Michigan. *Michigan Bot.* 23: 81-88.

Adams, B. 1986. *The flowering of the Pacific: being an account of Joseph Banks' travels in the South Seas and the story of his Florilegium*. Sydney, Collins; London, British Museum (Natural History).

Aedo, C. 1994. A new species and six combinations in *Geranium* L. subgen. *Erodioideae* (Picard) Yeo (Geraniaceae). *Anales Jard. Bot. Madrid* 52: 105-106.

Aedo, C. 1996. Revision of *Geranium* Subgenus *Erodioidea* (Geraniaceae). *Syst. Bot. Monogr.* 49: 1-104.

Aedo, C. 2000. The genus *Geranium* L. (Geraniaceae) in North America. I. Annual species. *Anales Jard. Bot. Madrid* 58: 39-82.

Aedo, C. 2001a. Taxonomic revision of *Geranium* sect. *Brasiliensia* (Geraniaceae). *Syst. Bot.* 26: 205-215.

Aedo, C. 2001b. The genus *Geranium* L. (Geraniaceae) in North America. II. Perennial species. *Anales Jard. Bot. Madrid* 59: 3-65.

Aedo, C. 2003. Taxonomic revision of *Geranium* sect. *Trygonium* (Geraniaceae). *Bot. Zhurn. (Moscow & Leningrad)* 88: 124-131.

Aedo, C. 2004. (1648) Proposal to conserve the name *Geranium core-core* against *G. rapulum* (Geraniaceae). *Taxon* 53: 1074.

Aedo, C. 2005. (1680) Proposal to conserve the name *Geranium ibericum* against *G. montanum* (Geraniaceae) with a conserved type. *Taxon* 54: 207-208.

Aedo, C. 2009. *Geranium* L. In: Wu, Z.Y. & Raven, P.H. (eds.). *Flora of China Illustrations* 11: 6-57. St. Louis, Missouri Botanical Garden Press.

Aedo, C. 2012. Revision of *Geranium* L. (Geraniaceae) of the New World. *Syst. Bot. Monogr.* 95: 1-550.

Aedo, C. 2015. *Geranium* L. In: Castroviejo, S. (coord. gen.). *Flora iberica* 9: 271-315. Madrid, CSIC.

Aedo, C. 2016. Taxonomic revision of *Geranium* L. section *Polyantha* (Geraniaceae). *Ann. Missouri Bot. Gard.* 101: 611-635.

Aedo, C. 2017a. Revision of *Geranium* L. (Geraniaceae) in the Western and Central Pacific Area. *Syst. Bot. Monogr.* 102: 1-240.

Aedo, C. 2017b. Taxonomic revision of *Geranium* L. sect. *Ruberta* and *Unguiculata* (Geraniaceae). *Ann. Missouri Bot. Gard.* 102: 409-465.

Aedo, C. & Estrella, M. 2006. Taxonomic revision of *Geranium* subsect. *Tuberosa* (Boiss.) Yeo (Geraniaceae). *Israel J. Pl. Sci.* 54: 19-54.

Aedo, C. & Fumeaux, N. 2012. Proposal to conserve the name *Geranium pyrenaicum* (Geraniaceae) with a conserved type. *Taxon* 61: 256.

Aedo, C. & Muñoz Garmendia, F. 1996. Some notes on the sectional nomenclature of Geranium (Geraniaceae). *Taxon* 45: 104-106.

Aedo, C., Aldasoro, J.J. & Navarro, C. 1998. Taxonomic revision of *Geranium* L., Sections *Divaricata* Rouy and *Batrachioidea* W. D. J. Koch (Geraniaceae). *Ann. Missouri Bot. Gard.* 85: 594-630.

Aedo, C., Aldasoro, J.J. & Navarro, C. 2002. Revision of *Geranium* sections *Azorelloida*, *Neoandina* and *Paramensia* (Geraniaceae). *Blumea* 47: 205-297.

Aedo, C., Aldasoro, J.J., Sáez, L. & Navarro, C. 2003. Taxonomic revision of *Geranium* sect. *Gracilia* (Geraniaceae). *Brittonia* 55: 93-126.

Aedo, C., Barberá, P. & Buira, A. 2016. Taxonomic Revision of *Geranium* sect. *Trilopha* (Geraniaceae). *Syst. Bot.* 41: 354-377.

Aedo, C., Fernández Alonso, J.L. & Navarro, C. 2009. *Geranium holosericeum* (Geraniaceae) revisited. *Brittonia* 61: 225-236.

Aedo, C., Fiz, O., Alarcón, M.L., Navarro, C., & Aldasoro, J.J. 2005b. Taxonomic Revision of *Geranium* sect. *Dissecta* (Geraniaceae). *Syst. Bot.* 30: 533-558.

Aedo, C., García, M.Á., Alarcón, M.L., Aldasoro, J.J. & Navarro, C. 2007. Taxonomic Revision of *Geranium* Subsect. *Mediterranea* (Geraniaceae). *Syst. Bot.* 32: 93-128.

Aedo, C., Muñoz Gamendia, F. & Pando, F. 1998. World checklist of *Geranium* L. (Geraniaceae). *Anales Jard. Bot. Madrid* 56: 211-252.

Aedo, C., Navarro, C. & Alarcón, M.L. 2005a. Taxonomic revision of *Geranium* sections *Andina* and *Chilensia* (Geraniaceae). *Bot. J. Linn. Soc.* 149: 1-68.

Ågren, J. & Willson, M.F. 1991. Gender variation and sexual differences in reproductive characters and seed production in gynodioecious *Geranium maculatum. Amer. J. Bot.* 78: 470-480.

Ågren, J. & Willson, M.F. 1992. Determinats of seed production in *Geranium maculatum. Oecologia* 92: 177-182.

Aiton, W. 1789. *Hortus Kewensis* 2: 414-438. London, G. Nicol.

Akiyama, S. 2001. *Geranium* L. In: Iwatsuki, K., Boufford, D.E. & Ohba, H. (eds.). *Flora of Japan* 2b: 287-293. Tokyo, Kodansha.

Albers, F. 1996. The taxonomic status of *Sarcocaulon* (Geraniaceae). *S. African J. Bot.* 62: 345-347.

Albers, F. & Van der Walt, J.J.A. 2007. Geraniaceae. In: Kubitzki, K. (ed.). *The Families and genera of vascular plants* 9: 157-167. Leipzig, Springer.

Alfarhan, A. & Thomas, J. 2001. Geraniaceae. In: Chaudhary, S.A. (eds.). *Flora of the Kingdom of Saudi Arabia* 2(1): 543-562. Riyadh, National Agriculure and Water Research Center.

Allan, H.H. 1961. *Flora of New Zealand* 1: 233-237. Wellington, R.E. Owen.

Al-Shehbaz, I.A., Al-Khakani, M.K. & Al-Mayah, A.A. 1983. New or noteworthy taxa for the flora of Iraq. *Candollea* 38: 349-358.

Alves, M.C. & Leitão, M.T. 1976. Contribuçao para o conhecimento citotaxonomico des Spermatophyta de Portugal XIII. *Bol. Soc. Brot. ser.* 2, 50: 231-245.

Andreev, N. 1982. IOPB Chromosome number reports LXXVI. *Taxon* 31: 574-598.

Andrews, H.C. 1805-06. *Geraniums: or a monograph of the genus Geranium.* London, R. Taylor.

Arias, J. C. 1968. *La expediciones científicas españolas durante el siglo XVIII*. Madrid, Ediciones Cultura Hispánica.

Arohonka, T. 1982. Chromosome counts of vascular plants of the island Seili in Nauvo, SW Finland. *Ann. Univ. Fenn. Abo., A* 3: 1-12.

Arora, J., Lakhanpaul, S. & Pandit, M.K. 2020. IATP chromosome data 33/1. *Taxon* 69: 1396.

Arreguín, M.L. 1979. *Geranium* L. In: Rzedowski, J. & Rzedowski, G.C. (eds.). *Flora Fanerogámica del Valle de México* 1: 355-359. México, Ed. Continental.

Aryavand, A. 1983. IOPB chromosome number reports LXXIX. *Taxon* 32: 321-322.

Asai, Y. 1975. On *Geranium dissectum* L., a new alien crane´s bill in Japan. *J. Jap. Bot.* 50: 159. [in Japanese].

Asikainen, E. & Mutikainen, P. 2003. Female frequency and relative fitness of females and hermaphrodites in gynodioecious *Geranium sylvaticum* (Geraniaceae). *Amer. J. Bot.* 90: 226-234.

Asikainen, E. & Mutikainen, P. 2005a. Preferences of Pollinators and herbivores in Gymnodioecious *Geranium sylvaticum. Ann. Bot. (Oxford)* 95: 879-886.

Asikainen, E. & Mutikainen, P. 2005b. Pollen and resource limitation in a gymnodioecious species. *Amer. J. Bot.* 92: 487-494.

Baker, H.G. 1955. *Geranium purpureum* Vill. and *G. robertianum* L. in the British flora, I. *Geranium purpureum. Watsonia* 3: 160-167.

Baker, H.G. 1956. *Geranium purpureum* Vill. and *G. robertianum* L. in the British

flora, II. *Geranium robertianum. Watsonia* 3: 270-278.
Baker, H.G. 1957. Genecological studies in *Geranium* (Section *Robertiana*). General considerations and the races of *G. purpureum* Vill. *New Phytol.* 56: 172-192.
Bakker, F.T., Breman, F. & Merckx, V. 2006. DNA sequence evolution in fast evolving mitochondrial DNA nad1 exons in Geraniaceae and Plantaginaceae. *Taxon* 55: 887-896.
Baltisberger, M. 1984. Zytologische Untersuchungen an einigen Pflanzen aus Albanien. *Ber. Geobot. Inst. E.T.H. Stiftung Rübel* 51: 63-77.
Baltisberger, M. 1987. Chromosomenzahlen einiger Pflanzen aus Albanien. *Ber. Geobot. Inst. E.T.H. Stiftung Rübel* 53: 47-63.
Baltisberger, M. 1991a. Cytological investigations of some Greek plants. *Fl. Medit.* 1: 157-173.
Baltisberger, M. 1991b. IOPB chromosome data 3. *Int. Organ. Pl. Biosyst. Newslett.* 17: 5-7.
Baltisberger, M. 1992. Botanische Notizen und zytologische Untersuchugen an einigen Pflanzen (insbesondere aus den Gattungen Ranunculus und Achilea) aus dem albanisch-jugoslawischen Grenzgebiet (Korab, Sar Planina). *Ber. Geobot. Inst. E.T.H. Stiftung Rübel* 58: 192-211.
Baltisberger, M. 1993. Two interesenting chromosome numbers from the Balkans. *Int. Organ. Pl. Biosyst. Newslett.* 20: 12-15.
Baltisberger, M. & Baltisberger, E. 1995. Cytological data of Albanian plants. *Candollea* 50: 457-493.
Baltisberger, M. & Huber, W. 1987. 3. Chromosome number report. *Int. Organ. Pl. Biosyst. Newslett.* 9: 4-5.
Baltisberger, M. & Huber, W. 1993. IOPB chromosome data 5. *Int. Organ. Pl. Biosyst. Newslett.* 20: 4-7.
Barboza, G. 1983. Recuentos cromosómicos en Geraniáceas argentinas. I. *Bol. Soc. Argent. Bot.* 22: 143-145.
Barboza, G. 1996. Geraniaceae. *Flora Fanerogámica Argentina*. Fascículo 26. 129. Córdoba, Proflora, Conicet.
Barboza, G. 1999. Geraniaceae. In: Zuloaga, F.O. & Morrone, O. (eds.). Catálogo de las Plantas Vasculares de la República Argentina II. *Monogr. Syst. Bot. Missouri Bot. Gard.* 74: 755-758.
Barboza, G. & Correa, M.N. 1988. *Geranium* L. In: Correa, M.N. (ed.). *Flora Patagonica* 8(5): 31-41. Buenos Aries, Colección científica del I.N.T.A.
Baskin, J.M. & Baskin, C.C. 1974. Some eco-physiological aspects of seed dormancy in *Geranium carolinianum* L. from Central Tennessee. *Oecologia* 16: 209-219.
Baskin, J.M. & Baskin, C.C. 2004. A classification system for seed dormancy. *Seed Sci. Research* 14: 1-16.
Batanouny, K.H. 1981. Ecology and flora of Qatar. University of Qatar 114, plate 56.
Bate-Smith, E.C. 1973. Chemotaxonomy of *Geranium. Bot. J. Linn. Soc.* 67: 347-359.
Bate-Smith, E.C. 1981. Astringent tannins of the leaves of *Geranium* species. *Phytochemistry* 20: 211-216.
Bauhin, J., Cherler, J.H. & Chabrey, D. 1651. *Historia plantarum* 3: 472-481. Edbroduni.
Bauhin, C. 1623. *Pinax Theatri Botanici*. Basileae, Sumptibus & typis Ludovici Regis.
Beaman, J.H., de Jong, D.C.D. & Stoutamire, W.P. 1962. Chromosome studies in the alpine and subalpine floras of Mexico and Guatemala. *Amer. J. Bot.* 49: 41-50.
Belaeva, V.A. & Siplivinsky, V.N. 1975. Chormosome numbers and taxonomy of some species of Baikal flora. *Bot. Zhurn. S.S.S.R.* 60: 864-872. [in Russian].
Belaeva, V.A. & Siplivinsky, V.N. 1981. IOPB Chormosome numbers reports LXXIII. *Taxon* 30: 857-860.
Bentham, G. & Hooker, J.D. 1862. *Genera Plantarum* 1(1): 269-278. London, A. Black.
Bertero, C.J. 1829. Lista de plantas que han sido observadas en Chile en 1928, por el Dr. Carlos José Bertero. *Mercurio Chileno* 14: 643.
Bertin, R.I. 2001. Life cycle, demography, and reproductive biology of herb Robert (*Geranium robertianum*). *Rhodora* 103: 96-116.
Bertoloni, A. 1850. *Flora italica* 7: 206-243. Bologna, Haerederum R. Masii.
Blazhevich, P.Y. & Shablunskii, N.I. 1977. O proizrastanii geranii temnoi (*Geranium phaeum* L.) no novogrudskoi vozvyshennosti. *Botanika (Minks)* 19: 149-151. [in Russian].
Bobrov, E.G. 1949. *Geranium* L. In: Shishkin, B.K. & Bobrov, E.G. (eds.). *Flora of the U.R.S.S.* ["U.S.S.R." in the English ed.] 14: 2-62 [3-49 in the English ed.]. Koenigstein, Koelzt Scientific Books.
Böcher, T.W. 1947. Cytogenetic and Biological Studies in *Geranium robertianum* L. *Biol. Meddel. Kongel. Danske Vidensk. Selsk.* 20: 3-29.
Böcher, T.W. & Larsen, K. 1955. Chromosome studies on some European flowerings plants. *Bot. Tidsskr.* 52: 125-132.
Böcher, T.W. & Larsen, K. 1958. Experimental and cytological studies plants species. IV. Further studies in short-lived herbs. *Biol. Skr.* 10: 1-24.
Böcher, T.W. & Lewis, M.C. 1962. Experimental and cytological studies on plant species. VII. *Geranium sanguineum. Biol. Skr.* 11: 1-25.
Boesewinkel, F.D. 1988. The seed structure and taxonomic relationships of *Hypseocharis* Remy. *Acta Bot. Neerl.* 37: 111-120.
Boesewinkel, F.D. 1997. Seed structure and phylogenetic relationships of the Geraniales. *Bot. Jahrb. Syst.* 119: 277-291.
Boesewinkel, F.D. & Been, W. 1979. Developement of ovule and testa of *Geranium pratense* L. and some other representatives of the Geraniaceae. *Acta Bot. Neerl.* 28: 335-348.
Bohlin, A. 1997. En möjlig hybrid mellan svedjenäva och brandnäva [A possible hybrid *Geranium bohemicum* × *lanuginosum*]. *Svensk Bot. Tidskr.* 90: 273-276.
Boissier, É. 1867. *Flora orientalis* 1: 864-884, 959. Basel, Genève & Lyon, H. Georg.
Boissier, É. 1888. *Flora orientalis*, *Supplementum.* Basel, Genève & Lyon, H. Georg.
Bonnet, E. & Barratte, G. 1896. *Catalogue raisonné des plantes vasculaires de la Tunisie*. Paris, Imprimerie Nationale.
Bono, G. 1996. *Flora y vegetación del estado de Táchira Venezuela.* Torino, Museo regionale di scienze naturali.
Borgmann, E. 1964. Anteil der Polyploiden in der Flora des Bismarckgebirges von Ostneuguinea. *Z. Bot.* 52: 118-172.
Bortenschlager, S. 1967. Vorläufige Mitteilunge zur Pollenmorphologie in der Familie der Geraniaceen und IHRE Systematische Bedeutung. *Grana Palynol.* 7: 400-468.
Brandes, D. 2004. *Geranium pyrenaicum* Burm. f., ein erfolgreicher, aber unauffälliger Neophyt? *Geranium pyrenaicum* Burm. f., a successful but inconspicuous alien? *Braunschweiger Naturkundliche Schriften* 7(1): 49-71.
Briquet, J. & Litardière, R. 1936. *Prodrome de la Flore Corse* 2(2): 5-37. Paris, P. Chevalier.
Britten, J. & Woodward, B.B. 1905. L'Héritier's Botanical Works. *J. Bot.* 43: 266-278.
Bubani, P. 1901. *Flora Pyrenaea* 3: 307-319. Milano, U. Hoepli.
Burdet, H. M. 2008. *Collecteurs de Candolle*. DVD.
Burdet, H.M., Charpin, A. & Jacquemoud, F. 1984. Types nomenclaturaux des taxa ibériques décrits par Boissier ou Reuter. VI. Euphorbiacées à Guttifères. *Candollea* 39: 771-789.
Burger, W. 1991. Flora costaricensis; family nº 99. Geraniaceae. *Fieldiana, Bot.* 28: 16-21.
Burman, N.L. 1759. *Specimen botanicum de Geraniis.* Leiden, Theodoor Haak.
Buttler, K.P. 1989. Chromosomenzahlen von Gefässpflanzen aus Hessen, 4. Folge. *Hess. Florist. Briefe* 38: 11-14.
Carlquist, S. 1980. *Hawaii, a natural history*. Lawai, Kauai, Hawaii, Pacific Tropical Botanical Garden.
Carlquist, S. & Bissing, D.R. 1976. Leaf anatomy of Hawaiian Geraniums in

relation to ecology and taxonomy. *Biotropica* 8: 248-259.

Carolin, R.C. 1964. Geraniaceae. In: Van Steenis, C.G.G.J. (ed.). *Flora Malesiana* 1(6): 445-449. Bogor, Leyden.

Carolin, R.C. 1965. The genus *Geranium* L. in the south western Pacific area. *Proc. Linn. Soc. New S. Wales* 89: 326-361, plates VI-VII.

Carr, G.D. 1978. Chromosome numbers of Hawaiian flowering plants and the significance of cytology in selected taxa. *Amer. J. Bot.* 65: 236-242.

Caruel, T. 1858. *Illustratio in hortum siccum Andreae Caesalpini.* Florentiae, Le Monnier.

Cavanilles, A.J. 1787. *Monadelphiae classis dissertationes decem. Quarta dissertatio botanica.* Parisiis, apud Franciscum Amb. Didot.

Celani, E. 1902. Sopra un erbario di Gherardo Cibo conservato nella R. Biblioteca Angelica di Roma. *Malpighia* 16: 1-46.

Cesalpino, A. 1583. *De Plantis libri XVI*. Florentiae, apud Georgium Marescottum.

Chang, S.-M. 2006. Female compensation through the quantity and quality of progeny in a gynodioecious plant, *Geranium maculatum* (Geraniaceae). *Amer. J. Bot.* 83: 263-270.

Chatterjee, A. & Sharma, A.K. 1970. Chromosome study in Geraniales. *Nucleus (Calcutta)* 13: 179-200.

Chaudhri, M.N., Vegter, I.H. & De Wal, C.M. 1972. Index herbariorum. Part II(3). I-L. *Regnum Veg.* 86.

Chiarugi, A. 1937. Sul limite boreale dell'area geografica del *Geranium argenteum* L. nelle Dolomiti Occidentali. *Nuovo Giorn. Bot. Ital. ser. 2,* 44: 635-640.

Chiovenda, E. 1928. Un antichissimo Erbario Anonimo del Museo Botanico di Firenze. *Ann. Bot. (Rome)* 19: 122-144.

Chrtek, J. 1968. *Geraniopsis* eine neue Gattung der familie Geraniaceae. *Novit. Bot. Delect. Seminum Horti Bot. Univ. Carol. Prag.* 1967: 9.

Ciaciura, M., Więcław, H., & Czerwińska, E. 2001. Rozmieszczenie *Geranium pyrenaicum* (Geraniaceae) w Polsce [Distribution of *Geranium pyrenaicum* (Geraniaceae) in Poland]. *Fragm. Florist. Geobot. Polonica* 8: 93-104.

Claphman, A.R, Tutin, T.G. & Moore, D.M. 1989. *Flora of the British Isles ed. 3.* Cambridge, New York, Cambridge Univ. Press.

Clement, E.J. 1997. *Geranium aequale* a new native crane's-bill. *Bot. Soc. Brit. Isles News* 84: 17-19.

Contandriopoulos, J., Noguet, D. & Zevaco-Schmitz, C. 1987. Contribution a l'etude de quelques especes interessantes de Corse: cytotaxonomie et comportement ecologique. *Rev. Biol.-Écol. Médit.* 10: 259-271.

Cooperative Group of the Flora of Anhui. 1988. *Flora of Anhui* 3: 219-226. Beijing, China Prospect Publishing House and technology Publishing House. [in Chinese].

Corriveau, J.L. & Coleman, A.W. 1988. Rapid Screening Method to Detect Potential Biparental Inheritance of Plastid DNA and Results for Over 200 Angiosperm Species. *Amer. J. Bot.* 75: 1443-1458.

Cristofolini, G. & Nepi, C. 2021. La paternità del cosiddetto "Erbario Merini" conservato presso il Museo di Storia Naturale dell'Università di Firenze: una questione aperta. *Not. Soc. Bot. Ital.* 5: 1-4.

Cruden, R.W. 1976. Intraspecific variation in pollen-ovule ratios and nectar secretion–Preliminary evidence of ecotypic adaptation. *Ann. Missouri Bot. Gard*. 63: 277-289.

Cruden, R.W. 1977. Pollen-ovule ratios: a conservative indicator of breeding systems in flowering plants. *Evolution* 31: 32-46.

Dahlgren, K.V.O. 1923. *Geranium bohemicum* L. × *G. bohemicum *deprehensum* Erik Almq., ein grün-weiss-marmorierter Bastard. *Hereditas (Lund)* 4: 239-250.

Dahlgren, K.V.O. 1949. En spontan bastard mellan *Geranium lanuginosum* och *Geranium bohemicum. Bot. Not.* 1949: 359-365.

Dahlgren, K.V.O. 1952. Chromosomes in *Geranium bohemicum* and *G. lanuginosum* with some notes on the hybrid. *Hereditas (Lund)* 38: 314-320.

Dahlgren, R., Karlsson, Th. & Lassen, P. 1971. Studies on the flora of the Balearic Island. I. Chromosome numbers in Balearic angiosperms. *Bot. Not.* 124: 249-269.

Dalgaard, V. 1986a. Chromosome studies in flowering plants from Macaronesia. *Anales Jard. Bot. Madrid* 43: 83-111.

Dalgaard, V. 1986b. Chromosome numbers in flowering plants from Madeira. *Willdenowia* 16: 221-240.

Dalgaard, V. 1991. Chromosome studies in flowering plants from Macaronesia II. *Willdenowia* 20: 139-152.

Davis, P.H. 1967. *Geranium* L. In: Davis, P.H., Cullen, J. & Coode, J.E. (eds.). *Flora of Turkey* 2: 451-474. Edinburgh, Univ. Press.

Davis, P.H. 1970. *Geranium* sect. *Tuberosa*, revision and evolutionary interpretation. *Israel J. Bot.* 19: 91-113.

Davis, P.H. & Roberts, J. 1955. Materials for a Flora of Turkey I. -Geraniaceae. *Notes Roy. Bot. Gard. Edinburgh* 22: 9-27.

Dawe, J.C. & Murray, D.F. 1979. IOPB Chromosome number reports LXIII. *Taxon* 28: 265-268.

Dawson, M.I. & Beuzenberg, E.J. 2000. Contributions to a chromosome atlas of the New Zealand flora 36. Miscellaneous families. *New Zealand J. Bot.* 38: 1-23.

De Candolle, A.L.P.P. 1874. *Calques de dessins de la flore du Mexique*. Genève.

De Candolle, A.P. 1805, 1815. *Geranium* L. In: Lamarck, J.B. & De Candolle, A.P. *Flore Française ed. 3.* 4, 844-853, 6: 628-629. Paris, Desray.

De Candolle, A.P. 1823. Rapport sur les plantes rares ou nouvelles qui ont fleuri dans le jardin de botanique de Genève pendant les années 1819, 1820 et 1821. *Mém. Soc. Phys. Genève* 1: 431-463.

De Candolle, A.P. 1824. *Prodromus systematis naturalis regni vegetabilis* 1: 639-644. Paris, Strasbourg & London, Treuttel & Würtz.

de Lange, P.J., Gardner, R.O., Crowcroft, G.M., Cameron, E.K., Stalker, F., Christian, M.L. & Braggins, J.E. 2005a. Vascular flora of Norfolk Island: some additions and taxonomic notes. *New Zealand J. Bot.* 43: 563-596.

de Lange, P.J., Murray, B.G. & Datson, P.M. 2004. Contributions to a chromosome atlas of the New Zealand flora-38. Counts for 50 families. *New Zealand J. Bot.* 43: 873-904.

De Leonardis, W., Pavone, P., Terrasi, M.C. & Zizza, A. 1981. Numeri cromosomici per la Flora Italiana: 814-830. *Inform. Bot. Ital.* 13(2-3): 158-167.

Deflers, A. 1889. *Voyage au Yemen.* Paris, P. Klincksieck.

Degener, O. & Greenwell, A.B. 1937. *Flora Hawaiiensis, fam. 171. Geraniaceae. Neurophyllodes arboreum. Rep. 1946.* Honolulu, publ. priv.

Delay, J. & Vivant, J. 1978. Sur quelques endémiques pyrénéennes. Cytotaxonomie (1er partie). *Bull. Soc. Bot. France* 125: 485-492.

Dersch, G. 1974. Über einige Chromosomenzählungen an mitteleuropäischen Blütenpflanzen. *Philippia* 2: 75-82.

Devesa, J.A. 1981. Números cromosómicos para la flora española. 182-256. Números 182-187. *Lagascalia* 10(2): 225-227.

Díaz Lifante, Z., Luque, T. & Santa Bárbara, C. 1992. Chromosome numbers of plants collected during Iter Mediterraneum II in Israel. *Bocconea* 3: 229-250.

Dlussky, G.M., Lavrova, N.V. & Erofeeva, E.A. 2000. Mechanisms of restiction of pollinator range in *Chamaenerion angustifolium* and two *Geranium* species (*G. palustre* and *G. pratense*). *Zhurn. Obshchei Biol.* 61: 181-197. [in Russian].

Dmitreva, S.A. & Parfenov, V.I. 1985. Kariologicheskaja kharakteristika nekotorykh vidov poleznykh rastenij flory Belorussii. *Izv. Akad. Nauk Belorussk. SSR.* 6: 3-8. [in Russian].

Dmitrieva, S.A. 1986. Chisla khromosom nekotorych vidov rastenij Berezinskogo Biosfernogo Zapovednika. *Zapov. Belorussii Issl.* 10: 24-28. [in Russian].

Dmitrieva, S.A., Parfenov, V.I. & Schvec, I.V. 1977. The karyological characterization of some species of the Belorussian flora. *Vesci Akad. Navuk Belarusk. SSR, Ser. Bijal. Selskagasp. Navuk* 19: 82-91. [in Russian].

Don, D. 1825. *Prodromus Florae Nepalensis.* London, J. Gale.

Douglas, G.W., Straley, G.B. & Meidinger, D. 1989. *The Vascular Plants of British Columbia.* Victoria, BC Ministry of Forest.

Downie, S.R. & Palmer, J.D. 1992. Use of Chloroplast DNA Rearrangements in Reconstructing Plant Phylogeny. In: Soltis, P., Soltis, D. & Doyle, J. (eds.). *Molecular Systematics of Plants*. Pp. 14-35. New York, Chapman & Hall.

Drabble, E. & Drabble, H. 1908. *Geranium pratense* x *robertianum. J. Bot.* 46: 301.

Dragunova, E.V. 1985. The ultrastructure of ovule integuments in *Geranium gracile* (Geraniaceae). *Bot. Zhurn. (Moscow & Leningrad)* 70: 1334-1336. [in Russian].

Dreyer, L.L., Leistner, O.A., Burgoyne, P. & Smith, G.F. 1997. *Sarcocaulon*: genus or section of *Monsonia* (Geraniaceae)? *S. African J. Bot.* 63: 240.

Du Rietz. C.E. 1930. The fundamental units of biological taxonomy. *Svensk Bot. Tidskr.* 24: 333-429.

Dumont de Courset, G.L.M. 1802, 1805. *Le botaniste cultivateur* 3: 5-31, 58-59; 5: 367-388. Paris, J.J. Fuchs & A. Bertrand.

Dumont de Courset, G.L.M. 1811. *Le botaniste cultivateur ed. 2*, 5: 1-49. Paris, Déterville, Goujon.

Dumortier, B.C.J. 1827. *Florula belgica.* Tournay, J. Casterman.

Dvořák, F. & Dadáková, B. 1984. Chromosome counts and chromosome morphology of some selected species. *Folia Geobot. Phytotax.* 19: 41-70.

Edgeworth, M.P. & Hooker, J.D. 1874. Geraniaceae. In: Hooker, J.D. *The Flora of British India* 1: 426-440. London, L. Reeve & Co.

Endress, P.K. 2010. Synorganisation without organ fusion in the flowers of *Geranium robertianum* (Geraniaceae) and its not trivial obdiplostemony. *Ann. Bot. (Oxford)* 106: 687-695.

Erbar, C. 1998. Coenokarpie ohne und mit Compitum: ein Vergleich der Gynoecen von *Nigella* (Ranunculaceae) und *Geranium* (Geraniaceae). *Beitr. Biol. Pflanzen* 71(1): 13-69.

Esfandani Bozchaloyi, S., Sheidai, M., Keshavarzi, M. & Noormohammadi, Z. 2018a. Morphometric and ISSR-Analysis of Local Populations of *Geranium molle* L. from the Southern Coast of the Caspian Sea. *Cytol. Genet.* 52: 309-321.

Esfandani Bozchaloyi, S., Sheidai, M., Keshavarzi, M., Noormohammadi, Z. 2017a. Analysis of genetic diversity in *Geranium robertianum* by ISSR markers. *Phytol. Balcan.* 23: 157–166.

Esfandani Bozchaloyi, S., Sheidai, M., Keshavarzi, M., Noormohammadi, Z. 2017b. Genetic and morphological diversity in *Geranium dissectum* (Sec. *Dissecta*, Geraniaceae) populations. *Biologia* 72: 1121-1130.

Esfandani Bozchaloyi, S., Sheidai, M., Keshavarzi, M., Noormohammadi, Z. 2017c. Genetic Diversity and Morphological Variability In *Geranium purpureum* Vill. (Geraniaceae) of Iran. *Genetika* 49: 543-557.

Esfandani Bozchaloyi, S., Sheidai, M., Keshavarzi, M., Noormohammadi, Z. 2017d. Species Delimitation In *Geranium* Sect. *Batrachioidea*: Morphological And Molecular. *Acta Bot. Hung.* 59: 319–334.

Esfandani Bozchaloyi, S., Sheidai, M., Keshavarzi, M., Noormohammadi, Z. 2018b. Species identification and population structure analysis in *Geranium* subg. *Geranium* (Geraniaceae). *Hacquetia* 17.

Estreller, A. (coord.) 2006. *De Materia Medica*. Published on the Internet http:// dioscorides.usal.es/, interactive Dioscorides based on the manuscript of the University of Salamanca.

Faasen, P.V. & Nadeau, P. 1976. IOPB chromosome number reports LI. *Taxon* 25: 156-158.

Favarger, C. 1965. Notes de carycologie alpine IV. *Bull. Soc. Neuchâteloise Sci. Nat. ser. 3,* 88: 5-60.

Favarger, C. 1975. Cytotaxonomie et histoire de la flore orophile des alpes et de quelques autres massif montagneux d'Europe. *Lejeunia ser. 2,* 77: 1-45.

Favarger, C., Galland, N. & Küpfer, Ph. 1979. Recherches cytotaxonomiques sur la flore orophile du Maroc. *Naturalia Monspel., Sér. Bot.* 29: 1-64.

Fawcett, W. & Rendle, A.B. 1920. *Flora of Jamaica.* London, British Museum.

Fernald, M.L. 1935. *Geranium carolinianum* and allies of northeastern North America. *Rhodora* 37: 295-301, pls. 371-374.

Fernández Casas, J., Pajarón, S. & Rodríguez Pascual M.L. 1978. Números cromosómicos para la flora española. 60-65. *Lagascalia* 8: 109-112.

Ferrarini, E. 1967. Studi sulla vegetazione di altitudine delle alpi Apuane. *Webbia* 22: 295-404.

Feuillée, L.É. 1725. *Journal des observations physiques, mathématiques et botaniques.* 3: 21, pl. 16. Paris, Jean Mariette.

Fiori, A. & Paoletti, G. 1901, 1907. *Flora analitica d'Italia* 2: 232-240, 4:157-159. Padova, Tip. Seminario. [G. Paoletti is co-author of the vols. 1-2; A. Béguinot is co-author of the vols. 2-3].

Fischer, F.E.L. & Meyer, C.A. 1835. *Index seminum, quae Hortus Botanicus Imperialis Petropolitanus pro mutua commutatione offert. Accedunt animadversiones botanicae nonnullae.* Petropoli.

Fiz, O., Vargas, P., Alarcón, M.L., Aedo, C. García, J.L. & Aldasoro, J.J. 2008. Phylogeny and Historical Biogeography of Geraniaceae in Relation to Climate Changes and Pollination Ecology. *Syst. Bot.* 33: 326-342.

Forbes, H.O. 1885. *A naturalist's wanderings in the Eastern Archipielago. Appendix VI. Prodromus florae timorensis*. *Polypetalae by J. Britten.* London, Sampson Low, Marston, Searle & Rivington.

Forsskål, P. 1775. *Flora Aegyptiaco-Arabica.* Hauniae, C. Niebuhr.

Fosberg, F.R. 1936. The Hawaiian Geraniums. *Occas. Pap. Bernice Pauahi Bishop Mus.* 12: 1-19.

Fosberg, F.R. 1942. Miscellaneous notes on Hawaiian plants-2. *Occas. Pap. Bernice Pauahi Bishop Mus.* 16: 337-347.

Franchet, A.R. 1885. Plantae Davidianae ex Sinuarum Imperio. Plantes du Thibet Oriental (province de Moupine). *Nouv. Arch. Mus. Paris ser. 2,* 8: 183-254.

Franchet, A.R. 1887. Plantas Yunnanenses a cl. J.M. Delavay collectas. *Bull. Soc. Bot. France* 33: 358-467.

Franchet, A.R. 1889. *Plantae Delavayane.* Paris. Paul Klincksieck.

Franzén, R. 1983. *Geranium thessalum* sp. nov. from northern Greece. *Nordic J. Bot.* 2: 549-552.

Franzén, R. & Gustavsson, L.-Å. 1983. Chromosome numbers in flowering plants from the high mountains of Sterea Ellas, Greece. *Willdenowia* 13: 101-106.

Fritsch, R.M. 1973. IOPB chromosome number reports XLI. *Taxon* 22: 460-461.

Frodin, D.G. 2004. History and concepts of big plant genera. *Taxon* 53: 753-776.

Fryxell, P.A. 1991. The identity of *Sida radiciflora* C. Presl. *Taxon* 40: 613-614.

Fuchs, L. 1542. *De Historia Stripium commentarii insignes*. Basileae, in officina Isingriana.

Gadella, T.W.J. & Kliphuis, E. 1966. Chromosome numbers of flowering plants in the Netherlands II. *Proc. Kon. Ned. Akad. Wetensch. C.* 69: 541-556.

Gadella, T.W.J. & Kliphuis, E. 1967. Chromosome numbers of flowering plants in the Netherlands. III. *Proc. Kon. Ned. Akad. Wetensch. C.* 70: 7-20.

Gagnepain, M.F. 1903. Contribution à l´étude du pollen des Géraniacées. *Bull. Soc. Hist. Nat. Autun* 16: 83-97.

Galland, N. 1988. Recherche sur l'origine de la flore orophile du Maroc: etude caryologique et cytogeographique. *Trav. Inst. Sci. Univ. Mohammed V, Sér. Bot.* 35: 1-168.

Gama-Arachchige, N.S., Baskin, J.M., Geneve, R.L. & Baskin, C.C. 2010. Identification anc characterization of the water gap in physically dormant seeds of Geraniaceae, with special reference to *Geranium carolinianum. Ann. Bot. (Oxford)* 105: 977-990.

Gama-Arachchige, N.S., Baskin, J.M., Geneve, R.L. & Baskin, C.C. 2011. Acquisition of physically dormancy and ontogeny of the micropyle-water-gap complex in developing seeds of *Geranium carolinianum* (Geraniaceae). *Ann. Bot. (Oxford)* 108: 51-64.

Gama-Arachchige, N.S., Baskin, J.M., Geneve, R.L. & Baskin, C.C. 2012. The autumn effect: timing of physical dormancy break in seeds of two winter annual species of Geraniaceae by a stepwise process. *Ann. Bot. (Oxford)* 110: 637-651.

Gamisans, J. & Jeanmonod, D. 1993. *Catalogue des plantes vasculaires de la Corse (Seconde édition)*. Genève, Conservatoire et Jardin Botaniques de la Ville de Genève.

Gams, H. 1924. *Geranium* L. In: Hegi, G. (ed.). *Illustrierte flora von Mittel-Europa* 4(3): 1668-1716. München, J. F. Lehmann.

García-Aloy, S., Sanmartín, I., Kadereit, G., Vitales, D., Roquet, C.,Vargas, P., Alarcón, M. & Aldasoro, J.J. 2017. Opposite trends in the genus *Monsonia* (Geraniaceae): specialization in the African deserts and range expansions throughout eastern Africa. *Sci. Rep.* 7: 9872.

Gardner, R.O. 1984. *Geranium solanderi* and allies in New Zealand. *New Zealand J. Bot.* 22: 127-134.

Gardner, R.O. 1999. *Geranium aequale* (Bab.) Aedo in New Zealand. *New Zealand Bot. Soc. Newsletter* 57: 15-16.

Garilleti, R. 1993. Herbarium cavanillesianum. *Fontqueria* 38: 1–248.

Gaudin, I. 1829. *Flora Helvetica* 4: 393-417. Zürich, Orelli & Co.

Gauger, W. 1937. Ergebnisse einer zytologischen Untersuchung der Familie der Geraniaceae. I. *Planta* 26: 529-531.

Gay, C. 1846. *Historia fisica y politica de Chile* 1(4): 379-386. Paris, Santiago, E. Thunot & al.

Genova, E. & Ivancheva, S. 1995. Quantitative analysis of tannin content in *Geranium macrorrhizum* L. (Geraniaceae) growing in Bulgaria. *Phytol. Balcan.* 1: 93-99.

Ghafoor, A. 1978. *Geranium* L. In: Jafri, S.M.H. & El-Gadi, A. (eds.). *Flora of Libya* 63: 41-57. Tripoli, Al Faateh University.

Gilbert, M.G. & Vorster, P. 2000. *Geranium* L. In: Edwards, S., Tadesse, M., Demissew, S. & Hedberg, I. (eds.). *Flora of Ethiopia & Eritrea* 2(1): 364-369. Addis Ababa & Uppsala, National Herbarium & Uppsala Univ.

Godron, D.A. 1847. *Geranium* L. In: Grenier, J.Ch.M. & Godron, D.A. *Flore de France* 1: 297-306. Paris, J.B. Baillière.

González Elizondo, M., González Elizondo, S. & Herrera, Y. 1991. *Listados florísticos de México IX. Flora de Durango.* México, Universidad Nacional Autónoma de México.

Graça, V.C., Barros, L., Calhelha, R.C., Dias, M.I., Carvalho, A.M., Santos, C., Ferreira, I, & Santos, P.F. 2016. Chemical characterization and bioactive properties of *Geranium molle* L.: from the plant to the most active extract and its phytochemicals. *Food Funct.* 7: 2204-2212.

Gray, A. 1854. *United States Exploring Expedition* 1: 308-316, tab. 29-31. New York, G.P. Putnam. [drawings are from 1856].

Green, B.B. 1978. Comparative ecology of *Geranium richardsonii* and *Geranium* nervosum. *Bull. Torrey Bot. Club* 105: 108-113.

Greuter, W. 1968. Notulae nomenclaturales et bibliogaphicae 1-4. *Candollea* 23: 81-108.

Gronovius, J. 1743. *Flora virginica.* Leiden, C. Haak. [reprint from the 1739 ed.].

Grossheim, A.A. 1932. *Flora Kavkaza* 3: 1-8. Tiflis & Baku. [in Russian].

Grossheim, A.A. 1962. *Flora Kavkaza*, ed. 2, 6: 9-22, maps 1-25. Baku, Moscova & Leningrad, Akademia Nauk SSSP. [in Russian].

Guisinger, M.M., Kuehl, J.V., Boore, J.L., & Jansen, R.K. 2011. Extreme Reconfiguration of Plastid Genomes in the Angiosperm Family Geraniaceae: Rearrangements, Repeats, and Codon Usage. *Molec. Phylogen. Evol.* 28: 583–600.

Guisinguer, M.M., Kuehl, J.V., Boore, J.L. & Jansen, R.K. 2008. Genome-wide analyses of Geraniaceae plastid DNA reveal unprecedented patterns on increased nucleotide substitutions. *Proc. Natl. Acad. Sci. U.S.A.* 105: 18424-18429.

Guittonneau, G.G. 1967. Note sur le texte de la Geraniologia de L'Héritier. *Bull. Soc. Bot. France* 114: 42-45.

Guittonneau, G.G. 1975. Contribution à l´étude caryosystématique et phylogénétique des Géraniacées dans le bassin méditarranéen. *Colloq. Int. C.N.R.S.* 235: 195-205.

Gureyeva, I.I. & Balashova, V.F. 2017. Type specimens of Geraniaceae in the P.N. Krylov Herbarium (TK). *Syst. Notes Krylov Herb.* 115: 12-22. [in Russian].

Gvinianidze, Z. & Avazneli, A. 1980. Investigatio caryologica complexus florisciti. *Not. Syst. Georg. Inst. Bot. Akad. Nauk. Gruzinsk (Tbilisi)* 36: 71-74. [in Russian].

Halfdan-Nielsen, B. 1996. Five new species of *Geranium* (Geraniaceae) from Ecuador. *Nordic J. Bot.* 16: 267-275.

Halloy, S.R.P. 1998. A new and rare, plate-shaped *Geranium* from the Cumbres Calchaquíes, Tucumán, Argentina. *Brittonia* 50: 467-472.

Hanks, L.T. & Small, J.K. 1907. *Geranium* L. In: Britton, L.T. & Small, J.K. *North American Flora* 25: 3-21. New York, New York Botanical Garden.

Hansen, B., Larsen, K. & Olsen, S-E. S. 1997. Protologues in seed catalogues from Botanic Garden Copenhagen 1843-1875. *Biol. Skr.* 47: 1-53.

Hara, H. 1952. Contributions to the study of variations in the Japanese plants closely related to those of Europe or North America. Part. 1. *J. Fac. Sci. Univ. Tokyo, Sect. 3, Bot.* 6: 29-96.

Hara, H. 1954. A new *Geranium* from Nepal collected by Sasuke Nakao. *Acta Phytotax. Geobot.* 16: 1.

Hara, H. 1955. *Geranium nakaoanum*. In: Kihara, H. (ed.). *Fauna and Flora of Nepal Himalaya. Scientific results of the Japanese expeditions to Nepal Himalaya, 1952-1953.* Pp. 276-278. Kyoto, Fauna and flora research Soc.

Hara, H. 1979. *Geranium* L. In: Hara, H. & Williams, L.H.J. *An enumeration of the flowering plants of Nepal* 2: 75-77. London, Trustees of British Museum (Natural History).

Hayek, A. 1925. Prodromus Florae peninsulae Balcanicae. *Repert. Spec. Nov. Regni Veg. Beih.* 30: 568-576.

Hedberg, I. & Hedberg, O. 1977. Chromosome numbers of afroalpine and afromontane angiosperms. *Bot. Not.* 130: 1-24.

Heenan, P., Mitchell, A.D., De Lange, P.J., Keeling, J. & Paterson, A.M. 2010. Late-Cenozoic origin and diversification of Chatham Islands endemic plants species revealed by analyses of DNA sequence data. *New Zealand J. Bot.* 48: 81-136.

Heitz, E. 1926. Der Nachweis der Chromosomen. Vergleichende Studien über ihre Zahl, Gröβe und Form im Pflanzenreich I. *Z. Bot.* 18: 625-681.

Hernández, F. 1649. *Rerum medicarum Novae Hispaniae thesaurus seu Plantarum animalium mineralium Mexicanorum historiam.* Roma, Vitalis Mascardi. [This is one of the N.A. Reccho editions of the Hernández manuscripts].

Herrera, J. 1991. Herbivory, seed dispersal and the distribution of a ruderal plant living in a natural habitat. *Oikos* 62: 209-215.

Hess, H.E., Landolt, E. & Hirzel, R. 1977. *Flora der Schweiz ed. 2*, 2: 615-629. Basel & Stuttgart, Birkhäuser Verlag.

Hessing, M.B. 1986. Pollen growth following self- and cross-pollination in *Geranium caespitosum* James. In: Mulcahy, D.L., Mulcahy, G.B. & Ottaviano, E. (eds.). *Biotechnology and ecology of pollen.* Pp.

467-472. New York, Berlin, Heidelberg & Tokyo, Springer-Verlag.
Hessing, M.B. 1988. Geitonogamus pollination and its consequences in *Geranium caespitosum. Amer. J. Bot.* 75: 1324-1333.
Hessing, M.B. 1989. Variation in self-fertility and floral characters of *Geranium caespitosum* (Geraniaceae) along an elevational gradient. *Pl. Syst. Evol.* 166: 225-241.
Hill, L.M. 1989. IOPB chromosome data 1. *Int. Organ. Pl. Biosyst. Newslett.* 13: 17-19.
Hillebrand, W. 1888. *Flora of the Hawaiian Islands.* London, Williams & Norgate.
Hilliard, O.M. & Burtt, B.L. 1985. A revision of *Geranium* in Africa south of the Limpopo. *Notes Roy. Bot. Gard. Edinburgh* 42: 171-225.
Hohenacker, R.F. 1833. Enumeratio Plantarum in territorio Elisabethopolensi et in provincia Karabach sponte nascentium, quas collegit R. Fr. Hohenacker. *Bull. Soc. Imp. Naturalistes Moscou* 6: 210-261.
Hollingsworth, P.M., Gornall, R.J. & Bailey, J.P. 1992. Contributions to a cytological catalogue of the British and Irish flora, 2. *Watsonia* 19: 134-137.
Holmgren, N.H. 1997. *Geranium* L. In: Cronquist, A., Holmgren, N.H. & Holmgren, P. K. (eds.). *Intermountain Flora* 3A: 330-336. New York, New York Botanical Garden.
Hong, D.-Y. & Zhang, S.-Z. 1990. Observations on chromosomes of some plants from western Sichuan. *Cathaya* 2: 191-197.
Hooker, W.J. 1834. Contributions towards of Van Dieman's land; from collections sent by R.W. Lawrence, and Ronald Gunn, Esqrs., and by Dr. Scott. *J. Bot. (Hooker)* 1: 241-258.
Hooker, W.J. 1837. *Icones Plantarum Ser.* 2. London, Longman & al.
Howard, R.A. 1980. E.H. Wilson as a Botanist. *Arnoldia* 40: 154-193.
Huerta, G. 1624, 1629. *Historia Natural de Cayo Plinio Secundo, traducida por el Licenciado Geronimo de Huerta*. 2 vols. Madrid, Luis Sánchez Impressor del Rey.
Humboldt, F.W.H.A., Bonpland, A. & Kunth, C.S. 1822. *Nova genera et species plantarum* 5: 228-232. Paris, Libr. Graeco-Latino-Germanicae.
Hurrah, I.A. & Wagh, V. 2020. *Geranium jainii* (Geraniaceae), a new species from Himachal Pradesh, India. *Nordic J. Bot.* 38: e02850.
Hurrah, I.A. & Wagh, V. 2021. Revisiting the taxonomy of *Geranium kishtvariense* (Geraniaceae) & notes on neotypification. *Phytotaxa* 516: 169-177.
Hurrah, I.A., Shukla, A.R. & Wagh, V. 2021. *Geranium indicum,* a new scapigerous species of Geraniaceae from India. *Nordic J. Bot.* 2022: e03245.
Huynh, K.-L. 1965. Contribution à l'étude caryologique et embryologique des Phanérogames du Pérou. *Denkschr. Schweiz. Naturf. Ges.* 85: 1-178, 20 tabs.
Hyeon, W.J. & Park, S.J. 2006. Phylogenetic study of Korean *Geranium* (Geraniaceae) based on nrDNA ITS sequences. *Korean J. Pl. Tax.* 36: 91-108. [in Korean].
Ikeda, H., Shimizu, A. & Aedo, C. 2015. Nomenclature and Typification of *Geranium yesoense* var. *pseudopalustre* (Geraniaceae). *J. Jap. Bot.* 90: 281-284.
Ilçim, A. & Behçet, L. 2006. *Geranium kalenderianum* (Geraniaceae), a new species from Turkey. *Ann. Bot. Fenn.* 43: 451-455.
IPNI. 2021. *International Plant Names Index.* Published on the Internet http://www.ipni.org, The Royal Botanic Gardens, Kew, Harvard University Herbaria & Libraries and Australian National Botanic Gardens. [retrieved 1 October 2021].
Ishimaru, K. & Shimonura, K. 1991. Tannin production in hairy root culture of *Geranium thunbergii. Phytochemistry* 30: 825-828.
Ivancheva, S. & Petrova, A. 2000. A chemosystematic study of eleven *Geranium* species. *Biochem. Syst. Ecol.* 28: 255-260.
Ivleva, V. 2013. Type specimens of names of some species of the genus *Geranium* L. (Geraniaceae) described by C. F. Ledebour. *Novosti Sist. Vyssh. Rast.* 44: 230-233. [in Russian].
Jackson, W. 1951. *Geranium pusillum* L. *Naturalist (Hull)* 1951: 114.
Jackson, W. 1952. What is *Geranium anemonefolium*? *Heredity* 6: 279.
James, E. 1823a. *Account of an expedition from Pittsburgh to the Rocky mountains, American ed.*, 2: 2-3. Philadelphia, H.C. Carey & I. Lea.
James, E. 1823b. *Account of an expedition from Pittsburgh to the Rocky mountains, English ed.*, 2: 186-191; 3: 344. London, Longman & al.
Jankun, A., Malecka, J., Izmailow, R., Wcislo, H., Czapik, R. & Musial, K. (eds.). 1996. Further studies in chromosome numbers of Polish angiosperms Part XXV. *Acta Biol. Cracov., Ser. Bot.* 38: 9-27.
Jarvis, C. 2007. *Order out of chaos.* London, Linnean Society.
Jarvis, C.E., Barrie, F.R. Allan, D.M. & Reveal, J.L. 1993. *A list of Linnaean Generic Names and their types.* Königstein, International Association for Plant Taxonomy.
Javurková, V. 1979. IOPB chromosome numbers reports LXIV. *Taxon* 28: 400-401.
Jones, G.N. & Jones, F.F. 1943. A revision of the perennial species of *Geranium* of the United States and Canada. *Rhodora* 45: 5-26; 32-53.
Jones, W.H. 1966. *Pliny Natural History with an English translation in ten volumes volume vii libri xxiv-xxvii*. Cambridge, Harvard Univ. Press & London, W. Heinemann.
Jørgensen, P. & León, S. (eds.). 1999. Catalogue of the Vascular Plants of Ecuador. *Monogr. Syst. Bot. Missouri Bot. Gard.* 75.
Kandori, I. 2002. Diverse visitors with various pollinator importance and temporal change in important pollinators of *Geranium thunbergii* (Geraniaceae). *Ecol. Res.* 17: 283-294.
Kenda, G. 1956. Das Hypoderm der Geraniaceen-Kelchblätter. *Phyton (Horn)* 6: 207-210.
Kent, D.H. 1959. 168/r. *Geranium retrorsum* L'Hérit. ex DC. *Proc. Bot. Soc. British Isles* 3: 284.
Kers, L.E. 1971. Notes on the flora of Angola. *Bot. Not.* 124: 16-24.
Kiehn, M., Vitek, E., Hellmayr, E., Walter, J. Tschnett, J. Justin, C. & Mann, M. 1991. Beiträge zur Flora von Österreich: Chromosomenzählungen. *Verh. Zool.-Bot. Ges. Österreich* 128: 19-39.
Kirschner, J., Stepánek, J. & Stepánková, J. 1982. IOPB chromosome number reports LXXVI. *Taxon* 31: 574-575.
Knuth, P. 1908. *Handbook of Flower Pollination* 2: 218-228. Oxford, Clarendon Press.
Knuth, R. 1903. Über die geographische Verbreitung und die Anpassungserscheinungen der Gattung *Geranium* im Verhältnis zu ihrer systematischen Gliederung. *Bot. Jahrb. Syst.* 32: 190-230.
Knuth, R. 1904. Die geographische verbreitung der gattung Geranium. *Schl. Gesell. Vaterl. Kultur* 81 II. Abt. Natur. b: 14-17.
Knuth, R. 1906. Geraniaceae andinae. *Bot. Jahrb. Syst.* 37: 555-568.
Knuth, R. 1908. Geraniaceae africanae. *Bot. Jahrb. Syst.* 40: 62-79.
Knuth, R. 1912. *Geranium* L. In: Engler, A. (ed.). *Das Pflanzenreich* IV.129 (Heft 53): 43-221, 575-583. Leipzig.
Knuth, R. 1913. *Geranium purpusii*, spec. nov. aus Mexico. *Repert. Spec. Nov. Regni Veg.* 12: 40.
Knuth, R. 1915. Herzog's bolivianische Pflanzen, II. *Meded. Rijks-Herb.* 27: 68-69.
Knuth, R. 1916. Geraniaceae. *Repert. Spec. Nov. Regni Veg.* 14: 328-329.
Knuth, R. 1922. Geraniaceae novae. Dekas I. *Repert. Spec. Nov. Regni Veg.* 18: 289-294.
Knuth, R. 1923. Geraniaceae novae. Decas 2. *Repert. Spec. Nov. Regni Veg.* 19: 228-233.
Knuth, R. 1930a. Geraniaceae novae. Decas 3 et 4. *Repert. Spec. Nov. Regni Veg.* 28: 1-10.
Knuth, R. 1930b. Dioscoreaceae novae. Decas 3-5. *Repert. Spec. Nov. Regni Veg.* 28: 87-93.
Knuth, R. 1931. Geraniaceae. In: Engler, A. & Harms, H. (eds.). *Die natürlichen Pflanzenfamilien ed. 2.* 19a: 43-66. Leizpig, Wilhelm Engelmann.

Knuth, R. 1933. Geraniaceae novae. Decas 6. *Repert. Spec. Nov. Regni Veg.* 34: 143-147.
Knuth, R. 1934. Geraniaceae. In: Mildbraed, J. Neue und seltene Arten aus Ostafrika (Tanganyika-Territ. Mandat) leg. H.J. Schlieben, V. *Notizbl. Bot. Gart. Berlin-Dahlem* 11: 1058-1092.
Knuth, R. 1936. Geraniaceae novae. Decas 7. *Repert. Spec. Nov. Regni Veg.* 40: 216-220.
Knuth, R. 1937a. Contributions to the flora of tropical America XXXIII. Plantae Hintonianae: V. *Bull. Misc. Inform. Kew* 10: 502-505.
Knuth, R. 1937b. Geraniaceae. *Biblioth. Bot.* 29: 98-99.
Knuth, R. 1938. Geraniaceae novae. Decas 8. *Repert. Spec. Nov. Regni Veg.* 45: 60-64.
Knuth, R. 1939. Geraniaceae. In: Melchior, H. Neue Arten vom Nanga Parbat leg. C. Troll. *Notizbl. Bot. Gart. Berlin-Dahlem* 14: 343-355.
Koch, W.D.J. 1835. *Synopsis Florae Germanicae et Helvetica* 1: 137-141. Frankfurt am Main, F. Wilmans.
Köie, M. 1945. Beitrag zur Flora Südwest-Irans I. In: Jessen, K. & Spärck, R. (eds.). *Danish Scientific investigations in Iran* 4: 9-55. Copenhagen, E. Munksgaard.
Kokwaro, J.O. 1969. Notes on East African Geraniaceae. *Kew Bull.* 23: 527-530.
Kokwaro, J.O. 1971a. The family "Geraniaceae" in North-East tropical Africa. *Webbia* 25: 623-669.
Konarska, A. & Masierowska, M. 2019. Structure of floral nectaries and female-biased nectar production in protandrous species *Geranium macrorrhizum* and *Geranium phaeum. Protoplasma* 257: 501-523.
Korhonen, J., Kytöviita, M.-M. & Siikamäki, P. 2004. Are resources allocated differently to symbiosis and reproduction in *Geranium sylvaticum* under different light conditions? *Canad. J. Bot.* 82: 89-95.
Krahulcová, A. 1990. Selected chromosome counts of the Czechoslovak Flora II. *Folia Geobot. Phytotax.* 25: 381-388.
Krogulevich, R.E. 1976. Chromosome numbers of plant species from the Tunkinsky Alpes (East Sayan). 1. *News Siber. Dep. Acad. Sci. USSR, Ser. Biol.* 15(3): 46-52. [in Russian].
Krogulevich, R.E. 1978. Karyological analysis of the species of the flora of easter Sayana. In: Malyshev, L.I. & Peshkova, G.A. (eds.). *Flora of the Prebaikal.* Pp. 19-48. Novosibirsk, Nauka, Sibirskoe otdnie. [in Russian].
Kumar, A. 1977. Studies in Geraniales: 5. The embryology of some Indian species of *Geranium* L. *J. Indian Bot. Soc.* 56: 328-334.
Küpfer, Ph. 1974. Recherches sur les liens de parenté entre la flore orophile des Alpes et celle des Pyrénées. *Boissiera* 23.
Kurata, S. Sakaguchi, S. & Ito, M. 2019. Genetic diversity and population demography of *Geranium soboliferum* var. *kiusianum*: a glacial relict plant in the wetlands of Japan. *Conservation Genetics* 20: 431-445.
Kurata, S. Sakaguchi, S., Hirota, S.K., Kurashima. O., Suyama, Y., Nishida, S. & Ito, M. 2021a. Refugia within refugium of *Geranium yesoense* (Geraniaceae) in Japan were driven by recolonization into the southern interglacial refugium. *Biol. J. Linn. Soc.* 132: 1-21.
Kurata, S., Sakaguchi, S., Ikeda, H., Hirota, S.K., Kurashima, O., Suyama, Y. & Ito, M. 2022. From East Asia to Beringia: reconstructed range dynamics of *Geranium erianthum* (Geraniaceae) during the last glaciar period in the northern Pacific region. *Pl. Syst. Evol.* 308: 28.
Kurata, S., Vasques, D.T., Sakaguchi, S., Hirota, S.K., Kurashima, O., Suyama, Y., Nishida, S. & Ito, M. 2021b. Phylogenetics of Japanese *Geranium* (Geraniaceae) using chloroplast genome sequences and genome-wide single nucleotide polymorphisms. *Pl. Syst. Evol.* 307: 63.
Laane, M.M. 1969. Meiosis and structural hybridity in some Norwegian plant species. *Blyttia* 27: 141-173.
Laane, M.M. 1971. Chromosome numbers in Norwegian vascular plants. *Blyttia* 29: 229-234.
Lam, H.J. 1945. Contributions to our knowledge of the flora of Celebes (coll. C. Monod de Froideville) and of some other Malaysian islands. *Blumea* 5: 554-599.
Lange, J. 1866. *Index seminum in horto academico Hauniensi a. 1865 collectorum.* Hauniae.
Larsen, K. 1956. Chromosome studies in some Mediterranean and South European flowering plants. *Bot. Not.* 109: 293-307.
Larsen, K. 1960. Cytological and experimental studies on the flowering plants of the Canary Islands. *Biol. Skr.* 11: 1-60.
Lauener, L.A. 1967. Catalogue of the names published by Hector Léveillé: V. *Notes Roy. Bot. Gard. Edinburgh* 27: 265-292.
Laundon, J.R. 1961. Notes on *Geranium* in Africa and Arabia. *Bol. Soc. Brot. ser. 2,* 35: 59-73, 5 pl.
Laundon, J.R. 1963. *Geranium* L. In: Exell, A.W., Fernandes, A. & Willd, H. (eds.). *Flora Zambesica* 2: 131-136. London.
Lawalrée, A. 2000. *Geranium aequale* (Babington) Aedo, une plante indigène méconnue en Belgique. *Adoxa* 28: 4.
Lazare, J.-J. & Royaud, A. 1994. Observations botaniques remarquables dans les Pyrénées. *Monde Pl.* 450: 1-4.
Lee, Y.N. 1967. Chromosome numbers of Flowering plants in Korea. *J. Korean Res. Inst. Ewha Women's Univ.* 11: 455-478.
Leifertová, I., Bučková, H. & Natherová, L. 1965. K chemotaxonomii znaku tříslovin u rodu *Geranium. Preslia* 37: 413-418.
Lewis, M.C. 1969. Genecological differentiation of leaf morphology in *Geranium sanguineum* L. *New Phytol.* 68: 481-503.
L'Héritier, C.L. 1792. Geraniologia. Paris, P.F. Didot.
Lidén, M. 1986. Synopsis of Fumarioideae (Papaveraceae) with a monograph of the tribe Fumarieae. *Opera Bot.* 88: l-133.
Lindley, J. & Paxton, J. 1851. *Paxton's flower garden* 1: 186. London, Bradbury & Evans.
Link, D.A. 1990. The nectaries of Geraniaceae. In: Vorster, P. (ed.). *Proceedings of the international Geraniaceae symposium.* Pp. 215-225. Stellenbosch, Univ. Stellenbosch.
Link, J.H.F. 1822. *Enumeratio Plantarum Horti Regii Berolinensis altera* 2: 196-198. Berolini, G. Reimer.
Linnaeus, C. 1753. *Species plantarum.* Stockholm, L. Salvii.
Linnaeus, C. 1767. *Mantissa plantarum 1.* Stockholm, L. Salvii.
Lojacono, M. 1906. Addenda et Emendanda ad Floram Siculam. *Malpighia* 20: 180-218.
López, G. 1982. Acerca de *Geranium acutilobum* Coincy. *Anales Jard. Bot. Madrid* 38: 528-529.
López, G. 2001. Sobre el año de publicación del fascículo sexto de las Notas Botánicas de C. Pau. *Anales Jard. Bot. Madrid* 59: 162.
López Udias, S., Fabregat, C. & Mateo, G. 1994. Historia, afinidades y distribución del conflictivo *Geranium benedictoi* Pau. *Xiloca* 13: 175-183.
Lousley, J.E. 1962. 168/R. *Geranium retrorsum* L'Hérit. *Proc. Bot. Soc. British Isles* 4: 413-414.
Löve, Á. 1965. IOPB chromosome number reports V. *Taxon* 14: 191-196.
Löve, Á. & Kjellqvist, E. 1974. Cytotaxonomy of Spanish plants. IV. Dicotyledons: Caesalpinaceae-Asteraceae. *Lagascalia* 4: 153-211.
Löve, Á. & Löve, D. 1945. Cyto-Taxonomical studies on boreal plants. III. Some new chromosome numbers of Scandinavian plants. *Ark. Bot.* 31A: 1-22.
Löve, Á. & Löve, D. 1956. Cytotaxonomical conspectus of the Icelandic flora. *Acta Horti Gothob.* 20: 65-291.
Löve, Á. & Löve, D. 1982. IOPB chromosome number reports LXXV. *Taxon* 31: 344-360.
Lovka, M., Susnik, F., Löve, A. & Löve, D. 1971. IOPB chromosome number reports XXXIV. *Taxon* 20: 785-797.
Lövkvist, B. & Hultgard, U. 1999. Chromosome numbers in South Swedish vascular plants. *Opera Bot.* 137: 1-42.

Lozada-Gobilard, S., Ávila-Calero, S., Ortuño, T & Weigend, M. 2020. Taxonomical revision of the genus *Hypseocharis* in Peru and Bolivia. *Revista Peru. Biol.* 27: 383-394.

Lu, Z.H., Yang, L.P. & Cao, W.Z. 1996. Pollen morphology and systematics of Geraniaceae in northeastern China. *Bull. Bot. Res., Harbin* 16: 315-321, pl. I-IV. [in Chinese].

Luque, T. & Díaz Lifante, Z. 1991. Chromosome numbers of plants collected during Iter Mediterraneum I in the SE of Spain. *Bocconea* 1: 303-364.

Macbride, J.F. 1949. Flora of Peru. *Field Mus. Nat. Hist., Bot. Ser.* 13: 511-538.

Macbryde, B. 1968. Flora of Panama. Family 85. Geraniaceae. *Ann. Missouri Bot. Gard.* 54: 201-205.

Májovský, J. (ed.). 1970a. Index of chromosome numbers of Slovakian flora. (Part 1). *Acta Fac. Rerum Nat. Univ. Comenianae, Bot.* 16: 1-26.

Májovský, J. (ed.). 1970b. Index of chromosome numbers of Slovakian flora. (Part 2). *Acta Fac. Rerum Nat. Univ. Comenianae, Bot.* 18: 45-60.

Májovský, J. (ed.). 1974a. Index of chromosome numbers of Slovakian flora (Part 3). *Acta Fac. Rerum Nat. Univ. Comenianae, Bot.* 22: 1-20.

Májovský, J. (ed.). 1974b. Index of chromosome numbers of Slovakian flora. Part 4. *Acta Fac. Rerum Nat. Univ. Comenianae, Bot.* 23: 1-23.

Májovský, J. (ed.). 1976. Index of chromosome numbers of Slovakian Flora (Part 5). *Acta Fac. Rerum Nat. Univ. Comenianae, Bot.* 25: 1-18.

Májovský, J. (ed.). 1978. Index of chromosome numbers of Slovakian flora (Part 6). *Acta Fac. Rerum Nat. Univ. Comenianae, Bot.* 27: 1-42.

Malhotra, C.L. 1997. Geraniacae. In: Hajra, P.K., Nair, V.J. & Daniel, P. (eds.). *Flora of India* 4: 62-94. Calcutta, Botanical Survey of India.

Malla, S.B., Bhattarai, S., Gorkhali, M., Saiju, H. & Kayastha, M. 1981. IOPB Chromosome number reports LXX. *Taxon* 30: 75.

Marcussen, T. & Meseguer, A. 2017. Species-level phylogeny, fruit evolution and diversification history of *Geranium* (Geraniaceae). *Molec. Phylogen. Evol.* 110: 134-149.

Marschall, E.S. 1911. *Geranium Endressi × striatum. Bot. Exch. Club Soc. Brit. Isles* 2: 551.

Marticorena, C. & Quezada, M. 1985. Catálogo de la flora vascular de Chile. *Gayana, Bot.* 42.

Martin, E., Kahraman, A., Dirmenci, T., Bozkurt, H. & Eroğlu, H.E. 2022. New Chromosomal Data and Karyological Relationships in Geranium: Basic Number Alterations, Dysploidy, Polyploidy, and Karyotype Asymmetry. *Brazil. Arch. Biol. Technol.* 65: e22210354.

Martin, M.C. 1965. An Ecological Life History of *Geranium maculatum. Amer. Midl. Naturalist* 73: 111-149.

McClintock, D. 1975. *Geranium* L. In: Stace, C.A. (ed.). *Hybridation and the Flora of the British Isles.* Pp. 190-193. London, Academic Press.

McGregor, R.L. 1986. Geraniaceae. In: Mcgregor, R.L., Barley, T.M., Brooks, R.E. & Schofield, E.K. (eds.). *Flora of the great plains.* Lawrence, Kansas, Univ. Press Kansas.

McVaugh, R. 2000. *Botanical results of the Sessé and Mociño expedition (1787–1803) VII. A guide to relevant scientific names of plants.* Pittsburgh, Hunt Institute for Botanical Documentation.

Medeiros, A.C. & St John, H. 1988. *Geranium hanaense* (Geraniaceae), a new species from Maui, Hawaiian Islands. *Brittonia* 40: 214-220.

Meisert, A. 2002. Physical dormancy in Geraniaceae seeds. *Seed Sci. Research* 12: 121-128.

Meisert, A., Schulz, D. & Lehmann, H. 1999. Structural features underlying hardseededness in Geraniaceae. *Pl. Biol.* 1: 311-314.

Melchior, H. 1957. Reinhard Knuth 1874-1957. *Taxon* 6: 185-186.

Micevski, K. 1980. *Geranium cinereum* Cav. in der Flora von Makedonien. *Maced. Acad. Sci. Arts Contr. I,* 2: 20-33, 4 Abb.

Micieta, K. 1981. Zytotaxonomische probleme einiger pflanzensippen des Javorníky-Gebirges. *Acta Fac. Rerum Nat. Univ. Comenianae, Bot.* 28: 95-104.

Milberg, P. 1994. Germination of up to 129-year old, dry-stored seeds of *Geranium bohemicum* (Geraniaceae). *Nordic J. Bot.* 14: 27-29.

Mirek, Z. 1980. *Geranium sibiricum* L. rzadki w Polsce gatunek synantropijny. *Fragm. Florist. Geobot.* 26: 251-257.

Mirimanoff, A. 1941. Remarques sur les glandes extra-staminales de quelques Géraniacées. *Bull. Soc. Bot. Genève* 32: 195-196.

Mitchell, A.D., Heenan, P.B. & Paterson, A.M. 2009. Phylogenetic relationships of *Geranium* species indigenous to New Zealand. *New Zealand J. Bot.* 47: 21-31.

Mizianty, M. Mirek, Z. & Frey, L. 1983. Chromosome numbers of Polish vascular plants (Part 4). *Acta Soc. Bot. Poloniae* 52: 205-214.

Mizianty, M., Frey, L. & Mirek, Z. 1981. Contribution to the knowledge on the chromsome numbers of Polish vascular plants. *Fragm. Florist. Geobot.* 27: 19-29.

Moffett, R.O. 1979. The genus Sarcocaulon. *Bothalia* 12: 581-613.

Moffett, R.O. 1997. The taxonomic status of *Sarcocaulon. S. African J. Bot.* 63: 239-240.

Moore, D.M. 1983. *Flora of Tierra del Fuego.* Oswestry, UK, A. Nelson.

Moore, H.E. 1943. A revision of the genus *Geranium* in Mexico and Central America. *Contr. Gray Herb.* 146: 1-108, 5 "Plate".

Moore, H.E. 1951. Notes on New World Gerania. *Gentes Herb.* 8: 250-257.

Moore, H.E. 1961. A remarkable new *Geranium* from Ecuador. *Brittonia* 13: 141-143.

Moore, H.E. 1963. *Geranium campii* and *G. durangense*-Two new species. *Brittonia* 15: 92-95.

Morton, J.K. 1993. Chromosome numbers and polyploidy in the flora of Cameroons Mountain. *Opera Bot.* 121: 159-172.

Moscoso, R.M. 1943. *Catalogus Florae Domingensis.* New York.

Mosyakin, S.L. & De Lange, P.J. 2019. Notes on typification and nomenclature of four taxa of Geraniaceae described by Turczaninow from New Zealand and Australia. *Phytotaxa* 419: 169-181.

Mouterde, P. 1966. *Nouvelle flore du Liban et de la Syrie* 2: 434-440, Atlas, pl. 180-186. Beyrouth, Dar El-Machreq eds.

Mulligan, G.A. 1959. Chromosome numbers of Canadian weeds. II. *Canad. J. Bot.* 37: 81-92.

Murín, A., Háberová, I. & Zamsran, C. 1984. Further karyological studies of the Mongolian flora. *Folia Geobot. Phytotax.* 19: 29-39.

Nagl, W. 1962. Über Endopolyploidie, Restitutionskernbildung und Kernstrukturen im Suspensor von Angiospermen und einer Gymnospermen. *Oesterr. Bot. Z.* 109: 431-494.

Nakai, T. 1912. Notulae ad Plantas Japoniae et Coreae VII. *Bot. Mag. (Tokyo)* 26: 251-266.

Nasir, Y.J. 1983. *Geranium* L. In: Nasir, E. & Ali, S.I. (eds.). *Flora of Pakistan* 149: 1-43. Islamabad, Pakistan Agric. Res. Council.

Natarajan, G. 1978. IOPB chromosome number reports LXII. *Taxon* 27: 526-531.

Nepi, C. 2007. La 'slegatura' dell'erbario di Andrea Cesalpino (1525-1603). *Museologia Scientifica* 1: 50-54.

Nepi, C. & Gusmeroli, E. 2008. *Gli erbari aretini da Andrea Cesalpino ai giorni nostri*. Firenze, Firenze University Press.

NGA GEOnet. 2021. *NGA GEOnet names server.* Published on the Internet https://geonames.nga.mil/gns/html, United States. National Geospatial-Intelligence Agency, United States Board on Geographic Names. [continuously updated resource].

Nieto Feliner, G. 1985. Estudio crítico de la flora orófila del suroeste de León: montes Aquilianos, Sierra del Teleno y Sierra de la Cabrera. *Ruizia* 2.

Nieto Feliner, G. & Aedo, C. 1995. A cladistics analysis of *Geranium* subgen. *Erodioidea* (Geraniaceae). *Bot. J. Linn. Soc.* 119: 195-212.

Nikolov, N.A. 1991. Chromosome numbers of Bulgarian Angiosperms from North Pirin Mountain: Reserve "Bajuvi Dupki-Džindžrica". *Fitologiya* 41: 70-75.

Nishida, S., Azuma, H., Naiki, A. & Ogawa, M. 2012. Molecular Phylogenetic Analyses of *Geranium robertianum* Populations Recently Found in Japan. *Acta Phytotax. Geobot.* 62: 79-87.

Nishikawa, T. 1985. Chromosome Counts of Flowering Plants of Hokkaido (9). *J. Hokkaido Univ. Educ., 2B* 36: 25-40. [in Japanese].

Nishikawa, T. 1990. Chromosome Counts of Flowering Plants of Hokkaido (13). *J. Hokkaido Univ. Educ., 2B* 40: 19-30. [in Japanese].

Novoselova, M.S. 1996. Obzor semeistva Geraniaceae tsentral'noi Asii [Synopsis of the family Geraniaceae in central Asia]. *Bot. Zhurn. (Moscow & Leningrad)* 81: 83-91. [in Russian].

Novoselova, M.S. 1998. Vidy roda *Geranium* L. (Geraniaceae) podroda *Geranium* flory Kavkaza [Generis *Geranium* L. (Geraniaceae) subgeneris *Geranium* species florae Caucasi]. *Novosti Sist. Vyssh. Rast.* 31: 143-158. [in Russian].

Novoselova, M.S. 1999. Family Geraniaceae in the flora of Russian Far East. *Bot. Zhurn. (Moscow & Leningrad)* 84: 127-135. [in Russian].

Novoselova, M.S. 2004. Type specimens of the genus *Geranium* (Geraniaceae) taxa from the East Asia kept in the Herbarium of Komarov Botanical Institute (LE). *Bot. Zhurn. (Moscow & Leningrad)* 89: 505-508. [in Russian].

Ohwi, J. 1965. *Flora of Japan.* Washington, Smithsonian Institution. [English edition by F.G. Meyer & E.H. Walker].

Okuda, T., Mori, K. & Hatano, T. 1980. The distribution of geraniin and mallotusinic acid in the order Geraniales. *Phytochemistry* 19: 547-551.

Ortiz, S. 1990. Caracterización taxonómica de las poblaciones ibérico-occidentales de *Geranium pyrenaicum* Burm. fil. (Geraniaceae). *Anales Jard. Bot. Madrid* 47: 242-244.

Osterhout, G.E. 1923. What is *Geranium caespitosum* James? *Bull. Torrey Bot. Club* 50: 81-84.

Pajarón, S. 1983. Números cromosomáticos de plantas occidentales, 251-260. *Anales Jard. Bot. Madrid* 40: 272-275.

Palazzesi, L., Gottschling, M., Barreda, V. & Weigend, M. 2012. First Miocene fossils of Vivianiaceae shed new lighton phylogeny, divergence times, and historical biogeography of Geraniales. *Biol. J. Linn. Soc.* 107: 67-85.

Palmer, J.D., Nugent, J.M. & Herbon, L.A. 1987. Unusual structure of *Geranium* chloroplast DNA: A triple-sized inverted repeat, extensive gene duplications, multiple inversions, and two repeat families. *Proc. Natl. Acad. Sci. U.S.A.* 84: 769-773.

Pantocsek, J. 1874. *Adnotationes ad Floram et Faunam Hercegovinae, Crnagorae et Dalmatiae.* Posonii, C.F. Wigand.

Paray, L. 1954. Nuevas Fanerógamas de México. *Bol. Soc. Bot. México* 16: 20-25.

Parfenov, V.I. & Dmitrieva, S.A. 1987. Kariologicheskaja kharakteristika predstavitelej flory sosudistykh rastenij Berezinskogo Biosfernogo Zapovednika. II. *Zapov. Belorussii Issl.* 11: 62-69. [in Russian].

Parfenov, V.I. & Dmitrieva, S.A. 1988. Kariologicheskaja kharakteristika predstavitelej flory sosudistykh rastenij Berezinskogo Biosfernogo Zapovednika. *Zapov. Belorussii Issl.* 12: 3-8. [in Russian].

Parfitt, B.D., Baker, M.A. & Gallagher, M.L. 1985. IOPB Chromosome number reports LXXXVI. *Taxon* 34: 162-163.

Park, S., Grewe, F., Zhu, A., Ruhlman, T.A., Sabir, J., Mower, J.P. & Jansen, R.K. 2015. Dynamic evolution of *Geranium* mitochondrial genomes through multiple horizontal and intracellular gene transfers. New Phytol. 208: 570-583.

Park, S.J. & Kim, S. 1997. A palynotaxonomic study of Asian *Geranium* L. (Geraniaceae). *Korean J. Pl. Tax.* 27: 295-315.

Parlatore, F. 1873. *Flora italiana* 5: 131-203. Firenze, Le Monnier.

Parsa, A. 1951. *Flore de l'Iran* 1(2): 1422-1449. Tehran, Museum D'Histoire Naturelle.

Pashuk, K.T. 1987. Chromosome numbers in species of subalpine belt of Chernogora (Ukrainian Carpahtians). *Bot. Zhurn. (Moscow & Leningrad)* 72: 1069-1074. [in Russian].

Patzelt, A. 2007. *Geranium* L. In: Ghazanfar, S.A. (ed.). *Flora of the Sultanate of Oman.* Pp. 134-136, 206-207. Meise, National Botanic Garden.

Pawłowska, S. 1959. Geraniaceae. In: Szafera, W. & Pawłowskiego, B. (eds.). *Flora Polska* 8: 325-354. Warszawa, Polska Akademia Nauk.

Pax, D.L., Price, R.A. & Michaels, H.J. 1997. Phylogenetic position of the Hawaiian geraniums based on rbcL sequences. *Amer. J. Bot.* 84: 72-78.

Payne, W.W. 1978. A glossary of plant hair terminology. *Brittonia* 30: 239-255.

Pedro, L., Campos, P. & Pais, M.S. 1990. Morphology, ontogeny and histochemistry of secretory trichomes of *Geranium robertianum* (Geraniaceae). *Nordic J. Bot.* 10: 501-509.

Pedro, L., Campos, P. & Pais, M.S.S. 1991. Ultrastructure of the apical cell of procumbent (type I) trichomes in *Geranium robertianum* L. (Geraniaceae). *Israel J. Bot.* 40: 209-217.

Pereira, E. 1967. *Ilhas de Zargo ed. 3.* Funchal, Câmara Municipal do Funchal.

Persson, J. 1987. *Geranium* L. In: Strid, A. (ed.). *Mountain Flora of Greece* 1: 538-549. Cambridge, New York, Cambridge Univ. Press.

Perveen, A. & Gaiser, M. 1999. Pollen flora of Pakistan -XV. Geraniaceae. *Turk. J. Bot.* 23: 263-269.

Peschkova, G.A. 1996. *Flora of Siberia* 10: 8-20, 261-263. Nauka Publ., Siberian Publishing Co. [in Russian]. [English ed. 2006. Enfield, Science Publishers].

Peşmen, H. & Güner, A. 1978. Four new taxa from Anatolia. *Notes Roy. Bot. Gard. Edinburgh* 36: 35-38.

Petrova, A. 2006. *Geranium aristatum* (Geraniaceae): a new species for the Bulgarian flora. *Phytol. Balcan.* 12: 215-220.

Petrova, A. & Stanimirova, P. 2001. Reports (1248-1253). *Fl. Medit.* 11: 460-466.

Petrova, A. & Stanimirova, P. 2002. Reports (1288-1294). *Fl. Medit.* 12: 454-460.

Petrova, A. & Stanimirova, P. 2003. Karycological study of some *Geranium* (Geraniaceae) species growing in Bulgaria. *Bocconea* 16: 675-682.

Philipp, M. 1985. Reproductive biology of *Geranium sessiliflorum*: 1. Flower and flowering biology. *New Zealand J. Bot.* 23: 567-580.

Phouphas, Ch. 1950. Développement de l'embryon chez le *Geranium Robertianum* L. *Bull. Soc. Bot. France* 97: 191-194.

Picard, C. 1837. Étude sur les Géraniées qui croisent spontanément dans les départements de la sommeet du Pas-de-Calais. *Mém. Soc. Agric. Boulogne-sur-Mer* 1: 95-138.

Pignatti, S. 1982. Flora d'Italia. Bologna, Edagricole.

Pittier, H. 1929. Botanical notes on, and descriptions of, new and old species of Venezuela plants. *J. Wash. Acad. Sci.* 19: 175-186.

Polozhiy A.V. & Balashova V.F. 1989. *Tipy taksonov v Gerbarii imeni P.N. Krylova [Types of taxa in the P.N. Krylov Herbarium].* Tomsk, Univ. Tomsk. [in Russian].

Pólya, L. 1950. Chromosome numbers of Hungarian plants II. *Ann. Biol. Univ. Debrecen.* 1: 46-56.

Porter, D.M. 1999. Charles Darwin's Chilean plant collections. *Revista Chilena Hist. Nat.* 72: 181-200.

Post, G.E. 1896. *Flora of Syria, Palestine, and Sinai.* Beirut, Syrian Protestant College.

Post, G.E. 1932. *Flora of Syria, Palestine, and Sinai ed. 2.* Beirut, American Press.

Pottier, G. 1979. *Flore de la Tunisie*. Tunis, Ministère de l'Enseignement Supérieur.

Presl, J.S. 1831-1835. *Reliquiae Haenkeanae*. Prague, J.G. Calve.

Price, R.A., Calie, P.J., Downie, S.R., Logsdon, J.M. & Palmer, J.D. 1990. Chloroplast DNA variation in the Geraniaceae–A preliminary report. In: Vorster, P. (ed.). *Proceedings of the international Geraniaceae symposium.* Pp. 235-243. Stellenbosch, Univ. Stellenbosch.

Price, R.A. & Palmer, J.D. 1993. Phylogenetic relationships of the Geraniaceae and Geraniales from rbcL sequence comparisons. *Ann. Missouri Bot. Gard.* 80: 661-671.

Probatova, N.S., Barkalov, V.Yu., Rudyka, E.G. & Shatalova, S.A. 2000. Chromosome Study on Vascular Plants of the Kurile Islands. *Nat. Hist. Res., Special Issue* 7: 21-38. [in Russian].

Probatova, N.S. & Chernyagina, O.A. 2019. IAPT chromosome data 30. *Taxon* 68: 1124-1130.

Probatova, N.S. & Sokolovskaya, A.P. 1988. Chromosome numbers in vascular plants from Primorye territory, the Amur river basin, North Koryakia, Kamchatka and Sakhalin. *Bot. Zhurn. (Moscow & Leningrad)* 73: 290-293. [in Russian].

Probatova, N.S., Rudyka, E.G. & Sokolovskaya, A.P. 1996. Chromosome numbers in synanthropic plants from the Russian Far East. *Bot. Zhurn. (Moscow & Leningrad)* 81: 98-101. [in Russian].

Probatova, N.S., Sokolovskaya, A.P. & Rudyka, E.G. 1989. Chromosome numbers in some species of vascular plants from the Kunashir island (the Kuril islands). *Bot. Zhurn. (Moscow & Leningrad)* 74: 1675-1678. [in Russian].

Probatova, N.S., Sokolovskaya, A.P. & Rudyka, E.G. 1991. Chromosome numbers in some species of vascular plans from the Soviet Far East and other regions of the USSR. *Bot. Zhurn. (Moscow & Leningrad)* 76: 1174-1178. [in Russian].

Probatova, N.S., Tzyrenova, D.Y., Rudyka, E.G., Barkalov, V.Y. & Nechaev, V.A. 2014. IAPT/IOPB chromosome data 17. *Taxon* 63: 1154-1155.

Proctor, M., Yeo, P. & Lack, A. 1996. *The natural history of pollination*. London, Harper Collins.

Pursh, F. 1814. *Flora Americae Septentrionalis.* London, White & Co.

Putrament, A. 1962. Some observations on male sterility in *G. sylvaticum* L. var. *alpestre* Schur. *Acta Soc. Bot. Poloniae* 31: 723-736.

Qosja, X. (ed.). 1992. *Flore de l'Albanie.* Tirane, Academie des Sciences.

Quézel, P. 1957. *Peuplement végétal des hautes montagnes de l'Afrique du Nord.* Paris, P. Lechevalier.

Rafinesque, C.S. 1817. *Florula ludoviciana.* New York, C. Wiley & Co.

Raunkiaer, C. 1888. Frøskallens Bygning og Udviklingshistorie hos Geraniaceerne. *Bot. Tidsskr.* 16: 152-167, Tav. 2, (3)-(7).

Ray, J. 1688, 1704. *Historia plantarum* 2: 1038, 1055-1065; 3: 511-515. Londini, Mariae Clark.

Reuter, G.F. 1858. *Catalogue des graines recueilles 1857 et offertes en échange par le jardin botanique de Genève*. Genève, Ramboz & Schuchard.

Reveal, J.L. & Pringle, J.S. 1993. Taxonomic botany and floristics. In: Morin, N.R. (ed.). *Flora of North America North of Mexico* 1: 157–192. New York, Oxford, Oxford University Press.

Ridley, H.N. 1916. Report on the Botany of the Wollaston Expedition to Duch New Guinea. *Trans. Linn. Soc. London, Bot.* 9: 1-269.

Risberg, L. & Granström, A. 2015. The ecology of *Geranium bohemicum* and *G. lanuginosum*. *Svensk Bot. Tidskr.* 109: 132-139.

Roberts, H.A. & Boddrell, J.E. 1985. Seed survival and seasonal emergence in some species of *Geranium, Ranunculus* and *Rumex. Ann. Appl. Biol.* 107: 231-238.

Robin, C.C. 1807. *Voyages dans l'intérieur de la Louisiane.* Paris, F. Buisson.

Rock, J.F. 1911. Notes upon Hawaiian plants with descriptions of new species and varieties. *Bull. Coll. Hawaii Publ.* 1: 3-20.

Rodríguez, J.Á. 1999. Viajeros alemanes a Venezuela en el siglo XIX. *Akademos* 2: 89-101.

Rohweder, H. 1937. Versuch zur Erfassung der mengenmässigen Bedeckung des Darss und Zingst mit polyploiden Pflanzen. Ein Beitrag zur Bedeutung der Polyploidie bei der Eroberung neuer Lebensräume. *Planta* 27: 501-549.

Rose, N.J. 1906. Studies of Mexican and Central America plants. *Contr. U.S. Natl. Herb.* 10: 79-132.

Rostanski, K. & Tokarski, M. 1973. *Geranium wilfordii* Maxim. -nowy efemerofit we florze Polski. *Fragm. Florist. Geobot.* 19: 385-388.

Roux, H. 1880. Catalogue des plantes de Provence spontanées ou généralement cultivées (suite). *Bull. Soc. Bot. Hort. Provence* 2: 117-148.

Rouy, G. 1897. *Geranium* L. In: Rouy, G. & Foucaud, J. (eds.). *Flore de France* 4: 74-98. Asnières & Paris, chez Rouy & É. Deyrolle.

Roy, S.C., Ghosh, S. & Chatterjee, A. 1988. A cytological survey of eastern Himalayan plants. II. *Cell Chromosome Res.* 11: 93-97.

Rudyka, E.G. 1990. Chromosome numbers of vascular plants from the various regions of the USSR. *Bot. Zhurn. (Moscow & Leningrad)* 75: 1783-1786. [in Russian].

Rzedowski, J. & Rzedowski, G.C. 1995. *Flora del Bajío y de regiones adyacentes* 40: 8-35. Pátzcuaro, Instituto de Ecología, A.C. Centro Regional del Bajío.

Sakai, K. 1935. Studies on the chromosome number in Alpine-plants. II. *Jap. J. Genet.* 11: 68-73. [in Japanese].

Sandwith, N.Y. 1942. Contributions to the flora of tropical America: XLV. *Bull. Misc. Inform. Kew* 1941: 218-228.

Sansome, F.W. 1936. Some experiments with *Geranium* species. *J. Genet.* 33: 359-363.

Schenk, A. 1840. *Plantarum Species quas in itinere per Aegytium, Arabian et Syriam.* Monachi, C. Wolf.

Schönbeck-Temesy, E. 1970. Geraniaceae. In: Rechinger, K.H. (ed.). *Flora Iranica* 69: 1-67. Graz, Akademische Druck.

Schur, F. 1877. Phytographische mittheilungen über pflanzenformen aus verschiedenen florengebieten des Oesterreichischen kaiserstaates. *Verh. Naturf. Vereins Brünn* 15: 5-200.

Scoggan, H.J. 1978. *The Flora of Canada* 3: 1043-1047. Ottawa, National Museum of Natural Sciences.

Scott-Shaw, C.R. & von Staden, L. 2007. *Geranium ornithopodioides* Hilliard & B.L.Burtt. National Assessment: Red List of South African Plants version 2020.1. [http://redlist.sanbi.org/species.php?species=1978-40; accessed on 19 Apr. 2021].

Seavey, S. 1975. In Löve, Á. (ed.), IOPB Chromosome number reports L. *Taxon* 24: 671-672.

Séguier, J.F. 1745. *Plantae veronenses.* Veronae, Typis Seminarii.

Semerenko, L.V. 1985. Chromosome numbers in some species of flowering plants of Byelorussian flora. *Bot. Zhurn. (Moscow & Leningrad)* 70: 992-994. [in Russian].

Şerbănescu, I. 1942. Contributions a l'étude systématique du *Geranium macrorrhizum* L. *Bull. Sect. Sci. Acad. Roumaine* 24: 615-621.

Şerbănescu, I. 1959. *Geranium* L. In: Săvulescu, T. (ed.). *Flora Reipublicae Popularis Romanicae* 6: 119-152. Bucuresti, Ed. Academiei RPR.

Sexton, R., Struthers, W.A. & Lewis, L.N. 1983. Some observations on the very rapid abcission of the petals of *Geranium robertianum* L. *Protoplasma* 116: 179-186.

Sharma, M., Singhal, V.K. & Kaur, P. 1988. *Geranium carolinianum* Linn. -an addition to the Indian flora from Patiala district, Punjab. *J. Bombay Nat. Hist. Soc.* 85: 247-249.

Sharples, R.W. & Minter, D.W. 1983. Theophrastus on Fungi: Inaccurate Citations in Athenaeus. *J. Hellenic. Studies* 103: 154-156.

Shaw, R.J. 1952. A cytotaxonomic study of the genus *Geranium* in the Wasatch region of Idaho and Utah. *Madroño* 11: 297-304.

Shehata, A.A. 2008. Pollen Morphology of Egyptian Geraniaceae: An assessment of Taxonomic Value. *Inter. J. Bot.* 4: 67-76.

Shimizu, M. 1971. Chromosome numbers of the Japanese species of *Geranium. J. Jap. Bot.* 46: 60-64.

Shirk, R.Y. & Hamrick, J.L. 2014. High but variable outcrossing rates in the in the invasive *Geranium carolinianum* (Geraniaeae). *Amer. J. Bot.* 101: 1200-1206.

Shirk, R.Y., Hamrick, J.L., Zhang, C. & Qiang, S. 2014. Patterns of genetic diversity reveal multiple introductions and recurrent founder effects during range expansion in invasive populations of *Geranium carolinianum* (Geraniaeae). *Heredity* 112: 497-507.

Siebold, P. F. & Zuccarini, J.G. 1845. Flora Japonica Familiae naturales, adjectis generum et specierum exemplis selectis sectio prima. *Abh. Mat.-Phys. Cl. Königl. Bayer. Akad. Wiss.* 4:1-96.

Sinclair, I. 1885. *Indigenous flowers of the Hawaiian Islands.* London, S. Low & al.

Skalińska, M., Czapik, R. & Piotrowicz, M. (eds.). 1959. Further studies in chromosome numbers of Polish angiosperms (Dicotiledons). *Acta Soc. Bot. Poloniae* 28: 487-529.

Skalińska, M., Jankum, J. & Wcislo, H. (eds.). 1976. Further studies in chromosome numbers of Polish angiosperms Eleventh contribution. *Acta Biol. Cracov., Ser. Bot.* 19: 107-148.

Skalińska, M., Pogan, E. & Czapik, R. (eds.). 1978. Further studies in chromosome numbers of Polish angiosperms Twelfth contribution. *Acta Biol. Cracov., Ser. Bot.* 21: 31-63.

Slavík, B., Jarolímová, V. & Chrtek, J. 1993. Chromosome counts of some plants from Cyprus. *Candollea* 48: 221-230.

Smith, L.P. 1999. *Geranium* L. In: Walsh, N.G. & Entwisle, T.J. (eds.). *Flora of Victoria* 4: 219-233. Melbourne, Inkata Pres.

Sokolovskaya, A.P. 1960. Geograficeskoe raspredelenie poliploidnych vidov rastenij [Issledovanie Flory o. Sachalina]. *Vestn. Leningradsk. Univ., Ser. Biol.* 4: 42-58. [in Russian].

Sokolovskaya, A.P. 1966. Geograficeskoe raspredelenie poliploidnych vidov rastenij. Issledovanie Flory Primorskogo kraga. *Vestn. Leningradsk. Univ., Ser. Biol.* 1: 92-106. [in Russian].

Sokolovskaya, A.P. & Probatova, N.S. 1986. Chromosome numbers and distribution of some anthropophytes in Primorye territory and Amur River Valley. *Vestn. Leningradsk. Univ., Ser. Biol.* 2: 57-63. [in Russian].

Sokolovskaya, A.P. & Strelova, O.S. 1948a. Geograficeskoe raspredelenie poliploidov II. Issledovanie Flory Altaja. *Uchen. Zap. Leningradsk. Gosud. Pedagog. Inst. Gertsena* 66: 179-193. [in Russian].

Sokolovskaya, A.P. & Strelova, O.S. 1948b. Geograficeskoe raspredelenie poliploidov III. Issledovanie Flory al'pjskoj oblasti Central' novo Kabkazskogo chrebta. *Uchen. Zap. Leningradsk. Gosud. Pedagog. Inst. Gertsena* 66: 195-216. [in Russian].

Sorsa, V. 1962. Chromosomenzahlen Finnischer Kormophyten I. *Ann. Acad. Sci. Fenn., Ser. A, IV, Biol.* 58: 1-14.

Sorsa, V. 1963. Chromosomenzahlen Finnischer Kormophyten II. *Ann. Acad. Sci. Fenn., Ser. A, IV, Biol.* 68: 1-14.

Spomer, G.G. 1999. Evidence of protocarnivorous capabilities in *Geranium viscosissimum* and *Potentilla arguta* and other sticky plants. *Int. J. Pl. Sci.* 160: 98-101.

Sprague, T.A. 1933. The dates of publication of Royle's illustrations. *Bull. Misc. Inform. Kew* 1933: 378-390.

Sprengel, C.K. 1793. *Das entdeckte Geheimniss der Natur im Bau und in der Befruchtung der Blumen*. Berlin, F. Vieweg.

Sprengel, C. 1826. *Systema Vegetabilium ed. 16*, 3: 70-75. Gottingae, Librariae Dieterichianae.

St. John, H. 1984. Novelties among the Phanerogamae, Hawaiian Plant Studies 123. *Bull. Torrey Bot. Club* 111: 479-482.

St. John, H. 1985. Typification of the Hawaiian plants described by Asa Gray from the WIlkes expedition collections, and an enumeration of the other Hawaiian collections. *Rhodora* 87: 565-595.

Stace, C.A. 1991. *New Flora of the British Isles.* Cambridge, New York, Cambridge University Press.

Stace, C.A. 2010. *New Flora of the British Isles, 3rd ed*. Cambridge, Cambridge University Press.

Stafford, P.J. & Blackmore, S. 1991. Geraniaceae. In: Punt, W. & Blackmore, S. (eds.). *The Northwest European Pollen Flora*, VI: 49-78. Amsterdam, London, New York, Elsevier.

Stafleu, F.A. & Cowan, R.S. 1981. Taxonomic literature. Volume III: Lh-O, ed. 2. *Regnum Veg.* 105.

Stafleu, F.A. & Cowan, R.S. 1985. Taxonomic literature. Volume V: Sal-Ste, ed. 2. *Regnum Veg.* 112.

Stafleu, F.A. & Cowan, R.S. 1988. Taxonomic literature. Volume VII: W-Z, ed. 2. *Regnum Veg.* 116.

Standley, P.C. 1915. A remarkable new *Geranium* from Venezuela. *J. Wash. Acad. Sci.* 5: 600-602.

Standley, P.C. & Steyermark, J.A. 1946. Flora of Guatemala. *Fieldiana, Bot.* 24: 370-373.

Stapf, O. 1926. *Geranium farreri. Bot. Mag.* 151, pl. 9092.

Stearn, W. T., ed. 1968. *Humboldt, Bonpland, Kunth and tropical American botany*. Stuttgart, J. Cramer.

Stearn, W. T. 1992. *Botanical Latin, fourth edition*. Newton Abbot, Devon, David & Charles.

Stefanaki A., Porck, H., Grimaldi, I. M., Thurn, N., Pugliano, V., Kardinaal, A., Salemink, J., Thijsse, G., Chavannes-Mazel, C., Kwakkel, E. & van Ande, T. 2019. Breaking the silence of the 500-year-old smiling garden of everlasting flowers: The En Tibi book herbarium. *PLoS ONE* 14: e0217779.

Stefanoff, B. & Jordanov, D. 1931. Beitrag zur Kenntnis der Flora des Dospadgebirges (West-Rhodopen). *Izv. Bulg. Bot. Druzh.* 4: 31-33.

Steudel, E.G. 1840. *Nomenclator botanicus ed. 2,* 1: 677-680. Stuttgard & Tubingae, J.G. Cottae.

Steudel, E.G. 1856. Einige Beiträge zu der Chilesischen und Peruanischen Flora, hauptsächlich nach den Sammlungen von Bertero und Lechler (Schluss.). *Flora* 39: 436-444.

Stevens, P. F. (2001 onwards). *Angiosperm Phylogeny Website. Version 14*, July 2017. [http://www.mobot.org/MOBOT/research/APweb/].

Strid, A. 1971. Chromosome numbers in some Albanien angiosperms. *Bot. Not.* 124: 490-496.

Strid, A. 1980. IOPB Chromosome number reports LXIX. *Taxon* 29: 709-711.

Strid, A. 2000. New taxa described in Grisebach's "Spicilegium Florae Rumelicae et Bithynicae". *Preslia* 72: 241-321.

Strid, A. & Andersson, I.J. 1985. Chromosome numbers of Greek mountain plants. An annotated list of 115 species. *Bot. Jahrb. Syst.* 107: 203-228.

Strid, A. & Franzén, R. 1981. IOPB chromosome number reports LXXIII. *Taxon* 30: 829-842.

Stuessy, T.F., Crawford, D.J., Soltis, D.E. & Soltis, P.S. 2014. *Plant Systematics*. Königstein, Koelz Scientific Books.

Stuessy, T.F. & Marticorena, C. 1985. Ortography of some epithets honoring Bertero in the vascular flora of the Juan Fernández island and continental Chile. *Gayana, Bot.* 47: 77-81.

Suzuka, O. 1950. Chromosome numbers in pharmaceutical plants I. *Rep. Kihara Inst. Biol. Res.* 4: 57-58.

Sweet, R. 1820-30. *Geraniaceae. The natural order of Gerania.* London, J. Ridway.

Täckholm, V. & Chrtek, J. 1968. Einige neue Arten der Gattung *Geranium* in der Vereinigten Arabischen Republik (Ägypten). *Preslia* 40: 139-142.

Tan, K., Siljak-Yakovlev, S. & Vold, G. 2011. *Geranium kikianum* sp. nov. (Gerania-

ceae) from the southern Peloponnese, Greece. *Nordic J. Bot.* 29: 1-5.

Tan, Z.M., Zhao, B. & Zhou, S. 1996. Study on the pollen morphology of *Geranium* in Sichuan and its significance of systematics. *J. Sichuan Univ. Nat. Sci. Ed.* 33(2): 206-214. [in Chinese].

Taylor, M.S. 1993a. *Geranium* L. In: Hickman, J.C. (ed.). *The Jepson Manual*. Pp. 673-674. Berkeley, Los Angeles, and London, University of California Press.

Taylor, M.S. 1993b. *Geranium* L. In: Brako, L. & Zarucchi, J.L. Cátalogo de las Angiospermas y Gimnospermas del Perú. *Monogr. Syst. Bot. Missouri Bot. Gard.* 45: 545-548.

Taylor, R.L. & Taylor, S. 1977. Chromosome numbers of vascular plants of British Columbia. *Syesis* 10: 125-138.

Tenore, M. 1820, 1835-36. *Flora Napolitana* 2: 98-105; 5: 80-86, tab. 240. Napoli, Stamperia francese.

Terracciano, A. 1890. Specie rare o critiche di Geranii italiani. *Malpighia* 4: 193-238.

Theobald, W.L., Krahulik, J.L. & Rollins, R.C. 1979. Trichome description and classification. In: Metcalfe, C.R. & Chalk, L. (eds.). *Anatomy of the Dicotyledons ed. 2.* Pp. 40-53. Oxford, Claredon Press.

Thulin, M. 1993. *Flora of Somalia* 1: 186-192. Kew, Royal Botanic Gardens.

Thunberg, C.P. 1784. *Flora Japonica.* Lipsiae, J.G. Mülleriano.

Tischler, G. 1934. Die bedeutung der polyploidie für die verbreitung der angiospermen, erläutert an den arten schleswig-Holsteins, mit Ausblicken auf andere Florengebiete. *Bot. Jahrb. Syst.* 67: 1-36.

Tischler, G. 1950. Die Chromosomenzahlen der Gefässpflanzen Mitteleuropas. Gravenhage, W. Junk.

Tjebbes, K. 1928. The chromosome numbers of some flowering plants. *Hereditas (Lund)* 10: 328-332.

Tofts, R.J. 2004a. Biological Flora of the British Isles. List Br. Vasc. Pl. (1958) no. 168, 16. *Geranium robertianum* L. *J. Ecol.* 92: 537-555.

Tofts, R.J. 2004b. Biological Flora of the British Isles. List Br. Vasc. Pl. (1958) no. 168, 17. *Geranium purpureum* Vill. *J. Ecol.* 92: 720-731.

Tokarski, M. 1972. Morphological and taxonomical analysis of fruits and seeds of the European and Caucasian species of the genus *Geranium* L. *Monogr. Bot.* 36: 5-115.

Tornadore, N., Popova, M. & Garbari, F. 1974. Numeri cromosomici per la flora italiana: 172-181. *Inform. Bot. Ital.* 6: 43-54.

Tournefort, J.P. 1700. *Institutiones Rei Herbarium*. Paris, typographia regia.

Townsend, C.C. 1964. More on the introduced Bordon and Alderney Geraniums. *Bot. Soc. Brit. Isles Proc.* 5: 224-226.

Trelease, W. 1888. A study of North American Geraniaceae. *Mem. Boston Soc. Nat. Hist.* 4: 71-103, pl. 9-12.

Troschkina, V. 2015. Type specimens of names of taxa of *Geranium* L. (Geraniaceae) described by L. P. Sergievskaja and deposited in the Krylov herbarium (TK). *Novosti Sist. Vyssh. Rast.* 46: 119-125. [in Russian].

Troschkina, V. 2016. Notes on systematic and chorology of *Geranium pseudosibiricum* and related species (Geraniaceae). *Rast. Mir Aziatsk. Rossii* 3: 22-32. [in Russian].

Troschkina, V. 2017. Systematics and chorology of *Geranium albiflorum* and related species (Geraniaceae). *Rast. Mir Aziatsk. Rossii* 3: 22-33. [in Russian].

Troschkina, V. & Ovchinnikova, S.V. 2020. Typification of names of two varieties of *Geranium pseudosibiricum* (Geraniaceae) from East Siberia. *Rast. Mir Aziatsk. Rossii* 3: 59-63. [in Russian].

Tschermark-Woess, E. & Hasitschka, G. 1954. Über die endomitotische Polyploidisierung im Zuge der Differenzierung von Trichomen und Trichozyten. *Oesterr. Bot. Z.* 101: 79-117.

Tsuchimatsu, T., Yoshitake, H. & Itol, M. 2014. Herbivore pressure by weevils associated with flower color polymorphism in *Geranium thunbergii* (Geraniaceae). *J. Pl. Res.* 127: 265-273.

Tsyrenova, D.J. 1985a. The genus *Geranium* (Geraniaceae) in the flora of the Soviet Far East. *Bot. Zhurn. (Moscow & Leningrad)* 70: 1636-1644. [in Russian].

Tsyrenova, D.J. 1985b. *Geranium erianthum* (Geraniaceae) and closely related species. *Bot. Zhurn. (Moscow & Leningrad)* 70: 476-482. [in Russian].

Tsyrenova, D.J. 1985c. On the section *Striata* of the genus *Geranium* (Geraniaceae). *Bot. Zhurn. (Moscow & Leningrad)* 70: 1255-1258. [in Russian].

Tsyrenova, D.J. 1986. *Geranium subumbeliforme* and its relation to *G. erianthum* (Geraniaceae). *Bot. Zhurn. (Moscow & Leningrad)* 71: 345-347. [in Russian].

Tsyrenova, D.J. 2006a. New adventice species of the genus *Geranium* in the Russian Far East. *Byull. Glavn. Bot. Sada* 192: 98-99. [in Russian].

Tsyrenova, D.J. 2006b. Geraniaceae. In: Kozhevnikov, A.E. & Probatova, N.S. (eds.), *Flora of the Russian Far East*. Dal'nauka, Vladivostok. [in Russian].

Tsyrenova, D.J. 2007. Generis *Geranium* L. (Geraniaceae) species nova e systemate fluvii Amur. *Novosti Sist. Vyssh. Rast.* 39: 218-219. [in Russian].

Tsyrenova, D.J. 2008. Two new species of the genus *Geranium* (Geraniaceae) from the Amur river basin. *Bot. Zhurn. (Moscow & Leningrad)* 93: 137-140. [in Russian].

Tumajanov, I.I & Beridze, R.K. 1968. A karyological investigation of some representatives of the upper alpine adnival floras of the Great Caucasus. *Bot. Zhurn. (Moscow & Leningrad)* 53: 58-68.

Tzvelev, N. 1993. Notae de Geraniaceis Florae Europae Orientalis. *Novosti Sist. Vyssh. Rast.* 29: 95-99. [in Russian].

Uhríkova, A. & Májovský, J. 1980. IOPB Chromosome number reports LXIX. *Taxon* 29: 725-726.

Utrera-Barillas, E. 2000. Geraniaceae. Sosa, V. (ed.), *Flora de Veracruz* 117: 1–31. Xalapa, INIREB.

Vaarama, A. & Jääskeläinen, O. 1967. Studies on gynodioecism in the Finnish populations of *Geranium sylvaticum* L. *Ann. Acad. Sci. Fenn., Ser. A, IV, Biol.* 108: 1-40.

Váchova, M. & Májovský, J. 1978. IOPB chromosome number reports LXI. *Taxon* 27: 381-383.

Vaillant, S. 1727. *Botanicon Parisiense*. Leiden & Amsterdam, chez Jean & Herman Verbeek et Balthazar Lakeman.

Valdés, E. & Castroviejo, S. 1979. Comentarios cariosistemáticos sobre algunas plantas de los Picos de Europa. *Mém. Soc. Bot. Genève* 1: 83-98.

Van Assche, J.A. & Vandelook, F.E.A. 2006. Germination ecology of eleven species of Geraniaceae and Malvaceae, with special reference to effects of drying seeds. *Seed Sci. Research* 16: 283-290.

Van Campo, E. 1989. Flore pollinique du Miocene superieur de Venta del Moro (Espagne). *Acta Palynol.* 1: 9-32.

Van Etten, M.L., Prevost, L.B., Deen, A.C., Ortiz, B.V., Donovan, L.A. & Shu Mei Chang. 2008. Gender differences in reproductive and physiological traits in a gynodioecious species, *Geranium maculatum* (Geraniaceae). *Int. J. Pl. Sci.* 169: 271-279.

Van Loon, J.C. 1984a. Hybridization experiments in *Geranium. Genetica* 65: 167-171.

Van Loon, J.C. 1984b. Chromosome numbers in *Geranium* from Europe, I. The perennial species. *Proc. Kon. Ned. Akad. Wetensch. C.* 87: 263-277.

Van Loon, J.C. 1984c. Chromosome numbers in *Geranium* from Europe, II. The annual species. *Proc. Kon. Ned. Akad. Wetensch. C.* 87: 279-296.

Van Loon, J.C. & Oudemans, J.J.M.H. 1982. IOPB chromosome number reports LXXXV. *Taxon* 31: 343-344.

Van Loon, J.C. & Van Setten, A.K. 1982. IOPB chromosome number reports LXXVI. *Taxon* 31: 589-592.

Van Loon, J.C., Gadella, T.W.J. & Kliphuis, E. 1971. Cytological studies in some flowering plants from southern France. *Acta Bot. Neerl.* 20: 157-166.

Vandelook, F.E. & Van Assche, J.A. 2010. A combined physical and physiological

dormancy controls seasonal seedling emergence of *Geranium robertianum. Pl. Biol.* 12: 765-771.

Väre, H. 2012. Catalogue and typifications of new taxa of vascular plants described by Finnish botanist Harald Lindberg (1871-1963). *Phytotaxa* 47: 1-98.

Varga, S., Laaksonen, E., Siikamäki, P. & Kytöviita, M. 2015. Absence of Sex Differential Plasticity to Light Availability during Seed Maturation in *Geranium sylvaticum. PLOSone* 10: 1-12.

Vegter, I.H. 1988. Index herbariorum. Part II(7). Collectors. T T/m Z. *Regnum Veg.* 117.

Velasco, M. 1992a. Estudios taxonómicos en las especies de la sect. *Subacaulia* Koch. ex Reiche del género *Geranium* L. (Geraniaceae), en la Península Ibérica. *Bull. Soc. Bot. France, Lettres Bot.* 139: 295-303.

Velasco, M. 1992b. *Estudio taxonómico de las especies de Geranium L. (Geraniaceae) presentes en la península Ibérica y Baleares.* Madrid, Memoria Tesis Doctoral, Univ. Complutense de Madrid.

Veldkamp, J.F. 2008. Gladde ooievaarsbek, *Geranium aequale* (Bab.) Aedo (Geraniaceae), een niet zo nieuwe soort voor Nederland. *Gorteria* 33: 50-58.

Veldkamp, J.F. & Moerman, A. 1978. A review of the Malesian species of *Geranium* L. (Geraniaceae). *Blumea* 24: 463-477.

Verhoeven, R.L. & Marais, E.M. 1990. Pollen morphology of the Geraniaceae. In: Vorster, P. (ed.). *Proceedings of the international Geraniaceae symposium.* Pp. 137-173. Stellenbosch, Univ. Stellenbosch.

Verhoeven, R.L. & Venter, H.J.T. 1992. Pollen morphology of *Geranium* (Geraniaceae) in southern Africa. *S. African J. Bot.* 58: 440-447.

Villars, D. 1786, 1789. *Histoire des plantes de Dauphiné* vols. 1, 3(2). Grenoble, chez l'Auteur, etc.

Vukojičić, S., Đurović, S.Z., Lakušić, D., Kabaš, E., Lazarević, P. & Clementi, M. 2021. Nomenclatural notes and typification of the names of plant taxa described by Josif Pančić from Montenegro. *Phytotaxa* 490: 1-17.

Wagensommer, R.P. & Venanzoni, R. 2021. *Geranium lucarinii* sp. nov. and re-evaluation of *G. kikianum* (Geraniaceae). *Phytotaxa* 489: 252-262.

Wagh, V.V. & Hurrah, I.A. 2019. Lectotypification of *Geranium grevilleanum* Wall. (Geraniaceae). *Phytotaxa* 395: 248-250.

Wagner, W.L., Herbst, D.R. & Sohmer, S.H. 1990. *Manual of the flowering plants of Hawai'i.* Honolulu, University of Hawaii Press.

Wahlstrom, R. 1978. *Geranium pratense*-en ny art for Nord-Norge [*Geranium pratense*- a species new to Northern Norway]. *Blyttia* 36: 91-94.

Wakasugi, Y., Azuma, H., Naiki, A. & Nishida, S. 2017. Morphological and molecular phylogenetic analyses of *Geranium yesoense* (Geraniaceae) in Japan. *Acta Phytotax. Geobot.* 68: 129–144.

Wallich, N. 1848. *A numerical list of dried specimens.* Pp. 288-289. London.

Warburg, E.F. 1938a. Taxonomy and relationship in the Geraniales in the light of their cytology. *New Phytol.* 37: 130-159.

Warburg, E.F. 1938b. Taxonomy and relationship in the Geraniales in the light of their cytology, II. *New Phytol.* 37: 189-210.

Ward, D.E. 1984. Chromosome counts from New Mexico and Mexico. *Phytologia* 56: 57-60.

Watson, S. 1882. List of plants from Southwestern Texas and Northern Mexico, collected chiefly by Dr. E. Palmer in 1879-80.-I. Polypetalae. *Proc. Amer. Acad. Arts* 17: 316-361.

Webb, C.J., Johnson, P. & Sykes, B. 1988. *Florwering plants of New Zealand.* Christchurch, DSIR Botany.

Webb, D.A. & Ferguson, J.K. 1968. *Geranium* L. In: Tutin, T.G., Heywood, V.H., Burges, N.A., Moore, D.M., Valentine, D.H., Walters, S.M. & Webb, D.A. (eds.). *Flora Europaea* 2: 193-199. Cambridge, Cambridge Univ. Press.

Weber, M. 1996. The existence of a special exine coating in *Geranium robertianum* pollen. *Int. J. Pl. Sci.* 157: 195-202.

Weddell, H.A. 1861. *Chloris Andina* 2: 284-287. Paris, P. Bertrand.

Weeda, E.J. 1993. Over het komen en gaan van de Glanzige ooievaarsbek (*Geranium lucidum* L.) in Nederland [*Geranium lucidum* L. coming and going in the Netherlands]. *Gorteria* 18: 127-129.

Welsh, S.L., Atwood, N.D., Goodrich, S. & Higgins, L.C. 1987. A Utah Flora. *Great Basin Naturalist Mem.* 9: 1-894.

Wilder-Kiefer, H. & Yeo, P.F. 1987. Fertility relationships of *Geranium* (Geraniaceae): sect. *Ruberta*, *Anemonifolia*, *Lucida* and *Unguiculata. Pl. Syst. Evol.* 155: 283-306.

Williams, C.F., Kuchenreuther, M.A. & Drew, A. 2000. Floral dimorphism, pollination, and self-fertilization in gynodioecious *Geranium richardsonii* (Geraniaceae). *Amer. J. Bot.* 87: 661-669.

Willson, M.F., Miller, L.J. & Rathcke, B.J. 1979. Floral display in *Phlox* and *Geranium*: adaptive aspects. *Evolution* 33: 52-63.

Wilmott, A.J. 1921. *Geranium purpureum* T.E. Foster. *J. Bot.* 59: 93-101.

Wondimu, T., Gizaw, A., Tusiime, F.M., Masao, C.A., Abdi, A.A., Hou, Y., Nemomissa, S. & Brochmann, C. 2017. Genetic structuring, dispersal and taxonomy of the high-alpine populations of the *Geranium arabicum/kilimandscharicum* complex in tropical eastern Africa. *PLOSone* 12: 1-16.

Wu, Z. 1984. *Index Florae Yunnanensis.* Kunming, Yunnan People's Publishing House. [in Chinese].

Xu, L.-G. & Aedo, C. 2008. *Geranium* L. In: Wu, Z.Y. & Raven, P.H. (eds.). *Flora of China* 11: 7-30. St. Louis, Missouri Botanical Garden Press.

Xu, L.-G., Huang, C.-C. & Huang, B.-X. 1998. Geraniaceae. In: Xu, L.-G. & Huang, C.-C. (eds.). *Flora Reipublicae Popularis Sinicae* 43(1): 18-89. Beijing, Science Press. [in Chinese].

Yeo, P.F. 1969. Two new *Geranium* species endemic to Madeira. *Bol. Mus. Munic. Funchal* 23: 25-35.

Yeo, P.F. 1970. The *Geranium palmatum* group in Madeira and the Canary Isles. *J. Roy. Hort. Soc.* 95: 410-414.

Yeo, P.F. 1973a. The biology and systematics of *Geranium*, sections *Anemonifolia* Knuth and *Ruberta* Dum. *Bot. J. Linn. Soc.* 67: 285-346.

Yeo, P.F. 1973b. *Geranium procurrens. Bot. Mag.* 179(3), pl. 644.

Yeo, P.F. 1975. *Geranium* species from Mount Victoria, Burma. *Notes Roy. Bot. Gard. Edinburgh* 34: 195-200.

Yeo, P.F. 1982. Fruit type and classification in *Geranium* L. *Watsonia* 14: 235.

Yeo, P.F. 1983. Tracking down 'missing' garden plants: *Geranium wardii*. *Natl. Council Conserv. Pl. Gard. Newslett.* 1: 19.

Yeo, P.F. 1984. Fruit-discharge-type in *Geranium* (Geraniaceae): its use in classification and its evolutionary implications. *Bot. J. Linn. Soc.* 89: 1-36.

Yeo, P.F. 1985. *Hardy Geraniums.* London, Croom Helm.

Yeo, P.F. 1990. The classification of Geraniaceae. In: Vorster, P. (ed.). *Proceedings of the international Geraniaceae symposium.* Pp. 1-22. Stellenbosch, Univ. Stellenbosch.

Yeo, P.F. 1992. A revision of *Geranium* L. in South-West China. *Edinburgh J. Bot.* 49: 123-211.

Yeo, P.F. 2002a. *Hardy Geraniums*, ed. 2. Portland, Oregon, Timber Press.

Yeo, P.F. 2002b. A new identity for the Alderney crane's bill: *Geranium herrerae* Knuth. *Bot. Soc. Brit. Isles News* 89: 24-25.

Yeo, P.F. 2003. The typification and correct citation of the name *Geranium purpureum* Vill. subsp. *forsteri* (Wilmott) H.G. Baker. *Watsonia* 24: 533-535.

Yeo, P.F. 2004. The morphology and affinities of *Geranium* sections *Lucida* and *Unguiculata. Bot. J. Linn. Soc.* 144: 409-429.

Yeo, P.F. & Wilder-Kiefer, H. 1990. The chemotaxonomy of *Geranium* (Geraniaceae). *Pl. Syst. Evol.* 173: 1-15.

Yildiz, B. & Tan, K. 1989. Thirteen new species from Turkey. *Notes Roy. Bot. Gard. Edinburgh* 45: 439-541.

Zachareva, O.I. & Astanova, C.B. 1968. Chromosomnye čisla nekotoryx dikorastuščich vidov cvetkovych rastenij srednej azii. *Dokl. Akad. Nauk Tadzhiksk. S.S.R.* 11: 72-75. [in Russian].

Zaganiaris, D.N. 1938. Herbarium macedonicum. Tertium et quartum mille. *Sci. Ann. Fac. Phys. Math. Aristotelian Univ. Thessaloniki* 5: 38-139.

Zhukova, P.G. 1967. Karyology of some plants, cultivated in the Artic-Alpine Botanical Garden. In: Avrorin, N.A. (ed.). *Plantarum in zonam polarem transportatio, Pars 2.* Pp. 139-149. Moskva, Izd-vo "Nauka". [in Russian].

Zhukova, P.G. 1980. Chromosome numbers of some southern Chukotka plant species. *Bot. Zhurn. Moscow & Leningrad)* 65: 51-59. [in Russian].

Zhukova, P.G. 1982. Chromosome numbers of some north-eastern Asia plant species. *Bot. Zhurn. (Moscow & Leningrad)* 67: 360-364. [in Russian].

Zohary, M. 1972. *Flora Palaestina* 2: 227-231, pl. 323-331. Jerusalem, Israel Academy of Sciences and Humanities.

Zohary, M., Heyn, C.C. & Heller, D. 1983. *Conspectus Florae Orientalis.* Jerusalem, Israel Academy of Sciences and Humanities.

Zollinger, H. 1845. Observationes phytographicae genera et species nova nonnulla respicientes. *Natuur- Geneesk. Arch. Ned.-Indië* 2: 563-587.

APPENDIX 1. CHROMOSOME COUNTS OF GERANIUM

Accepted names are in boldface. Between square brackets are indicated the names of the original publication if they differ from the accepted in this monograph. The country, locality, collector and herbarium that keeps the voucher are indicated when available (in parentheses). *Van Loon 3650, 11253, 11254, 11811, 12343* vouchers are attributed to different species and/or localities.

Geranium aequale [sub *G. molle* f. *preuschoffii*]. Germany, Schleswig-Holstein, *unknown collector* (?): 2*n* = 26 (Gauger 1937: 529).

G. aequale [sub *G. molle* var. *aequale*]. Sweden, Skane, Lomma, Alnarp, *Lövkist 1070* (LD): 2*n* = 26 (Lövkvist & Hultgard 1999: 21).

G. albanum. unknown origin, *unknown collector* (?): *n* = 14? (Warburg 1938a: 145).

G. albanum. unknown origin, cultivated material from several Botanical Gardens, *Van Loon 3452, 3504, 3507, 3533, 3534, 3535* (U): 2*n* = 20 (Van Loon 1984b: 276).

G. albicans. Argentina, Córdoba, entre La Serranita y Villa Ciudad de América, *Barboza 9* (CORD?): *n* = 14 (Barboza 1983: 143).

G. albiflorum. Russia, Buryatiya, Lake Baikal, Tarkulik, *Belaeva & Siplivinsky 77-100* (LE): 2*n* = 28 (Belaeva & Siplivinsky 1981: 859).

G. albiflorum. Russia, Buryatiya, Istoki p. Šumilichi, *unknown collector* (?): 2*n* = 28 (Belaeva & Siplivinsky 1975: 869).

G. albiflorum [sub *G. albiflorum* var. *lilacinum*]. Russia, Irkutsk, *unknown collector* (?): 2*n* = 28 (Krogulevich 1978: 27).

G. albiflorum [sub *G. albiflorum* var. *lilacinum*]. Russia, Tunkinsky Alpes, East Sayan, *unknown collector* (?): 2*n* = 26, 28 (Krogulevich 1976: 49).

G. arabicum [sub *G. simense*]. Cameroon, Cameroons Mt, *Morton & Venn K1271* (WAT, YA): 2*n* = 28 (Morton 1993: 168).

G. arabicum [sub *G. simense*]. Cameroon, Cameroons Mt, *Morton K466* (WAT): 2*n* = 28 (Morton 1993: 168).

G. arabicum. Kenya, Mt Kenya, *Hedberg 4136* (UPS): 2*n* = 28 (Hedberg & Hedberg 1977: 16).

G. arabicum. Kenya, Galama Mts, *Hedberg 4136* (UPS): 2*n* = 28 (Hedberg & Hedberg 1977: 16).

G. arabicum. Tanzania, Kilimanjaro, *Hedberg B 66159: 1* (UPS): 2*n* = 28 (Hedberg & Hedberg 1977: 16).

G. arabicum. Tanzania, Ngara distr., *Kokwaro 1969* (?): 2*n* = 28 (Hedberg & Hedberg 1977: 16).

G. arboreum. USA, Hawaii, Maui, Puu Nianiau, *Carr 906* (HAW): *n* = ca. 25 (Carr 1978: 237).

G. argenteum. Italy, Verona, monte Baldo, *Küpfer 3322* (NEU?): *n* = 14 (Favarger & al. 1979: 52).

G. argenteum. Slovenia, Črna prst, *unknown collector* (LJU): 2*n* = 28 (Lovka & al. 1971: 790).

G. argenteum. unknown origin, cultivated at Kiel, Germany, *unknown collector* (?): 2*n* = 28 (Gauger 1937: 529).

G. argenteum. unknown origin, *unknown collector* (?): 2*n* = 28 (Warburg 1938a: 150).

G. argenteum. unknown origin, *unknown collector* (?): 2*n* = 28 (Warburg 1938a: 150).

G. aristatum. Bulgaria, Mt Vlahina, *Petrova s.n.* (SOM): 2*n* = 26 (Petrova 2006: 217).

G. aristatum. unknown origin, cultivated at München, Germany, *unknown collector* (?): 2*n* = 28 (Gauger 1937: 529).

G. asphodeloides. Bulgaria, Strandzha Mt, *Petrova & Stanimirova 59200* (SOM): 2*n* = 24 (Petrova & Stanimirova 2003: 677).

G. asphodeloides. Greece, S of Kataphygion, Pieria Ori, 30 km E of Kozani, *Baltisberger 11392* (ZT): 2*n* = 24 (Baltisberger 1991a: 165).

G. asphodeloides. Greece, Mt. Olympus, NW side, Petra to Kokkinoplos, *Strid & al. G74-30-01* (C): 2*n* = 30+f (Strid & Franzén 1981: 835).

G. asphodeloides. Greece, Thessalia, Kastania, *Van Loon 24466* (U): 2*n* = 24 (Van Loon 1984b: 266).

G. asphodeloides. Greece, Mt Pindhos, Kastania, *Van Loon 24466* (U): 2*n* = 24 (Van Loon & Oudemans 1982: 343).

G. asphodeloides. Turkey, Küçük Mesoraş, *Kahraman 2185* (Middle East Technical University, Ankara): 2*n* = 26 (Martin & al. 2022: 8).

G. asphodeloides. unknown origin, *unknown collector* (?): *n* = 14, 2*n* = 28 (Warburg 1938a: 145).

G. ayavacense. Peru, Cordillère de Vilcabamba, *Terrier 7 02 24* (NEU): 2*n* = 52 (Huynh 1965: 67).

G. berteroanum. Chile, Región Metropolitana, Baños de Colina, *Aedo 6737* (MA): 2*n* = 56 (Aedo & al. 2005a: 8).

G. berteroanum. Chile, Biobío, Concepción, *Aedo 6913* (MA): 2*n* = 84 (Aedo & al. 2005a: 8).

G. berteroanum. Chile, Maule, Constitución, *Aedo 7154* (MA): 2*n* = 52 (Aedo & al. 2005a: 8).

G. berteroanum. Chile, Magallanes, pr. Puerto Natales, *Aedo 7459* (MA): 2*n* = 84 (Aedo & al. 2005a: 8).

G. bicknellii. Canada, Manitoba, Kings Park, *Löve & Löve 5019* (COLO or WIN): 2*n* = 52 (Löve & Löve 1982: 348).

G. bohemicum. Bulgaria, summit Chivira, *Petrova & Stanimirova 60200* (SOM): 2*n* = 28 (Petrova & Stanimirova 2003: 677).

G. bohemicum. Norway, Oslo, *Dahlgren s.n.* (?): 2*n* = 28 (Dahlgren 1952: 315).

G. bohemicum. Norway, Telemark, Nootdden, Hestasen, *Van Loon 24184* (U): 2*n* = 28 (Van Loon 1984c: 294).

G. bohemicum. Sweden, Östergötland, Skedvi, Byle, *Dahlgren s.n.* (?): 2*n* = 28 (Dahlgren 1952: 315).

G. bohemicum. Sweden, Tyresö, *Dahlgren s.n.* (?): 2*n* = 28 (Dahlgren 1952: 315).

G. bohemicum. Sweden, Dalarna, Hedemora, Granby, *Dahlgren s.n.* (?): 2*n* = 28 (Dahlgren 1952: 315).

G. bohemicum. Sweden, Södermanland, Gryt, Rösunda, *Dahlgren s.n.* (?): 2*n* = 28 (Dahlgren 1952: 315).

G. bohemicum. Sweden, Medelpad, Timra, *unknown collector* (?): 2*n* = 28 (Dahlgren 1952: 315).

G. bohemicum. Sweden, Uppland, Blidö, *unknown collector* (?): 2*n* = 28 (Dahlgren 1952: 315).
G. bohemicum. Sweden, Tränke, Niesky, *Van Loon 15507* (U): 2*n* = 28 (Van Loon 1984c: 294).
G. bohemicum. Turkey, Bolu, between Bolu and Yedigöller, *Kahraman 2157* (Middle East Technical University, Ankara): 2*n* = 28 (Martin & al. 2022: 8).
G. brevicaule [sub *G. sessiliflorum* subsp. *novazelandiae*]. New Zealand, Archerfield, Waihao Forks, Canterbury, *Dawson & Beuzenberg s.n.* (CHR-517723): 2*n* = 52 (Dawson & Beuzenberg 2000: 5).
G. brevicaule [sub *G. sessiliflorum* var. *arenarium*]. New Zealand, Southland, Omaui, Three Sisters Dunes, *de Lange & al. s.n.* (AK-286142): *n* = 26 (de Lange & al. 2004: 880).
G. brevipes [sub *G. ocellatum*]. Cameroon, Cameroons Mt, *Hedberg 3518A* (UPS): 2*n* = 56 (Hedberg & Hedberg 1977: 16).
G. brevipes [sub *G. ocellatum*]. Cameroon, Cameroons Mt, *Morton K584* (WAT): 2*n* = 56 (Morton 1993: 168).
G. brevipes [sub *G. ocellatum*]. Cameroon, Cameroons Mt, *Morton K728* (WAT, K, S): 2*n* = 56 (Morton 1993: 168).
G. caeruleatum. Bulgaria, Pirin Mt, Bajuvi dupki, Kamenitica, *Andreev NA-8042* (SOM): 2*n* = 28 (Andreev 1982: 576).
G. caeruleatum. Bulgaria, Vitosha Mt, *Petrova 7200* (SOM): 2*n* = 28, 56 (Petrova & Stanimirova 2002: 454).
G. caespitosum. USA, New Mexico, Doña Ana Co., Organ Mtns., Aguirre Springs Recreation Area, *Arsuffi 81-157* (NMC): *n* = 26 (Ward 1984: 58).
G. caffrum. South Africa, Somerset East, Buffelshoekse pass, on R337 N from Pearson, *Gibby & Barret 462* (BM): 2*n* = 22 (unpublished).
G. carolinianum [sub *G. sphaerospermum*]. Canada, Ontario, Abitibi co., Iroquois Falls, *Bassett & Baldwin 4015* (DAO): 2*n* = 52 (Löve 1965: 195).
G. carolinianum. Canada, Manitoba, St. Elizabeth, *Löve & Löve 5890* (COLO or WIN): 2*n* = 52 (Löve & Löve 1982: 348).
G. carolinianum. unknown origin, *unknown collector* (?): 2*n* = 46-48 (Warburg 1938a: 142).
G. carolinianum. USA, Idaho, Idaho Co., *Davis 2290* (UTC): 2*n* = 52 (Shaw 1952: 299).
G. cataractarum [sub *G. cataractarum* subsp. *pitardii*]. Morocco, Moyen Atlas,entre Aïn Leuh et Oum Er Bia, *Guittonneau 72.07.08.01* (herb. Guittonneau): 2*n* = 36 (Guittonneau 1975: 200).
G. cataractarum [sub *G. cataractarum* subsp. *pitardii*]. Morocco, Moyen Atlas, falaise de Senoual, pr. Bekrit, *Guittonneau 72.07.10.05* (herb. Guittonneau): 2*n* = 36 (Guittonneau 1975: 200).
G. cataractarum. Spain, Sierra de Cazorla, Jaén (plants sent to Kew, received at Cambridge and raised at Greenport, Long Island, New York), *Barneby 240-70* (CGG): 2*n* = 36 (Yeo 1973a: 345).
G. cataractarum. Spain, Jaén, Orcera, barranco del río Madera, Calar de Peña Rubia, *Pajarón 1266* (MA): 2*n* = 36 (Pajarón 1983: 273).
G. cataractarum. Spain, Jaén, sierra de Cazorla, *Van Loon 12614* (U): 2*n* = 36 (Van Loon 1984b: 266).
G. cazorlense. Spain, Jaén, Sierra del Pozo, Cerro Cabañas, *Küpfer K01431* (NEU): 2*n* = 28 (Küpfer 1974: 34).
G. cinereum. France, Vallée d'Ossoue, Petit Pic de Tapou, *Küpfer K01433* (NEU): 2*n* = 28 (Küpfer 1974: 34).
G. cinereum. Spain, Navarra, Pic d'Orhy, crête SW, *Küpfer K01434* (NEU): 2*n* = 28 (Küpfer 1974: 34).
G. cinereum. Spain, Huesca, Parque Nacional de Ordesa, Soaso, *Van Loon 15495* (U): 2*n* = 28 (Van Loon 1984b: 266).
G. cinereum. unknown origin, cultivated at München, Germany, *unknown collector* (?): 2*n* = 28 (Gauger 1937: 529).
G. cinereum. unknown origin, *unknown collector* (?): *n* = 14 (Warburg 1938a: 150).
G. collinum. Russia, *Van Loon 22399* (U): 2*n* = 28 (Van Loon 1984b: 266).
G. collinum. Turkey, Ardahan, Haçuvan village, *Kahraman 2170* (Middle East Technical University, Ankara): 2*n* = 28 (Martin & al. 2022: 8).
G. collinum [sub *G. collinum* var. *glandulosum*]. unknown origin, *unknown collector* (?): 2*n* = 28 (Warburg 1938a: 144).
G. columbinum. Scandinavia, *unknown collector* (?): 2*n* = 18 (Löve & Löve 1945: 17).
G. columbinum. Albania, Durrës, *Strid 0509* (LD): 2*n* = 18 (Strid 1971: 492).
G. columbinum. Bosnia-Herzegovina, vic. Turbe, *Van Loon 17276* (U): 2*n* = 18 (Van Loon 1984c: 294).
G. columbinum. Bosnia-Herzegovina, vic. Dobrun, *Van Loon 17361* (U): 2*n* = 18 (Van Loon 1984c: 294).
G. columbinum. Bulgaria, Stara Planina, vic. Sliven, *Van Loon 25288* (U): 2*n* = 18 (Van Loon 1984c: 294).
G. columbinum. Bulgaria, Black Sea coast, around Aladzha monastir, *Petrova 23242* (SOM): 2*n* = 18 (Petrova & Stanimirova 2001: 460).
G. columbinum. Croatia, Istria, Zminj, *Van Loon 17189* (U): 2*n* = 18 (Van Loon 1984c: 294).
G. columbinum. Croatia, Istria, Rovinj, *Van Loon 3647* (U): 2*n* = 18 (Van Loon 1984c: 294).
G. columbinum. Czech Republic, vic. Liberec, *Van Loon 18917* (U): 2*n* = 18 (Van Loon 1984c: 294).
G. columbinum. France, Var, Presqu'ile-de-Giens, *Van Loon 10133* (U): 2*n* = 18 (Van Loon 1984c: 294).
G. columbinum. France, Yonne, Vézelay, *Van Loon 11248* (U): 2*n* = 18 (Van Loon 1984c: 294).
G. columbinum. France, Sâone-et-Loire, Velay, *Van Loon 11250* (U): 2*n* = 18 (Van Loon 1984c: 294).
G. columbinum. France, Pyrénées-Orientales, Thuès entre Vals, *Van Loon 11818* (U): 2*n* = 18 (Van Loon 1984c: 294).
G. columbinum. France, Sâone-et-Loire, Givry, *Van Loon 18913* (U): 2*n* = 18 (Van Loon 1984c: 294).
G. columbinum. France, *Van Loon 3477* (U): 2*n* = 18 (Van Loon 1984c: 294).
G. columbinum. France, Côte-d'or, Chaux-Urcy, *Van Loon 3637* (U): 2*n* = 18 (Van Loon 1984c: 294).
G. columbinum. France, Hérault, Hérault, St. Étiènne d'Issenac, *Van Loon 5974* (U): 2*n* = 18 (Van Loon 1984c: 294).
G. columbinum. France, Hérault, St. Étiènne d'Issenac, *Van Loon 5974* (U): 2*n* = 18 (Van Loon & al. 1971: 159).
G. columbinum. France, Auvergne, gorges de Gourgoul, *Van Loon 9975* (U): 2*n* = 18 (Van Loon 1984c: 294).
G. columbinum. France, Cantal, Massiac, *Van Loon 9980* (U): 2*n* = 18 (Van Loon 1984c: 294).
G. columbinum. Germany, Schleswig-Holstein, *unknown collector* (?): 2*n* = 18 (Gauger 1937: 529).
G. columbinum. Germany, Gera, vic. Jena, *Van Loon 15512* (U): 2*n* = 18 (Van Loon 1984c: 294).
G. columbinum. Germany, Rheinland-Pfalz, Eifel, *Van Loon 18918* (U): 2*n* = 18 (Van Loon 1984c: 294).
G. columbinum. Great Britain, Somerset, *unknown collector* (?): 2*n* = 18 (Warburg 1938a: 142).
G. columbinum. Greece, Mt. Olympus, NW side, Petra to Kokkinoplos, *Strid & al. 344* (C): 2*n* = 18 (Strid & Franzén 1981: 835).
G. columbinum. Greece, Macedonia, Pades, *Van Loon 20229* (U): 2*n* = 18 (Van Loon 1984c: 294).
G. columbinum. Greece, Thessalia, along theroad from Metsobon to Trikala, *Van Loon 20231* (U): 2*n* = 18 (Van Loon 1984c: 294).
G. columbinum. Greece, Macedonia, vic. Drama, *Van Loon 20250* (U): 2*n* = 18 (Van Loon 1984c: 294).
G. columbinum. Greece, Macedonia, vic. Serrai, *Van Loon 20259* (U): 2*n* = 18 (Van Loon 1984c: 294).
G. columbinum. Italy, Venezia-Giulia, Aurisina, *Van Loon 17095* (U): 2*n* = 18 (Van Loon 1984c: 294).
G. columbinum. Montenegro, Briscica, *Van Loon 17427* (U): 2*n* = 18 (Van Loon 1984c: 294).

G. columbinum. Poland, Krzeszowice near Kraków, *unknown collector* (?): 2*n* = 18 (Skalińska & al. 1976: 120).
G. columbinum. Portugal, Ansião, *Alves & Leitão 3225* (COI?): 2*n* = 18 (Alves & Leitão 1976: 233).
G. columbinum. Portugal, Coimbra, S. Paulo de Frades, *Alves & Leitão 5968* (COI?): 2*n* = 18 (Alves & Leitão 1976: 233).
G. columbinum. Portugal, Sintra, Algueirão, *Alves & Leitão 6491* (COI?): 2*n* = 18 (Alves & Leitão 1976: 233).
G. columbinum. Portugal, Bragança, Vilarinho, *Alves & Leitão 7825* (COI?): 2*n* = 18 (Alves & Leitão 1976: 233).
G. columbinum. Portugal, Condeixa, *Alves & Leitão 891* (COI?): 2*n* = 18 (Alves & Leitão 1976: 233).
G. columbinum. Portugal, Beira Litoral, Contanhedi, Povoa de Lomba, *Van Loon 24223* (U): 2*n* = 18 (Van Loon 1984c: 294).
G. columbinum. Portugal, Beira Litoral, vic. Coimbra, *Van Loon 3549* (U): 2*n* = 18 (Van Loon 1984c: 294).
G. columbinum. Russia, Krym, Yalta, *Van Loon 25490* (U): 2*n* = 18 (Van Loon 1984c: 294).
G. columbinum. Slovakia, Považský Inovec, Jalšové, nera chalet Mier, *Feráková s.n.* (?): 2*n* = 18 (Májovský 1974b: 10).
G. columbinum. Slovakia, Nitrianska Pahorkatina, Dubodiel, *Van Loon 24191* (U): 2*n* = 18 (Van Loon 1984c: 294).
G. columbinum. Spain, Huesca, Torla, *Van Loon 15494* (U): 2*n* = 18 (Van Loon 1984c: 294).
G. columbinum. Sweden, Skane, Ven, *Lövkist 2800* (LD): 2*n* = 18 (Lövkvist & Hultgard 1999: 21).
G. columbinum. Sweden, Malmöhus, Skanör, *Van Loon 3553* (U): 2*n* = 18 (Van Loon 1984c: 294).
G. columbinum. Turkey, between Karabük and Bartin, *Kahraman 2141* (Middle East Technical University, Ankara): 2*n* = 18 (Martin & al. 2022: 8).
G. core-core. Chile, Antofagasta, Toconao, *Aedo 7006* (MA): 2*n* = 56 (Aedo & al. 2005a: 8).
G. core-core. Chile, O'Higgins, Rancagua, *Aedo 7073* (MA): 2*n* = 56 (Aedo & al. 2005a: 8).
G. crenophilum [sub *G. asphodeloides* subsp. *sintenisii*]. Syria, mont des Alaouites, pr. Slenfé, *Guittonneau 73.07.03.07* (herb. Guittonneau): 2*n* = 26 (Guittonneau 1975: 201).
G. cruentum. New Zealand, Aukland (cultivated), *de Lange 9220* (AK, CHR): 2*n* = 52 (Heenan & Rogers 2021: 10).
G. dahuricum. Russia, Primorskij kraj Nadezdinskij r-n, okr. s. Terechovka Doroga na Chasan, *Probatova & al. 6018* (?): 2*n* = 28 (Probatova & Sokolovskaya 1988: 291).
G. dahuricum [sub *G. pissjaukovae*]. Russia, Amurskaya oblast, *Tzyrenova 9939* (VLA): 2*n* = 28 (Probatova & al. 2014: 1155).
G. dalmaticum. Albania, an N-exponierten Felsen, in der Schlucht des Flusses Cem, *Baltisberger 83/1001* (ZT): 2*n* = 46 (Baltisberger 1984: 70).
G. dalmaticum. Albania, strasse Shkodër-Vermosh, ca. 40 km N von Shkodër, Bezirk Shkoder, *Baltisberger 83/1002* (ZT): 2*n* = 46 (Baltisberger 1984: 70).
G. deltoideum. Mexico, Sinaola, Sierra Surutato, *Breedlove 19220* (?): *n* = 26 (Seavey 1975: 671).
G. dissectum. Belgium, Antwerpen, *unknown collector* (?): 2*n* = 22 (Gauger 1937: 529).
G. dissectum. Belgium, Ardenne, vic. Rocroi, *Van Loon 11244* (U): 2*n* = 22 (Van Loon 1984c: 294).
G. dissectum. Bulgaria, Ahtopol, *Petrova 221825* (SOM): 2*n* = 22 (Petrova & Stanimirova 2002: 454).
G. dissectum. Czech Republic, Bohemia, Karlovy Vary, pr. Buč, Štěpánek s.n. (PR): 2*n* = 22 (Kirschner & al. 1982: 575).
G. dissectum. Czech Republic, monte Ceské, Stredohori, *Van Loon 24222* (U): 2*n* = 22 (Van Loon 1984c: 294).
G. dissectum. France, Bouche-du-Rhône, Ile-de-Levant, *Van Loon 10124* (U): 2*n* = 22 (Van Loon 1984c: 294).
G. dissectum. France, Bouche-du-Rhône, Presqu'ile-de-Giens, *Van Loon 10125* (U): 2*n* = 22 (Van Loon 1984c: 294).
G. dissectum. France, Vaucluse, Avignon-Villeneuve, *Van Loon 10135* (U): 2*n* = 22 (Van Loon 1984c: 294).
G. dissectum. France, Vaucluse, Avignon, *Van Loon 10166* (U): 2*n* = 22 (Van Loon 1984c: 294).
G. dissectum. France, Sâone-et-Loire, Velay, *Van Loon 11249* (U): 2*n* = 22 (Van Loon 1984c: 294).
G. dissectum. France, Aveyron, Entraygues-sur-Truyère, *Van Loon 11257* (U): 2*n* = 22 (Van Loon 1984c: 294).
G. dissectum. France, Puy-de-Dôme, St. Nectaire, *Van Loon 12343* (U): 2*n* = 22 (Van Loon 1984c: 294).
G. dissectum. France, Doubs, commune de Pirey, *Van Loon 24173* (U): 2*n* = 22 (Van Loon 1984c: 294).
G. dissectum. France, Gironde, Mios, *Van Loon 24179* (U): 2*n* = 22 (Van Loon 1984c: 294).
G. dissectum. France, Bouche-du-Rhône, vic. Marseille, *Van Loon 3457* (U): 2*n* = 22 (Van Loon 1984c: 294).
G. dissectum. France, Hérault, Montpellier, *Van Loon 3746* (U): 2*n* = 22 (Van Loon 1984c: 294).
G. dissectum. France, Cantal, Dienne near Murat, *Van Loon 9979* (U): 2*n* = 22 (Van Loon 1984c: 294).
G. dissectum. Germany, Marburg, *unknown collector* (?): 2*n* = 22 (Gauger 1937: 529).
G. dissectum. Germany, Schleswig-Holstein, *unknown collector* (?): 2*n* = 22 (Gauger 1937: 529).
G. dissectum. Germany, Hessen, Rüsselsheim, *Van Loon 3646* (U): 2*n* = 22 (Van Loon 1984c: 294).
G. dissectum. Germany, Ober Lausitz, Bautzen, *Van Loon 3740, 10610* (U): 2*n* = 22 (Van Loon 1984c: 294).
G. dissectum. Great Britain, W Lancaster, v.c. 60, near Lancaster, *Hollingsworth s.n.* (LTR): 2*n* = 22 (Hollingsworth & al. 1992: 135).
G. dissectum. Great Britain, Cambridge, *unknown collector* (?): 2*n* = 22 (Warburg 1938a: 142).
G. dissectum. Greece, Mt. Olympus, NW side, Petra to Kokkinoplos, *Strid & al. 368* (C): 2*n* = 22 (Strid & Franzén 1981: 835).
G. dissectum. Ireland, Mayo, Lough Furnace, *Van Loon 9946* (U): 2*n* = 22 (Van Loon 1984c: 294).
G. dissectum. Ireland, Roscommon, Annaghmoor, *Van Loon 9956* (U): 2*n* = 22 (Van Loon 1984c: 294).
G. dissectum. Israel, Bet-Shean valley, 6 km SSW of Bet-Shean, *Optima Iter II 38.027* (SEV): 2*n* = 22 (Díaz Lifante & al. 1992: 243).
G. dissectum. Italy, Sicilia, exact provenience unknown, *Van Loon 15528, 15331* (U): 2*n* = 22 (Van Loon 1984c: 294).
G. dissectum. Italy, Venezia-Giulia, Udine, *Van Loon 20858* (U): 2*n* = 22 (Van Loon 1984c: 294).
G. dissectum. Italy, Toscana, Monsindoli, *Van Loon 24200* (U): 2*n* = 22 (Van Loon 1984c: 294).
G. dissectum. Italy, Sicilia, Lentini, Siracusa, *Zizza s.n.* (CAT): 2*n* = 22 (De Leonardis & al. 1981: 162).
G. dissectum. Malta, Mishra-Valley, *Van Loon 10171* (U): 2*n* = 22 (Van Loon 1984c: 294).
G. dissectum. Netherlands, along the river Eem near Baarn, prov. of Utrecht, *Gadella & Kliphuis 1807* (U): 2*n* = 22 (Gadella & Kliphuis 1966: 548).
G. dissectum. Netherlands, Zeeland, Scharrendijke, *Van Loon 11165* (U): 2*n* = 22 (Van Loon 1984c: 294).
G. dissectum. Poland, Rabka, *unknown collector* (?): 2*n* = 22 (Skalińska & al. 1976: 120).
G. dissectum. Poland, Dziekanowice, *unknown collector* (?): 2*n* = 22 (Skalińska & al. 1976: 120).
G. dissectum. Portugal, Sintra, Algueirão, *Alves & Leitão 2442, 6492* (COI?): 2*n* = 22 (Alves & Leitão 1976: 234).
G. dissectum. Portugal, Oeiras, *Alves & Leitão 7826* (COI?): 2*n* = 22 (Alves & Leitão 1976: 234).

G. dissectum. Portugal, Maia, Moreira, *Alves & Leitão 8592* (COI?): 2*n* = 22 (Alves & Leitão 1976: 234).
G. dissectum. Portugal, Coimbra, Alcarraques, *Alves & Leitão 892* (COI?): 2*n* = 22 (Alves & Leitão 1976: 234).
G. dissectum. Portugal, Coimbra, *unknown collector* (?): 2*n* = 22 (Warburg 1938a: 142).
G. dissectum. Portugal, Beira Litoral, Sonzelas, *Van Loon 24224* (U): 2*n* = 22 (Van Loon 1984c: 294).
G. dissectum. Russia, Krym, Yalta, *Van Loon 25493* (U): 2*n* = 22 (Van Loon 1984c: 294).
G. dissectum. Scandinavia, *unknown collector* (?): 2*n* = 22 (Löve & Löve 1945: 17).
G. dissectum. Slovakia, Nízke Poloniny, potatofield above Nová Sedlieca, *Májovský s.n.* (?): 2*n* = 22 (Májovský 1974a: 9).
G. dissectum. Spain, Jaén, Sierra de Cazorla, roadsides N of Cazorla, *Löve 0178* (?): 2*n* = 22 (Löve & Kjellqvist 1974: 163).
G. dissectum. Spain, Andalucia, San Roque, *Van Loon 22318* (U): 2*n* = 22 (Van Loon 1984c: 294).
G. dissectum. Sweden, *Cheryagina 13405* (VLA): 2*n* = 22 (Probatova & Chernyagina 2019: 1128).
G. dissectum. Sweden, Skane, Torrlösa, Höjelycke, *Lövkist 1210* (LD): 2*n* = 22 (Lövkvist & Hultgard 1999: 21).
G. dissectum. Sweden, Skane, Gladsax, Bäckhalladalen, *Lövkist 2396* (LD): 2*n* = 22 (Lövkvist & Hultgard 1999: 21).
G. dissectum. Turkey, between Akseki and İbradi, *Kahraman 1774* (Middle East Technical University, Ankara): 2*n* = 22 (Martin & al. 2022: 8).
G. divaricatum. Bulgaria, Rila Mt., around Rilski monastery, *Petrova 221364* (SOM): 2*n* = 28 (Petrova & Stanimirova 2002: 456).
G. divaricatum. Bulgaria, Rila Mt., Vodnya, *Petrova 24199* (SOM): 2*n* = 28 (Petrova & Stanimirova 2002: 456).
G. divaricatum. Hungary, *Van Loon 24233, 25472* (U): 2*n* = 28 (Van Loon 1984c: 294).
G. divaricatum. Poland, Zator-Przereb, *Zajac s.n.* (?): 2*n* = 28 (Jankun & al. 1996: 12).
G. divaricatum. Slovakia, Podunajská nížina, Jur pri Bratislave, Šúr, *Feráková s.n.* (?): 2*n* = 26 (Májovský 1974b: 10).
G. divaricatum. Switzerland, Botanische Garten Neuchâtel, Wildherkunft, Alpen, *unknown collector* (?): 2*n* = 28 (Dersch 1974: 77).
G. divaricatum. Turkey, between Akdağmadeni and Şarkişla, *Kahraman 2109* (Middle East Technical University, Ankara): 2*n* = 28 (Martin & al. 2022: 8).
G. dolomiticum. Spain, Montes Aquilianos, Ferradillo, *Nieto 393GN* (MA): 2*n* = 28 (Nieto Feliner 1985: 120).
G. endressii. Belgium, Namur, Rocroi, *Van Loon 11245* (U): 2*n* = 28 (Van Loon 1984b: 266).
G. endressii. France, versant sud du Causse des Arbailles o Pic d'Orhy, près Larrau, *unknown collector* (?): *n* = 13?, 2*n* = 26? (Delay & Vivant 1978: 487).
G. endressii. Germany, Kiel, *unknown collector* (?): 2*n* = 26? (Gauger 1937: 259).
G. endressii. unknown origin, *unknown collector* (?): *n* = 14 (Warburg 1938a: 144).
G. erianthum. Japan, Hokkaido, Mashuko, *unknown collector* (?): 2*n* = 28+1-2B (Shimizu 1971: 61).
G. erianthum. Japan, Hokkaido, Iwaobetsu, *unknown collector* (?): 2*n* = 28+1-2B (Shimizu 1971: 61).
G. erianthum. Russia, Shumshu Island, Boljshoye Lake, near mouth of Bettobu R., *Barkalov s.n.* (VLA): 2*n* = 28 (Probatova & al. 2000: 26).
G. erianthum [sub *G. subumbelliforme*]. Russia, Sakhalin, Dolinskij, *Sokolovskaya 150* (?): 2*n* = 28 (Probatova & al. 1991: 1175).
G. erianthum. Russia, Sakhalin, *unknown collector* (?): 2*n* = 28 (Sokolovskaya 1960: 47).
G. erianthum. Russia, Magadan, Južn. Čukotka, nos. Beringovskij, *Zhukova 74-01C* (?): 2*n* = 28 (Zhukova 1982: 363).
G. erianthum. Russia, Magadan, Chr. Rarytkin, *Zhukova 77-46* (?): 2*n* = 28 (Zhukova 1980: 57).
G. erianthum. unknown origin, *unknown collector* (?): 2*n* = 30 (Sakai 1935: 72).
G. erianthum. USA, Alaska, Sutwik Island, Chowiet Island, *Hatch 85* (ALA): 2*n* = 28 (Dawe & Murray 1979: 267).
G. favosum. unknown origin, *unknown collector* (?): 2*n* = 50 (Warburg 1938a: 143).
G. glaberrimum. Turkey, entre Anamur et Ermenek, Saray Mahallesi, *Guittonneau 73.06.26.03* (herb. Guittonneau): 2*n* = 30 (Guittonneau 1975: 200).
G. glaberrimum. Turkey, Gündoğmuş, Gelesandra plateau, *Kahraman 1789* (Middle East Technical University, Ankara): 2*n* = 30 (Martin & al. 2022: 8).
G. gracile. Turkey, towards to Zigana gateway, *Kahraman 1879* (Middle East Technical University, Ankara): 2*n* = 26 (Martin & al. 2022: 8).
G. gymnocaulon. Turkey, Şavşat, *Kahraman 2412* (Middle East Technical University, Ankara): 2*n* = 28 (Martin & al. 2022: 8).
G. gymnocaulon. unknown origin, *unknown collector* (?): 2*n* = 28 (Tumajanov & Beridze 1968: 62).
G. homeanum. New Zealand, Auckland, Mt. Albert, Jesmond Terrace, *de Lange & al. s.n.* (AK-285216): *n* = 26 (de Lange & al. 2004: 880).
G. hyperacrion. Papua Guinea, Mt. Wilhelm, *Borgmann 92* (L): 2*n* = 56 (Borgmann 1964: 149).
G. ibericum [partially sub *G. ibericum* subsp. *jubatum*]. Turkey, between Hayrat and Sarmaşik village, *Kahraman 1900* (Middle East Technical University, Ankara): 2*n* = 28 (Martin & al. 2022: 8).
G. ibericum. unknown origin, cultivated at Kiel, Germany, *unknown collector* (?): 2*n* = 56? (Gauger 1937: 529).
G. ibericum. unknown origin, cultivated material from Botanical Garden, *Van Loon 3459* (U): 2*n* = 28 (Van Loon 1984b: 266).
G. koreanum. South Korea, Solaksan, *Lee s.n.* (?): 2*n* = 28+2B (Lee 1967: 460).
G. krameri. Japan, Nagamo, Karuizawa, *unknown collector* (?): 2*n* = 28 (Shimizu 1971: 61).
G. krameri. Japan, Fukushima, lake Nanko, *unknown collector* (?): 2*n* = 28 (Shimizu 1971: 61).
G. krameri [sub *G. sieboldii*]. Russia, Primorskii krai, *Korkishko 9947, 9948* (VLA): 2*n* = 28 (Probatova & al. 2014: 1155).
G. lamberti. India, Lloyd Botanical Garden, Darjeeling, *Sharma & al. 2115* (?): *n* = 15 (Roy & al. 1988: 95).
G. lambertii [sub *G. grevilleanum*]. India, valley of Flowers, Western Himalayas, *Sharma 2299* (CUH): *n* = 15 (Chatterjee & Sharma 1970: 183).
G. lambertii [sub *G. grevilleanum*]. India, Darjeeling, E Himalayas, *Sharma 416* (CUH): 2*n* = 30, 32 (Chatterjee & Sharma 1970: 183).
G. lanuginosum. Sweden, Smaland, Lofta, Ekvik, *Dahlgren s.n.* (?): 2*n* = 48 (Dahlgren 1952: 316).
G. lanuginosum. Sweden, Södermanland, Tyresö, *Dahlgren s.n.* (?): 2*n* = 48 (Dahlgren 1952: 316).
G. lanuginosum. Sweden, Dalsland, Gunnarsnäs, Rostock, *Dahlgren s.n.* (?): 2*n* = 48 (Dahlgren 1952: 316).
G. lanuginosum. Turkey, Erdek, between Ormanli and Balli, *Kahraman 2361* (Middle East Technical University, Ankara): 2*n* = 48 (Martin & al. 2022: 8).
G. lanuginosum [sub *G. deprehesum*]. unknown origin, *unknown collector* (?): 2*n* = 42 (Warburg 1938a: 142).
G. lanuginosum. unknown origin, cultivated material from Botanical Garden, *Van Loon 3532, 3547* (U): 2*n* = 48 (Van Loon 1984c: 281).
G. lasiopus. Turkey, Akseki, Güzelsu, *Kahraman 1791* (Middle East Technical University, Ankara): 2*n* = 48 (Martin & al. 2022: 8).
G. libani. Turkey, Belen, Güzelyayla, *Kahraman 2076* (Middle East Technical University, Ankara): 2*n* = 28 (Martin & al. 2022: 8).

G. libanoticum. Turkey, Derebucak-İbradi, *Kahraman 2311* (Middle East Technical University, Ankara): 2*n* = 28 (Martin & al. 2022: 8).

G. lucidum. Bulgaria, Strouma valley, Kresnensko, *Petrova & Stanimirova 2356* (SOM): 2*n* = 40 (Petrova & Stanimirova 2003: 678).

G. lucidum. France, Hérault, St. Guilhelm-le-Désert, *Van Loon 11811* (U): 2*n* = 40-44 (Van Loon 1984c: 294).

G. lucidum. France, Côtes-du-Nord, St. Brieuc, Le Légué, *Van Loon 11819* (U): 2*n* = 40-44 (Van Loon 1984c: 294).

G. lucidum. France, Lozère, Gorges du Tarn, Point Sublieme, *Van Loon 12337* (U): 2*n* = 40-44 (Van Loon 1984c: 294).

G. lucidum. France, Loire-Atlantique, Ancenis, *Van Loon 15509* (U): 2*n* = 40-44 (Van Loon 1984c: 294).

G. lucidum. France, Lozère, Vébron, *Van Loon 24255* (U): 2*n* = 40-44 (Van Loon 1984c: 294).

G. lucidum. France, *Van Loon 3479* (U): 2*n* = 40-44 (Van Loon 1984c: 294).

G. lucidum. France, Hérault, Mons, *Van Loon 3636* (U): 2*n* = 40-44 (Van Loon 1984c: 294).

G. lucidum. Great Britain, Westmorland, v.c. 69, near Meathop Moss, ca. 3 km EN of Lindale, *Hollingsworth s.n.* (LTR): 2*n* = 40 (Hollingsworth & al. 1992: 135).

G. lucidum. Great Britain, Cambridge, *unknown collector* (?): *n* = 10 (Warburg 1938a: 143).

G. lucidum. Great Britain, *Van Loon 11852* (U): 2*n* = 40-44 (Van Loon 1984c: 294).

G. lucidum. Greece, NW of Mt. Olympus, 4 km SSW AG. Dimitrios, *Strid & al. 227* (C): 2*n* = ca. 40 (Strid & Franzén 1981: 835).

G. lucidum. Greece, Macedonia, Brissochori, *Van Loon 20221, 20223* (U): 2*n* = 40-44 (Van Loon 1984c: 294).

G. lucidum. Hungary, Veszprem near Tapolca, *Van Loon 10760* (U): 2*n* = 40-44 (Van Loon 1984c: 294).

G. lucidum. Iran, Tang e Baba Abbas, Khorramabad, *Aryavan 76-1302* (ISF): *n* = 30 (Aryavand 1983: 322).

G. lucidum. Ireland, Sligo, Knocknareah Grange House, *Van Loon 9952, 9954, 9955* (U): 2*n* = 40-44 (Van Loon 1984c: 294).

G. lucidum. Morocco, Haut Atlas, Ori, Rhat, Abachkou T-n-Tighist, *Galland 1148[82-43]* (NEU): 2*n* = 40 (Galland 1988: 144).

G. lucidum. Morocco, Haut Atlas, Toubkal, Imlil, *Galland 2048[82-370]* (NEU): *n* = 20 (Galland 1988: 144).

G. lucidum. Morocco, Moyen Atlas, Tichchoukt, versant W, *Galland 605[80-29]* (NEU): *n* = 20 (Galland 1988: 144).

G. lucidum. Portugal, Tábua a Midões, *Alves & Leitão 4517* (COI?): 2*n* = ca. 40 (Alves & Leitão 1976: 235).

G. lucidum. Portugal, Coimbra, *unknown collector* (?): 2*n* = 20 (Warburg 1938a: 143).

G. lucidum. Portugal, Beira Litoral, Villa Franca, *Van Loon 22049* (U): 2*n* = 40-44 (Van Loon 1984c: 294).

G. lucidum. Portugal, Beira Litoral, Penacova, *Van Loon 24226* (U): 2*n* = 40-44 (Van Loon 1984c: 294).

G. lucidum. Portugal, Beira Litoral, vic. Coimbra, *Van Loon 3546, 11836B, 15503* (U): 2*n* = 40-44 (Van Loon 1984c: 294).

G. lucidum. Russia, *Van Loon 13650* (U): 2*n* = 40-44 (Van Loon 1984c: 294).

G. lucidum. Slovakia, Podunajská nížina, Jelenec, *Májovský s.n.* (SLO): 2*n* = 20 (Uhríkova & Májovský 1980: 726).

G. lucidum. Spain, Jaén, Sierra de Cazorla, Torre del Vinagre, *Löve 0268* (?): 2*n* = 20 (Löve & Kjellqvist 1974: 164).

G. lucidum. Spain, Granada, Jerez del Marquesado, Arroyo de Alcázar, *unknown collector* (SEV): 2*n* = 40 (Luque & Díaz Lifante 1991: 312).

G. lucidum. Sweden, Uppsala, *Van Loon 11805* (U): 2*n* = 40-44 (Van Loon 1984c: 294).

G. lucidum. Switzerland, Jura, Neuchatel, *Galland 1234[83-1234]* (NEU): 2*n* = 42 (Galland 1988: 144).

G. lucidum. Turkey, between Karabük and Bartin, *Kahraman 2144* (Middle East Technical University, Ankara): 2*n* = 20 (Martin & al. 2022: 8).

G. macrorrhizum. Albania, Mali i Melesinit, Leskoviku, *Baltisberger 11921* (Z): 2*n* = 92 (Baltisberger & Baltisberger 1995: 470).

G. macrorrhizum. Albania, *unknown collector* (?): *n* = 23 (Warburg 1938a: 151).

G. macrorrhizum. Bulgaria, Markova, *Petrova 5998* (SOM): 2*n* = 46 (Petrova & Stanimirova 2002: 456).

G. macrorrhizum. Bulgaria, Moursalitsa hill, *Petrova 4498* (SOM): 2*n* = 46 (Petrova & Stanimirova 2002: 456).

G. macrorrhizum. Bulgaria, Vrachanska Mt, *Petrova 53297* (SOM): 2*n* = 46, 92 (Petrova & Stanimirova 2002: 456).

G. macrorrhizum. Greece, Kataphygion to Velvendos, Pieria Ori, *Baltisberger 11411* (ZT): 2*n* = 46 (Baltisberger 1991a: 167).

G. macrorrhizum. Greece, Mt Olympus, E side pr. AG. Dionysios, *Strid & al. G74-06-02* (C): 2*n* = ca. 46 (Strid & Franzén 1981: 835).

G. macrorrhizum. Greece, military post of Gydhotopos ca. 22 km NNE Paranestion, *Strid 13719* (C, G): 2*n* = 46 (Strid & Andersson 1985: 213).

G. macrorrhizum. Italy, Venezia Giulia, Nimis, *Van Loon 16584* (U): 2*n* = 87-93 (Van Loon 1984b: 266).

G. macrorrhizum. Italy, Venezia Giulia, Nimis, *Van Loon 16585* (U): 2*n* = 87-93 (Van Loon 1984b: 266).

G. macrorrhizum. Italy, Venezia Giulia, Nimis, *Van Loon 16587* (U): 2*n* = 87-93 (Van Loon 1984b: 266).

G. macrorrhizum. Italy, Venezia Giulia, Nimis, *Van Loon 16588* (U): 2*n* = 87-93 (Van Loon 1984b: 266).

G. macrorrhizum. Italy, Venezia Giulia, Ponte Brisicul, *Van Loon 17119* (U): 2*n* = 87-93 (Van Loon 1984b: 266).

G. macrorrhizum. Italy, Venezia Giulia, Subitl, *Van Loon 17137* (U): 2*n* = 87-93 (Van Loon 1984b: 266).

G. macrorrhizum. Turkey, Erdek, between Ormanli and Balli, *Kahraman 2362* (Middle East Technical University, Ankara): 2*n* = 46 (Martin & al. 2022: 8).

G. macrorrhizum. unknown origin, cultivated at Kiel, Germany, *unknown collector* (?): 2*n* = 87-93 (Gauger 1937: 529).

G. macrostylum. Greece, Mt. Olympus, NW side, Kokkinoplos to Petra, *Strid & al. G76-10-20* (C): 2*n* = 28 (Strid & Franzén 1981: 835).

G. macrostylum. Greece, Sterea Ellas, Mt. Parnassos, *Van Loon 24487* (U): 2*n* = 28, 42 (Van Loon 1984b: 266).

G. macrostylum. Greece, Sterea Ellas, Mt. Parnassos, *Van Loon 24497* (U): 2*n* = 28, 42 (Van Loon 1984b: 266).

G. macrostylum. Greece, Sterea Ellas, Mt. Parnassos, *Van Loon 24507* (U): 2*n* = 28, 42 (Van Loon 1984b: 266).

G. macrostylum. Greece, Sterea Ellas, Mt. Parnassos, *Van Loon 24515* (U): 2*n* = 28, 42 (Van Loon 1984b: 266).

G. macrostylum [sub *G. tuberosum*]. Greece, Sterea Ellas, Mt. Parnassos, *Van Loon 24495* (U): 2*n* = 28 (Van Loon & Oudemans 1982: 343).

G. macrostylum. Turkey, Elmali, Uzungeriş hill, *Kahraman 1837* (Middle East Technical University, Ankara): 2*n* = 28 (Martin & al. 2022: 8).

G. maculatum. USA, Michigan, Allegan co., 8 miles S of Holland, *Van Faasen 3564* (HCHM): *n* = 26 (Faasen & Nadeau 1976: 157).

G. maderense. Portugal, Madeira, Paul da Serra (from seeds received at Kew from Mr. P.F. Parker of Aberystwyth been sent to him by Major Pickering), *Pickering s.n.* (K): 2*n* = 68 (Yeo 1969: 29, 34).

G. magellanicum. Chile, Magallanes, Porvenir, *Aedo 7445* (MA): 2*n* = 112 (Aedo & al. 2005a: 8).

G. malviflorum. Spain, Málaga, puerto de Montejaque, *Navarro 3483* (MA): 2*n* = ca. 56 (Aedo 2015: 298).

G. maximowiczii. Russia, Primorye, *unknown collector* (?): 2*n* = 28 (Sokolovskaya 1966: 98).

G. molle. Belgium, West Vlaanderen, Ostende, *Van Loon 12336* (U): 2*n* = 26 (Van Loon 1984c: 295).

G. molle. Belgium, West Vlaanderen, Gent, *Van Loon 20857* (U): 2*n* = 26 (Van Loon 1984c: 295).
G. molle. Bulgaria, Strouma valley, Rupite, *Petrova & Stanimirova 2358* (SOM): 2*n* = 26 (Petrova & Stanimirova 2003: 678).
G. molle [sub *G. brutium*]. Bulgaria, Vrachanska Mt, *Petrova 2991* (SOM): 2*n* = 26, 52 (Petrova & Stanimirova 2002: 456).
G. molle. Canada, British Columbia, Chilliwack, *Faris 2285* (DAO): 2*n* = 26 (Mulligan 1959: 83).
G. molle. Czech Republic, Devínska Kobyla, Devin, *Feráková s.n.* (?): 2*n* = 26 (Májovský 1978: 25).
G. molle. Denmark, Jutland, Bur, *Van Loon 19276* (U): 2*n* = 26 (Van Loon 1984c: 295).
G. molle. Denmark, Jutland, Hjardemaal, *Van Loon 19289* (U): 2*n* = 26 (Van Loon 1984c: 295).
G. molle. France, environs de Montpellier, Bel-Air, *Natarajan s.n.* (MPU): 2*n* = 26 (Natarajan 1978: 529).
G. molle. France, Var, Presqu'ile-de-Giens, *Van Loon 10127* (U): 2*n* = 26 (Van Loon 1984c: 295).
G. molle. France, Var, Hyères, *Van Loon 10132* (U): 2*n* = 26 (Van Loon 1984c: 295).
G. molle. France, Bouche-du-Rhône, Les Stes.-Maries-de la Mer, *Van Loon 10137* (U): 2*n* = 26 (Van Loon 1984c: 295).
G. molle. France, Vaucluse, Orange, *Van Loon 10670* (U): 2*n* = 26 (Van Loon 1984c: 295).
G. molle. France, Puy-de-Dôme, St. Nectaire, *Van Loon 12343* (U): 2*n* = 26 (Van Loon 1984c: 295).
G. molle. France, Hautes-Pyrénées, Orbeost, *Van Loon 22043* (U): 2*n* = 26 (Van Loon 1984c: 295).
G. molle. Germany, Schleswig-Holstein, *unknown collector* (?): 2*n* = 26 (Gauger 1937: 529).
G. molle. Great Britain, Aberdeen, *unknown collector* (?): 2*n* = 26 (Warburg 1938a: 142).
G. molle. Great Britain, Lough Ine, Cork, *unknown collector* (?): *n* = 13 (Warburg 1938a: 142).
G. molle. Great Britain, Cambridge, *unknown collector* (?): 2*n* = 26 (Warburg 1938a: 142).
G. molle. Greece, Mt Yiorla, W Lampirion, *Gustavsson 5790* (LD): 2*n* = 26 (Franzén & Gustavsson 1983: 104).
G. molle [sub *G. brutium*]. Greece, Macedonia, vic. Konitsa, *Van Loon 20214* (U): 2*n* = 26 (Van Loon 1984a: 170).
G. molle [sub *G. brutium*]. Greece, Macedonia, Brissochori, *Van Loon 20218* (U): 2*n* = 26 (Van Loon 1984a: 170).
G. molle [sub *G. brutium*]. Greece, Macedonia, Brissochori, *Van Loon 20218* (U): 2*n* = 26 (Van Loon 1984c: 281).
G. molle [sub *G. brutium*]. Greece, Macedonia, Konitsa, *Van Loon 20214* (U): 2*n* = 26 (Van Loon 1984c: 281).
G. molle. Hungary, lake Balaton, Keszthely, *Van Loon 10761* (U): 2*n* = 26 (Van Loon 1984c: 295).
G. molle. Iceland, *unknown collector* (?): 2*n* = 26 (Löve & Löve 1956: 209).
G. molle. Ireland, Connemara, Lisdoonvarna, *Van Loon 9947, 9949* (U): 2*n* = 26 (Van Loon 1984c: 295).
G. molle. Netherlands, Fort Hoofddijk, de Bilt, prov. of Utrecht, *Gadella & Kliphuis 1639* (U): 2*n* = 26 (Gadella & Kliphuis 1966: 548).
G. molle. Netherlands, S of Voorne, prov. of Zuid-Holland, *Gadella & Kliphuis 1920* (U): 2*n* = 26 (Gadella & Kliphuis 1966: 548).
G. molle. Netherlands, Zuid-Holland, Wassenaarsche Duinen, *Van Loon 10728* (U): 2*n* = 26 (Van Loon 1984c: 295).
G. molle. Netherlands, Friesland, Schiermonnikoog, *Van Loon 12349* (U): 2*n* = 26 (Van Loon 1984c: 295).
G. molle. Netherlands, Noord-Holland, Texel, *Van Loon 19063* (U): 2*n* = 26 (Van Loon 1984c: 295).
G. molle. Netherlands, Utrech, *Van Loon 22295-22299* (U): 2*n* = 26 (Van Loon 1984c: 295).
G. molle. Netherlands, Utrech, Rhenen, *Van Loon 3438* (U): 2*n* = 26 (Van Loon 1984c: 295).
G. molle. Poland, Dziekanowice, *unknown collector* (?): 2*n* = 26 (Skalińska & al. 1976: 120).
G. molle. Poland, Wieliczka, *unknown collector* (?): 2*n* = 26 (Skalińska & al. 1976: 120).
G. molle. Portugal, Vila Nova de Gaia, Serra do Pilar, *Alves & Leitão 3937* (COI?): 2*n* = 26 (Alves & Leitão 1976: 233).
G. molle. Portugal, Estrada de Portimão a Faro, *Alves & Leitão 4516* (COI?): 2*n* = 26 (Alves & Leitão 1976: 233).
G. molle. Portugal, Coimbra, Eiras, *Alves & Leitão 5937* (COI?): 2*n* = 26 (Alves & Leitão 1976: 233).
G. molle. Portugal, Igrejas, estrada de S. Pedro do Sul-Arouca, *Alves & Leitão 894* (COI?): 2*n* = 26 (Alves & Leitão 1976: 233).
G. molle. Portugal, Coimbra, *unknown collector* (?): 2*n* = 26 (Warburg 1938a: 142).
G. molle. Portugal, Beira Litoral, Coimbra, *Van Loon 22048, 24225* (U): 2*n* = 26 (Van Loon 1984c: 295).
G. molle. Russia, Krym, Yalta, *Van Loon 25494* (U): 2*n* = 26 (Van Loon 1984c: 295).
G. molle. Spain, Jaén, Sierra de Cazorla, pantano del Tranco, *Löve 0157* (?): 2*n* = 26 (Löve & Kjellqvist 1974: 163).
G. molle. Spain, Galicia, Meira, *Van Loon 22039* (U): 2*n* = 26 (Van Loon 1984c: 295).
G. molle. Spain, Andalucia, Estegon, *Van Loon 22316* (U): 2*n* = 26 (Van Loon 1984c: 295).
G. molle. Spain, Catalonia, Camppius, Vallès Orientalis, *Van Loon 25511* (U): 2*n* = 26 (Van Loon 1984c: 295).
G. molle. Sweden, Skane, Hofterup, Lundakra, *Lövkist 1635* (LD): 2*n* = 26 (Lövkvist & Hultgard 1999: 21).
G. molle. unknown origin, *Böcher & Larsen 3952* (C?): 2*n* = 26 (Böcher & Larsen 1958: 19).
G. molle. USA, Virginia, *Hill 7932* (VPI): 2*n* = 26 (Hill 1989: 18).
G. molle [partially sub *G. molle* subsp. *brutium*]. Turkey, between Kula and Salihli, *Kahraman 1701* (Middle East Technical University, Ankara): 2*n* = 26, 28 (Martin & al. 2022: 8).
G. nanum [sub *G. cinereum* subsp. *nanum*]. Morocco, Moyen Atlas, Bou Iblane, Moussa ou Salah, *Galland 429 [79-1287]* (NEU): 2*n* = 28 (Galland 1988: 144).
G. nanum [sub *G. cinereum* subsp. *nanum*]. Morocco, Haut Atlas, Toubkal, Lepiney-T-n-Tazaghart, *Galland 98[78-1423]* (NEU): 2*n* = 28 (Galland 1988: 144).
G. nanum [sub *G. cinereum* subsp. *nanum*]. Morocco, Haut-Atlas, Jbel Ayachi, pr. Tizi-n'Tirecht, *Guittonneau 72.07.12.02* (herb. Guittonneau): 2*n* = 28 (Guittonneau 1975: 200).
G. nanum. Morocco, massif Toubkal, vallée de Reraira, refuge Neltner, *Küpfer 3330* (NEU?): 2*n* = 28 (Favarger & al. 1979: 52).
G. nanum [sub *G. cinereum* subsp. *nanum*]. Morocco, Ayachi, *unknown collector* (?): *n* = 13? (Quézel 1957: 393).
G. napuligerum. unknown origin, *unknown collector* (?): 2*n* = 28 (Warburg 1938a: 144).
G. nepalense. India, Palmajoa, *Sharma & al. 1569* (?): *n* = 13 (Roy & al. 1988: 94).
G. nepalense. India, Batasi, *Sharma & al. 1661* (?): *n* = 14 (Roy & al. 1988: 94).
G. nepalense. India, Darjeeling, E Himalayas, *Sharma 146* (CUH): *n* = 14, 2*n* = 28 (Chatterjee & Sharma 1970: 183).
G. nepalense. India, Darjeeling, E Himalayas, *Sharma 1569* (CUH): *n* = 13 (Chatterjee & Sharma 1970: 183).
G. nepalense. Nepal, Godawari, Royal Botanic Garden, *Bhattarai 3038* (herb. Dep. Medicinal Plants, Godawari, Lalitpur): 2*n* = 26 (Malla & al. 1981: 75).
G. niuginiense [sub *G. potentilloides*]. Papua Guinea, Mt. Wilhelm, *Borgmann 66* (L): 2*n* = 36 (Borgmann 1964: 149).
G. nodosum. France, Haut Savoie, Le Châtelard, *Van Loon 11265* (U): 2*n* = 28 (Van Loon 1984b: 266).
G. nodosum. Italy, Toscane, Braccio, *Van Loon 24201* (U): 2*n* = 28 (Van Loon 1984b: 266).

G. nodosum. Italy, Torino, Cervelli, *Van Loon 24214* (U): 2*n* = 28 (Van Loon 1984b: 266).

G. nodosum. unknown origin, cultivated at Kiel, Germany, *unknown collector* (?): 2*n* = 28 (Gauger 1937: 529).

G. nodosum. unknown origin, *unknown collector* (?): *n* = 14 (Warburg 1938a: 144).

G. palmatum. Portugal, Madeira, Levada do Ribeiro Frio, *Dalgaard & Christensen s.n.* (C): 2*n* = 68 (Dalgaard 1991: 141).

G. palmatum. Portugal, Madeira, *Hamann 71023* (C): 2*n* = 68 (Dalgaard 1991: 141).

G. palmatum. Portugal, Madeira, Ribeiro Frio, *Hansen 13452* (C): 2*n* = 68 (Dalgaard 1986b: 234).

G. palmatum. Portugal, Madeira, plants grown at Leeds from seed supplied by Messr. Ingwersen Ltd., East Grinstead, Sussex, from a stock obtained in cultivation in N Italy after 1945, *unknown collector* (?): *n* = 34, 2*n* = 68 (Yeo 1973a: 308).

G. palmatum. Portugal, Madeira, plants grown at Leeds from seed supplied by Messr. Thopson and Morgan, Ipswich, *unknown collector* (herb. Jackson): 2*n* = 68 (Yeo 1973a: 308).

G. palmatum. Portugal, Madeira, plants grown at Leeds from a stock supplied in 1946 and another plant supplied in 1956, by the Royal Botanic Garden, Edinburgh, *unknown collector* (herb. Jackson): *n* = 34, 2*n* = 68 (Yeo 1973a: 308).

G. palmatum. Portugal, Madeira, Ribeiro Frio, *Van Loon 20268* (U): 2*n* = 68 (Van Loon 1984a: 170).

G. palmatum [sub *G. anemonifolium*]. unknown origin, *unknown collector* (?): *n* = 34, 2*n* = 68 (Warburg 1938a: 151).

G. palustre. Austria, Eisenerzer Alpen, Erzberg, Müllkompostierungs-Versuchsfläche, *Vitek & Walter s.n.* (WU): 2*n* = 28 (Kiehn & al. 1991: 29).

G. palustre. Belorussiya, Minks, *unknown collector* (?): 2*n* = 28 (Dmitrieva & al. 1977: 87).

G. palustre. Bulgaria, Rila, Mt. Borovels, *Petrova & Stanimirova 50200* (SOM): 2*n* = 28 (Petrova & Stanimirova 2003: 677).

G. palustre. Germany, Wetterau, Muschenheim, Berger Mühle, *Ludwig & al. MB 84/1371, 5518/21* (herb. Buttler): 2*n* = 28 (Buttler 1989: 13).

G. palustre. Germany, Königsberg, *unknown collector* (?): 2*n* = 28, 56 (Gauger 1937: 529).

G. palustre. Hungary, Debrecen, pr. Haláp, *unknown collector* (?): 2*n* = 28 (Pólya 1950: 51).

G. palustre. Poland, Tarnawa near Sucha, *unknown collector* (?): 2*n* = 28 (Skalińska & al. 1976: 121).

G. palustre. Poland, Sucha, *unknown collector* (?): 2*n* = 28 (Skalińska & al. 1976: 121).

G. palustre. Poland, Bilczyce near Gdów, *unknown collector* (?): 2*n* = 28 (Skalińska & al. 1976: 121).

G. palustre. Poland, Krakow, Ojców, *Van Loon 3886* (U): 2*n* = 28 (Van Loon 1984b: 276).

G. palustre. Poland, Biezanów, *Wcislo s.n.* (?): 2*n* = 28 (Skalińska & al. 1976: 121).

G. palustre. Slovakia, Západné Tatry, Oravice, near the forester's house, *Hindáková & Uhríková s.n.* (?): 2*n* = 28 (Májovský 1974b: 10).

G. palustre. Turkey, between Sarıkamiş and Karaurgan, *Kahraman 2174* (Middle East Technical University, Ankara): 2*n* = 28 (Martin & al. 2022: 8).

G. palustre. unknown origin, *unknown collector* (?): 2*n* = 28 (Parfenov & Dmitrieva 1988: 4).

G. palustre. unknown origin, *unknown collector* (?): *n* = 14 (Warburg 1938a: 144).

G. petri-davisii. Turkey, Höbek mountain, *Kahraman 2130* (Middle East Technical University, Ankara): 2*n* = 28 (Martin & al. 2022: 8).

G. phaeum [sub *G. phaeum* var. *lividum*]. Austria, *unknown collector* (?): 2*n* = 28 (Warburg 1938a: 144).

G. phaeum. Bosnia-Herzegovina, Mt Jahorina, vic. Pale, *Van Loon 17012* (U): 2*n* = 28 (Van Loon 1984b: 276).

G. phaeum. Bulgaria, Western Stara planina, Midzhou, *Petrova & Stanimirova 3998-1* (SOM): 2*n* = 28 (Petrova & Stanimirova 2003: 678).

G. phaeum. Czech Republic, E Bohemia, Rychnov n. Kněžnou, Dobré village, *Hašková 377 626* (PR): *n* = 14, 2*n* = 28 (Krahulcová 1990: 386).

G. phaeum. France, Savoie, Modane, *Van Loon 3669* (U): 2*n* = 28 (Van Loon 1984b: 276).

G. phaeum. Poland, near Wantule, Western Tatra, *unknown collector* (?): 2*n* = 28 (Skalińska & al. 1959: 498).

G. phaeum. Poland, valley Jaworzynka, Western Tatra, *unknown collector* (?): 2*n* = 28 (Skalińska & al. 1959: 498).

G. phaeum. Poland, valley Bedkowska, NW Krakow, *unknown collector* (?): 2*n* = 28 (Skalińska & al. 1959: 498).

G. phaeum. Russia, *Van Loon 18910* (U): 2*n* = 28 (Van Loon 1984b: 276).

G. phaeum. Serbia, vic. Titovo Uzice, *Van Loon 17028, 17029* (U): 2*n* = 28 (Van Loon 1984b: 276).

G. phaeum. Slovakia, Zadné Medodoly, Belanské Tatry Mts, *Májovský s.n.* (?): 2*n* = 28 (Májovský 1970b: 53).

G. phaeum. Sweden, Skane, Lund, *Lövkist 1550* (LD): 2*n* = 28 (Lövkvist & Hultgard 1999: 21).

G. phaeum. Switzerland, *Van Loon 3476* (U): 2*n* = 28 (Van Loon 1984b: 276).

G. phaeum. unknown origin, *unknown collector* (?): 2*n* = 14? (Nagl 1962: 448).

G. phaeum. unknown origin, *unknown collector* (?): 2*n* = 28 (Tischler 1950: 102).

G. phaeum. unknown origin, *unknown collector* (?): 2*n* = 14? (Tschermak-Woess & Hasitschka 1954: 97).

G. phaeum. unknown origin, *unknown collector* (?): *n* = 14 (Warburg 1938a: 144).

G. platyanthum [sub *G. eriostemon*]. China, Emei Mountain and Baoxing County, western Sichuan Province, *unknown collector* (PE): *n* = 14 (Hong & Zhang, 1990: 192).

G. platyanthum [sub *G. eriostemon*]. Russia, Irkutsk, *unknown collector* (?): 2*n* = 28 (Krogulevich 1978: 27).

G. platyanthum [sub *G. eriostemon*]. Russia, Primorye, *unknown collector* (?): 2*n* = 28 (Sokolovskaya 1966: 95).

G. platyanthum [sub *G. eriostemon*]. unknown origin, cultivated at Kiel, Germany, *unknown collector* (?): 2*n* = 28 (Gauger 1937: 529).

G. platyanthum [sub *G. eriostemon*]. unknown origin, *unknown collector* (?): *n* = 14 (Warburg 1938a: 144).

G. platypetalum. Turkey, between Şavşat and Ardahan, *Kahraman 2167* (Middle East Technical University, Ankara): 2*n* = 28 (Martin & al. 2022: 8).

G. platypetalum. unknown origin, cultivated at Kiel, Germany, *unknown collector* (?): 2*n* = 42 (Gauger 1937: 529).

G. platypetalum. unknown origin, *unknown collector* (?): 2*n* = 28, 42 (Warburg 1938a: 144).

G. polyanthes. unknown origin, *unknown collector* (?): 2*n* = 28 (Warburg 1938a: 150).

G. ponticum. Turkey, Zigana mountain, from Kepenek hill to Yayla village, *Kahraman 1886* (Middle East Technical University, Ankara): 2*n* = 26 (Martin & al. 2022: 8).

G. potentilloides [sub *G. microphyllum*]. New Zealand, Lyttelton Reserve, Port-Hills, Canterbury, *Dawson & Beuzenberg s.n.* (CHR-517722): 2*n* = 52-54 (Dawson & Beuzenberg 2000: 5).

G. potentilloides [sub *G. microphyllum*]. New Zealand, Campbell I., *Dawson & Beuzenberg s.n.* (CHR-517721): 2*n* = 52-54 (Dawson & Beuzenberg 2000: 5).

G. potentilloides. New Zealand, South Auckland, Pureora, Waihaha river, *de Lange & al. s.n.* (AK-284499): 2*n* = 112 (de Lange & al. 2004: 880).

G. pratense. Austria, Steiermark, Bad Aussee, *Van Loon 11431* (U): 2*n* = 28 (Van Loon 1984b: 276).

G. pratense. Belorussiya, Berezinskogo, *Dmitrieva 84* (?): 2*n* = 28 (Parfenov & Dmitrieva 1987: 65).

G. pratense. Bulgaria, Balkan Range (western), at the foot of the summit Midzhourr, *Petrova 3998* (SOM): 2*n* = 28 (Petrova & Stanimirova 2001: 460).

G. pratense. Czech Republic, C Bohemia, Mělník, SW of Křenek, *Javurek 375678* (PRC): 2*n* = 28 (Javurková 1979: 401).

G. pratense. Czech Republic, Hrensko, *Van Loon 24165* (U): 2*n* = 28 (Van Loon 1984b: 276).

G. pratense. Czech Republic, Moravia occ., Monte Ceskomoravska, *Van Loon 24217* (U): 2*n* = 28 (Van Loon 1984b: 276).

G. pratense. Czech Republic, Besohidium Orient., *Van Loon 24218* (U): 2*n* = 28 (Van Loon 1984b: 276).

G. pratense. France, Jura, Bourg de Sirod, *Van Loon 24175* (U): 2*n* = 28 (Van Loon 1984b: 276).

G. pratense. France, Ille-et-Vilaine, Rennes, *Van Loon 3561* (U): 2*n* = 28 (Van Loon 1984b: 276).

G. pratense. Germany, seeds obtained from E Germany, *unknown collector* (CUH): 2*n* = 28 (Chatterjee & Sharma 1970: 183).

G. pratense. Germany, Kiel, *unknown collector* (?): 2*n* = 28 (Gauger 1937: 529).

G. pratense. Germany, Ober Lausitz, Bautzen, *Van Loon 10607* (U): 2*n* = 28 (Van Loon 1984b: 276).

G. pratense. Germany, Gera, Rudolstadt, *Van Loon 10611* (U): 2*n* = 28 (Van Loon 1984b: 276).

G. pratense. Germany, Niedersachen, Hameln, *Van Loon 10612* (U): 2*n* = 28 (Van Loon 1984b: 276).

G. pratense. Germany, Halle, Sangerhausen, *Van Loon 10616* (U): 2*n* = 28 (Van Loon 1984b: 276).

G. pratense. Germany, Erfurt, Reiser, *Van Loon 24216* (U): 2*n* = 28 (Van Loon 1984b: 276).

G. pratense. Germany, Erfurt, Niedersachswerfen, *Van Loon 25323* (U): 2*n* = 28 (Van Loon 1984b: 276).

G. pratense. Germany, Halle, Süsser See, Eisleben, *Van Loon 25324* (U): 2*n* = 28 (Van Loon 1984b: 276).

G. pratense. Great Britain, Durham, v.c. 66, 2 km N of Barnard Castle, *Hollingsworth s.n.* (LTR): 2*n* = 28 (Hollingsworth & al. 1992: 135).

G. pratense. Great Britain, Derys, v.c. 57, Milldale, *Hollingsworth s.n.* (LTR): 2*n* = 28 (Hollingsworth & al. 1992: 135).

G. pratense. Great Britain, Marlborough Wilts, *unknown collector* (?): *n* = 14, 2*n* = 28 (Warburg 1938a: 144).

G. pratense. Great Britain, Wiltshire, Chippenham, *Van Loon 10603* (U): 2*n* = 28 (Van Loon 1984b: 276).

G. pratense. Great Britain, Derby, vic. Rowsley, *Van Loon 12350* (U): 2*n* = 28 (Van Loon 1984b: 276).

G. pratense. Iceland, *unknown collector* (?): 2*n* = 28 (Löve & Löve 1956: 208).

G. pratense [sub *G. transbaicalicum*]. Mongolia, Chanch, bajan gol., *Háberová & Žamsran s.n.* (SLO): 2*n* = 28 (Murín & al. 1984: 34).

G. pratense. Norway, *Wahlstrom s.n.* (?): *n* = 14, 2*n* = 28 (Wahlstrom 1978: 93).

G. pratense. Poland, Kostrze, *unknown collector* (?): 2*n* = 28 (Skalińska & al. 1978: 42).

G. pratense. Poland, Januszowice, *unknown collector* (?): 2*n* = 28 (Skalińska & al. 1978: 42).

G. pratense. Poland, Balice, *unknown collector* (?): 2*n* = 28 (Skalińska & al. 1978: 42).

G. pratense. Poland, Bolechowice, *unknown collector* (?): 2*n* = 28 (Skalińska & al. 1978: 42).

G. pratense. Poland, Krzeszowice, *unknown collector* (?): 2*n* = 28 (Skalińska & al. 1978: 42).

G. pratense. Poland, Weoclow, Bobolice, *Van Loon 3879* (U): 2*n* = 28 (Van Loon 1984b: 276).

G. pratense. Russia, Buryatiya, Guba Davše, *unknown collector* (?): 2*n* = 28, 28+B (Belaeva & Siplivinsky 1975: 869).

G. pratense [sub *G. transbaicalicum*]. Russia, Irkutsk, *unknown collector* (?): 2*n* = 28 (Krogulevich 1978: 27).

G. pratense. Russia, Moskva, *Van Loon 25321* (U): 2*n* = 28 (Van Loon 1984b: 276).

G. pratense. Russia, Irkutskaya Oblast, *Zavgorodnyaya 13421* (VLA): 2*n* = 28 (Probatova & Chernyagina 2019: 1128).

G. pratense. Russia, Altai, *unknown collector* (?): 2*n* = 28 (Zhukova 1967: 138).

G. pratense. Slovakia, Zádielska dolina, *Májovský s.n.* (?): 2*n* = 28 (Májovský 1970a: 12).

G. pratense. Slovakia, Hornadska Kotlina, Sobotisko, *Van Loon 24193* (U): 2*n* = 28 (Van Loon 1984b: 276).

G. pratense. Spain, Riaño, borde de hayedo a orillas del Esla, *Valdés 4277EV* (MA): 2*n* = 28 (Valdés & Castroviejo 1979: 87).

G. pratense. Turkey, between Sarıkamiş and Karaurgan, *Kahraman 2175* (Middle East Technical University, Ankara): 2*n* = 26 (Martin & al. 2022: 8).

G. pratense. unknown origin, *unknown collector* (?): *n* = 12? (Tischler 1934: 10).

G. pratense. unknown origin, *unknown collector* (?): *n* = 12? (Tjebbes 1928: 328).

G. pratense [sub *G. affine*]. unknown origin, *unknown collector* (?): *n* = 14, 2*n* = 28 (Warburg 1938a: 144).

G. pratense [sub *G. transbaicalicum*]. unknown origin, *unknown collector* (?): 2*n* = 28 (Zhukova 1967: 138).

G. pseudosibiricum. Russia, Altai, *unknown collector* (?): 2*n* = 28 (Sokolovskaya & Strelova 1948a: 190).

G. pseudosibiricum. Russia, Buryatiya, Dolina p. Davše, *unknown collector* (?): 2*n* = 28 (Belaeva & Siplivinsky 1975: 869).

G. pseudosibiricum [sub *G. caeruleum*]. Russia, Irkutsk, *unknown collector* (?): 2*n* = 28 (Krogulevich 1978: 27).

G. psilostemon. Turkey, between Kayaiçi village (Toroslu) and Yağmurdere, *Kahraman 1891* (Middle East Technical University, Ankara): 2*n* = 26 (Martin & al. 2022: 9).

G. psilostemon. unknown origin, cultivated material from two Botanical Gardens, *Van Loon 3495, 12617* (U): 2*n* = 28, 56 (Van Loon 1984b: 277).

G. purpureum. Bulgaria, Strouma valley, Rupite, *Petrova & Stanimirova 2371* (SOM): 2*n* = 32 (Petrova & Stanimirova 2003: 677).

G. purpureum. Croatia, vic. Vratnik, *Van Loon 17203* (U): 2*n* = 32 (Van Loon 1984c: 295).

G. purpureum. Croatia, Istria, Dirsici, *Van Loon 17233* (U): 2*n* = 32 (Van Loon 1984c: 295).

G. purpureum. Croatia, Istria, Peroj, *Van Loon 17241, 17243* (U): 2*n* = 32 (Van Loon 1984c: 295).

G. purpureum. Croatia, Istria, Rovinj, *Van Loon 3650* (U): 2*n* = 32 (Van Loon 1984c: 295).

G. purpureum [sub *G. robertianum*]. Finland, island Seili in Nauvo, *unknown collector* (TUR): *n* = 16 (Arohonka 1982: 5).

G. purpureum [sub *G. robertianum*]. Finland, N., H:ki, Jollas, *unknown collector* (?): 2*n* = 32 (Sorsa 1962: 11).

G. purpureum [sub *G. robertianum* subsp. *purpureum*]. France, Corse, Albo, pelouses à Férules, *Contandriopoulos & al. 85.155* (MARSSJ): 2*n* = 32 (Contandriopoulos & al. 1987: 267).

G. purpureum [sub *G. robertianum* subsp. *purpureum*]. France, Corse, Port Agro au S de Calvi, *Contandriopoulos & al. 85.156* (MARSSJ): 2*n* = 32 (Contandriopoulos & al. 1987: 267).

G. purpureum [sub *G. robertianum* subsp. *purpureum*]. France, environs de Montpellier, Creux-de-Miège, *Natarajan s.n.* (MPU): 2*n* = 32 (Natarajan 1978: 529).

G. purpureum. France, Guernsey, Channel I, *unknown collector* (?): 2*n* = 32 (Böcher & Larsen 1955: 129).

G. purpureum. France, Montpellier, *unknown collector* (?): 2*n* = 32 (Warburg 1938a: 143).

G. purpureum. France, Var, Ile-de-Levant, *Van Loon 10128* (U): 2*n* = 32 (Van Loon 1984c: 295).

G. purpureum. France, Var, Ile-Port-Cros, *Van Loon 10130* (U): 2*n* = 32 (Van Loon 1984c: 295).

G. purpureum. France, Vaucluse, Orange, *Van Loon 10134* (U): 2*n* = 32 (Van Loon 1984c: 295).

G. purpureum. France, Vaucluse, Avignon, *Van Loon 10165* (U): 2*n* = 32 (Van Loon 1984c: 295).
G. purpureum. France, Tarn, Cordes, *Van Loon 11256* (U): 2*n* = 32 (Van Loon 1984c: 295).
G. purpureum. France, Aveyron, Conques, *Van Loon 11259* (U): 2*n* = 32 (Van Loon 1984c: 295).
G. purpureum. France, Hérault, St. Guilhelm-le-Désert, *Van Loon 11811* (U): 2*n* = 32 (Van Loon 1984c: 295).
G. purpureum. France, Ardèche, Ruoms, *Van Loon 20860* (U): 2*n* = 32 (Van Loon 1984c: 295).
G. purpureum. France, Var, Ramatuelle, *Van Loon 22456-22464* (U): 2*n* = 32 (Van Loon 1984c: 295).
G. purpureum. France, Gironde, Mios, *Van Loon 24176* (U): 2*n* = 32 (Van Loon 1984c: 295).
G. purpureum. France, Alpes-Maritimes, Menton, *Van Loon 24205* (U): 2*n* = 32 (Van Loon 1984c: 295).
G. purpureum. France, *Van Loon 3458, 3666* (U): 2*n* = 32 (Van Loon 1984c: 295).
G. purpureum. France, Hérault, St. Germain de Londres, *Van Loon 3630* (U): 2*n* = 32 (Van Loon 1984c: 295).
G. purpureum. France, Hérault, Montpellier, *Van Loon 3747, 5935* (U): 2*n* = 32 (Van Loon 1984c: 295).
G. purpureum [sub *G. robertianum*]. Great Britain, Cambridge, *unknown collector* (?): *n* = 16 (Warburg 1938a: 143).
G. purpureum. Great Britain, *unknown collector* (?): *n* = 16 (Warburg 1938a: 143).
G. purpureum. Greece, Sterea Ellas, Mt. Parnassos, *Van Loon 15500* (U): 2*n* = 32 (Van Loon 1984c: 295).
G. purpureum. Greece, Macedonia, vic. Konitsa, *Van Loon 20211, 20212, 20215* (U): 2*n* = 32 (Van Loon 1984c: 295).
G. purpureum. Greece, Macedonia, Pades, *Van Loon 20228* (U): 2*n* = 32 (Van Loon 1984c: 295).
G. purpureum. Greece, Thessalia, along the road from Elasson to Katerini, *Van Loon 20241* (U): 2*n* = 32 (Van Loon 1984c: 295).
G. purpureum. Greece, Macedonia, along the road from Drama to Potamoi, *Van Loon 20251* (U): 2*n* = 32 (Van Loon 1984c: 295).
G. purpureum. Greece, Macedonia, vic. Drama, *Van Loon 20253* (U): 2*n* = 32 (Van Loon 1984c: 295).
G. purpureum. Italy, Venezia-Giulia, Aurisina, *Van Loon 17100, 17142, 17147* (U): 2*n* = 32 (Van Loon 1984c: 295).
G. purpureum. Italy, Toscana, Casaciano di Murlo, *Van Loon 24198* (U): 2*n* = 32 (Van Loon 1984c: 295).
G. purpureum. Italy, Toscana, Eremo di Lecceto, *Van Loon 24199* (U): 2*n* = 32 (Van Loon 1984c: 295).
G. purpureum. North Macedonia, Skopje, *Van Loon 15505* (U): 2*n* = 32 (Van Loon 1984c: 295).
G. purpureum. Portugal, Ferreira de Zêzere, Lagar do Gato, *Alves & Leitão 4517* (COI?): 2*n* = 32 (Alves & Leitão 1976: 235).
G. purpureum. Portugal, Madeira, Rabaçal, Levada dos 25 Fontes, *Dalgaard & Christensen 5340* (C): 2*n* = 32 (Dalgaard 1986b: 234).
G. purpureum. Portugal, Coimbra, *unknown collector* (?): 2*n* = 32 (Böcher & Larsen 1955: 129).
G. purpureum. Portugal, Estremadura, Oeiras, *Van Loon 13647* (U): 2*n* = 32 (Van Loon 1984c: 295).
G. purpureum. Portugal, Lisboa, *Van Loon 13657* (U): 2*n* = 32 (Van Loon 1984a: 170, Van Loon 1984c: 295).
G. purpureum. Portugal, Lisboa, *Van Loon 13657* (U): 2*n* = 32 (Van Loon 1984a: 170).
G. purpureum. Portugal, Cernache, *Van Loon 22047* (U): 2*n* = 32 (Van Loon 1984c: 295).
G. purpureum. Portugal, Beira Litoral, vic. Coimbra, *Van Loon 3544, 11836, 15502* (U): 2*n* = 32 (Van Loon 1984c: 295).
G. purpureum. Spain, Tenerife, ladera de Güimar, *Dalgaard 6010* (C?): 2*n* = 32 (Dalgaard 1986a: 99).
G. purpureum. Spain, Córdoba, Trassierra, Las Jaras, *Domínguez & al. s.n.* (SEV): 2*n* = 32 (Devesa 1981: 225).
G. purpureum. Spain, Gran Canaria, San Bartolomé de Tirajana, *Larsen 71* (C): 2*n* = 32 (Larsen 1960: 16).
G. purpureum. Spain, Jaén, Sierra de Cazorla, near El Tranco, *Löve 0158* (?): 2*n* = 32 (Löve & Kjellqvist 1974: 164).
G. purpureum. Spain, Tenerife, Mercedes, *Van Loon 13763* (U): 2*n* = 32 (Van Loon 1984a: 170).
G. purpureum. Spain, Tenerife, Puerto de la Cruz, *Van Loon 13766* (U): 2*n* = 32 (Van Loon 1984a: 170).
G. purpureum. Spain, Málaga, Istán, *Van Loon 15501* (U): 2*n* = 32 (Van Loon 1984c: 295).
G. purpureum. Spain, Málaga, Marbella, *Van Loon 22317* (U): 2*n* = 32 (Van Loon 1984c: 295).
G. purpureum. Switzerland, railway station Buchs, *Seitter 11841* (ZT): 2*n* = 32 (Baltisberger 1991b: 6).
G. purpureum. Turkey, between Manavgat and Akseki, *Kahraman 1770* (Middle East Technical University, Ankara): 2*n* = 32 (Martin & al. 2022: 9).
G. purpureum [sub *G. robertianum* subsp. *purpureum*]. unknown origin, cultivated material from Lisbon Botanical Garden, *Böcher 455* (C?): 2*n* = 32 (Böcher 1947: 5).
G. pusillum. Belgium, Antwerpen, *unknown collector* (?): 2*n* = 26 (Gauger 1937: 529).
G. pusillum. Bulgaria, Stara Planina, Sipkova, *Van Loon 25295* (U): 2*n* = 26 (Van Loon 1984c: 295).
G. pusillum. Bulgaria, Central Stara planina Mts, near Karlovo, *Petrova & Stanimirova 25259* (SOM): 2*n* = 26 (Petrova & Stanimirova 2003: 678).
G. pusillum. Denmark, Jutland, Aarhus, *Van Loon 24207* (U): 2*n* = 26 (Van Loon 1984c: 295).
G. pusillum. Finland, island Seili in Nauvo, *unknown collector* (TUR): 2*n* = 26 (Arohonka 1982: 5).
G. pusillum. France, Var, Ile-de-Levant, *Van Loon 10123* (U): 2*n* = 26 (Van Loon 1984c: 295).
G. pusillum. France, Var, Hyères, *Van Loon 10129* (U): 2*n* = 26 (Van Loon 1984c: 295).
G. pusillum. France, Doubs, Saône, *Van Loon 24171* (U): 2*n* = 26 (Van Loon 1984c: 295).
G. pusillum. France, Gironde, Mios, *Van Loon 24178* (U): 2*n* = 26 (Van Loon 1984c: 295).
G. pusillum. France, Yvelines, Poissy, *Van Loon 24254* (U): 2*n* = 26 (Van Loon 1984c: 295).
G. pusillum. Germany, Marburger Bergland, Marburg, Lahnberge, Botanische Garten, *Buttler 5118/44* (herb. Buttler): 2*n* = 26 (Buttler 1989: 13).
G. pusillum. Germany, Lusatia, district Cottbus, waste place near Sachsendorf, *Fritsch 270-71* (GAT): 2*n* = 26 (Fritsch 1973: 460).
G. pusillum. Germany, Marburg, *unknown collector* (?): 2*n* = 26 (Gauger 1937: 529).
G. pusillum. Germany, Schleswig-Holstein, *unknown collector* (?): 2*n* = 26 (Gauger 1937: 529).
G. pusillum. Germany, Halle, Grausee, Germendorf, *Van Loon 10167* (U): 2*n* = 26 (Van Loon 1984c: 295).
G. pusillum. Germany, Niedersachsen, Weser, Harriersand, *Van Loon 11829* (U): 2*n* = 26 (Van Loon 1984c: 295).
G. pusillum. Germany, Niedersachsen, Pirgo Altenoythe, *Van Loon 24208* (U): 2*n* = 26 (Van Loon 1984c: 295).
G. pusillum. Germany, Hessen, Fritzlar, *Van Loon 3652* (U): 2*n* = 26 (Van Loon 1984c: 295).
G. pusillum. Germany, Halle, Gerbstedt, *Van Loon 3735* (U): 2*n* = 26 (Van Loon 1984c: 295).
G. pusillum. Great Britain, near Huntingdon, *Jackson s.n.* (?): 2*n* = 26 (Jackson 1951: 114).
G. pusillum. Greece, Thessalia, Metsobon, *Van Loon 20232* (U): 2*n* = 26 (Van Loon 1984c: 295).

G. pusillum. Hungary, Cott. Hajdú-Bihar, pr. Konyár, *unknown collector* (?): 2*n* = 26 (Pólya 1950: 51).
G. pusillum. Hungary, Várpalota, *Van Loon 10743* (U): 2*n* = 26 (Van Loon 1984c: 295).
G. pusillum. Iceland, *unknown collector* (?): 2*n* = 26 (Löve & Löve 1956: 209).
G. pusillum. Luxembourg, Beaufort, *Van Loon 22304* (U): 2*n* = 26 (Van Loon 1984c: 295).
G. pusillum. Luxembourg, Echternach, *Van Loon 22308* (U): 2*n* = 26 (Van Loon 1984c: 295).
G. pusillum. Luxembourg, Larochette, *Van Loon 9154* (U): 2*n* = 26 (Van Loon 1984c: 295).
G. pusillum. Netherlands, Oost-Voorne, near Tenellaplas, prov. of Zuid-Holland, *Gadella & Kliphuis 2001* (U): 2*n* = 26 (Gadella & Kliphuis 1966: 548).
G. pusillum. Netherlands, Grebbeberg near Rhenen, prov. of Utrecht, *Gadella & Kliphuis s.n.* (U): 2*n* = 26 (Gadella & Kliphuis 1966: 548).
G. pusillum. Netherlands, Utrech, Rhenen, *Van Loon 3444* (U): 2*n* = 26 (Van Loon 1984c: 295).
G. pusillum. Poland, Grzybów, *Marynowska s.n.* (?): 2*n* = 26 (Skalińska & al. 1976: 121).
G. pusillum. Poland, Klonów, *Pogan s.n.* (?): 2*n* = 26 (Skalińska & al. 1976: 121).
G. pusillum. Poland, Kraków, *unknown collector* (?): 2*n* = 26 (Skalińska & al. 1976: 121).
G. pusillum. Poland, Mogiła, *unknown collector* (?): 2*n* = 26 (Skalińska & al. 1976: 121).
G. pusillum. Poland, *Van Loon 3565* (U): 2*n* = 26 (Van Loon 1984c: 295).
G. pusillum. Portugal, Guarda, *Alves & Leitão 5812* (COI?): 2*n* = 26 (Alves & Leitão 1976: 233).
G. pusillum. Russia, Krym, Yalta, *Van Loon 25495* (U): 2*n* = 26 (Van Loon 1984c: 295).
G. pusillum. Slovakia, Malé Karpaty, Bratislava, Mlynská dolina, *Májovský s.n.* (?): 2*n* = 26 (Májovský 1974: 10).
G. pusillum. Spain, Huesca, valle de Pineta, *Montserrat 2459-1973* (JACA): 2*n* = 26 (Fernández Casas & al. 1978: 109).
G. pusillum. Sweden, Skane, Lomma, Alnarp, *Lövkist 1071* (LD): 2*n* = 26 (Lövkvist & Hultgard 1999: 21).
G. pusillum. Sweden, Scania, *unknown collector* (?): 2*n* = 26 (Löve & Löve 1945: 11).
G. pusillum. Sweden, Stockholm, Blidö, *Van Loon 3650* (U): 2*n* = 26 (Van Loon 1984c: 295).
G. pusillum. Switzerland, Alpes, *Van Loon 12609* (U): 2*n* = 26 (Van Loon 1984c: 295).
G. pusillum. Turkey, road of Fethiye-Denizli, between Çavdir and Acıpayam, *Kahraman 2060* (Middle East Technical University, Ankara): 2*n* = 26 (Martin & al. 2022: 9).
G. pusillum. unknown origin, *unknown collector* (?): 2*n* = 26 (Parfenov & Dmitrieva 1988: 5).
G. pusillum. unknown origin, *unknown collector* (?): 2*n* = 34? (Warburg 1938a: 142).
G. pusillum. USA, Utah, Cache co., *Shaw 36* (UTC): 2*n* = 26 (Shaw, 1952: 299).
G. pylzowianum. unknown origin, cultivated at Oliva, Poland, *unknown collector* (?): 2*n* = 28 (Gauger 1937: 530).
G. pyrenaicum. Belorussiya, Minskaja obl., Minskij r-s G. Minsk, Tret'jakov, *Semerenko 484* (?): 2*n* = 26 (Semerenko 1985: 993).
G. pyrenaicum. Bosnia-Herzegovina, Turbe, *Van Loon 17269* (U): 2*n* = 26 (Van Loon 1984b: 277).
G. pyrenaicum. Bosnia-Herzegovina, Mt. Jahorina, Pale, *Van Loon 17288* (U): 2*n* = 26 (Van Loon 1984b: 277).
G. pyrenaicum. Bulgaria, Šipka Pass, Mt. Stoletov, *Van Loon & Van Setten 25087* (U): 2*n* = 26 (Van Loon & Van Setten 1982: 591).
G. pyrenaicum. Bulgaria, Balkan range (middle), between the rest houses "Echo" and "Kozjata stena", *Petrova 6298* (SOM): 2*n* = 26 (Petrova & Stanimirova 2001: 460).
G. pyrenaicum. Bulgaria, Pirin Mt, grassy, rocky places near the summit Orelek, *Petrova 2498* (SOM): 2*n* = 26 (Petrova & Stanimirova 2001: 460).
G. pyrenaicum. Bulgaria, Stara Planina, Mt. Stoletov, *Van Loon 25087* (U): 2*n* = 26 (Van Loon 1984b: 277).
G. pyrenaicum. Bulgaria, Stara Planina,vic. Sliven, *Van Loon 25290* (U): 2*n* = 26 (Van Loon 1984b: 277).
G. pyrenaicum. Bulgaria, Stara Planina, Sipkova, *Van Loon 25293* (U): 2*n* = 26 (Van Loon 1984b: 277).
G. pyrenaicum. Bulgaria, Pirin Planina, Vihren, *Van Loon 25312* (U): 2*n* = 26 (Van Loon 1984b: 277).
G. pyrenaicum. Bulgaria, Stara Rodopi, Pestera to Batak, *Van Loon 25315* (U): 2*n* = 26 (Van Loon 1984b: 277).
G. pyrenaicum. Bulgaria, Stara Rodopi, Cudtine Mostove, *Van Loon 25318* (U): 2*n* = 26 (Van Loon 1984b: 277).
G. pyrenaicum. Czech Republic, Malé Karpaty, Bratislava, Mlynská dolina, *Májosvský s.n.* (?): 2*n* = 26 (Májovský 1974b: 11).
G. pyrenaicum. Denmark, vic. Greena, *Van Loon 19315, 19316* (U): 2*n* = 26 (Van Loon 1984a: 170).
G. pyrenaicum. Denmark, Jutland, Hadsund, *Van Loon 19329* (U): 2*n* = 26 (Van Loon 1984b: 277).
G. pyrenaicum. Denmark, Jutland, Kundby, *Van Loon 24297* (U): 2*n* = 26 (Van Loon 1984b: 277).
G. pyrenaicum. France, Hautes-Alpes, Villard, *Van Loon 11253* (U): 2*n* = 26 (Van Loon 1984b: 277).
G. pyrenaicum. France, Puy-de-Dôme, Besse-en-Chandesse, *Van Loon 12341* (U): 2*n* = 26 (Van Loon 1984b: 277).
G. pyrenaicum. France, Puy-de-Dôme, St. Nectaire, *Van Loon 12342* (U): 2*n* = 26 (Van Loon 1984b: 277).
G. pyrenaicum. France, Bas-Rhin, Strasbourg, *Van Loon 12624* (U): 2*n* = 26 (Van Loon 1984b: 277).
G. pyrenaicum. France, Yvelines, Versailles, *Van Loon 12625* (U): 2*n* = 26 (Van Loon 1984b: 277).
G. pyrenaicum. France, Yvelines, Darois, *Van Loon 12626* (U): 2*n* = 26 (Van Loon 1984b: 277).
G. pyrenaicum. France, Hts.-Pyrénées, Hospice de France, *Van Loon 15490* (U): 2*n* = 26 (Van Loon 1984a: 170).
G. pyrenaicum. France, Haute-Loire,Fay s. Lignon, *Van Loon 15498* (U): 2*n* = 26 (Van Loon 1984b: 277).
G. pyrenaicum. France, Doubs, Sâone, *Van Loon 24171* (U): 2*n* = 26 (Van Loon 1984b: 277).
G. pyrenaicum. France, Côte-d'Or, Mâlain, *Van Loon 3633* (U): 2*n* = 26 (Van Loon 1984b: 277).
G. pyrenaicum. France, Côtes-du-Nord, Tréguier, *Van Loon 3668* (U): 2*n* = 26 (Van Loon 1984b: 277).
G. pyrenaicum. France, Rhône, Lyon, *Van Loon 4914* (U): 2*n* = 26 (Van Loon 1984b: 277).
G. pyrenaicum. France, Savoie, Bonneval-sur-Arc, *Van Loon 4970, 5027, 12339* (U): 2*n* = 26 (Van Loon 1984b: 277).
G. pyrenaicum. France, Hérault, Le Caylar, *Van Loon 5941* (U): 2*n* = 28? (Van Loon & al. 1971: 159).
G. pyrenaicum. France, Orne, Sées, *Van Loon 10332* (U): 2*n* = 26 (Van Loon 1984b: 277).
G. pyrenaicum. France, Cantal, Dienne, *Van Loon 9971* (U): 2*n* = 26 (Van Loon 1984b: 277).
G. pyrenaicum. Germany, seeds obtained from E Germany, *unknown collector* (CUH): 2*n* = 20? (Chatterjee & Sharma 1970: 183).
G. pyrenaicum. Germany, Schleswig-Holstein, *unknown collector* (?): 2*n* = 26 (Gauger 1937: 530).
G. pyrenaicum. Germany, Nordhein-Westfalen, Aachen, *Van Loon 11814* (U): 2*n* = 26 (Van Loon 1984b: 277).
G. pyrenaicum. Germany, Niedersachen, Langeoog, *Van Loon 24209* (U): 2*n* = 26 (Van Loon 1984b: 277).
G. pyrenaicum. Germany, Niedersachen, Hameln, *Van Loon 25329* (U): 2*n* = 26 (Van Loon 1984b: 277).

G. pyrenaicum. Germany, Bayern, Weissbach, *Van Loon 25330* (U): 2*n* = 26 (Van Loon 1984b: 277).
G. pyrenaicum. Germany, Niedersachen, Ottbergen, *Van Loon 9256* (U): 2*n* = 26 (Van Loon 1984b: 277).
G. pyrenaicum. Great Britain, Cambridge, *unknown collector* (?): 2*n* = 28? (Warburg 1938a: 151).
G. pyrenaicum. Greece, Kastanea, *Baltisberger 11349* (ZT): 2*n* = 26 (Baltisberger 1991a: 167).
G. pyrenaicum. Greece, Mt. Olympus, S side, ravine W Katafygion, *Strid & al. 1332* (C): 2*n* = 26 (Strid & Franzén 1981: 836).
G. pyrenaicum. Greece, Mt Pangaion, along road from Akrovounion to the summit, *Strid 862* (C): 2*n* = 26 (Strid 1980: 710).
G. pyrenaicum. Greece, Makedonia, Pissoderion, *Van Loon 20197* (U): 2*n* = 26 (Van Loon 1984b: 277).
G. pyrenaicum. Greece, Makedonia, Mt. Vernon, *Van Loon 20206* (U): 2*n* = 26 (Van Loon 1984b: 277).
G. pyrenaicum. Greece, Makedonia, Eptachorion, *Van Loon 20210* (U): 2*n* = 26 (Van Loon 1984b: 277).
G. pyrenaicum. Greece, Makedonia, Epideiros, Mt. Gamila, *Van Loon 20226* (U): 2*n* = 26 (Van Loon 1984b: 277).
G. pyrenaicum. Greece, Makedonia, Metsobon, *Van Loon 20233* (U): 2*n* = 26 (Van Loon 1984b: 277).
G. pyrenaicum. Greece, Thessalia, Mt. Olympus, *Van Loon 20234, 20235* (U): 2*n* = 26 (Van Loon 1984b: 277).
G. pyrenaicum. Italy, Macerata, Mt. Pennino, *Van Loon 12611* (U): 2*n* = 26 (Van Loon 1984b: 277).
G. pyrenaicum. Italy, L'Aquila, *Van Loon 13334* (U): 2*n* = 26 (Van Loon 1984b: 277).
G. pyrenaicum. Luxembourg, Larochette, *Van Loon 6164* (U): 2*n* = 26 (Van Loon 1984b: 277).
G. pyrenaicum. Macedonia, Mavrovska, *Van Loon 8809* (U): 2*n* = 26 (Van Loon 1984b: 277).
G. pyrenaicum. Morocco, Haut Atlas, Toubkal, gorges sous Lepiney, *Galland 1053[81-782]* (NEU): *n* = 13 (Galland 1988: 144).
G. pyrenaicum. Morocco, Moyen Atlas, Bou Iblane, versant N, *Galland 470[78-1328]* (NEU): 2*n* = 26 (Galland 1988: 144).
G. pyrenaicum. Morocco, Moyen Atlas, Tichchoukt, versant W, *Galland 517[79-1375]* (NEU): *n* = 13, 2*n* = 26 (Galland 1988: 144).
G. pyrenaicum. Netherlands, Limburg, Gulpen, *Van Loon 13863* (U): 2*n* = 26 (Van Loon 1984b: 277).
G. pyrenaicum. Netherlands, Utrech, Wijk bij Duurstede, *Van Loon 22301* (U): 2*n* = 26 (Van Loon 1984b: 277).
G. pyrenaicum. Norway, Akershus, Asker, *Van Loon 20864* (U): 2*n* = 26 (Van Loon 1984b: 277).
G. pyrenaicum. Poland, Zakopane, *Mirek s.n.* (?): 2*n* = 28? (Mizianty & al. 1983: 208).
G. pyrenaicum. Poland, Dziekanowice, *unknown collector* (?): 2*n* = 26 (Skalińska & al. 1978: 42).
G. pyrenaicum. Poland, Wieliczka, *unknown collector* (?): 2*n* = 26 (Skalińska & al. 1978: 42).
G. pyrenaicum. Portugal, Castro de Avelãs, Bragança, *Alves & Leitão 3001* (COI?): 2*n* = 26 (Alves & Leitão 1976: 232).
G. pyrenaicum. Spain, San Sebastián, *unknown collector* (?): 2*n* = 28? (Warburg 1938a: 151).
G. pyrenaicum. Spain, Galicia, Biville, *Van Loon 22040* (U): 2*n* = 26 (Van Loon 1984b: 277).
G. pyrenaicum. Sweden, Skane, Lund, *Lövkist 1072* (LD): 2*n* = 26 (Lövkvist & Hultgard 1999: 21).
G. pyrenaicum. Sweden, Skane, Torrlösa, Höjelycke, *Lövkist 1209* (LD): 2*n* = 26 (Lövkvist & Hultgard 1999: 21).
G. pyrenaicum. Sweden, Stockholm, *unknown collector* (?): 2*n* = 28? (Warburg 1938a: 151).
G. pyrenaicum. Sweden, Skane, Röddinge, *Van Loon 24163* (U): 2*n* = 26 (Van Loon 1984b: 277).
G. pyrenaicum. Sweden, Stockholm, Freslkati, *Van Loon 3643* (U): 2*n* = 26 (Van Loon 1984b: 277).
G. pyrenaicum. Switzerland, Graubünden, Brigels, *Van Loon 10665* (U): 2*n* = 26 (Van Loon 1984b: 277).
G. pyrenaicum. Switzerland, Graubünden, Waltensburg, *Van Loon 11253* (U): 2*n* = 26 (Van Loon 1984b: 277).
G. pyrenaicum. Switzerland, Alpes, *Van Loon 12609* (U): 2*n* = 26 (Van Loon 1984b: 277).
G. pyrenaicum. Switzerland, Wallis, Champex, *Van Loon 20261* (U): 2*n* = 26 (Van Loon 1984b: 277).
G. pyrenaicum. Switzerland, Wallis, Hohtschuggen, *Van Loon 23419* (U): 2*n* = 26 (Van Loon 1984b: 277).
G. pyrenaicum. Switzerland, Wallis, Bourg-St.-Pierre, *Van Loon 3625* (U): 2*n* = 26 (Van Loon 1984b: 277).
G. pyrenaicum. Turkey, Gölören village, *Kahraman 2137* (Middle East Technical University, Ankara): 2*n* = 26 (Martin & al. 2022: 9).
G. pyrenaicum. unknown origin, *unknown collector* (?): *n* = 11-12? (Heitz 1926: 642, 678).
G. pyrenaicum. unknown origin, *unknown collector* (?): *n* = 11-12? (Tischler 1934: 10).
G. reflexum. Bulgaria, Pirin Mt., Bajuvi dupki, near Pogledec, *Andreev 8021* (SOM): 2*n* = 28 (Andreev 1982: 576).
G. reflexum. Bulgaria, Vrachanska Mt., *Petrova 8197* (SOM): 2*n* = 28, 56 (Petrova & Stanimirova 2002: 459).
G. reflexum. unknown origin, *unknown collector* (?): *n* = 14 (Warburg 1938a: 144).
G. refractum. unknown origin, *unknown collector* (?): 2*n* = 28 (Warburg 1938a: 144).
G. reinii [sub *G. eriostemon* var. *reinii*]. Japan, Nagano, Mt. Togakushi, *unknown collector* (?): 2*n* = 28 (Shimizu 1971: 61).
G. reinii [sub *G. eriostemon* var. *reinii*]. Japan, Nagano, Yunodaira, *unknown collector* (?): 2*n* = 28 (Shimizu 1971: 61).
G. retrorsum. New Zealand, Auckland, Owairaka, Oakley Creek, *de Lange & al. s.n.* (AK-285250): *n* = 26 (de Lange & al. 2004: 880).
G. retrorsum. New Zealand, Auckland, Penrose, Anne's Creek, *de Lange & al. s.n.* (AK-285249): *n* = 26 (de Lange & al. 2004: 880).
G. reuteri [sub *G. anemonifolium*]. Portugal, from Madeira [probably mistake], *unknown collector* (?): 2*n* = 128 (Jackson 1952: 279).
G. reuteri [sub *G. canariense*]. Spain, plants collected by Leeds University Expedition to Madeira and the Canary Islands, 1949, and, their progeny, grown at Leeds, *unknown collector* (herb. Jackson): *n* = ca. 64, 2*n* = 128 (Yeo 1973a: 308).
G. reuteri [sub *G. canariense*]. Spain, plants grown at Leeds from seeds received from Royal Botanic Garden, Edinburgh, in 1951, *unknown collector* (herb. Jackson): *n* = ca. 64, 2*n* = 128 (Yeo 1973a: 308).
G. richardsonii. unknown origin, *unknown collector* (?): *n* = 28 (Warburg 1938a: 144).
G. richardsonii. USA, Arizona, Coconino co., Mogollon Rim, ca. 2.4 km S of Potato Lake, *Parfitt 3070* (ASU): *n* = 28 (Parfitt & al. 1985: 162).
G. richardsonii. USA, Utah, Wasatch co., *Shaw 30* (UTC): *n* = 26 (Shaw 1952: 299).
G. rivulare. Switzerland, Arolla, Valais, *Correvon 57/804* (NEU): *n* = 14 (Favarger 1965: 28).
G. robertianum. Austria, Ober-Österreich, Gossl, *Van Loon 11424* (U): 2*n* = 64 (Van Loon 1984c: 295).
G. robertianum. Austria, Ober-Österreich, Fuschlsee, *Van Loon 11425* (U): 2*n* = 64 (Van Loon 1984c: 295).
G. robertianum. Austria, Ober-Österreich, Bad Aussee, *Van Loon 11426, 11428, 11429* (U): 2*n* = 64 (Van Loon 1984c: 295).
G. robertianum. Austria, Ober-Österreich, Hallstatt, *Van Loon 11646* (U): 2*n* = 64 (Van Loon 1984c: 295).
G. robertianum. Belgium, Antwerpen, *unknown collector* (?): 2*n* = 56? (Gauger 1937: 530).
G. robertianum. Belgium, West-Vlaanderen, Ostende, *Van Loon 12335* (U): 2*n* = 64 (Van Loon 1984c: 295).

G. robertianum. Belgium, Ardenne, Ovifat, *Van Loon 19394* (U): 2*n* = 64 (Van Loon 1984c: 295).
G. robertianum. Bosnia-Herzegovina, vic. Bocac, *Van Loon 17258* (U): 2*n* = 64 (Van Loon 1984c: 296).
G. robertianum. Bosnia-Herzegovina, Mt. Jahorina vic. Pale, *Van Loon 17292, 17319* (U): 2*n* = 64 (Van Loon 1984c: 296).
G. robertianum. Bosnia-Herzegovina, vic. Visegrad, *Van Loon 17326* (U): 2*n* = 64 (Van Loon 1984c: 296).
G. robertianum. Bosnia-Herzegovina, Mt. Babina Gora, *Van Loon 17349* (U): 2*n* = 64 (Van Loon 1984c: 296).
G. robertianum. Bulgaria, Stara Planina, Trojan-pass, *Van Loon 25117* (U): 2*n* = 64 (Van Loon 1984c: 295).
G. robertianum. Bulgaria, Stara Planina, Mt. Stoletov, *Van Loon 25292* (U): 2*n* = 64 (Van Loon 1984c: 295).
G. robertianum. Bulgaria, Stara Planina, Sipkova, *Van Loon 25296* (U): 2*n* = 64 (Van Loon 1984c: 295).
G. robertianum. Bulgaria, Rila Planina, Mt. Rila, Paniciste, *Van Loon 25300* (U): 2*n* = 64 (Van Loon 1984c: 295).
G. robertianum. Bulgaria, Rila Planina, Partizanska Poljána, *Van Loon 25306, 25309* (U): 2*n* = 64 (Van Loon 1984c: 295).
G. robertianum. Bulgaria, Rila Planina, vic. Bistrica, *Van Loon 25310* (U): 2*n* = 64 (Van Loon 1984c: 295).
G. robertianum. Bulgaria, Rodopi Planina, along the road from Pestera to Batak, *Van Loon 25316* (U): 2*n* = 64 (Van Loon 1984c: 295).
G. robertianum. Bulgaria, Rodopi Planina, Cudnite Mostove, *Van Loon 25317* (U): 2*n* = 64 (Van Loon 1984c: 295).
G. robertianum. Bulgaria, Beklemeto, *Petrova 221426* (SOM): 2*n* = 64, 128 (Petrova & Stanimirova 2002: 456).
G. robertianum. Croatia, Triest, *unknown collector* (?): 2*n* = 56? (Gauger 1937: 530).
G. robertianum. Croatia, Istria, vic. Opatija, *Van Loon 17164* (U): 2*n* = 64 (Van Loon 1984c: 296).
G. robertianum. Croatia, Istria, Vela Ucka, *Van Loon 17170* (U): 2*n* = 64 (Van Loon 1984c: 296).
G. robertianum. Croatia, Istria, Zminj, *Van Loon 17190* (U): 2*n* = 64 (Van Loon 1984c: 296).
G. robertianum. Croatia, vic. Senj, *Van Loon 17200* (U): 2*n* = 64 (Van Loon 1984c: 296).
G. robertianum [sub *G. robertianum* var. *rubricaule*]. Denmark, Klintebjerg, Sealand, *Böcher 450* (C?): 2*n* = 64 (Böcher 1947: 5).
G. robertianum. Denmark, Lille Vroj, Sealand, *Böcher 451* (C?): 2*n* = 64 (Böcher 1947: 5).
G. robertianum [sub *G. robertianum* var. *genuinum*]. Denmark, Harager Hegn, Sealand, *Böcher 452* (C?): 2*n* = 64 (Böcher 1947: 5).
G. robertianum. Denmark, Jutland, exact provenience unknown, *Van Loon 11831* (U): 2*n* = 64 (Van Loon 1984c: 295).
G. robertianum. Denmark, Jutland, Jernhatten, *Van Loon 19298, 19301* (U): 2*n* = 64 (Van Loon 1984c: 295).
G. robertianum. Denmark, Jutland, Glatved, *Van Loon 19303, 19304, 19306* (U): 2*n* = 64 (Van Loon 1984c: 295).
G. robertianum. Denmark, Jutland, Stokkebro, *Van Loon 19325* (U): 2*n* = 64 (Van Loon 1984c: 295).
G. robertianum. Denmark, Jutland, Gjerrild, *Van Loon 19326* (U): 2*n* = 64 (Van Loon 1984c: 295).
G. robertianum. Denmark, Jutland, Skelund, *Van Loon 19332* (U): 2*n* = 64 (Van Loon 1984c: 295).
G. robertianum. Finland, Uusimaa, Tvärminne, *Van Loon 11834, 13656* (U): 2*n* = 64 (Van Loon 1984c: 295).
G. robertianum. Finland, Tvärminne, *Van Loon 13656* (U): 2*n* = 64 (Van Loon 1984a: 171).
G. robertianum. Finland, vic. Helsinki, *Van Loon 3641* (U): 2*n* = 64 (Van Loon 1984c: 295).
G. robertianum. Finland, *Van Loon 3885* (U): 2*n* = 64 (Van Loon 1984c: 295).
G. robertianum [sub *G. robertianum* subsp. *robertianum*]. France, Corse, Zicavo, *Contandriopoulos & al. 84.548* (MARSSJ): 2*n* = 64 (Contandriopoulos & al. 1987: 267).
G. robertianum [sub *G. robertianum* subsp. *robertianum*]. France, Corse, Vizzavona, hêtraie à la Cascade des Anglais, *Contandriopoulos & al. 84.558* (MARSSJ): 2*n* = 64 (Contandriopoulos & al. 1987: 267).
G. robertianum. France, Morbihan, Poulhan, *Van Loon 10331* (U): 2*n* = 64 (Van Loon 1984c: 296).
G. robertianum. France, Sâone-et-Loire, Velay, *Van Loon 11242* (U): 2*n* = 64 (Van Loon 1984c: 295).
G. robertianum. France, Yonne, Vézelay, *Van Loon 11246, 11247* (U): 2*n* = 64 (Van Loon 1984c: 295).
G. robertianum. France, Bas-Alpes, Colmar, *Van Loon 11254* (U): 2*n* = 64 (Van Loon 1984c: 296).
G. robertianum. France, Doubs, Source de la Loue, *Van Loon 11254* (U): 2*n* = 64 (Van Loon 1984c: 295).
G. robertianum. France, Tarn, Guyenne, *Van Loon 11258* (U): 2*n* = 64 (Van Loon 1984c: 296).
G. robertianum. France, Doubs, Fuans, *Van Loon 11809* (U): 2*n* = 64 (Van Loon 1984c: 295).
G. robertianum. France, Puy-de-Dôme, Conde, *Van Loon 11820* (U): 2*n* = 64 (Van Loon 1984c: 296).
G. robertianum. France, Paris, vic. Paris, *Van Loon 11841* (U): 2*n* = 64 (Van Loon 1984c: 296).
G. robertianum. France, Bas-Rhin, vic. Strasbourg, *Van Loon 11844, 13654* (U): 2*n* = 64 (Van Loon 1984c: 296).
G. robertianum. France, Puy-de-Dôme, Besse-en-Chandese, *Van Loon 12340* (U): 2*n* = 64 (Van Loon 1984c: 296).
G. robertianum. France, Puy-de-Dôme, Lac de Chambedare, *Van Loon 12345* (U): 2*n* = 64 (Van Loon 1984c: 296).
G. robertianum. France, Puy-de-Dôme, Bois-de-Besse, *Van Loon 12346* (U): 2*n* = 64 (Van Loon 1984c: 296).
G. robertianum. France, Cantal, Montbard, *Van Loon 12347* (U): 2*n* = 64 (Van Loon 1984c: 295).
G. robertianum. France, Cantal, cirque de Mondailles, *Van Loon 12348* (U): 2*n* = 64 (Van Loon 1984c: 295).
G. robertianum. France, Hte.-Loire, exact provenience unknown, *Van Loon 13652* (U): 2*n* = 64 (Van Loon 1984c: 296).
G. robertianum. France, Bas-Rhin, vic. Strasbourg, *Van Loon 13654* (U): 2*n* = 64 (Van Loon 1984a: 171).
G. robertianum. France, Hte.-Loire, Fays.-Lignon, *Van Loon 15489* (U): 2*n* = 64 (Van Loon 1984c: 296).
G. robertianum. France, Pyrénées, Foix, *Van Loon 15493* (U): 2*n* = 64 (Van Loon 1984c: 295).
G. robertianum. France, Pyrénées-Atlantiques, Ferrières, *Van Loon 22042* (U): 2*n* = 64 (Van Loon 1984c: 295).
G. robertianum. France, Doubs, vic. Besançon, *Van Loon 24170* (U): 2*n* = 64 (Van Loon 1984c: 295).
G. robertianum. France, Doubs, Mt. Miroir, *Van Loon 5218* (U): 2*n* = 64 (Van Loon 1984c: 295).
G. robertianum. France, Pyrénées, Viscos, *Van Loon 6527* (U): 2*n* = 64 (Van Loon 1984c: 295).
G. robertianum. France, Cantal, Dienne, *Van Loon 9970* (U): 2*n* = 64 (Van Loon 1984c: 295).
G. robertianum. France, Cantal, Condat-en-Féniers, *Van Loon 9974* (U): 2*n* = 64 (Van Loon 1984c: 295).
G. robertianum. Germany, Kiel, *unknown collector* (?): 2*n* = 56? (Gauger 1937: 530).
G. robertianum. Germany, Schleswig-Holstein, *unknown collector* (?): 2*n* = 56? (Gauger 1937: 530).
G. robertianum. Germany, Ober Lausitz, Bautzen, *Van Loon 10608* (U): 2*n* = 64 (Van Loon 1984c: 296).
G. robertianum. Germany, Ober Lausitz, Grausee, Blumenow, *Van Loon 10614* (U): 2*n* = 64 (Van Loon 1984c: 296).

G. robertianum. Germany, Niedersachsen, vic. Güterlosh, *Van Loon 10727* (U): 2*n* = 64 (Van Loon 1984c: 296).

G. robertianum. Germany, Baden-Württenberg, Wutachschlucht, *Van Loon 11826* (U): 2*n* = 64 (Van Loon 1984c: 296).

G. robertianum. Germany, Niedersachsen, Hasbruch, *Van Loon 11828* (U): 2*n* = 64 (Van Loon 1984c: 296).

G. robertianum. Germany, Rheinland-Pfalz, Kaub, *Van Loon 12600* (U): 2*n* = 64 (Van Loon 1984c: 296).

G. robertianum. Germany, Rheinland-Pfalz, Thallbürgel, *Van Loon 12603, 24166* (U): 2*n* = 64 (Van Loon 1984c: 296).

G. robertianum. Germany, Rheinland-Pfalz, Schellrode, *Van Loon 12604* (U): 2*n* = 64 (Van Loon 1984c: 296).

G. robertianum. Germany, Rheinland-Pfalz, vic. Düsseldorf, *Van Loon 13655* (U): 2*n* = 64 (Van Loon 1984c: 296).

G. robertianum. Germany, Halle, Harzgerode, *Van Loon 13661* (U): 2*n* = 64 (Van Loon 1984c: 296).

G. robertianum. Germany, Ober Lausitz, Schmeheim, *Van Loon 25322* (U): 2*n* = 64 (Van Loon 1984c: 296).

G. robertianum. Germany, Niedersachsen, vic. Hameln, *Van Loon 25331* (U): 2*n* = 64 (Van Loon 1984c: 296).

G. robertianum. Great Britain, Somerset, Cheddar, *Van Loon 10599* (U): 2*n* = 64 (Van Loon 1984c: 295).

G. robertianum. Great Britain, Somerset, Axmonth, *Van Loon 10600* (U): 2*n* = 64 (Van Loon 1984c: 295).

G. robertianum. Great Britain, Devon, Lyntonr, *Van Loon 10601* (U): 2*n* = 64 (Van Loon 1984c: 295).

G. robertianum. Great Britain, Devon, North Bovey, *Van Loon 10602* (U): 2*n* = 64 (Van Loon 1984c: 295).

G. robertianum. Great Britain, Devon, Padley Wood, Grindl, *Van Loon 12351* (U): 2*n* = 64 (Van Loon 1984c: 295).

G. robertianum. Great Britain, Derby, Stretton, *Van Loon 12352* (U): 2*n* = 64 (Van Loon 1984c: 295).

G. robertianum. Great Britain, Derby, Rowsley, *Van Loon 12353* (U): 2*n* = 64 (Van Loon 1984c: 295).

G. robertianum. Great Britain, Scotland, vic. Glen Affric, *Van Loon 13390* (U): 2*n* = 64 (Van Loon 1984c: 296).

G. robertianum. Greece, Mt. Olympus, E side, pr. Katafygion, *Strid & al. 9480* (C): 2*n* = ca. 64 (Strid & Franzén 1981: 836).

G. robertianum. Greece, Macedonia, Pisoderion, *Van Loon 20198, 20199* (U): 2*n* = 64 (Van Loon 1984c: 296).

G. robertianum. Greece, Macedonia, Mt. Vernon, *Van Loon 20202* (U): 2*n* = 64 (Van Loon 1984c: 296).

G. robertianum. Greece, Macedonia, Mt. Gamila, *Van Loon 20219* (U): 2*n* = 64 (Van Loon 1984c: 296).

G. robertianum. Greece, Macedonia, Mt. Olympus, *Van Loon 20237* (U): 2*n* = 64 (Van Loon 1984c: 296).

G. robertianum. Greece, Athos, vic. Karyes, *Van Loon 20244* (U): 2*n* = 64 (Van Loon 1984c: 296).

G. robertianum. Greece, Macedonia, vic. Mokros, *Van Loon 20257* (U): 2*n* = 64 (Van Loon 1984c: 296).

G. robertianum. Greece, Thessalia, Mt. Olympus, *Van Loon 24443* (U): 2*n* = 64 (Van Loon & Oudemans 1982: 343).

G. robertianum. Hungary, Debrecen, in silva arenosa Nagyerdó, *unknown collector* (?): 2*n* = 64 (Pólya 1950: 51).

G. robertianum. Hungary, Gödöllö, *Van Loon 11816* (U): 2*n* = 64 (Van Loon 1984c: 296).

G. robertianum. Iceland, *unknown collector* (?): 2*n* = 64 (Löve & Löve 1956: 208).

G. robertianum. India, valley of Flowers, Western Himalayas, *Sharma 2166* (CUH): *n* = 26? (Chatterjee & Sharma 1970: 183).

G. robertianum. India, Western Himalaya, Uttarakhand, *Arora 2553* (CHN): 2*n* = 52? (Arora & al. 2020: 1396).

G. robertianum. Ireland, Norwest of N Ross, *unknown collector* (?): 2*n* = 64 (Böcher & Larsen 1955: 129).

G. robertianum [sub *G. robertianum* subsp. *celticum*]. Ireland, Poulsallagh, *unknown collector* (?): 2*n* = 64 (Böcher & Larsen 1955: 129).

G. robertianum. Ireland, Sligo, vic. Sligo, *Van Loon 9951* (U): 2*n* = 64 (Van Loon 1984c: 296).

G. robertianum. Italy, Abbruzzo, L'Aguila, *Van Loon 12333* (U): 2*n* = 64 (Van Loon 1984c: 296).

G. robertianum. Italy, Lazio, vic. Rome, *Van Loon 13651* (U): 2*n* = 64 (Van Loon 1984c: 296).

G. robertianum. Italy, Venezia-Giulia, Pulfera, *Van Loon 17118* (U): 2*n* = 64 (Van Loon 1984c: 296).

G. robertianum. Italy, Venezia-Giulia, Taipana, *Van Loon 17120* (U): 2*n* = 64 (Van Loon 1984c: 296).

G. robertianum. Italy, Valle d'Aosta, Trana, *Van Loon 24211* (U): 2*n* = 64 (Van Loon 1984c: 296).

G. robertianum. Italy, Venezia-Giulia, Chiesa nuova de Levanto, *Van Loon 24546* (U): 2*n* = 64 (Van Loon 1984c: 296).

G. robertianum. Italy, Valle d'Aosta, La Salle, *Van Loon 5236* (U): 2*n* = 64 (Van Loon 1984c: 296).

G. robertianum. Japan, *unknown collector* (?): 2*n* = 32?, 56?, 64 (Hara 1952: 81).

G. robertianum. Japan, Shiga, Kawachi, *unknown collector* (?): 2*n* = 64 (Shimizu 1971: 61).

G. robertianum. Japan, Shiga, Gongendani, *unknown collector* (?): 2*n* = 64 (Shimizu 1971: 61).

G. robertianum. Luxembourg, Echternach, *Van Loon 19409, 22310* (U): 2*n* = 64 (Van Loon 1984c: 296).

G. robertianum. Luxembourg, Beaufort, *Van Loon 22310* (U): 2*n* = 64 (Van Loon 1984c: 296).

G. robertianum. Luxembourg, vic. Michelaux, *Van Loon 22312* (U): 2*n* = 64 (Van Loon 1984c: 296).

G. robertianum. Luxembourg, Larochette, *Van Loon 9152, 22307* (U): 2*n* = 64 (Van Loon 1984c: 296).

G. robertianum. Luxembourg, vic. Vianden, *Van Loon 9155* (U): 2*n* = 64 (Van Loon 1984c: 296).

G. robertianum. Montenegro, vic. Mojkovac, *Van Loon 17410* (U): 2*n* = 64 (Van Loon 1984c: 296).

G. robertianum. Netherlands, Fort Hoofddijk, De Bilt, prov. of Utrecht, *Gadella & Kliphuis 1434* (U): 2*n* = 64 (Gadella & Kliphui 1967: 14).

G. robertianum. Netherlands, near Rhijnauwen, prov. of Utrecht, *Gadella & Kliphuis 1682* (U): 2*n* = 64 (Gadella & Kliphui 1967: 14).

G. robertianum. Netherlands, Zeeland, Renesse, *Van Loon 11166* (U): 2*n* = 64 (Van Loon 1984c: 296).

G. robertianum. Netherlands, Limburgh, Sibbe, *Van Loon 19384-19386* (U): 2*n* = 64 (Van Loon 1984c: 296).

G. robertianum. Netherlands, Limburgh, Wylre, *Van Loon 19387, 19388* (U): 2*n* = 64 (Van Loon 1984c: 296).

G. robertianum. Netherlands, Limburgh, Beertsenhove, *Van Loon 19397, 19399* (U): 2*n* = 64 (Van Loon 1984c: 296).

G. robertianum. Netherlands, Limburgh, Gulpen, *Van Loon 19405, 19406* (U): 2*n* = 64 (Van Loon 1984c: 296).

G. robertianum. Netherlands, Limburgh, Elkenrade, *Van Loon 19409* (U): 2*n* = 64 (Van Loon 1984c: 296).

G. robertianum. Netherlands, Utrecht, Rhenen, *Van Loon 3424* (U): 2*n* = 64 (Van Loon 1984c: 296).

G. robertianum. Netherlands, Utrecht, Utrecht, *Van Loon 9251, 22300* (U): 2*n* = 64 (Van Loon 1984c: 296).

G. robertianum. Norway, Notteroy, Vestfold, *unknown collector* (?): *n* = 32 (Laane 1971: 230).

G. robertianum. Norway, Ostfold, Moss, *Van Loon 12620* (U): 2*n* = 64 (Van Loon 1984c: 296).

G. robertianum. Poland, Mieliwo near Brodnica, *Jankun s.n.* (?): 2*n* = 64 (Skalińska & al. 1976: 121).

G. robertianum. Poland, Słonne Mts near Sanok, *Konarska s.n.* (?): 2*n* = 64 (Skalińska & al. 1976: 121).

G. robertianum. Poland, Kraków, *unknown collector* (?): 2*n* = 64 (Skalińska & al. 1976: 121).
G. robertianum. Poland, Tenczynek, *unknown collector* (?): 2*n* = 64 (Skalińska & al. 1976: 121).
G. robertianum. Poland, Brzesko, *unknown collector* (?): 2*n* = 64 (Skalińska & al. 1976: 121).
G. robertianum. Poland, Kalwaria, *unknown collector* (?): 2*n* = 64 (Skalińska & al. 1976: 121).
G. robertianum. Poland, valley of Kluczwoda and Olkusz, *unknown collector* (?): 2*n* = 64 (Skalińska & al. 1976: 121).
G. robertianum. Poland, Kostrze, *unknown collector* (?): 2*n* = 64 (Skalińska & al. 1976: 121).
G. robertianum. Poland, Tegoborze, *unknown collector* (?): 2*n* = 64 (Skalińska & al. 1976: 121).
G. robertianum. Poland, Poznan, *Van Loon 13658, 13659* (U): 2*n* = 64 (Van Loon 1984c: 296).
G. robertianum. Portugal, Estremadura, Oeiras, *Van Loon 13648* (U): 2*n* = 64 (Van Loon 1984c: 296).
G. robertianum. Portugal, Madeira, Ribeiro Frio, *Van Loon 20683* (U): 2*n* = 64 (Van Loon 1984a: 171).
G. robertianum. Romania, Suceava, vic. Rarám, *Van Loon 24195* (U): 2*n* = 64 (Van Loon 1984c: 296).
G. robertianum. Russia, Krym, Yalta, *Van Loon 25496* (U): 2*n* = 64 (Van Loon 1984c: 296).
G. robertianum. Slovakia, Malé Karpaty, Bratislava, Krasňany, *Murín s.n.* (?): 2*n* = 64 (Májovský 1976: 7).
G. robertianum. Spain, Jaén, Sierra de Cazorla, Laguna de Valdeazores, *Löve 026* (?): 2*n* = 64 (Löve & Kjellqvist 1974: 164).
G. robertianum [sub *G. purpureum*]. Spain, Granada, puerto de la Ragua, between the crosroads of Canjayar, *unknown collector* (SEV): 2*n* = 64 (Luque & Díaz Lifante 1991: 312).
G. robertianum. Spain, Huesca, San Juan de la Peña, *Van Loon 15499* (U): 2*n* = 64 (Van Loon 1984c: 296).
G. robertianum. Spain, Navarra, along the road from Santesteban to Leiza, *Van Loon 22033* (U): 2*n* = 64 (Van Loon 1984c: 296).
G. robertianum. Spain, Cantabria, vic. S. Vicente, *Van Loon 22035* (U): 2*n* = 64 (Van Loon 1984c: 296).
G. robertianum. Spain, vic. Gijón, *Van Loon 22036* (U): 2*n* = 64 (Van Loon 1984c: 296).
G. robertianum. Spain, Galicia, Marco de Alvare, *Van Loon 22038* (U): 2*n* = 64 (Van Loon 1984c: 296).
G. robertianum. Sweden, Skane, Hov, Segelstorp, *Lövkist 1363* (LD): 2*n* = 64 (Lövkvist & Hultgard 1999: 21).
G. robertianum. Sweden, Skane, Ivö, *Lövkist 1960* (LD): 2*n* = 64 (Lövkvist & Hultgard 1999: 21).
G. robertianum. Sweden, Skane, Simris, *Lövkist 2386* (LD): 2*n* = 64 (Lövkvist & Hultgard 1999: 21).
G. robertianum. Sweden, Stockholm, Blidö, *Van Loon 11830* (U): 2*n* = 64 (Van Loon 1984c: 296).
G. robertianum. Sweden, Stockholm, Hybry, *Van Loon 12605* (U): 2*n* = 64 (Van Loon 1984c: 296).
G. robertianum. Sweden, Stockholm, Törnfall, *Van Loon 12606* (U): 2*n* = 64 (Van Loon 1984c: 296).
G. robertianum. Sweden, Skaane, *Van Loon 3557* (U): 2*n* = 64 (Van Loon 1984c: 296).
G. robertianum. Switzerland, Graubünden, Waltensburg, *Van Loon 10668* (U): 2*n* = 64 (Van Loon 1984c: 296).
G. robertianum. Switzerland, Valais, Meyrin, *Van Loon 11822* (U): 2*n* = 64 (Van Loon 1984c: 296).
G. robertianum. Switzerland, Valais, Champex, *Van Loon 11823, 20260* (U): 2*n* = 64 (Van Loon 1984c: 296).
G. robertianum. Switzerland, Graubünden, Brigels, *Van Loon 11850* (U): 2*n* = 64 (Van Loon 1984c: 296).
G. robertianum. Switzerland, Valais, *Van Loon 12612, 18915* (U): 2*n* = 64 (Van Loon 1984c: 296).
G. robertianum. Switzerland, Vaud, Genève, *Van Loon 3626* (U): 2*n* = 64 (Van Loon 1984c: 296).
G. robertianum. Turkey, between Manavgat and Akseki, *Kahraman 1772* (Middle East Technical University, Ankara): 2*n* = 64 (Martin & al. 2022: 9).
G. robertianum. unknown origin, cultivated material from Cracow Botanical Garden, *Böcher 447* (C?): 2*n* = 64 (Böcher 1947: 5).
G. robertianum. unknown origin, cultivated material from Cluj Botanical Garden, *Böcher 448* (C?): 2*n* = 64 (Böcher 1947: 5).
G. robertianum. unknown origin, cultivated material from Nancy Botanical Garden, *Böcher 453* (C?): 2*n* = 64 (Böcher 1947: 5).
G. robertianum. unknown origin, cultivated material from Ghent Botanical Garden, *Böcher 454* (C?): 2*n* = 64 (Böcher 1947: 5).
G. robertianum. unknown origin, cultivated material from Leiden Botanical Garden, *Böcher 467* (C?): 2*n* = 64 (Böcher 1947: 5).
G. robertianum. unknown origin, *unknown collector* (?): *n* = 27?, 28? (Rohweder 1937: 521).
G. rotundifolium. Albania, Kruj, *Strid 0733* (LD): 2*n* = 26 (Strid 1971: 492).
G. rotundifolium. Bulgaria, hill Venetsa, near Belogradchik, *Petrova 23433* (SOM): 2*n* = 26 (Petrova & Stanimirova 2001: 461).
G. rotundifolium. Cyprus, Paralimni, *Dostál 41810* (PR): 2*n* = 26 (Slavík & al. 1993: 226).
G. rotundifolium. Cyprus, Episkopi, *Dostál 41911* (PR): 2*n* = 26 (Slavík & al. 1993: 226).
G. rotundifolium. France, environs de Montpellier, Bel-Air, *Natarajan s.n.* (MPU): 2*n* = 26 (Natarajan 1978: 529).
G. rotundifolium. France, Aveyron, Entraygues, *Van Loon 11252* (U): 2*n* = 26 (Van Loon 1984c: 296).
G. rotundifolium. France, Aveyron, Guyenne, Rivière, *Van Loon 11263* (U): 2*n* = 26 (Van Loon 1984c: 296).
G. rotundifolium. France, Isère, La Tour-du-Pin, *Van Loon 11338* (U): 2*n* = 26 (Van Loon 1984c: 296).
G. rotundifolium. France, Gironde, *Van Loon 20859* (U): 2*n* = 26 (Van Loon 1984c: 296).
G. rotundifolium. France, Hérault, Manguio, *Van Loon 24177* (U): 2*n* = 26 (Van Loon 1984c: 296).
G. rotundifolium. France, Hérault, Pas de l'Escalette, *Van Loon 24206* (U): 2*n* = 26 (Van Loon 1984c: 296).
G. rotundifolium. France, Bouche-du-Rhône, vic. Marseille, *Van Loon 3456* (U): 2*n* = 26 (Van Loon 1984c: 296).
G. rotundifolium. France, Doubs, *Van Loon 3480, 24172* (U): 2*n* = 26 (Van Loon 1984c: 296).
G. rotundifolium. France, Hérault, vic. Montpellier, *Van Loon 5636* (U): 2*n* = 26 (Van Loon 1984c: 296).
G. rotundifolium. France, Hérault, Montpellier, *Van Loon 5936* (U): 2*n* = 26 (Van Loon & al. 1971: 159).
G. rotundifolium. Germany, Nördl. Oberrheinniederung, Trebur, südl. Astheim, *Böger 6016/32* (herb. Buttler): 2*n* = 26 (Buttler 1989: 13).
G. rotundifolium. Germany, Östl, Untermainebene, Frankfurt, Ostpark, oberhalb Carl-Heck-Weg, *Buttler 27340* (herb. Buttler): 2*n* = 26 (Buttle, 1989: 13).
G. rotundifolium. Germany, Nordhein-Westfalen, vic. Duisburg, *Van Loon 3764* (U): 2*n* = 26 (Van Loon 1984c: 296).
G. rotundifolium. Greece, Mt Giona, EN Lidorikion, *Gustavsson 1195* (LD): 2*n* = 26 (Franzén & Gustavsson 1983: 104).
G. rotundifolium. Greece, Mt. Olympus, W side, pr. Kokkinoplos, *Strid & al. 54* (C): 2*n* = 26 (Strid & Franzén 1981: 836).
G. rotundifolium. Greece, Macedonia, vic. Kastoria, *Van Loon 20200, 20209* (U): 2*n* = 26 (Van Loon 1984c: 296).
G. rotundifolium. Greece, Macedonia, vic. Konitsa, *Van Loon 20213* (U): 2*n* = 26 (Van Loon 1984c: 296).

G. rotundifolium. Greece, Thessalia, along the road from Elasson to Katerini, *Van Loon 20240* (U): 2*n* = 26 (Van Loon 1984c: 296).
G. rotundifolium. Greece, Macedonia, vic. Arnaia, *Van Loon 20243* (U): 2*n* = 26 (Van Loon 1984c: 296).
G. rotundifolium. Greece, Athos, vic. Karyes, *Van Loon 20247* (U): 2*n* = 26 (Van Loon 1984c: 296).
G. rotundifolium. Greece, Athos, vic. Daphne, *Van Loon 20248* (U): 2*n* = 26 (Van Loon 1984c: 296).
G. rotundifolium. Greece, Macedonia, vic. Drama, *Van Loon 20252* (U): 2*n* = 26 (Van Loon 1984c: 296).
G. rotundifolium. Greece, Macedonia, vic. Serrai, *Van Loon 20258* (U): 2*n* = 26 (Van Loon 1984c: 296).
G. rotundifolium. Italy, Scala, San Cataldo, *Larsen 54-87* (C): 2*n* = 26 (Larsen 1956: 305).
G. rotundifolium. Morocco, Haut Atlas, Rhat plateau, *Galland 1160[82-55]* (NEU): *n* = 13 (Galland 1988: 144).
G. rotundifolium. Portugal, Serra de Monsanto, *Alves & Leitão 2143* (COI?): 2*n* = 26 (Alves & Leitão 1976: 232).
G. rotundifolium. Portugal, Estrada Batalha-Rio Maior, *Alves & Leitão 3226* (COI?): 2*n* = 26 (Alves & Leitão 1976: 232).
G. rotundifolium. Portugal, Ansião, *Alves & Leitão 4518* (COI?): 2*n* = 26 (Alves & Leitão 1976: 232).
G. rotundifolium. Portugal, Coimbra, Fornos, *Alves & Leitão 896* (COI?): 2*n* = 26 (Alves & Leitão 1976: 232).
G. rotundifolium. Portugal, Beira Litoral, Santa Clara, *Van Loon 22046* (U): 2*n* = 26 (Van Loon 1984c: 296).
G. rotundifolium. Portugal, Beira Litoral, vic. Coimbra, *Van Loon 3543* (U): 2*n* = 26 (Van Loon 1984c: 296).
G. rotundifolium. Russia, Krym, Yalta, *Van Loon 25491* (U): 2*n* = 26 (Van Loon 1984c: 296).
G. rotundifolium. Serbia, Mt. Zlatibor, Cajetina, *Van Loon 17393* (U): 2*n* = 26 (Van Loon 1984c: 296).
G. rotundifolium. Spain, Jaén, Sierra de Cazorla, Pantano del Tranco, *Löve 0175* (?): 2*n* = 26 (Löve & Kjellqvist 1974: 163).
G. rotundifolium. Spain, Mallorca, pass S of Soller, *MMF 607* (LD): 2*n* = 26 (Dahlgren & al. 1971: 255).
G. rotundifolium. Spain, Andalusia, vic. San Lucas, *Van Loon 22319* (U): 2*n* = 26 (Van Loon 1984c: 296).
G. rotundifolium. unknown origin, *unknown collector* (?): *n* = 13, 2*n* = 26 (Warburg 1938a: 142).
G. sanguineum. Austria, Niederösterreich, Hainburg a.d. Donau, *Van Loon 3471, 20861* (U): 2*n* = 84 (Van Loon 1984b: 277).
G. sanguineum. Belorussiya, *unknown collector* (?): 2*n* = 84 (Dmitreva & Parfenov 1985: 4).
G. sanguineum. Bulgaria, N Pirin mountains, between Javorova Poljana and Parev Grov, *Nikolov 81115* (?): 2*n* = 84 (Nikolov 1991: 72).
G. sanguineum. Bulgaria, Rila Planina, Paniciste, *Van Loon 25305* (U): 2*n* = 84 (Van Loon 1984b: 277).
G. sanguineum. Bulgaria, Pirin Mt, near the summit Orelek, *Petrova 2598* (SOM): 2*n* = 84 (Petrova & Stanimirova 2001: 461).
G. sanguineum. Denmark, Jutland, vic. Hirsthals, *Van Loon 11130* (U): 2*n* = 84 (Van Loon 1984b: 277).
G. sanguineum. Denmark, Tversted, *Van Loon 19338, 19340* (U): 2*n* = 84 (Van Loon 1984b: 277).
G. sanguineum. Denmark, Glatved, *Van Loon B170* (U): 2*n* = 84 (Van Loon 1984b: 277).
G. sanguineum. Finland, Al, Eckerö, Skag, *unknown collector* (?): *n* = 26-28? (Sorsa 1963: 11).
G. sanguineum. Finland, Föglö, Överö, *Van Loon 20863* (U): 2*n* = 84 (Van Loon 1984b: 277).
G. sanguineum. France, Rouen, *unknown collector* (?): 2*n* = 84 (Böcher & Lewis 1962: 5).
G. sanguineum. France, Aveyron, La Couvertoirade, *Van Loon 6018* (U): 2*n* = 84 (Van Loon 1984b: 277).
G. sanguineum. Germany, seeds obtained from E Germany, *unknown collector* (CUH): 2*n* = 82? (Chatterjee & Sharma 1970: 183).
G. sanguineum. Germany, Kiel, *unknown collector* (?): 2*n* = 84 (Gauger 1937: 530).
G. sanguineum. Great Britain, Co. Durham, v.c. 66, coastal cliffs between Blackhall and Crimdon, *Hollingsworth s.n.* (LTR): 2*n* = 84 (Hollingsworth & al. 1992: 135).
G. sanguineum. Great Britain, Walney Island, Lancashire, *Tutin s.n.* (?): 2*n* = 84 (Böcher & Lewis 1962: 5).
G. sanguineum. Great Britain, Cumberland, *unknown collector* (?): *n* = 42, 2*n* = 84 (Warburg 1938a: 144).
G. sanguineum. Greece, Epideiros, Mt Gamila, *Van Loon 20220* (U): 2*n* = 84 (Van Loon 1984b: 277).
G. sanguineum. Greece, Makedonia, vic. Mokros, *Van Loon 20256* (U): 2*n* = 84 (Van Loon 1984b: 277).
G. sanguineum. Ireland, Mayo, Black Head, *Van Loon 9889* (U): 2*n* = 84 (Van Loon 1984b: 277).
G. sanguineum. Ireland, Connemara, Vanmore, *Van Loon 9984* (U): 2*n* = 84 (Van Loon 1984b: 277).
G. sanguineum. Latvia, vic. Riga, *Van Loon 3767* (U): 2*n* = 84 (Van Loon 1984b: 277).
G. sanguineum. Norway, Aust-Agder, Isefjaenfjord, *Van Loon 11129* (U): 2*n* = 84 (Van Loon 1984b: 277).
G. sanguineum. Poland, Kostrze, *Jankun s.n.* (?): 2*n* = 84 (Skalińska & al. 1978: 43).
G. sanguineum. Poland, Choragiewka near Inowroclaw, *Jankun s.n.* (?): 2*n* = 84 (Skalińska & al. 1978: 43).
G. sanguineum. Poland, Tunel, *Sawicka s.n.* (?): 2*n* = 84 (Skalińska & al. 1978: 43).
G. sanguineum. Poland, valley Bedkowska, *Skalinska s.n.* (?): 2*n* = 84 (Skalińska & al. 1978: 43).
G. sanguineum. Poland, Bielany near Kraków, *unknown collector* (?): 2*n* = 84 (Skalińska & al. 1978: 43).
G. sanguineum. Slovakia, Ipelsko-rimavská brazda, Vyšná Pokoradz, *Májovský & Murín s.n.* (?): 2*n* = 84 (Májovský 1978: 25).
G. sanguineum. Slovakia, Malé Karpaty, Bratislava, Mlynská dolina, *Májovský s.n.* (?): 2*n* = 84 (Májovský 1974a: 9).
G. sanguineum. Slovakia, Matricum, *Van Loon 24219* (U): 2*n* = 84 (Van Loon 1984b: 277).
G. sanguineum. Sweden, Skane, Löderup, Hagestad, *Lövkist 1074* (LD): 2*n* = 84 (Lövkvist & Hultgard 1999: 21).
G. sanguineum. Sweden, Stockholm, Blidö, *Van Loon 3651* (U): 2*n* = 84 (Van Loon 1984b: 277).
G. sanguineum. Switzerland, Tessin, EN of Lugano, south side of Denti della Vecchia, *Huber 12077* (Z-ZT): 2*n* = 84 (Baltisberger & Huber 1993: 5).
G. sanguineum. Turkey, Zigana village, *Kahraman 1877* (Middle East Technical University, Ankara): 2*n* = 84 (Martin & al. 2022: 9).
G. sanguineum. unknown origin, *unknown collector* (?): *n* = 42 (Rohweder 1937: 510).
G. sanguineum. unknown origin, *unknown collector* (?): *n* = 42, 2*n* = 84 (Sakai 1935: 72).
G. saxatile [sub *G. regelii*]. Tadzhikistan, *unknown collector* (?): 2*n* = 28 (Zachareva & Astanova 1968: 73).
G. seemannii [sub *G. culminicola*]. Guatemala, dept. of Huehuetenango, Sierra de los Cuchumatanes, *Beaman 3739* (MICH): *n* = 26 (Beaman & al. 1962: 43).
G. seemannii [sub *G. cruceroense*]. Mexico, State of Mexico, 3 km N of Paso de Cortés on road to Iztaccihuatl, *Beaman 3518* (MICH): *n* = 26 (Beaman & al. 1962: 43).
G. sessiliflorum [sub *G. tucumanum*]. Argentina, Salta, Chicoana, Piedra del Molino, *Barboza 13* (CORD?): *n* = 26 (Barboza 1983: 143).
G. sessiliflorum. Chile, Biobío, Termas de Chillán, *Aedo 7500* (MA): 2*n* = 56 (Aedo & al. 2005a: 8).

G. sessiliflorum. unknown origin, cultivated at Kiel, Germany, *unknown collector* (?): 2*n* = 56 (Gauger 1937: 530).

G. sessiliflorum. unknown origin, *unknown collector* (?): *n* = 28, 2*n* = 56 (Warburg 1938a: 150).

G. shikokianum [sub *G. shikokianum* var. *yamatense*]. Japan, Nara, Mt. Ohmine, *unknown collector* (?): 2*n* = 28 (Shimizu 1971: 61).

G. shikokianum [sub *G. shikokianum* var. *kai-montanum*]. Japan, Yamanashi, Mt. Mitsu-toge, *unknown collector* (?): 2*n* = 28 (Shimizu 1971: 61).

G. shikokianum [sub *G. shikokianum* var. *shikokianum*]. Japan, Tokushima, Mt. Tsurugi, *unknown collector* (?): 2*n* = 28 (Shimizu 1971: 61).

G. sibiricum. Czech Republic, Brno, Faculty of Sciences, *Dvořák s.n.* (BRNU): 2*n* = 28 (Dvořák & Dadáková 1984: 66).

G. sibiricum. Finland, Keskisuomi, Jyväskylä, *Van Loon 24280* (U): 2*n* = 28 (Van Loon 1984b: 276).

G. sibiricum [sub *G. sibiricum* var. *glabrius*]. Japan, Hokkaido, Asahikawa, *unknown collector* (?): 2*n* = 28 (Nishikawa 1985: 31).

G. sibiricum. Japan, Hokkaido, Asahikawa, *unknown collector* (?): 2*n* = 28 (Shimizu 1971: 61).

G. sibiricum. Japan, Hokkaido, Iwaobetsu, *unknown collector* (?): 2*n* = 28 (Shimizu 1971: 61).

G. sibiricum. Poland, Słomniki near Kraków, *Mirek s.n.* (?): 2*n* = 28 (Mizianty & al. 1981: 20).

G. sibiricum. Russia, Sakhalin, Južno-Sachalinska v napraveenii k G. Cholmsku, u Dorogi, *Pereval 6173* (?): 2*n* = 28 (Probatova & al. 1996: 99).

G. sibiricum. Russia, Amur, s. Bogorodskoe, *Probatova & Rudyka 5089* (?): 2*n* = 28 (Sokolovskaya & Probatova 1986: 61).

G. sibiricum [sub *G. sibiricum* subsp. *sibiricum*]. Slovakia, Nize Beskydy, Humenné, *Dostál s.n.* (SLO): 2*n* = 28 (Váchova & Májovský 1978: 381).

G. sibiricum. Turkey, Uzungöl area, *Kahraman 2414a* (Middle East Technical University, Ankara): 2*n* = 28 (Martin & al. 2022: 9).

G. sibiricum. Ukraina, s. Soloncy, Vygon, *Probatova & Rudyka 5093* (?): 2*n* = 28 (Sokolovskaya & Probatova 1986: 61).

G. sinense. unknown origin, *unknown collector* (?): *n* = 14 (Warburg 1938a: 144).

G. sintenisii. Turkey, towards to Zigana gateway, *Kahraman 1880* (Middle East Technical University, Ankara): 2*n* = 26 (Martin & al. 2022: 9).

G. skottsbergii. Chile, Valparaiso, Papudo, *Aedo 6821* (MA): 2*n* = ca. 39 (Aedo & al. 2005a: 8).

G. skottsbergii. Chile, Coquimbo, Pichidangui, *Aedo 6832* (MA): 2*n* = 52 (Aedo & al. 2005a: 8).

G. soboliferum. Japan, Nagano, Minamikaruizawa, *unknown collector* (?): 2*n* = 28 (Shimizu 1971: 61).

G. solanderi. New Zealand, Auckland, Owairaka, Oakley Creek, *de Lange & al. s.n.* (AK-285253): *n* = 26 (de Lange & al. 2004: 880).

G. solanderi. New Zealand, Auckland, Penrose, Anne's Creek, *de Lange & al. s.n.* (AK-285206): *n* = 26 (de Lange & al. 2004: 880).

G. solanderi. New Zealand, Chatham is, *de Lange 225* (AK): 2*n* = ca. 24 (Aedo & al. 2005a: 8).

G. subacutum [sub *G. cinereum* subsp. *subcaulescens*]. Turkey, 91 km E Fethyé, *Guittonneau 73.06.22.02* (herb. Guittonneau): 2*n* = 28 (Guittonneau 1975: 200).

G. subargenteum. Spain, Santander, Sierra de Cordel, versant S, *Küpfer K01438* (NEU): 2*n* = 28 (Küpfer 1974: 34).

G. subargenteum [sub *G. cinereum* subsp. *subargenteum*]. Spain, Palencia, Redondo-Areños, subida a Peña Labra, *Valdés 4212EV* (MA): 2*n* = 28 (Valdés & Castroviejo 1979: 87).

G. subcaulescens. Albania, 11 km S des Mali i Galicia, 7 km S von Topojani, ca. 20 km SE von Kukës, *Baltisberger 82/1395* (ZT): 2*n* = 28 (Baltisberger 1987: 54).

G. subcaulescens. Greece, near Kataphygion, 35 km W of Katerini, *Baltisberger & Lenherr 83/552, 11584* (ZT): 2*n* = 28 (Baltisberger & Huber 1987: 4).

G. subcaulescens. Greece, Mount Karava, 30 km W Kartitsa, *Baltisberger 11298* (ZT): 2*n* = 28 (Baltisberger 1991a: 167).

G. subcaulescens. Greece, SE side of Mount Kajmakcalan, Voras Oros, *Baltisberger 11686* (ZT): 2*n* = 28 (Baltisberger 1991a: 167).

G. subcaulescens. Greece, Mt Vardousia, E Artonina, *Gustavsson 3198* (LD): 2*n* = 28 (Franzén & Gustavsson 1983: 105).

G. subcaulescens. Greece, Mt. Olympus, S side, pr. Katafygion, *Strid & al. G74-69-20* (C): 2*n* = 28 (Strid & Franzén 1981: 836).

G. subcaulescens. Greece, Mt. Olympus, *Van Loon 20238, 20239* (U): 2*n* = 28 (Van Loon 1984b: 277).

G. subcaulescens. Greece, Sterea Ellas, Mt. Parnassos, *Van Loon 24523* (U): 2*n* = 28 (Van Loon & Oudemans 1982: 343).

G. subcaulescens. Greece, Sterea Ellas, Mt. Parnassos, *Van Loon 24534* (U): 2*n* = 28 (Van Loon 1984b: 277).

G. subcaulescens. Macedonia, Macedonia, Popova Sapka, 10 km W of Tetovo, *Baltisberger 12250* (ZT): 2*n* = 56 (Baltisberger 1993: 12).

G. subcaulescens [sub *G. cinereum* subsp. *subcaulescens*]. Macedonia, Macedonia, Šar Planina, *unknown collector* (LJU): 2*n* = 28 (Lovka & al. 1971: 790).

G. subcaulescens. North Macedonia, EN des Kula Ziberit, Korab mts., *Baltisberger 12227* (ZT): 2*n* = 28 (Baltisberger 1992: 198).

G. subcaulescens. unknown origin, cultivated at Kiel, Germany, *unknown collector* (?): 2*n* = 28 (Gauger 1937: 530).

G. subcaulescens. unknown origin, *unknown collector* (?): 2*n* = 28 (Warburg 1938a: 150).

G. sylvaticum. Scandinavia, *unknown collector* (?): 2*n* = 28 (Löve & Löve 1945: 17).

G. sylvaticum [sub *G. sylvaticum* var. *glanduligerum*]. Bulgaria, N Pirin mountains, near Parev Grob, *Nikolov 81405* (?): 2*n* = 28 (Nikolov 1991: 72).

G. sylvaticum. Bulgaria, Vitosha Mt, *Petrova 1896* (SOM): 2*n* = 28 (Petrova & Stanimirova 2001: 462).

G. sylvaticum. Finland, island Seili in Nauvo, *unknown collector* (TUR): 2*n* = 28 (Arohonka 1982: 5).

G. sylvaticum. Finland, N., Espoo, Solvalla, *unknown collector* (?): *n* = 14 (Sorsa, 1962: 10).

G. sylvaticum. Finland, Ta., Riihimäki, Käpälämäki, *unknown collector* (?): 2*n* = ca. 28 (Sorsa 1962: 10).

G. sylvaticum. Finland, Turku, Piikkiö, Hirvensalmi, Siilinjärvi, Oulainen, Kemi, Rovaniemi, Sodankylä, Inari & Utsjoki [exact provenience of the counted material is not indicated], *unknown collector* (?): 2*n* = 28 (Vaarama & Jääskeläinen 1967: 23).

G. sylvaticum. France, Doubs, *Van Loon 3481* (U): 2*n* = 28 (Van Loon 1984b: 277).

G. sylvaticum. France, Puy-de-Döme, Col du Béal, *Van Loon 9972* (U): 2*n* = 28 (Van Loon 1984b: 277).

G. sylvaticum. France, Cantal, Condat, *Van Loon 9973* (U): 2*n* = 28 (Van Loon 1984b: 277).

G. sylvaticum. France, Cantal, Plomb du Cantal, *Van Loon 9976* (U): 2*n* = 28 (Van Loon 1984b: 277).

G. sylvaticum. Georgia, Kasbegi, Sameba, *Gvinianidze & Avazneli s.n.* (?): 2*n* = 24? (Gvinianidze & Avazneli 1980: 71).

G. sylvaticum. Germany, Kiel, *unknown collector* (?): 2*n* = 28 (Gauger 1937: 530).

G. sylvaticum. Great Britain, *Van Loon 12618* (U): 2*n* = 28 (Van Loon 1984b: 277).

G. sylvaticum. Iceland, *unknown collector* (?): 2*n* = 28 (Löve & Löve 1956: 155).

G. sylvaticum. Italy, Cuneo, Val Stura di Demonte, Pontebernardo, *Van Loon 24212* (U): 2*n* = 28 (Van Loon 1984b: 277).

G. sylvaticum. Norway, Bogstad, Oslo, *unknown collector* (?): *n* = 14 (Laane 1969: 149).

G. sylvaticum. Norway, vic. Sundvollen, *Van Loon 11067* (U): 2*n* = 28 (Van Loon 1984b: 277).

G. sylvaticum. Norway, Opland, *Van Loon 11126* (U): 2*n* = 28 (Van Loon 1984b: 277).
G. sylvaticum. Norway, Sognog Fjordane, Jostedal, *Van Loon 11128* (U): 2*n* = 28 (Van Loon 1984b: 277).
G. sylvaticum. Norway, August-Agder, Bykle, *Van Loon 11131* (U): 2*n* = 28 (Van Loon 1984b: 277).
G. sylvaticum. Norway, Sortrondelag, Opdal, *Van Loon 24203* (U): 2*n* = 28 (Van Loon 1984b: 277).
G. sylvaticum. Poland, Tatra mountains, *unknown collector* (?): 2*n* = 28 (Putrament 1962: 725).
G. sylvaticum. Poland, Czerwone Wierchy, Western Tatra, *unknown collector* (?): 2*n* = 28 (Skalińska & al. 1959: 498).
G. sylvaticum. Poland, Kobylarz, Western Tatra, *unknown collector* (?): 2*n* = 28 (Skalińska & al. 1959: 498).
G. sylvaticum. Poland, Wielka Turnia, Western Tatra, *unknown collector* (?): 2*n* = 28 (Skalińska & al. 1959: 498).
G. sylvaticum. Poland, valley Jaworzynka, *unknown collector* (?): 2*n* = 28 (Skalińska & al. 1959: 498).
G. sylvaticum. Slovakia, Slovakia, Nizke Tatry, Špania dolina, *Májovský s.n.* (SLO): 2*n* = 28 (Uhríkova & Májovský 1980: 726).
G. sylvaticum [sub *G. sylvaticum* subsp. *sylvaticum*]. Slovakia, Javorníky-Gebirge, Siedlung Bartkovce, *Mičieta s.n.* (?): 2*n* = 28 (Micieta 1981: 98).
G. sylvaticum. Slovakia, regio Slovensky, *Van Loon 24221* (U): 2*n* = 28 (Van Loon 1984b: 277).
G. sylvaticum. Sweden, Torne Lappmark, Jukkasjärvi, Abisko, *Lövkist 1781* (LD): 2*n* = 28 (Lövkvist & Hultgard 1999: 21).
G. sylvaticum. Sweden, Skane, Langaröd, *Lövkist 1854* (LD): 2*n* = 28 (Lövkvist & Hultgard 1999: 21).
G. sylvaticum. Sweden, Skane, Jhärsas, Haraberga, *Lövkist 1965* (LD): 2*n* = 28 (Lövkvist & Hultgard 1999: 21).
G. sylvaticum. Sweden, Uppland, Stockholm, Frescati, *Lövkist D77* (LD): 2*n* = 28 (Lövkvist & Hultgard 1999: 21).
G. sylvaticum. Sweden, Dalarne, *unknown collector* (?): *n* = 12? (Tjebbes 1928: 328).
G. sylvaticum. Sweden, *Van Loon 3497* (U): 2*n* = 28 (Van Loon 1984b: 277).
G. sylvaticum. Sweden, Upland, Järfälla, *Van Loon 3656* (U): 2*n* = 28 (Van Loon 1984b: 277).
G. sylvaticum. Switzerland, Graubünden, Waltensburg, *Van Loon 10053* (U): 2*n* = 28 (Van Loon 1984b: 277).
G. sylvaticum. Switzerland, Graubünden, Tiefencastel, *Van Loon 10666* (U): 2*n* = 28 (Van Loon 1984b: 277).
G. sylvaticum. Switzerland, Wallis, Gäserried, *Van Loon 23416* (U): 2*n* = 28 (Van Loon 1984b: 277).
G. sylvaticum. Switzerland, Wallis, Grächen, *Van Loon 23420* (U): 2*n* = 28 (Van Loon 1984b: 277).
G. sylvaticum. Switzerland, Wallis, Champex, *Van Loon 24202* (U): 2*n* = 28 (Van Loon 1984b: 277).
G. sylvaticum. Turkey, between Düzce and Sakarya, *Kahraman 1978* (Middle East Technical University, Ankara): 2*n* = 28 (Martin & al. 2022: 9).
G. sylvaticum [sub *G. alpestre*]. Ukraina, *unknown collector* (?): 2*n* = 28 (Pashuk 1987: 1070).
G. sylvaticum. unknown origin, *unknown collector* (?): 2*n* = 24? (Dmitrieva 1986: 26).
G. sylvaticum. unknown origin, *unknown collector* (?): *n* = 14 (Warburg 1938a: 144).
G. thunbergii. Japan, Hokkaido, Asahikawa, *unknown collector* (?): 2*n* = 28 (Nishikawa 1985: 31).
G. thunbergii [sub *G. nepalense* subsp. *thunbergii*]. Japan, Saitama, Mt. Tohnosu, *unknown collector* (?): 2*n* = 28 (Shimizu 1971: 61).
G. thunbergii [sub *G. nepalense* subsp. *thunbergii*]. Japan, Yamanashi, Misaka-toge, *unknown collector* (?): 2*n* = 28 (Shimizu 1971: 61).
G. thunbergii [sub *G. nepalense*]. Japan, *unknown collector* (?): 2*n* = 28 (Suzuka 1950: 57).
G. traversii. New Zealand, Chatham I., *Dawson & Beuzenberg s.n.* (CHR-518409): 2*n* = 52-54 (Dawson & Beuzenberg 2000: 5).
G. traversii [sub *G. traversii* var. *elegans*]. Unknown origin, *unknown collector* (?): *n* = 14 (Warburg 1938a: 150).
G. tripartitum. Japan, Fukushima, Mt. Ohtakine, *unknown collector* (?): 2*n* = 28+2B (Shimizu 1971: 61).
G. tripartitum. Japan, Kanagawa, Mt. Ohyama, *unknown collector* (?): 2*n* = 28+2B (Shimizu, 1971: 61).
G. tuberosum. Turkey, Elmali, Uzungeriş hill, *Kahraman 1838* (Middle East Technical University, Ankara): 2*n* = 28 (Martin & al. 2022: 9).
G. versicolor. Italy, Sicilia, Pian Pomo, Madonie, *Tornadore & Garbari s.n.* (?): 2*n* = 28 (Tornadore & al. 1974: 47).
G. versicolor [sub *G. striatum*]. Unknown origin, *unknown collector* (?): *n* = 14 (Warburg 1938a: 144).
G. viscosissimum [sub *G. viscosissimum* var. *viscosissimum*]. Canada, British Columbia, 7.2 km W of Bridge Lake Post Office, *Taylor & Taylor 5292* (UBC): *n* = 26, 2*n* = 52 (Taylor & Taylor 1977: 131).
G. viscosissimum [sub *G. nervosum*]. USA, Idaho, Bear Lake Co., *Shaw 68* (UTC): *n* = 26 (Shaw 1952: 299).
G. wallichianum. India, Lakshmanganga, *Sharma & al. 2200* (?): 2*n* = 26 (Roy & al. 1988: 95).
G. wallichianum. India, Hemkund, Western Himalayas, *Sharma 2200* (CUH): *n* = 13, 2*n* = 26 (Chatterjee & Sharma 1970: 183).
G. wallichianum. Unknown origin, *unknown collector* (?): *n* = 14 (Warburg 1938a: 144).
G. wilfordii [sub *G. wilfordii* var. *yezoense*]. Japan, Futami, Toi, *unknown collector* (?): 2*n* = 28 (Nishikawa 1990: 20, 22).
G. wilfordii. Japan, Shiga, Mt. Ibuki, *unknown collector* (?): 2*n* = 28+2B (Shimizu 1971: 61).
G. wilfordii. Japan, Nagano, Torii-toge, *unknown collector* (?): 2*n* = 28+2B (Shimizu 1971: 61).
G. wilfordii. Russia, Primorskij kraj, okr. Vladivostoka leso park Botaničeskogo sada, *Probatova & al. 6684* (?): 2*n* = 28 (Probatova & Sokolovskaya 1988: 292).
G. wilfordii. Russia, Primorskii krai, *Tzyrenova 9824* (VLA): 2*n* = 28 (Probatova & al. 2014: 1155).
G. wilfordii. unknown origin, *unknown collector* (?): *n* = 14, 2*n* = 28 (Warburg 1938a: 144).
G. wlassovianum. Russia, Primorskij kraj, Dal'negorskij r-n, okr. pos. Rudnaja Pristan', *Probatova & al. 6440* (?): 2*n* = 56 (Probatova & Sokolovskaya 1988: 291).
G. wlassovianum. Russia, Primorye, Okeanskaja bliz Vladibostoka, *Sokolovskaya 338* (?): 2*n* = 28 (Probatova & al. 1991: 1175).
G. wlassovianum. unknown origin, *unknown collector* (?): *n* = 28 (Warburg 1938a: 144).
G. yeoi [sub *G. rubescens*]. Portugal, Madeira, from plants supplied to Mr. Jackson by T.G. Tutin, Univiersity of Leicester, *unknown collector* (herb. Jackson): 2*n* = 128 (Yeo 1969: 35).
G. yeoi [sub *G. rubescens*]. Portugal, Madeira, from plants obtained from the Royal Botanic Gardens, Kew, and the University Botanic Garden, Oxford, *unknown collector* (herb. Jackson): *n* = ca. 64, 2*n* = 128 (Yeo 1969: 35).
G. yesoense [sub *G. yesoense* var. *pseudopalustre*]. Japan, Akita, Oga Peninsula, *unknown collector* (?): 2*n* = 28 (Shimizu 1971: 61).
G. yesoense [sub *G. yesoense* var. *nipponicum*]. Japan, Nagano, Mt. Kirigamine, *unknown collector* (?): 2*n* = 28 (Shimizu 1971: 61).
G. yesoense [sub *G. yesoense* var. *nipponicum*]. Japan, Shiga, Mt. Ibuki, *unknown collector* (?): 2*n* = 28 (Shimizu 1971: 61).
G. yesoense [sub *G. yesoense* var. *nipponicum*]. Japan, Nagano, Mt. Yunomaru, *unknown collector* (?): 2*n* = 28 (Shimizu 1971: 61).
G. yesoense [sub *G. yesoense* var. *yesoense*]. Japan, Hokkaido, Hamakoshi-

mizu, *unknown collector* (?): 2*n* = 28 (Shimizu 1971: 61).

G. yesoense. Russia, Kuril Is, Kunashir island, *Probatova 6801* (?): 2*n* = 28 (Probatova & al. 1989: 1676).

G. yoshinoi. Japan, Aichi, Shitara, *unknown collector* (?): 2*n* = 28 (Shimizu 1971: 61).

G. yoshinoi. Japan, Hiroshima, Akana-toge, *unknown collector* (?): 2*n* = 28 (Shimizu 1971: 61).

G. sp. [sub *G. anemonifolium*]. India, Darjeeling, Eastern Himalayas, *Sharma 637* (CUH): *n* = 56 (Chatterjee & Sharma 1970: 183).

G. sp. [sub *G. eginense*]. Turkey, Kemaliye, Karanlik Canyon road, *Kahraman 2387* (Middle East Technical University, Ankara): 2*n* = 26 (Martin & al. 2022: 8).

G. sp. [sub *G. gymnocaulon*]. Unknown origin, *unknown collector* (?): *n* = 28, 2*n* = 56 (Sokolovskaya & Strelova 1948b: 213).

G. sp. [sub *G. ibericum* var. *talyshense*]. Unknown origin, *unknown collector* (?): *n* = 28 (Warburg 1938a: 144).

G. sp. [sub *G. nepalense*]. Russia, Kuril Is, Kuril'skie o-va, o-v Kunašir, morska terrasa u mysa Alechina, *Probatova 6800* (?): 2*n* = 28 (Rudyka 1990: 1784).

G. sp. [sub *G. subcaulescens*]. Turkey, Melikler plateau, *Kahraman 1831* (Middle East Technical University, Ankara): 2*n* = 28 (Martin & al. 2022: 9).

G. sp. [sub *G. sp.*]. New Zealand, upper Oreti R., Southland, *Dawson & Beuzenberg s.n.* (CHR-518391): 2*n* = 54-56 (Dawson & Beuzenberg 2000: 5).

APPENDIX 2. NAMES OF GERANIUM BELONGING TO OTHER GENERA

The names described or combined under *Geranium* and now transferred to other genera (indicated between square brackets) are listed here, because of their interest to the nomenclature of the genus *Geranium*. Nevertheless, their status should be investigate further, particularly those with the same epithet. A part of these names with the same epithet are probably "isonyms", that is names based on the same type that have been published independently at different times, by different authors (art. 6.3, note 2). Consequently, the later isonyms should be disregarded. Another part becomes homonyms and then illegitimate, if they are spelled exactly like names based on a different type that was previously and validly published for a taxon at the same rank (art. 53.1). As stated before, their final status should be clarified in the context of a deep knowledge of the taxonomy, typifications and nomenclature of the genera involved.

Geranium abrotanifolium Andrews, Geraniums 2, [pl. 1]. 1805, [*Pelargonium*].

Geranium abrotanifolium L. f., Suppl. Pl.: 304. 1782, [*Pelargonium*].

Geranium absinthoides (Willd.) Poir., in Lam., Encycl. Suppl. 2: 741. 1812, [*Erodium*].

Geranium acaule Burm. f. ex DC., Prodr. 1: 649. 1824, [*Pelargonium*], nom. nud., pro syn.

Geranium acaule L., Syst. Nat. ed. 10 2: 1143. 1759, [*Erodium*].

Geranium acaule Thunb., Prodr. Pl. Cap.: 116. 1800, [*Pelargonium*].

Geranium acerifolium (L'Hér.) Dum. Cours., Bot. Cult. 3: 20. 1802, [*Pelargonium*].

Geranium acerifolium Cav., Diss. 4: 243, tab. 112 fig. 2. 1787, [*Pelargonium*].

Geranium acerifolium Thunb., Prodr. Fl. Cap.: 114. 1800, [*Pelargonium*].

Geranium acetosum Dum. Cours., Bot. Cult. ed. 2, 5: 16. 1811, [*Pelargonium*].

Geranium acetosum L., Sp. Pl.: 678. 1753, [*Pelargonium*].

Geranium acetosum var. *roseum* Dum. Cours., Bot. Cult. ed. 2, 5: 16. 1811, [*Pelargonium*].

Geranium aculeatum Paterson ex J.F. Gmel.,, Syst. Nat. 2(2): 1024. 1792, [*Pelargonium*].

Geranium aculeatum Raeusch., Nomen. Bot.: 194. 1797, [*Pelargonium*], nom. nud.

Geranium acuminatum Thunb., Prodr. Pl. Cap.: 116. 1800, [*Pelargonium*].

Geranium adulterinum Thunb., Prodr. Fl. Cap.: 115. 1800, [*Pelargonium*].

Geranium adulterinum var. *curtisii* Dum. Cours., Bot. Cult. 5: 373. 1805, [*Pelargonium*].

Geranium aethiopicum Lam., Encycl. 2: 662. 1788, [*Erodium*].

Geranium africanum Cav., Diss. 4: 242, tab. 104 fig. 1. 1787, [*Pelargonium*].

Geranium alceoides Burm. f., Spec. Bot. Geran.: 32. 1759, [*Pelargonium*].

Geranium alchimilloides L., Sp. Pl.: 678. 1753, [*Pelargonium*].

Geranium alnifolium (Willd.) Poir. in Lam., Encycl. Suppl. 2: 758. 1812, [*Pelargonium*].

Geranium alpinum Burm. f., Spec. Bot. Geran.: 30. 1759, [*Erodium*].

Geranium alternans (J.C. Wendl.) Dum. Cours., Bot. Cult. 5: 386. 1805, [*Pelargonium*].

Geranium althaeoides L., Sp. Pl.: 679. 1753, [*Pelargonium*].

Geranium anceps (L'Hér.) Dum. Cours., Bot. Cult. 3: 19. 1802, [*Pelargonium*].

Geranium andrewsii Sweet, Hort. Brit.: 77. 1826, [*Pelargonium*], nom. nud.

Geranium anemonoides Thunb., Prodr. Pl. Cap.: 112. 1800, [*Monsonia*].

Geranium angulosum Dum. Cours., Bot. Cult. 3: 20. 1802, [*Pelargonium*].

Geranium angulosum Mill., Gard. Dict. ed. 8 n.° 22. 1768, [*Pelargonium*].

Geranium angustifolium L'Hér. ex R. Knuth in Engl., Pflanzenr. IV.129 (Heft 53): 420. 1912, [*Pelargonium*], nom. nud.

Geranium angustifolium Thunb., Prodr. Fl. Cap.: 113. 1800, [*Pelargonium*].

Geranium anthemifolium (M. Bieb.) Poir. in Lam., Encycl. Suppl. 2: 742. 1812, [*Erodium*].

Geranium aphanoides Thunb., Prodr. Pl. Cap.: 113. 1800, [*Pelargonium*].

Geranium apiifolium Andrews, Geraniums 2, [pl. 3]. 1805, [*Pelargonium*].

Geranium appendiculatum L. f., Suppl. Pl.: 304. 1782, [*Pelargonium*].

Geranium arborescens Desf., Fl. Atlant. 2: 110. 1798, [*Erodium*].

Geranium ardens Andrews, Geraniums 1, [pl. 28]. 1805, [*Pelargonium*].

Geranium ardens var. *ardescens* Andrews, Geraniums 2, [pl. 4]. 1805, [*Pelargonium*].

Geranium ardens var. *minor* Andrews, Geraniums 1, [pl. 29]. 1805, [*Pelargonium*].

Geranium ardescens Andrews, Geraniums 1. 1805, [*Pelargonium*].

Geranium arduinum L., Sp. Pl. ed. 2: 952. 1763, [*Erodium*].

Geranium arenarium Burm. f., Spec. Bot. Geran.: 48. 1759, [*Erodium*].

Geranium arenicola Steud., Flora 39(28): 439. 1856, [*Erodium*].

Geranium articulatum Cav., Diss. 4: 252, tab. 122 fig. 1. 1787, [*Pelargonium*].

Geranium asperifolium Andrews, Geraniums 1, [pl. 2]. 1805, [*Pelargonium*].

Geranium asperum (Willd.) Poir. in Lam., Encycl. Suppl. 2: 759. 1812, [*Pelargonium*].

Geranium asplenioides Desf., Fl. Atlant. 2: 109, tab. 168. 1798, [*Erodium*].

Geranium astragalifolium Andrews, Bot. Repos. 3, pl. 190. 1801, [*Pelargonium*].

Geranium astragalifolium Cav., Diss. 3: [186]. 1787, [*Pelargonium*], nom. nud.

Geranium astragalifolium Cav., Diss. 4: 257, tab. 104 fig. 2. 1787, [*Pelargonium*].

Geranium astragalifolium var. *ardens* Andrews, Geraniums 2, [pl. 7]. 1805, [*Pelargonium*].

Geranium astragalifolium var. *multifidae* Andrews, Geraniums 2, [pl. 7]. 1805, [*Pelargonium*].

Geranium atro-fulgens Andrews, Geraniums 2, [pl. 8]. 1805, [*Pelargonium*].

Geranium atrum (L'Hér.) Poir. in Lam., Encycl. Suppl. 2: 746. 1812, [*Pelargonium*].
Geranium augustum Andrews, Geraniums 1, [pl. 3]. 1805, [*Pelargonium*].
Geranium auriculatum (Willd.) Poir. in Lam., Encycl. Suppl. 2: 745. 1812, [*Pelargonium*].
Geranium auritum L., Sp. Pl.: 679. 1753, [*Pelargonium*].
Geranium australe (Willd.) Dum. Cours., Bot. Cult. 5: 381. 1805, [*Pelargonium*].
Geranium balsameum (Jacq.) Dum. Cours., Bot. Cult. ed. 2, 5: 27. 1811, [*Pelargonium*].
Geranium barbatum (Jacq.) Andrews, Bot. Repos. 5, pl. 303. 1803, [*Pelargonium*].
Geranium barbatum var. *minor* Andrews, Bot. Repos. 5, pl. 323. 1803, [*Pelargonium*].
Geranium barbatum var. *undulatum* Andrews, Bot. Repos. 6, pl. 366. 1804, [*Pelargonium*].
Geranium barringtonii (Willd.) Poir. in Lam., Encycl. Suppl. 2: 751. 1812, [*Pelargonium*].
Geranium beaufortiae Andrews, Geraniums 1, [pl. 4]. 1805, [*Pelargonium*].
Geranium beaufortianum (Desf.) Dum. Cours., Bot. Cult. ed. 2, 5: 25. 1811, [*Pelargonium*].
Geranium beaufortianum (Desf.) Poir. in Lam., Encycl. Suppl. 2: 748. 1812, [*Pelargonium*].
Geranium beaufortianum Desf. ex R. Knuth in Engl., Pflanzenr. IV.129 (Heft 53): 505. 1912, [*Pelargonium*], nom. nud., pro syn.
Geranium betonicum Burm. f., Spec. Bot. Geran.: 32. 1759, [*Pelargonium*].
Geranium betulinum L., Sp. Pl.: 679. 1753, [*Pelargonium*].
Geranium bicolor Jacq., Hort. Bot. Vindob. 3: 23, tab. 39. 1776, [*Pelargonium*].
Geranium bicolor var. *magna* Andrews, Geraniums 2, [pl. 9]. 1805, [*Pelargonium*].
Geranium biflorum Burm. ex Cav., Diss. 4: 251. 1787, [*Pelargonium*].
Geranium bifolium Burm. f., Spec. Bot. Geran.: 52. 1759, [*Pelargonium*].
Geranium bipinnatum Cav., Diss. 5: 273, tab. 126 fig. 3. 1788, [*Erodium*].
Geranium blandfordium Andrews, Geraniums 2, [pl. 10]. 1805, [*Pelargonium*].
Geranium blattarium (Jacq.) Poir. in Lam., Encycl. Suppl. 2: 748. 1812, [*Pelargonium*].
Geranium botrys Cav., Diss. 4: 218, tab. 90 fig. 2. 1787, [*Erodium*].
Geranium broadleyae Andrews, Geraniums 1, [pl. 7]. 1805, [*Pelargonium*].
Geranium bubonifolium Andrews, Bot. Repos. 5, pl. 328. 1803, [*Pelargonium*].
Geranium canariense (Willd.) Poir. in Lam., Encycl. Suppl. 2: 752. 1812, [*Pelargonium*].
Geranium capillare Cav., Diss. 4: 258, tab. 97 fig. 1. 1787, [*Pelargonium*].
Geranium capillare Cav., Diss. 3: [186]. 1787, [*Pelargonium*], nom. nud.
Geranium capitatum L., Sp. Pl.: 678. 1753, [*Pelargonium*].
Geranium carneum (Jacq.) Dum. Cours., Bot. Cult. ed. 2, 5: 7. 1811, [*Pelargonium*].
Geranium carnosum L., Cent. Pl. I: 20. 1755, [*Pelargonium*].
Geranium caucalifolium (Jacq.) Poir. in Lam., Encycl. Suppl. 2: 750. 1812, [*Pelargonium*].
Geranium ceratophyllum (L'Hér.) Dum. Cours., Bot. Cult. 3: 27. 1802, [*Pelargonium*].
Geranium chaerophyllum Cav., Diss. 4: 226, tab. 95 fig. 1. 1787, [*Erodium*].
Geranium chamaedrifolium (Jacq.) Poir. in Lam., Encycl. Suppl. 2: 747. 1812, [*Pelargonium*].
Geranium chamaedryoides Cav., Diss. 3: [186]. 1787, [*Erodium*], nom. nud.
Geranium chamaedryoides Cav., Diss. 4: 197, tab. 76 fig. 2. 1787, [*Erodium*].
Geranium chelidonium Houtt., Nat. Hist. 10: 8, pl. 61 fig. 1. 1779, [*Pelargonium*].
Geranium chium Burm. f., Spec. Bot. Geran.: 32. 1759, [*Erodium*].
Geranium ciconium L., Cent. Pl. I: 21. 1755, [*Erodium*].
Geranium cicutarium Cav. ex R. Knuth in Engl., Pflanzenr. IV.129 (Heft 53): 279. 1912, [*Erodium*], nom. nud., pro syn.
Geranium cicutarium L., Sp. Pl.: 680. 1753, [*Erodium*].
Geranium cicutarium var. *album* Weston, Bot. Univ. 2: 349. 1771, [*Erodium*].
Geranium cicutarium var. *chaerophyllum* (Cav.) Gaudin, Fl. Helv. 4: 395. 1829, [*Erodium*].
Geranium cicutarium var. *erectum* Weston, Bot. Univ. 2: 349. 1771, [*Erodium*].
Geranium cicutarium var. *moschatum* L., Sp. Pl.: 680. 1753, [*Erodium*].
Geranium cicutarium var. *pilosissimum* Gaudin, Fl. Helv. 4: 396. 1829, [*Erodium*].
Geranium cicutarium var. *pimpinellifolium* (Cav.) Gaudin, Fl. Helv. 4: 394. 1829, [*Erodium*].
Geranium ciliatum Andrews, Bot. Repos. 4, pl. 247. 1802, [*Pelargonium*].
Geranium ciliatum Cav., Diss. 4: 234, tab. 118 fig. 2. 1787, [*Pelargonium*].
Geranium ciliatum Thunb., Prodr. Pl. Cap.: 113. 1800, [*Pelargonium*].
Geranium citriodorum Andrews, Geraniums 1, [pl. 14]. 1805, [*Pelargonium*].
Geranium citriodorum Cav., Icon. 1: 6, tab. 8. 1791, [*Pelargonium*].
Geranium concavifolium (Pers.) Dum. Cours., Bot. Cult. ed. 2, 5: 46. 1811, [*Pelargonium*].
Geranium condensatum (Pers.) Poir. in Lam., Encycl. Suppl. 2: 757. 1812, [*Pelargonium*].
Geranium conduplicatum (Willd.) Poir. in Lam., Encycl. Suppl. 2: 751. 1812, [*Pelargonium*].
Geranium consanguineum (Willd.) Poir. in Lam., Encycl. Suppl. 2: 759. 1812, [*Pelargonium*].
Geranium cordifolium Andrews, Geraniums 1, [pl. 20]. 1805, [*Pelargonium*].
Geranium cordifolium Cav., Diss. 4: 240, tab. 117 fig. 3. 1787, [*Pelargonium*].
Geranium cordifolium Cav., Diss. 3: [186]. 1787, [*Pelargonium*], nom. nud.
Geranium cordifolium var. *squarrosum* Dum. Cours., Bot. Cult. 3: 17. 1802, [*Pelargonium*].
Geranium coriandrifolium L., Sp. Pl. ed. 2: 949. 1763, [*Pelargonium*].
Geranium coronillaefolium Andrews, Bot. Repos. 5, pl. 305. 1803, [*Pelargonium*].
Geranium coronopifolium Andrews, Bot. Repos. 5, pl. 338. 1803, [*Pelargonium*].
Geranium corsicum (DC.) Poir. in Lam., Encycl. Suppl. 2: 743. 1812, [*Erodium*].
Geranium cortusaefolium Andrews, Bot. Repos. 2, pl. 121. 1800, [*Pelargonium*].
Geranium cortusaefolium var. *cortusoides* Andrews, Geraniums 2, [pl. 10]. 1805, [*Pelargonium*].
Geranium cotyledonis L., Mant. Pl. Altera: 569. 1771, [*Pelargonium*].
Geranium crassicaule (L'Hér.) Dum. Cours., Bot. Cult. 3: 18. 1802, [*Pelargonium*].
Geranium crassicaule (L'Hér.) Dum. Cours. ex Andrews, Geraniums 2, [pl. 13]. 1805, [*Pelargonium*].
Geranium crassicaule (L'Hér.) Poir. In Lam., Encycl. Suppl. 2: 752. 1812, [*Pelargonium*].
Geranium crassifolium Cav., Diss. 4: 219 tab. 90 fig. 1. 1787, [*Erodium*].
Geranium crassifolium Desf., Fl. Atlant. 2: 111. 1798, [*Erodium*].
Geranium crassifolium Forssk., Fl. Aegypt.-Arab.: 123. 1775, [*Erodium*].
Geranium crassifolium L'Hér. in Aiton, Hort. Kew.: 414. 1789, [*Erodium*].
Geranium crassum Poir. in Lam., Encycl. Suppl. 2: 741. 1812, [*Erodium*].
Geranium crataegifolium Roth, Bot. Abh. Beobacht.: 50, tab. 9. 1787, [*Pelargonium*].
Geranium crataegifolium Thunb., Prodr. Pl. Cap.: 115. 1800, [*Pelargonium*].
Geranium crenatum Andrews, Geraniums 2, [pl. 14]. 1805, [*Pelargonium*].
Geranium crenatum var. *mollifoliata* Andrews, Geraniums 2, [pl. 15]. 1805, [*Pelargonium*].
Geranium crenatum var. *monstrosiflorum* Andrews, Geraniums 2, [pl. 16]. 1805, [*Pelargonium*].
Geranium crispum L. ex R. Knuth in Engl., Pflanzenr. IV.129 (Heft 53): 257. 1912, [*Pelargonium*], nom. nud., pro syn.
Geranium crispum P.J. Bergius, Descr. Pl. Cap.: 176. 1767, [*Pelargonium*].
Geranium crithmifolium (Sm.) Poir. in Lam., Encycl. Suppl. 2: 756. 1812, [*Pelargonium*].
Geranium cucullatum L., Sp. Pl.: 677. 1753, [*Pelargonium*].
Geranium cucullatum var. *barringtoniae* (Willd.) Dum. Cours., Bot. Cult. 5: 370. 1805, [*Pelargonium*].

Geranium cucullatum var. *fimbriatum* Burm. f., Spec. Bot. Geran.: 35. 1759, [*Pelargonium*].
Geranium cucullatum var. *lobatum* Dum. Cours., Bot. Cult. ed. 2, 5: 20. 1811, [*Pelargonium*].
Geranium cuspidatum Andrews, Geraniums 2, [pl. 55]. 1805, [*Pelargonium*].
Geranium cynosbatifolium (Willd.) Poir. in Lam., Encycl. Suppl. 2: 758. 1812, [*Pelargonium*].
Geranium daucifolium Murray, Commentat. Soc. Regiae Sci. Gott. 3: 13, tab. 4. 1780, [*Pelargonium*].
Geranium daucifolium Thunb., Prodr. Pl. Cap.: 116. 1800, [*Pelargonium*].
Geranium decumbens Balb., Cat. Pl. ed. 1814: 11. 1814, [*Pelargonium*].
Geranium delphinifolium (Willd.) Poir. in Lam., Encycl. Suppl. 2: 752. 1812, [*Pelargonium*].
Geranium dentatum Andrews, Geraniums 1, [pl. 22]. 1805, [*Pelargonium*].
Geranium dentatum var. *album* Andrews, Geraniums 1, [pl. 25]. 1805, [*Pelargonium*].
Geranium denticulatum (Jacq.) Dum. Cours., Bot. Cult. ed. 2, 5: 2. 1811, [*Pelargonium*].
Geranium dianthiflorum Andrews, Geraniums 2, [pl. 17]. 1805, [*Pelargonium*].
Geranium dipetalum (L'Hér.) Poir. in Lam., Encycl. Suppl. 2: 744. 1812, [*Pelargonium*].
Geranium diphyllum L'Hér. ex DC., Prodr. 1: 646. 1824, [*Erodium*], nom. nud., pro syn.
Geranium divaricatum Thunb., Prodr. Fl. Cap.: 115. 1800, [*Pelargonium*].
Geranium diversifolium (J.C. Wendl. ex Willd.) Poir. in Lam., Encycl. Suppl. 2: 750. 1812, [*Pelargonium*].
Geranium echinatum Thunb., Prodr. Fl. Cap.: 114. 1800, [*Pelargonium*].
Geranium echinatum var. *rubro-purpureo* Andrews, Bot. Repos. 3, pl. 158. 1801, [*Pelargonium*].
Geranium echinatum var. *saepeflorens* Andrews, Geraniums 1, [pl. 54]. 1805, [*Pelargonium*].
Geranium elegans Andrews, Bot. Repos. 1, pl. 28. 1798, [*Pelargonium*].
Geranium elegans Dum. Cours., Bot. Cult. ed. 2, 5: 9. 1811, [*Pelargonium*].
Geranium ellipticum Thunb., Fl. Cap. ed. 2: 525. 1823, [*Pelargonium*].
Geranium elongatum Cav., Diss. 3: [186]. 1787, [*Pelargonium*], nom. nud.
Geranium elongatum Cav., Diss. 4: 233, tab. 101 fig. 3. 1787, [*Pelargonium*].
Geranium emarginatum L. f., Suppl. Pl.: 306. 1782, [*Monsonia*].
Geranium emarginatum Thunb., Prodr. Pl. Cap.: 112. 1800, [*Monsonia*].
Geranium ensatum Thunb., Prodr. Fl. Cap.: 113. 1800, [*Pelargonium*].
Geranium eriostemon (Jacq.) Poir. in Lam., Encycl. Suppl. 2: 759. 1812, [*Pelargonium*].
Geranium erodiiflorum Souza Brito, Rev. Fl. Med. 4: 571. 1938, [*Pelargonium*], nom. inval., without Latin description (art. 39.1)
Geranium erodium L'Hér. ex Dum. Cours., Bot. Cult. 3: 28. 1802, [*Pelargonium*], nom. nud., pro syn.
Geranium eximium Andrews, Geraniums 1, [pl. 37]. 1805, [*Pelargonium*], nom. nud.
Geranium expansum Thunb., Prodr. Pl. Cap.: 112. 1800, [*Pelargonium*].
Geranium exstipulatum Cav., Diss. 4: 253, tab. 123 fig. 1. 1787, [*Pelargonium*].
Geranium ferulaceum Burm. f., Spec. Bot. Geran.: 52. 1759, [*Pelargonium*].
Geranium ficaria (Willd.) Poir. in Lam., Encycl. Suppl. 2: 745. 1812, [*Pelargonium*].
Geranium fissifolium Andrews, Bot. Repos. 6, pl. 378. 1804, [*Pelargonium*].
Geranium fissilium Andrews ex Dum. Cours., Bot. Cult. ed. 2, 5: 47. 1811, [*Pelargonium*], ortho. var.
Geranium flabellatum Desf. ex Dum. Cours., Bot. Cult. ed. 2, 5: 35. 1811, [*Pelargonium*], nom. nud.
Geranium flavum Burm. f., Fl. Indica: 19. 1768, [*Pelargonium*].
Geranium flavum L., Mant. Pl.: 257. 1767, [*Pelargonium*].
Geranium flexuosum Thunb., Prodr. Pl. Cap.: 116. 1800, [*Pelargonium*].
Geranium floribundum Andrews, Bot. Repos. 6, pl. 420. 1805, [*Pelargonium*].
Geranium foetidum L., Fl. Monsp.: 21. 1756, [*Erodium*], nom. nud.
Geranium foetidum L., Amoen. Acad. 4: 487. 1759, [*Erodium*].
Geranium foetidum L. ex B.D. Jacks., Proc. Linn. Soc. London Suppl. 1912: 79. 1912, [*Erodium*], nom. inval., not accepted by its author (art. 36.1)
Geranium foliaceum Andrews, Geraniums 2, [pl. 29]. 1805, [*Pelargonium*], nom. nud.
Geranium formosum (Desf.) Poir. in Lam., Encycl. Suppl. 2: 748. 1812, [*Pelargonium*].
Geranium formosum Andrews, Geraniums 2, [pl. 18]. 1805, [*Pelargonium*].
Geranium formosum Dum. Cours., Bot. Cult. 5: 380. 1805, [*Pelargonium*].
Geranium formosum var. *maculatum* Andrews, Geraniums 2, [pl. 19]. 1805, [*Pelargonium*].
Geranium fothergillianum Andrews ex R. Knuth in Engl., Pflanzenr. IV.129 (Heft 53): 513. 1912, [*Pelargonium*], nom. nud., pro syn.
Geranium fothergillum Andrews, Geraniums 2, [pl. 20]. 1805, [*Pelargonium*].
Geranium fragile (Willd.) Dum. Cours., Bot. Cult. 5: 383. 1805, [*Pelargonium*].
Geranium fragile Andrews, Bot. Repos. 1, pl. 37. 1798, [*Pelargonium*].
Geranium fragrans (Willd.) Poir. in Lam., Encycl. Suppl. 2: 751. 1812, [*Pelargonium*].
Geranium fragrans Dum. Cours., Bot. Cult. 3: 22. 1802, [*Pelargonium*].
Geranium fruticosum Cav., Diss. 4: 263, tab. 122 fig. 2. 1787, [*Pelargonium*].
Geranium fulgidum L., Sp. Pl.: 676. 1753, [*Pelargonium*].
Geranium fuscatum (Jacq.) Dum. Cours., Bot. Cult. ed. 2, 5: 22. 1811, [*Pelargonium*].
Geranium geifolium Desf., Fl. Atlant. 2: 108. 1798, [*Erodium*].
Geranium gibbosum L., Sp. Pl.: 677. 1753, [*Pelargonium*].
Geranium glabrum Dum. Cours., Bot. Cult. 3: 27. 1802, [*Pelargonium*].
Geranium glandulosum Cav. in Lam., Encycl. 2: 665. 1788, [*Erodium*].
Geranium glaucoides Andrews, Geraniums 1, [pl. 35]. 1805, [*Pelargonium*].
Geranium glaucophyllum L., Sp. Pl.: 679. 1753, [*Erodium*].
Geranium glaucum Andrews, Geraniums 1, [pl. 34]. 1805, [*Pelargonium*].
Geranium glaucum Burm. f., Spec. Bot. Geran.: 47, tab. 1 n. 62. 1759, [*Pelargonium*].
Geranium glaucum Cav., Diss. 4: 237, tab. 103 fig. 2. 1787, [*Pelargonium*].
Geranium glaucum L. f., Suppl. Pl.: 306. 1782, [*Pelargonium*].
Geranium glomeratum Andrews, Geraniums 2, [pl. 24]. 1805, [*Pelargonium*].
Geranium glutinosum Jacq., Icon. Pl. Rar. 1: 13, tab. 131. 1783?, [*Pelargonium*].
Geranium glutinosum L'Hér. ex Dum. Cours., Bot. Cult. 3: 21. 1802, [*Pelargonium*].
Geranium grandiflorum Andrews, Bot. Repos. 1, pl. 12. 1798, [*Pelargonium*].
Geranium grandiflorum Cav. ex B. D. Jacks., Index Kew. 2: 1019. 1893, [*Grielum*], nom. inval., not accepted by its author (art. 36.1).
Geranium grandiflorum L., Sp. Pl.: 683. 1753, [*Grielum grandiflorum* (L.) Druce; Neuradaceae].
Geranium grandiflorum var. *formania* Andrews, Geraniums 1, [pl. 33]. 1805, [*Pelargonium*].
Geranium grandiflorum var. *parvifoliata* Andrews, Geraniums 1, [pl. 32]. 1805, [*Pelargonium*].
Geranium gratum (Willd.) Poir. in Lam., Encycl. Suppl. 2: 758. 1812, [*Pelargonium*].
Geranium graveolens Thunb., Prodr. Fl. Cap.: 115. 1800, [*Pelargonium*].
Geranium grenvilliae Andrews, Geraniums 1, [pl. 63]. 1805, [*Pelargonium*].
Geranium grossularioides L., Sp. Pl.: 679. 1753, [*Pelargonium*].
Geranium gruinum L., Sp. Pl.: 680. 1753, [*Erodium*].
Geranium guttatum Desf., Fl. Atlant. 2: 113, tab. 169. 1798, [*Erodium*].
Geranium hastatum Andrews, Geraniums 2, [pl. 23]. 1805, [*Pelargonium*].
Geranium hederifolium Dum. Cours., Bot. Cult. 5: 374. 1805, [*Pelargonium*].
Geranium hederinum Andrews, Geraniums 1, [pl. 38]. 1805, [*Pelargonium*].

Geranium hederinum var. *zonales* Andrews, Geraniums 2, [pl. 25]. 1805, [*Pelargonium*].
Geranium heliotropioides Cav., Diss. 4: 220, tab. 113 fig. 2. 1787, [*Monsonia*].
Geranium hepaticaiefolium Dum. Cours., Bot. Cult. 5: 375. 1805, [*Pelargonium*].
Geranium hepaticifolium Andrews, Geraniums 2, [pl. 26]. 1805, [*Pelargonium*].
Geranium hermanniaefolium P.J. Bergius, Descr. Pl. Cap.: 177. 1767, [*Pelargonium*].
Geranium hermannioides Burm. f., Fl. Indica: 19. 1768, [*Pelargonium*].
Geranium heterogamum (L'Hér.) Dum. Cours., Bot. Cult. 3: 19. 1802, [*Pelargonium*].
Geranium heterophyllum (Jacq.) Poir. in Lam., Encycl. Suppl. 2: 746. 1812, [*Pelargonium*].
Geranium heterophyllum Andrews, Geraniums 2, [pl. 27]. 1805, [*Pelargonium*].
Geranium heterophyllum Thunb., Prodr. Fl. Cap.: 113. 1800, [*Pelargonium*].
Geranium hirsutum Burm. f., Spec. Bot. Geran.: 50, tab. 2 fig. 68. 1759, [*Pelargonium*].
Geranium hirtum Burm. f., Spec. Bot. Geran.: 48, tab. 1 fig. 64. 1759, [*Pelargonium*].
Geranium hirtum Forssk., Fl. Aegypt.-Arab.: 123. 1775, [*Erodium*].
Geranium hispidum L. f., Suppl. Pl.: 304. 1782, [*Pelargonium*].
Geranium hybridum Cav. ex R. Knuth in Engl., Pflanzenr. IV.129 (Heft 53): 490. 1912, [*Pelargonium*], nom. nud., pro syn.
Geranium hybridum L., Mant. Pl.: 97. 1767, [*Pelargonium*].
Geranium hymenodes Andrews, Bot. Repos. 6, pl. 413. 1804, [*Erodium*].
Geranium ignescens Andrews, Geraniums 1, [pl. 30]. 1798, [*Pelargonium*].
Geranium ignescens var. *humile* Andrews, Geraniums 2, [pl. 28]. 1805, [*Pelargonium*].
Geranium ignescens var. *major* Andrews, Geraniums 1, [pl. 31]; 2, [pl. 28]. 1805, [*Pelargonium*].
Geranium ignescens var. *tuberosum* Andrews, Geraniums 2, [pl. 29]. 1805, [*Pelargonium*].
Geranium incarnatum L., Syst. Nat. ed. 10 2: 1142. 1759, [*Erodium*].
Geranium incisum Andrews, Bot. Repos. 1, pl. 67. 1799, [*Pelargonium*].
Geranium incisum Dum. Cours., Bot. Cult. 3: 28. 1802, [*Pelargonium*].
Geranium incrassatum Andrews, Bot. Repos. 4, pl. 246. 1802, [*Pelargonium*].
Geranium inodorum (Willd.) Dum. Cours., Bot. Cult. 5: 381. 1805, [*Pelargonium*].
Geranium inodorum (Willd.) Poir. in Lam., Encycl. Suppl. 2: 752. 1812, [*Pelargonium*].
Geranium inquinans L., Sp. Pl.: 676. 1753, [*Pelargonium*].
Geranium inquinans var. *roseum* Dum. Cours., Bot. Cult. ed. 2, 5: 16. 1811, [*Pelargonium*].
Geranium irbyanum Andrews, Geraniums 1, [pl. 16]. 1805, [*Pelargonium*].
Geranium lacerum (Jacq.) Dum. Cours., Bot. Cult. ed. 2, 5: 12. 1811, [*Pelargonium*].
Geranium lacerum Andrews, Geraniums 2, [pl. 32]. 1805, [*Pelargonium*].
Geranium lacerum var. *minor* Andrews, Geraniums 2, [pl. 32]. 1805, [*Pelargonium*].
Geranium laciniatum Andrews, Bot. Repos. 2, pl. 131. 1801, [*Pelargonium*].
Geranium laciniatum Cav., Diss. 4: 228 tab. 113 fig. 3. 1787, [*Erodium*].
Geranium laciniatum var. *bicolor* Andrews, Bot. Repos. 4, pl. 269. 1802, [*Pelargonium*].
Geranium laciniatum var. *flore-purpureo* Andrews, Bot. Repos. 3, pl. 204. 1802, [*Pelargonium*].
Geranium laevigatum L. f., Suppl. Pl.: 306. 1782, [*Pelargonium*].
Geranium lanatum Thunb., Prodr. Pl. Cap.: 114. 1800, [*Pelargonium*].
Geranium lanceolatum Cav., Diss. 3: [186]. 1787, [*Pelargonium*], nom. nud.
Geranium lanceolatum Cav., Diss. 4: 235, tab. 102 fig. 2. 1787, [*Pelargonium*].
Geranium lateripes (L'Hér.) Dum. Cours., Bot. Cult. 3: 24. 1802, [*Pelargonium*].
Geranium lawianum Nimmo in J. Graham, Cat. Pl. Bombay: [last page]. 1839, [*Monsonia*].
Geranium lineare Andrews, Bot. Repos. 3, pl. 193. 1801, [*Pelargonium*].
Geranium lineatum Dum. Cours., Bot. Cult. ed. 2, 5: 18. 1811, [*Pelargonium*].
Geranium littoreum (DC.) Poir. in Lam., Encycl. Suppl. 2: 744. 1812, [*Erodium*].
Geranium littoreum Cav., Diss. 4: 222. 1787, [*Erodium*].
Geranium lobatum Burm. f., Spec. Bot. Geran.: 44. 1759, [*Pelargonium*].
Geranium lobatum L., Sp. Pl. ed. 2: 950. 1763, [*Pelargonium*].
Geranium lobatum var. *hirsutum* (Burm. f.) L., Sp. Pl. ed. 2: 950. 1763, [*Pelargonium*].
Geranium lobatum var. *pinnatifidum* (Burm. f.) L., Sp. Pl. ed. 2: 950. 1763, [*Pelargonium*].
Geranium longicaule Thunb., Prodr. Pl. Cap.: 116. 1800, [*Pelargonium*].
Geranium longiflorum (Jacq.) Poir. in Lam., Encycl. Suppl. 2: 745. 1812, [*Pelargonium*].
Geranium longiflorum var. *depressum* (Jacq.) Poir. in Lam., Encycl. Suppl. 2: 744. 1812, [*Pelargonium*].
Geranium longifolium Burm. f., Spec. Bot. Geran.: 50, tab. 2, fig. 67. 1759, [*Pelargonium*].
Geranium lupinoides Burm. f., Spec. Bot. Geran.: 48. 1759, [*Pelargonium*].
Geranium luridum Andrews, Geraniums 2, [pl. 34]. 1805, [*Pelargonium*].
Geranium luteum Andrews, Bot. Repos. 6, pl. 423. 1805, [*Pelargonium*].
Geranium macradenum Lapeyr. ex R. Knuth in Engl., Pflanzenr. IV.129 (Heft 53): 269. 1912, [*Erodium*], nom. nud., pro syn.
Geranium macrocarpos Cav., Diss. 3: 186. 1787, [*Erodium*].
Geranium maculatum Andrews, Geraniums 2, [pl. 33]. 1805, [*Pelargonium*].
Geranium maculatum Dum. Cours., Bot. Cult. 5: 377. 1805, [*Pelargonium*].
Geranium malachoides G. Don, Gen. Hist. 1: 724. 1831, [*Erodium*], nom. nud., pro syn.
Geranium malacoides L., Sp. Pl.: 680. 1753, [*Erodium*].
Geranium malacoides var. *rubens* Weston, Bot. Univ. 2: 349. 1771, [*Erodium*].
Geranium malopoides Desf., Fl. Atlant. 2: 112. 1798, [*Erodium*].
Geranium marginatum Cav., Diss. 4: 230. 1787, [*Pelargonium*].
Geranium marginatum Cav., Diss. 3: [186]. 1787, [*Pelargonium*], nom. nud.
Geranium maritimum Burm. f., Spec. Bot. Geran.: 46. 1759, [*Erodium*].
Geranium maritimum L., Syst. Nat. ed. 10 2: 1143. 1759, [*Erodium*].
Geranium maritimum Ucria, Hort. Panhorm.: 287. 1789, [*Erodium*].
Geranium melananthon (Jacq.) Dum. Cours., Bot. Cult. 5: 385. 1805, [*Pelargonium*].
Geranium melananthum Andrews, Bot. Repos. 3, pl. 209. 1802, [*Pelargonium*].
Geranium melissimum Andrews, Geraniums 2, [pl. 42]. 1805, [*Pelargonium*].
Geranium menthaeodorum Nocca, Ticin. Hort. Pl.: 12, tab. 6. 1800, [*Pelargonium*].
Geranium miniatum Andrews, Geraniums 2, [pl. 36]. 1805, [*Pelargonium*].
Geranium miniatum var. *album* Andrews, Geraniums 2, [pl. 36]. 1805, [*Pelargonium*].
Geranium minimum Cav., Diss. 4: 260, tab. 121 fig. 3. 1787, [*Pelargonium*].
Geranium minimum var. *chamaedryoides* Boccone ex R. Knuth in Engl., Pflanzenr. IV.129 (Heft 53): 251. 1912, [*Erodium*], nom. nud., pro syn.
Geranium modestum Dum. Cours., Bot. Cult. ed. 2, 5: 29. 1811, [*Pelargonium*].
Geranium monsonia Thunb., Prodr. Pl. Cap.: 112. 1800, [*Monsonia*].
Geranium monstrum (L'Hér.) Dum. Cours., Bot. Cult. 3: 19. 1802, [*Pelargonium*].
Geranium moschatum (L.) Burm. f., Spec. Bot. Geran.: 29. 1759, [*Erodium*].
Geranium moschatum (L.) L., Syst. Nat. ed. 10 2: 1143. 1759, [*Erodium*].
Geranium moschatum Andrews, Geraniums 2, [pl. 37]. 1805, [*Pelargonium*].
Geranium moschatum var. *pimpinellifolium* Weston, Bot. Univ. 2: 349. 1771, [*Erodium*].
Geranium mucronatum Dum. Cours., Bot. Cult. 5: 377. 1805, [*Pelargonium*].
Geranium multicaule (Jacq.) Poir. in Lam., Encycl. Suppl. 2: 749. 1812, [*Pelargonium*].
Geranium multifidum Andrews, Geraniums 1, [pl. 52]. 1805, [*Pelargonium*].
Geranium multifidum Jacq. ex Steud., Nomencl. Bot. ed. 2, 1: 678. 1840, [*Pelargonium*], nom. nud.
Geranium multifidum Patrin ex DC., Prodr. 1: 645. 1824, [*Erodium*], nom. nud., pro syn.

Geranium murcicum Cav., Diss. 5: 272, tab. 126 fig. 1. 1788, [*Erodium*].
Geranium murrayanum R. Knuth in Engl., Pflanzenr. IV.129 (Heft 53): 515. 1912, [*Pelargonium*], nom. nud., pro syn.
Geranium myrrhifolium L., Sp. Pl.: 677. 1753, [*Pelargonium*].
Geranium myrrhifolium Thunb., Fl. Cap. ed. 2: 531. 1823, [*Pelargonium*].
Geranium myrrhifolium var. *betonicum* (Burm. f.) P.J. Bergius, Descr. Pl. Cap.: 179. 1767, [*Pelargonium*].
Geranium myrrhifolium var. *dissectum* P.J. Bergius, Descr. Pl. Cap.: 180. 1767, [*Pelargonium*].
Geranium myrrhifolium var. *incarnatum* Burm. f., Spec. Bot. Geran.: 45. 1759, [*Pelargonium*].
Geranium myrrhifolium var. *rapaceum* Burm. f., Spec. Bot. Geran.: 45. 1759, [*Pelargonium*].
Geranium myrrhifolium var. *striatum* Weston, Bot. Univ. 2: 347. 1771, [*Pelargonium*].
Geranium nervifolium (Jacq.) Poir. in Lam., Encycl. Suppl. 2: 747. 1812, [*Pelargonium*].
Geranium nobile F. Dietr. ex Walp., Repert. Bot. Syst. 1: 458. 1842, [*Pelargonium*], nom. nud., pro syn.
Geranium notatum Andrews, Geraniums 2, [pl. 38]. 1805, [*Pelargonium*].
Geranium nothum (Willd.) Poir. in Lam., Encycl. Suppl. 2: 758. 1812, [*Pelargonium*].
Geranium numidicum Poir., Voy. Barbarie 2: 201. 1789, [*Erodium*].
Geranium numidicum Salzm. ex R. Knuth in Engl., Pflanzenr. IV.129 (Heft 53): 587. 1912, [*Erodium*], nom. nud.
Geranium obtusilobum (Willd.) Poir. in Lam., Encycl. Suppl. 2: 759. 1812, [*Pelargonium*].
Geranium odoratissimum L., Sp. Pl.: 679. 1753, [*Pelargonium*].
Geranium odoratissimum var. *erectum* Andrews, Geraniums 1, [pl. 58]. 1805, [*Pelargonium*].
Geranium odoratum Burm. f., Spec. Bot. Geran.: 37. 1759, [*Pelargonium*].
Geranium odoratum Thunb., Prodr. Fl. Cap.: 114. 1800, [*Pelargonium*].
Geranium odoriferum G. Don, Gen. Hist. 1: 739. 1831, [*Pelargonium*].
Geranium oenotherae L. f., Suppl. Pl.: 305. 1782, [*Pelargonium*].
Geranium ovale Burm. f., Fl. Indica: 19. 1768, [*Pelargonium*].
Geranium ovatum Cav., Diss. 4: 238, tab. 103 fig. 3. 1787, [*Pelargonium*].
Geranium ovatum Cav., Diss. 3: [186]. 1787, [*Pelargonium*], nom. nud.
Geranium oxalidifolium Andrews, Bot. Repos. 5, pl. 300. 1803, [*Pelargonium*].
Geranium oxaloides Burm. f., Spec. Bot. Geran.: 51, tab. 2, fig. 71. 1759, [*Pelargonium*].
Geranium oxoniense Andrews, Geraniums 1, [pl. 43]. 1805, [*Pelargonium*].
Geranium oxoniense Dum. Cours., Bot. Cult. 5: 378. 1805, [*Pelargonium*].
Geranium oxyrhinchum (M. Bieb.) Poir. in Lam., Encycl. Suppl. 2: 743. 1812, [*Erodium*].
Geranium pallens Andrews, Geraniums 2, [pl. 41]. 1805, [*Pelargonium*].
Geranium pallidum (Willd.) Poir. in Lam., Encycl. Suppl. 2: 759. 1812, [*Pelargonium*].
Geranium papilionaceum L., Sp. Pl.: 676. 1753, [*Pelargonium*].
Geranium parviflorum Andrews, Geraniums 2, [pl. 43]. 1805, [*Pelargonium*].
Geranium parvulum Scop., Delic. Fl. Faun. Insubr. 1: 8 tab. 3 fig. B. 1786, [*Erodium*].
Geranium pastinacaefolium Mill., Gard. Dict. ed. 8 n.° 37. 1768, [*Pelargonium*].
Geranium pavoninum Andrews, Geraniums 2, [pl. 45]. 1805, [*Pelargonium*].
Geranium peltatum L., Sp. Pl.: 678. 1753, [*Pelargonium*].
Geranium penicillatum (Willd.) Poir. in Lam., Encycl. Suppl. 2: 758. 1812, [*Pelargonium*].
Geranium penniforme (Pers.) Dum. Cours., Bot. Cult. ed. 2, 5: 47. 1811, [*Pelargonium*].
Geranium pentandrum Gilib., Fl. Lit. Inch. 2: 178. 1782, [*Erodium*], nom. inval., suppressed work (art. 34.1)
Geranium pepperatum Dum. Cours., Bot. Cult. 5: 372. 1805, [*Pelargonium*], nom. nud., pro syn.
Geranium petraeum Gouan, Ill. Observ. Bot.: 45, tab. 21 fig. 1. 1773, [*Erodium*].
Geranium petroselinum L'Hér. ex Webb & Berthel., Hist. Nat. Iles Canaries 3(1): 22. 1835, [*Erodium*], nom. nud., pro syn.
Geranium pictum Andrews, Bot. Repos. 3, pl. 168. 1801, [*Pelargonium*].
Geranium pigmaeum Dum. Cours., Bot. Cult. ed. 2, 5: 35. 1811, [*Pelargonium*].
Geranium pilosum Andrews, Bot. Repos. 4, pl. 259. 1802, [*Pelargonium*].
Geranium pilosum Cav., Diss. 5: 273, 6: 352, tab. 199. 1788, [*Pelargonium*].
Geranium pilosum Thuill., Fl. Env. Paris ed. 2: 346. 1799, [*Erodium*].
Geranium pimpinellaefolium Moench, Methodus: 282. 1794, [*Erodium*].
Geranium pimpinellifolium Cav. ex R. Knuth in Engl., Pflanzenr. IV.129 (Heft 53): 279. 1912, [*Erodium*], nom. nud., pro syn.
Geranium pimpinellifolium With., Bot. Arr. Brit. Pl. ed. 2, 2: 724. 1787, [*Erodium*].
Geranium pingue Thunb., Prodr. Pl. Cap.: 116. 1800, [*Pelargonium*].
Geranium pinnatifidum Burm. f., Spec. Bot. Geran.: 50, tab. 2 fig. 69. 1759, [*Pelargonium*].
Geranium pinnatifidum Moench, Methodus: 282. 1794, [*Erodium*].
Geranium pinnatifidum Murray ex Steud., Nomencl. Bot. ed. 2, 1: 679. 1840, [*Pelargonium*], nom. nud.
Geranium pinnatum Andrews, Bot. Repos. 5, pl. 311. 1803, [*Pelargonium*].
Geranium pinnatum Cav., Diss. 4: 257, tab. 115 fig. 2. 1787, [*Pelargonium*].
Geranium pinnatum L., Sp. Pl.: 677. 1753, [*Pelargonium*].
Geranium plicatum Thunb., Prodr. Pl. Cap.: 116. 1800, [*Pelargonium*].
Geranium praecox Cav., Diss. 5: 272, tab. 126 fig. 2. 1788, [*Erodium*].
Geranium praemorsum Andrews, Bot. Repos. 3, pl. 150. 1801, [*Pelargonium*].
Geranium procumbens Andrews, Bot. Repos. 4, pl. 254. 1802, [*Pelargonium*].
Geranium proliferum Burm. f., Spec. Bot. Geran.: 51, tab. 2 fig. 70. 1759, [*Pelargonium*].
Geranium prolificum L., Sp. Pl. ed. 2: 949. 1763, [*Pelargonium*].
Geranium prolificum var. *auritum* (L.) L., Sp. Pl. ed. 2: 950. 1763, [*Pelargonium*].
Geranium prolificum var. *longifolium* (Burm. f.) L., Sp. Pl. ed. 2: 950. 1763, [*Pelargonium*].
Geranium prolificum var. *oxaloides* (Burm. f.) L., Sp. Pl. ed. 2: 950. 1763, [*Pelargonium*].
Geranium prolificum var. *pinnatum* (L.) L., Sp. Pl. ed. 2: 949. 1763, [*Pelargonium*].
Geranium prolificum var. *proliferum* (Burm. f.) L., Sp. Pl. ed. 2: 949. 1763, [*Pelargonium*].
Geranium pseudomolle Pant., Adnot. Fl. Faun. Herceg.: 121. 1874, ["pseudo-molle"], described by Pantocsek (1874: 121) as *Geum* L., as informed Knuth (1912: 221).
Geranium pubescens Andrews, Geraniums 1, [pl. 46]. 1805, [*Pelargonium*].
Geranium pubescens Thunb., Prodr. Pl. Cap.: 113. 1800, [*Pelargonium*].
Geranium pulchellum (Sims) Poir. in Lam., Encycl. Suppl. 2: 758. 1812, [*Pelargonium*].
Geranium pulchellum Nois. ex Steud., Nom. 1: 365. 1821, [*Pelargonium*].
Geranium pulverulentum Cav., Diss. 5: 272, tab. 125 fig. 1. 1788, [*Erodium*].
Geranium pulverulentum Desf., Fl. Atlant. 2: 111. 1798, [*Erodium*].
Geranium pumilum (Willd.) Poir. in Lam., Encycl. Suppl. 2: 751. 1812, [*Pelargonium*].
Geranium punctatum Andrews, Bot. Repos. 1, pl. 60. 1799, [*Pelargonium*].
Geranium punctatum Cav. ex Steud., Nomencl. Bot. 1: 314, 365. 1821, [*Erodium*], nom. nud.
Geranium pungens Poir. in Lam., Encycl. Suppl. 2: 759. 1812, [*Sarcocaulon*].
Geranium purpurascens (Pers.) Poir. in Lam., Encycl. Suppl. 2: 757. 1812, [*Pelargonium*].
Geranium purpureum Andrews, Geraniums 1, [pl. 55]. 1805, [*Pelargonium*].
Geranium quercifolium Andrews, Geraniums 1, [pl. 47]. 1805, [*Pelargonium*].
Geranium quercifolium L. f., Suppl. Pl.: 306. 1782, [*Pelargonium*].

Geranium quinatum (Sims) Poir. in Lam., Encycl. Suppl. 2: 758. 1812, [*Pelargonium*].
Geranium quinquelobum Lam., Encycl. 2: 671. 1788, [*Pelargonium*].
Geranium quinquevulnerum Andrews, Bot. Repos. 2, pl. 114. 1800, [*Pelargonium*].
Geranium radiatum Andrews, Bot. Repos. 4, pl. 222. 1802, [*Pelargonium*].
Geranium radicatum Lapeyr., Fig. Pl. Pyrénées 1: 1, tab. 1. 1795-1801, [*Erodium*].
Geranium radicatum Vent. ex Dum. Cours., Bot. Cult. ed. 2, 5: 46. 1811, [*Pelargonium*], nom. nud., pro syn.
Geranium radicatum var. *tomentosum* Lapeyr., Fig. Pl. Pyrénées 1: 1. 1795-1801, [*Erodium*].
Geranium radicatum var. *villosum* Lapeyr., Fig. Pl. Pyrénées 1: 1. 1795-1801, [*Erodium*].
Geranium radula Cav., Diss. 4: 262, tab. 101 fig. 1. 1787, [*Pelargonium*].
Geranium radula Cav., Diss. 3: [186]. 1787, [*Pelargonium*], nom. nud.
Geranium radula Roth, Bot. Abh. Beobacht.: 51, tab. 10. 1787, [*Pelargonium*].
Geranium ramosissimum Burm. ex Cav., Diss. 4: 260. 1787, [*Pelargonium*].
Geranium ranunculoides Burm. f., Spec. Bot. Geran.: 17. 1759, [*Pelargonium*].
Geranium rapaceum L., Syst. Nat. ed. 10 2: 1141. 1759, [*Pelargonium*].
Geranium rapaceum var. *purpureum* Weston, Bot. Univ. 2: 356. 1771, [*Pelargonium*].
Geranium reflexum Andrews, Bot. Repos. 4, pl. 224. 1802, [*Pelargonium*].
Geranium refulgens Andrews, Geraniums 2, [pl. 46]. 1805, [*Pelargonium*].
Geranium reichardii Murray, Commentat. Soc. Regiae Sci. Gott. 3: 11, tab. 3. 1780, [*Erodium*].
Geranium reniforme Andrews, Bot. Repos. 2, pl. 108. 1800, [*Pelargonium*].
Geranium reniforme var. *cortusoides* Colville in Andrews, Geraniums 2, [pl. 10]. 1805, [*Pelargonium*].
Geranium reticulatum Nocca, Ticin. Hort. Pl.: 9, tab. 5. 1800, [*Pelargonium*].
Geranium revolutum Andrews, Bot. Repos. 5, pl. 354. 1804, [*Pelargonium*].
Geranium revolutum Jacq., Icon. Pl. Rar. 1: 13, tab. 133. 1783?, [*Pelargonium*].
Geranium ribifolium (Jacq.) Poir. in Lam., Encycl. Suppl. 2: 754. 1812, [*Pelargonium*].
Geranium ribifolium Dum. Cours., Bot. Cult. ed. 2, 5: 19. 1811, [*Pelargonium*].
Geranium rigidum (Willd.) Dum. Cours., Bot. Cult. 3: 23. 1802, [*Pelargonium*].
Geranium rigidum (Willd.) Poir. in Lam., Encycl. Suppl. 2: 755. 1812, [*Pelargonium*].
Geranium romanum Burm. f., Spec. Bot. Geran.: 30. 1759, [*Erodium*].
Geranium rosa DC., Prodr. 1: 674. 1824, [*Pelargonium*], nom. nud., pro syn.
Geranium roseum Andrews, Bot. Repos. 3, pl. 173. 1801, [*Pelargonium*].
Geranium rubens Andrews, Geraniums 2, [pl. 47]. 1805, [*Pelargonium*].
Geranium rubens Thunb., Prodr. Pl. Cap.: 113. 1800, [*Pelargonium*].
Geranium rubescens Andrews, Geraniums 2, [pl. 46]. 1805, [*Pelargonium*].
Geranium rugosum Andrews, Geraniums 2, [pl. 48]. 1805, [*Pelargonium*].
Geranium rupestre Pourr. ex Cav., Diss. 4: 225, tab. 110 fig. 3. 1787, [*Erodium*].
Geranium saxatile Cav., Icon. 2: 38 (1793); 67. 1793-94, [*Erodium*], nom. nud.
Geranium scabrum L., Amoen. Acad. 4: 281. 1759, [*Pelargonium*].
Geranium scandens (Ehrh.) Dum. Cours., Bot. Cult. 5: 386. 1805, [*Pelargonium*].
Geranium scandens (Ehrh.) Poir. in Lam., Encycl. Suppl. 2: 750. 1812, [*Pelargonium*].
Geranium selinum Andrews, Bot. Repos. 4, pl. 239. 1802, [*Pelargonium*].
Geranium selinum var. *flavum* Andrews, Geraniums 2, [pl. 49]. 1805, [*Pelargonium*].
Geranium semitrilobum (Jacq.) Poir. in Lam., Encycl. Suppl. 2: 755. 1812, [*Pelargonium*].
Geranium senecioides (L'Hér.) Dum. Cours., Bot. Cult. 3: 26. 1802, [*Pelargonium*].
Geranium serratum Thunb., Prodr. Pl. Cap.: 113. 1800, [*Pelargonium*].
Geranium setosum Thunb., Fl. Cap. ed. 2: 517. 1823, [*Pelargonium*].
Geranium sidaefolium Thunb., Prodr. Fl. Cap.: 114. 1800, [*Pelargonium*].
Geranium spathulatum Andrews, Bot. Repos. 3, pl. 152. 1801, [*Pelargonium*].
Geranium spathulatum var. *affine* (Pers.) Poir. in Lam., Encycl. Suppl. 2: 757. 1812, [*Pelargonium*].
Geranium spathulatum var. *curviflorum* Andrews, Bot. Repos. 4, pl. 282. 1803, [*Pelargonium*].
Geranium speciosum (L.) Thunb., Prodr. Pl. Cap.: 112. 1800, [*Monsonia*].
Geranium speciosum Andrews, Geraniums 2, [pl. 50]. 1805, [*Pelargonium*].
Geranium speciosum Dum. Cours., Bot. Cult. 5: 378. 1805, [*Pelargonium*].
Geranium speciosum L. ex Steud., Nomencl. Bot. 1: 365, 537. 1821, [*Erodium*], nom. nud.
Geranium spinosum (Willd.) Dum. Cours., Bot. Cult. ed. 2, 5: 36. 1811, [*Sarcocaulon*].
Geranium spinosum Burm. f., Spec. Geran.: 16. 1759, [*Sarcocaulon*].
Geranium splendens (Willd.) Poir. in Lam., Encycl. Suppl. 2: 789. 1812, [*Pelargonium*].
Geranium spurium (Willd.) Poir. in Lam., Encycl. Suppl. 2: 758. 1812, [*Pelargonium*].
Geranium spurium Christm., Vollst. Pflanzensyst. 4: [38], 124. 1779, [*Pelargonium*].
Geranium squarrosum Dum. Cours., Bot. Cult. 5: 379. 1805, [*Pelargonium*].
Geranium stenopetalum (Ehrh.) Poir. in Lam., Encycl. Suppl. 2: 750. 1812, [*Pelargonium*].
Geranium stenopetalum Andrews, Geraniums 2, [pl. 52]. 1805, [*Pelargonium*].
Geranium stenopetalum Dum. Cours., Bot. Cult. ed. 2, 5: 19. 1811, [*Pelargonium*], nom. nud., pro syn.
Geranium stephanianum (Willd.) Poir. in Lam., Encycl. Suppl. 2: 741. 1812, [*Erodium*].
Geranium steveni (M. Bieb.) Poir. in Lam., Encycl. Suppl. 2: 742. 1812, [*Erodium*].
Geranium stipulaceum L. f., Suppl. Pl.: 306. 1782, [*Pelargonium*].
Geranium stockeri Murr, Neu. Übers. Bl.-Pfl. Vorarlberg: 188. 1923, [*Pelargonium*].
Geranium strigosum Burm. f., Fl. Indica: 19. 1768, [*Pelargonium*].
Geranium suaveolens (Desf.) Poir. in Lam., Encycl. Suppl. 2: 747. 1812, [*Pelargonium*].
Geranium suaveolens Andrews, Geraniums 1, [pl. 59]. 1805, [*Pelargonium*].
Geranium superbum Andrews, Geraniums 2, [pl. 51]. 1805, [*Pelargonium*], nom. nud.
Geranium tabulare Burm. f., Spec. Bot. Geran.: 36, tab. 1 fig. 44. 1759, [*Pelargonium*].
Geranium tabulare Burm. f. ex L., Sp. Pl. ed. 2: 947. 1763, [*Pelargonium*].
Geranium tataricum (Willd.) Poir. in Lam., Encycl. Suppl. 2: 741. 1812, [*Erodium*].
Geranium tectum Thunb., Prodr. Fl. Cap.: 116. 1800, [*Pelargonium*].
Geranium tenellum Andrews, Geraniums 2, [pl. 53]. 1805, [*Pelargonium*].
Geranium tenellum var. *flavum* Andrews, Geraniums 2, [pl. 54]. 1805, [*Pelargonium*].
Geranium tenuifolium (L'Hér.) Dum. Cours., Bot. Cult. 3: 27. 1802, [*Pelargonium*].
Geranium terebinthinaceum Cav., Diss. 4: 250, tab. 114 fig. 1. 1787, [*Pelargonium*].
Geranium terebinthinaceum Cav., Diss. 3: [186]. 1787, [*Pelargonium*], nom. nud.
Geranium terebinthinaceum Murray, Commentat. Soc. Regiae Sci. Gott. 7: 88, tab. 4. 1786, [*Pelargonium*].
Geranium ternatum L. f., Suppl. Pl.: 306. 1782, [*Pelargonium*].
Geranium ternatum var. *laxum* (Willd.) Poir. in Lam., Encycl. Suppl. 2: 740. 1812, [*Pelargonium*].
Geranium ternatum var. *strictum* (Willd.) Poir. in Lam., Encycl. Suppl. 2: 740. 1812, [*Pelargonium*].
Geranium tetragonum L. f., Suppl. Pl.: 305. 1782, [*Pelargonium*].
Geranium tomentosum Andrews, Bot. Repos. 2, pl. 115. 1800, [*Pelargonium*].
Geranium tomentosum Thunb., Prodr. Pl. Cap.: 116. 1800, [*Pelargonium*].
Geranium tordylioides Desf., Fl. Atlant. 2: 107. 1798, [*Erodium*].
Geranium tottum Thunb., Prodr. Pl. Cap.: 115. 1800, [*Pelargonium*].

Geranium triangulare Forssk., Fl. Aegypt.-Arab.: 123. 1775, [*Erodium*].
Geranium trichostomum (Jacq.) Poir. in Lam., Encycl. Suppl. 2: 759. 1812, [*Pelargonium*].
Geranium tricolor Andrews, Geraniums 1, [pl. 60]. 1805, [*Pelargonium*].
Geranium tricolor Dum. Cours., Bot. Cult. 3: 24. 1802, [*Pelargonium*].
Geranium tricolor J. Kern., Hortus Sempervirens, tab. 11. 1795-1830, [*Pelargonium*].
Geranium tricolor var. *arborea* Andrews, Geraniums 1, [pl. 61]. 1805, [*Pelargonium*].
Geranium tricolor var. *ovalifolium* Andrews, Geraniums 1, [pl. 62]. 1805, [*Pelargonium*].
Geranium tricuspidatum Andrews, Geraniums 2, [pl. 55]. 1805, [*Pelargonium*].
Geranium tricuspidatum Lam., Encycl. 2: 671. 1788, [*Pelargonium*].
Geranium trifidum Burm. f., Spec. Bot. Geran.: 52. 1759, [*Pelargonium*].
Geranium trifoliatum Andrews, Geraniums 2, [pl. 56]. 1805, [*Pelargonium*].
Geranium trifolium Cav., Diss. 3: [186]. 1787, [*Erodium*], nom. nud.
Geranium trifolium Cav., Diss. 4: 223, tab. 97 fig. 3. 1787, [*Erodium*].
Geranium trigonum Scop., Delic. Fl. Faun. Insubr. 1: 12, tab. 5. 1786, [*Pelargonium*].
Geranium trilobatum (Jacq.) Steud., Nomencl. Bot. ed. 2, 1: 680. 1840, [*Erodium*].
Geranium trilobum Dum. Cours., Bot. Cult. 3: 12. 1802, [*Erodium*].
Geranium trilobum Thunb., Prodr. Pl. Cap.: 114. 1800, [*Pelargonium*].
Geranium triphyllum (Jacq.) Poir. in Lam., Encycl. Suppl. 2: 747. 1812, [*Pelargonium*].
Geranium triste Cav., Diss. 4: 261, tab. 107 fig. 1. 1787, [*Pelargonium*].
Geranium triste L., Sp. Pl.: 676. 1753, [*Pelargonium*].
Geranium undulatum Andrews, Bot. Repos. 5, pl. 292. 1803, [*Pelargonium*].
Geranium undulatum var. *minor* Andrews, Bot. Repos. 5, pl. 317. 1803, [*Pelargonium*].
Geranium uniflorum Pacho, Voy. Marmarique Cyrén. pl. 96. 1827, [*Erodium*].
Geranium variegatum L. f., Suppl. Pl.: 305. 1782, [*Pelargonium*].
Geranium venustum Andrews, Geraniums 2, [pl. 57]. 1805, [*Pelargonium*].
Geranium verbascifolium Andrews, Geraniums 2, [pl. 58]. 1805, [*Pelargonium*].
Geranium verbascifolium Steud., Nomencl. Bot. ed. 2, 1: 680. 1840, [*Pelargonium*].
Geranium villosum Andrews, Geraniums 2, [pl. 59]. 1805, [*Pelargonium*].
Geranium villosum J.F. Gmel., Syst. Nat. 2(2): 1025. 1792, [*Pelargonium*].
Geranium villosum Mill., Gard. Dict. ed. 8 n.° 38. 1768, [*Pelargonium*].
Geranium villosum Thunb., Prodr. Pl. Cap.: 116. 1800, [*Pelargonium*].
Geranium villosum var. *frutescens* Thunb., Fl. Cap. ed. 2: 528. 1823, [*Pelargonium*].
Geranium villosum var. *hirtum* (Burm. f.) Thunb., Fl. Cap. ed. 2: 528. 1823, [*Pelargonium*].
Geranium villosum var. *villosum* J.F. Gmel., Syst. Nat. 2(2): 1025. 1792, [*Pelargonium*].
Geranium violarium (Jacq.) Dum. Cours., Bot. Cult. ed. 2, 5: 35. 1811, [*Pelargonium*].
Geranium virgineum Poir. in Lam., Encycl. Suppl. 2: 757. 1812, [*Pelargonium*].
Geranium viscosum Cav., Diss. 3: [186]. 1787, [*Pelargonium*], nom. nud.
Geranium viscosum Cav., Diss. 4: 246, tab. 108 fig. 2. 1787, [*Pelargonium*].
Geranium viscosum Mill., Gard. Dict. ed. 8 n.° 20. 1768, [*Erodium*].
Geranium viscosum Scop., Delic. Fl. Faun. Insubr. 2: 27, tab. 14. 1787, [*Pelargonium*].
Geranium vitifolium L., Sp. Pl.: 678. 1753, [*Pelargonium*].
Geranium vitifolium var. *ribesioides* Burm. f., Spec. Bot. Geran.: 34. 1759, [*Pelargonium*].
Geranium zonale L., Sp. Pl.: 678. 1753, [*Pelargonium*].
Geranium zonale var. *marginatum* (Cav.) Dum. Cours., Bot. Cult. ed. 2, 5: 17. 1811, [*Pelargonium*].
Geranium zonale var. *minima* Andrews, Geraniums 2, [pl. 60]. 1805, [*Pelargonium*].

INDEX TO NUMBERED COLLECTIONS EXAMINED

The numbers in parentheses refer to the corresponding names in the text and in the Conspectus of Classification (p. 39-40). Mixed collections are indicated by a slash (e.g., 81/91).

Fuentes, A. & al. 9761 (118), 9850 (118), 11970 (118), 12021 (165b), 12530 (118), 12665 (118).
Fuertes, J. & Aguirre, J. 6 (165c).
Fujita, N. & Miki, E. 141 (55).
Fukuoka, N. 236 (62), 4991 (58), 6318 (69).
Fukuoka, N. & Kurosaki, N. 2012 (61).
Fukuoka, N. & Wakabayashi, M. 1012 (300).
Funck, N. & Schlim, L.J. 861 (207), 1127 (215), 1128 (220), 1251 (214).
Funk, E. 6 (228), 8A (230), 9 (228), 10A (228), 12A (229d), 14A (228), 18 (227), 203 (228), 206 (230), 215 (227).
Funk, E. & al. 204 (227).
Funk, V.A. 374 (134), 498 (120).
Funston, F. 100 (31).
Furlong, C.W. 89c (109), 91 (118), 92a (106), 92b (106), 92c (106).
Furness, H.D. & Phillipson, P.B. 70 (245), 54 (239), 228 (239).
Furse, P. 1079 (277), 1087 (63), 1577 (259a), 1649 (261), 1892 (281), 1933 (258), 2021 (265), 2470 (280), 2521 (87), 2767 (279a), 2979 (280), 3913 (279a), 3931 (18), 5669 (259b), 6230 (281), 6601 (259b), 7117 (277), 7165 (259a).
Furuse, M. 6281 (62), 19954 (68), 20092 (55), 21348 (58), 28078 (55), 28332 (58), 29772 (59), 29773 (58), 33192 (59), 33210 (58), 39223 (58), 39484 (68), 44153 (55), 45857 (58), 48211 (55).
Furze, P. 1649 (261).
G.C.M. 30 (31).
Gaarder, G. 18 (298), 1306 (298), 1340 (298).
Gabriel, A. 85 (286), 120 (286), 127 (282).
Gad, L.M. 3924 (300).
Gage, S. 1150 (31), 2165 (31), 2851 (277), 4061 (31), 4621 (31).
Gage, S. & Semsrott, B. BS0014 (31).
Gagnidze, R. & al. 915 (271), 920 (268), 923 (35).
Gagnidze, R. & Nakhutsrishvili, G. 918 (270).
Gagnon, A. 2978 (121), 5956 (121).
Gaillardot, C. 1681b (265), 2487 (273).
Galán, A. & Linares, E. 2691 (118), 2710 (118), 2751 (118).
Galán Cela, P. 124 (279b), 979 (279a), 1261 (89), 1280 (89), 1930 (279a).
Galeano, G. & Bernal, R. 350 (121).
Galeotti, H. 4018 (143), 4019 (153a), 4020 (140), 4022 (158), 4023 (140), 4024 (153a), 4029 (153a).
Galindo, R. & al. 1343 (216).
Gallagher, M.D. 6398/12 (286).
Gallegher, B. 659 (128).
Gallegos, F. 350 (153a), 410 (153a), 449 (153a).
Gallinal, J.P. & al. 782 (108), 922 (258), 1232 (258), 1343 (108), 1766 (108), 5290 (108), 5354 (108).
Gallinal, R. 5019 (300), 5761 (300).
Galpin, E.E. 1631 (240), 1739 (246), 2247 (252), 9813 (251), 11722 (252), 11723 (248), 12035 (248), 12438 (234), 14087 (233b), 14588 (251), 32252 (238).
Galván, R. 2990 (141).
Galván, R. & Galván, J.D. 2810 (136).
Gamble, J.S. 1059 (40), 18102 (65), 19987 (277), 20004 (258), 20055 (279a).
Gamboa, B. 791 (153a), 1585 (153a).
Ganbold, E. 1344 (57).
Gándara, J.M. & Dorantes, J. 65 (143).
Gandoger, M. 353 (299), 1100 (279a), 2299 (87), 2812 (87), 4373 (298).
Ganeschin, S.S. 1187 (64), 1199 (64), 1258 (64).
Gao, X.F. 1438 (51).
Gaoligong Shan Biod. Survey 16972 (292), 17732 (66), 20254 (66), 20671 (66), 21338A (66), 22262 (287), 22963 (66), 23443 (66), 24001 (66), 25649 (46), 25760 (42), 25979 (66), 27384 (66), 27767 (66), 31204 (43), 31342 (43), 31431 (42), 31609 (48), 31628 (43), 31659 (48), 32158 (292), 32220 (292), 32748 (66), 32790 (48), 32907 (292), 33341 (66).
Gaoligong Shan Exped. 8275 (46).
Garaventa, A. 4929 (110).
Garay, L.A. 3818 (300).
Garcavi, E.A. 79 (67).
García 311 (111).
García, E. 2343 (118).
García, E. & al. 911 (118), 934 (118).
García, E. & Pérez, E. 3188 (153a), 3653 (146).
García, G. 3938 (153a), 3959 (136).
García, H.E. 39 (216).
García, J.G. 445 (144).
García, J.L. 260 (143).
García, M. 205 (155).
García, M.Á. 1025 (30).
García, M.Á. & al. 1351 (80), 1402 (258), 1447 (80), 1481 (80), 3751 (298), 3752 (63), 6102 (87), 6103 (63), 6106 (299), 6152 (277), 6221 (299).
García Adá, R. 4702 (89).
García Adá, R. & al. 5249 (300).
García Barriga, H. 4530 (196), 8111 (209), 12637 (219), 16140 (216), 16141 (216), 16175 (209), 16176 (219), 16178 (165c), 16180 (216), 16181 (216).
García Barriga, H. & al. 18592 (170).
García Barriga, H. & Jaramillo, R. 19811 (165c).
García Cardo, Ó. 635 (34), 701 (34).
García González, I. 112 (141).
García Martínez, X.R. 3847 (298), 7779 (299), 7797 (87).
García Robledo, C. 53 (209).
García Ruiz, I. 4580 (146).
García Tapia, G. & López, N. 1273 (263).
Gardner 2441 (279a).
Gardner, G. 39 (121).
Gardner, J.A. & al. 365 (102), 384 (102).
Gardner, M.F. & Gardner, S.G. 427 (5), 2209 (6).
Gardner, M.F. & Knees, S.G. 6188 (109).
Gardner, R.O. 1034 (73), 1056 (75), 1075 (277), 1105 (299), 1123 (299), 1262 (116), 1349 (75), 1584 (73), 1635 (102), 1944 (102), 1997 (75), 2002 (75), 2016 (75), 2087 (75), 2118 (73), 2172 (116), 2188 (73), 2219 (102), 2246 (75), 2419 (102), 2634 (75), 2635 (102), 2645 (102), 2647 (102), 2712 (102), 2772 (105), 2775 (102), 2777 (102), 2801 (116), 3376 (102), 3851 (105), 3899 (105), 3904 (102), 3913 (102), 3976 (73), 4000 (102), 4046 (73), 4061 (105), 4289 (105), 4407 (73), 6066 (102), 6598 (105), 6919 (102), 7504 (105).
Garganta Fábrega, M. 1038 (196), 1039 (216), 1201 (210), 1233 (219), 1280bis (219), 2188 (210).
Garraty, R. 8 (102).
Garret, A.O. 7550 (128).
Garrett 1090 (278).
Garriga de Gallardo, N. & al. 2M.9104 (155).
Garton, C.E. 2193a (121), 2997 (121), 2997b (121), 4620 (121), 6518 (121), 7376 (121), 7406 (121), 7595 (121), 8269 (121), 8740 (121), 9223 (121), 9700 (121), 11707 (121), 20330 (121).
Garwood, N. & al. 1216 (153b), 1275 (168).
Garza, A.S. 425 (136).
Garzón, M. 164 (165c), 511 (209).
Garzón, M. & al. 63 (165c), 84 (165c).
Garzón, R. 11 (216), 67 (216).
Gates, F.C. & Gates, M.T. 10296 (300).
Gauba, E.
Gauba, E. 755 (63), 227 (277), 747 (286), 751 (282), 752 (277), 753 (277), 1225-b (268), 1453 (280), 1454 (268), 1455 (34), 1553 (280).
Gaudichaud, C. 4 (107), 179 (110), 1203 (300), 1204 (111).
Gauvin, C. & al. 80-307 (121).
Gavilanes, M. & Funk, V. 871 (165a).
Gavioli, O. 3328 (267), 27547 (80).
Gay, C. 131 (300), 783 (118), 785 (110), 1208 (184), 2109 (165b).
Geerinck-Coutrez, D. 3484 (63).
Gehriger, W. 114 (207), 139 (207).
Geissler, P. 5972 (1).
Geldenhuye, C.J. 355 (250).
Geltman, D. 2033 (30).
Geltman, D. & al. 780 (63).
Gentry, A. 12337 (201), 12364 (191), 12683 (191), 12684 (191), 34842 (191), 44164 (118), 44178 (118).
Gentry, A. & al. 8895 (210), 8930 (210), 23174 (165b), 23377 (203), 30526 (174), 39757 (187), 47740 (165a), 61346 (198), 74519 (107).
Gentry, A. & Blaney, C. 64382 (165a).
Gentry, A. & Ortiz, R. 74367 (177).
Gentry, H.S. 544 (127), 1420 (247), 1756 (127), 1813 (157), 1937 (127), 2115 (127), 2481 (157), 2576 (157), 2740 (146), 2745 (153a), 2756 (133), 2804 (127), 5848 (146), 6291 (153a), 6341 (157), 7188 (146), 8094 (146).
Gentry, J.L. 194 (63).
Gentry, J.L. & Davidse, G. 1629 (120).
Genty, P.A. 600 (35).
Geobot. Exped. 1241 (67).

INDEX TO SCIENTIFIC NAMES

INDEX TO NEW NAMES AND COMBINATIONS

Carlos Aedo studied at the University of Oviedo, obtaining his Bachelor's degree in Biology in 1984. He received his Ph.D. from the University of Salamanca in 1994 with a thesis on the taxonomy of *Geranium subg. Erodioidea*. Since joining the *Real Jardín Botánico de Madrid* (CSIC) in 1992, he has worked in various positions and is currently Scientific Researcher since 2007. He has published widely in both scientific and popular science journals on floristics and taxonomy of vascular plants, producing more than 150 articles and contributed as author or co-author of more than 30 books. He has worked mainly on the "Flora iberica Project", which he coordinated from 2009 until its completion in 2021. He is also responsible for *Anthos*, a sister project of *Flora iberica* that has not yet been completed. During this time, he has been continually working on the taxonomy of the genus *Geranium*. This project has been developed with an initial strategy to review sections or subgenera that were well-characterized morphologically, combined with the study of species from little or poorly known areas, which have finally converged in the updated monograph of the genus presented here.

GOBIERNO DE ESPAÑA
MINISTERIO DE CIENCIA E INNOVACIÓN
CSIC
Consejo Superior de Investigaciones Científicas
EDITORIAL CSIC
9 788400 111236