

11.

Key concepts

THE word *biodiversity* often conjures up pristine landscapes, with flowers, butterflies, the sounds of birds, lush forests, sparkling streams... images that are becoming increasingly rare and more distant from cities, where most of the world's population is concentrated. Biodiversity, however, is something much more varied and complex, found everywhere, from the atmosphere to several kilometres deep in the oceans or in the rocks, as well as in the centre of large cities. Biological diversity is thus the variety of life on Earth: genetic variety, which makes all individuals in a population and all populations different; the variety of species, ranging from micro-organisms to large mammals or trees; and the variety of habitats and ecosystems that cover the entire planet.

Figure 1 The three levels of biodiversity



Source: Compiled from Primack, R. B. (1993).
Essentials of conservation biology. Sinauer.

Beyond being the sole source of food and other material goods, biodiversity provides, for free, other **vital ecosystem services**, such as air and water purification, climate regulation, protection against the transmission of diseases from wild animals to humans (zoonoses), and plays a fundamental role in mental health and spiritual development. Early estimates of its value suggested figures of three times the value of the world's entire commercial production, although there is as yet no unanimously accepted system for rigorous comparison. What is clear is that its loss is of enormous human significance. Understanding and conserving it, and halting its deterioration and loss in an increasingly human-altered world, is therefore an absolutely vital objective because of the significant implications for both the overall health of the planet and for human survival and physical and mental well-being.

The complexity of biodiversity is the result of the evolution of life and the way in which the resources of a changing environment have been efficiently exploited over millions of years. This long process has generated a spectrum of multiple life forms. But, as these have emerged, they have also been lost through genetic erosion, the disappearance of populations, the extinction of species or the transformation of habitats. In general, the changes experienced have been slow over the course of Earth's history, with more rapid episodes of mass extinction associated with geological catastrophes, such as volcanic eruptions or the impact of large meteorites, or accelerated processes of species formation resulting from the emergence of new ecological opportunities. Due to the numerous environmental modifications that our planet has undergone, about 98% of the species that have inhabited it (not only the dinosaurs) have disappeared and have been replaced by others. Sadly, we are far from such replacements in the current moment of biodiversity crisis, considered as **the sixth extinction**, because the big difference with the previous five is the enormous speed at which it is happening. The other big difference is the cause of the crisis: human activity.

Figure 2 Evolution of ideas regarding the need to conserve nature

Source: Compiled from Mace, G. M. (2014). Whose conservation? *Science*, 345, 1558-1560.

Biodiversity is highly varied and complex. It includes not only the species we can see, but also the microscopic organisms that live in the air, soil, water and inside other organisms like ours (hidden biodiversity) and whose activity is crucial for maintaining species and ecosystems. Genetic diversity is inside all of them, responsible for making each being slightly different from the rest of the same species. This genetic diversity means that, during a bad year or in the face of a pest, some have advantages over others, for example in terms of reproduction or survival. This is why populations in which individuals vary have a much better long-term future than those whose members are very similar to each other, as in monocultures optimised by the agri-food industry for a single type of environment. Moreover, the genetic diversity of a population is greater if it is made up of many individuals, so that small populations are less able to cope with change than large ones.

On the other hand, living things are not static as in a museum, but constantly interact to survive and reproduce, and species often hybridise, a phenomenon that in some cases allows the development of adaptations to new environmental conditions. Plants, animals, and bacteria naturally interact in intricate **biological networks** involving processes ranging from fierce competition, parasitism or predation to mutual collaboration (e.g. pollination of plants by animals or the action of many of the bacteria that inhabit our bodies). Such networks tend to be stable after slow adjustments at each site, but destabilise in response to external disturbances, such as the entry of invasive species, persistent drought, or overexploitation of forests or fisheries. Similarly, the loss of a single species in an ecosystem may be of little ecological significance if another species takes over its function; hence ecosystems with higher biodiversity tend to be more stable and resilient. However, there are also some irreplaceable species whose extinction can have a cascading effect on the extinction of the species that depend on them.



Lake Plan in Aigüestortes
National Park and Lake San
Maurici, a place where the
LIFE ResqueAlpyr project
is carrying out ecological
restoration actions.
/ E. BALLESTEROS



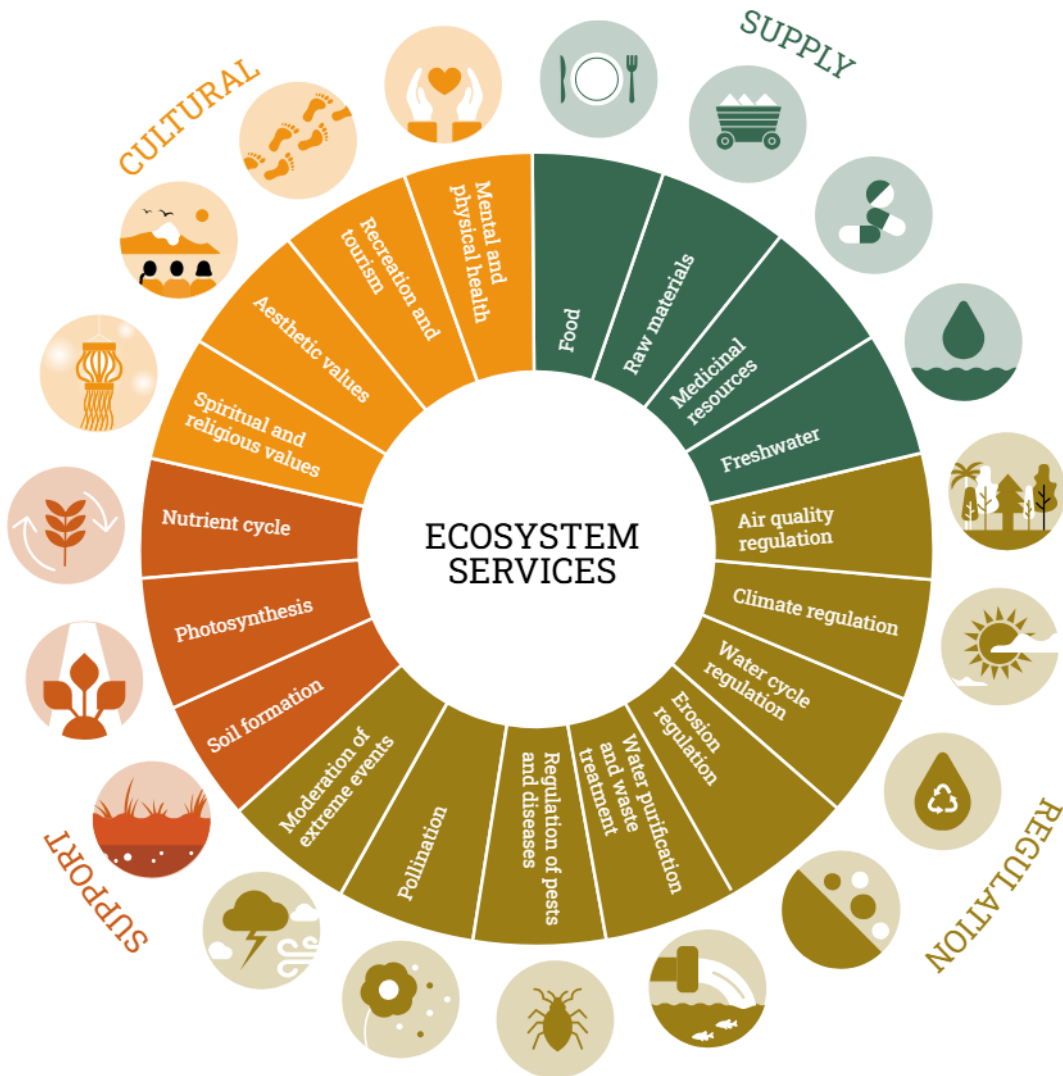
Some ecosystem services of biological diversity

Food production. All the food we use has its origin in nature and its biodiversity. We have learned to domesticate species without which we would not survive, but we also depend on a multitude of non-domesticated organisms, such as many fish or the insects responsible for pollination. Without them we cannot guarantee food security. Maintaining the diversity of local ancestral varieties is essential for the genetic improvement of current foods, for their adaptation to future environmental conditions and for reducing the likelihood of diseases and pests. The survival of local human communities and their cultural heritage depend directly on biodiversity.

Human health. The active ingredients of many medicines come from naturally occurring plants, animals and micro-organisms. The loss of biodiversity can affect the ability to find new cures and medical treatments. In addition, we have learned from the recent COVID-19 pandemic that disruption of natural ecosystems may be behind emerging diseases and that those with high biodiversity act as firewalls in the potential transmission of pathogens between animals and humans [zoonoses].

Climate regulation. Vegetation cools environmental temperatures and regulates evapotranspiration (moisture loss). Mature tree forests, wetlands, angiosperm seagrass meadows (especially *Posidonia oceanica*, endemic to the Mediterranean) and macroalgae forests act as carbon sinks. They fix CO₂ that accumulates in undecomposed soils and sediments, and help mitigate climate change. In cities, the presence of trees and vegetation helps moderate extreme temperatures in heat waves.

Ecosystem stability and resilience. Scientific evidence has corroborated the stabilising role of biodiversity in the face of disturbances. It has been shown that simpler systems are more vulnerable than more complex ones. An example of this is represented by Mediterranean ecosystems, where fire has historically been a recurrent problem. In these ecosystems, some species such as holm oak and cork oak have developed adaptations that allow them to resist fire and coexist with fast-growing colonising plants that help post-fire regeneration. This diversity of ecological strategies promotes rapid recovery and maintains their long-term stability.

Figure 3 Ecosystem services

Source: WWF Living Planet Report, 2016



Some ecosystem services of biological diversity *(continuation)*

Leisure. Tourism is a huge driver of local and national development. The strong return to the enjoyment of nature after the recent pandemic boosts the economy. Tourists seek out well-preserved places with a rich biodiversity, such as national parks. The deterioration of these resources has a negative impact on the local and global economy.

Cultural and recreational value. Many communities depend on biodiversity for their traditions, spiritual practices and recreational activities. The loss of well-conserved species or environments can have a profound impact on their cultural identity. Programmes have also demonstrated the role of landscape in improving physical and mental health.

Ethics and intergenerational responsibility. Preserving biodiversity is a matter of ethics and responsibility towards future generations. As users, but also guardians of the planet, we are obliged to maintain biological diversity so that future generations can also enjoy the benefits it provides.
