Chapter VII: Conservation of biological diversity

The direct (overexploitation, habitat destruction, etc.) or indirect effects of human activities on natural areas challenge, in the medium term, the future of biological diversity, the renewal of resources, and more generally the conditions of life on Earth. It is therefore necessary to take swift measures in response to the scale of biodiversity erosion and the various threats it faces.

However, following a general awareness, humans have implemented various means to protect and conserve this natural and genetic heritage. The stated objectives are both very ambitious and somewhat vague: to promote sustainable development by protecting and using biological resources without reducing species diversity or destroying important habitats and ecosystems.

VII.1. Definition and objectives of biodiversity conservation

The terms *conservation*, *preservation*, and *protection* cover a wide variety of practices, which can lead to some confusion in discussions. We therefore propose the following definitions:

- The term *protection* or *preservation* will be reserved for actions explicitly aimed at safeguarding species or environments threatened by human activities. This involves putting particular ecosystems under protection.
- *Conservation* is an approach that considers the long-term viability of ecosystems in resource and environmental management projects. It is a form of protection that does not prohibit human intervention in natural processes; it is a philosophy of environmental management that avoids both waste and depletion.

According to Ehrlich and Pringle (2008), biodiversity conservation has five major objectives, summarized as follows:

- Develop and improve the effectiveness of protection and restoration of threatened areas and species;
- Reconcile biodiversity and human activities in urban, industrial, and agricultural habitats;
- Promote the involvement of local communities in developing countries in biodiversity preservation;
- Strengthen the links between nature and culture;
- Limit and stabilize humanity’s ecological footprint.

VII.2. Why protect biological diversity?

Biodiversity conservation revolves around two distinct but increasingly convergent traditions:

- **Resource management**, which implicitly recognizes that the protection of "useful" species is necessary for economic development;
- **An ethical perception of nature**, for which any loss of species is regrettable and advocates for maximum protection of biological diversity.

VII.3. Priorities in conservation

Which types of ecosystems should be protected as a priority? How should they be distributed? And what criteria should guide the selection of areas or species for protection?

Several proposals have been made regarding priorities:

- **Protect threatened species.** This is an extension of the "species-based" approach, applied, for example, in the protection of pandas, gorillas, and more generally large African wildlife.
- **Prioritize threatened evolutionary lineages.** The goal here is to preserve future options by protecting all major currently known phyla.
- **Protect hotspots or critical zones.** For some, identifying these critical zones—where biodiversity is both highly endemic and threatened—is a way to select priority conservation areas.

VII.4. Conservation approach

The operational implementation of conservation has sparked numerous, often passionate, debates regarding the most appropriate courses of action. One conclusion is clear: there is no simple or universal solution. Actions are most often taken urgently, and nothing is ever entirely satisfactory in the long term.

VII.4.1. In Situ Conservation

One common practice is *in situ* conservation, which involves maintaining living organisms within their natural habitat. For the conservation of individual species, effective approaches include legal protection of threatened species, improving management plans, and establishing reserves to protect particular species or unique genetic resources. This type of conservation allows animal and plant communities to continue evolving and adapting to environmental changes, and it encompasses a large number of species without requiring prior inventories.

VII.4.1.1. Protected areas

The generic term *protected areas* actually covers very different situations, ranging from large wildlife and flora reserves to small sites dedicated to the conservation of particular species. These may include strict nature reserves, where human intervention is excluded, or inhabited areas where flora and fauna are protected through the involvement of local populations in managing the environment and species. Currently, there are estimated to be around 4,500 protected sites worldwide, representing 3.5% of terrestrial land.

The IUCN (International Union for Conservation of Nature) distinguishes several categories of protected areas in decreasing order of the level of protection measures:

- **Category I – Strict Nature Reserves or Wilderness Areas:** Areas managed mainly for scientific purposes or for the protection of wild species and habitats.
- **Category II – National Parks:** Protected areas managed primarily to protect ecosystems and for recreational, educational, and cultural purposes.
- **Category III – Natural Monuments or Features:** Areas managed to preserve particular natural features of national significance.
- **Category IV – Habitat/Species Management Areas:** Protected areas managed mainly for conservation purposes, with intervention at the management level.
- **Category V – Protected Landscapes/Seascapes:** Protected areas managed primarily to ensure the conservation of landscapes (terrestrial or marine) and for recreational purposes.
- **Category VI – Protected Areas with Sustainable Use of Natural Resources:** Protected areas managed specifically for sustainable use of natural ecosystems.

Natural reserves

A natural reserve (ecological or biological reserve) is a portion of land, more or less large (from several tens to hundreds of hectares), whose environment has biological or geological interest. The primary role of a natural reserve is to conserve and preserve terrestrial or marine biodiversity and geology, ensuring long-term protection of habitats and species. It may also have an educational function, serving as a site for research and experimentation.

Management of a natural reserve may be entrusted to nature protection associations, public institutions (national parks, forestry offices, etc.), or local authorities (municipalities). Most financial resources come from the state.

An example of a natural reserve in Algeria is the **Babors Reserve**, covering 2,367 hectares in the Petite Kabylie region (Wilaya of Sétif). It includes Algeria's only Fir station. Several plant communities characterize the Babors forest: Cedar, Zeen, Numidian Fir, Holm Oak, etc. Among the mammals identified are Jackal, Fox, Wild Boar, Barbary Macaque, Weasel, and Mongoose. Other Algerian natural reserves include Mergueb (Wilaya of M'sila), Béni-Salah (Wilaya of Guelma), Marine Habibas Islands (Wilaya of Oran), and La Macta (Wilayas of Oran, Mostaganem, and Mascara).

National Parks

The aim of national parks is to protect ecosystems and use them for recreational purposes while preserving representative examples of physiogeographical regions, species, and ecological diversity. The area must be large enough to contain one or more entire ecosystems.

Any form of exploitation or occupation incompatible with this designation is eliminated and prevented from reoccurring. Resource use for subsistence is allowed, provided it does not compromise ecosystem protection. Public access is limited to maintain the area in its natural state. Ownership and management can be assigned to councils of indigenous populations.

Example: Tlemcen National Park Tlemcen National Park, located in northwestern Algeria, was designated a national park in 1993. Covering 8,225 hectares, the park is rich in biodiversity with a variety of fauna and flora. Most of the park consists of medium-altitude mountains (1,100 m), giving it a mountainous character.

Flora includes 904 species, classified as cosmopolitan (732), protected (22), endemic (31), rare (38), threatened (44), and fungi (44). Dominant species include Holm Oak, Cork Oak, Zeen Oak, along with Mediterranean Palm, Strawberry Tree, Pistachio, Hawthorn, etc.

Fauna comprises 174 species: birds (100 species, 38 protected), mammals (16 species, 8 protected), reptiles (18 species, 1 protected), insects (33 species, 2 protected), and amphibians (7 species). The fauna is highly diverse, including Fox, Wild Boar, Jackal, European Rabbit, and Pigeon. Some species are endangered, such as the Sparrowhawk, Golden Eagle, Mongoose, Wild Cat, Porcupine, and Weasel.

The park also contains several archaeological, historical, and natural sites, including the ruins of Mansourah, the mosque of Sidi Boumediene, the mosque of Sidi Bou Ishaq El Tayar, the Sultan’s tomb, the caves of El Ourit with its cliffs and waterfalls, the Safsaf caves, and the Boumaaza caves.

VII.4.2. Ex Situ Conservation

However, *in situ* conservation is not always possible, as many habitats are already highly disturbed, and some have even disappeared. In such cases, *ex situ* conservation is used, which involves preserving species outside their natural habitat.

Ex situ conservation allows for the protection of endangered species, restoration and regeneration of threatened species, management of genetic resources of useful plants, and reintroduction of species into their natural habitat.

VII.4.2.1. Botanical Gardens

There are approximately 1,600 botanical gardens worldwide. The oldest gardens initially collected plants used in traditional medicine. They later evolved into acclimatization gardens to house and attempt to domesticate tropical species brought by travelers and to develop new economically and ornamentally valuable crops. Recently, their mission has evolved further, specializing in local fauna and flora for conservation engineering and public education.

A botanical garden is considered a territory managed by a public, private, or associative institution aimed at displaying wild and/or horticultural plant species and varieties.

Example: El Hamma Experimental Garden (Wilaya of Algiers)

Created in 1832 by the colonial state and covering 32 hectares, it is considered one of the most important experimental and acclimatization gardens in the world. It hosts over 3,000 species of food and ornamental plants: Plane Trees, Ficus, Bamboos, Palms, Cocos, and many other tropical and aquatic plants. The site also contains a zoological garden with specimens of North African fauna and some wild animals. Alongside scientific and technical work, the El Hamma Botanical Garden has long educated the public about nature and horticulture.

VII.4.2.2. Zoological Parks

Public or private zoological parks, as well as specialized collections of living animals (often focused on spectacular taxa such as fish, snakes, birds, or insects), have similar missions to botanical gardens. There are over 2,000 zoological parks worldwide, housing approximately 250,000 living specimens and their ancestors, belonging to about 6,000 species.

VII.5. Conservation Biology

Conservation biology, which aims to preserve biodiversity, emerged in the 1970s in response to the evident acceleration of species extinction associated with human expansion. Its approach analyzes the relationships between humans and biodiversity to propose options that reconcile human activities with ecosystem preservation. To achieve this, it must be multidisciplinary, integrating ecology with social sciences such as economics and anthropology.

Conservation biology works urgently to save species and habitats at risk of disappearing without effective measures. This practice requires both *ex situ* and *in situ* approaches, whose methods are rapidly advancing.

VII.5.1. Habitat Fragmentation

According to the theory of island biogeography, the number of species present in an ecosystem is a function of its area. Habitat reduction favors the extinction of certain species. Conservation biologists are called upon to answer questions such as:

- What is the minimum size of a reserve to protect a given species?
- Is it better to create a single large reserve or several smaller reserves?
- How many individuals of a threatened species need protection to avoid extinction?
- When several reserves are created, should they be close together or far apart? Should they be isolated or connected by corridors?

VII.5.2. Species Reintroduction

Reintroduction of animal and plant species is always considered in conservation biology. It involves introducing species that have become extinct (or whose numbers are greatly reduced) into habitats where they previously existed.

VII.5.3. Restoration Ecology

Ecological restoration is an intentional action that initiates or accelerates the recovery of an ecosystem while respecting its health, integrity, and sustainability. The ecosystem needing restoration has been degraded, damaged, transformed, or entirely destroyed, as a direct or indirect result of human activity. In some cases, these impacts have been caused or worsened by natural phenomena such as fires, floods, storms, or volcanic eruptions, to the point where the ecosystem cannot return to its pre-disturbance state or historical trajectory.

VII.5.3.1. Restoration

Restoration is an intentional transformation of an environment to reestablish the ecosystem considered native and historical, with its original taxonomic composition and essential functions (production, self-reproduction).

VII.5.3.2. Rehabilitation

When pressure on an ecosystem has been too strong or prolonged, it cannot return to its previous state even if human pressure is removed. Only strong, time-limited human intervention can redirect the ecosystem toward the recovery of essential functions.

VII.5.3.3. Reassignment

When an ecosystem has been heavily transformed by humans, it can be put to a new use without attempting to rehabilitate it. The new state has no structural or functional relation to its previous state.

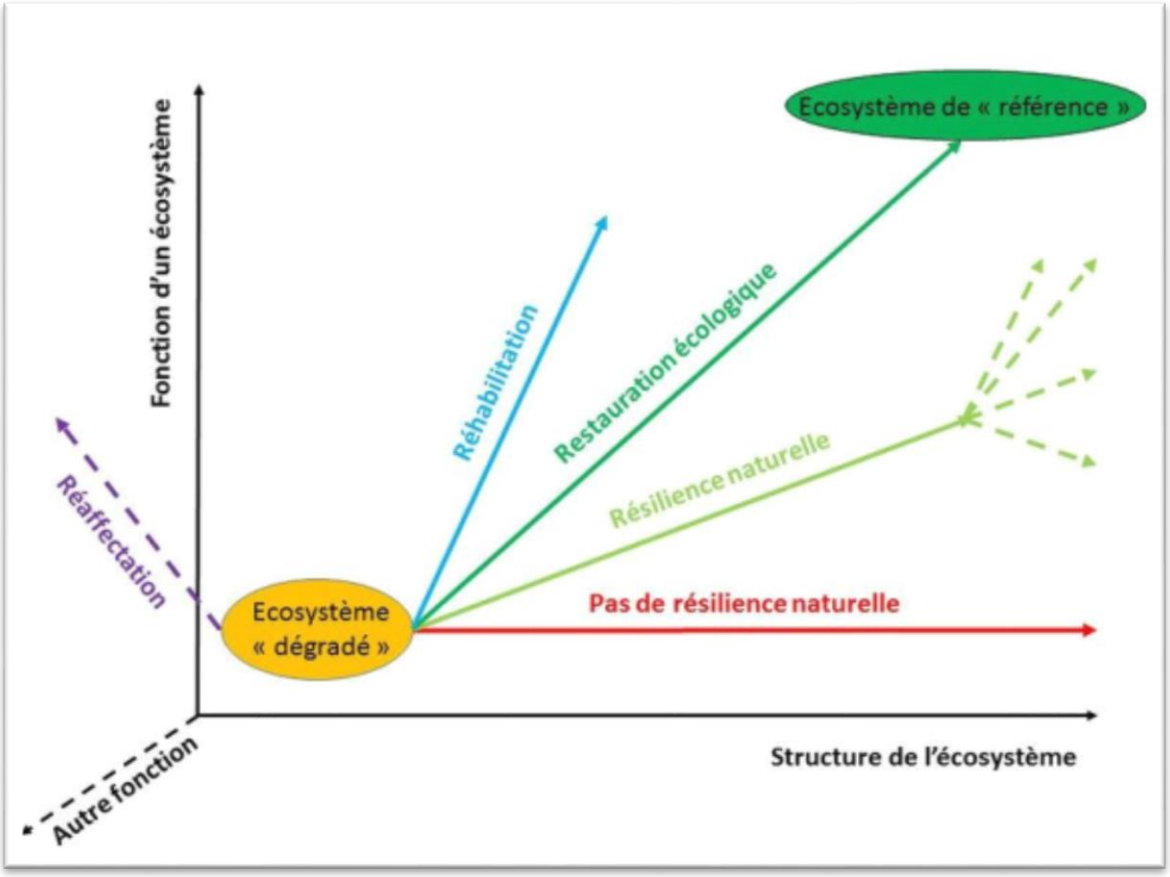

Figure 13: Schematic representation of ecosystem development and possible options for site restoration.