CHAPTER 3

Introduction to Biodiversity: Definitions and Concepts

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BIOLOGICAL DIVERSITY: DEFINITION

Biological diversity (or biodiversity) embraces the totality of different forms of life (plants, animals and micro-organisms, including the genetic variability within individual species) and of ecosystems. The Convention on Biological Diversity defines biological diversity as *"the variability among living organisms from all sources, inter alia, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems."*

There is a distinction between biological diversity and biological resources. The latter includes genetic resources, organisms or their parts, populations, or any other biotic component of ecosystems. Biological resources are tangible biotic entities such as seeds, genes, maize, fish, elephants, etc. and are only sub-sets of all the earth's genetic resources, organisms or populations, whereas biodiversity refers to the variability among them. There are three levels of biological diversity: genetic diversity, species diversity and ecosystem diversity.

Genetic diversity

Genetic diversity is the hereditary variation within living organisms of specific species, i.e the genetic differences among populations of a single species and among individuals within a population. Genes are the principal units of heredity, passed from an organism to its offspring. Every individual organism has a slightly different combination of genes. Genetic diversity allows species to adapt over time to environmental stresses and makes changes (mutations) possible. It forms the basis of (natural) selection and thus of breeding and other forms of (genetic) manipulation by man, for example for agricultural purposes (varieties, cultivars and strains, including clones and hybrids). Genetic diversity in both wild and bred species is vital. Species and varieties of agricultural animals and crops were transposed from one ecosystem to another over many centuries and wild species in cultivated areas are often under pressure.

Species diversity

Species diversity is the variety of taxonomically distinguished species, whether wild or domesticated. As well as their popular names, species have distinct scientific names (for example the rubber tree is *Hevea brasiliensis)*. Lower-order differences result in sub-species and varieties or, in agriculture, cultivars. There are different ways of measuring species diversity in a geographical area. One example is "species richness", i.e the number of different species occurring within a particular sample area.

Ecosystem diversity

Ecosystem diversity refers to the diversity of ecosystems. An ecosystem is a dynamic functional unit of different living components (plants, animals, micro-organism communities) and processes (photosynthesis, evolution) interacting with their non-living environment (soil, air, water, etc). Ecosystems diversity describes the multiplicity of interactions between species in areas which can be regarded as forming an ecological entity, for example a woodland ecosystem, a savannah, coral or mountain ecosystem. It comprises a community of organisms and their physical environment which interact together as a unit. Systems cannot be defined as precisely as species or genes.

Three partly overlapping categories of ecosystem can be distinguished, based on the degree of change wrought by humans.

1. Natural areas, or wild lands: these are more or less undisturbed wildernesses. Examples are virgin forests or jungles, Antarctica, Serengeti.

2. Semi-natural areas: these are areas in which the natural ecosystem has been changed by man, in which the characteristics of the original ecosystem (for example native species or the structure of the vegetation) are still recognisable. Examples are managed forests (with the laying of roads and selective felling), and areas intensively grazed by livestock such as the Sahel zone.

3. Man-made areas: the ecological characteristics of such areas have been so changed by conscious intervention, such as changes in the mix of species and in the processes, that little of the original structure and few of the original species are to be found there. Examples are plantations, meadow lands, arable land, fish-ponds, villages and cities.

NATURE CONSERVATION AND MANAGEMENT

The terms 'conservation of biological diversity' and 'nature conservation or nature management' are used often synonymously. Biodiversity conservation includes the protection and sustainable exploitation of natural resources and the management of the genetic diversity of both wild and domesticated species. Nature management involves the protection, regeneration and development of both the living and non-living nature. Both terms imply the integration of biological objectives into other sectors. **'Conservation'** embraces the ideas both protection and sustainable use while '**preservation**' is closer in meaning to protection. **'Protection**' is used for saving specific components of the biological diversity, in particular regions and species in reserves and national parks or by means of special measures.

In the Convention on Biological Diversity, the term '**sustainable use**' was defined as "the use of components of biological diversity in a way and at a rate that does not lead to the long-term decline of biological resources, thereby maintaining its potential to meet the needs and aspirations of the present and future generations.

In situ conservation

In situ biodiversity conservation refers to the management of ecosystems and species in their natural habitats, varying from strictly protected areas (such as national parks and nature reserves) in which a whole range of uses are not permitted, to natural areas which are traditionally managed and utilised by the local population or in semi-natural ecosystems, e.g. cultivated areas, managed for the conservation of genetic diversity on farm. In situ conservation includes the maintenance and recovery of viable populations of species in their natural environment, and in the case of domesticated or cultivated species, in the surroundings where they have developed their distinctive properties. A **habitat** means a place or type of site where an organism naturally occurs.

Ex situ conservation

A part of the biological diversity can be stored up elsewhere outside their natural environment (ex situ), for example in botanical gardens, zoos, seed and gene banks and other man-made cultures. This is important, particularly for agriculture and biotechnology. Ex situ conservation results in impoverishment of the genetic diversity and evolutionary processes are halted. Ex situ conservation is complementary and offers additional certainty in situations in which 'in situ' conservation is uncertain.

Protected areas

The conservation of natural ecosystems is the most effective means of maintaining as large as possible a range of biological diversity. A significant part of the natural biological diversity must be conserved in protected areas. These are geographically defined areas which are designated, regulated and managed to achieve specific conservation objectives which vary from no human use to controlled exploitation.

IUCN Categories of Protected Areas (IUCN 1993)	
Category I	Strict Nature Reserve/Wilderness Area: protected area managed for scientific purposes.
Category II	National Park: protected area managed for ecosystem protection and recreation.
Category III	Natural Monument/Natural Landmark: protected area, mainly managed for the conservation of a specific natural phenomenon.
Category IV	Habitat and Species Management Area: protected area mainly actively managed for conservation.
Category V	Protected Landscape/Seascape: protected area mainly managed for the conservation of a landscape/seascape.
Category VI	Managed Resource Protected Area: protected area mainly managed for the sustainable use of natural resources.

Buffer zones

The appointment of effective buffer zones is increasingly tending to form an integral part of the land-use planning around protected areas. Protection is integrated with rural development in these zones. This principle is developed, for example, in the concept of a 'biosphere reserve' with zoning for different degrees of use. The purpose of the buffer zones is:

- the removal of pressure on the protected area;
- the removal of nuisance for the population;
- to allow the population to benefit from the protected areas (in particular hunting).

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