

**Biodiversity**

**Introduction**

The great variety of life on earth has provided for man’s needs over thousands of years. This diversity of living creatures forms a support system which has been used by each civilization for its growth and development. Those that used this “bounty of nature” carefully and sustainably survived. Those that overused or misused it disintegrated.

Science has attempted to classify and categorize the variability in nature for over a century. This has led to an understanding of its organization into communities of plants and animals. This information has helped in utilizing the earth’s biological wealth for the benefit of humanity and has been integral to the process of ‘development’. This includes better health care, better crops and the use of these life forms as raw material for industrial growth which has led to a higher standard of living for the developed world. However this has also produced the modern consumerist society, which has had a negative effect on the diversity of biological resources upon which it is based. The diversity of life on earth is so great that if we use it sustainably we can go on developing new products from biodiversity for many generations. This can only happen if we manage biodiversity as a precious resource and prevent the extinction of species.

1. **Definition**

Biodiversity is a comprehensive umbrella term for the extent of natures variety or variation within the natural system; both in number and frequency. It is often understood in terms of the wide variety of plants, animals and microorganisms, the genes they contain and the ecosystem they form. The biodiversity we see today is the result of billions of years of evolution, shaped by natural processes and, increasingly, by the influence of humans. It forms the web of life of which we are an integral part and upon which we so fully depend. So far, about 2.1 million species have been identified, mostly small creatures such as insects. Scientists believe that there are actually about 13 million species, though as per UNEP estimates there are 9.0 to 52 million species exist on earth (Mora *et al.*, 2011).

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| *‘Biological diversity’ or biodiversity is that part of nature which includes the differences in genes among the individuals of a species, the variety and richness of all the plant and animal species at different scales in space, locally, in a region, in the country and the world, and various types of ecosystems, both terrestrial and aquatic, within a defined area.* |

Biodiversity also includes genetic differences within each species - for example, between varieties of crops and breeds of livestock. Chromosomes, genes, and DNA the building blocks of life determine the uniqueness of each individual and each species. Yet another feature of biodiversity is the variety of ecosystems such as those that occur in deserts, forests, wetlands, mountains, lakes, rivers, and agricultural landscapes. In each ecosystem, living creatures including human form a community, interacting with one another and with the air, water, and soil around them. **Biodiversity is thus considered at 3 major levels:**

1. **Genetic diversity:**

This is the variety of genetic information contained in all of the individual plants, animals and microorganisms occurring within populations of species. Simply it is the variation of genes within species and populations.

1. **Species diversity:**

This is the variety of species or the living organisms. It is measured in terms of *Species Richness.* The latter refers to the total count of species in a defined area. *Species Abundance* refers to the relative numbers among species. If all the species have the same equal abundance, this means that the variation is high hence high diversity, however if the one species is represented by 96 individuals, whilst the rest are represented by 1 species each, this is low diversity. In nature, not all species of a community are equally different. It is possible to classify species on the basis of their functions:

**a) Functional types:** Functional types are those species, which perform different ecological functions.

**b) Functional analogues:** Functional analogues represent distinct taxa performing the same or very similar ecological functions.

1. **Ecosystem diversity:**

This relates to the variety of habitats, biotic communities and ecological processes in the biosphere. Biodiversity is not distributed evenly on Earth. It is the richest in the tropics. Terrestrial biodiversity tends to be highest near the equator (Gaston, 2000), which seems to be the result of the warm climate and high primary productivity (Field et al., 2009). Marine biodiversity tends to be highest along coasts in the Western Pacific, where sea surface temperature is highest and in the mid-latitudinal band in all oceans. There are latitudinal gradient in species diversity (Tittensor et al., 2010). Biodiversity generally tends to cluster in hotspots (Myers et al., 2000), and has been increasing through time (McPeeket al., 2007) but will be likely to slow in the future (Robosky, 2009).

# Uses of Biodiversity

At the ecosystem level, biodiversity provides the conditions to drive the processes that sustain the global economy and our survival as a species. The benefits and services provided by ecosystems include:

#### *Ecosystem services*

Biodiversity is essential for the maintenance of ecosystem services and their sustainable utilization. These services include maintenance of gaseous composition of the atmosphere, climate control by forests and oceanic systems, natural pest control, pollination of plants by insects and birds, formation and protection of soil, conservation and purification of water and nutrient cycling etc.

#### *Prevention and mitigation of natural disasters*

Forests and grasslands protect landscapes against erosion, nutrient loss, and landslides through the binding action of roots. Ecosystems bordering regularly flooding rivers (floodplain forests and wetlands) help to absorb excess water and thus, reduce the damage caused by floods.

#### *Source of economically important products*

1. **Food:**

About 150 crops feed most of the human population at present, but just 12 of them provide about 80% of food energy (with wheat, rice, maize and potato alone providing about 60%). Also, about 30 mammalian and bird species are used extensively, but just 15 of them account for over 90 percent of global livestock production. Biodiversity increases the range of food products suitable for human consumption. Wild biodiversity provides a wide variety of important foodstuffs, including fruits, meats, nuts, mushrooms, honey, spices and flavorings. These wild foods are especially important when agricultural supplies fail. Indeed, wild biodiversity guards against the failure of even the most advanced agricultural systems. For example, the productivity of many of the developed world’s agricultural crops is maintained through the regular assimilation of new genes from wild relatives of these crops. These wild genes offer resistance to the pests and diseases that pose an ever-evolving threat to harvests.

1. **Medicines:**

Biodiversity is also a rich source of substances with therapeutic properties like morphine (used as an analgesic), quinine (used for the treatment of malaria) and taxol (an anticancer drug). A significant proportion of drugs are derived, directly or indirectly, from biological sources. Moreover, only a small proportion of the total diversity of organisms has been thoroughly investigated for potential sources of new drugs.

1. **Industrial materials:**

A wide range of industrial materials are derived directly from biological resources. These include building materials, fibers, dyes, resins, gums, adhesives, rubber and oil. There is enormous potential of obtaining economically important materials from a wider diversity of organisms.

*Total economic value of Biodiversity*

*Direct use Indirect use*

* *Support and regulate ecosystem services*

*Consumptive use Non consumptive use*

*source of economically Eco-tourism*

*important products Education*

*such as food, Recreation*

*medicines Cultural and aesthetic value*

1. **Consequences of Biodiversity Loss**

There is considerable evidence that contemporary biodiversity decline will lead to subsequent decline in the functioning and stability of ecosystem. Biodiversity experiments have tested whether biodiversity declines will influence ecosystem functioning or stability by manipulating some component of biodiversity, such as the number of species, and measuring various types of ecosystem functioning or stability. These studies have been conducted in lab, grassland, forest, marine and freshwater ecosystems. From these studies, it is clear that ecosystem functioning often depends on species richness, species composition and also on species evenness and genetic diversity. Furthermore, stability often depends on species richness and species composition. Thus, contemporary changes in biodiversity will likely lead to subsequent changes in ecosystem properties. Further investigation at larger spatiotemporal scales in managed ecosystems is needed to improve our understanding of the consequences of biodiversity declines.

1. **Threats to Biodiversity:**

The most obvious manifestation of biodiversity loss is the extinction of species. This is a natural phenomenon: species have been going extinct since life began. Indeed, it is estimated that many more species have gone extinct than exist at present. What’s worrying is the rate at which species are currently dying out. Since the total number of species on the Earth can only be estimated, the exact rate of current species loss is difficult to gauge. Working from the conservative estimate that the Earth is home to 10 million species in all, it is estimated that between 0.2 and 0.6 percent of species are being lost every year. This rate is at least 10,000 times greater than the ‘background’ or natural rate of species extinction, as estimated using the fossil record. The main causes of biodiversity loss are considered under the following headings:

#### *Habitat loss and fragmentation*

Habitat means the place or type of site where an organism or population naturally occurs. When a natural habitat, such as a forest or wetland, is altered so dramatically that it no longer supports the species it originally sustained. Plant and animal populations are destroyed or displaced, leading to a loss of biodiversity. It is called *habitat loss* or *habitat destruction*. Habitat destruction is different from *habitat degradation*. According to IUCN, a decline in species-specific habitat quality that leads to reduced survival and/or reproductive success in a population is called habitat degradation. *Habitat fragmentation* is the ‘breaking apart’ of continuous habitat into distinct pieces. The loss of habitats is the primary reason for the loss of biodiversity. When people cut down trees, fill a wetland, plough grassland or burn a forest, the natural habitat of a species is changed or destroyed. These changes can kill or force out many plants, animals and microorganisms as well as disrupt complex interactions among the species. With the fragmentation of a large forest tract, species occupying deeper parts of forest are the first to disappear.

#### *Introduction of invasive species*

An invasive species (also called *introduced, exotic, non-native*) can be any kind of living organism that is not native to an ecosystem and which has a tendency to damage the ecosystem. Common characteristics of invasive species include rapid reproduction and growth, high dispersal ability, phenotypic plasticity (ability to adapt physiologically to new conditions) and ability to survive on various food types and in a wide range of environmental conditions. These species grow and reproduce quickly, and spread aggressively, with potential to cause harm. Invasive species are capable of causing extinctions of native plants and animals by competing with them for limited resources and altering habitats. Thus, leading to loss of biodiversity. The sudden introduction of invasive species to a given ecosystem (especially on islands and in freshwater habitats) causes disastrous consequences for native species. Such introductions are usually the result of human activities. The accidental introduction of an Atlantic comb jellyfish species to the Black Sea is a well-known example. These invaders have out-competed native fauna, and now comprise some 95 percent of the Black Sea’s total biomass. In the US, meanwhile, the introduction of exotic species has been implicated in close to 70 percent of the past century’s freshwater fish extinctions.

#### *Overexploitation*

The term *overexploitation* refers to the human activities connected with excessive capturing and harvesting (hunting, fishing, farming) of organisms. According to IUCN, it is an exploitation of (removal of individuals or biomass from) a natural population at a rate greater than the population is able to match with its own recruitment, thus tending to drive the population towards extinction. Overexploitation of a particular species reduces the size of its population to an extent that it becomes vulnerable to extinction. The decline of the Earth’s largest terrestrial animal, the African elephant, is a classic example of the impact of overhunting. Largely because of the trade in ivory, elephant populations have been declining in most of Africa.

#### *Climate change and pollution*

#### The link between climate change and biodiversity has long been established. Although throughout Earth’s history the climate has always changed but rapid climate change due to manmade activities affects species ability to adapt and so biodiversity loss increases. In addition to global warming, more frequent extreme weather and changing patterns of rainfall and drought have significant impacts on biodiversity. Some species may benefit from rapid climate change but most species will not find it as beneficial as they will not be able to adapt.

# Conservation of Biodiversity

Biodiversity is a source of significant economic, aesthetic, health and cultural benefits which form the foundation for sustainable development. However, there is general scientific consensus that the world is rapidly becoming less biologically diverse in terms of genes, species and ecosystems. The reason for this is clearly anthropogenic. The scale of human impact on biological diversity has been increasing exponentially primarily because of world-wide patterns of consumption, production, trade, agricultural, industrial, settlement development and human population growth.

Neither the economic nor the ecosystem value of biodiversity is as yet well understood. In particular, there is insufficient knowledge of the interdependence of species within ecosystems and the impact of the extinction of one species on others. Hence, reducing the rate of biodiversity loss and conserving still existing biodiversity as the basis of sustainable development remains a major global challenge.

Conservation is the protection, preservation, management or restoration of wildlife and natural resources such as forests and water. Through the conservation of biodiversity, the survival of many species and habitats which are threatened due to human activities can be ensured.

**‘***Conservation of biodiversity is an active management of the biosphere to ensure the survival of the maximum diversity of species and the maintenance of genetic variability within species. It includes the maintenance of biosphere function e.g. nutrient cycling and ecosystem function. The term also includes the concept of sustainable resource use so that the environment may yield the greatest sustainable benefit to current generations while maintaining its potential to meet the needs and aspirations of future generations. Conservation of species and biological processes must be simultaneous with conservation of abiotic resources or it is unlikely to succeed*.**’**

