

Biodiversity

[UPSC Notes]

What is Biodiversity?

Biodiversity is defined as the total number and variety of species in a particular area or region. It includes diversity within species, between the species, and the ecosystem. Biodiversity has two major components, i.e., Species Richness and Species Evenness. Whittaker did the measurement of biodiversity.

- **Species Richness-** Species richness is species diversity within a community. It has three types- Alpha diversity, beta diversity, and gamma diversity.
- **Species Evenness-** Species evenness is the measure of species proportion in a given site.

Types of Biodiversity

Based on the diversity within species, between species, and between the ecosystem, Biodiversity can be differentiated into the following types-

- **Genetic Diversity-** The type of Biodiversity in which every individual of a specific species is different from each other in terms of genetic makeup, and this variability of the genes within the members of the same species of plants and animals are termed Genetic Diversity. The closely related species have more common genetic information.
- **Species Diversity-** The type of Biodiversity in which different species live in a specific area, habitat, or region. Species diversity can occur in Agricultural as well as Natural ecosystems.
- **Ecosystem Diversity-** The diversity among different ecosystems with different species is termed Ecosystem Diversity. There is a difference in species in a diverse ecosystem per the habitats. It includes mountains, deserts, grasslands, and forests. It can be observed within a country, state, or a specific geographical region.

Hotspots of Biodiversity

A hotspot of Biodiversity is any biogeographical area with many species, but a significant amount of Biodiversity is threatened by destruction. These hotspots are essential for maintaining the ecosystem balance. By far, there are 36 hotspots of Biodiversity. The biodiversity hotspots are as follows-

- Mountains of Central Asia
- The Mediterranean basin and its Eastern Coastal region
- Iran-Anatolia region
- Caucasus region
- Atlantic forest
- Tropical Andes
- Tumbes-Choco-Magdalena
- Chilean winter rainfall (Valdivian) Forests
- Brazil's Cerrado
- The Mesoamerican forests
- Modrean pine-oak woodlands of the USA and Mexico border
- Caribbean islands hotspot
- California Floristic Province
- South-Western Australia
- Polynesia and Micronesian Islands Complex, including Hawaii
- The Western Ghats

- Wallace
- Western Sunda
- Philippine biodiversity hotspot
- New Zealand biodiversity hotspot
- New Caledonia
- Mountains of South-West China
- Japan biodiversity hotspot
- The Eastern Himalayas
- Himalayan hotspot
- Coastal forests of Eastern Africa
- South Africa's Cape floristic hotspot
- East Melanesian islands
- Succulent Karou
- Maputoland, Podoland, Albany hotspot
- Madagascar and the Indian Ocean Islands
- Horn of Africa
- The Guinean forests of Western Africa
- Eastern Afro-Montane
- Sunderbans
- Sundaland

Hotspots of Biodiversity In India

India is rich in Biodiversity, and out of 36 biodiversity hotspots, India has 6 Hotspots of Biodiversity In India with a vibrant diversity of fauna and flora (including endangered species). The Hotspots of Biodiversity In India are the Himalayas, Indo-Burma region, Terrai-duar Savannah, Western Ghats, Sundaland, and Sunderbans. Sunderbans is also a UNESCO World Heritage Site in India. The detailed description of the Hotspots of Biodiversity In India is as under-

Himalayas

The Eastern Himalayas is one of the major hotspots of India. It includes the area of Nepal, Bhutan, Sikkim, Arunanchal Pradesh, and Burma. It has an evergreen forest that includes trees like oak and alpine. The fauna consists of charismatic western tragopan, clouded leopard, slow loris, golden langur, golden cat, snow cock, heron, tiger, white-winged wood duck, and Indian civet.

Terrai-duar Savannah

The Terrai-duar Savannah forms a narrow stretch at the base of the Himalayas and then continues to the Indo Gangetic plain of Bhutan, Nepal, and India. Terrai-duar Savannah is the land of the world's rarest and tallest grasslands with rich slits. Every year, these slits are deposited by heavy monsoon floods. The prominent fauna of the Terrai-duar Savannah is the one-horned rhinoceros, sloth bears, Asian elephants, and much more.

Indo-Burma region

The indo-Burma region is one of the largest hotspots of India. It spreads to a large area, including Cambodia, Laos PDR, Thailand, Myanmar, the plains of Ganga, parts of Andaman and Nicobar island, and regions around the Brahmaputra river. It is one of the most threatened sites with many flora and fauna species, including the grey-crowned crocias and Annamite muntjac. But, because of increasing human threats, the region requires legal protection.

Sunderbans

Sunderbans is a combination of 104 islands in the Ganga-Brahmaputra delta. Sunderbans is one of India's UNESCO World Heritage sites, with the world's largest mangrove forest. It is the home to the Royal Bengal tigers. Along with the Royal Bengal tigers, its fauna also includes the

estuarine crocodile and Gangetic dolphins and a lot of other species of fish, mammals, and birds.

But nowadays, the increase in the sea level because of global warming is causing considerable danger to the species living there.

Sundaland

Sundaland hotspot of India lies in the Nicobar Islands and extends to the tectonic plates under the Indian Ocean. It is the land for the species like proboscis monkeys, Javan and Sumatran rhinos, pig-tailed langurs, and orangutans. Of these, the proboscis monkeys are found in the Borneo region only.

Not only this, but the world's largest flower, the rafflesia (it is one meter long), is also found in the Sundaland hotspot.

Western Ghats

The Western Ghats runs from the north to the south beyond the west coast of India. It is also one of the UNESCO World Heritage sites with many montane tropical rainforests. These forests are home to a variety of fauna and flora. It includes leopards, black panthers, and tigers. The fauna in the southern part of the Western Ghats includes the endangered shy lion-tailed macaques.

The Western Ghats observe the presence of the weird pig-nosed purple frog during monsoon. New species are still being discovered in the dense forests.

Importance of Biodiversity

Biodiversity has a significant role in maintaining the ecological balance within the ecosystem. It plays an important ecological, economic, and scientific function. The importance of Biodiversity can be summarized as-

- **Ecological Role-** If the ecosystem is diverse, there will be better chances of species' survival from attacks and adversities. Thus, it contributes to preserving species and maintaining the ecological balance. It serves an essential role in human survival by capturing and storing energy, producing and decomposing organic material, contributing to the water cycle, and regulating the climate.
- **Economic Role-** Biodiversity, especially agrobiodiversity, is an essential day-to-day life resource. It is significant in producing medicinal resources, food crops, livestock, fish, and other introductory material for pharmaceuticals, food manufacturing, and cosmetics.
- **Scientific Role-** The species (extinct or alive) contributes to understanding the evolutionary concept. It helps in understanding the role and function performed by a species in a particular environment and indicating their different relationships.
- **Other Roles-** Along with these roles, it is also essential to maintain the food web, pollination, nutrient cycling, greenhouse reduction, soil formation, etc.

Loss of Biodiversity

The loss of Biodiversity can be defined as the loss of a particular species, genes, or ecosystem because of natural or manufacturing activities. The loss of Biodiversity is documented in the IUCN Red Data book. It has recorded 784 extinct species (87 plants, 359 invertebrates, and 338 vertebrates). It has reported the loss of 30 biodiversities (approx) in the last 20 years.

As per the Living Planet report:

- The present species extinction rate is up to 100 to 1000 species extinction per 10,000 species in 100 years. This is almost 1000 times more than the natural rate of extinction.
- The living planet index, which measures the biodiversity abundance levels, shows a persistent downward trend. The monitored species population has declined by 58% since 1970.
- There has been a 40% decline in species in tropical forests since 1970.

- In temperate grasslands, the species population has declined by 18%, and in freshwater habitats, the species population has declined by 81% since 1970.

The primary causes that are responsible for the loss of Biodiversity are-

- **Habitat loss and fragmentation:** This primary cause drives animals and plants to extinction. The habitat loss and fragmentation have been through changes in land use, in particular, the conversion of natural ecosystems to cropland, the development of infrastructure projects like rails and roadways, and increasing urbanization and mining activities.
 - As per the Living Planet report, there has been about 30% decline in wetlands in the last 40 years. Wetlands have been primarily reclaimed for agriculture and urbanization. Also, about 50% of the tropical and subtropical forests and 45% of the temperate grasslands have been converted for human use.
 - Besides total loss, the degradation of many habitats by pollution also threatens the survival of many species. When large habitats are broken up into smaller fragments because of different human activities, mammals and birds require large territories. Certain animals with migratory habits are adversely affected, causing a decline in their population.
- **Over-exploitation of species:** Unsustainable use of ecosystems and over-exploitation of biodiversity are major reasons behind biodiversity loss. Over-hunting or poaching of species, overfishing, and over-harvesting of plant products can quickly decline biodiversity. Changing consumption patterns of humans is often cited as the key reason for this unsustainable exploitation of natural resources. Many species which got extinct in the past 5 centuries, like Steller's sea cow, and the passenger pigeon, were subject to over-exploitation by humans.
- **Introduction of alien species:** Plants, animals, and microorganisms transported deliberately or unintentionally from an outside geographical region can cause great damage to native species by competing with them for food and shelter, spreading diseases unknown to them, causing genetic changes through the process of interbreeding with native species, and disrupting various aspects of their food chains and the physical environment. For example, in India, the British introduced water hyacinth for beautification. But over time, it has become an invasive species, clogging rivers, lakes, and other water bodies, thus not allowing any aquatic life to grow and survive.
- **Environmental pollution:** Pollution such as phosphorus and nitrogen largely from excess fertilizers running off farmland, harmful chemicals from urban and suburban runoff, industrial effluents, etc., which are discharged into the natural water bodies. For example, an oil spill off the port of Ennore in Chennai in 2017. Similarly, plastic pollution causes the death of animals. Also, air pollution from industries and vehicles has resulted in the death of many bird species in urban areas.
- **Global climate change:** Climate change is projected to become a progressively more significant threat to biodiversity in the coming decades. Already, changes in the flowering and migration patterns as well as in the distribution of various species have been observed throughout the world. These changes have altered food chains and created mismatches within ecosystems where different species have evolved synchronized inter-dependence.
- **Co-extinctions:** When a particular species becomes extinct, the plants and animals associated with it in an obligatory way also come the danger of becoming extinct. For example, When a host fish species becomes extinct, its unique assemblage of parasites also meets the same fate.

- **Natural causes:** Floods, earthquakes, and other natural disasters also cause biodiversity loss.

Conservation of Biodiversity

Seeing the threats to Biodiversity, there is a need to conserve Biodiversity. The Conservation of Biodiversity means preserving, protecting, and managing the ecosystem and natural habitats. There are two types of biodiversity conservation-

In-situ conservation-

The Conservation of Biodiversity in the natural environment is called in-situ conservation. E.g., Sanctuaries, National parks, Reserved forests, Biosphere Reserves, etc.

The principal aims of in-situ conservation include:

- Promotion of protection, restoration, and sustainable management of the protected area.
- Development of strategies for conservation of biodiversity within the area.
- Creation of natural corridors linking areas of biological interest to prevent further habitat fragmentation.
- Introduction of legislation to protect the species.
- Information dissemination, education, and awareness generation.
- Promoting sustainable tourism in sensitive areas.

Ex-situ conservation-

Conservation of the Biodiversity outside the naturally occurring area is known as ex-situ conservation: E.g., DNA banks, cryopreservation, Zoological parks, Wildlife Safari parks, botanical gardens, Seed banks, Sperm banks, and Collection of living organisms for research and development purposes.