

Biodiversity

Biodiversity describes the richness and variety of life on earth. It refers to variabilities among plants, animals and microorganism species. It includes the number of different organisms and their relative frequencies in an ecosystem. It also reflects the organization of organisms at different levels.

Biodiversity holds ecological and economic significance. It provides us with nourishment, housing, fuel, clothing and several other resources. It also extracts monetary benefits through tourism. Therefore, it is very important to have a good knowledge of biodiversity for a sustainable livelihood.

Types of Biodiversity

Species diversity

Species diversity refers to the variety of different types of species found in a particular area. It is the biodiversity at the most basic level. It includes all the species ranging from plants to different microorganism. The individuals of the same species are exactly similar. For example, humans show a lot of diversity among themselves.

Genetic diversity

It refers to the variations among the genetic resources of the organisms. Every individual of a particular species differs from each other in their genetic constitution. That is why every human looks different from each other. Similarly, there are different varieties in the same species of rice, wheat, maize, barley, etc.

Ecological diversity

An ecosystem is a collection of living and non-living organisms and their interaction with each other. Ecological biodiversity refers to the variations in the plant and animal species living together and connected by food chains and food webs. It is the diversity observed among the different ecosystems in a region. Diversity in different ecosystems like deserts, rainforests, mangroves, etc., include ecological diversity.

Importance of Biodiversity

Biodiversity and its maintenance are very important for sustainable development on earth. It maintains the Ecological Stability and every species has a specific role in an ecosystem. The ecosystem supports the services without which humans cannot survive. A diverse ecosystem is more productive and can withstand environmental stress.

Biodiversity is a reservoir of resources for the manufacture of food, cosmetic products and pharmaceuticals. Crops livestock, fishery, and forests are a rich source of food.

Wild plants such as Cinchona and Foxglove plant are used for medicinal purposes. Wood, fibers, perfumes, lubricants, rubber, resins, poison and cork are all derived from different plant species.

The national parks and sanctuaries are a source of tourism. They are a source of beauty and joy for many people.

All the species have a right to exist. Humans should not cause their voluntary extinction. Biodiversity preserves different cultures and spiritual heritage. Therefore, it is very important to conserve biodiversity.

Biodiversity Conservation Methods

Biodiversity conservation is the protection and management of biodiversity to obtain resources for sustainable development.

Biodiversity conservation has three main objectives:

- To preserve the diversity of species.
- Sustainable utilization of species and ecosystem.
- To maintain life-supporting systems and essential ecological processes

Biodiversity refers to the variability of life on earth. It can be conserved in the following ways:

- In-situ Conservation
- Ex-situ Conservation

In-situ Conservation

In-situ conservation of biodiversity is the conservation of species within their natural habitat. In this method, the natural ecosystem is maintained and protected. Certain protected areas where in-situ conservation takes place include national parks, wildlife sanctuaries and biosphere reserves.

National Parks

These are small reserves maintained by the government. Its boundaries are well demarcated and human activities such as grazing, forestry, habitat and cultivation are prohibited.

Wildlife Sanctuaries

These are the regions where only wild animals are found. Human activities such as timber harvesting, cultivation, collection of woods and other forest products are allowed here as long as they do not interfere with the conservation project. Also, tourists visit these places for recreation.

Biosphere Reserves

Biosphere reserves are multi-purpose protected areas where the wildlife, traditional lifestyle of the inhabitants and domesticated plants and animals are protected. Tourist and research activities are permitted here.

The in-situ conservation has several advantages.

- It is a cost-effective and a convenient method of conserving biodiversity.
- A large number of living organisms can be conserved simultaneously.
- Since the organisms are in a natural ecosystem, they can evolve better and can easily adjust to different environmental conditions.

Ex-situ Conservation

Ex-situ conservation of biodiversity involves the breeding and maintenance of endangered species in artificial ecosystems such as zoos, nurseries, botanical gardens, gene banks, etc. There is less competition for food, water and space among the organisms.

Ex-situ conservation has the following advantages:

- The animals are provided with a longer time and breeding activity.
- The species bred in captivity can be reintroduced in the wild.
- Genetic techniques can be used for the preservation of endangered species.

Biodiversity is being lost due to the loss of habitat, over-exploitation of resources, climatic changes, pollution, invasive exotic species, diseases, hunting, etc. Since it provides us with several economic and ethical benefits and adds aesthetic value, it is very important to conserve biodiversity.

Biodiversity in India

India is one of the world's 'mega diversity' country. It has tremendous biodiversity, genetic as well as of species and ecosystems. It contains over 7 per cent of the world's biodiversity on 2.5 per cent of the Earth's surface. This diversity can be attributed to the vast variety of landforms and climates resulting in habitats ranging from tropical to temperate, and from alpine to desert.

India is one of the most diverse nations in the world. It ranks ninth in terms of plant species richness. Two of the world's 25 biodiversity hotspots are found in India. It is the origin of important crop species such as pigeon pea, eggplant, cucumber, cotton and sesame. India is also a center of various domesticated species such as millets, cereals, legumes, vegetables, medicinal and aromatic crops, etc. It is ranked ninth in the world in terms of higher plant species richness.

The number of plant species in India is estimated to be over 45,523 representing about 11.8 per cent of the world's flora. These include over 17,500 flowering plants of which 4,950 species are endemic. It is estimated that 32% of Indian plants are endemic to the country and found nowhere else in the world. Among the plant species the flowering plants have a much higher degree of endemism, a third of these are not found elsewhere in the world. India is also considered as one of the world's eight centers of origin of cultivated plants.

India's faunal wealth is equally diverse. The total number of animal species is estimated at 91,307, representing about 7.46 per cent of the world's fauna. India's known animal diversity includes about 8,61,696 insects, 21,723 fish, 240 amphibians, 460 reptiles, 1,232 birds and 39 mammals. It also includes about 86,413 invertebrates. Among amphibians found in India, 62% are unique to this country. Among lizards, of the 153 species recorded, 50% are endemic. High endemism has also been recorded for various groups of insects, marine worms, centipedes, mayflies and fresh water sponges. India also contains vast microbial diversity.

Endangered species in India

Endangered species are the organisms whose number have reduced drastically and if not conserved will become **extinct**. The IUCN Red List of Threatened Species (also known as the IUCN Red List or Red Data List), founded in 1964, is the world's most comprehensive inventory of the global conservation status of biological species. The International Union for the Conservation of Nature (IUCN) is the world's main authority on the conservation status of species.

India's biodiversity is threatened by the destruction and degradation of ecosystems and by over exploitation of species. Due to rapid habitat loss, and over exploitation in particular large number of epiphytes, herbs, climbers disappear from their native regions over the years. Many orchids, tree, ferns, medicinal herbs of hills, cycads were considered as major endangered plant species.

Identically large number of mammals, birds, reptiles, corals and fishes were demarked as threatened in our country. A good number of conservation sites were declared for protection of such endangered plants and animals.

On the basis of survey carried out by Botanical Survey of India and also by Zoological Survey of India, the Red data book with respect to endangered plants and animals were already published. It contains 132 species of plants and animals in India listed as critically endangered. According to the IUCN Red List by the International Union for Conservation of Nature there are also 48 critically endangered plant species in India. (2019)

Table 7.6: Some Endangered Plants of India
(Scientific name only)

1. <i>Coptis teeta</i>	11. <i>Dendrobium falconeri</i>
2. <i>Rheum nobile</i>	12. <i>Cymbidium tigrinum</i>
3. <i>Dioscorea vexans</i>	13. <i>Cerbera odollam</i>
4. <i>Berberis asiatica</i>	14. <i>Phoenix rupicola</i>
5. <i>Hoya wightii</i>	15. <i>Aldrovanda vasiculosa</i>
6. <i>Alstonia venenata</i>	16. <i>Mangifera sylvatica</i>
7. <i>Acer laevigatum</i>	17. <i>Clematis theobromina</i>
8. <i>Penax pseudo-ginseug</i>	18. <i>Calanthe alpine</i>
9. <i>Vanda coerulea</i>	19. <i>Citrullus colocynthis</i>
10. <i>Caelogyne nitida</i>	20. <i>Arundina chinensis</i>

Table 7.7: Some endangered animals of India
(Common English name)

Mammals	Amphibian and Reptiles
1. Black Buck	1. Crocodiles
2. Blue whale	2. Gharial
3. Chinese Paugolin	3. Green sea Turtle
4. Chinkara	4. Salamander
5. Dugong	5. Pythons
6. Golden Langur	6. Tortoise
7. Himalayan Thar	7. Water Lizard
8. Hoolock Gibbon	Birds
9. Indian Elephant	1. Andaman Teal
10. Indian Wild Ass	2. Bazas
11. Indian Wolf	3. Bengal Florican
12. Leopard Cat	4. Cheer Pheasant
13. Panther	5. Forest spotted owl
14. Sloth Bear	6. Hanks
15. Wild Buffalo	7. Hornbills
16. Tiger	8. Monal Pheasants
17. Swamp Deer	9. Nicobor Pigeon
18. Snow Leopard	10. Peafowl
19. Rhinoceros	11. Siberian white Crane
20. Musk Deer	12. White ballied Sea Eagle
	13. White spoonbill
	14. Spur fowl

Table 7.5: Status of threatened plants and vertebrate species in India

<i>Categories</i>	<i>Estimated number</i>
1. Flowering	1,336
2. Mammals	39
3. Birds	72
4. Reptiles	17
5. Amphibians	3
6. Fish	2

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The list of critically endangered animals in India

Ganges Dolphin is distributed in the Gangetic-Brahmaputra-Meghna and Karnaphuli- Sangu river systems of India. The total population of Ganges Dolphin is estimated to be between 2500 and 3000 out of which more than 80% is within Indian Territory. The reasons they are an endangered species are accidental killing, entanglement in fishing gear, poaching for its oil and meat, river pollution, constructions of dams and barrages etc.

Gharial is one of the three crocodilians found in India and is the longest of all living crocodilians. Their major population remain in three tributaries of the Ganges River: the Chambal and the Girwa Rivers in India, and the Rapti Naryani River in Nepal. 1200 gharials survive in the wild in India and less than 100 in Nepal. About 1000 gharials are also being reared in various zoos and captive center. River Pollution, human pressure on their habitat, stolen eggs, entanglement in fishermen's nets are the reasons it is an endangered species.

Snow Leopard is a large cat native to the mountain ranges in Central and South. There are as few as 4000 snow leopards in the wild, and their numbers are declining. Habitat loss due to human practices, poaching for the bones, skin and organs of large cats to be used in traditional Asian medicine and the impact of climate change have been the driving force for the declining numbers.

Red Panda is also known as the lesser panda or red cat-bear. It is an arboreal mammal native to the eastern Himalayas. Red Panda's population is on a decrease with the total numbers being around 10,000. Red pandas are often killed when they get caught in traps meant for other animals such as wild pigs and deer. They are also poached for their distinctive pelts, habitat loss and fragmentation, and inbreeding depression is the reasons why it is an endangered species.

One Horned Rhinoceros are large mammal, found in Assam. Despite numerous efforts to help increase their numbers, there are only 3,555 One Horned Rhinoceros. Excessive hunting has reduced the number of this species as these rhinos are killed to saw off their horn, which are sold at a very high value. Also, the disappearance of alluvial plain grasslands has

driven the numbers down as the need for land by the growing human population is a threat to this endangered species habitat.

The Nilgiri Tahr is an ungulate, endemic to the Nilgiri Hills. The latest reports indicate their numbers to be around 1800-2000. Principal threats are habitat loss due to domestic livestock, the spread of invasive plants, and also poaching.

Kashmir Red Stag (Hangul) is a critically endangered species. A survey put the numbers of the red Kashmir Stag is on the brink of extinction. The degradation and loss of habitat from overgrazing and pollution in the periphery of the National Park, along with biotic interferences, are among the main causes for the decreasing population size of this endangered species.

Lion Tailed Macaque is native to the Western Ghats of South India. With an estimated number of less than 4000, which is divided into 47 isolated subpopulations into seven different locations. The major threat to this endangered species today is habitat fragmentation, with many of these fragments getting further fragmented. Also, certain features of the reproductive biology and ecology of this species (such as large inter-birth periods, seasonal resource availability, and female competition for mating opportunities) combine to make it an endangered species.

Asiatic Lion is a Lion subspecies which is endangered. The current total population of Asiatic Lion is around 350. It was increasing in past but has now reached a stable number because of increased poaching incidents. The Asiatic lion is vulnerable to extinction from unpredictable events, such as an epidemic or large forest fire. There have also been indications of poaching incidents in recent years and of drownings after Lions fell into wells.

Bengal Tiger is the national animal of both India and Bangladesh. Although from the latest available survey, the estimated population figures are of 1706, an increase from earlier numbers, still it comes up as an endangered species. Numerous biologists and researchers in the field blame their decline on Poaching and Habitat Loss.

WESTERN GHATS

The Western Ghats are internationally recognized as a region of immense global importance for the conservation of biological diversity, besides containing areas of high geological, cultural and aesthetic values. A significant characteristic of the Western Ghats is the exceptionally high level of biological diversity and endemism. This mountain chain is recognized as one of the world's eight 'hottest hotspots' of biological diversity along with Sri Lanka.

The Western Ghats, a 1600 km long mountain range that runs parallel to the western coast of India, approximately 30-50 km inland, the Ghats traverse the States of Kerala, Tamil Nadu, Karnataka, Goa, Maharashtra and Gujarat. Older than the great Himalayan mountain chain, the Western Ghats of India are a geomorphic feature of immense global importance. The Outstanding Universal Value of the Western Ghats is manifested in the region's unique and fascinating influence on large-scale biophysical and ecological processes over the entire Indian peninsula.

The mountains of the Western Ghats and their characteristic montane forest ecosystems influence the Indian monsoon weather patterns that mediate the warm tropical climate of the region, presenting one of the best examples of the tropical monsoon system on the planet. The Ghats act as a key barrier, intercepting the rain-laden monsoon winds that sweep in from the south-west during late summer.

The forests of the Western Ghats include some of the best representatives of non-equatorial tropical evergreen forests in the world. At least 325 globally threatened (IUCN Red Data List) species occur in the Western Ghats.

The globally threatened flora and fauna in the Western Ghats are represented by 229 plant species, 31 mammal species, 15 bird species, 43 amphibian species, 5 reptile species and 1 fish species. Of the total 325 globally threatened species in the Western Ghats, 129 are classified as Vulnerable, 145 as Endangered and 51 as Critically Endangered.

The Western Ghats contain exceptional levels of plant and animal diversity and endemism for a continental area. In particular, the level of endemism for some of the 4-5,000 plant species recorded in the Ghats is very high: of the nearly 650 tree species found in the Western Ghats, 352 (54%) are endemic. Animal diversity is also exceptional, with amphibians (up to 179 species, 65% endemic), reptiles (157 species, 62% endemic), and fishes (219 species, 53% endemic).

Invertebrate biodiversity, once better known, is likely also to be very high (with some 80% of tiger beetles endemic). A number of flagship mammals occur in the property, including parts of the single largest population of globally threatened 'landscape' species such as the Asian Elephant, Gaur and Tiger.

Endangered species such as the lion-tailed Macaque, Nilgiri Tahr and Nilgiri Langur are unique to the area. The property is also key to the conservation of a number of threatened habitats, such as unique seasonally mass-flowering wildflower meadows, Shola forests and Myristica swamps. The range is home to new species of flora and fauna continue to be regularly discovered in this region, despite the negative effects of shrinking ecosystems and climate change.

There are over 40 different national parks, and wildlife sanctuaries and Biosphere reserves spread across this region, besides numerous hill stations. There are five iconic species of this region:

1. The Great Indian Hornbill -The heaviest member of the Hornbill family, their impressive size and colour have made them important in many tribal cultures and rituals. The Great Hornbill is long-lived, living for nearly 50 years and usually mates for life. They are also crucial to the seed dispersal of several tree species since they are avid fruit eaters.

2. Gaur (Indian Bison) - The largest and tallest wild cattle species in the world, the Gaur or Indian Bison, is to be found their largest concentration here. Standing 6 to 7.5 ft tall and weighing over a ton, Gaur have few natural predators, and have been known to successfully defend themselves from tigers.

3. Lion Tailed Macaque -Also known as the Wanderoo, this primate species is endemic to the Western Ghats, and is marked by its distinct appearance of a silver mane. It is an endangered species that thrives in the upper reaches of the tropical forest

4. Nilgiri Tahr - also called Ibex, is the state animal of Tamilnadu and is another endemic species to this region. They inhabit the region of open grasslands at the higher elevations above 2000m, also known as the Shola Forest.

5. Nilgiri Marten - The only species of Marten to be found in south India, this is an extremely rare and elusive animal. It is unmistakable with a bright orange throat and is a mostly arboreal (tree dwelling) creature that descends to the ground only occasionally.

Project Tiger – Tiger Conservation

Tiger, the national animal of India, is among the most prized sightings in the country's jungles, which boast more than half of the world's population of the feline. To protect this majestic denizen of the forest, Project Tiger, a conservation project was launched in 1972. Indian tiger population at the end of the 20th century was estimated at 20,000 to 40,000 individuals. The project is administered by the National Tiger Conservation Authority (NTCA). It aims at ensuring a viable population of Bengal tigers in their natural habitats, protecting them from extinction etc. Under this project the govt. has set up a Tiger Protection Force to combat poachers and funded relocation of villagers to minimize human-tiger conflicts

- The first country-wide tiger census conducted in 1972 estimated the population to comprise a little more than 1,800 individuals, an alarming reduction in tiger population.
- In 1973, Project Tiger was launched in the Palamau Tiger Reserve, and various tiger reserves were created in the country based on a 'core-buffer' strategy.
- The first Project Tiger was launched in Jim Corbett National Park of Uttarakhand in 1973.
- India has more than 80 national parks and 441 Sanctuaries of which some have been declared as Tiger reserves.
- Tiger reserves are governed by the Project Tiger (1973).
- It is a Centrally Sponsored Scheme of the **Ministry of Environment and Forests**.
- It is administered by the **National Tiger Conservation Authority**.
- Aim: Protect tigers from extinction by ensuring a viable population in their natural habitats.
- Government has set up a **Tiger Protection Force** under PT to combat poachers. PT funds relocation of villagers to minimize human-tiger conflicts.

Core and Buffer zones

- The Tiger Reserves are constituted on a 'core-buffer strategy'.

Core Zone

- The core area is kept **free of biotic disturbances** and forestry operations, where collection of minor forest produce, grazing, human disturbances are not allowed within.
- These areas are required to be kept for the purposes of tiger conservation, without affecting the rights of the Scheduled Tribes or such other forest dwellers.
- These areas are notified by the **State Government** in consultation with an Expert Committee (constituted for that purpose).

Buffer Zone

- The Act defines buffer zone as the area peripheral to the critical tiger habitat or core area providing **supplementary habitat** for dispersing tigers, besides offering scope for **co-existence of human activity (tribals)**.
- The limits of such areas are determined with the concerned **Gram Sabha** and an Expert Committee constituted for the purpose.

The Tiger reserves in India

The tiger count is prepared after every four years by the National Tiger Conservation Authority (NTCA) provides details on the number of tigers in the 18 tiger reserve states with 50 tiger reserves in India which are governed by Project Tiger which is administered by the National Tiger Conservation Authority (NTCA).

India is home to 80 percent of tigers in the world. In 2006, there were 1,411 tigers which increased to 1,706 in 2010, 2,226 in 2014 and 2,967 in 2018. The Indian increase played a big role in driving up global populations as well; the number of wild tigers globally rose from 3,159 in 2010 to 3,890 in 2016 according to World Wildlife Fund and Global Tiger Forum.

By the year 2018, according to the National Tiger Conservation Authority, there were estimated only 2,967 tigers in existence in India.^[6] The 2010 National Tiger Assessment estimated the total population of tigers in India at 1,706. As per Ministry of Environment and Forests, the tiger population in India stood at 2,226 in 2014 with an increase of 30.5% since the 2010 estimate.

This exhaustive study indicated that better protected tiger source sites, especially tiger reserves, have maintained viable populations. However, the area occupied by tigers outside protected areas has decreased

considerably. This demonstrates the need for corridors in order for tigers to move between source sites. The existing tiger reserves represent around one-third of India's high density forest area.^[7] More tigers were killed in the first quarter of 2016 than in the entire previous year. This significant revelation comes at a time when the tiger census numbers are disputed by the scientific community.

Tiger reserves of India	
National Tiger Conservation Authority Project Tiger	
Assam	Kaziranga Tiger Reserve Manas Tiger Reserve Nameri Tiger Reserve Orang Tiger Reserve
Arunachal Pradesh	Kamlang Wildlife Sanctuary Namdapha Tiger Reserve Pakhui Tiger Reserve
Andhra Pradesh	Nagarjunsagar-Srisaillam Tiger Reserve
Bihar	Valmiki Tiger Reserve
Chhattisgarh	Achanakmar Tiger Reserve Indravati Tiger Reserves Udanti & Sitanadi Tiger Reserve
Jharkhand	Palamau Tiger Reserve
Karnataka	Bandipur Tiger Reserve Kali Tiger Reserve Nagarhole Tiger Reserve Bhadra Tiger Reserve Anshi Dandeli Tiger Reserve Biligiri Rangaswamy Temple Wildlife Sanctuary
Kerala	Periyar Tiger Reserve

	Parambikulam Tiger Reserve
Madhya Pradesh	Bandhavgarh Tiger Reserve Bori-Satpura Tiger Reserve Kanha Tiger Reserve Panna Tiger Reserve Pench Tiger Reserve Sanjay-Dubri Tiger Reserve
Maharashtra	Melghat Tiger Reserve Tadoba-Andhari Tiger Reserve Shahayadri Tiger reserve Nagzira-Navegaon Tiger Reserve Bor Tiger Reserve
Mizoram	Dampa Tiger Reserve
Odisha	Satkosia Tiger Reserve Simlipal Tiger Reserve Sunabeda Tiger Reserve
Rajasthan	Ranthambhore Tiger Reserve Sariska Tiger Reserve Mukandra Hills Tiger Reserve
Tamil Nadu	Kalakkad Mundanthurai Tiger Reserve Anamalai Tiger Reserve Mudumalai Tiger Reserve Sathyamangalam Tiger Reserve
Telangana	Kawal Tiger Reserve Nagarjunsagar-Srisailam Tiger Reserve Amrabad Tiger Reserve
Uttar Pradesh	Dudhwa Tiger Reserve Pilibhit Tiger Reserve
Uttarakhand	Corbett Tiger Reserve Rajaji Tiger reserve

West Bengal

Buxa Tiger Reserve
Sunderbans Tiger Reserve

