

Biodiversity: Genetic species and ecosystem diversity, bio-geographical classification of India. Value of biodiversity, threats to biodiversity, endangered and endemic species of India, conservation of biodiversity.

3.1 BIODIVERSITY

.1 Genetic Species and Ecosystem Diversity

What is Biodiversity? Explain different types of Biodiversity.

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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 uniqueness of all the plant and animal species at different scales in space-locally, in a region, in the country and the world; and the types of ecosystems, both terrestrial and aquatic, within a defined area.

Biological diversity deals with the degree of nature's variety in the biosphere. This variety can be observed at three levels the genetic variability within a species; the variety of species within a community; and the organization of species in an area into distinctive plant and animal communities.

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Genetic Diversity

Each member of any animal or plant species differs widely from other individuals in its genetic makeup, owing to the large number of combinations possible in the genes that give every individual specific characteristics. Thus, for example, each human being is very different from all others. This genetic variability is essential for a healthy breeding population of a species. If the number of breeding individuals is reduced, the dissimilarity of genetic makeup is reduced and

in-breeding occurs. This leads to genetic anomalies and, eventually, to the extinction of that particular species.

The diversity wild species forms the 'gene pool' from which our crops and domestic animals have been developed over thousands of years. Today, the variety of nature's bounty is being further exploited by using wild relatives to create new varieties of more productive, disease-resistant crops and to breed superior domestic animals. Modern biotechnology also manipulates genes to develop better types of medicines and a variety of industrial products.

2. Species Diversity

The number of species of plants and animals that are present in a region constitutes its species diversity. This diversity is seen both in natural ecosystems and in agricultural ecosystems. Some areas are richer in species than others.

For example, natural undisturbed tropical forests have much greater species richness than monoculture plantations developed by the Forest Department for timber production. A natural forest ecosystem provides a large number of non-timber forest products (NTFPs) that local people depend on, such as fruit, fuelwood, fodder, fiber, gum, resin and medicines. Timber plantations do not provide the large variety of goods that are essential for local consumption. In the long-term, the economic sustainable returns from NTFPs is said to be greater than the returns from felling a forest for its timber.

Thus, the commercial value of a natural forest, with all its species richness, is much greater than a plantation. Modern intensive agricultural ecosystems have a relatively lower diversity of crops than traditional agro-pastoral farming systems, where multiple crops were planted.

At present, conservation scientists have been able to identify and categorize about 1.8 million species on Earth. However, this is only a fraction of what really exists. Many new species are being identified; especially in the flowering plants and insects. Areas that are rich in species diversity are called 'hotspots' of diversity; India is among the world's 15 nations that are exceptionally rich in species diversity.

3. Ecosystem Diversity

There are a large variety of different ecosystems on Earth, each having their own complement of distinctive interlinked species based on the differences in the habitat. Ecosystem diversity can be described for a specific geographical region, or a political entity such as a country, a State or a talukd. Distinctive ecosystems include landscapes like forests, grasslands, deserts, mountains, etc., as well as aquatic ecosystems like rivers, lakes, and seas. Each region also has man-modified areas such as farmland or grazing pastures.

An ecosystem is referred to as 'natural' when it is relatively undisturbed by human activities or 'modified' when it is changed to other types of uses, such as farmland or urban areas. Ecosystems are most natural in wilderness areas. If natural ecosystems are overused or misused their productivity eventually decreases and they are then said to be degraded.

Q2. What are hot spots of Biodiversity?

Ans :

Hotspots of biodiversity are those areas which are mostly rich in endemic species and are in constant threat of overexploitation. Across the world, 18 biodiversity hotspots have been identified out of which three of them are located in India. These are

the Eastern Himalayas, the Western Ghats and hilly ranges of India Myanmar border. All the hotspots contain approximately 49,995 endemic plant species in 746,400 sq km or 0.5% of earth land surface.

1. North-east Himalayas

From the dense evergreen and semi-evergreen vegetation of the foothills in the Eastern Himalaya, the character of vegetation changes at altitudes of 1525 m to 1830 m. Oaks, magnolias, laurels and birches covered with moss and ferns replace the sal, silk-cotton trees and giant bamboos of the foothills. About 2745 m to 3660 m one enters the coniferous forest of pine, fir yew and juniper.

There is undergrowth of scrub Rhododendrons and dwarfs bamboos. Due to high humidity and much higher rainfall lichens, mosses, orchids and other epiphytes cover the tree trunks. The animal life in the temperate region is different from the western Himalaya and is characterized by the presence of Indo Chinese fauna. The red panda, hog badgers, ferret badgers, crested porcupines are typical species of this area. Three kinds of goat antelopes also occur in the eastern Himalaya and are relatives of the European chamois. Goral is a smaller goat antelope found throughout the tract of rugged grassy slopes and on rocky ground near the conifers forests.

2. Western Ghats

The Western Ghats and the central belt lying to the west of it, is a region of very high rainfall and is characterized by evergreen vegetation its flora and fauna being a kin to the evergreen rain forest of north-eastern India. Among primates the lion tailed (Macaca silenus), one of the world's most endangered primates surviving in the evergreen forests of the Western Ghats of south India, its total population is estimated to be about 800 only. In the langur group, the nilgiri 'langur' (Presbytis johni) is a multihabitat species occurring in addition to the shoals, in the temperate evergreen forests above 1700 m altitude in the Western Ghats. A number

climbing animals have evolved gliding mechanisms and are particularly characteristic of these forests. Among these are the flying squirrels. The other characteristic species of the Western Ghats are the Nilgiri mongoose, the striped mongoose, the malabar civet and the spiny mouse.

The flora and fauna of these evergreen regions have not been fully explored. Being a store house of a large variety of plants and animals, these forests represent one of the richest gene pool resources of flora and fauna in the country. Though a large number of such forests have not been destroyed for various plantation crops like rubber, cocoa, coffee etc., whatever virgin forests remain have to be specially protected as in the Silent Valley of Kerala or the rich orchid belt of the north-eastern Himalayas in Arunachal Pradesh and Sikkim.

3.2 BIO-GEOGRAPHICAL CLASSIFICATION OF INDIA

Q3. Explain Bio-Geographical Classification of India.

(Imp.)

Ans :

India can be conveniently divided into ten major and other invertebrates that live in them. Each of these regions contains a variety of ecosystems such as forests, grasslands, lakes, rivers, wetlands, mountains and hills which have specific plant and animal species.

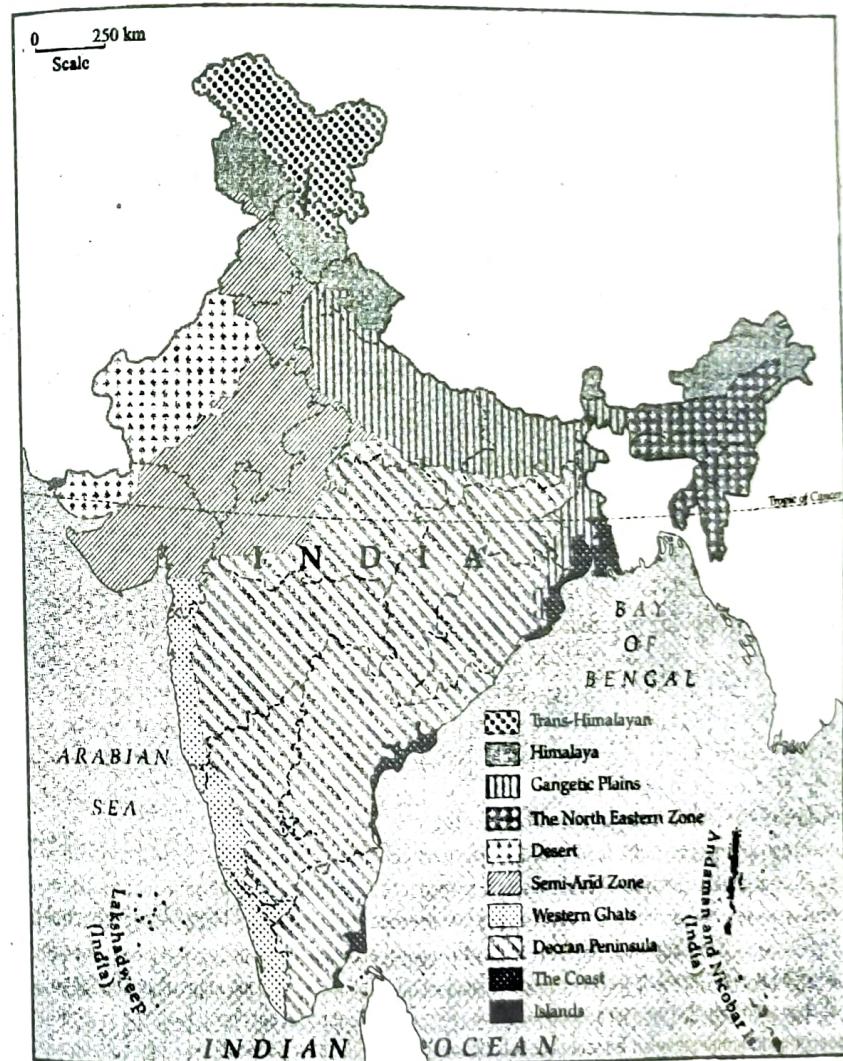


Fig.: Biogeographic classification of India

India's Biogeographic Zones

- (i) The cold, mountainous, snow-covered trans-Himalayan region of Ladakh.
- (ii) The Himalayan ranges and valleys of Kashmir, Himachal Pradesh, Uttarakhand, Assam and other Northeastern states.
- (iii) The Terai, the lowland where the Himalayan rivers flow into the plains
- (iv) The Gangetic and Brahmaputra plains.
- (v) The Thar desert of Rajasthan
- (vi) The semi-arid grassland region of the Deccan plateau, Gujarat, Maharashtra, Andhra Pradesh, Karnataka and Tamil Nadu
- (vii) The Northeastern states of India
- (viii) The Western ghats in Maharashtra, Karnataka and Kerala
- (ix) The Andaman and Nicobar islands
- (x) The long western and eastern coastal belts with sandy beaches, forests and mangroves.

3.2.1 Value of Biodiversity

Q4. Explain about Value of biodiversity.

Ans : (Imp.)

Biodiversity provides a variety of environmental services from its species and ecosystems that are essential at the global, regional and local levels. The production of oxygen, reduction of carbon dioxide, maintenance of the water cycle and protection of the soil are some important services.

Biological diversity is also essential for preserving ecological processes, such as fixing and recycling of nutrients, soil formation, circulation and cleansing of air and water, global life support (plants absorb CO₂ and give out O₂), maintaining the water balance within ecosystems, watershed protection, maintaining stream and river flows throughout the year, erosion control and local flood reduction.

Food, clothing, housing, energy and medicines are all resources that are directly or indirectly linked to the biological variety present in the biosphere. This is most obvious in the case of tribal communities who directly gather resources from the forest or fisherfolk who catch fish in marine

or freshwater ecosystems. For others, such as agricultural communities, biodiversity is used to grow crops to suit the environment. Urban communities generally use the greatest amount of goods and services, which are all indirectly drawn from natural ecosystems.

It has become obvious that the preservation of biological resources is essential for the well-being and the long-term survival of humans. This diversity of living organisms, which is present in the wilderness as well as in crops and livestock, plays a major role in human development. The preservation of biodiversity is, therefore, integral to any strategy that aims at improving the quality of human life.

Q5. Explain about Consumptive use Value.

Ans :

Man is mostly dependent on plant and animal resources for his' dietary requirements. A major share of our food comes from domesticated crops and animals. Still we derive major of food from wild species. A large section of human population is dependent on food, which we gather from seas and oceans that is harvested from free roaming wild organisms. Seafood is rich in minerals and vitamins and contains up to 60 percent of the protein. Unfortunately, deforestation, hunting and clearing of forests, grazing and expansion of agricultural land removes potentially valuable food species and the wild ancestors of our domestic crops.

Q6. Explain about Predictive use value of Biodiversity.

Ans :

This category comprises marketable goods. The biotechnologist uses bio-rich areas to prospect and search for potential genetic properties in plants or animals that can be used to develop better varieties of crops for use in farming and plantation programmes or to develop better livestock. To the pharmacist, biological diversity is the raw material from which new drugs can be identified from plant or animal products. To industrialists, biodiversity is a rich storehouse from which to develop new products. For the agricultural scientist, the biodiversity in the wild relatives of crop plants is the basis for developing better crops.

Genetic diversity enables scientists and farmers to selectively develop better crops and domestic animals through careful breeding programs. Earlier, this was done by selecting or pollinating crops artificially to obtain a more productive or disease-resistant strain. Today, it is increasingly being done by genetic engineering selecting genes from one plant and introducing them into another. New crop varieties (cultivars) are being developed using the genetic material found in wild relatives of crop plants through biotechnology.

Even today, new species of plants and animals are being constantly discovered in the wild. These wild species are the building blocks for the betterment of human life and their loss is a great economic loss. Among the known species, only a tiny fraction has been investigated for their value in terms of food or their medicinal or industrial potential.

A variety of industries such as pharmaceuticals, are highly dependent on identifying compounds of great economic value from the wide variety of wild species of plants heated in undisturbed natural forests. This is called biological prospecting.

Q7. Explain about Social Value in Biodiversity.

Ans :

While traditional societies that have a smaller population and required less resources had preserved their biodiversity as a life-supporting resource, modern man has rapidly depleted it up to the extent of leading to the irrecoverable loss due to extinction of several species. So, apart from the local use or sale of products of biodiversity, there is also the social aspect in which more and more resources are used by affluent societies. Our biodiversity has, to a great extent, been preserved by traditional societies that valued it as a resource and appreciated that its depletion would be a great loss to their society. Therein lies a lesson which we would be wise to learn from.

The consumptive and productive value of biodiversity is closely linked to social concerns in traditional communities. 'Ecosystem people' value biodiversity as a part of their livelihood, as well as through cultural and religious sentiments. A great

variety of crops have been cultivated in traditional agricultural systems and this permitted a wide range of produce to be grown and marketed throughout the year and acted as an insurance against the failure of one crop (today's 'monoculture'). In recent years, farmers have begun to receive economic incentives to grow cash crops for national or international markets, rather than to supply local needs. This has resulted in local food shortages, unemployment (cash crops are usually mechanized), landlessness, and increased vulnerability to drought and floods.

Q8. Explain about Ethical and Optional Values in Biodiversity.

Ans :

Ethical Values

Ethical values related to biodiversity conservation are based on the importance of protecting all forms of life. Most religious and secular creeds believe that all forms of life have the right to exist on earth. Humans are only a small part of the earth's great diversity of species. We do not know if life as we know it exists anywhere else in the universe.

Option Value

Keeping future possibilities open for their use is called the option value. It is impossible to predict which of our species or traditional varieties of crops and domestic animals will be of greatest use in the future. To continue to improve cultivars and domestic livestock, we need to return to wild relatives of crop plants and animals. Thus, the preservation of biodiversity must also include traditionally used strains already in existence in crops and domestic animals.

3.2.2 Threats to Biodiversity

Q9. State the various reasons for loss of Biodiversity on earth.

Ans :

(Imp.)

There are numerous reasons which led to the loss of biodiversity on earth. Few of these reasons are effectively discussed below.

1. Urbanization or Industrialization

Urban areas refers to those regions of the society where the local residents have

extremely high standard of life in all respects. Hence, urbanization is a process by which the standard of a given area can be enhanced. This generally happens when a given region is promoted to many developmental activities in which industrialization is said to be the prime motive. As many societies of a given country turn out to be urbanized, people belonging to these areas do not care about various other notions such as nature and other elements.

Hence, with the increase in population in these areas, various drastic effects such as sharing of limited supply of goods and services, vacating many forests areas, not caring for the values of flora and faunas etc., are seen, which is leading to the loss of biodiversity.

Rapid industrialization and urbanization is also destroying the natural habitats of flora and fauna, hence, they are becoming endangered species. Example, destruction of grasslands in India had led the blackbuck (*Antelope cervicapra*) to become an endangered species.

2. Deforestation or Reduced Green Cover Throughout the World

Man's selfishness and greed to acquire greater land was one of the major causes which led to deforestation. Deforestation here refers to cutting down the forests and utilizing these lands for various other purposes like converting into agricultural lands, constructing houses etc. This may resort to loss in biodiversity since the trees which were destroyed supported many species of animal kingdom as the trees are the major source of livelihood and shelter to these animals. This depletion can lead to huge increase in pollution as trees intake harmful carbon dioxide and release the oxygen during the photosynthesis process.

It also accounts for decrease in rainfall, as the trees help to bring about the rain-laden clouds. Loss of soil erosion also occurs as the roots are not present to bind the soil particles, which leads to loss of highly organic humus

soil content. It also leads to decrease in the ground water table as surface-runoff of water occurs, thereby the ground water resources are not replenished.

3. Soil Degradation/Erosion, Loss of Fertility of Land

These generally occur due to deforestation, overgrazing, large streams of running water, droughts, famines, improper tilling and levelling of lands, Jhoom cultivation etc.

4. Drilling, Excavations, Constructions of Roads and Projects

These activities also cause loss of biodiversity since, drilling of land causes usage of heavy machineries which consumes gallons of fuels and at the same time releasing poisonous or harmful gases, hence polluting the earth. At certain times, improper drilling of lands (during laying of roads or excavating ores) can lead to severe earthquakes causing huge loss to life and property. While implementing river valley projects, if the outcomes of projects are not analyzed scientifically, this may cause huge loss to life and property.

Example, the Hydel project which was used for irrigating cultivated lands and also for producing electricity created a serious impact on the ecosystems of the environment.

3.3 ENDANGERED AND ENDEMIC SPECIES OF INDIA

Q10. Explain Endangered and Endemic Species of India.

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(Imp.)

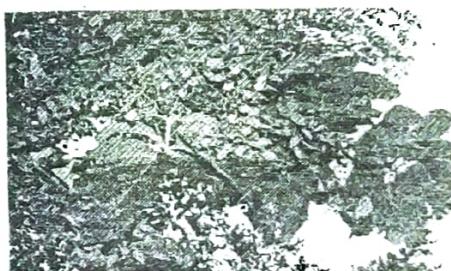
To appreciate the endemic and endangered species of India, it is important to understand the wide variety of plant and animal species found in the country. Of the well-known species, several are endangered by human activity. The endangered species are categorized as vulnerable, rare, indeterminate and threatened. Other species are found only in India and are thus endemic or restricted to our country. Some of these may have very localized distribution and are considered highly endemic.

Several plant and animal species in the country are now found in only one or a few PAs. Among the important endangered animals are charismatic species such as the tiger, elephant, and rhinoceros. The less well-known major mammals, restricted to a single area, include the Indian wild ass, Hangul or Kashmir stag, golden langur, pygmy hog and a host of others. There are also endangered bird species, like the Siberian crane, the great Indian bustard, the florican and several birds of prey. In the recent past, vultures, which were common a decade ago, have suddenly disappeared and are now highly threatened. Equally threatened are several species of reptiles and amphibians. Many invertebrates are also threatened, including a large number of species that inhabit our coral reefs.

Common Plant Species

(i) Teak

This tree is from the southwest of peninsular India. It is a common tree in deciduous forests, and yields the much-sought-after timber used for making furniture. During the early British period, it was cut down from many forest tracts to build ships. As stocks were diminishing, the British selected areas which they called Reserved Forests where teak was planted for the Government's use. Teak is grown extensively by the Forest Department and is a highly priced wood.



Teak

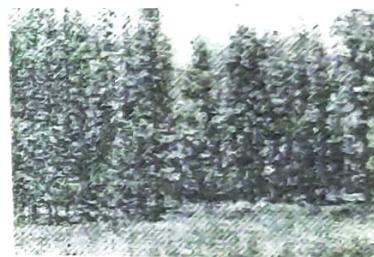
The teak tree is identified by its large leaves, which grow to more than 40-50 cm long and 20 cm wide; it has tiny flowers and fruit. In the winter, the trees shed all their leaves. In the growing season, which begins in April and extends through the monsoon, teak forests are bright green and shady. Most natural teak forests have various other species of plants

and a large number of wild animals. Some teak forests that have exceptional populations of wildlife have been declared as PAs and included in our national parks and wildlife sanctuaries.

(ii)

Sal

This is a common species found in several types of forests of the Northeastern region of India, extending into Madhya Pradesh and Orissa. It has bright green foliage and its canopy remains green almost throughout the year. Sal wood is hard and durable. Sal trees yield a large number of seeds used in making cosmetics. Sal forests are rich in wild mammals, birds, reptiles and insect life. Several areas are included in our network of national parks and sanctuaries.



Sal

(iii) Mango

This has become one of our most popular horticultural species, with different varieties being grown all over the country. The wild mango tree has small tangy fruit and a big seed, in comparison to the large pulpy fruit used in horticulture. The mango tree is an evergreen species and has small flowers pollinated by insects. In the forest, fruit-dependent animals such as monkeys, squirrels, fruit bats and birds relish its ripe fruit.



Mango

(iv) **Ficus**

The peepal, banyan and many other ficus species comprise this. They are all ecologically of great importance as many different species of insects, birds and mammals feed on ficus berries. The flowers are inside the berries. They are pollinated by a specific wasp, which lays its eggs inside the berries on which the larvae feed and grow.

The ficus trees bear berries throughout the year, thus supplying nutritious food to several animal species when the other trees have no fruit. Ficus species are thus known as 'keystone' species and support a major part of the food web in several ecosystems. Ficus trees, such as the peepal and banyan, are considered sacred and are protected in India.



Ficus

(v) **Neem**

This species is known as *Azadirachta indica*. It has been traditionally used in indigenous medicine. It has small yellow fruit; the leaves and fruit are bitter in taste. It is used extensively as an environmentally friendly insecticide. It grows extremely well in semi-arid regions and can be planted in afforestation programmes where the soil is poor and rainfall is low.



Neem

(vi) **Tamarind**

One of the best known Indian trees, it grows to a large size and is known to live for over 200 years. Its familiar fruit is a curved pod with sour pulp, containing a number of squarish seeds. The pulp in the fresh fruit is either green or red. As it ripens, it turns sticky and brown and separates from the skin. It is commonly cultivated as a shade tree and for its edible sour fruit, which contains high concentrations of vitamin C. It is used as a preservative and an additive in food to give a tangy flavour. It is valued for its timber as well as for fuelwood.

(vii) **Babul**

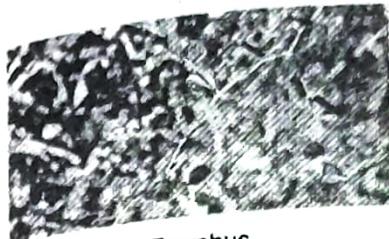
This is a thorny species that is characteristic of the semi-arid areas of Western India and the Deccan plateau. It grows sparsely in tracts of grassland and around farms, and is used for fodder and fuelwood. It remains green throughout the year even under the driest conditions and is browsed on by wild animals and cattle. It has small leaves and bright yellow flowers and small seed-pods with multiple seeds. Its main characteristic is its long, sharp, straight thorns, which prevent excessive browsing Babul of its older branches.



Babul

(viii) **Zizyphus**

These are the small trees and shrubs typically found in the arid and semi-arid areas of India; *Z mauritania* and *Z jujuba* are the most commonly found species. It is a favourite of frugivorous birds. The tree fruits extensively and these are eaten by a variety of birds and mammals. The popular fruit is commonly collected and sold in local markets.



Zizyphus

(ix) **Jamun**

This tree is an evergreen species, which has a tasty purple fruit. It is a favourite with people and with many wild birds and mammals. It grows in many parts of India and has several varieties with fruits of different sizes.



Jamun

(x)

Tendu

A mid-sized, deciduous tree, commonly found in dry deciduous forests throughout the Indian subcontinent. There are around 50 Indian species. Its bark exfoliates in large rectangular scales. It branches out profusely forming a dense crown. The leaves are elliptical and leathery and its young leaves are extensively used for making bidis. The fruit is brownish-yellow and astringent. Tendu-leaf collection necessitates burning the undergrowth and slashing the branches of the trees to get at the leaves. The resulting disturbance to wildlife is a serious issue in PAs.

(xi)

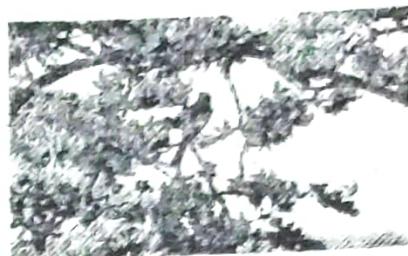
Jackfruit

This tree is planted around many villages and has huge fruit growing directly from its branches. The fruit has a prickly skin. The unripe fruit is cooked like a vegetable. Once ripe, it turns into a sweet, sticky, golden-yellow fruit, which has a strong smell.

(xii) **Flame of the forest (Butea monosperma)**

This tree grows in many parts of India. It has bright orange flowers when it is leafless, and is thus called the 'flame of the forest'. The

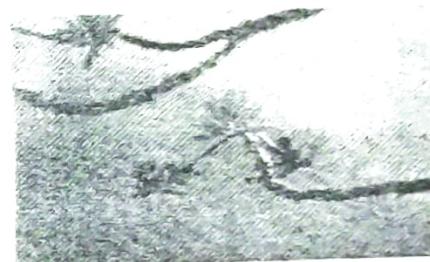
flowers are full of nectar, which attract monkeys and many nectar-dependent birds.



Butea monosperma

(xiii) **Coral tree (Erythrina)**

A common deciduous tree that is leafless in February, when it gets bright scarlet flowers that are used for their nectar by many birds such as mynas, crows and sunbirds, which are its major pollinators. Its long black seed-pods contain several shiny brown seeds which germinate well. This tree can also be propagated by cutting and planting its young branches. It is a rapid grower and usually begins to flower in four or five years' time.



Erythrina

(xiv) **Amla (gooseberry)**

This deciduous medium-sized tree is known for its sour, greenish-yellow fruit, which are rich in vitamin C. It is used as a medicine, in pickles, and for dyeing and tanning. It is frequently referred to as the Indian olive, to which it has no similarity either in appearance or taste.



Amla

(xv) **Dipterocarps**

This group of trees grows in evergreen forests of the southern part of the Western ghats and in the Northeast parts of India, in high rainfall areas. It grows to an enormous height and has a wide girth. The seed has a pair of wing-like structures which aid in wind dispersal.

(xvi) **Quercus (oak)**

It is a large tree and is an economically important genus, which includes many trees known for their beautiful shape and their changing seasonal colours. There are 30-40 Indian species of this genus, found in the temperate areas throughout the Himalayas. The fruit is a large, hard, solitary characteristic nut (acorn). Oaks provide the finest hardwoods of great strength and durability and were once used for building ships and bridges. It is a famous wood for high-quality furniture. Some of its species are also excellent fodder plants.

(xvii) **Pine**

There are five species of true pines found in India in the Himalayan region. The timber of these trees is frequently used in construction, carpentry and the paper industry. Pine resin is used to make turpentine, rosin, tar and pitch. Pine oils are obtained by distillation of the leaves and shoots. Pine leaves are thin and needle-like. The male and female spores are produced in woody cones, and the dispersal of pollen is aided by each grain having two wings.



Pine

(xviii) **Cycads**

These plants are uncommon in India and have a palm-like appearance. Cycads along with conifers make up the gymnosperms. They are among the most primitive seed plants, and have remained virtually un-changed through the past 200 million years (since Jurassic times). There are five species found in India, mostly in high rainfall areas.

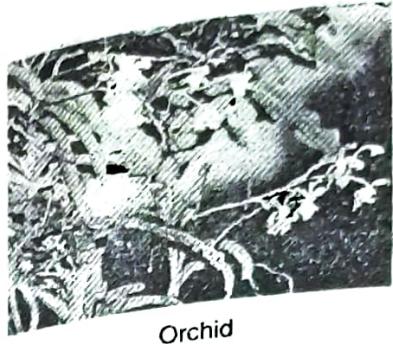
(xix) **Coconut**

This tall stately palm has a more or less straight trunk with circular markings, and is grows mostly in coastal plains. The base is surrounded by a mass of fine roots. It produces the familiar coconut, filled with liquid and a soft white edible, jelly-like material that hardens when the fruit ripens. It is a common ingredient of food in India, especially in the southern states. It is extensively cultivated along the coastal regions and islands of India. Most parts of the tree yield several useful products, such as broomsticks from its leaves and fibre from the husk of dried coconuts.

(xx) **Orchids**

This is the largest group of flowering plants in the world, with over 18,000 known species. Of these, 1500 species are found in India, making it one of the largest plant families in the country with a high concentration of a staggering 700 species in the Northeastern states. These plants are terrestrial or epiphytic herbs. The flowers show a range of bright colours and great variation in structure.

In some species, one of the petals is distinct from the others and is called a lip or labellum; this colorful petal attracts pollinators. In India, a large number of orchid species are found in the Western ghats, the Northeast and the Andaman and Nicobar islands. Orchids are, however, seen in several ecological conditions except extremes such as very cold or very hot and dry ecosystems.



Orchid

(xxi) **Drosera**

This is a small insectivorous plant, usually 5 or 6 cm in height, which has tiny hairs that secrete a sticky droplet of fluid on which insects get stuck. The leaf winds around the struggling insect, which is then slowly digested. The plant has pretty flowers. It grows in shallow, poor-quality soil. It is a rare plant and is found in small patches.

II) **Common Animal Species**

1. **Mammals**

The common deer species found in India include the sambar, chital, barasingha and barking deer. Sambar live in small family parties especially in hilly forested areas and feed mainly on shrubs and leaves of low branches. They are dark brown in colour and have large thick antlers, each having three branches. Chital or spotted deer live in large herds in forest clearings where they graze on the grass. They have a rust-brown body with white spots, which camouflages them in the forest.



Chital

Each antler has three branches called tines. The rare Hangul deer is found only in Kashmir. It has a magnificent spread of antlers with six branches on each antler. The Barasingha or swamp deer has wide hoofs that enable this beautiful animal to live in boggy areas of the terai. Each antler has six or more branches. The tiny barking deer lives in many forest areas all over India. It has two ridges on its face and short antlers with only two branches. Its call sounds like the bark of a dog.



Hangul



Barasingha

The blackbuck is the only true antelope found in India. It lives in large herds. The males are black on top and cream below and have beautiful spiral horns that form a 'V' shape. The chinkara, also known as the Indian gazelle, is a smaller animal, pale brown in colour, with beautiful curved horns. The rare Chausingha, or four-horned antelope, is the only animal in the world that has four horns. The Nilgai is the largest of the dryland herbivores.



Blackbuck

The males are blue-gray in colour. The Nilgai have white markings on the legs and head, and short strong spike-like horns.

A very special rare species is the Indian wild ass, endemic to the Little Rann of Kutch. The Himalayan pastures support several species of wild goat and sheep, many of them restricted to the region, like the goral and the Himalayan Tahr or mountain goat. A single species, the Nilgiri Tahr is found in the Nilgiri and Anamalai hills in South India.



Nilgai



Chinkara

The one-horned rhinoceros is now restricted to Assam, but was once found throughout the Gangetic plains. The wild buffalo or gaur is now also restricted to the terai. The Indian elephant is distributed in the Northeastern and Southern states. It is threatened by habitat loss and poaching for ivory. The gaur is found in patches in several well-wooded parts of India.

The best known predator of our forests is the tiger. Its gold and black stripes hide it perfectly in the forest undergrowth. It preys on herbivores,

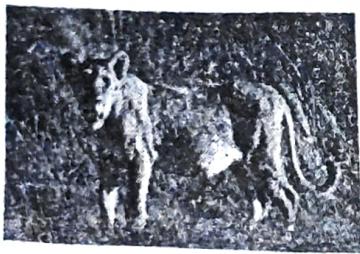


Tiger

such as the sambar or chital, or less frequently on domestic animals.

The tiger kills only three or four times a month. Its numbers have declined due to poaching for its skin, and for the supposed magical value of its teeth, claws and whiskers. In the recent past, it has been extensively killed for the supposed medicinal properties of its bones that are used in Chinese medicine.

The Asiatic lion is now found only in the Gir forests of Gujarat.



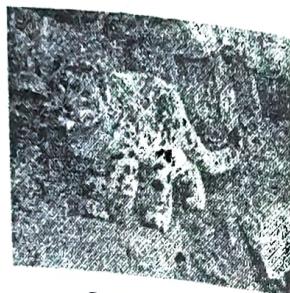
Lion

The leopard is more adaptable than the tiger and lives both in thick forests and degraded forest areas. Its beautiful rosette markings camouflage it so perfectly that its prey cannot see its stealthy approach. The smaller jungle cat, which is a light-brown animal and the leopard cat, which is a little bigger than a domestic cat, are very rare.



Leopard

The most typical predator of the Himalayas is the snow leopard, which is very rare and is poached for its beautiful skin, which is pale grey with darker grey ring-like markings.



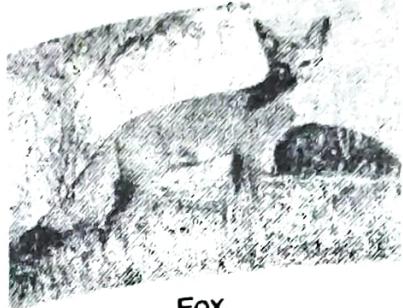
Snow leopard

The wolf, jackal, fox and the wild dog called Dhole form a group called canids. Another threatened predator is the Himalayan wolf. The wolves are now highly threatened as they have become increasingly dependent on domestic sheep flocks. Thus, the shepherds constantly devise ways to kill the wolves.



Dhole

The Indian pangolin is found in many parts of India, including national parks such as Corbett and Gir. The Indian pangolin lives mainly in burrows, its habitat include tropical rain forests, lower slopes of mountains, and sub-tropical thorn forests and plains. Like other pangolins, it has a small triangular shaped head and large, overlapping scales to protect its body. Indian pangolins are insectivores that feed on ants and termites.



Fox

One of the common monkey species of the forest is the bonnet macaque, which has a red face, a very long tail and a whorl of hair on the scalp which looks like a cap. Our other common monkey is the rhesus macaque, which is smaller and has a shorter tail than the bonnet. A rare macaque is the lion-tailed macaque found only in a few forests of the southern Western ghats and Anamalai ranges. It is black in colour, has long hair, a grey mane and a tassel at the end of its tail that looks like a lion's tail.

The common langur has a black face and is also known as the Hanuman langur. The rare golden langur is golden-yellow in colour and lives along the banks of the Manas River in Assam. The capped langur is an uncommon species of Northeast India. The rare black Nilgiri langur lives in the southern Western ghats, the Nilgiris and Lion-tailed macaque Anamalais.



Lion-tailed macaque

2. Birds

There are over 1200 bird species found in India in different habitats.

Most of our forest birds are specially adapted to life in certain forest types. Some

Himalayan species, however, can also be seen in the Western ghats. There are several species of hornbills that live on fruit.

They have heavy curved beaks sometimes with a casque on top.



Hornbill

Frugivores such as parakeets, barbets and bulbuls live on fruit and are often seen eating Ficus fruits such as those of banyan and peepal.

Insectivorous birds of many species live on forest insects. They include various species of flycatchers, bee-eaters and others. The male paradise flycatcher is a small beautiful white bird with a black head and two long white trailing tail feathers. The female is brown and does not have the long tail feathers. There are several birds of prey such as eagles, falcons and kites, many of which are now endangered.



Paradise flycatcher



Bird of prey



Bee-eater

The grasslands support many species of birds. The most threatened species is the great Indian bustard, a large brown stately bird with long legs, which struts about through grasslands looking for locusts and grasshoppers. Another rare group of threatened birds are the floricans.



Great Indian bustard

There are many species of quails, partridges, larks, munias and other grain-eating birds that are adapted to the grasslands.



Partridge

There are several species of aquatic birds such as waders, gulls and terns, which live along the seashore and go out fishing many kilometres to the sea. Many of these birds have lost their coastal habitats due to pollution. The freshwater aquatic birds have long legs and are known as waders such as stilts, egrets and sandpipers. The other group form birds that swim on water like several species of ducks and geese.



Stilt

There are many species of spectacular large birds associated with water or marshy areas. These include different species of storks, cranes, spoonbills, herons, Stilt and pelicans. Many aquatic species are migrants. They breed in Northern Europe or Siberia and come to India in thousands during winters.



Flamingo

3. Reptiles

India has a wide variety of lizards, snakes and turtles and tortoises, with a high level of endemism. The lizards include the common garden lizard, the fan-throated lizard, chameleon, skink, common monitor and water monitor. Most of these are threatened due to trade in reptile skins.



The Indian snakes include the rock python, the grass snake and the vine snake. We rarely appreciate the fact that only a few species of snakes such as the king cobra, cobra, krait and Russell's viper are poisonous and most other snakes are harmless.



King Cobra

The star tortoise and Travancore tortoise are now rare. The Olive Ridley is a marine turtle and comes to nest in large numbers on the coast of Orissa; this unique phenomenon is called the arribada. The freshwater turtles include the flap-shell turtle, the Gangetic and the tented turtles. Many turtles are becoming increasingly rare due to the poaching of adults and eggs. The Star tortoise crocodile is our largest reptile, which is poached for its prized skin.



Star Tortoise

The gharial is a species of fish-eating crocodile, endemic to India and is highly threatened.

Amphibians

Most of the amphibians found in India are frogs and toads; there is one species of skink. These include several species such as the Indian bullfrog and tree frog. These amphibians are mostly found in the hotspots in the Northeast and the Western ghats. It is now believed that global warming and increasing levels of UV radiation may be seriously affecting amphibian populations in some areas.

Invertebrates

Invertebrates include a variety of taxa that inhabit both terrestrial and aquatic ecosystems. Microscopic animals like protozoa and zooplankton form the basis of the food chain in aquatic habitats. Coral is formed by colonies of polyp-like animals. Worms, mollusks (snails), spiders, crabs, jellyfish and octopus are a few of the better-known invertebrates found in India.



Crab



Beetle

There are more than a million insect species on earth that are known. They include grass hoppers, bugs, beetles, ants, bees, butterflies and moths. India is rich in its butterfly and moth species.



Snail



Spider

6. Marine life

Marine ecosystems are most frequently associated with fish and crustaceans, like crabs and shrimp, which we use as food. The other endangered species include marine turtles (reptiles) and whales (mammals). There are a large number of species of freshwater fish found in Indian rivers and lakes that are now threatened by the introduction of fish from abroad as well as due to being introduced from one river into another. Fish are also now seriously affected by pollution. Marine fisheries are

being over-harvested in our coastal waters and the fish catch has decreased seriously over the few years. Mechanised boats with giant, small-meshed nets are a major cause of the depletion. There are many endangered fish such as the Mahseer, which once grew to over a metre in length. Many species of marine animals, such as whales, sharks and dolphins that live in the Indian Ocean, are now threatened by extinction due to fishing in the deep sea.

3.3.1 Conservation of Biodiversity

Q11. What is Conservation of Biodiversity?

(OR)

Explain Ex Situ and In Situ Conservation of Biodiversity.

Ans :

India is the seventh largest country in the world and one of the top bio-rich nations with great diversity in the geographical and biological features. In this context, the term conservation refers to protection, preservation, management, or restoration of biological resources as well as natural resources. There is a pressing need for the conservation of biodiversity as it is being threatened due to human activities. The other reasons for conserving biodiversity include preserving the valuable natural resources for future generations and maintain the dynamic balance of nature's complex ecosystem. The main objectives of conserving biodiversity are,

- Sustain the ecological processes and life supporting systems.
- Preserve the biological diversity for future generations.
- Ensure the survival of many species and habitats. Conservation of biodiversity can be broadly categorized into two types: In-situ conservation and ex-situ conservation.

1. In-situ Conservation

In-situ conservation of biodiversity refers to preserving the biological diversity within the natural habitat.

The objectives of in-situ conservation are,

- Maintenance of genetic diversity of species in their natural habitat along with evolutionary adaptations to enable them to adapt to changing environmental conditions.
- Preserving the interlinked species along with the target species.
- Preserving the diversity of threatened species.

The measures involved in in-situ conservation of biological diversity includes designating specific areas as protected sites such as national parks and wildlife sanctuaries. This enables the total diversity of a region from microscopic unicellular plants and animals to the giant trees and large mammals to be preserved and protected.

Wildlife Sanctuaries and National Parks in India

India is home to 441 wildlife sanctuaries and 80 national parks, consisting about two thousand different species of birds, 3500 species of mammals, around 30,000 species of different kinds of insects and above 15,000 varieties of plants. Some endangered species of animals and birds especially the Asian Elephant, the Royal Bengal Tiger, the snow Leopard and the Siberian crane reside in these sanctuaries and forest reserves.

The great Himalayan National Park has more than 375 faunal species, the major ones being blue sheep, Himalayan brown bear, snow leopard, Himalayan thar, musk deer, serow, rhesus macaque, barking deer, goral, Himalayan black bear, red fox, gray shrew, porcupine, pheasants, western tragopon, large variety of insects, worms, mollusks.

The Dachigam Sanctuary has the highly endangered hangul or the Kashmiri stag, Himalayan black bear, wild goat, leopard, musk deer, ibis, Himalayan marmot, blood pheasant, golden eagle and bearded vultures.

The Manas Sanctuary in Assam is a habitat for rare and endangered species such as tiger, one-horned rhino, swamp deer, pygmy hog and Bengal Florican.

Kanha National Park in Madhya Pradesh is home to one of the largest population of tigers in India. Others include sloth bear, leopard, striped hyena, spotted deer, wild boar and more than 200 species of birds.

Bharatpur Bird Sanctuary also referred as Keoladeo Ghana National Park in Rajasthan is home to the gorgeous Siberian Cranes, the stately sarus (cranes), the multihued kingfishers, white-breasted water hens, the grey and purple herons, the elegant darters, slow-white egrets and many more.

The inhabitants of Thar desert include black buck, chinkara, wolf, Indian fox, hare, desert cat. The Gir sanctuary in Gujarat has one of the major big-cat population in India with about 300 lions and 300 leopards. The other inhabitants are sambar, spotted deer (chital), blue bull (nilgai), chousingha, chinkara, wildboar and more than 250 species of birds.

The sanctuaries of the Western Ghats include Bhadra Wildlife Sanctuary, Attiveri Bird Sanctuary, Arabithittu Wildlife Sanctuary, Brahmagiri Wildlife Sanctuary, Cauvery Wildlife Sanctuary, Dandeli Wildlife sanctuary, Godavi Bird Sanctuary, Mookambika Wildlife sanctuary, Pushpagiri wildlife sanctuary, Shettihalli and Talakaveri Wildlife Sanctuaries, to name a few.

Indian peninsula is bounded by water on three sides the Arabian Sea, the Bay of Bengal and the Indian Ocean. The Indian coastline extends upto 7500 kins covering 9 coastal states, 2 groups of islands and union territories. The natural coastal ecosystem includes the coral reefs, mangroves, estuaries and the deltas.

Mangroves are found in the Sundarbans of West Bengal and Anadaman and Nicobar Islands. They are an important habitat for the Royal Bengal Tiger, Olive Ridley Turtles, seaotters, migratory birds, crocodiles, dugongs and dolphins. The coral reefs in India are found in Gulf of Kutcli, Mandapam group of islands in Gulf of Mannar, Andaman and Nicobar Islands and Lakshadweep islands.

Integrated Protected Area System

A protected area is an area of land and /or sea meant for the protection and conservation of biological diversity. India has about 8.1 million hectares of protected area comprising of 14% of country's forest regions and 4.60% of land mass.

The protected areas in India are, the whole states of Manipur, Mizoram, Arunachal Pradesh, Nagaland, Sikkim, parts of states of Uttaranchal, Jammu and Kashmir, Rajasthan and Himachal Pradesh.

The 8,000 kms of coastline of India has five marine protected areas, Gulf of Mannar National Park, Tamil Nadu, Gulf of Kutch Marine National park and Gulf of Kutch Marine Sanctuary, Gujarat, Mahatma Gandhi Marine National Park, Andaman and Nicobar Islands and Gahirmatha Sanctuary, Orissa.

The marine environment of India harbours a variety of resident and migratory wildlife which includes dolphins, olive ridley turtles, a variety of sharks, sea cucumbers, sea shells, soft and hard corals, many of which are facing threat due to habitat destruction, overexploitation, commercial fishing, etc.

The objectives of the integrated protected area system for preservation of biodiversity are,

- Conservation of natural habitats.
- Protection and management of natural habitats and biodiversity.
- Sustainable management of protected areas.
- Create public awareness, both locally and nationally, about the need for conservation of protected areas.
- Promoting fundamental rights of indigenous communities living in and around the protected areas.
- Encourage sustainable tourism.
- Prohibition of illegal harvesting of plants and animals.
- Strive towards increased skills and practical application of environmental knowledge through positive environmental behaviour.

Considering the vast biodiversity in the country, there is a need for more protected areas with developed management plans.

2. Ex-situ Conservation

Ex-situ conservation of biodiversity refers to preserving the biodiversity out of the context of natural habitats.

The objectives of ex-situ conservation are,

- Preserve the threatened germplasm of plants and animals.
- Carryout research on conservation biology of indigenous and exotic flora and fauna.
- Provide material for conservation education and display to the public.

Ex-situ conservation of biological resources can be accomplished in two ways,

(a) Conventional Method

This method includes the gene banks, community seed banks and ordinary seed banks.

(b) Biotechnological Method

This method includes in-vitro conservation, cryopreservation, low pressure storage and oxygen storage.