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BIODIVERSITY CONSERVATION

A wide variety of living organisms including plants, animals and micro-organisms with whom we share this planet earth makes the world a beautiful place to live in. Living organisms exist almost everywhere from mountain peaks to the ocean depths; from deserts to the rainforests. They vary in their habit and behaviour, shapes, sizes and colour. The remarkable diversity of living organisms form an inseparable and significant parts of our planet however, the ever increasing human population is posing serious threats to bio-diversity.

In this lesson we shall learn the ways humans are causing loss of biodiversity and the efforts that are being taken or need to be taken to protect and conserve the biodiversity.

OBJECTIVES

After completing this lesson, you will be able to:

- *explain the concept of biodiversity;*

- *describe the importance of biodiversity to human welfare and economic development;*

- *explain the uniqueness of Indian biodiversity and associated regional specificity;*

- *list the causes of biodiversity depletion in Indian and global context;*

- *justify the conservation of biodiversity;*

- *distinguish between extinct, endangered and threatened species;*

- *describe various in-situ and ex-situ methods of conservation;*

- *explain the objectives of specific wildlife conservation projects like project tiger, project elephant, project crocodile etc.;*

- *describe the importance of national parks, sanctuaries and biosphere reserves;*

- *legal measures adopted by national and international bodies.*

15.1 WHAT IS BIOLOGICAL DIVERSITY

Sum total of all the variety of living organisms on earth constitute biodiversity. Biological diversity is usually considered at three different levels – a) genetic diversity i.e. at genetic level , b) species diversity i.e. at the level of species, and c) ecosystem diversity i.e. at the level of ecosystem.

15.1.1 Genetic diversity

Each species, varying from bacteria to higher plants and animals, stores an immense amount of genetic information. For example, the number of genes is about 450-700 in mycoplasma, 4000 in bacteria (eg. *Escherichia coli)* , 13,000 in Fruit-fly *(Drosophila melanogaster);* 32,000 – 50,000 in rice (*Oryza sativa*); and 35,000 to 45,000 in human beings (*Homo sapiens sapiens).* This variation of genes, not only of numbers but of structure also, is of great value as it enables a population to adapt to its environment and to respond to the process of natural selection. If a species has more genetic variation, it can adapt better to the changed environmental conditions. Lower diversity in a species leads to genetic uniformity of genetically similar crop plants. This homogeneity is desirable in producing uniform quality of grain. But genetic uniformity restricts adaptability of a species to environmental stress as all the plants have same level of resistance.

With the above background, **genetic diversity** refers to the variety of genes contained within species of plants, animals and micro-organisms. New genetic variation in individuals occurs by gene and chromosomal mutation, and in organisms with sexual reproduction may be spread across the population by recombination. For instance, two brothers differ in their structure, although their parents are the same. The differences could be in alleles (different variants of the same gene), in entire gene (the traits determining particular characteristics) or in chromosomal structure. The amount of genetic variation (gene pool) present in an inter-breeding population is shaped or decided by the process of natural selection. Selection leads to certain genetic attributes being preferred and results in changes in the frequency of genes within this pool. This forms the basis of adaptation among the living organisms. India has high genetic diversity and is regarded as a Vavilov's centre of high crop genetic diversity – so named after the Russian agro-botanist N I Vavilov, who identified eight such centres of origin of cultivated plants around the world in the 1950s.

15.1.2 Species diversity

Species diversity refers to the variety of species within a geographical area.

Species diversity can be measured in terms of:

(a) **Species richness –** refers to the number of various species in a defined area.

(b) **Species abundance –** refers to the relative numbers among species. For example, the number of species of plants, animals and microorganisms may be more in an area than that recorded in another area.

(c) **Taxonomic or phylogenetic diversity –** refers to the genetic relationships between different groups of species.
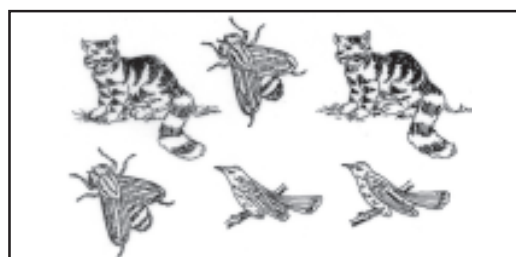
Kinds of species that are present in an area is also important. When taxonomically unrelated species are present in an area, the area represents greater species diversity as compared to an area represented by taxonomically related species. Observe the diagram shown below. Fig. 15.1
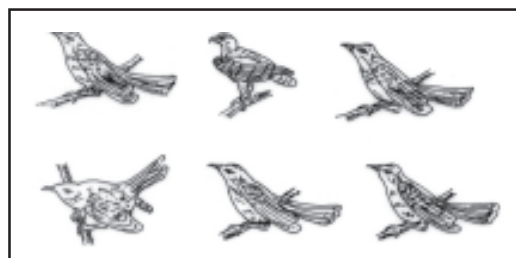
Sample Area A
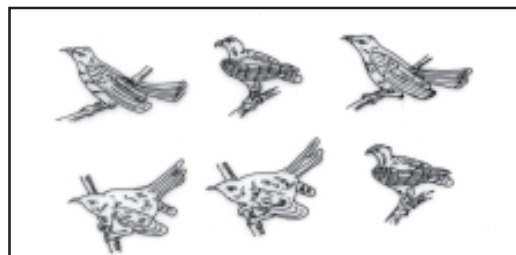
Sample Area B

Sample Area C

Fig. 15.1: The different sample areas showing species diversity.

{Note – Know that all the three sample areas are represented by three kinds of species. (species richness is same). However they vary in species abundance varying number of individuals per species) and in taxonomic diversity. Observe that sample C has the highest species diversity as it is represented by taxonomically unrelated species}

At the global level, an estimated 1.7 million species of living organisms have been described to date and many more are yet to be discovered. It has been currently estimated that the total number of species may vary from 5 - 50 millions. Species diversity is not evenly distributed across the globe. The overall richness of species is concentrated in equatorial regions and tends to decrease as one moves from equatorial to polar regions. In addition, biodiversity in land ecosystems generally decreases with increasing altitude. The other factors that influence biodiversity are amount of rainfall and nutrient level in soil. In marine ecosystems, species richness tends to be much higher in continental shelves.

India is a country of vast diversity (Fig. 15.2) and it is among the 12 "mega-diversity" countries in the world.

Bacteria

(a) Number of species of plants and bacteria
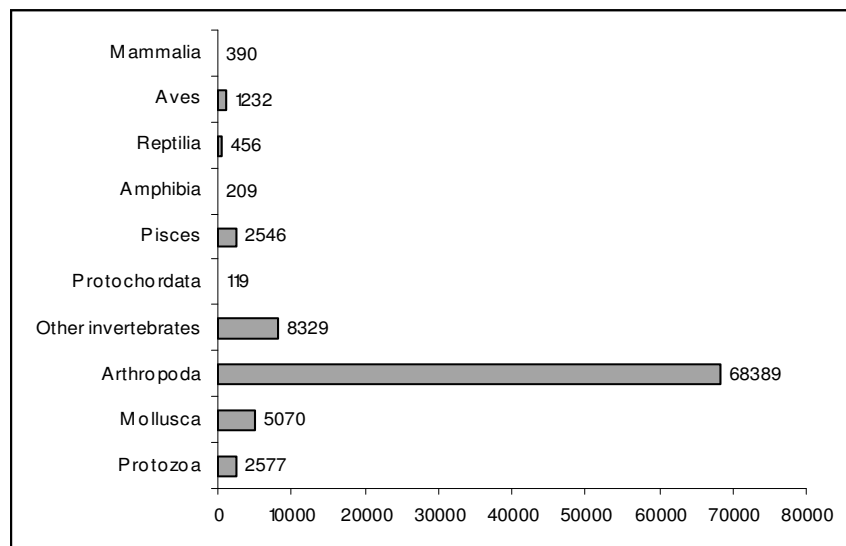
(b) Number of species of animals

Fig. 15.2: *Number of plant and animal species in different groups recorded in India*

15.1.3 Ecosystem diversity

It refers to the presence of different types of ecosystems. For instance, the tropical south India with rich species diversity will have altogether different structure compared to the desert ecosystem which has far less number of plant and animal species. Likewise, the marine ecosystem although has many types of fishes, yet it differs from the freshwater ecosystem of rivers and lakes in terms of its characteristics. So such variations at ecosystem level are termed as *ecosystem diversity*.

As stated above, ecosystem diversity encompasses the broad differences between ecosystem, and the diversity of the habitats and ecological processes occurring within each ecosystem type. India has very diverse terrestrial and aquatic ecosystems ranging from ice-capped Himalayas to deserts, from arid scrub to grassland to wetlands and tropical rainforests, from coral reefs to the deep sea. Each of these comprises a great variety of habitats and interactions between and within biotic and abiotic components. The most diversity-rich are western-ghats and the north-eastern region. A very large number of species found in these ecosystems are **endemic** or found in these areas only in India i.e. they are found no where else except in India. The endemics are concentrated mainly in north-east, western-ghats, north-west Himalaya, and Andaman and Nicobar Islands. About 33% of the flowering plants recorded in India are endemic to our country. Indian region is also notable for endemic fauna. For example, out of recorded vertebrates, 53% freshwater fish, 60% amphibians, 36% reptiles and 10% mammalian fauna are endemic.

15.1.4 Hot spots of biodiversity

Biodiversity is not uniformly distributed across the geographical regions of the earth. Certain regions of the world are very rich in biodiversity. We call such areas as "mega diversity zones". We also refer to them as "hot-spots". For example, India accounts for only 2.4 % of the land area of the world; but it contributes approximately 8% species to the global diversity due to existence of such pockets.

Norman Myers, a British Ecologist, developed the concept of hot spots in 1988 to designate priority areas for *in situ* conservation. According to him, the hot spots are the richest and the most threatened reservoirs of biodiversity on the earth. The criteria for determining a hot spot are:

i)   The area should support >1500 endemic species,

ii)   It must have lost over 70 % of the original habitat

Twenty-five biodiversity hot spots have been identified in the world. These hot spots are characterized by posing exceptionally high biodiversity. For example the total area of these 25 hot spots cover 1.4% of the total land area, support 44% of plant and 35% terrestrial vertebrates. (Refer to the Fig. 15.3)

1. Tropical Andes, 2. Mesoamerica, 3. Caribbean, 4. Brazil's Atlantic Forests, 5. Choco/Darien/Western Ecuad
6. Brazil's Cerrado, 7. Central Chile, 8. California Floristic Province, 9. Madagascar, 10. Eastern Arc & Coastal Fores
of Tanzania/Kenya, 11. West African Forests, 12. Cape Floristic Province, 13. Succulent Karoo, 14. Mediterrane
Basin, 15. Caucasus, 16. Sundland, 17. Wallacea, 18. Philippines, 19. Indo-Burma, 20. South-Central Chir
21. Western Ghats/Sri Lanka, 22. Southwest Australia, 23. New Caledonia, 24. New Zealand, 25. Polynesia/Micrones

Fig. 15.3: The terrestrial biodiversity hot spots

Among the 25 hot spots of the world, 2 are found in India namely western ghats and the eastern Himalayas. These two areas of the country are exceptionally rich in flowering plants, reptiles, amphibians, butterflies and some species of mammals.

The eastern Himalayan hot spot extends to the north – eastern India and Bhutan. The temperate forests are found at an altitude of 1780 to 3500 m. Many deep and semi-isolated valleys are exceptionally rich in endemic plant species.

The Western Ghat region lies parallel to the western coast of Indian peninsula for almost 1600 km, in Maharashtra, Karnataka, Tamil Nadu and Kerala. These forests at low elevation (500 m above mean sea level) are mostly evergreen, while those at 500- 1500 m height are generally semi-evergreen forests.

INTEXT QUESTIONS 15.1

1. What do you understand by biological diversity?
   _____

2. List the various levels of biodiversity.
   _____

3. Name the two hot spots in India.
   _____

4. Name the most abundant (i) group of plants and (ii) group of animal recorded in India.
   _____

15.2 WHY IS BIOLOGICAL DIVERSITY IMPORTANT

Humans depend for their sustenance, health, wellbeing and cultural growth on nature. Biotic resources provide food, fruit, seed, fodder, medicines and a host of other goods and services. The enormous diversity of life is of immense value, imparting resilience to ecosystems and natural processes. Biodiversity also has enormous social and cultural importance.

The value of biological diversity

The various benefits of biological diversity can be grouped under three categories: a) ecosystem services, b) biological resources, and c) social benefits.

15.2.1 Ecosystem services

Living organisms provide many ecological services free of cost that are responsible for maintaining ecosystem health. Thus biodiversity is essential for the maintenance and sustainable utilization of goods and services from ecological system as well as from individual species.

i) **Protection of water resources:** Natural vegetation cover helps in maintaining hydrological cycles, regulating and stabilizing water run-off and acting as a buffer against extreme events such as floods and droughts. Vegetation removal results in siltation of dams and waterways. Wetlands and forests act as water purifying systems, while mangroves trap silt thereby reducing impacts on marine ecosystems.

ii) **Soil protection:** Biological diversity helps in the conservation of soil and retention of moisture and nutrients. Clearing large areas of vegetation cover has been often seen to accelerate soil erosion, reduce its productivity and often result in flash floods. Root systems allows penetration of water to the sub soil layer. Root system also brings mineral nutrients to the surface by nutrient uptake.

iii) **Nutrient storage and cycling:** Ecosystem perform the vital function of recycling nutrients found in the atmosphere as well as in the soil. Plants are able to take up nutrients, and these nutrients then can form the basis of food chains, to be used by a wide range of life forms. Nutrients in the soil, in turn, is replenished by dead or waste matter which is transformed by micro-organisms; this may then feed others such as earthworms which also mix and aerate the soil and make nutrients more readily available.

iv) **Pollution reduction:** Ecosystems and ecological processes play an important role in maintenance of gaseous composition of the atmosphere, breakdown of wastes and removal of pollutants. Some ecosystems, especially wetlands have the ability to breaking down and absorb pollutants. Natural and artificial wetlands are being used to filter effluents to remove nutrients, heavy metals, suspended solids; reduce the BOD (Biological Oxygen Demand) and destroy harmful micro-organisms. Excessive quantities

of pollutants, however, can be detrimental to the integrity of ecosystems and their biota.

v) **Climate stability:** Vegetation influences climate at macro as well as micro levels. Growing evidence suggests that undisturbed forests help to maintain the rainfall in the vicinity by recycling water vapor at a steady rate back into the atmosphere. Vegetation also exerts moderating influence on micro climate. Cooling effect of vegetation is a common experience which makes living comfortable. Some organisms are dependent on such microclimates for their existence.

vi) **Maintenance of ecological processes:** Different species of birds and predators help to control insect pests, thus reduce the need and cost of artificial control measures. Birds and nectar–loving insects which roost and breed in natural habitats are important pollinating agents of crop and wild plants. Some habitats protect crucial life stages of wildlife populations such as spawning areas in mangroves and wetlands.

Without ecological services provided by biodiversity it would not be possible to get food, pure air to breathe and would be submerged in the waste produced.

15.2.2 Biological resources of economic importance

i) **Food, fibre, medicines, fuel wood and ornamental plants:** Five thousand plant species are known to have been used as food by humans. Presently about 20 species feed the majority of the world's population and just 3 or 4 only are the major staple crops to majority of population in the world.

A large number of plants and animals materials are used for the treatment of various ailments. The usage of medicinal plants in India has an ancient history, dating back to the pre-vedic culture, at least 4000 years B. C. The therapeutic values of herbal medicines led to evolution of *Ayurveda* which means "science of life". It is estimated that at least 70 % of the country's population rely on herbal medicines and over 7000 species of plants are used for medicinal purposes.

Wood is a basic commodity used worldwide for making furniture and for building purposes. Fire wood is the primary source of fuel widely used in third world countries. Wood and bamboo are used for making paper.

Plants are the traditional source of fibre such as coir, hemp, flax, cotton, jute.

ii) **Breeding material for crop improvement:** Wild relatives of cultivated crop plants contain valuable genes that are of immense genetic value in crop improvement programmes. Genetic material or genes of wild crop plants are used to develop new varieties of cultivated crop plants for restructuring of the existing ones for improving yield or resistance of crops plants. For example: rice grown in Asia is protected from four main diseases by genes contributed by a single wild rice variety.

iii) **Future resources:** There is a clear relationship between the conservation of biological diversity and the discovery of new biological resources. The relatively few developed plant species currently cultivated have had a large amount of research and selective breeding applied to them. Many presently under-utilised food crops have the potential to become important crops in the future. Knowledge of the uses of wild plants by the local people is often a source for ideas on developing new plant products.

15.2.3 Social benefits

i) **Recreation:** Forests, wildlife, national parks and sanctuaries, garden and aquaria have high entertainment and recreation value. Ecotourism, photography, painting, film making and literary activities are closely related.

ii) **Cultural values:** Plants and animals are important part of the cultural life of humans. Human cultures have co-evolved with their environment and biological diversity can be impart a distinct cultural identity to different communities.

The natural environment serves the inspirational, aesthetic, spiritual and educational needs of the people, of all cultures. In a majority of Indian villages and towns, plants like Tulsi (*Ocimum sanctum),* Peepal (*Ficus religiosa),* Khejri (*Prosopis cineraria)* are planted and considered sacred and worshipped.

15.2.4 Research, Education and Monitoring

There is still much to learn on how to get better use from biological resources, how to maintain the genetic base of harvested biological resources, and how to rehabilitate degraded ecosystems. Natural areas provide excellent living laboratories for such studies, for comparison with other areas under systems of use and for valuable research in ecology and evolution.

INTEXT QUESTIONS 15.2

1. Name the three important categories under which the uses of biodiversity can be described.

    _____

2. Mention two examples of ecosystem services.

    _____

3. List any two ways by which biodiversity contributes towards cleaner environment.

    _____

15.3 UNIQUENESS OF INDIAN BIODIVERSITY AND ASSOCIATED REGIONAL SPECIFICITY

India is uniquely rich in all aspects of biodiversity including ecosystem, species and genetic biodiversity. For any one country in the world, it has perhaps the largest array of environmental situations by virtue of its tropical location, varied physical features and climate types. India has the widest variety of ecosystems. With only 2.4% of the land area, India accounts for 7-8 % of the recorded species of the world. More than 45000 species of plants and 81,000 species of animals are found in India. India is also one of the eight primary centers of origin of cultivated plants and has a rich agricultural biodiversity.

The trans-Himalayan region with its sparse vegetation has the richest wild sheep and goat community in the world. The snow leopard (*Panthera uncia*) and Black-necked Crane (*Grus nigricollis)* are found here. The Great Indian Bustard (*Ardeotis nigriceps*) which is highly endangered bird, is found in (Gujrat) region, rich in extensive **grasslands.**

North-east India is one of the richest regions of biodiversity in the country. It is especially rich in orchids, bamboos, ferns, citrus, banana, mango and jute.

India is also rich in coral reefs. Major reef formations in Indian seas occur in the Gulf of Mannar, Palk Bay, Gulf of Kutch, the Andaman and Nicobar Islands and the Lakshadweep. The threat to mangroves trees (growing in marshy lands) and coral reefs comes from the biotic pressure such as extraction for market demands, fishing, land-use changes in surrounding areas, and from pollution of water etc.

15.4 CAUSES OF BIODIVERSITY DEPLETION

Loss of species is a serious cause of concern for human survival. It has been observed that 79 species of mammals, 44 of birds, 15 of reptiles and 3 of amphibians are threatened. Nearly 1500 species of plants are endangered in India. The threat to survival or loss may be caused in the following three ways:

- **Direct ways:** Deforestation, hunting, poaching, commercial exploitation.

- **Indirect ways:** Loss or modification of the natural habitats, introduction of exotic species, pollution, etc.

- **Natural causes** - Climate change.

Among these causes, habitat destruction and over-exploitation are the main.

i) **Habitat (natural home) destruction** may result from clearing and burning forests, draining and filling of wetlands, converting natural areas for agricultural or industrial

uses, human settlements, mines, building of roads and other developmental projects. This way the natural habitats of organisms are changed or destroyed. These change either kill or force out may species from the area causing disruption of interactions among the species. Fragmentation of large forest tracts (eg. the corridores) affects the species occupying the deeper part of the forest and are first to disappear. Apart from the direct loss of species during the development activities, the new environment is unsuitable for the species to survive. Over exploitation reduces the size of the population of a species and may push it towards extinction.

ii) **Introduction of exotic species**: Seeds catch on people's clothes. Mice, rats and birds hitch-hike on ships. When such species land in new places, they breed extra fast due to absence of any enemy and often wipe out the native species already present there. **Exotic species** (new species entering geographical region) may wipe out the native ones. A few examples are-

(i) Parthenium hysterophorus (Congress grass- a tropical American weed) has invaded many of the vacant areas in cities, towns and villages in India leading to removal of the local plants and the dependent animals.

(ii) Nile perch, an exotic predatory fish introduced into Lake Victoria (South Africa) threatened the entire ecosystem of the lake by eliminating several native species of the small Cichlid fish that were endemic to this freshwater aquatic system.

(iii) Water hyacinth clogs lakes and riversides and threatens the survival of many aquatic species. This is common in Indian plains.

(iv) *Lantana camara* (an American weed) has invaded many forest lands in various parts of India and wiped out the native grass species.

iii) **Pollution:** Air pollution, acid rain destroy forests. Water pollution kills fishes and other aquatic plants and animals. Toxic and hazardous substances drained into waterways kill aquatic life. Oil spills kill coastal birds, plants and other marine animals. Plastic trash entangles wildlife. It is easy to see how pollution is a big threat to biodiversity**.**

iv) **Population growth and poverty:** Over six billion people live on the earth. Each year, 90 million more people are added. All these people use natural resources for food, water, medicine, clothes, shelter and fuel. Need of the poor and often greed of the rich generate continuous pressure resulting in over-exploitation and loss of biodiversity.

The World Conservation Union (IUCN) (formerly known as International Union for the Conservation of Nature and Natural Resources, IUCN) has recognized eight Red List categories according to the conservation status of species. These categories are defined below in Table 15.2.

Table 15.2: The IUCN Threat Categories

List Category	Definition
Extinct	A taxon is extinct when there is no reasonable doubt that the last individual has died.
Extinct in the wild	A taxon is extinct in the wild when exhaustive surveys in known and/or expected habitats have failed to record an individual.
Critically endangered	A taxon is critically endangered when it is facing high risk of extinction in the wild in immediate future.
Endangered	A taxon is endangered when it is not critically endangered but is facing a very high risk of extinction in the wild in near future.
Vulnerable	A taxon is vulnerable when it is not critically endangered or endangered but is facing high risk of extinction in the wild in the medium term future.
Lower risk	A taxon is lower risk when it has been evaluated and does not satisfy the criteria for critically endangered, endangered or vulnerable.
Data deficient	A taxon is data deficient when there is inadequate information to make any direct or indirect assessment of its risk of extinction.
Not evaluated	A taxon is not evaluated when it has not yet been assessed against the above criteria.

Status of threatened species

The IUCN Red List is an authentic source of information for this purpose. The 2000 Red List is the latest available. It uses a set of criteria, relevant to all species and all regions of the world, to evaluate the extinction risk of species. The 2000 Red List contains assessment of more than18,000 species; 11,000 of which are threatened (5,485 animals and 5611 plants). Out of these, 1,939 are listed as critically endangered (925 animals, and 1,014 plants).According to the Red List, in **India,** 44 plant species are critically endangered., 113 endangered and 87 vulnerable. Amongst animals, 18 are critically endangered, 54 endangered and 143 Vulnerable. A few examples of these plant and animals are given below :

Table 15.3: Examples of threatened species in India

Category	Plant species	Animal species
Critically endangered	*Berberis nilghiriensis*	*Sus salvanius*, (Pigmy hog)
Endangered	*Bentinckta nicobarica*	*Allurus fulgens* , (Red Panda)
Vulnerable	*Cupressus cashmeriana*	*Antilope cervicapra*, (Black buck)

15.5 CONSERVATION OF BIODIVERSITY

Conservation is the planned management of natural resources, to retain the balance in nature and retain the diversity. It also includes wise use of natural resources in such a way that the needs of present generation are met and at the same time leaving enough for the future generations. Conservation of biodiversity is important to:-

- prevent the loss of genetic diversity of a species,

- save a species from becoming extinct, and

- protect ecosystems damage and degradation.

INTEXT QUESTIONS 15.3

1. Which region in India has the richest wild sheep and goat community in the world?

   _____

2. List any three factors by virtue of which India has a rich and unique biodiversity.

   _____

3. Name the richest regions of biodiversity.

   _____

4. What are exotic species? What effect do they have on the local species?

   _____

5. List the three zones of a biosphere reserve and which one of them allow settlements etc.

   _____

6. List the three objectives of convention of biological diversity signed during the earth summit-1993.

   _____

7. Expand IUCN.

   _____

8. Howe many animals and how many plants in India are listed as critically endangered in red list.

   _____

15.6 CONSERVATION STRATEGIES

Conservation efforts can be grouped into the following two categories:

1. *In-situ* (on-site) conservation includes the protection of plants and animals within their natural habitats or in protected areas. Protected areas are land or sea dedicated to protect and maintain biodiversity.

2. *Ex-situ* (off-site) conservation of plants and animals outside their natural habitats. These include botanical gardens, zoo, gene banks, seek bank, tissue culture and cryopreservation.

15.6.1 In-situ methods

i) **Protection of habitat**: The main strategy for conservation of species is the protection of habitats in representative ecosystems. Currently, India has ninety six National Parks, five hundred Wildlife Sanctuaries, thirteen Biosphere Reserves, twenty seven Tiger Reserves and eleven Elephant Reserves covering an area of 15.67 million hectares or 4.7 % of the geographical area of the country. Twenty one wetlands, thirty mangrove areas and four coral reef areas have been identified for intensive conservation and management purposes by the Ministry of Environment and Forests, Govt. of India.

• National parks and sanctuaries

India is unique in the richness and diversity of its vegetation and wildlife. India's national parks and wildlife sanctuaries (including bird sanctuaries) are situated Ladakh in Himalayas to Southern tip of Tamil Nadu with its rich bio-diversity and heritage. Wildlife sanctuaries in India attract people from all over the world as the rarest of rare species are found here. With 96 national parks and over 500 wildlife sanctuaries, the range and diversity of India's wildlife heritage is unique. Some of the main sanctuaries in India are:

The Jim Corbett Tiger Reserve- Uttaranchal, Kanha National Park, Madhya Pradesh, Bandhavgarh National Park- Madhya Pradesh, Ranthambhor National Park-Sawai Madhopur, Gir National Park-Sasangir (Gujarat) etc.

Wildlife lovers eager to see magnificent Bird Sancturaty at Bharatpur, Rajasthan as it is the second habitat in the world that is visited by the Siberian Cranes in winter and it provides a vast breeding area for the native water birds, Great Indian bustard is found in the Indian deserts. In wesern Himalayas, one can see birds like Himalayan monal pheasant, western tragopanm koklass, white crested khalij pheasant, griffon vultures, lammergiers, choughs, ravens. In the Andaman and Nicobar region, about 250 species and subspecies of birds are found, such as rare Narcondum horn bill, Nicobar pigeon and megapode. While the national parks and sanctuaries in South India, too. For e.g. Madumalai in Tamil Nadu and Bandipur Tiger Reserve and Nagahole National Park in Karnataka.

Many National Parks and Sancturies have been established to preserve wildlife in their natural environment. Some of them are given below along with important species found there.

- Kaziranga sanctuary (Assam) – One-horned rhinoceros
- Manas sanctuary (Assam) – Wild buffaloes
- Gir forest (Gujarat) – Lions, chital, sambar, wild bears
- Kelameru bird sanctuary (Andhra Pradesh) – Pelicans and marine birds
- Dachigam sanctuary (Jammu and Kashmir) – Kashmir stags, Himalayan tahr, wild goats, sheep, antelopes.
- Bandipur sanctuary (Karnataka) – Indian bison, elephants, langurs
- Periyar sanctuary (Kerala) – Elephants, barking deer, sambhar
- Kanha National Park (Madhya Pradesh) – Tiger, leopards, wild dogs

- Simipal National Park (Orissa) – Mangroves, marine turtles lay eggs

- Bharatpur bird sanctuary (Rajasthan) – Ducks, herons

- Corbett National Park (Uttaranchal) –Tigers, barking deer, sambar, wild bear, rhesus monkey.

- Jaladpara sanctuary (West Bengal) – Rhinoceros

Wildlife Conservation Society (WCS) India in association with other NGO partners and tribal people, is making every possible effort to develop new models of wildlife conservation to preserve India's most treasured fauna and to protect the environment.
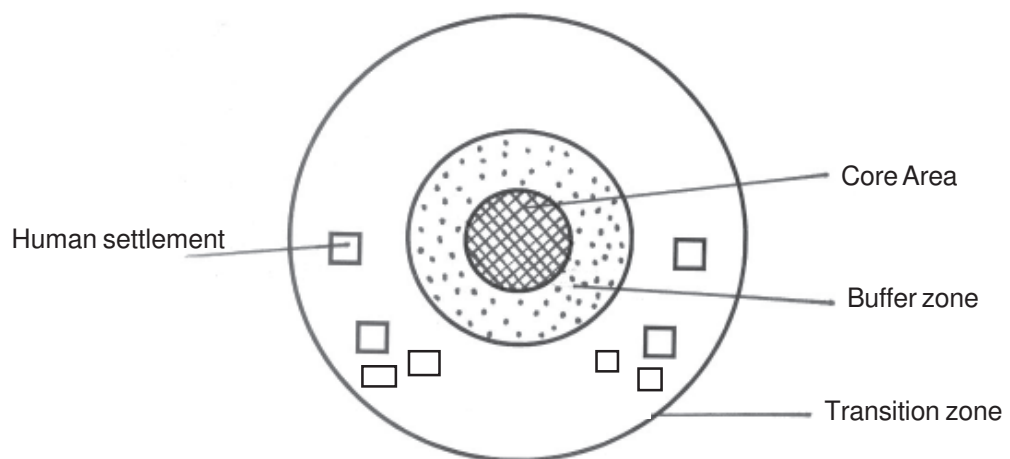
- **Biosphere Reserves**

These are representative parts of natural and cultural landscapes extending over large areas of terrestrial or coastal/marine ecosystems which are internationally recognized within UNESCO's Man and the Biosphere Programme **Thirteen biodiversity**- rich representative ecosystems , largely within the forest land (total area – 53,000 sq. km.), have been designated as Biosphere Reserves in India. shown in Figure 15.4.

1. Nanda Devi
2. Nokrek
3. Manas
4. Dibru Saikhowa
5. Dehang Debang
6. Sunderbans
7. Gulf of Mannar
8. Nilgiri
9. Great Nicobar
10. Similipal
11. Khanghendzonga
12. Pachmarhi
13. Agasthyamalai

Fig. 15.4: *The Biosphere reserves in India*

The concept of Biosphere Reserves (BR) was launched in 1975 as a part of UNESCO's Man and Biosphere Programme, dealing with the conservation of ecosystems and the genetic material they contain. A Biosphere Reserve consists of core, buffer and transition zones. (a) The **core zone** is fully protected and natural area of the Biosphere Reserve least disturbed by human activities. It is legally protected ecosystem in which entry is not allowed except with permission for some special purpose. Destructive sampling for scientific investigations is prohibited. (b) The **buffer zone** surrounds the core zone and is managed to accommodate a greater variety of resource use strategies, and research and educational activities. (c) the **transition zone**, the outermost part of the Biosphere Reserve, is an area of active cooperation between the reserve management and the local people, wherein activities like settlements, cropping, forestry , recreation and other economic that are in harmony with the conservation goals. **Till date** there were 553 biosphere reserves located in 107 countries.

Fig. 15.5: Human Settlement (A terrestrial BR – Biosphere reserve)

The main functions of the biosphere reserves are:

- **Conservation:** Long term conservation of representatives, landscapes and different types of ecosystems, along with all their species and genetic resources.

- **Development:** Encourages traditional resource use and promote economic development which is culturally, socially and ecologically sustainable.

- **Scientific research, monitoring and education-** Support conservation research, monitoring, education and information exchange related to local, national and global environmental and conservation issues.

ii) **Species-oriented projects:** Certain species have been identified as needing a concerted and specifically directed protection effort. Project Tiger, Project Elephant and Project crocodile are examples of focusing on single species through conserving their habitats.

- **Project Tiger – A success in species conservation**

Tigers which were once abundant in Indian forests have been hunted. As a result tiger population within the country declined drastically from estimate of 40,000 at the turn of

century to 1200 by the 1970. This led to initiate the Project Tiger in 1973 with the objective of conserving and rescuing this species from extinction. In 2007, there were more than 40 Project Tiger wildlife reserves covering an area of 37,761 km². Project Tiger helped to increase the population of these tigers from 1,200 in the 1970s to 3,500 in 1990s. However, a 2008 census held by Government of India revealed that the tiger population had dropped to 1,411. A total ban has been imposed on hunting of tigers and trading in tiger products at the national and international levels. Elaborate management plans are made for each of the tiger reserves for tiger habitat improvement and anti -poaching measures.

• **Project Elephant**

Project Elephant was launched in February, 1992 to assist states having free ranging populations of wild elephants to ensure long-term survival of identified viable populations of elephants in their natural habitats. The project is being implemented in twelve states viz. Andhra Pradesh, Arunachal Pradesh, Assam, Jharkhand, Karnataka, Kerala, Meghalaya, Nagaland, Orissa, Tamil Nadu Uttaranchal and West Bengal.

• **Crocodile breeding and management project**

This project was started in 1976 with FAO - UNDP assistance to save three endangered crocodilian species, namely, the fresh water crocodile, salt water crocodile and the rare *gharial. The* project surveyed the crocodile habitats and facilitated their protection through declaration of sanctuaries and National Parks. Captive breeding and reintroduction or restocking programmes involved careful collection of eggs from the wild. Thousands of crocodiles of three species have been reared at sixteen centres and several of these have been released in the wild. Eleven sanctuaries have been declared specially for crocodile protection including the National Chambal Sanctuary in Madhya Pradesh.

(iii) **Sacred forests and sacred lakes:** A traditional strategy for the protection of biodiversity has been in practice in India and some other Asian countries in the form of sacred forests. These are small forest patches protected by tribal communities due to religious sanctity. These have been free from all disturbances. Sacred forests are located in several parts of India i.e. Karnataka, Maharashtra, Kerala, Meghalaya , Similarly, several water bodies for example, Khecheopalri lake in Sikkim, have been declared sacred by the people, leading to protection of aquatic flora and fauna.

15.6.2 Ex-situ Conservation

(i) **Botanical gardens, zoos, etc.** To complement *in-situ* conservation efforts, *ex-situ* conservation is being undertaken through setting up botanic gardens, zoos, medicinal plant parks, etc by various agencies. The Indian Botanical Garden in Howrah (West Bengal) is over 200 years old. Other important botanical gardens are in Ooty, Bangalore and Lucknow. The most recent one is The Botanical Garden of Indian Republic established at NOIDA, near Delhi in April, 2002. The main objectives of this garden are –

• *ex-situ* conservation and propagation of important threatened plant species,

• serve as a Centre of Excellence for conservation., research and training,

• build public awareness through education on plant diversity and need for conservation.

A number of zoos have been developed in the country. These zoological parks have been looked upon essentially as centres of education about animal species and recreation. They have also played an important role in the conservation of endangered animal species such as the Manipur Thamin Deer (*Cerus eldi eldi*) and the White winged Wood Duck (*Cairina scutulata).* Notable successful examples of captive breeding are those of Gangetic gharial (*Gavialis gangeticus),* turtles and the white tiger.

(ii) **Gene Banks :** *Ex-situ* collection and preservation of genetic resources is done through gene banks and seed banks. The National Bureau of Plant Genetic Resources (NBPGR), New Delhi preserves seeds of wild relatives of crop plants as well as cultivated varieties; the National Bureau of Animal Genetic Resources at Karnal, Haryana maintains the genetic material for domesticated animals, and the National Bureau of Fish Genetic Resources, Lucknow for fishes.

(iii) **Cryopreservation:** ("freeze preservation") is particularly useful for conserving vegetative propagated crops. Cryopreservation is the storage of material at ultra low temperature of liquid nitrogen (-196^{0}C) and essentially involves suspension of all metabolic processes and activities. Cryopreservation has been successfully applied to meristems, zygotic and somatic embryos, pollen, protoplasts cells and suspension cultures of a number of plant species.

(iv) **Conservation at molecular level (DNA level):** In addition to above, germplasm conservation at molecular level is now feasible and attracting attention. Cloned DNA and material having DNA in its native state can all be used for genetic conservation. Furthermore, non-viable material representing valuable genotypes stored in gene banks can all be used as sources of DNA libraries from where a relevant gene or a combination of genes can be recovered.

Legal measures : Market demand for some body parts like bones of tiger, rhino horns, furs, ivory, skins, musk, peacock feathers , etc results in killing the wild animals. **The Wildlife Protection Act (1972)** contain provisions for penalties or punishment to prevent poaching and illegal trade. India is also a signatory to the **Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES)**. The Convention entered into force on 1st July, 1975. In addition to this, India is also a signatory to **Convention on Biological Diversity (CBD)**, which it signed on 29th December, 1993 at Rio de Janeiro during the Earth Summit. The Convention has three key objectives:

1. Conservation of biological diversity,

2   Sustainable use of biodiversity and

3. Fair and equitable sharing of benefits arising out of the utilization of genetic resources.

The CITES and the CBD are international initiatives. Government of India have also passed the Biological Diversity Act, 2002, the details of this acts is given in lesson 23.

Biological Diversity Act, 2002

- This Act provides for setting up of a National Biodiversity Authority (NBA), State Biodiversity Boards (SBB) and Biodiversity Management Committees (BMC) in local bodies.

- All foreign nationals organizations require prior approval of NBA for obtaining biological resources and/or associated knowledge for any use.

- Similarly, Indian nationals or organizations will require to give prior intimation to the concerned SBB about any biological resources being imported for commercial use. The SBB may prohibit the import if found to violate the objectives of conservation, sustainable use and benefit sharing.

- However, local people and communities of the area, including *Vaids* and *Hakims* will have free access to use biological resources within the country for their own use, medicinal purposes and research.

- While granting approvals, NBA will impose terms and conditions to secure equitable sharing of benefits.

- There is a enabling provision for setting up a framework for protecting traditional knowledge.

- The monetary benefits, fees and royalties, as a result of approvals by NBA are to be deposited in National Biodiversity Fund which will be used for conservation and development of areas from where the resource has been accessed, in consultation with local self government.

- World Wide Fund for Nature (WWF) and World Conservation Union supports projects to promote conservation and appropriate development of Biosphere Reserves.

INTEXT QUESTIONS 15.4

1. What are the main conservation strategies?

   _____

2. Name two important tiger reserves.

   _____

3. Expand WCS.

   _____

4. What are the main functions of biosphere reserve?

   _____

5. Expand the following:

   i. NBPGR ii. NBG, iii. CITES, iv. IUCN, v. CBD, vi. NBA.

   _____

Notes

WHAT YOU HAVE LEARNT

- Biodiversity refers to the totality of genes, species, and ecosystems of plant, animals or micro-organisms in a region. Study of biodiversity has become very important recently after realising the value of biodiversity for our survival. It has many medicinal, commercial, economic and scientific uses.

- Wild relatives of cultivated crop plants are the source of genes for disease resistance and several other attributes required for crop improvement.

- Biodiversity also provides valuable services like water conservation, clean air, soil conservation and improvement of soil fertility, pollution break-down, aesthetic needs and so on.

- The total number of species on earth is estimated to range from 5-100 million, but only about 1.8 million species have so far been described.

- India is very rich in biodiversity and is one of 12 megadiversity countries globally recognized. In India, 70 % of the country's area has been surveyed and around 45,000 species of microorganisms and plants; and 81,000 species of animals have been described till date.

- Biodiversity has 3 levels - i) genetic, ii) species, and iii) community or ecosystem. Species are distinct units of diversity and each species plays a specific role in a ecosystem.

- The diversity within a species often increases with environmental variability. Species diversity refers to the variety of species within a region. In ecosystem biodiversity, the biodiversity increases from polar regions towards the equator, and from high elevations to low elevations.

- Habitat loss and fragmentation, over-exploitation, environmental pollution, climate change and introduction of exotic species pose major threat to biodiversity. It is estimated that 14,000-40,000species are being lost every year from the tropical forests alone.

- The IUCN Red list is the world's most comprehensive inventory of the global conservation status of threatened plant and animal species.

- It is important to ensure the conservation of landscapes, ecosystems, species and genetic resources failing which it will create survival crisis for mankind.

- Conservation strategies include *in-situ* (on-site)and *ex-situ (off-site)* approaches.

- Habitat protection is the main *in-situ* approach. The Protected Area Network for habitat protection includes national parks, wildlife sanctuaries, biosphere reserves, sacred groves or sacred forests.

- Ex-situ conservation is doen by setting up botanical gardens, zoos, gene banks and seed banks, cryopreservation and preservation of germplasm.

- Areas that need immediate protection for conservation of biodiversity are called Biodiversity Hot Spots. Twenty-five hot spots of biodiversity have been identified the world over, of which two are in India.

- Convention on Biodiversity is an important international instrument promoting biodiversity conservation globally.

- IUCN and WWF are among the leading international organizations concerned with biodiversity conservation. The Wildlife Protection Act (1972) and Biodiversity Act (2002) at the national level and The CITES and The Convention on Biodiversity at the international level regulate the trade in biodiversity and promote its conservation and sustainable use.

TERMINAL EXERCISE

1. What is biodiversity? Why has it become important in recent years?

2. List different levels of biodiversity and explain what is meant by genetic diversity.

3. What are various *in-situ* methods of conservation?

4. Write short notes on : a) Cryopreservation, b). Protected areas, c) Biosphere Reserves, d) IUCN Red List, e) Gene banks, f) Hot spots of biodiversity , g) Biodiversity Act,2002.

5. Describe various causes of depletion of biodiversity.

6. How is biodiversity distributed along major environmental gradients?

7. Write a brief note on biodiversity conservation efforts in India.

8. Match the words in column I with those in Column II

Column I	Column II
i) 13000 genes	(a) *Lantana camara*
ii) Exotic species	(b) *Drosophila melanogaster*
iii) Transition zone	(c) Red List
iv) Endangered	(d) Biosphere Reserve

9. What is the resultant of the Earth Summit held at Rio de Janeiro in 1992?

10. What is an approximate percentage of endemic vascular plants in India?

ANSWER TO INTEXT QUESTIONS

15.1

1. Sum total of all the variety of living organisms on earth constitute biological diversity.

2. Genetic, species and ecological biodiversity

3. Western ghats and eastern Himalayas

4. (i)Angiosperms (ii) Arthropods

15.2

1. Ecological services, biological resource, aesthetic and cultural values.

2. Pollination, protection of soil, climatic control.

3. Reduce pollutants, maintenance of gaseous composition of air, degradation of wastes.

15.3

1. Trans-Himalayan region

2. • Its tropical location

    • Varied physical features and climatic situations

    • Meeting of three major biogeographical realm

3. North east India

4. New species entering a geographical region or exotic species and may cause disappearance of native species through changed biotic interaction.

5. Core zone, buffer zone and transition zone; transition zone.

6. Conservation of biological diversity; sustainable use of biodiversity and fair and equitable sharing of benefits arising out of the utilization of genetic resources.

7. International Union for Conservation of nature and Natural Resources

8. 18,44

15.4

1. Two strategies- i. In-situ and ii. Ex-situ

2. Jim Corbett National Park in Uttaranchal, Kanha National Park, Bandhavgarh National park.

3. Wildlife Conservation Society.

4. It consists of core, buffer and transition zone

5. 1. Conservation, 2. Development,

6. i. The National Bureau of Plant Genetic Resources, New Delhi

    ii. National Botanical Garden

    iii. Convention on International Trade inN Endanger Species of Wild Fauna and Flora

    iv. The international Union for the Conservation of Nature and Natural Resources.

    v. Convention on Biological Diversity

    vi. National Biodiversity Authority