

## UNIT 2: ECOSYSTEM, BIODIVERSITY & CONSERVATION

**Ecosystem: Definition, types, structure and function of ecosystem.**

**Energy flow in ecosystem: Food chain and food webs.**

**Case studies on forest, lake, river and marine ecosystem.**

**Biodiversity: Levels of biological diversity- genetic, species, and ecosystem diversity**

**Biogeography zones of India. India as a mega diversity nation. Hotspots of biodiversity**

**Threats to biodiversity- habitat loss and poaching of wildlife conflicts**

**Endangered and endemic species of India.**

**Conservation of biodiversity: In-Situ and Ex-Situ conservation of biodiversity**

### **Definition:**

An ecosystem is a self-regulating group of biotic communities of species interacting with one another and with their non-living environment exchanging energy and matter.

Ecology is the study of interactions among organisms or group of organisms with their environment. Ecology is the study of Ecosystems. The term ecology was first used by German zoologist **Ernst Haeckel**

The term “oekologie” is derived from the Greek word “oikos” meaning "house" or "dwelling", and “logos” meaning "science" or "study".“

The **biologist Jacob Van Uerkal (1864-1944)** introduced the term ‘environment’ in Ecology.

However, **Alexander Von Humboldt** was the first to take up the study of the relationship between organisms and their environment. Alexander Von Humboldt is considered as the Father of Ecology.

### **Features of ecosystem:**

An ecosystem is an integrated unit consisting of interacting plants, animals and micro-organisms whose survival depends upon the maintenance and regulation of their biotic and abiotic structures and functions.

The ecosystem is a unit or a system which is composed of a number of sub-units, that are all directly or indirectly linked with each other.

Open ecosystem: Ecosystems which freely exchange energy and matter from outside as in an open ecosystem

Closed ecosystem: Ecosystems which may be isolated from outside in term of exchange of matter area closed ecosystems.

### **Structure of Ecosystem**

Components of ecosystem:

Ecosystems have basically two types of components, **the biotic and abiotic**, as described below:

(a) **BIOTIC COMPONENTS:** Different living organisms constitute the biotic component of an ecosystem and belong to the following categories:

(i) **Producers:** These are mainly producing food themselves e.g., Green plants produce food by photosynthesis in the presence of sunlight from raw materials like water and carbon dioxide. They are known as **photo-autotrophs** (auto = self, photo = light, troph = food). There are some **chemo-autotrophs**, which are a group of bacteria, producing their food from oxidation of certain chemicals. e.g. sulphur bacteria.

(ii) Consumers: These organisms get their food by feeding on other organisms. They are of the following types:

- Herbivores—which feed on plants e.g. rabbit, insect.
- Carnivores—which feed on herbivores as secondary carnivores (e.g., frog, small fish) or tertiary carnivores (e.g., snake, big fish), which feed on other consumers.
- Omnivores—which feed on both plants and animals e.g., humans, rats, many birds.
- Detritivores—which feed on dead organisms e.g., earth worm, crab, ants.

(iii) Decomposers: These are micro-organisms which break down organic matter into inorganic compounds and in this process they derive their nutrition. They play a very important role in converting the essential nutrients from unavailable organic form to free inorganic form that is available for use by plants e.g., bacteria, fungi. Decomposers attack the dead remains of producers and consumers and degrade the complex organic substances into simpler compounds. The simple organic matters are then attacked by another kind of bacteria, the transformers which change these organic compounds into the inorganic forms that are suitable for reuse by producers or green plants. The decomposers and transformers play very important role in maintaining the dynamic nature of ecosystems.

(b) ABIOTIC COMPONENTS: Various physico-chemical components of the ecosystem constitute the abiotic structure

- (i) Physical components include sunlight, solar intensity, rainfall, temperature, wind speed and direction, water availability, soil texture etc.
- (ii) Chemical components include major essential nutrients like C, N, P, K, H<sub>2</sub>, O<sub>2</sub>, S etc. and micronutrients like Fe, Mo, Zn, Cu etc., salts and toxic substances like pesticides. These physico-chemical factors of water, air and soil play an important role in ecosystem functioning.

### **Functioning of eco systems:**

#### **The main functions of Ecosystem are:**

- **Productivity:** Producing biomass (plant/animal material used for energy production) being first function as if in Terrestrial ecosystem, a tree produces food or creates biomass for herbivores. The herbivore integrate food taken by them into their biomass which is further utilized by carnivore which is a result of Energy Flow.

- **Energy flow:** Energy moves life. The cycle of energy is based on the flow of energy through different trophic levels in an ecosystem. Our ecosystem is maintained by the cycling energy and nutrients obtained from different external sources.

- **Decomposition:** Organisms when die are processed by process of Decomposition. The decomposers further process these organisms and frees nutrients available in them into atmosphere or say in soil completing Nutrient Cycling the fourth function.

- **Cycling of nutrients:** The cycle starts again once the complex compounds are simplified.

## Food chains and food webs

- (i) **Food chain** is the sequence of eating and being eaten. e.g.,  
Grass → Grasshopper → Frog → Snake → Hawk

Phytoplanktons (water-algae) → water fleas → small fish → large fish (Tuna)

These are known as **grazing food chain**—which start with green plants and culminate with carnivores.

**Parasitic food chain:** This food chain starts from herbivore but food energy passes from larger to smaller organism without outright killing as in case of predator. Hence, the larger animals are considered to be the hosts and the smaller animals which fulfill their nutritional requirements from the hosts are considered as parasites.

Another type is **detritus food chain**—which starts with dead organic matter. e.g.,  
Leaf litter in a forest → Fungi → bacteria

### Food chains in Forest Ecosystem:

In a forest ecosystem, grass is eaten by a deer, which in turn is eaten by a tiger. The grass, deer and tiger form a food chain. In this food chain, energy flows from the grass (producer) to the deer (primary consumer) to the tiger (secondary consumer).

### Food chains in Aquatic Ecosystem

In a freshwater aquatic ecosystem like a pond, the organisms in the food chain include algae, small animals, insects and their larvae, small fish, big fish and a fish is eaten by a bird or animal.

**Food Web:** Food chains are generally found to be interlinked and inter-woven as a network and known as Food Web. There are several options of eating and being eaten in a food web. Hence these are more stable.

- (ii) There is **uni-directional flow of energy** in an ecosystem. It flows from sun and then after being captured by primary producers (green plants), flows through the food chain or food web, following the laws of thermodynamics.
- (iii) At every successive step in the food-chain, there is huge loss of about 90% of the energy in different processes (respiration, excretion, locomotion etc.) and only 10% moves to next level (**Ten per cent law of energy flow**).
- (iv) Nutrients (Materials) in an ecosystem move in a cyclic manner. The cycling of nutrients takes place between the biotic and abiotic components, hence known as biogeochemical cycles (bio = living, geo = earth, chemical = nutrients).
- (v) Every ecosystem functions to produce and sustain some primary production (plant biomass) and secondary production (animal biomass). (v) Every ecosystem regulates and maintains itself and resists any stresses or disturbances up to a certain limit. This self regulation or control system is known as cybernetic system.

## **Types of Ecosystems**

1. Terrestrial: Forest, Grassland, Desert, Tundra
2. Aquatic: Freshwater, Marine, Wetlands, Estuaries

### **Types of Ecosystems- Forest Ecosystems**

- Forest ecosystems are classified according to their climate type as tropical, temperate or boreal.
- Temperate forests are in regions where the climate changes a lot from summer to winter. Temperate forests made of two types of trees, deciduous and evergreen.
- Deciduous trees are trees that lose their leaves in the winter.
- Evergreens are trees that keep them all year long, like pine trees.
- Tropical rain forests are in regions where the climate stays constant all year long. These ecosystems contain more diverse flora and fauna than ecosystems in any other region on earth. In these warm, moisture-laden environments, trees grow tall and greenery is lush and dense, with species inhabiting the forest floor all the way up to the canopy.
- In the far north, just south of the Arctic, Boreal forests – also known as Taiga – feature abundant coniferous trees.

### **Types of Ecosystems- Grassland Ecosystems**

- Grassland ecosystems are dominated by the grass with few or no trees in the area.
- Grassland Ecosystem is an area where the vegetation is dominated by grasses and other herbaceous (non-woody) plants.
- The Grassland Ecosystem is also called “Transitional Landscape”.
- These are known by different names in different region of the world like steppes in Europe and Asia, pampas in South America, Veldt in South Africa and Downs in Australia.
- The Grassland Ecosystem covers about 10 percent of the Earth's surface.
- It is found where rainfall is about 15-75 cm per year not enough to support a forest, but more than that of true desert.
- In India, they are found mainly high Himalayas.
- Trees are sparse or nonexistent, but flowers may be spread with the grasses.

- Grasslands provide an ideal environment for grazing animals

### **Types of Ecosystems- Desert Ecosystems**

The common defining feature among desert ecosystems is low precipitation/rainfall, generally less than 25 centimeters, or 10 inches, per year. Not all deserts are hot – desert ecosystems can exist from the tropics to the arctic, but regardless of latitude, deserts are often windy.

Some deserts contain sand dunes, while others feature mostly rock. • The air is dry in a desert ecosystem, and human survival is difficult if not impossible.

Vegetation is sparse or nonexistent, and any animal species, such as insects, reptiles and birds, must be highly adapted to the dry conditions.

**Tundra Ecosystems:** • As with deserts, a harsh environment characterizes ecosystems in the tundra. Tundra ecosystem is characterized by snow-covered, windswept, treeless region.

- The soil is frozen year-round, a condition known as Permafrost. During the brief spring and summer, snows melt, producing shallow ponds which attract migrating waterfowl. Lichens (algae) and small flowers may become visible during this time of year.

- The term “tundra” most commonly denotes polar areas, but at lower altitudes.

### **Types of Ecosystems- Freshwater Ecosystems**

Freshwater ecosystems can be found in streams, rivers, springs, ponds, lakes and freshwater swamps. They are subdivided into two classes:

Lentic: those in which the water is nearly stationary, such as ponds, lake and

Lotic: those in which the water flows, such as river, stream.

Freshwater ecosystems are home to more than just fish: algae, plankton, insects, amphibians and underwater plants also inhabit them.

### **Types of Ecosystems- Marine Ecosystems**

- Marine ecosystems differ from freshwater ecosystems as they contain saltwater, which usually supports different types of species than does freshwater. Marine ecosystems are the most abundant types of ecosystems in the world. They encompass not only the ocean floor and surface but also tidal zones, estuaries, salt marshes and saltwater swamps, mangroves and coral reefs.

## **Artificial Ecosystem**

- An artificial ecosystem is a human made system of plants, animals, and people living in an area together with their surroundings. An artificial ecosystem is not self-sustaining, and it would perish without human assistance.
- Artificial Ecosystems also called Man-made or Man-engineered Ecosystems. They are maintained artificially by man where, by addition of energy and planned manipulation, natural balance is disturbed regularly, e.g. farms, gardens, villages, cities, dams, zoo, aquarium etc.,

## **Biodiversity**

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

### **Three levels of Biodiversity**

Biological diversity deals with the degree of nature's variety in the biosphere. This variety can be observed at three levels;

1. The genetic variability within a species,
  2. The variety of species within a community, and
  3. Ecosystem diversity: The organisation of species in an area into distinctive plant and animal communities.
1. **Genetic diversity:** Each member of any animal or plant species differs widely from other individuals in its genetic makeup because of 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. Eventually this can lead to the extinction of the species. The diversity in wild species forms the 'gene pool' from which our crops and domestic animals have been developed over thousands of years
  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 more rich in species than others. Natural undisturbed tropical forests have a much greater species richness than plantations developed by the Forest Department for timber production. A natural forest ecosystem provides a large number of non-wood products that local people depend on such as fruit, fuel wood, fodder, fiber, gum, resin and medicines.

At present conservation scientists have been able to identify and categorise about 1.8 million species on earth. However, 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, which have their own complement of distinctive inter linked 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 taluka. Distinctive ecosystems include landscapes such as forests, grasslands, deserts, mountains, etc., as well as aquatic ecosystems such as rivers, lakes, and the sea. Each region also has man-modified areas such as farmland or grazing pastures.

The diversity of life at all three organisational levels, genetic, species and ecosystem, is thus being rapidly modified by modern man. This is a great loss to future generations who will follow us.

## **BIOGEOGRAPHIC CLASSIFICATION OF INDIA**

Our country can be conveniently divided into ten major regions, based on the geography, climate and pattern of vegetation seen and the communities of mammals, birds, reptiles, amphibia, insects 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.

### **India's Biogeographic Zones**

1. The cold mountainous snow covered Trans Himalayan region of Ladakh.
2. The Himalayan ranges and valleys of Kashmir, Himachal Pradesh, Uttarakhand, Assam and other North Eastern States.
3. The Terai, the lowland where the Himalayan rivers flow into the plains.
4. The Gangetic and Bhramaputra plains.
5. The Thar Desert of Rajasthan.
6. The semi arid grassland region of the Deccan plateau Gujarat, Maharashtra, Andra Pradesh, Karnataka and Tamil Nadu.
7. The Northeast States of India,
8. The Western Ghats in Maharashtra, Karnataka and Kerala.
9. The Andaman and Nicobar Islands.
10. The long western and eastern coastal belt with sandy beaches, forests and mangroves.

## **VALUE OF BIODIVERSITY**

**Environmental services from species and ecosystems** are essential at global, regional and local levels. Production of oxygen, reducing carbon dioxide, maintaining the water cycle, protecting soil are important services.

**Forests are the main mechanism for the conversion of carbon dioxide into carbon and oxygen.** The loss of forest cover, coupled with the increasing release of carbon dioxide and other gases through industrialization contributes to the 'greenhouse effect'.

**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 CO<sub>2</sub>, give out O<sub>2</sub>), 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, medicines, are all resources that are directly or indirectly linked to the biological variety present in the biosphere.**

This is most obvious in **the tribal communities** who 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 their 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 mankind.** The preservation of 'biodiversity' is therefore integral to any strategy that aims at improving the quality of human life.

**Commonly used modern drugs derived from plant sources:**

**Bromelain from Pineapple-**Controls tissue inflammation due to infection.

**Caffeine from Tea, Coffee-** Stimulant of the central nervous system.

**Camphor from Camphor tree-**Rebefeicent- increases local blood supply.

**Cocaine from Cocoa Analgesic and local anesthetic-** reduces pain & prevents pain during surgery.

### **Values of biodiversity**

**Consumptive use value:** The direct utilisation of timber, food, fuelwood, fodder by local communities.

**Productive use value:** Marketable goods.

**Ethical and moral values:** Ethical values related to biodiversity conservation are based on the importance of protecting all forms of life

**Aesthetic value:** Knowledge and an appreciation of the presence of biodiversity for its own sake is another reason to preserve it.

**Option value:** Keeping future possibilities open for their use is called option value. It is impossible to predict which of our species or traditional varieties of crops and domestic animals will be of great use in the future.

## **INDIA AS A MEGA DIVERSITY NATION**



Among the biologically rich nations, India stands among the top 10 countries for its great variety of plants and animals, many of which are not found elsewhere.

### **Animal diversity**

India has 350 different mammals (rated eight highest in the world), 1,200 species of birds (eighth in the world), 453 species of reptiles (fifth in the world) and 45,000 plant species, of which most are angiosperms, (fifteenth in the world).

India has 50,000 known species of insects, including 13,000 butterflies and moths. It is estimated that the number of unknown species could be several times higher.

Among amphibians found in India, 62% are unique to this country. Among lizards, of the 153 species recorded, 50% are endemic.

High endemism has also been recorded for various groups of insects, marine worms, centipedes, mayflies and fresh water sponges.

### **Plant diversity**

These include especially high species diversity of ferns (1022 species) and orchids (1082 species).

It is estimated that 18% of Indian plants are endemic to the country and found nowhere else in the world.

Among the plant species the flowering plants have a much higher degree of endemism, a third of these are not found elsewhere in the world.

### **Diversity of cultivated crops and domestic livestock**

Apart from the high biodiversity of Indian wild plants and animals there is also a great diversity of cultivated crops and breeds of domestic livestock. This is a result of several thousand years during which civilizations have grown and flourished in the Indian subcontinent.

The traditional cultivars included 30,000 to 50,000 varieties of rice and a number of cereals, vegetables and fruit. The highest diversity of cultivars is concentrated in the high rainfall areas of the Western Ghats, Eastern Ghats, Northern Himalayas and the North-Eastern hills.

Gene-banks have collected over 34,000 cereals and 22,000 pulses grown in India.

India has 27 indigenous breeds of cattle, 40 breeds of sheep, 22 breeds of goats and 8 breeds of buffaloes.

### **HOTSPOTS OF BIODIVERSITY**

The earth's biodiversity is distributed in specific ecological regions. There are over a thousand major ecoregions in the world.

Of these, 200 are said to be the richest, rarest and most distinctive natural areas. These areas are referred to as the **Global 200**.

**Coined by Norman Myers, the term "Biodiversity hotspots"** can be defined as the regions which are known for their high species richness and endemism.

**Megadiversity nation:**

It has been estimated that 50,000 endemic plants which comprise 20% of global plant life, probably occur in only 18 'hot spots' in the world. Countries which have a relatively large proportion of these hot spots of diversity are referred to as 'megadiversity nations'.

The rate at which the extinction of species is occurring throughout our country remains obscure. It is likely to be extremely high as our wilderness areas are shrinking rapidly.

India is known for its rich biodiversity and has around 24.46% of the geographical area covered by forests and trees.

**According to Conservation International, a region must fulfill the following two criteria to qualify as a hotspot:**

1. The region should have at least 1500 species of vascular plants i.e., it should have a high degree of endemism.
2. It must contain 30% (or less) of its original habitat, i.e. it must be threatened.

Following the criteria must for an area to be declared as Biodiversity Hotspot, there are major four biodiversity hotspots in India:

**The Himalayas****Indo-Burma Region****The Western Ghats****Sundaland****The Himalayas**

Considered the highest in the world, the Himalayas (overall) comprises North-East India, Bhutan, Central and Eastern parts of Nepal. This region (NE Himalayas) holds a record of having 163 endangered species which includes the Wild Asian Water Buffalo, One-horned Rhino; and as many as 10,000 plant species, of which 3160 are endemic. This mountain range covers nearly 750,000 km<sup>2</sup>.

**Indo – Burma Region**

The Indo-Burma Region is stretched over a distance of 2,373,000 km<sup>2</sup>. In the last 12 years, 6 large mammal species have been discovered in this region: the Large-antlered Muntjac, the Annamite Muntjac, the Grey-shanked Douc, the Annamite Striped Rabbit, the Leaf Deer, and the Saola.

This hotspot is also known for the endemic freshwater turtle species, most of which are threatened with extinction, due to over-harvesting and extensive habitat loss. There are also 1,300 different bird species, including the threatened White-eared Night-heron, the Grey-crowned Crocias, and the Orange-necked Partridge.

### **The Western Ghats**

The Western Ghats are present along the western edge of peninsular India and covers most of the deciduous forests and rain forests. As per UNESCO, it is home to at least 325 globally threatened flora, fauna, bird, amphibian, reptile and fish species.

Originally, the vegetation in this region was spread over 190,000 km<sup>2</sup> but has been now reduced to 43,000 km<sup>2</sup>. The region is also known for the globally threatened flora and fauna represented by 229 plant species, 31 mammal species, 15 bird species, 43 amphibian species, 5 reptile species and 1 fish species. UNESCO mentions that “Of the total 325 globally threatened species in the Western Ghats, 129 are classified as Vulnerable, 145 as Endangered and 51 as Critically Endangered.”

Knowing in detail about the Western Ghats will be helpful for the aspirants for the Geography preparation.

### **Sundaland**

The Sundaland hotspot lies in South-East Asia and covers Singapore, Thailand, Indonesia, Brunei, and Malaysia. In the year 2013, the Sundaland was declared as a World Biosphere Reserve by the United Nations. This region is famous for its rich terrestrial and marine ecosystem. Sundaland is one of the biologically richest hotspots in the world which comprises 25,000 species of vascular plants, of which 15,000 are found only in this region.

### **THREATS TO BIODIVERSITY: HABITAT LOSS, POACHING OF WILDLIFE, MAN-WILD- LIFE CONFLICTS**

Man has begun to **overuse or misuse** most of these natural ecosystems. Due to this ‘**unsustainable**’ resource-use, once productive forests and grasslands have been turned **into deserts and wasteland** have increased all over the world.

**Mangroves have been cleared for fuelwood and prawn farming, which has led to a decrease in the habitat essential for breeding of marine fish.**

**Wetlands have been drained to increase agricultural land.** The current destruction of the remaining large areas of wilderness habitats, especially in the super diverse tropical forests and coral reefs, is the most important threat worldwide to biodiversity. Scientists have estimated that human activities are likely to eliminate approximately 10 million species by the year 2050.

There are about 1.8 million species of plants and animals, both large & microscopic, known to science in the world at present. Unfortunately at the present rate of extinction about 25% of the world’s species will undergo extinction fairly rapidly within the next twenty or thirty years

Much of this mega extinction spasm is related **to human population growth, industrialization and changes in land-use patterns.** A major part of these extinctions will occur in ‘biorich’ areas such as tropical forests, wetlands, and coral reefs. The loss of wild habitats due to rapid human population growth and short term

economic development are major contributors to the rapid global destruction of biodiversity.

**Habitat loss** also results from man's introduction of species from one area into another, disturbing the balance in existing communities. In the process, the purposely or accidentally introduced organisms (Eupatorium, Lantana, Hyacinth, Congress grass or Parthenium) have led to the extinction of many local species.

In India, forests and grasslands are continuously being changed to agricultural land.

**Encroachments** have been legalized repeatedly. Similarly natural wetland systems have been drained to establish croplands resulting in loss of aquatic species.

Grasslands that were once sustainably used by a relatively smaller number of human beings and their cattle are either changed to other forms of use or degraded by **overgrazing**.

**Overharvesting of fish**, especially by trawling is leading to serious depletion of fish stocks. Turtles are being massacred off the coast of Orissa. The rare whale shark, a highly endangered species, is being killed off the coast of Gujarat.

**Poaching:** Specific threats to certain animals are related to large economic benefits. Skin and bones from tigers, ivory from elephants, horns from rhinos and the perfume from the musk deer are extensively used abroad. Bears are killed for their gall bladders. Corals and shells are also collected for export or sold on the beaches of Chennai and Kanyakumari. A variety of wild plants with real or at times dubious medicinal value are being over harvested. The commonly collected plants include Rauvolfia, Nuxvomica, Datura, etc. Collection of garden plants includes orchids, ferns and moss.

## **ENDANGERED AND ENDEMIC SPECIES OF INDIA**

To appreciate the endemic and endangered species of India it is important to understand the wide variety of plant and animal species that are found in the country. Of the well-known species, there are several which are endangered by human activity.

**The endangered species in the country are categorised 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 Protected Areas. Among **the important endangered animals are charismatic species such as the tiger, the elephant, the rhino, etc.**

The less well-known major mammals restricted to a single area include the Indian wild ass, the Hangul or Kashmir stag, the Golden langur, the pygmy hog and a host of others. There are also endangered bird species such as the Siberian crane, the Great Indian Bustard, the Florican and several birds of prey. During the recent past, vultures which were common a decade ago, have suddenly disappeared and are now highly threatened, including a large number of species that inhabit our coral reefs.

To protect endangered species India has created the **Wildlife Protection Act**. This includes lists of plants and animals categorised according to the threat on their survival.

### **Common Plant species**

**Teak:** This tree is from the Southwest parts of peninsular India. It is a common tree in deciduous forests. It yields a much sought after timber used for making excellent furniture.

**Sal:** This is a common species of 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 nearly throughout the year.

**Mango:** This has become one of our most popular horticultural species with different varieties grown all over the country.

**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 to taste. It is used extensively as an environmentally friendly insecticide.

**Amla:** This deciduous medium sized tree is known for its sour, green-yellow fruit which is rich in vitamin C. It is used as a medicine, in pickles and for dying and tanning. It is frequently referred to as the Indian 'olive'.

### **Common Animal species**

**Mammals:** The common deer species found in India include the **sambar, chital, barasingha and barking deer**.

The **blackbuck** is the only true antelope found in India. The **chinkara**, also known as the Indian gazelle, is a smaller animal and is pale brown in colour it has 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. The males are blue-gray. Nilgai have white markings on the legs and head. They have short strong spike-like horns.

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

**The rhinoceros** is now restricted to Assam but was once found throughout the Gangetic plains.

The **wild buffalo** is now also restricted to the Terai. The elephant is distributed in the Northeastern and Southern States. It is threatened by habitat loss and poaching for ivory. **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.

One of the common monkey species of the forest is the **bonnet macaque**, which has a redface, 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 Annamalai ranges.

## **CONSERVATION OF BIODIVERSITY: IN-SITU AND EX-SITU**

### **In-situ conservation**

Biodiversity at all its levels, genetic species and as intact ecosystems, can be best preserved insitu by setting aside an adequate representation of wilderness as 'Protected Areas'. Conservation of a species is best done by protecting its habitat along with all the other species that live in it in nature. This is known as in-situ conservation, which is conserving a species in its own environment by creating National Parks and Wildlife Sanctuaries.

These should consist of a network of **National Parks and Wildlife Sanctuaries** with each distinctive ecosystem included in the network. Such a network would preserve the total diversity of life of a region.

In the past **National Parks and Sanctuaries** in India were notified to preserve major wildlife species such as tigers, lions, elephants, and deer. The objective of these areas should be expanded to the preservation of relatively intact natural ecosystems, where biological diversity – from microscopic unicellular plants and animals, to the giant trees and major mammals – can all be preserved.

**Wildlife Sanctuaries and National Parks of India:** There are 589 Protected Areas in India of which 89 are National Parks and 500 are Wildlife Sanctuaries. They include a variety of ecosystems and habitats. Some have been created in order to protect highly endangered species of wild plants and animals found nowhere else in the world.

The **Great Himalayan National Park** is the largest sanctuary in this ecosystem and is onem of the last homes of the beautiful snow leopard. **Dachigam Sanctuary** is the only place where the rare Hangul or Kashmir stag is found.

There are several Sanctuaries in the Terai region, **Kaziranga National Park** is the most famous which has elephant, wild buffalo, gaur, wild boar, swamp deer, and hog deer, in large numbers, as well as tiger and leopard. Its bird life is extremely rich and includes ducks, geese, pelicans and storks. The **Manas Sanctuary**, in addition to the above Terai species, also includes the rare golden langur and the very rare pygmy hog, the smallest wild boar in the world.

### **Ex-situ conservation**

Though conservation of a species is best done in in-situ conservation, however, there are situations in which an endangered species is so close to extinction that unless alternate methods are instituted, the species may be rapidly driven to extinction. This strategy is known as **ex-situ conservation, i.e. outside its natural habitat in a carefully controlled situation such as a botanical garden for plants or a zoological park** for animals, where there is expertise to multiply the species under artificially managed conditions. These breeding programs for rare plants and animals are however more expensive than managing a Protected Area.

**Gene bank:** There is also another form of preserving a plant by preserving its germ plasm in a **gene bank** so that it can be used if needed in future. This is even more

expensive. When an animal is on the brink of extinction, it must be carefully bred so that inbreeding does not lead to the genetic makeup becoming weak.