Chapter 15

Biodiversity and Conservation

Biodiversity: Types, Importance, Biodiversity in India

What is Biodiversity?

Biodiversity is the variation among living organisms from different sources including terrestrial, marine and desert ecosystems, and the ecological complexes of which they are a part.

- Biodiversity describes the richness and variety of life on earth. It is the most complex and important feature of our planet. Without biodiversity, life would not sustain
- The term **biodiversity was coined in 1985**. It is important in natural as well as artificial ecosystems. It deals with nature's variety, the biosphere. It refers to variabilities among plants, animals, and microorganism species.
- Biodiversity includes the number of different organisms and their relative frequencies in an ecosystem. It also reflects the organization of organisms at different levels.
- Biodiversity holds ecological and economic significance. It provides us with nourishment, housing, fuel, clothing, and several other resources. It also extracts monetary benefits through tourism. Therefore, it is very important to have a good knowledge of biodiversity for a sustainable livelihood.

Types of Biodiversity

There are the following three different types of biodiversity:

- Genetic Biodiversity
- Species Biodiversity
- Ecological Biodiversity

Genetic diversity

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

Species diversity

- Species diversity refers to the variety of different types of species found in a particular area.
- It is biodiversity at the most basic level. It includes all the species ranging from plants to different microorganisms.
- No two individuals of the same species are exactly similar. For example, humans show a lot of diversity among themselves.

Ecological diversity

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

Importance Of Biodiversity

Biodiversity and its maintenance are very important for sustaining life on earth. A few of the reasons explaining the importance of biodiversity are:

Ecological Stability

- Every species has a specific role in an ecosystem. They capture and store energy and also produce and decompose organic matter.
- The ecosystem supports the services without which humans cannot survive. A diverse ecosystem is more productive and can withstand environmental stress.

Economic Importance

- Biodiversity is a reservoir of resources for the manufacture of food, cosmetic products and pharmaceuticals.
- Crops livestock, fishery, and forests are a rich source of food.
- Wild plants such as Cinchona and Foxglove plant are used for medicinal purposes.
- Wood, fibres, perfumes, lubricants, rubber, resins, poison and cork are all derived from different plant species.
- The national parks and sanctuaries are a source of tourism. They are a source of beauty and joy for many people.

Ethical Importance

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

Loss of Biodiversity

- Loss of biodiversity is the decrease in the number of a particular species in a certain habitat. Loss of biodiversity also leads to the extinction of the plant and animal species and this loss can be either reversible or permanent.
- Human activities have been the major cause of the loss of biodiversity which has led to sudden changes in climate causing a big threat to biodiversity.
- There has also been an increased demand for natural resources along with the growing population leading to greater waste generation.

Causes of Loss of Biodiversity

Some of the major causes that have resulted in the loss of biodiversity are mentioned below:

- The natural habitat of the ecosystem plays a major role in maintaining the ecological balance. Several trees are cut down every year for the construction of industries, highways, settlements,s and so on to fulfill human demands. As a result, the species become the target of predation and eventually dies.
- Hunting of wild animals for the commercialization of their products has been a major reason for the loss of biodiversity. Since the year 2013, more than 90 rhinos were killed by the poachers for their horns and as per the records of 2016, 9 Indian Rhinos have been killed in Kaziranga National Park of Assam.
- The exploitation of medicinal plants for several laboratory purposes has resulted in the extinction of these species. Also, several animals are sacrificed for various research in science and medicine.
- Natural calamities like floods, earthquakes, forest fires also lead to the loss of biodiversity.
- Air pollution has a major role in the loss of biodiversity. Rapid cutting down of the trees has resulted in the increase of carbon dioxide in the atmosphere leading to climate change. As a result, there has been an increase in the land and ocean temperature leaving an inimical impact on species.

Biodiversity in India

- India is one of the most diverse nations in the world. It ranks ninth in terms of plant species richness. Two of the world's 25 biodiversity hotspots are found in India.
- It is the origin of important crop species such as pigeon pea, eggplant, cucumber, cotton, and sesame. India is also a center of various domesticated species such as millets, cereals, legumes, vegetables, medicinal and aromatic crops, etc.
- India is equally diverse in its faunal wealth. There are about 91000 animal species found here.
- However, diversity is depleting at a drastic rate and various programs on biodiversity conservation are being launched to conserve nature.

Patterns of Biodiversity, Importance & Loss of Biodiversity

Patterns of Biodiversity

(i) Latitudinal gradients: The diversity of plants and animals is not uniform throughout the world but shows a rather uneven distribution. For many group of animals or plants, there are interesting patterns in diversity, the most well- known being the latitudinal gradient in diversity. In general, species diversity decreases as

we move away from the equator towards the poles. With very few exceptions, tropics (latitudinal range of 23.5° N to 23.5° S) harbor more species than temperate or polar areas. Colombia located near the equator has nearly 1,400 species of birds while New York at 41° N has 105 species and Greenland at 71° N only 56 species. India, with much of its land area in the tropical latitudes, has more than 1,200 species of birds. A forest in a tropical region like Ecuador has up to 10 times as many species of vascular plants as a forest of equal area in a temperate region like the Midwest of the USA. The largely tropical Amazonian rain forest in South America has the greatest biodiversity on earth- it is home to more than 40,000 species of plants, 3,000 of fishes, 1,300 of birds, 427 of mammals, 427 of amphibians, 378 of reptiles and of more than 1,25,000 invertebrates. Scientists estimate that in these rain forests there might be atleast two million insect species waiting to be discovered and named.

What is so special about tropics that might account for their greater biological diversity? Ecologists and evolutionary biologists have proposed various hypotheses; some important ones are (a) Speciation is generally a function of time, unlike temperate regions subjected to frequent glaciations in the past, tropical latitudes have remained relatively undisturbed for millions of years and thus, had a long evolutionary time for species diversification, (b) Tropical environments, unlike temperate ones, are less seasonal, relatively more constant and predictable. Such constant environment promote niche specialisation and lead to a greater species diversity and (c) There is more solar energy available in the tropics, which contributes to higher productivity; this in turn might contribute indirectly to greater diversity.

(ii) Species-Area relationships: During his pioneering and extensive explorations in the wilderness of South American jungles, the great German naturalist and geographer Alexander von Humboldt observed that within a region, species

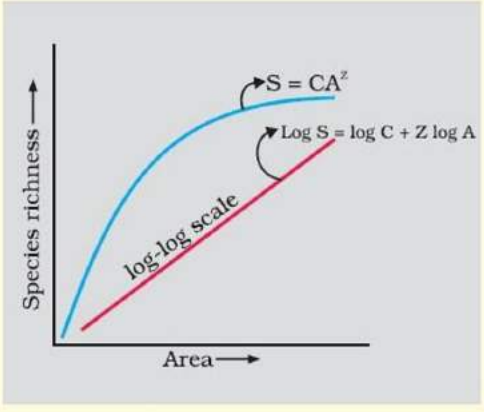

Figure 15.2 Showing species area relationship. Note that on log scale the relationship becomes linear

richness increased with increasing explored area, but only upto a limit. In fact, the relation between species richness and area for a wide variety of taxa (angiosperm plants, birds, bats, freshwater fishes) turns out to be a rectangular hyperbola (Figure 15.2). On a logarithmic scale, the relationship is a straight line described by the equation:

log S = log C + Z log A

where

S= Species richness A= Area

Z = slope of the line (regression coefficient)

C = Y-intercept

Ecologists have discovered that the value of Z lies in the range of 0.1 to 0.2, regardless of the taxonomic group or the region (whether it is the plants in Britain, birds in California or molluscs in New York state, the slopes of the regression line are amazingly similar). But, if you analyse the species-area relationships among very large areas like the entire continents, you will find that the slope of the line to be much steeper (Z values in the range of 0.6 to 1.2). For example, for frugivorous (fruit-eating) birds and mammals in the tropical forests of different continents, the slope is found to be 1.15. What do steeper slopes mean in this context?

The importance of Species Diversity to the Ecosystem

Does the number of species in a community really matter to the functioning of the ecosystem? This is a question for which ecologists have not been able to give a definitive answer. For many decades, ecologists believed that communities with more species, generally, tend to be more stable than those with less species. What exactly is stability for a biological community? A stable community should not show too much variations in productivity from year to year; it must be either resistant or resilient to occasional disturbances (natural or man-made), and it must also be resistant to invasions by alien species. We don't know how these attributes are linked to species richness in a community, but David Tilman's long-term ecosystem experiments using outdoor plots provide some tentative answers. Tilman found that plots with more species showed less year-to-year variations in total biomass. He also showed that in his experiments, increased diversity contributed to higher productivity.

Although, we may not understand completely how species richness contributes to the well-being of an ecosystem, we know enough to realise that rich biodiversity is not only essential for ecosystem health but imperative for the very survival of the human race on this planet. At a time when we are losing species at an alarming pace, one might ask– Does it really matter to us if a few species become extinct? Would Western Ghats ecosystems be less functional if one of its tree frog species is lost forever? How is our quality of life affected if, say, instead of 20,000 we have only 15,000 species of ants on earth?

There are no direct answers to such näive questions but we can develop a proper perspective through an analogy (the 'rivet popper hypothesis') used by Stanford ecologist Paul Ehrlich. In an airplane (ecosystem) all parts are joined together using thousands of rivets (species). If every passenger travelling in it starts popping a rivet to take home (causing a species to become extinct), it may not affect flight safety (proper functioning of the ecosystem) initially, but as more and more rivets are removed, the plane becomes dangerously weak over a period of time. Furthermore, which rivet is removed may also be critical. Loss of rivets on the wings (key species that drive major ecosystem functions) is obviously a more serious threat to flight safety than loss of a few rivets on the seats or windows inside the plane.

Loss of Biodiversity

While it is doubtful if any new species are being added (through speciation) into the earth's treasury of species, there is no doubt about their continuing losses. The biological wealth of our planet has been declining rapidly and the accusing finger is clearly pointing to human activities. The colonisation of tropical Pacific Islands by humans is said to have led to the extinction of more than 2,000 species of native birds. The IUCN Red List (2004) documents the extinction of 784 species (including 338 vertebrates, 359 invertebrates and 87 plants) in the last 500 years. Some examples of recent extinctions include the dodo (Mauritius), quagga (Africa), thylacine (Australia), Steller's Sea Cow (Russia) and three subspecies (Bali, Javan, Caspian) of tiger. The last twenty years alone have witnessed the disappearance of 27 species. Careful analysis of records shows that extinctions across taxa are not random; some groups like amphibians appear to be more vulnerable to extinction. Adding to the grim scenario of extinctions is the fact that more than 15,500 species world-wide are facing the threat of extinction. Presently, 12 per cent of all bird species, 23 per cent of all mammal species, 32 per cent of all amphibian species and 31 per cent of all gymnosperm species in the world face the threat of extinction. From a study of the history of life on earth through fossil records, we learn that large-scale loss of species like the one we are currently witnessing have also happened earlier, even before humans appeared on the scene. During the long period (> 3 billion years) since the origin and diversification of life on earth there were five episodes of mass extinction of species. How is the 'Sixth Extinction' presently in progress different from the previous episodes? The difference is in the rates; the current species extinction rates are estimated to be 100 to 1,000 times faster than in the pre-human times and our activities are responsible for the faster rates. Ecologists warn that if the present trends continue, nearly half of all the species on earth might be wiped out within the next 100 years.
In general, loss of biodiversity in a region may lead to (a) decline in plant production, (b) lowered resistance to environmental perturbations such as drought

and (c) increased variability in certain ecosystem processes such as plant productivity, water use, and pest and disease cycles. Causes of biodiversity losses: The accelerated rates of species extinctions that the world is facing now are largely due to human activities. There are four major causes (The Evil Quartet ' is the sobriquet used to describe them).

(i) Habitat loss and fragmentation: This is the most important cause driving animals and plants to extinction. The most dramatic examples of habitat loss come from tropical rain forests. Once covering more than 14 per cent of the earth's land surface, these rain forests now cover not more than 6 per cent. They are being destroyed at a fast pace. By the time you finish reading this chapter, 1000 more hectares of rain forest would have been lost. The Amazon rain forest (it is so huge that it is called the 'lungs of the planet') harbouring probably millions of species is being cut and cleared for cultivating soya beans or for conversion to grasslands for raising beef cattle. Besides total loss, the degradation of many habitats by pollution also threatens the survival of many species. When large habitats are broken up into small fragments due to various human activities, mammals and birds requiring large territories and certain animals with migratory habits are badly affected, leading to population declines.

(ii) Over-exploitation: Humans have always been dependent on nature for food and shelter, but when 'need' turns to 'greed', it leads to over -exploitation of natural resources. Many species extinctions in the last 500 years (Steller's sea cow, passenger pigeon) were due to over exploitation by humans. Presently many marine fish populations around the world are over harvested, endangering the continued existence of some commercially important species.

(iii) Alien species invasions: When alien species are introduced unintentionally or deliberately for whatever purpose, some of them turn invasive, and cause decline or extinction of indigenous species. The Nile perch introduced into Lake Victoria in east Africa led eventually to the extinction of an ecologically unique assemblage of more than 200 species of Cichlid fish in the lake. You must be familiar with the environmental damage caused and threat posed to our native species by invasive weed species like carrot grass (Parthenium), Lantana and water hyacinth (Eicchornia). The recent illegal introduction of the African catfish Clarias gariepinus for aquaculture purposes is posing a threat to the indigenous catfishes in our rivers.

(iv) Co-extinctions: When a species becomes extinct, the plant and animal species associated with it in an obligatory way also become extinct. When a host fish species becomes extinct, its unique assemblage of parasites also meets the same fate. Another example is the case of a coevolved plant-pollinator mutualism where extinction of one invariably leads to the extinction of the other.

Biodiversity Conservation

Biodeversity and its Conversion

India's Famous Tiger Reserve –

- Jim Corbett National Park – Nainital (Uttaranchal)
- Dudhwa National Park – Lakhimpur Kheri (U.P.)
- Kanha National Park – Mandala and Balghat (Madhya Pradesh)
- Indrawati National Park – (Chattishgarh)
- Simli National Park – (Orissa)
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Some Special Animals –

- **Asiatic wild ass – (Endangered) –** Found in Rann of Kutch and Pakistan
- **Red Panda – (Endangered) –** Found in Kanchenjunga (Sikkim)
- **Hangul–Kashmir Stag (Endangered)–**Found in Dachigam (Sri-Nagar – Jammu & Kashmir)
- **Siberian Crane – (Endangered) –** Found in Keoladeo (Ghana) National Park

The Great Indian Bustard is a huge ground bird with a long neck and long bare legs. It is an inhabitant of the semi-arid areas of Rajasthan, Gujarat and Maharashtra. Hunting for its flesh has reduced its population to over 800. It is a highly endangered bird.

"Ex-situ conservation" is the protection of wild life in zoos and botanical gardens. Other e.g., of Ex-situ conservation are gene banks, germ plasm bank, seed bank.**"In situ conservation"** is the protection of species (wild life) in their natural habitat or National parks.

1. The world's first National Park (America) – Yellow stone National Park.
2. India's first National Park – Jim Corbett National Park – Nainital (Uttaranchal)
3. Smallest tiger reserve in India – Ranthambore National Park - Sawaimadhopur (Rajasthan). It is famous for Asiatic wild ass.
4. Largest Tiger reserve in India – Nagarjuna Sagar Saisailum Sanctuary - Guntoor - Andhra Pradesh.
5. Nandan-Kanan zoo is known for - White tiger.
Note: Sunderbans [W.Bengal] is also famous for tigers.
6. Periyar wild life Sanctuary (Kerala) – Famous for elephant & others.
7. Valley of flower National park – It is situated at Chamoli- Garhwal (Uttaranchal)
8. Flamingoes are protected in Chilka lake Balagaon (Orissa)
9. Rachel Carson written a book "Silent Spring" – concerned with awareness about "Nature conservation and Environment" -1962.

Note: It mentioned the effect of DDT on birds. The population of Ladybird bettle declined.

10. The black buck is one of the most graceful antelopes native of India. The male possesses a pair of spirally twisted horns. Once abundant in several parts of India, its population had come down until the enforcement of the wild life (Protection) Act.

SOME IMPORTANT INFORMATION:

1. (i) National Forest Policy revised in – 1988.
(ii) Biodiversity act of India was passed by the Parliament in the year-2002
(iii) Forest Act–1927.
(iv) Biosphere Reserve Scheme– 1986

2. Wild life protection act 1972 (Revised in 1991): Objectives:
(1) Restriction and prohibition on hunting of animals.
(2) Protection of specified plants.
(3) Setting up and managing **Sanctuaries** and National parks.
(4) Empowering zoo authority.
(5) Control of trade and commerce of wildlife.

3. Chipko Movement was born in March-1973 at Gopeshwar in Chamoli district. The movement had two leaders- Sundarlal Bahuguna of Silyara in Tehri and Chandi Prasad Bhatt of Gopeshwar.

Appiko Movement – Similar type movement, Appiko movement was under taken by Poundurang hegde in south in 1983.

SPECIAL WILDLIFE PROJECTS IN INDIA

Project tiger - Running since 1 April 1973 - Central Government.

The Gir Lion Sanctuary Project - Running since 1972-Central Govt. and Gujrat Govt.

Himalayan Musk Deer Project - U.P. Govt. IUCN and Central Govt.

The Manipur Brow-Antlered Deer Project- Running since 1977 **Project Hangul** - Since 1970 - J.& K. Govt. IUCN, WWF.
Crocodile Breeding Project - Since 1975 UNDP, Central Govt.
Project Elephant - Recently started.

ABOUT WILDLIFE

- **Red Data Book**: This book contains a record of **animals & plants** which are known to be in danger. This Book is maintained by the **IUCN** [International Union of Conservation of Nature and Natural Resources].
- **Green Data book**:A book containing a list of **rare plants** in a protected area like Botanical gardens.
- **Silent Valley**:-It is tropical evergreen forest in Kerala (Palghat) declared as National Reserve Forest. It is called silent valley because there is no noise in the forest during night, even that of cicadas, as they are not found there. **It is related to conservation of forest.**
- **Butterfly Park** :- India's first and only butterfly park was established in 1992 near Gangtok **(Sikkim).**

SOME OTHER INFORMATION ABOUT BIODIVERSITY:

1. Sacred forest: These are forest patches protected by tribal communities due to religious sanctity in Karnataka, Maharashtra, Kerala, Meghalaya.
Sacred lake : Khecheopalri lake in Sikkim has been declared "Sacred lake" by people.

2. Mine Spoil: The land that has been destroyed due to mining is known as **derelict land** or **mine spoil.**

3. Hot Spot: Norman Myers developed the hot spot concept in 1988. This is a mega diversity zone where large number of species are found. It is an area of the richest and the most threatened reservoirs of plant and animal life on the earth. Initially 25 biodiversity hot spots were identified in world, now number of biodiversity hot spots in the world are 34 out of these 3 hot spots are found in India.
(i) Western Ghats and Sri Lanka
(ii) Indo-Burma
(iii) The Himalayas Note:

- Hot spot covers the 1.4% of the earth's land area.
- The key criteria for determining a hot spot are :

Number of endemic species.
Degree of threat.

4. Biodiversity: The term biodiversity refers to the totality of genes, species and ecosystem of a region.

- **Species diversity:** Variety of species within a region.
- **Species richness:** The number of species in per unit area.

- If species evenness or equitability is high in an area then it will be considered more diverse.

5. Diversity at the level of community – Three types:

(i) **Alpha diversity:** Diversity within community.
(ii) **Beta diversity:** Diversity between community.
(iii) **Gamma diversity:** Diversity of the habitats over the total landscape or geographical area.

6. Reason for loss of Biodiversity:

(i) Habitat loss and fragmentation.
(ii) Disturbance and pollution.
(iii) Introduction of exotic species – New species entering in a geographical region it is called exotic species or alien species. Such species may cause disappearance of native species through changed biotic interactions. Exotic species are having large impact especially in island ecosystem. e.g. of exotic species:

- Nile perch (Predatory fish introduced into lakeVictoria, (East Africa) – Responsible for extinction of Cichlid fish.
- Water hyacinth (Eicchornia)
- Lantana camara w African catfish (Clarias gariepinus) – Responsible for extinction of Indian cat fish.

7. Type of Extinction of species:

(i) Natural extinction: Due to change in environmental condition. (ii) Mass extinction: Due to catastrophs. (iii) Anthropogenic extinction:
Due to human activities like hunting.

Co-extinctions: When a species becomes extinct, the plant and animal species associated with it in an obligatory way also become extinct. e.g.Plant-pollinator.

8. The characteristics of species particularly susceptible to extinction are :-Large body size, small population size, low reproductive rate, feeding at high tropic levels in the food chain, Fixed migratory routes and habitat (e.g : Blue whale and whooping crane) and localized and narrow range of distribution (e.g : Woodland caribou, Island species)

9. Landscape: It is a unit of land with a natural boundary having a mosaic of patches. These patches generally represent different ecosystem.

Note: In ecological hierarchy landscape can be present between Ecosystem and Biomes.

10. India is divided into 10 Biogeographical regions.

(i) Trans - Himalaya (ii) Himalaya (iii) Desert (iv) Semi - Arid (v) Western ghats (vi) Deccan peninsula (vii) Gangetic plain (viii) Coasts (ix) North east (x) Islands

Note: Deccan peninsula has maximum coverage of the Indian land mass (42%), western ghats 4% and north-east 5.2%.

11. Endemic Flowering Species of India – 33% of flowering plants recorded in India, are en demic.

12. Endemic fauna (Animals Species) of India – Out of the recorded vertebrates, 60% amphibians, 53% fresh water fish, 36% reptiles and 10% mammalian fauna.

- Maximum endemic amphibian species are found in western ghats.
- From ten high-diversity localities in tropical forest some 17,000 endemic plant species and 350,000 endemic animal species could be lost in near future.
- The tropical forests alone are losing roughly 14,000 - 40,000 species per year (or 2-5 species per hour).
- The earth may lose up to 50 percent of the species by the end of the 21st century.
- According to IUCN (2004), total number of plant and animal species on the earth is 1.5 million.
- According to Robert May, global species diversity is about 7 million.
- More than 70 percent of all species recorded are animals, while plants comprise no more than 22%.
- Out of 10 animals on this planet, 7 are insects.
- India's share of the global species diversity is about 8.1 percent.
- Some examples of recent extinction include the dodo (Mauritius), quagga (Africa), thylacine (Australia), stellars' sea cow (Russia) and three subspecies (Bali, Javan, Caspian) of tigers.
- According to IUCN Red list (2004), 784 species were extinct in the last 500 years.
- Last 20 years alone have witnessed the disappearance of 27 species.
- The Amazon rain forest is so huge that it is called "Lungs of the Planet".

13. Wet lands: Low lying area's covered with shallow water are called wet lands. The wet lands are transitional zones between terrestrial and aquatic areas. 6% of the world's land surface is occupied by wet lands.

- Marshes: Wetlands where grass - like plants dominate.
- Swamps: Wetlands where trees or shrubs dominate.
- Riverine forest: Periodically Flooded forests found in lowland along streams.
- Mangrove is a salty water swamp. Significance of Wet lands: (1) Wetland are highly productive, provide food and habitat. (2) Wetlands helps to

control floods by holding excess water. (3) Ground water recharging areas. (4) Help to clean and purify water run-off. (5) Provides sites for fishing, boating, nature study.

Wetlands conservation measures:

(i) Preparation of wetland inventories. (ii) Checking waste disposal in wetland. (iii) Reduction of excessive inflow of nutrients and silt into wetlands.

14. Grassland management measures:

(1) Protection from grazing. (2) Use of rotational grazing. (3) Removal of woody bushes or shrubs and weeds. (4) Conservation of soil and water of grasslands. (5) Use of controlled burning to promote recycling of nutrients.
Some other Information related to Grass land –

- India has 16 recognized forest types, which represent a rich diversity.
- In India, the Grass cover area including fallow and waste land is 18% of total land area.
- 37% of land are available for grazing including forest.
- Grassland is also called Rangeland.
- The conversion of grassland or forest to desert is called desertification.
- The average annual production of dry grass or hay in India is about 250 million tonnes.

15. Conservation and management of water: Main approaches for conservation of water are :

- Reducing agricultural water wastage by increasing efficiency of irrigation.
- Reducing water wastage in industry by recycling the used water.
- Reducing domestic water wastage by constructing waste water treatment.
- Rainwater harvesting by employing practices to store rainwater and recharge ground water.
- Afforestation and protection of water sheds to improve water economy.

Approaches to provide a sustainable supply of high quality water are :
(i) Construction of dams and reservoirs to ensure year-round supply of water, in addition, controlling floods and generating electricity.
(ii) Desalinisation of seawater and saline ground water and making it fit for drinking and other purposes.
(iii) Regular dredging and salinisation of water bodies.

16. Phenotypic Plasticity: The phenotype is the physical expression of the interaction between genotype of an organism and its environment.

The phenotypes show variations due to difference in the environmental conditions within the local habitat. Such type of variations are known as phenotypic plasticity.
17. Ecocline – Transition form between two ecotypes called "Ecocline".
18. Guild – Organism of same tropic level is known as guild (e.g. Cow, Goat, Rabbit).
19. Arboreta – Botanical garden where specific trees & shrubs species are cultivated.
20. Botanochemicals – Plants can also be used for the manufacture of innumerable synthetic products called botanochemicals.
21. The key elements that lead to so much variation in the physical and chemical conditions of different habitats are temperature, water, light and soil.
22. Mango trees do not grow in temperate countries like Canada and Germany, snow leopards are not found in Kerala forests and tuna fish are rarely caught beyond tropical latitudes in the ocean due to unfavourable temperatures.
23. The salt concentration (measured as salinity in parts per thousand) is less than 5 percent in inlands water, 30-35 percent the sea and more then 100 percent in same hypersaline lagoons. Some organisms are tolerant of a wide range of salinites (euryhaline) but others are restricted to a narrow range (stenohaline).
24. Diapause: Under unfavourable conditions many zooplankton species in lakes and ponds are known to enter diapause a stage of suspended development.
25. Predators acting as conduits for energy transfer across tropic levels, predators play other important roles. They keep prey populations under control In the absence of predators, prey species could achieve very high population densities and cause ecosystem instability, When certain exotic species are introduced into a geographical area, they become invasive and start spreading fast because the invaded land does not have its natural predators, The prickly pear cactus introduced into Australia in the early 1920's caused havoc by spreading rapidly into millions of hectares of rangeland. Finally, the invasive cactus was brought under control only after a cactus feeding predator (a moth) from its natural habitat was introduced into the country.
Biological control methods adopted in agricultural pest control are based on the ability of the predator to regulate prey population. Predator also help in maintaining species diversity in community, by reducing the intensity of competition among competing prey species. In the rocky intertidal communities of the american Pacific Coast the starfish Pisaster is an important predator. In a field experiment, when all the starfish were removed from an enclosed intertidal area, more than 10 species of invertebrates became extinct within a year, because of interspecific competition.
If a predator is too efficient and overexploits its prey, then the prey might become extinct and following it, the predator will also become extinct for lack of food. This is reason why predators in nature are 'prudent'. Prey species have evolved various defenses to lessen the impact of predation. Some species of insects and frogs are cryptically-coloured (camouflaged) to avoid being detected easily by the predator. Some are poisonous and therefore avoided by the predators. The Monarch butterfly is highly distasteful to its predator (bird) because of special chemical present in its

body. Interestingly, the butterfly acquires this chemical during its caterpillar stage by feeding on poisonous weed.
You must have seen the weed Calotropis growing in abandoned fields. The plant produces highly poisonous cardiac glycosides and that is why you never see any cattle or goats browsing on this plant. A wide variety of chemical substances that we extract from plants on a commercial scale (nicotine, caffeine, quinine, strychnine, opium, etc.,) are produced by them actually as defence against grazers and browsers.

SOME GENERAL INFORMATIONS

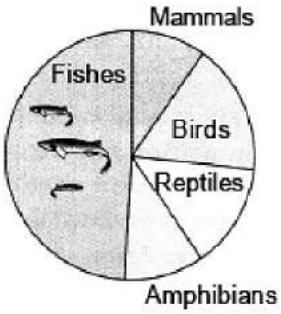
1. Planktons – Planktons are free floating and small organisms they swim due to water currents. They lack locomotory organs or the locomotory organs may be reduced. It includes –

1. Phytoplankton – Microscopic, inactive floating plants e.g. Diatoms.
2. Zooplankton – Microscopic, inactive floating animals. e.g. Protozoans, Crustaceans, Larvae.
2. Nektons – Those aquatic plants and animals which are capable of swimming actively are called nektons. They have well developed locomotory organs. It includes –

- Phytonektons – usually flagella are present in these plants. e.g. Chlamydomonas and Dinoflagellates
- Nektons (animals) – Jelly fishes, sharks, fishes, frog, cuttle fishes.

3. Benthonic – The sedentary organisms of sea are called benthonic. e.g. Crabs, Snails, Star fishes
4. Periphyton – Organism which lives on hydrophytes like. Damsel fly, vorticella, Hydra, Rotifers.
5. Hibernation – Winter sleep or period of dormancy of Cold blooded animals e.g. Amphibians, reptiles are Hot blooded animals – e.g. Polar bear, North ground squirrels.
6. Aestivation (Summer sleep) – Escape from heat of sun e.g. Lung fishes, Snails, Ground squirrels in south-west desert.
7. Cyclomorphosis – Change in body shape with the change in temperature e.g. Daphnia, Cladocera.

Vertebrates



WILDLIFE ORGANISATIONS

I.U.C.N. = The International Union for Conservation of Nature and Natural Resources. (Switzerland)
W.C.U. = World Conservation Union. (New Name of I.U.C.N.)
W.W.F. = The World Wildlife Fund.
W.F.N. = World Wild Fund for Nature (New Name of W.W.F.)
I.B.W.L. = India Board for Wildlife.
B.N.H.S. = The Bombay Natural History Society.
W.P.S.I. = The Wildlife Preservation Society of India.
C.P.C.B. = Central Pollution Control Board.
I.B.P. = International Biology Programme.
M.A.B. = Man and Biosphere Programme.
U.N.E.P. = United Nation Environment Programme.
N.M.N.H. = National Museum of Natural History.
U.N.D.P. = United Nations Development Programme.
B.R.P. = Biosphere Reserve Programme.
Z.S.I. = Zoological Survey of India.
B.S.I. = Botanical Survey of India.
C.A.Z.R.I. = Central Arid Zone Research Institute, Jodhpur.
C.I.T.E.S. = Convention and International Trade in Endangered Species of Wild Fauna and Flora.(1976)
F.R.I. = Forest Research Institute, Dehradun.
W.I.I. = Wild Life Institute of India, Dehradun.
U.N.E.S.C.O. = United Nations Educational Scientific and Cultural Organization

28th February – Science Day
21st March – World Forest Day
22nd April – Earthday
21 May – World Biodiversityday
5th June – World Environment Day

7th July – Van Mahotsav Day 11th July – World Populationday
16 September – World Ozone Day
3rd October – World Animal Day 4th October – World Habitat Day 1st Week of October – Wild life week
2 December – National pollution prevention day or National environment day 3rd December – World Conservationday

Natural Resources

Biodiversity and its Conversion

NATURAL RESOURCES

The materials or any component, that can be utilized by man and are necessary for welfare of life, which is available in the natural environment in Atmosphere, Hydrosphere, Lithosphere are called natural resources.
e.g. O_2, Land, Soil, Water, Forest, Animals, Soil, micro-organisms.

Classification of natural resources:

1. Inexhaustible resources: Available in unlimited quantities, and the earth quantity may remain unchanged by human impact.
e.g. Solar Energy, Wind Power, Tidal power, Air, Geothermal Energy.

Note: Its quality can be affected due to continuous increase in human population.
e.g. Air pollution
2. Exhaustible resources: These are likely to be finished by human use or unsustainable uses.

It is further divided in two groups:

(i) Renewable resources: Those which are being continuously consumed by man but renewed continuously by nature, always available if managed in a proper way, otherwise they may even get totally exhausted. **e.g.** Biotic resources, forest, grazing animals, Rangeland, wild life, Agriculture crop system and fresh water yield, soil etc.

(ii) Non renewable resources: They are not renewable after use and are not replaced by nature, cannot be regained. **e.g.** Fossil fuels (Coal, Petroleum), Natural Gas, Nuclear energy, Biotic species, Minerals etc.

Note: Nuclear energy is a non renewable and unlimited resource.

HYDROSPHERE OR WATER RESOURCES

1. Water is the major constituent of the hydrosphere and covers 3/4 of the earth's surface.
2. The total volume of water in the hydrosphere is 1.4 billion cubic kilometers[km^3], about **97.5%** is the **ocean water**, unsuitable for human use. Only **2.5%** is available as **fresh water.** About **1.97%** is stored in **ice-caps** (Polar ice) and glaciers and 0.5% is ground water and soil moisture (0.01%). The rest [about 0.36 percent] is distributed in lakes swamps, rivers and streams.
3. About 84% of the total global evaporation occurs from ocean surface and 16% from land surface.
4. Kelps and a few marine animals are used as human food. Various chemicals are extracted such as iodine and industrial gums from seaweeds. Agar is produced from the red algae-Gracillaria and Gelidium. Algin is derived from Sargassum and Turbinaria species.

LAND RESOURCES:

1. Earth's one-fourth area is formed by land.
2. About 4/5 of the land area is covered by soil.
3. At the beginning of 20th century, about **30%** of land in India was covered with forest but by the end of the 20th century, the forest cover reduced to **19.4%.** Out of 19.4 %, only **12%** area was covered by dense forest.

- Per capita forest area available in India is = **0.06** hec.
- Per capita forest area available in world is = **0.64** hec.
- In India **33%** forest area is recommended by national forest policy (1988).
-

FOREST CONSERVATION

IT IS CONDUCTED BY TWO METHODS

1. Protection or conservation forestry: By Making national parks and Bio-sphere Reserves.
2. Production or commercial forestry:
IT IS OF TWO TYPES-

(a) Social forestry - To grow the trees and shrubs on unused farmland, road sides, Rail sides, community land etc.
(b) Agro forestry: Woody species are grown in combination with herbaceous crops either at the same time or in time sequence.

Taungya system– Growing agricultural crops between rows of planted trees.

Shifting Cultivation or Jhum Cultivation: It is a major cause of deforestation. Many tribal communities practice slash and burn agriculture in tropical and subtropical regions of Asia, Africa and Oceania. This consists of cutting down trees and setting them or fire and raising crops on the resulting ash called "Jhuming" in north eastern India.

MINERAL RESOURCES

Table - Some Important Minerals and some of their uses

Metallic	
Minerals	**Uses**
Uranium	Nuclear bombs, electricity, tinting glass
Thorium	Nuclear bombs, electricity, gas mantles
Iron	Steel
Manganese	Alloy steels, disinfectants
Columbium	Stainless steel, nuclear reactors
Ghromium	Metallurgy, refractory, chemicals
Molybdenum	Alloys steels
Nickel Over	3000 alloys
Tungsten	Alloys and chemicals
Vanadium	Alleys
Copper	Electrical products, alloys
Lead	Batteries, gasoline, paints, alloys
Tin	Tin plate, solder, chemicals
Zinc	Galvanizing, solder, die-casting, chemicals
Aluminium	Aircraft, rockets, building materials, electrical wiring, utensils
Magnesium	Structural refractories
Titanium	Pigments, aircraft, alloys

Zirconium	Refractories, ceramics, metals, chemicals
Beryllium	Copper alloys, refractories, atomic energy field
Gold	Monetary purposes, jewellery, dentistry
Radium	Medical and industrial uses, radiography

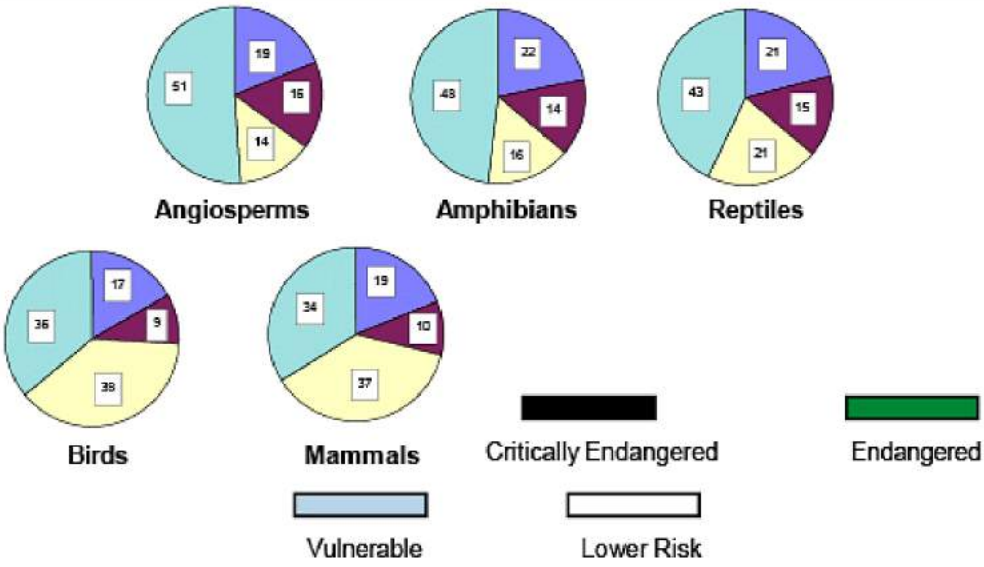
2. Non-metallic Minerals

Minerals	Uses
Asbestos	Insulation, textiles, roofings, glass, ceramic, gasoline, solid propellants.
Corundum	Abrasives
Feldspar	Ceramic flux, artificial teeth.
Fluorspar	Flux, acid, refrigerants, propellants
Phosphates	Fertilisers, chemicals
Salt	Chemicals, glass, metallurgy
Sulphur	Fertilisers, acid, iron and steel industries

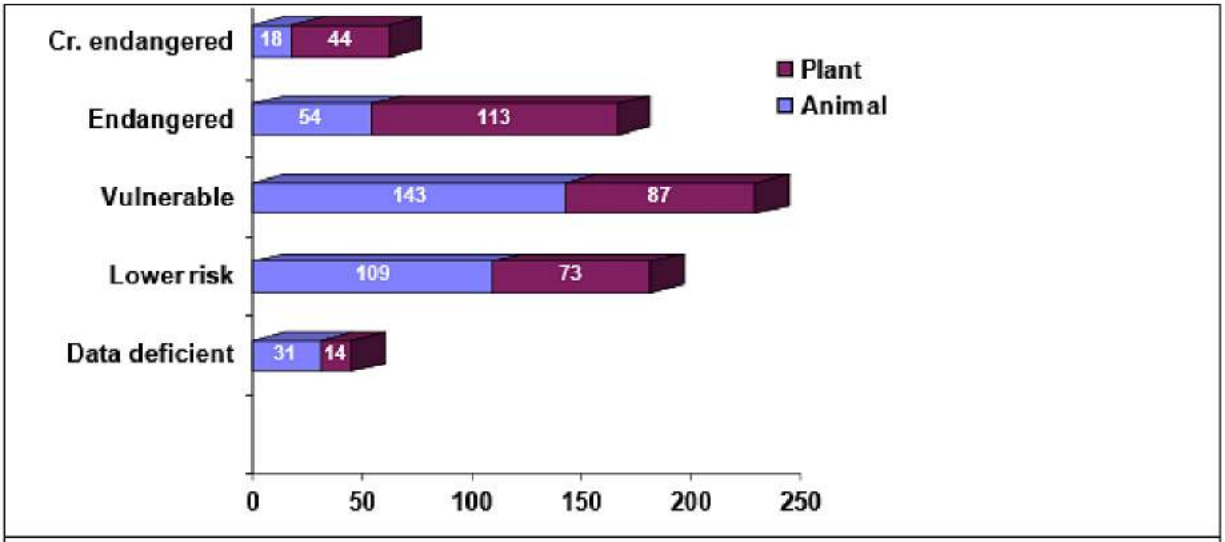
THREATENED SPECIES CONCEPT

The International Union for Conservation of Nature and Natural Resources (IUCN), having its head quarters at Morgis in Switzerland and maintains a Red Data Book providing a record of animals and plants which are known to be in danger. In India the Wildlife (Protection) Act, 1972 provides four schedules categorizing the fauna of India based on their conservation status. Schedule I lists the rare and endangered species which are afforded legal protection. For the purpose of conservation species are categorized as below:

Threatened (T): The term is used in context with conservation of the species which are in any one of the above 3 categories (E, V, R).
Threatened = Endangered + Vulnerable + Rare
1. Endangered (E): Those species which are in the immediate danger of extinction and whose survival is unlikely, whose number have been reduced to a critical level, if the casual factors continue to be operating.
2. Vulnerable (V) : The species likely to move into the endangered category in the near future if the casual factors continue to operate. Their population is still abundant but are under threat throughout their range.
3. Rare (R) : These are species with small population in the world. These are not at present endangered and vulnerable, but are at risk due to their less number. These species are usually localised within restricted geographical areas or habitats.



The percentage of threatened angiosperms, amphibians, reptiles, birds and mammalscategories as critically Endangered, Endangered, Vulnerable and at Lower Risk



The number of plant and animal species of various threat categories in India

SOME IMPORTANT EXAMPLES OF THREATENED SPECIES IN INDIA

Category	Plants	Animals
(1) Critically endangered	Barberis nilghiriensis	Sus salvanius (Pigmyhog)
(2) Endangered	Bentinckia nicobarica	Ailurus fulgens (Red panda)
(3) Vulnerable	Cupressus cashmeriana	Antelope cervicapra (Black buck)

Note: Rauwolfia serpentiana (medicinal plast) is endangered