CHAPTER 15

BIODIVERSITY AND CONSERVATION

POINTS TO REMEMBER

Biodiversity : Term used to describe diversity at all levels of biological organisation. Term coined by socio-biologist Edward Wilson and was also used by Walter G Rosen for the diversity of life forms. Biodiversity refers to totality of genes in species and ecosytems of a region.

Three inter-related levels of Biodiversity : Genetic diversity, Species diversity, Ecological diversity.

❑ *Genetic diversity :* Diversity in the number and types of genes, as well as chromosomes present in different species and the variations in the genes and their alleles in the same species. It helps in speciation.

❑ *Species diversity :* Varieties in the number and richness of the species of a region.

❑ *Ecological diversity :* Variety in the types of ecosystems.

IUCN : International Union for Conservation of Nature and Natural Resources. It is situated in Morges, Switzerland.

India has : More than 50,000 genetically different varieties of rice; 1000 varieties of mango;

❑ India has 1,42,000 known species of plants and animals (Around 45,000 species of plants and rest of animals);

❑ India has 8.1% of share of global biodiversity.

❑ India is one of **12 Mega diversity** countries of the world.

Latitudinal Gradients

❑ 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¢X N to 23.5¢XS) harbour more species than temperate or polar areas.

- ❑ Colombia located near the equator has nearly 1,4000 species of birds while New York at 41°X N has 105 species and Greenland at 71°X N only 56 species.

- ❑ India has more than 1,200 species of birds.

- ❑ A forest in a tropical region like Equador 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.

Species-Area relationships

- ❑ German naturalist and geographer Alexander von Humboldt observed that within a region species richness increased with increasing explored area, but only up to a limit.

- ❑ 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.

- ❑ On a logarithmic scale, the relationship is a straight line decribed 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.

- ❑ Value of Z lies in the range of 0.1 to 0.2, regardless of the taxonomic group or the region.

- ❑ The species-area relationships among very large areas like the entire continents has much steeper slope of the line (Z values in the range of 0.6 to 1.2).
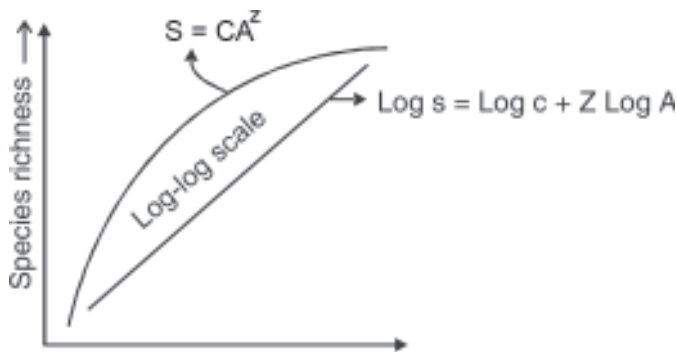
Causes of Biodiversity Losses

1. **Habitat loss and fragmentation :** This is most important cause of plants and animals extinction. *For example :* Tropical rain forest being destroyed fast. The Amazonian rain forest is called the 'lungs of the planet'. It is being cut for cultivating soyabeans.

2. **Over–exploitation :** Many species extinctions are due to over exploitation by humans. eg :- extinction of steller's cow, passenger pigeon is last 500 years.

3. **Alien Species Invasions :** When alien species are introduced some of them turn invasive and cause decline or extinction of indigenous species. eg. :- Carrot grass (Parthenium), Lantana and water hyacinth *(Eichornia)* posed threat to native species.

4. **Co-extinctions :** When a species becomes extinct, the plant and animal species associated with it in an obligating way also become extinct. eg.:- When a host fish species becomes extinct, its assemblage of parasites also becomes extinct.

Reasons for Conservation of Biodiversity

1. **Narrowly utilitarian :** Humans derive countless direct economic benefit from nature food (cereals, pulses, fruits), firewood, fibre, construction material, industrial products (tannins, lubricants, dyes, resins, perfumes) and products of medicinal importance.

2. **Broadly utilitarian :** Biodiversity plays a major role in many ecosystem services that nature provides.

3. **Ethical :** every species has an intrinsic value, even if it may not be of any current economic value to us. We have a moral duty to care for their well-being and pass on our biological legacy in good order to future generations.

Types of Conservation Strategies

In-situ conservation : Conservation and protection of the whole ecosystem and its biodiversity at all levels in order to protect the threatened species. Endangered species protected in natural conditions.

❑   **Sacred Groves :** Tracts of forest are set aside and all the trees and wildlife within are venerated and given total protection. E.g., some forest in Khasi and Jaintia hills in Meghalaya, Aravalli hills of Rajasthan.

- ❑ **Hot Spots :** Areas with high density of biodiversity or mega diversity. E.g., Out of 34 hot spots in world, 3 occur in India. i.e., Western Ghats and Sri Lanka, Indo-Burma (North-East India) and Himalaya.

- ❑ **Protected Areas :** Ecological or Biogeographical areas where biological diversity with natural and cultural resources are protected. E.g., National parks, sanctuaries and Biosphere reserves.

Ex-situ conservation : Conservation and protection of selected rare plants or animals in places outside their natural homes.

- ❑ **Offsite collections :** Live collections of wild and domesticated species in Botanical gardens, Zoological parks etc.

- ❑ **Gene Banks :** Institutes which maintain stock of viable seeds, live growing plants, tissue culture and frozen germplasm with the whole range of genetic variability.

Cryopreservation : Preservation of seeds, embryos etc. at ¡V196¢XC in liquid nitrogen.

Co-extinction : Extinction of a species can cause extinction of plants and species associated with it.

National Parks : Areas reserved for wild life where they are able to obtain all the required natural resources and proper habitats. India has 89 national parks at present.

Sanctuaries : Tracts of land with or without lake where animals are protected from all types of exploitation and habitat disturbance. India has 492 sanctuaries at present.

Biosphere Reserves : Large tracts of protected land with multiple use preserving the genetic diversity of the representative ecosystem by protecting wild life, traditional life styles of the tribals and varied plant and animal genetic resources. India has 14 biosphere reserves.

Red Data Book : Record of threatened species of plants and animals maintained by IUCN.

Important Wild Life Projects in India :

- ❑ **Project tiger :** Started in 1973 to check depletion in population of tiger. Jim Corbett National Park.

Biodiversity Hotspots : Regions of high endemism and high level of species richness.

Endemic Species : Species which are confined to a particular region and not found anywhere else.

Exotic or Alien Species : New species which enter a geographical regions.

Bio prospecting : Exploration of molecular, genetic and species level diversity for products of economic importance.

International Efforts for Biodiversity Conservation :

❑ World Conservation Union (formerly IUCN) : provides leadership, common approach and expertise in the area of conservation.

❑ The Earth Summit : Historical convention on Biological diversity held in 1992 at Rio de Janerio, Brazil.

❑ The World Summit on Sustainable Development : Held in 2002 in Johannesburg, South Africa to pledge to reduce biodiversity losses at global and local levels.

QUESTIONS

VSA (1 MARK)

1. Habitat loss and fragmentation has caused severe damage to a particular type of ecosystem. Name it.

2. What trend is observed in respect of species diversity when we move from equator to poles?

3. Which region is considered as the one with highest biodiversity on earth? What is the name given to such region.forests?

4. Ecologists have discovered that value of ¡¥Z¡¦ lies in range of 0.1 to 0.2 regardless of taxonomic group or region. When will the slope of line steeper in species area relationship?

5. Define cryopreservation. Why is it useful in conserving biodiversity?

6. What is the reason for genetic variation shown by medicinal plant *Rauwolfia vomitoria?*

7. How many species of plants and animals have been described by IUCN in 2004? What is global species diversity according to Robert May?

8. Explain co-extinction with a suitable example.

9. Study the pie-diagram and answer the questions which follows :
    What do A, B, C and D represent in these diagrams.

Invertebrates

Taxa of Plants
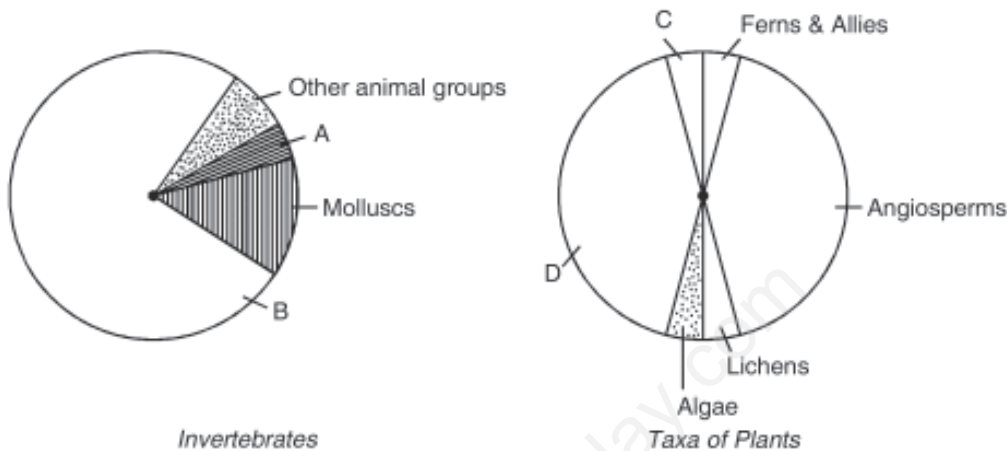
SA-I (3 MARKS)

10. Hot spots are the regions of exceptionally high biodiversity. But they have become regions of accidental habitat loss too. Name the three hot spots of our country. Why are they called 'Hot spot'?

11. Study the diagram of the earth given below. Give the name of the pattern of biodiversity therein. Suggest any two reasons for this type of occurance.
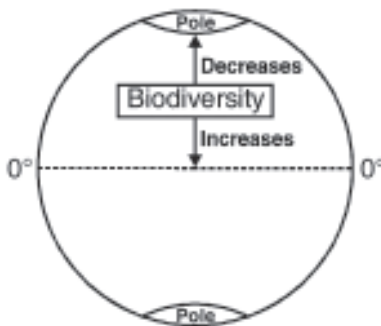
12. What is so special about tropics that might account for their greater biological diversity?

13. Why is the sobriquet 'The Evil Quartet' used in context of biodiversity? Name the members of this quartet. Why do we grieve for the genes when a species is lost?

14. Describe at least two approaches each for ex-situ conservation and in situ conservation as a strategy for biodiversity conservation.

ANSWERS

VSA (1 MARK)

1. Tropical Rain Forest.

2. In general, species diversity decreases as we move away from the equator towards poles.

3. Amazonian rain forests. They are also called the 'Lungs of the planet'.

4. Slope of line is much steeper if one analyses the species¡Varea relationship among very large areas like entire continents.

5. Preserving a material in liquid nitrogen at $-196°C$. It can be done to preserve threatened species in viable and fertile condition for long period.

6. Genetic variation might be in terms of potency and concentration of the active chemical reserpine produced by plant.

SA-II (2 MARKS)

7. IUCN (2004) has described slightly more than 1.5 million species of plants and animals.

   According to Robert May¡¦s estimates the global species diversity is about 7 million.

8. Coextinction refers to the disappearance of species with extinction of another species of plant or animal with which it was associated in an obligatory way. e.g., Plant-pollinator mutualism.

9.   A $\rightarrow$ Crustaceans   B $\rightarrow$ Insects

       C $\rightarrow$ Mosses   D $\rightarrow$ Fungi

SA-I (3 MARKS)

10. Western Ghats and Sri lanka; Indo-Burma; Himalaya called ¡¥biodiversity hot spots¡¦ as they show

    (i) High level of species richness

    (ii) High degree of endemism

11. Latitudinal gradients

    (i) More solar energy available in tropics, more productivity.

    (ii) Tropical environments are less seasonal, so more predictable.

12. a) Speciation is a function of time, unlike temperate regions subjected to frequent glaciations in the past, tropical latitude have remained relatively undisturbed for million of years and thus had long evolutionary time for species diversification

    b) Tropical environment are less seasonal, more constant and predictable

    c) More solar energy awailable in the tropics contributing to high productivity leading to greater diversity.

LA (5 MARKS)

13. The 'Evil Quartet' is used as a sobriquet to refer to the cause of loss of biodiversity :

    (i) **Habitat loss and fragmentation :** When large habitats are broken up into smaller fragments due to various human activities, the animals requiring large territories (elephants, birds etc.) are badly affected and their populations decline.

    (ii) **Over-exploitation :** When need of a resource becomes greed. e.g., over exploitation of passenger pigeon led to its extinction. Also marine fish is at brink of being endangered due to over exploitations.

    (iii) **Alien species invasion :** Intentional or non-Intentional introduction of a species to a nearby area may disturb the harmony of existing species. e.g., Eichhornia after introduction posed a big threat to the native species.

    (iv) **Co-extinction :** Extinction of one species invariably leads to extinction of another when they are associated with each other in an obligatory way. e.g., when host species is extinct, obligate parasites dependent on it also die.

    (v) We grieve for the loss of genes, because the wild forms are hardy and more resistant to pathogen attack and can be beneficial in crop breeding programmes.

14. **In situ conservation :**

    (i) Identification and maximum protection of 'hot spots'

    (ii) Legal protection to ecologically rich areas.

    (iii) Biosphere reserves, national parks and sanctuaries

    (iv) Sacred groves.

Ex situ Conservation :

    (i) Creation of zoological parks, botanical garden, wild life sanctuary

    (ii) Cryopreservation

    (iii) Seed bank.