

**Question 1:**

Name the three important components of biodiversity.

Answer

Biodiversity is the variety of living forms present in various ecosystems. It includes variability among life forms from all sources including land, air, and water. Three important components of biodiversity are:

- (a)** Genetic diversity
- (b)** Species diversity
- (c)** Ecosystem diversity

**Question 2:**

How do ecologists estimate the total number of species present in the world?

Answer

The diversity of living organisms present on the Earth is very vast. According to an estimate by researchers, it is about seven millions.

The total number of species present in the world is calculated by ecologists by statistical comparison between a species richness of a well studied group of insects of temperate and tropical regions. Then, these ratios are extrapolated with other groups of plants and animals to calculate the total species richness present on the Earth.

**Question 3:**

Give three hypotheses for explaining why tropics show greatest levels of species richness.

Answer

There are three different hypotheses proposed by scientists for explaining species richness in the tropics.

- (1)** Tropical latitudes receive more solar energy than temperate regions, which leads to high productivity and high species diversity.
- (2)** Tropical regions have less seasonal variations and have a more or less constant environment. This promotes the niche specialization and thus, high species richness.
- (3)** Temperate regions were subjected to glaciations during the ice age, while tropical regions remained undisturbed which led to an increase in the species diversity in this region.

**Question 4:**

What is the significance of the slope of regression in a species – area relationship?

Answer

The slope of regression ( $z$ ) has a great significance in order to find a species-area relationship. It has been found that in smaller areas (where the species-area relationship is analyzed), the value of slopes of regression is similar regardless of the taxonomic group or the region. However, when a similar analysis is done in larger areas, then the slope of regression is much steeper.

**Question 5:**

What are the major causes of species losses in a geographical region?

Answer

Biodiversity is the variety of living forms present in various ecosystems. It includes variability among life forms from all sources including land, air, and water. Biodiversity around the world is declining at a very fast pace. The following are the major causes for the loss of biodiversity around the world.

**(i) Habitat loss and fragmentation:** Habitats of various organisms are altered or destroyed by uncontrolled and unsustainable human activities such as deforestation, slash and burn agriculture, mining, and urbanization. This results in the breaking up of the habitat into small pieces, which effects the movement of migratory animals and also, decreases the genetic exchange between populations leading to a declination of species.

**(ii) Over-exploitation:** Due to over-hunting and over-exploitation of various plants and animals by humans, many species have become endangered or extinct (such as the tiger and the passenger pigeon).

**(iii) Alien species Invasions:** Accidental or intentional introduction of non-native species into a habitat has also led to the declination or extinction of indigenous species. For example, the Nile perch introduced in Lake Victoria in Kenya led to the extinction of more than two hundred species of native fish in the lake.

**(iv) Co-extinction:** In a native habitat, one species is connected to the other in an intricate network. The extinction of one species causes the extinction of other species, which is associated with it in an obligatory way. For example, the extinction of the host will cause the extinction of its parasites.

**Question 6:**

How is biodiversity important for ecosystem functioning?

Answer

An ecosystem with high species diversity is much more stable than an ecosystem with low species diversity. Also, high biodiversity makes the ecosystem more stable in productivity and more resistant towards disturbances such as alien species invasions and floods.

If an ecosystem is rich in biodiversity, then the ecological balance would not get affected. As we all know, various trophic levels are connected through food chains. If any one organism or all organisms of any one trophic level is killed, then it will disrupt the entire food chain. For example, in a food chain, if all plants are killed, then all deer's will die due to the lack of food. If all deer's are dead, soon the tigers will also die. Therefore, it can be concluded that if an ecosystem is rich in species, then there will be other food alternatives at each trophic level which would not allow any organism to die due to the absence of their food resource.

Hence, biodiversity plays an important role in maintaining the health and ecological balance of an ecosystem.

**Question 7:**

What are sacred groves? What is their role in conservation?

Answer

Sacred groves are tracts of forest which are regenerated around places of worship. Sacred groves are found in Rajasthan, Western Ghats of Karnataka, and Maharashtra, Meghalaya, and Madhya Pradesh. Sacred groves help in the protection of many rare, threatened, and endemic species of plants and animals found in an area. The process of deforestation is strictly prohibited in this region by tribals. Hence, the sacred grove biodiversity is a rich area.

**Question 8:**

Among the ecosystem services are control of floods and soil erosion.

How is this achieved by the biotic components of the ecosystem?

Answer



The biotic components of an ecosystem include the living organisms such as plants and animals. Plants play a very important role in controlling floods and soil erosion. The roots of plants hold the soil particles together, thereby preventing the top layer of the soil to get eroded by wind or running water. The roots also make the soil porous, thereby allowing ground water infiltration and preventing floods. Hence, plants are able to prevent soil erosion and natural calamities such as floods and droughts. They also increase the fertility of soil and biodiversity.

**Question 8:**

What measures, as an individual, you would take to reduce environmental pollution?

Answer

The following initiatives can be taken to prevent environmental pollution:

**Measures for preventing Air pollution:**

- (i) Planting more trees
- (ii) Use of clean and renewable energy sources such as CNG and bio-fuels
- (iii) Reducing the use of fossil fuels
- (iv) Use of catalytic converters in automobiles

**Measures for preventing water pollution:-**

- (i) Optimizing the use of water
- (ii) Using kitchen waste water in gardening and other household purposes

**Measures for controlling Noise pollution:-**

- (i) Avoid burning crackers on Diwali
- (i) Plantation of more trees

**Measures for decreasing solid waste generation:-**

- (i) Segregation of waste
- (ii) Recycling and reuse of plastic and paper
- (iii) Composting of biodegradable kitchen waste
- (iv) Reducing the use of plastics

**Question 10:**

Can you think of a situation where we deliberately want to make a species extinct? How would you justify it?

Answer



Yes, there are various kinds of parasites and disease-causing microbes that we deliberately want to eradicate from the Earth. Since these micro-organisms are harmful to human beings, scientists are working hard to fight against them. Scientists have been able to eliminate small pox virus from the world through the use of vaccinations. This shows that humans deliberately want to make these species extinct. Several other eradication programmes such as polio and Hepatitis B vaccinations are aimed to eliminate these disease-causing microbes.

## CHAPTER 15

# BIODIVERSITY AND CONSERVATION

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### 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 ecosystems 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°N to 23.5°S) 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° N has 105 species and Greenland at 71° 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

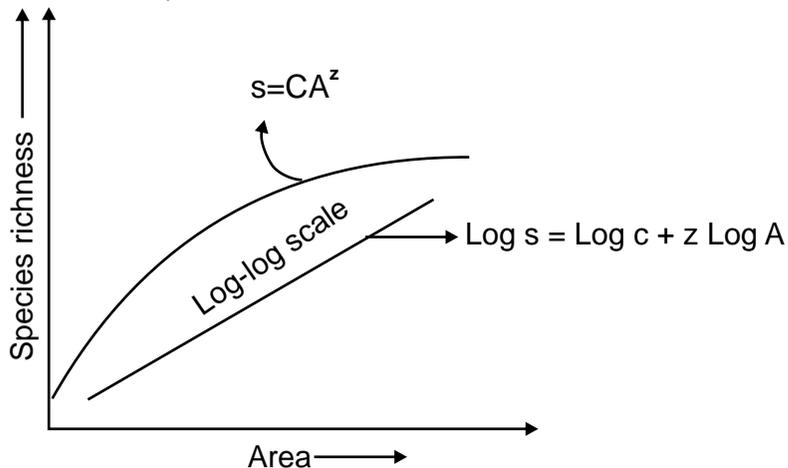
- German naturalist and geographer Alexander von Humboldt observed that within a region species richness increased with increasing explored area, but only up to a limit.
- The relation between species richness and area for a wide variety of taxa (angiosperm plants, birds, bats, freshwater fishes) turns out to be a rectangular hyperbola.
- On a logarithmic scale, the relationship is a straight line 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.

- 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 — 196°C in liquid nitrogen.

**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 Janeiro, 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)**

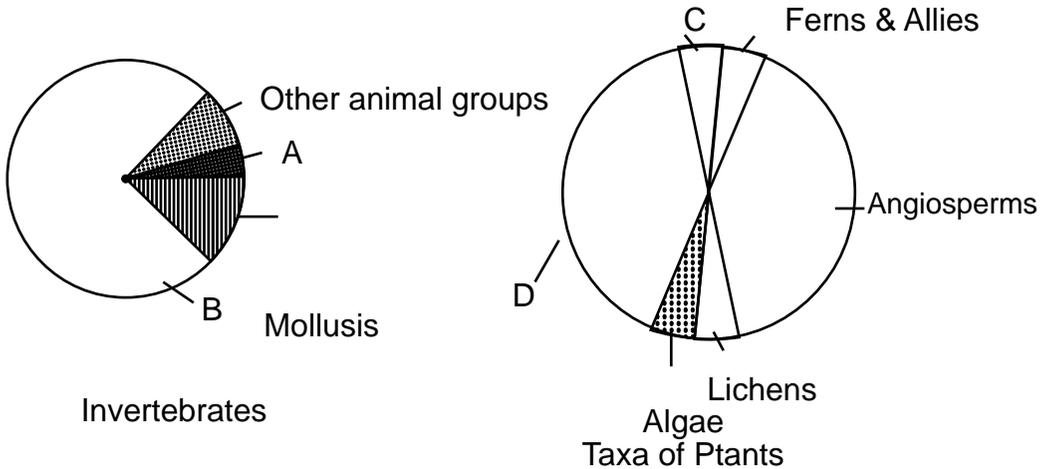
1. Habitat loss and fragmentation has caused severe damage to a particular type of ecosystem. Name it.
2. What trend is observed in respect of species diversity when we move from equator to poles?
3. Which region is considered as the one with highest biodiversity on earth? What is the name given to such region of 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*?

**SA-II (2Marks)**

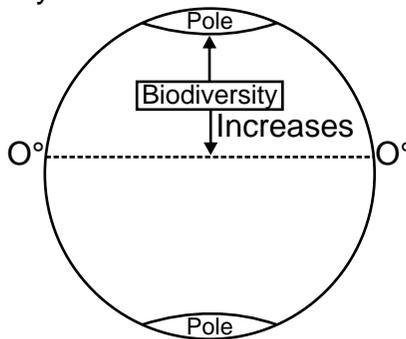
7. How many species of plants and animals have been described by IUCN in 2004? What is global species diversity according to Robert May?
8. Explain co-extinction with a suitable example.

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

**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 occurrence.
12. What is so special about tropics that might account for their greater biological diversity?



**LA (5 MARKS)**

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 area relationship among very large areas like entire continents.
5. Preserving a material in liquid nitrogen at  $-196^{\circ}\text{C}$ . 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 → Crustaceans      B → Insects  
C → Mosses            D → 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 available 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.