Biodiversity and Conservation

Biodiversity

- There are more than **20,000 species** of ants, **3,00,000 species** of beetles**, 28,000** species of fishes and nearly **20,000** species of orchids.
- Biodiversity is the term popularized by the sociobiologist **Edward Wilson** to describe the combined diversity at all the levels of biological organization
- **Biodiversity can be described as the sum total of genes, species and ecosystem of a region**

Patterns of Biodiversity

(i) Species-Area relationships:
- According to **German naturalist** and geographer **Alaxander Von Humboldt**, species richness increased with increasing explored area,but only upto a limit.
- The relationship 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
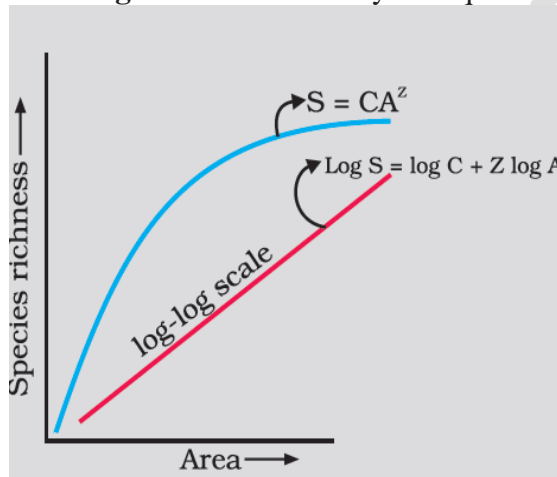
$\log S = \log C + Z \log A$
where

      S= Species richness A= Area
      Z = slope of the line (regression coefficient)

      C = Y-intercept

- 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)

- 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**

The importance of Species Diversity to the Ecosystem

- A community with more species tend to be more stable than those with less stable.
- A community which should not show too much variation in productivity from year to year called **Stable community. Such community are resistant to occasional disturbance (natural or man made) and resistant to alien species invasion.**
- **David Tilman** conducted some long term experiments using outdoor plots, explained that increased diversity contributed to higher productivity.
- Rich diversity and higher productivity are not only essential for a healthy ecosystem but also important for the survival of human race

RIVET POPPER HYPOTHESIS

- Proposed 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

➢ 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)**
> ➢ **Three subspecies of tiger (Bali, Javan, Caspian)**.

➢ Loss of biodiversity in a region may lead to
(**a) Decline in plant production,**
(b) Lowered resistance to environmental perturbations such as drought
(c) Increased variability in certain ecosystem processes such as plant productivity, water use, and pest and disease cycle.

Causes of biodiversity losses:

➢ There are four major causes
('The Evil Quartet' is the sobriquet)

(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 % of the earth's land surface**, these rain forests now cover **not more than 6 %**. They are being destroyed fast. By the time you finish reading this Printout of zoology, **100 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')** harboring 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 depended on nature for food and shelter, but when 'need' turns to 'greed' it leads to **over-exploitation of natural resources**.

➢ Eg: Many species extinctions in the last 500 years **(Steller's sea cow, passenger pigeo**n) were due to overexploitation by humans.

(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.

➢ Eg 1: **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.**

➢ **Eg 2:** the environmental damage caused and threat posed to our native species by invasive weed species like **carrot grass (*Parthenium*), Lantana and water hyacinth (*Eicchornia*)**.

➢ **Eg 3:** 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**.

➢ **Eg 1:** When a host fish species becomes extinct, its unique assemblage of parasites also meets the same fate.

➢ **Eg 2:** a coevolved plant-pollinator mutualism where extinction of one invariably leads to the extinction of the other.

BIODIVERSITY CONSERVATION

How do we conserve Biodiversity?
Conservation of biodiversity can be done by two ways
> **a)In-situ conservation**
> **b)Ex-situ conservation**

a)In-situ (On site) conservation
The conservation of genetic resources through their maintenance **within natural or even human-made ecosystem in which they occur** is called In-situ conservation.

Examples.

1. **National park,**
2. **Sanctuaries,**
3. **Biosphere reserves,**
4. **Natural monuments,**
5. **Hot spots,**
6. **sacred grooves,**
7. **cultural landscapes**

> **India** has
> **14 biosphere reserves**,
> **90 national parks** and
> **448 wildlife sanctuaries.**

> **Sacred groves** are found in **Khasi and Jaintia Hills in Meghalaya, Aravalli Hills of Rajasthan, Western Ghat regions of Karnataka and Maharashtra and the Sarguja, Chanda and Bastar areas of Madhya Pradesh**. In Meghalaya, the sacred groves are the last refuges for a large number of rare and threatened plants

Hotspots:

> Scientists identified certain regions with very **high level of species richness and high degree of Endemism (species that is confined to that region and not found anywhere else)** to protect biodiversity.
> Hot spots are the richest and most threatened reservoirs of plants and animal life on earth.
> Initially 25 biodiversity hotspots were identified but subsequently nine more have been added to the list, bringing the total number of **biodiversity hotspots in the world to 34**. These hotspots are also regions of accelerated habitat loss.
> Three of these hotspots – **Western Ghats and Sri Lanka, Indo-Burma and Himalaya – cover our country's exceptionally high biodiversity regions.**
> Although all the biodiversity hotspots put together cover less than **2% of the earth's land area**, the number of species they collectively harbour is extremely high and strict protection of these hotspots could reduce the **ongoing mass extinctions by almost 30 per cent.**

(b) Ex situ (off site) Conservation

Conservation **outside their habitat** is called ex-situ conservation. In this approach, threatened animals and plants are taken out from their natural habitat and placed in special setting where they can be protected and given special care.

Examples

1. **Cryoprservation,**
2. **Zoological parks,**
3. **Botanical gardens**
4. **Wildlife safari parks**

Cryopreservation

> Storage of materials (Like seeds, gametes) at very low temperature is called cryopreservation.
> Gametes of threatened species can be preserved in viable and fertile condition for long periods using cryopreservation techniques.

Biodiversity knows no political boundaries and its conservation is therefore a collective responsibility of all nations.

✓ **The historic Convention on Biological Diversity ('The Earth Summit') held in Rio de Janeiro in 1992,** called upon all nations to take appropriate measures **for conservation of biodiversity and sustainable utilisation of its benefits**.

✓ In a follow-up, the **World Summit on Sustainable Development held in 2002 in Johannesburg, South Africa,** 190 countries pledged their commitment to achieve by 2010, a significant reduction in the current rate of biodiversity loss at global, regional and local levels.