

Biodiversity

- The term biodiversity refers to the totality of genes, species, and ecosystems of a region.

Types of biodiversity as described by **Edward Wilson**

- **Genetic diversity:** A single species might show high diversity at the genetic level over its distributional range.
 - Medicinal plant ***Rauwolfia vomitoria*** of Himalayan range produces active chemical **reserpine** shows genetic variation.
 - India has more than 50000 different strain of rice.
 - 1000 varieties of mango.
- **Species diversity:** different species of a single animal like frog.
- **Ecological diversity:** diversity in the ecosystem level like desert, rain forest, mangroves, coral reef, wetlands, estuaries etc.

Latitudinal gradients

- Species diversity decreases as we move away from the equator towards the pole.
- Tropic (23.5° N to 23.5° S) harbors more species than temperate and pole
- The largely tropical Amazonian rain forest in South America has the greatest biodiversity on earth:
 - 40,000 species of plants.
 - 3000 species of fishes.
 - 1300 of birds.
 - 427 amphibians
 - 378 reptiles
 - More than 1, 25,000 invertebrates.

Tropical rain forest has greater biodiversity

- Tropical latitudes have remained relatively undisturbed for millions of years and thus, had a long evolutionary time for species diversification.
- Tropical environments are less seasonal, relatively more constant and predictable, promote niche specialization and lead to greater species diversity.
- There is more solar energy available in the tropics, which contribute to higher productivity.

Species area relationship

- ALEXANDER VON HUMBOLDT observed 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 turns out to be a rectangular hyperbola.
- On a logarithmic scale the relationship is a straight line describe by the equation
- **$\text{Log}S = \text{log}C + Z \text{ log } A$**
- Where S= species richness, A = Area, Z = slope of the line (regression coefficient), C = Y- intercept.

Importance of species diversity to the Ecosystem

- Community with more species generally tends to be more stable than those with less species.
- A stable community should not show too much variation in productivity from year to year; it must be resistant or resilient to occasional disturbances (natural or man-made)
- Stable community must be resistant to invasion by alien species.
- **David Tillman's long-term field experiment finds that:**
 - Plots with more species showed less year to year variation in biomass
 - Increased diversity contributed to higher productivity.

The rivet popper hypothesis

- In an airplane (ecosystem) all parts are joined together by thousands of rivets (species).
- If every passenger starts popping a rivet to take home (species extinct), it may not affect flight safety initially but as more and more rivets are removed the plane becomes dangerously weak.
- Further more which rivet is removed may also be critical.
- Loss of rivets on the wings (key species) 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 IUCN Red List (2004) documents the extinction of 784 species.
- Recent extinction includes:
 - Dodo (Mauritius).
 - Quake (Africa)
 - Thylacine (Australia)
 - Stiller's cow (Russia)
 - Three subspecies of tiger (Bali, Java, Caspian).
- Since the origin and diversification of life on earth there were **five episodes of mass extinction** of species.
- **The sixth mass Extinctions in progress now.**

How the sixth Extinction is different from the previous five extinctions

- The current extinction rate is 100 to 1000 times faster.
- All others are pre-human period, this one is anthropogenic.

Effect of biodiversity loss

- Decline in plant production.
- Lowered resistance to environmental perturbations such as drought.
- Increased variability in certain ecosystem processes such as plant productivity, water use, and pest and disease cycle.

Causes of biodiversity loss

- The present loss is all due to human activity (anthropogenic)
- There are four major causes “**The Evil Quartet**” are as follows:
 - a. **Habitat loss and fragmentation**
 - b. **Over-exploitation**
 - c. **Alien species invasion**
 - d. **Co-extinction**

Habitat loss and fragmentation

- Most important cause driving animals and plants to extinct.
- The tropical rain forest reduced to 6 % from 14 % of earth land surface.
- The Amazonian rain forest is called as '**lungs of the planet**' is being cut cleared for cultivating soya beans.
- Degradation of many habitat by pollution is also threatens the loss of diversity.
- Large areas are broken into fragments also the cause of diversity loss

Over-exploitation

- When 'need' turns to 'greed' it leads to over-exploitation of natural resources.
- Many species extinctions in the last 500 years (Stiller's cow, passenger pigeons) were due to over-exploitation.
- Many marine fish populations around the world are over harvested

Alien species invasion

- The alien species became invasive and cause decline or extinction of indigenous species.
- **Nile perch** introduced into Lake Victoria in east Africa led to extinction of 200 species of **cichlid fish** in the lake.
- ***Parthenium***, (carrot grass), ***Lantana***, and water hyacinth (***Eichornia***) posed a threat to indigenous species.
- African cat fish ***Clarias gariepinus*** for aquaculture purposed is posing a threat to indigenous catfishes in our rivers.

Co-extinction

- When a species becomes extinct, the plant and animal species associated with it in an obligatory way also become extinct.
- Extinction of **Host species** leads to extinction of the **parasite** also.
- Co-evolved **plant-pollinator** mutualism where extinction of one invariably leads to the extinction of the other.

BIODIVERSITY CONSERVATION

- **Narrowly utilitarian.**
- **Broadly utilitarian**
- **Ethical**

Narrowly utilitarian

- Human derive countless direct economic benefits from nature-
- Food (cereals, pulses, fruits), firewood, fiber, construction material.
- Industrial products (tannins, lubricants, dyes, resins, perfumes)
- Products of medicinal importance.
- **Bioprospecting**: exploring molecular genetic and species-level diversity for products of economic importance

Broadly Utilitarian

- Amazonian forest alone produce 20% of oxygen during photosynthesis.
- **Pollinator layer:** bees, bumblebees, birds and bat that pollinate the plant without which seed cannot be produced by plants.
- Aesthetic pleasure we get from the biodiversity

In situ conservation

- We conserve and protect the whole ecosystem, its biodiversity at all level is protected – we save the entire forest to save the tiger.
- **Biodiversity hot spot:** regions with very high levels of species richness and high degree of **endemism**.(species confined to that region and not found anywhere else)
- Out of 34 hot spot in the world, three hot spot located in India:
 - Western Ghats and Srilanka.
 - Indo-Burma.
 - Himalaya.
- Other protected area under in situ conservations are:
 - 14 biosphere reserve
 - 90 national park
 - 448 wild life sanctuary
 - **Sacred groves:** tract of forest were set aside, and all the trees and wildlife within were venerated and given total protection.

Ex situ conservation

- 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.
- Zoological Park.
- Botanical garden
- Wildlife safari.
- Conservation of gamete by **cryopreservation**.
- Genetic strains are preserved in **seed bank**.

Convention on Biodiversity

- **“The earth Summit”** held in Rio de Janeiro in 1992 called upon all nations to take appropriate measures for conservation of biodiversity and sustainable utilization of its benefits.
- **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 level