

## Chapter-15: BIODIVERSITY AND CONSERVATION

Biodiversity is defined as the totality of **genes, species and ecosystems** of a given region, It is the **variety** and **variability** of life form (all animals, plants and microbes on earth) and the ecological complexes in which they occur. The term was first coined by **Walter G. Rosen**(1985), however the term was popularized by the American sociobiologist **Edward Wilson**(1988)

### Hierarchical levels of Biodiversity:

- 1) Species Diversity
- 2) Genetic Diversity and.
- 3) Ecosystem/Community/Habitat Diversity

### Patterns of Biodiversity:

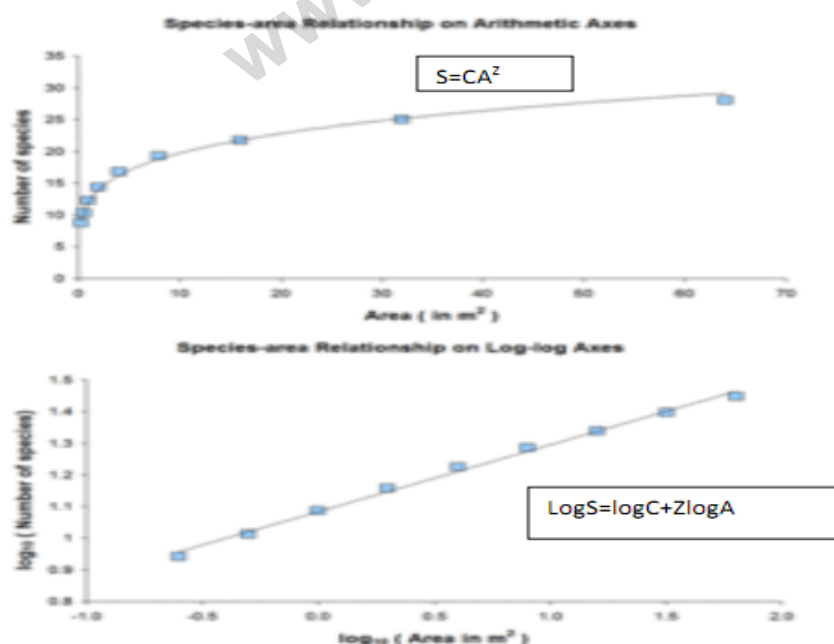
- 1) **Latitudinal gradients** – species diversity decreases, from equator to poles. Tropics (23.50N -23.50S) show richest species diversity. Speciation is generally a function of time. Temperate region is subjected to glaciations. Tropical regions remained relatively undisturbed for millions of years and thus had a long evolutionary time for species diversification. Tropical environments are less seasonal, relatively more constant and predictable. Constant environment facilitates niche specialisation and lead to greater species diversity. Tropical latitudes also get huge solar radiations which promote higher productivity.

2)

### SPECIES – Area relationships :

Arrhenius (1921) concluded that the number of **species** increases continuously less as the **area** increases.

This phenomenon is known as **the species/area relationship (SAR)**. This is reflected in the quantitative formula  $S = cA^z$ , in which **S** represents the number of **species** and **A** the size of the **area**. The constant **c** is an empirically determined multiplier that varies among taxa and **areas**. The exponent **z** varies according to the topographic diversity, the isolation of the **area** and the mobility of the taxon. It is usually higher\* for islands (around 0.3) than for the mainland (commonly assumed less than 0.2). (\* the lower **z**, the less space is needed to capture a greater number of species.)



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 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. It has been noted that regardless of the **taxonomic group** or **region** the **slope of the regression line are amazingly similar**. However, for a very **large area** like the entire continent the **slope of the line is steeper**.

### **Loss of biodiversity:**

Loss of biodiversity in a region may lead to

- 1) decline in plant production
- 2) lowered resistance to environmental changes such as drought.
- 3) increased variability in certain ecosystem processes such as plant productivity, water use, pest & disease cycles.

### **Major causes of biodiversity loss:**

- i) Habitat loss and fragmentation
- ii) Over exploitation
- iii) Alien species invasions
- iv) Co-extinctions and mass extinctions,
- v) Overexploitation
- vi) Urbanization
- vii) Pollution
- viii) Global climate change

### **Biodiversity conservation**

Reasons for conservation can be grouped into three categories:

- a) narrow utilitarian-for deriving direct economic benefit from nature.
- b) broad utilitarian-as biodiversity plays a major role in many ecosystem services.
- c) ethical-we need to realise that every species has an intrinsic value and we need to pass on our biological legacy to future generations.

### **How to conserve biodiversity:**

**In-situ Conservation**– Threatened /endangered plants and animals are provided with urgent measures to save from extinction **within their natural habitat**( in wildlife sanctuaries, national parks & biosphere reserves, sacred groves /lakes-i.e. in **protected areas**)

**Biodiversity hotspots** – regions with very high levels of species richness and endemism. Norman Myers developed the concept of hotspots in 1998 to designate priority areas for *insitu* conservation. They are the most threatened reservoir of biodiversity on earth. In India 2 hotspots are there, eg. Western ghats, and the Eastern Himalayas.

**Ex-situ Conservation** –Threatened animals& plants are **taken out from their natural habitat**& placed in a setting where they can be protected and given care as in botanical gardens, zoological gardens, seed/pollen/gene banks etc.

### **Efforts to conserve biodiversity:**

#### **Convention on Biological Diversity(CBD)**

The three main goals of CBD are

- 1) Conservation of biological diversity
- 2) Sustainable use of components and
- 3) Fair and equitable sharing of benefits

### **Indian efforts:**

Taking cognizance of the provisions of the CBD, India has enacted an umbrella legislation called the Biological Diversity Act, 2002 and also notified the Biological Diversity Rules, 2004. Its primary aim is to endorse the main goals of CBD suiting to India's national needs and circumstances.

India will host the 11<sup>th</sup> Conference of Parties(COP) (known as RIO+20) in October 2012.

### **Drivers of biodiversity loss**

- The main threats to biodiversity are one or more of the following developments:
- **Human population growth** - means growing demands for space and food.
  - **Intensive agriculture** - encroach on habitats.
  - **Extension of road, rail and electricity networks** - fragments habitats and scares away some species.
  - **Overexploitation** - we consume too much of a species or goods that ecosystems provide. includes excessive hunting, collecting and trade in species and parts of species.
  - **Pollution** - affects the health of animals and plants as much as human health.
- Environmental disasters* such as **oil spills** have devastating consequences for birds and the marine fauna and flora.
- **Climate change** – global rise in temperature between 1.4° and 5.8° Celsius and the sea level by between 9 and 88 cm. *Many species will not be able to adapt or move to other regions in next century.*
  - **Invasive alien species** - species that enter an ecosystem where they don't occur naturally and then thrive and overwhelm endemic species.
  - The tasty Nile perch was introduced to Lake Victoria in Africa in 1954 and caused the extinction of more than 200 endemic fish
- Endangered species** a species that is in danger of extinction throughout all or a significant portion of its range.
- Ex situ conservation**- removal of germplasm resources (seed, pollen, sperm, individual organisms), from their original habitat or natural environment. Keeping components of biodiversity alive outside of their original habitat or natural environment.
- Extinction**-termination of a species caused by the failure to reproduce and the death of all remaining members of the species; the natural failure to adapt to environmental change.
- Fauna**-All of the animals found in a given area.
- Flora**-All of the plants found in a given area.
- Gene bank**- A facility established for the ex situ conservation of individuals (seeds), tissues, or reproductive cells of plants or animals.
- Genetic diversity**-The variety of genes within a particular population, species, variety, or breed.
- Hotspot**-An area on earth with an unusual concentration of species, many of which are endemic to the area, and which is under serious threat by people.
- Red List**-The IUCN Red List of Threatened Species provides taxonomic, conservation status and distribution information on taxa that have been globally evaluated. (are Near Threatened).
- Species diversity**-The number and variety of species found in a given area in a region.

**Table 1.** Comparison Between the Number of Species in India and the World.

Group	Number of species in India (SI)	Number of species in the world (SW)	SI/SW (%)
Mammals	350 (1)	4,629 (7)	7.6
Birds	1224 (2)	9,702 (8)	12.6
Reptiles	408 (3)	6,550 (9)	6.2
Amphibians	197 (4)	4,522 (10)	4.4
Fishes	2546 (5)	21,730 (11)	11.7
Flowering Plants	15,000 (6)	250,000 (12)	6.0

**Table 2.** Globally Threatened Animals Occurring in India by Status Category.

Group	1994 IUCN Red List Threat Category				
	Endangered	Vulnerable	Rare	Indeterminate	Insufficiently Known
TOTAL					
Mammals	13	20	2	5	13
Birds	6	20	25	13	5
Reptiles	6	6	4	5	2
Amphibians	0	0	0	3	0
Fishes	0	0	2	0	0
Invertebrates	1	3	12	2	4
TOTAL	26	49	45	28	24

Source: Groombridge, B. (ed). 1993. *The 1994 IUCN Red List of Threatened Animals*. IUCN, Gland, Switzerland and Cambridge, UK. lvi +

**Table 3.** Summary of Plant Conservation Status Information at WCMC.

IUCN Threat category	Number of species
Extinct	19
Extinct/Endangered	43
Endangered	149
Endangered/Vulnerable	2
Vulnerable	108
Rare	256
Indeterminate	719
Insufficiently Known	9
No information	1441
Not threatened	374
TOTAL	3120

Source: WCMC Species Unit.\

Questions:

Q1. Define Biodiversity.

Ans-totality of **genes, species and ecosystems** of a given region

Q2.What is ecosystem diversity?

Ans.-No. of habitats or ecosystem in a given region of the biosphere.

Q3.Expand the term IUCN.

Ans. *International Union for Conservation of Nature and Natural resources.*

Q4.Who popularized the term biodiversity?

Ans .Edward Wilson

Q5.Can you mention the estimated number of species so far identified on earth?

Ans 1.7 to 1.8 million

Q6. Establish the relationship between species richness and explored area

Ans-.(comment on the species – area relationship curve).

Ans- (David Tilman)

Q8. Who proposed the 'Rivet popper hypothesis'? Comment on the major postulate of this hypothesis.

Ans- (Paul Ehrlich)

Q9. Mention the major causes behind biodiversity loss.

Ans- refer study material

Q10. Why should we conserve biodiversity?

Ans- (comment on the broad/narrow utilitarian and ethical value of biodiversity)

Q11. What do you mean by the term 'ecosystem services'?

Ans- refer NCERT Text book

Q12. What is meant by the term 'endemism'?

Ans- native

Q13. What are hot spots? Name two factors for declaring a hot spot. What are the hot spots found in India?

Ans- Eastern Himalaya and Western Ghat

Q14. Distinguish between in-situ and ex-situ conservation measures with examples.

Ans- refer concept map

Q15. Can you mention some national and international efforts towards biodiversity conservation?

Q16. Write short notes on i) sacred groves and ii) traditional ecological knowledge.

Ans- refer NCERT text book