SYJC
Ch. 15
Biodiversity, Conservation and Environmental Issues

Unit 15.1 to 15.6 and 15.11

Pg. no. 321 to 330 and 341

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Biodiversity

It is the part of nature which includes the differences in the genes among the individuals of a species; the variety and richness of all the plants and animal species at different scales in a space – local regions, country and the world; and the types of ecosystem, both terrestrial and aquatic, within a defined area.

Walter Rosen

Coined the term

Edward Wilson

Popularized the term

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Unit 15.1 Levels of Biodiversity

Genetic/ Intraspecific Diversity	Species/ Interspecific Diversity	Ecological/ Ecosystem Diversity
Diversity of genes in different species as well as in same species.	Diversity of species in a particular region	Diversity of ecosystems in a geographical area

Genetic Diversity

Species Diversity

Ecosystem Diversity

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Unit 15.1 Levels of Biodiversity

Genetic/Intraspecific Diversity

Diversity in the number and types of genes and chromosomes present in different species

Variation of the genes and their alleles in the same species.

Includes variation within a population as well as between different populations with respect to adaptation to local conditions.

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Genetic/Intraspecific Diversity – Importance

- Genetic variation makes way for evolution.
- Improves chances of survival of species in changing environmental conditions.
- Allows best adapted organisms to survive.
- Essential for a healthy breeding population of a species.

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Genetic/Intraspecific Diversity – Examples

Existence of sub species and races.

Example: ***Rauwolfia vomitoria***

- Medicinal plant found in Himalayas.
- Secretes Reserpine.
- Shows variation in terms of – potency, concentration of active chemical from location to location.

Other examples:

- Different varieties of Mango, Rice and Wheat in India.

Rauwolfia vomitoria **plant**

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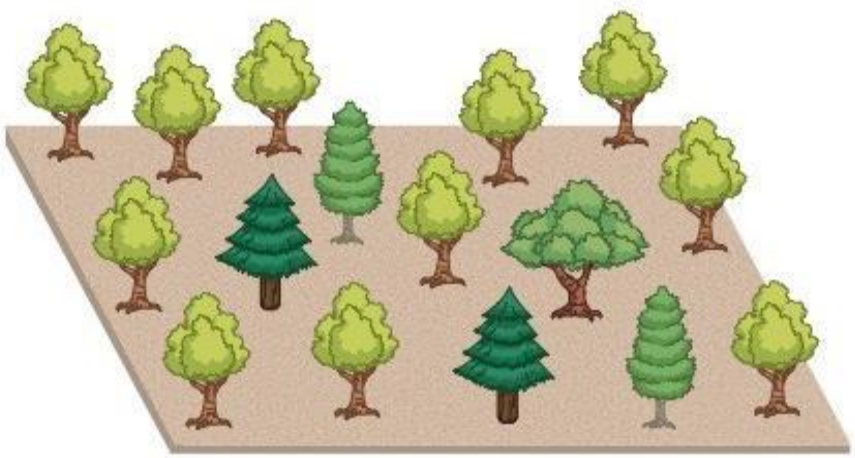
Species/Interspecific Diversity

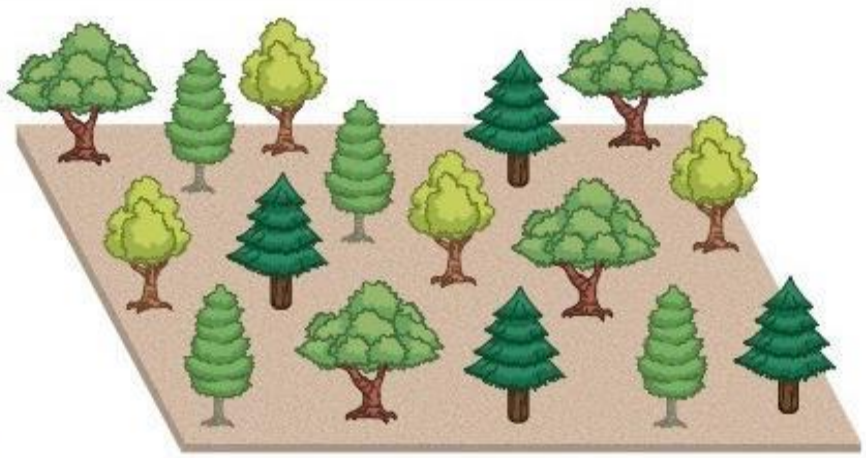
The number of species of plants and animals that are present in a region.

Deals with:

Species Richness – Variety of species

Species Evenness – number of individuals of a species.





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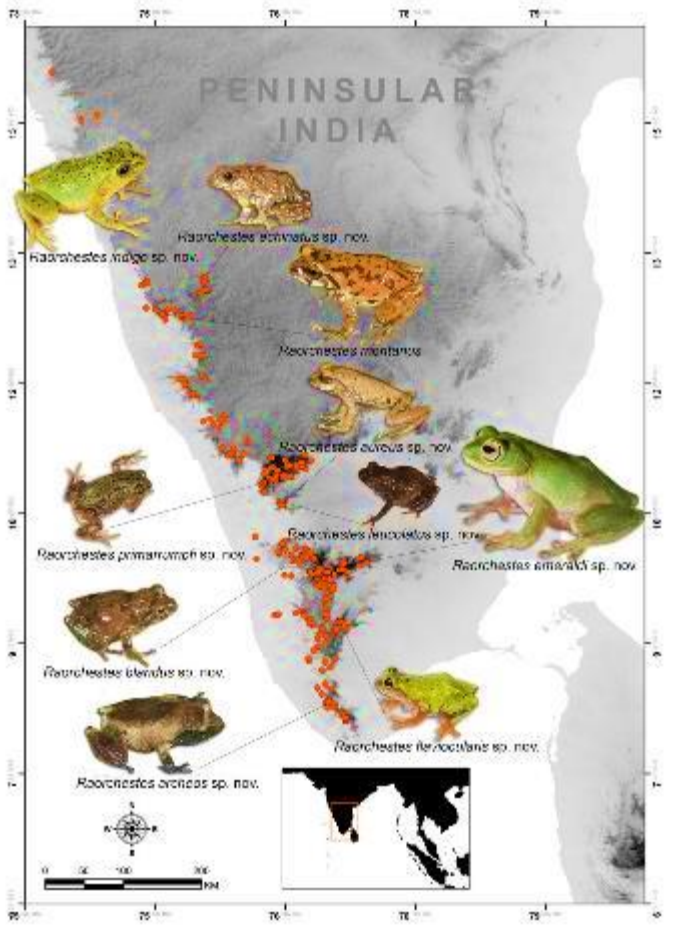
Unit 15.1 Levels of Biodiversity

Species/Interspecific Diversity – Examples

Examples:

- Amphibian species diversity is more in Western Ghats than Eastern Ghats.
- Natural undisturbed forest has greater species richness than monoculture timber plantation.
- India among 15 nations that are rich in species diversity.



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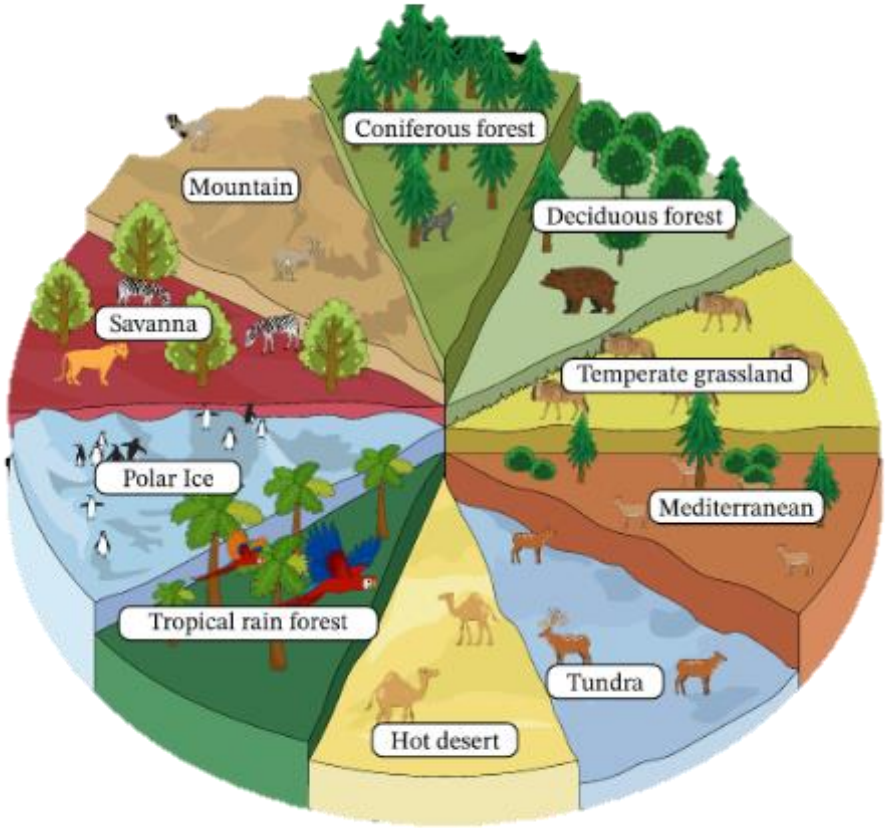
Ecological/Ecosystem Diversity

- Different types of ecosystems/ habitats within a given geographical area.
- Variety of ecosystems on Earth.
- Ecosystems have their own complement of distinctive interlinked species.
- In a region – there may be one or many different types of ecosystems.



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Ecological/Ecosystem Diversity – Examples

Examples

- Ecological diversity is high in India as compared to Norway.
- Western Ghats has more diversity than Ladakh or Rann of Kutch

Western Ghats

Rann of Kutch

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Unit 15.1 Levels of Biodiversity

Genetic/ Intraspecific Diversity

Species/ Interspecific Diversity

Ecological/ Ecosystem Diversity

Rapidly modified by Modern Humans

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15.2 Patterns of Biodiversity

- **Latitudinal & Altitudinal gradient**
- **Species – Area relationship**

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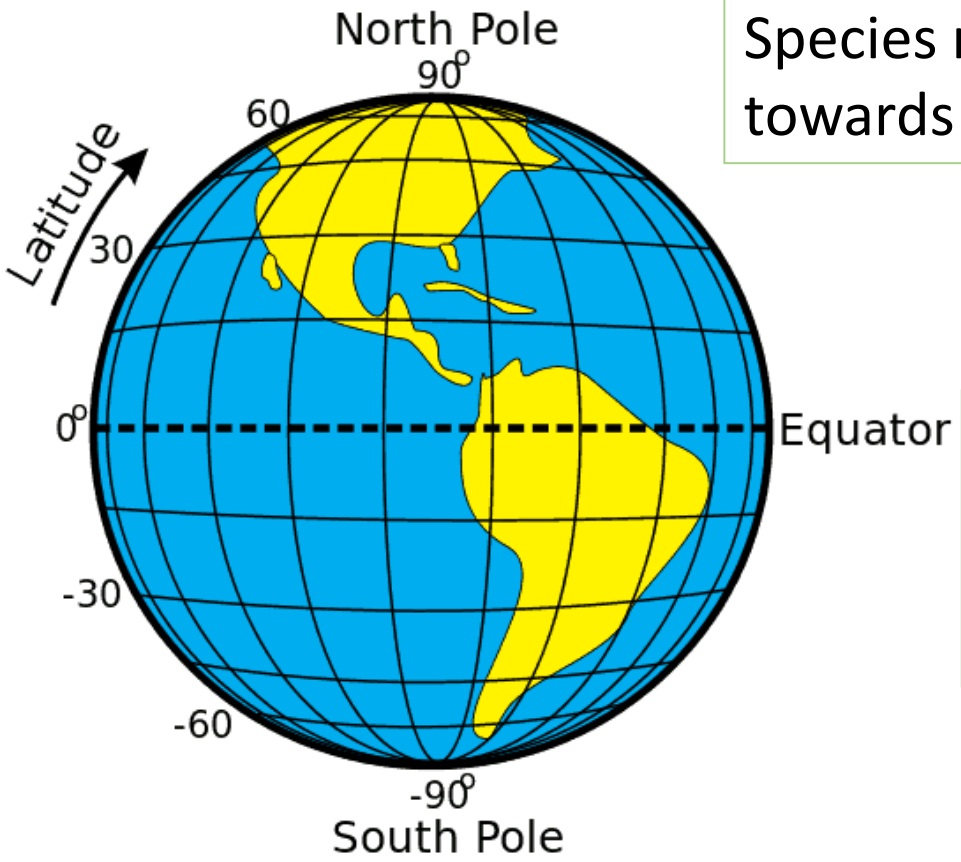
15.2 Patterns of Biodiversity

a) Latitudinal & Altitudinal gradient

1. Latitudinal gradient

- **Latitude** lines are a numerical way to measure how far north or south of the equator a place is located.



Species richness decline towards the poles

Species Richness higher at Lower latitudes.

Eg. Maximum in Tropical rain forest of **Amazon**.

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15.2 Patterns of Biodiversity

a) Latitudinal & Altitudinal gradient

1. Latitudinal gradient

Factors favoring speciation and maintaining stability of Tropical regions.

- Lesser climatic changes throughout the year.
- Availability of plenty of sunlight.
- Lesser drastic climatic disturbances.
- Lesser migrations has lead to lesser gene flows between isolated regions, thus favouring Speciation.
- Abundance of resources, for e.g.; variety of fruits available for frugivorous animals in the rainforest than the temperate region.

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15.2 Patterns of Biodiversity

a) Latitudinal & Altitudinal gradient

2. Altitudinal gradient

- **Altitude** is the height from mean sea level (MSL) upwards.

Higher altitude – less Species diversity
(due to drastic climatic changes, seasonal variations)

Lower altitude –
more Species diversity

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15.2 Patterns of Biodiversity

b) Species – Area relationship

- Number of Species is directly proportional to the area.
- Larger area has more resources that can be distributed among the inhabitants.

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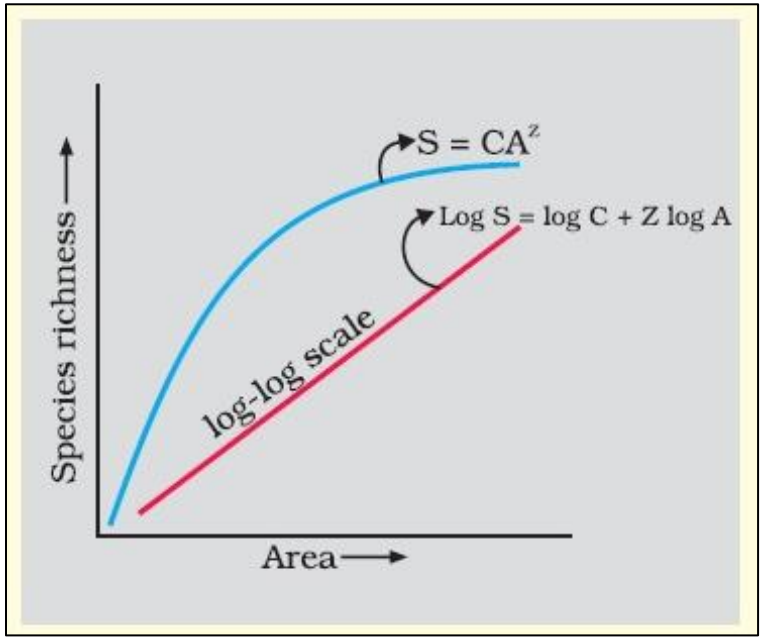
15.2 Patterns of Biodiversity

b) Species – Area relationship

According to **Alexander Von Humboldt** (German naturalist)

- Species richness increases with increase in area but up to a limit.



Graph representing Species – Area Relationship

S – Species Richness
A – Area under study
C – Y intercept
Z – slope of the line

Species – Area relationship : **log S = log C + Z log A**

- For many species – curve in the graph is a **rectangular hyperbola**.
- On log scale – **straight line**
- For smaller areas – Z ranges between **0.1 to 0.2** (regardless of species)
- For larger areas – slopes closer to vertical axis (**steeper**)

Conclusion: In very large areas, number of species found, increase faster than area explored.

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15.2 Patterns of Biodiversity

b) Species – Area relationship
Importance of species to the ecosystem

Productivity – Stability hypothesis

By **David Tillman**

- Rich diversity leads to lesser variation in biomass production over a period of time.

A community is said to be stable, when:

- Average biomass production remains constant over a period of time.
- Strong enough to withstand disturbances and recover quickly.
- Resistant to invasive species.

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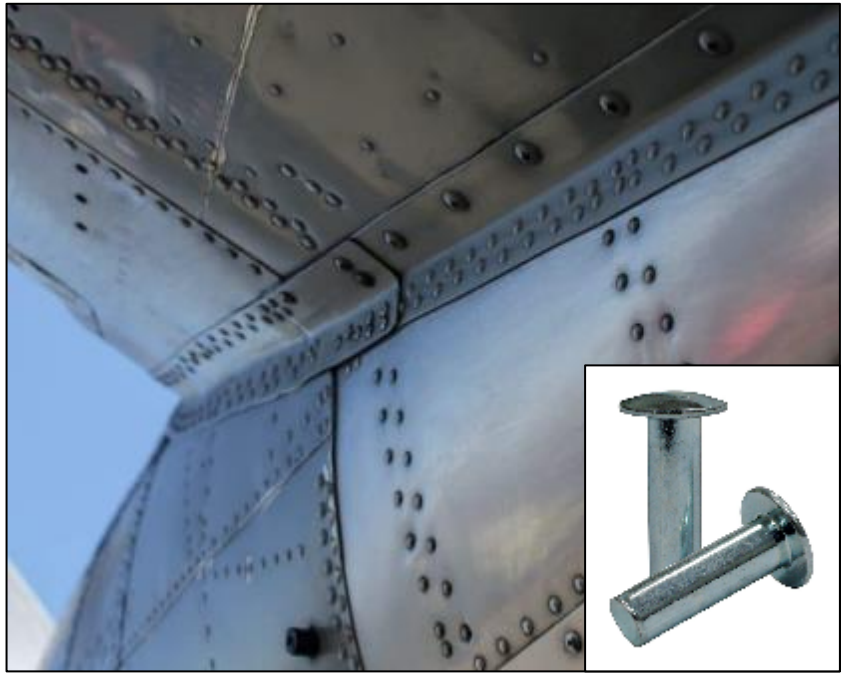
15.2 Patterns of Biodiversity

b) Species – Area relationship
Importance of species to the ecosystem

Rivet Popper hypothesis

By **Paul Ehrlich** (Stanford Ecologist)

- Compared :
  - Ecosystem → Aeroplane
  - Species → Rivets
- Thousands of rivets are needed to hold all the parts of the Aeroplane together.



Rivets – fasteners that keep all parts of Aeroplane together

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15.2 Patterns of Biodiversity

b) Species – Area relationship

Importance of species to the ecosystem

Rivet Popper hypothesis

If a passenger pops out one rivet → Initially not much turbulence experienced → More rivets are popped → Serious threat to the safety of Aeroplane

If one species goes extinct → Initially not much effect on the ecosystem → More species goes extinct → Serious threat to the stability of ecosystem

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15.2 Patterns of Biodiversity

b) Species – Area relationship

Importance of species to the ecosystem

Rivet Popper hypothesis

If Rivets at key positions are removed	→	**Cause threat in very short span of time**
Key species are removed from ecosystem	→	• Cause threat in very short span of time • Affect food chains, food web, energy flow, natural cycles, etc. • Affect balance of ecosystem

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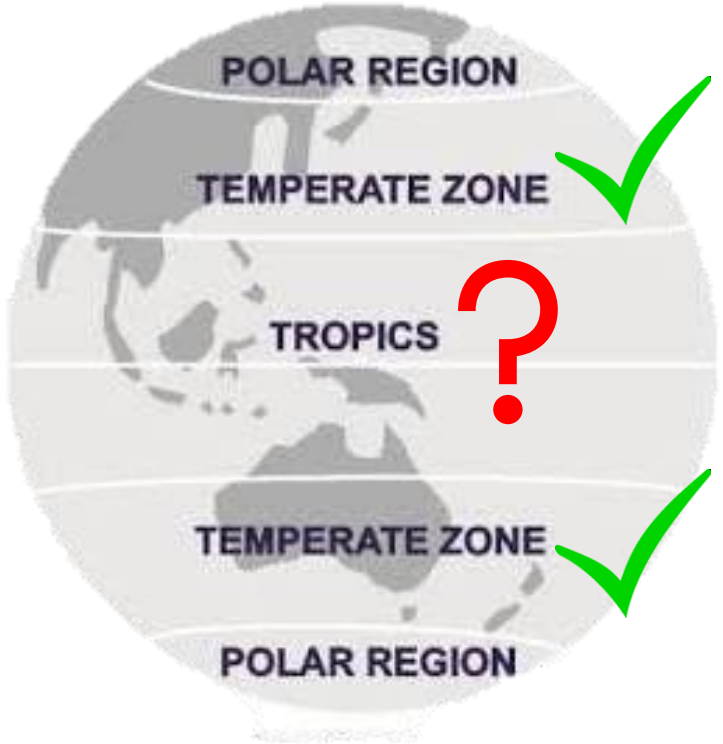
15.3 Biodiversity Current Scenario

- As per IUCN data (2004) – over 1.5 million species have been documented.
- But most of the studies were carried in temperate regions.
- Tropical rain forests needs more exploration.
- According to Robert May – around 7 million species around the globe.



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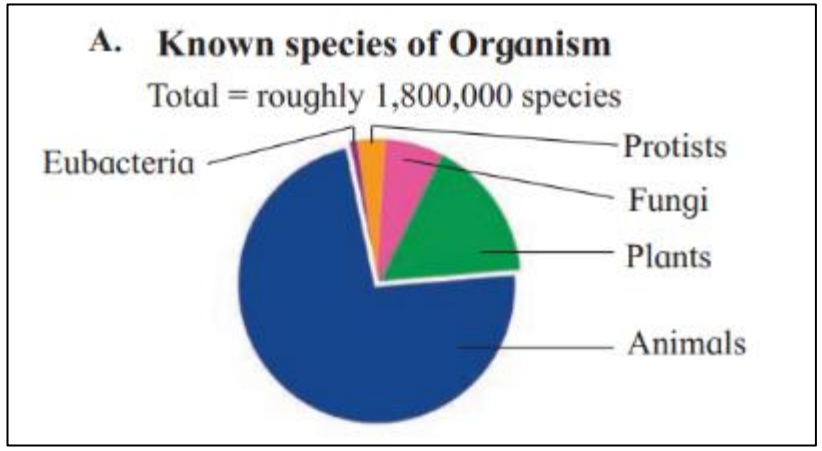
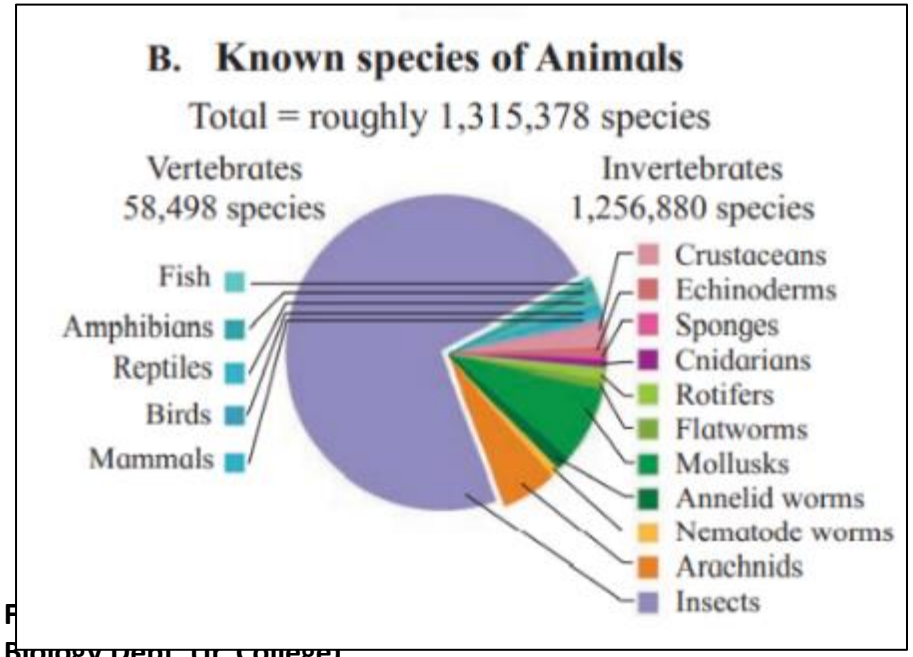
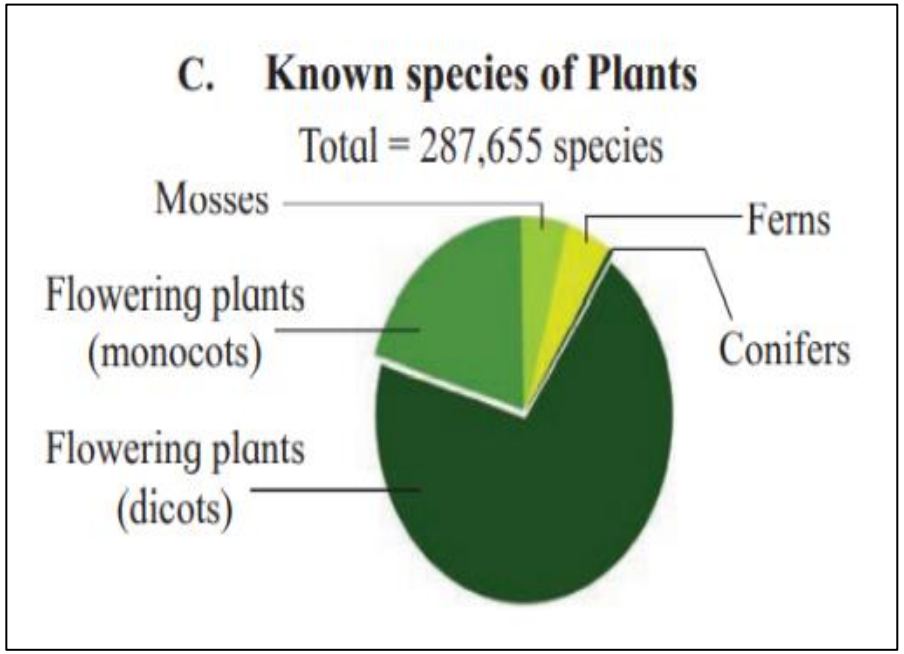
15.3 Biodiversity Current Scenario







No data about Prokaryotes in given diagram:

- Many monerans not cultivable under lab conditions.
- Conventional taxonomic methods unsuitable for them.

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15.3 Biodiversity Current Scenario

Indian share in World Biodiversity

- **8.1 %** of total earth's biodiversity.
- One of the 12 megadiversity country.
- **2.4 %** of total land area of earth.
- Identified – 45000 plant species, almost double number of animal species.
- According to May's estimate – we have recorded 22 % of our natural wealth.

Our concerns right now!!!

- **Need of more taxonomists to study biodiversity.**
- **Possibility of loss of varieties, before even being discovered.**

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15.4 Loss of Biodiversity

Major mass extinctions

The Sixth Extinction

- Current loss of biodiversity.
- Progressing at an alarming rate(100 to 1000 times faster).
- Due to human intervention in natural habitats.
- Can lead to –
  - Decline in plant production.
  - Lower resilience to environmental disturbance.
  - Alteration in environmental processes like disease cycle, plant productivity, etc.

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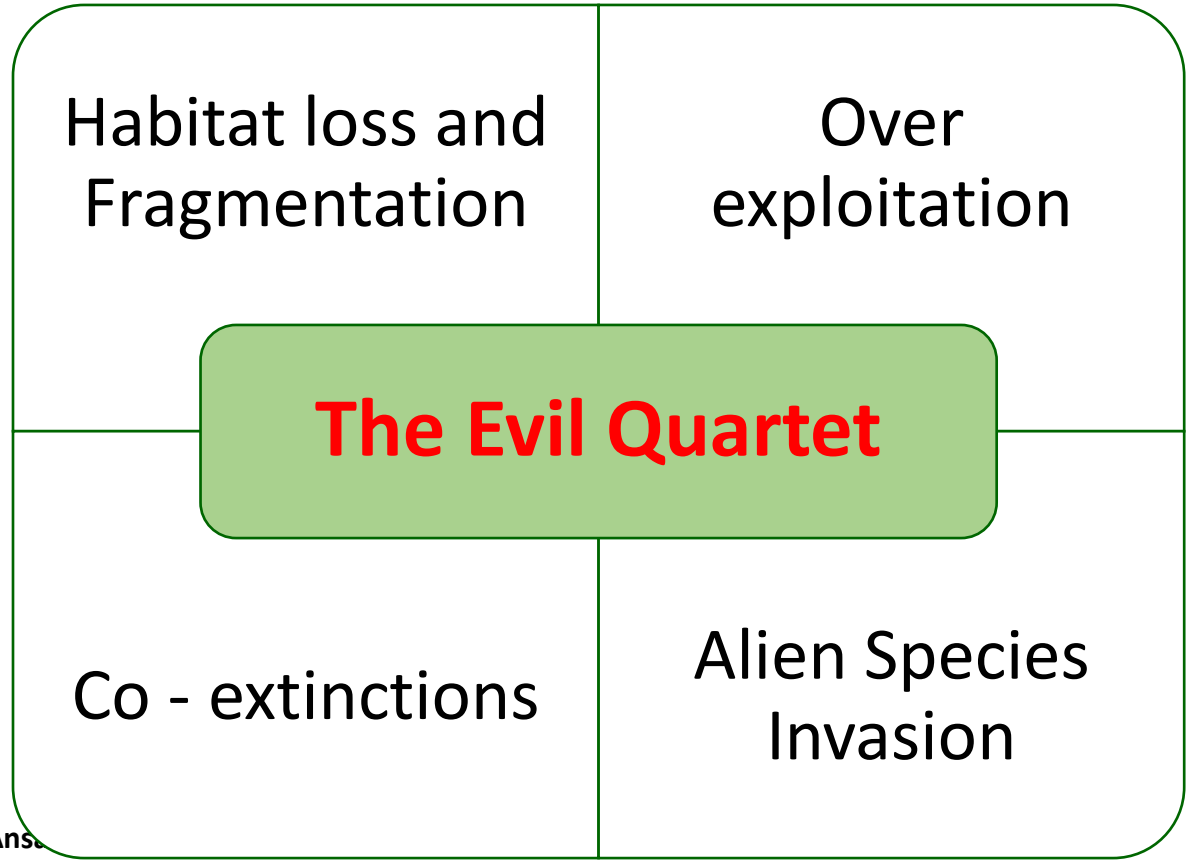
15.4 Loss of Biodiversity

Causes of Biodiversity Losses:



Due to:

- **Man made reasons** – habitat destruction, hunting, settlement, overexploitation and reclamation.
- **Natural reasons** – Forest fires, earthquakes, volcanic eruptions, etc.

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15.4 Loss of Biodiversity

Causes of Biodiversity Losses:

Habitat loss and Fragmentation

The Evil Quartet

- **Prime cause**.
- Reduction in vast natural habitats and local degradation.
- By – Pollution.
- Creates – crisis situation for living beings.
- Effects –
  - Threat to migratory birds.
  - Threat to animals needing larger territories.
  - Tropical Rain forest cover reduced from 14 to 6%

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15.4 Loss of Biodiversity

Causes of Biodiversity Losses:

Human tendency – to accumulate beyond needs.

↓

Overexploitation of resources

↓

Threat to various organisms

Animals extinct due to over exploitation:

- Dodo Bird
- Stellar Sea cow
- Passenger pigeon

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15.4 Loss of Biodiversity

Causes of Biodiversity Losses:

The Evil Quartet

- Alien Species Invasion

Invasive Species

New species introduced in ecosystem (Accidently or intentionally)

↓

May prove harmful to existing species

↓

Can lead to extinction of local species

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15.4 Loss of Biodiversity

Causes of Biodiversity Losses:

Examples of invasive species :

- **Carrot grass (*Parthenium*)**
- ***Lantana***
- **Water hyacinth (*Eichhornia*)**

Invasion of Water hyacinth in a lake

The Evil Quartet

Alien Species Invasion

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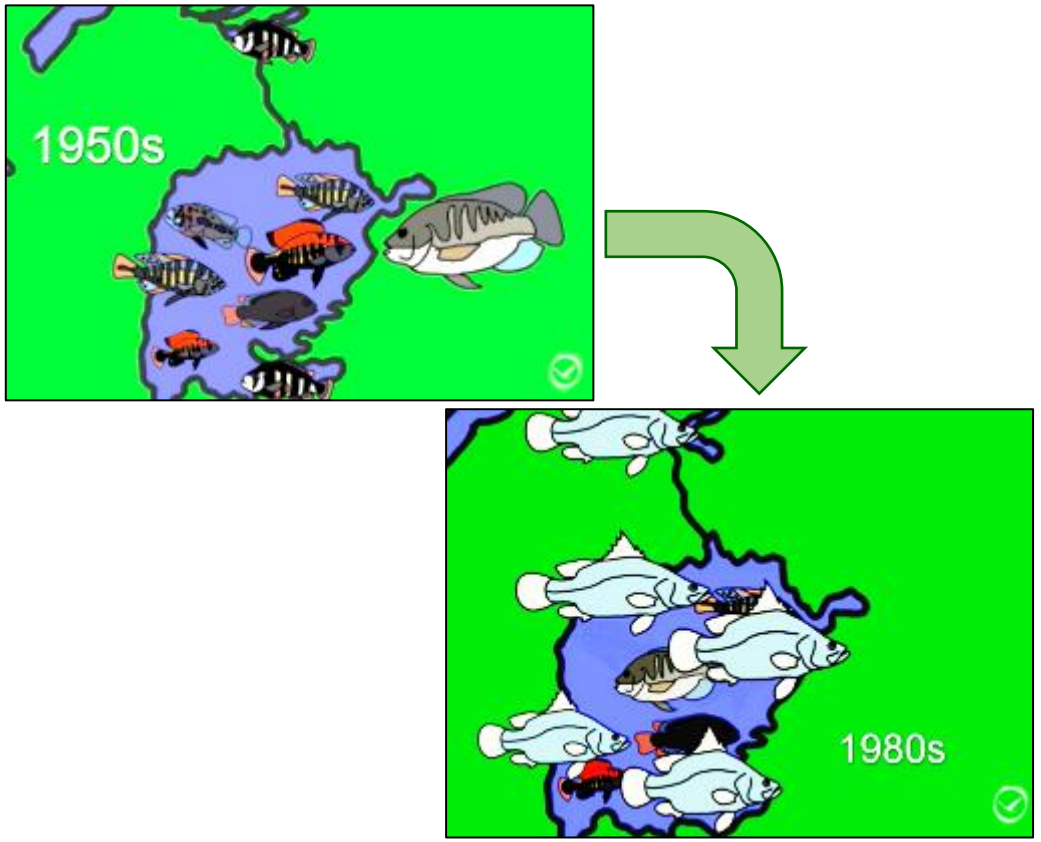
15.4 Loss of Biodiversity

Causes of Biodiversity Losses:

Example: Introduction of Predator fish Nile Perch in Lake Victoria proved deleterious to Cichlid fishes (200 local species)

The Evil Quartet

Alien Species Invasion



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15.4 Loss of Biodiversity

Causes of Biodiversity Losses:

Example: Introduction of African catfish *Clarias gariepinus* for aquaculture purposes proved harmful to endemic catfish varieties due to lack of local predators.

The Evil Quartet

Alien Species Invasion

Invasion of African catfish *Clarias gariepinus*

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15.4 Loss of Biodiversity

Causes of Biodiversity Losses:

- Organisms associated with each other in obligatory way.
- Extinction of one variety leads to loss of associate variety.

Examples:

- Extinction of host fishes → unique parasites.
- Coevolved plant pollinator

The Evil Quartet

Co - extinctions

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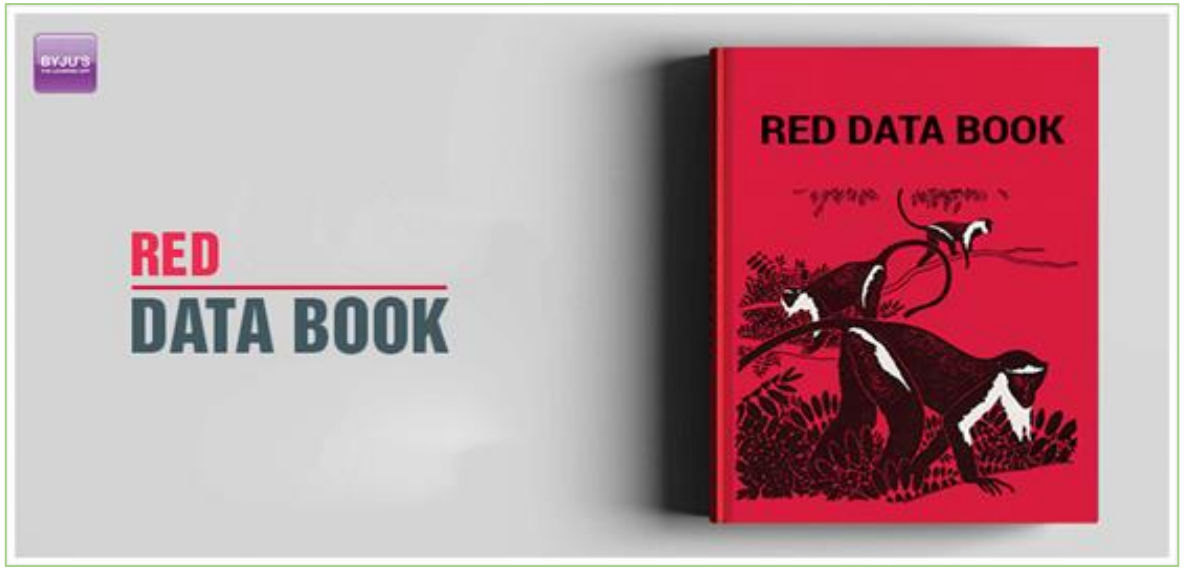
15.4 Loss of Biodiversity

International Union for Conservation of Nature and Natural Resources



Red Data Book \ List

maintains records of conservation status of animals and plants species.

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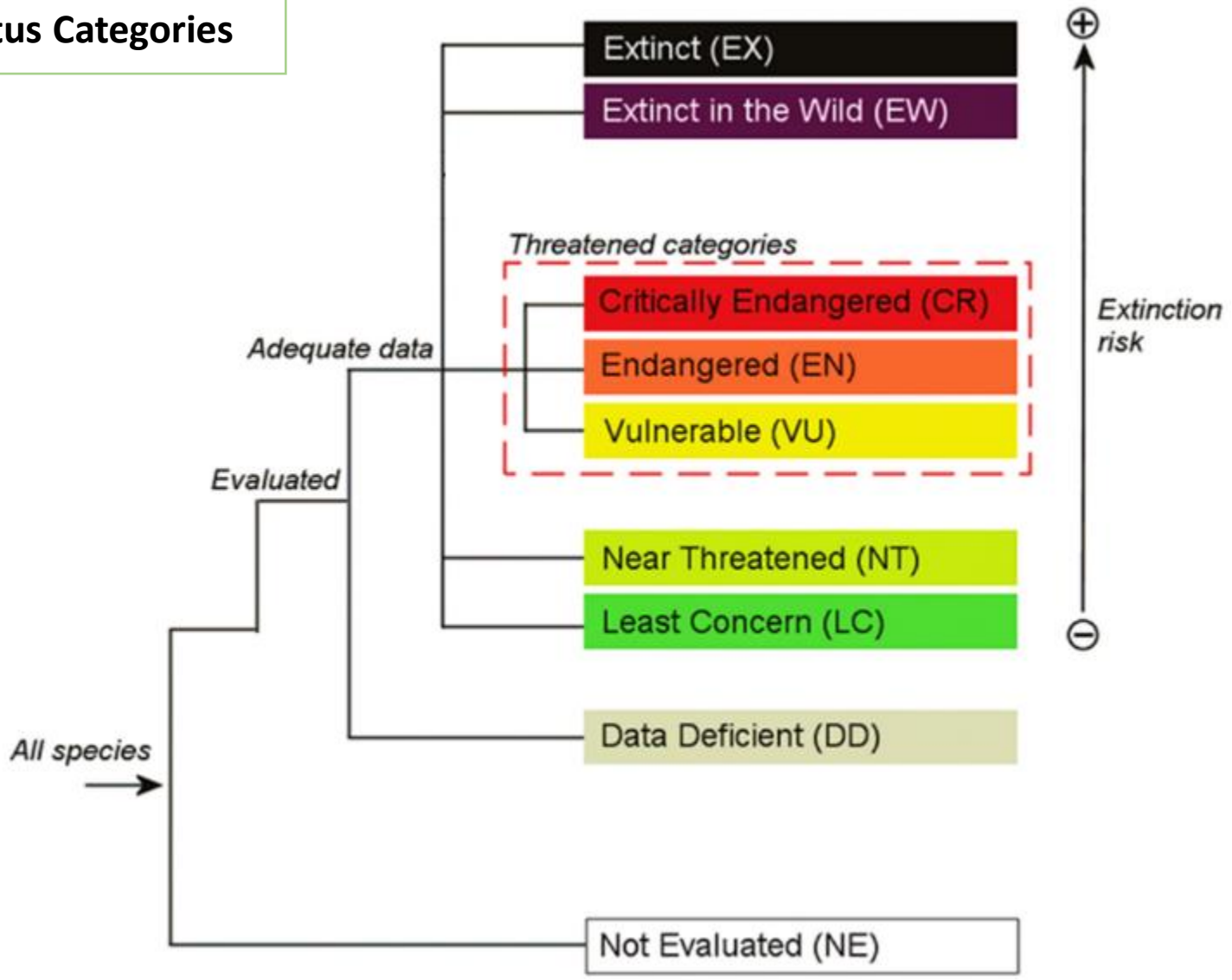
15.4 Loss of Biodiversity

Conservation Status Categories



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15.4 Loss of Biodiversity

Conservation Status Categories

Extinct (EX)	Last individual of species has died.
Extinct in Wild (EW)	Members of species survive only in captivity.
Critically Endangered (CR)	Species posses an extremely high risk of extinction with very few surviving members (50).
Endangered (EN)	High risk of extinction due to rapid population decline (from 50 to 70%) over previous 10 years.
Vulnerable (VU)	High risk of extinction due to rapid population decline (from 30 to 50%) over previous 10 years.
Near Threatened (NT)	Species close to becoming threatened or may become threatened in future.
Least Concern (LC)	Species pervasive and abundant after careful assessment.
Data Deficient (DD)	Amount of available data about species risk of extinction is lacking.
Not Evaluated (NE)	Nearly 1.9 million species described by scientist but not assessed by IUCN.

15.5 Conservation of Biodiversity

Conservation:

Protection, upliftment and scientific management of biodiversity to maintain its optimum level and to derive sustainable benefits for the present and future strategies.

Why to conserve the biodiversity?

a) **Narrowly utilitarian reasons.**
b) **Broadly utilitarian reasons.**
c) **Ethical reasons**

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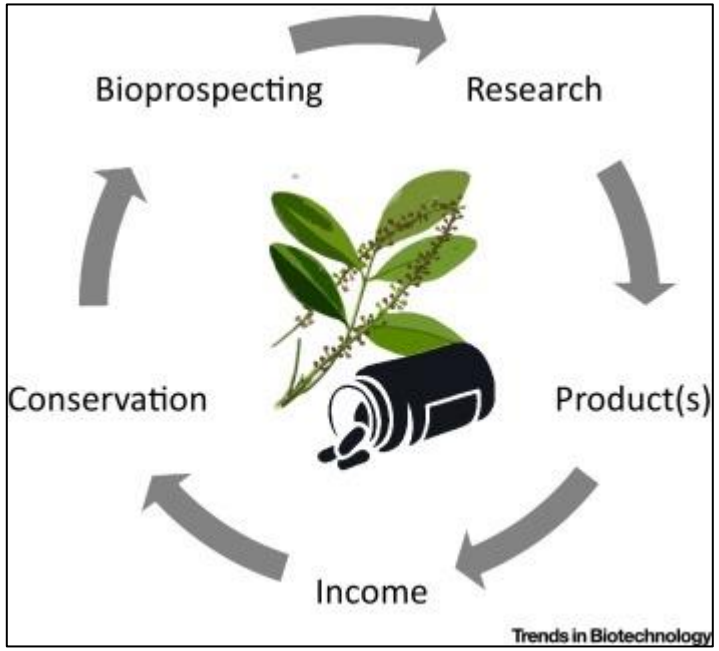
15.5 Conservation of Biodiversity

a) Narrowly utilitarian reasons

- Basic needs – resources for food, clothes, shelter.
- Industrial products like resins, tannins, perfume base, etc.
- Aesthetic use – ornaments or artefacts
- Medicinal use – 25 % of global medicine market. Tribals use around 25000 species as traditional medicines.

Bioprospecting

Systematic search for development of new sources of chemical compounds, genes, micro organisms, and other valuable products from nature.



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15.5 Conservation of Biodiversity

b) Broadly utilitarian reasons

- Provides Oxygen – Amazon rain forests produce 20% of total oxygen of earth's atmosphere.
- Pollination
- Seed dispersal
- Recreational use.

In 2019:

- Devastating forest fires in Amazon
- **Slash and burn policy** of locals in Brazil - 9,06,000 hectares of forest devastation.

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15.5 Conservation of Biodiversity

c) Ethical reasons

We have NO RIGHT to destroy the diversity.

All living beings have EQUAL RIGHTS to survive.

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15.5 Conservation of Biodiversity

How do we conserve biodiversity?

a) In situ conservation

Conservation in natural habitat

b) Ex situ conservation

Conservation in captivity

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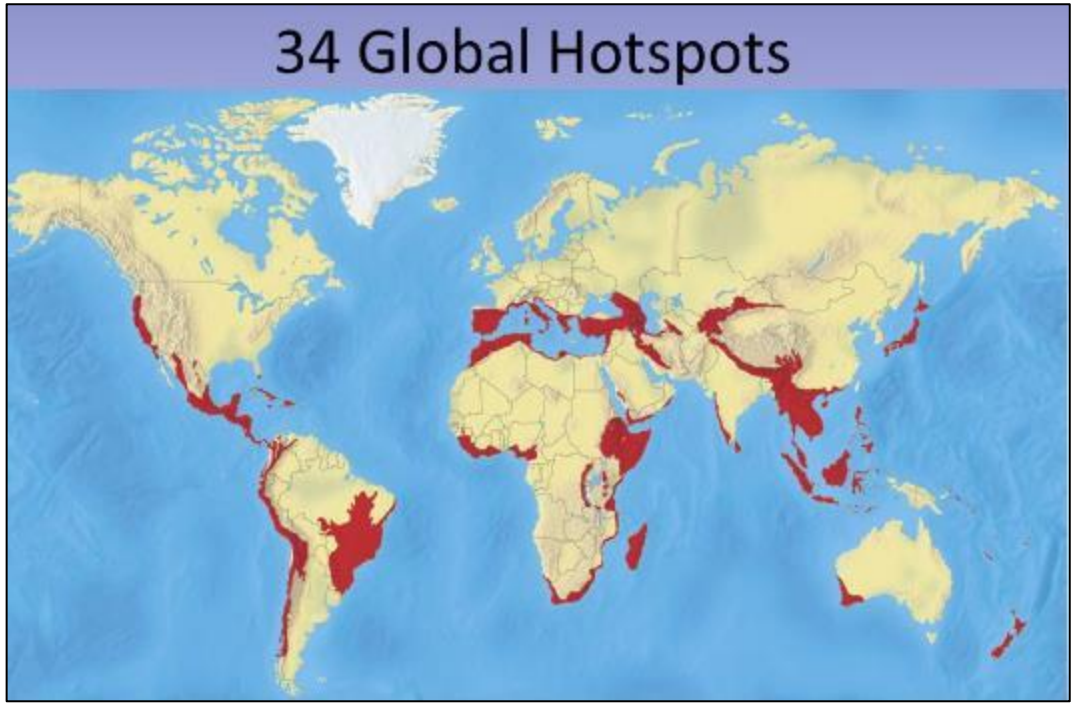
15.5 Conservation of Biodiversity

a) In situ conservation

- Most appropriate method of conservation.
- Protection of organism in its own habitat.
- Conservation at home.

Biodiversity Hotspots

- **34** biodiversity hotspots in the world.
- Regions with high species richness and density.
- These areas need strategic protection by setting legislative measures along with awareness and conservation.



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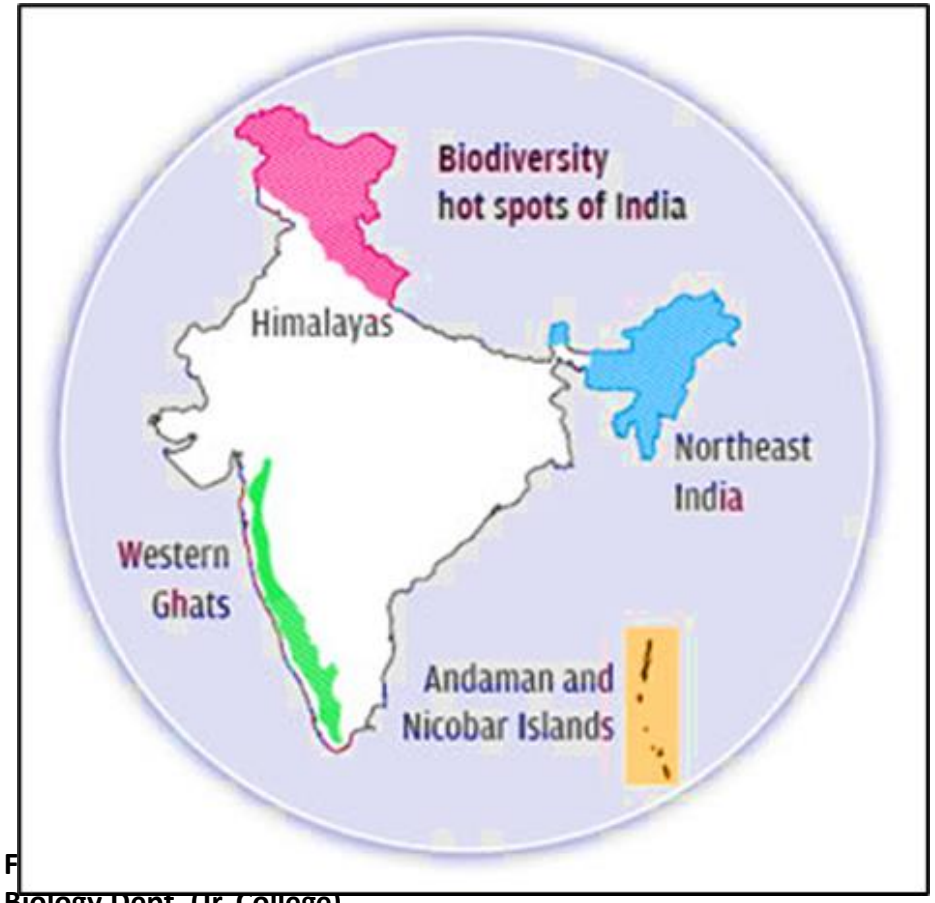
15.5 Conservation of Biodiversity

a) In situ conservation



In India:

- 3 Biodiversity Hotspots –
  1. **Western ghats**
  2. **Indo – Burma**
  3. **Eastern Himalayas**
- Their protection can reduce extinction rate by almost 30%.
- 14 Biosphere reserves
- 90 National Parks
- 448 Wildlife Sanctuaries

In Maharashtra

- 5 National Parks
- 11 Wildlife Sanctuaries

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15.5 Conservation of Biodiversity

a) In situ conservation

- Introduction of traditional varieties in farming and horticulture.

Example:

Pawra Tribes in Satpuda (Maharashtra) have protected varieties of corn with different colored kernels.

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15.5 Conservation of Biodiversity

a) In situ conservation

Sacred Grooves

- Stretches of forests were set aside and protected in the name of Almighty.
- Only chance of survival for some endangered varieties of animal and plant species.
- Tribals do not allow to cut even a single branch from the groove.
- Some Examples:
  - Khasi and Jaintia Hills in Meghalaya
  - Western Ghats In Maharashtra and Karnataka
  - Aravali Hills of Rajasthan and Bastar
  - Chanda and Sarguja areas of Madhya Pradesh.

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15.5 Conservation of Biodiversity

b) Ex situ conservation

- Protection in captivity.
- Living beings are protected away from their natural habitats in special settings.
- Animals with low population are bred in captivity in order to protect them.
- Wildlife parks, Zoological parks, Botanical gardens.

Crocodile Bank of Chennai

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15.5 Conservation of Biodiversity

b) Ex situ conservation

Seed Banks

To conserve wild varieties of food grains and vegetables.

Modern Techniques used:

- Tissue culture
- In vitro fertilization of eggs.
- Cryopreservation of gametes (at low temperature of -196° C)

Tissue culture

Cryopreservation

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15.6 Biological Diversity Act 2002

- India participated in Earth Summit (Rio de Janerio) – **Convention on Biological Diversity** (CBD - 1992)
- **Biological Diversity Act** (BD) – 2002 in compliance wit CBD

Biological Diversity Act (BD)

Law defines Biodiversity as –

- Biodiversity, as plants, animals and micro organisms as parts, their genetic material and by products.
- It excludes value added products and human genetic material.

Objectives -

- Regulation of access to Indian biological resources.
- Scientific cataloguing of traditional knowledge about ethnobiological materials.

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15.6 Biological Diversity Act 2002

A three tier system:

National Biodiversity Authority
at National level

State Biodiversity Authority
at State level

Biodiversity Management Committees
at Local level

Purpose:

- Approval for utilization of any biological resource for commercial or research purpose.

Powers:

- Mandatory for foreigners, NRIs as well as Indians citizens and institutions to seek permission from NBA before exploiting local resource.
- NBA has powers of civil court.
- Can penalize to jail and fine up to 10 lakhs for not seeking permission.

Firdous Ansari (Asst. Teacher)
Biology Dept. (Jr. College)
Mithibai College

15.11 Mission Harit Maharashtra

An ambitious project by Maharashtra Government (2016) in line with National Forest Policy (NCF).

Aims:

- **50 crores trees in 4 years**
- **Yearly targets to each district**
- **To maintain 33% forest cover in country.**

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Provisions:

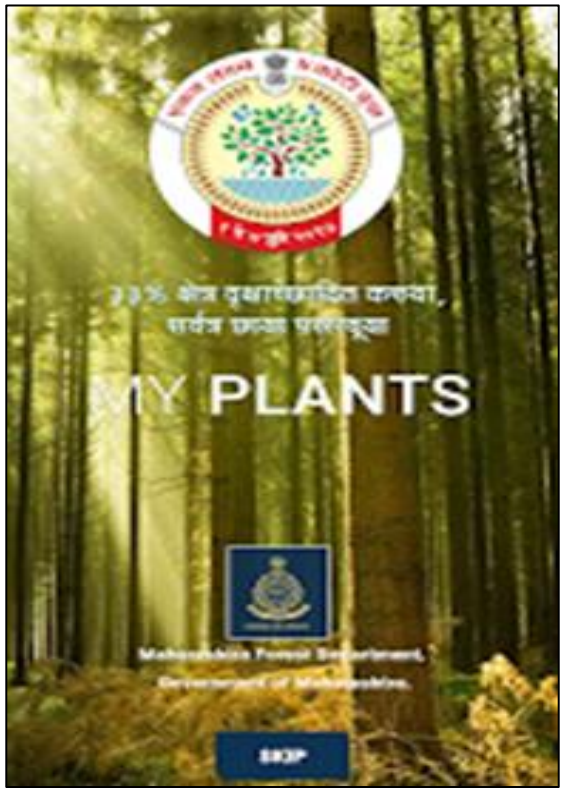
Hello Forest – 1926

24 Hour toll free number

Information about – plantation, protection and mass awareness.

My Plants

Mobile application



To record details of the plantation such as numbers, species and location.

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Achievements:

1st year – 2016 – **2.87 crore** saplings were planted.

2nd year – 2017 – **5.7 crore** saplings were planted.

3rd year – 2018 – **15. 17 crore** of saplings were planted.

In 2019 (4th year) Government aimed to plant **33 crore** saplings which was launched at Anandwan, Warora

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State Forest Department and Social Forestry Department have run successful pilot plantations of **Japanese Miyawaki Method** in Beed, Hingoli, Pune, Jalgaon, Aurangabad, etc.

Akira Miyawaki
developer of Miyawaki Method

Miyawaki Forest
a small but dense forest

Firdous Ansari (Ass
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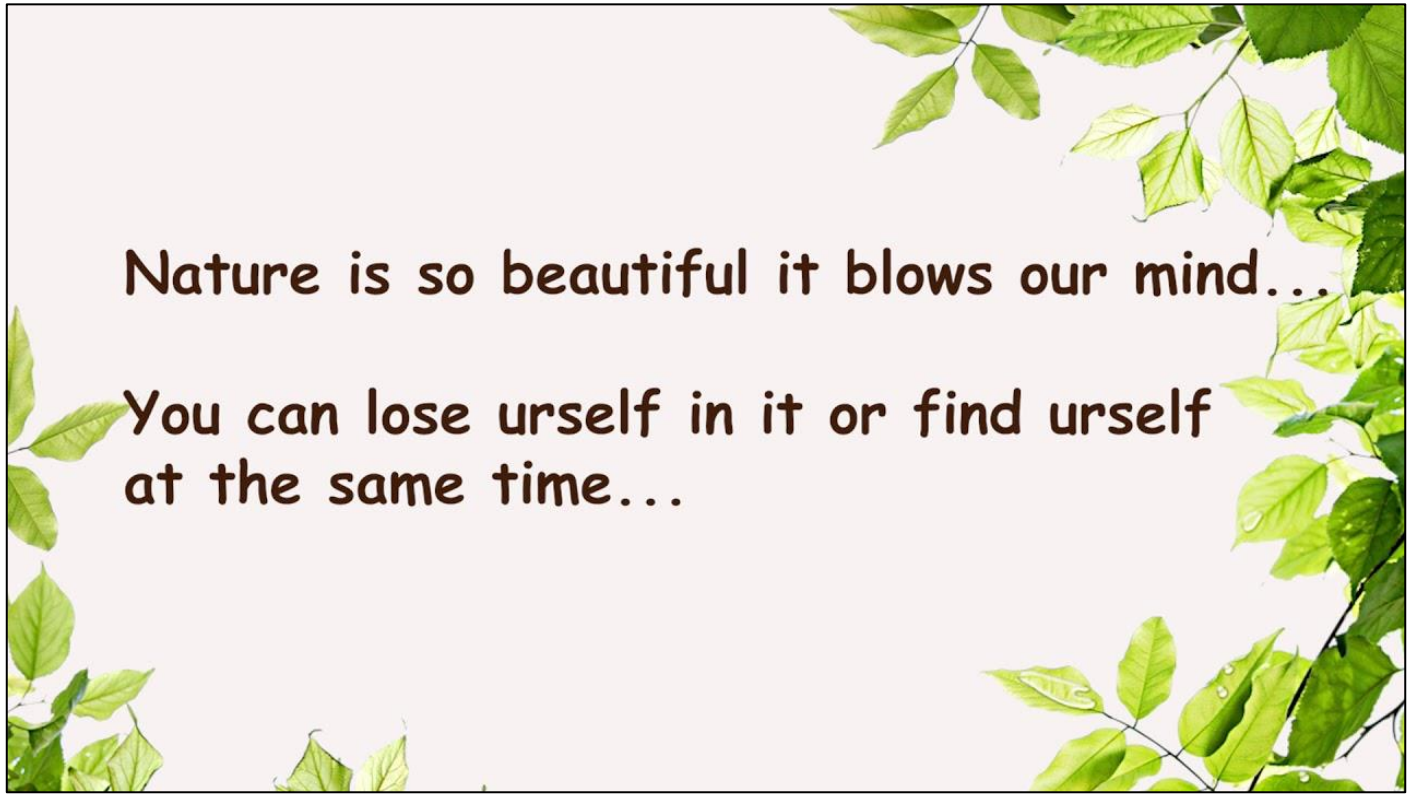

End of Presentation