

Biodiversity and Conservation

Biodiversity and Conservation – Introduction

- If an alien visitor from a distant galaxy were to arrive on **planet Earth**, one of the first things that would amaze and perplex them would be the enormous diversity of life present here.
- Even for humans, the vast variety of living organisms with which we share this planet continues to **astonish and fascinate** us.

The Astonishing Numbers of Life Forms

- Ant species – Over **20,000**
- Beetle species – About **3,00,000**
- Fish species – Nearly **28,000**
- Orchid species – Nearly **20,000**

Key Scientific Questions About Biodiversity

- Ecologists and evolutionary biologists study biodiversity by seeking answers to important questions such as:
 1. Why are there so many species on Earth?
 2. Did such great diversity exist throughout Earth's history?
 3. How did this diversification evolve over time?
 4. Why is biodiversity important for the biosphere's functioning?
 5. Would the biosphere function differently if biodiversity was much less?
 6. How do humans benefit from the diversity of life?

Biodiversity

Introduction

- The biosphere contains an immense variety of life forms - a concept known as **biodiversity**.
- This diversity exists at all levels of biological organisation, from the smallest macromolecules within cells to the largest ecosystems and biomes.
- The term "**biodiversity**" was popularised by sociobiologist **Edward Wilson**, and it refers to the combined diversity seen at all levels of biological organisation.

Levels of Biodiversity

Biodiversity can be studied at three major levels:

1. Genetic Diversity

- Refers to the variation of genes within a species.
- Even a single species can show a wide range of genetic variation across its distribution.
- **Example:**
 - *Rauwolfia vomitoria*, a medicinal plant growing in different Himalayan regions, shows genetic differences in the potency and concentration of the chemical **reserpine** it produces.
 - India has over **50,000 genetically distinct strains of rice** and more than **1,000 varieties of mango**.

2. Species Diversity

- Refers to the variety of species within a region.
- Different regions may have different numbers and types of species.
- **Example:**
 - The **Western Ghats** have a greater diversity of amphibian species compared to the Eastern Ghats.

3. Ecological (Ecosystem) Diversity

- Refers to the variety of ecosystems found within a geographical area.
- **Example:**
 - India displays high ecosystem diversity with its deserts, rainforests, mangroves, coral reefs, wetlands, estuaries, and alpine meadows.
 - In contrast, countries like **Norway** have relatively lower ecosystem diversity.

Significance of Biodiversity

- The vast biodiversity we see today is the result of millions of years of evolution.

- However, due to human activities, we are now losing species at an alarming rate.
- If this continues, we may lose much of our biodiversity in **less than two centuries**.

Need for Conservation

- Biodiversity is essential for the survival and well-being of all life forms on Earth.
- Its conservation has become a **critical global issue**, as people worldwide are realising its importance in maintaining ecological balance and supporting life systems.

How many Species are there on Earth and in India?

Introduction

- While all species that have been **formally described and named** are recorded in published lists, the exact total number of species on Earth remains unknown.
- Many species are yet to be discovered, especially in tropical regions.

Global Species Count

- According to the International Union for Conservation of Nature and Natural Resources (**IUCN, 2004**), the total number of plant and animal species described so far is slightly more than 1.5 million.
- The number of undiscovered species is unknown, with **estimates ranging widely**:
 - Extreme estimates: 20–50 million species.
 - More conservative and scientifically sound estimate: About **7 million species** (Robert May).

Methods of Estimating Total Species

1. Select a taxonomic group with complete records (e.g., insects).
2. Compare **species richness** between **temperate** and **tropical** regions.
3. Extrapolate these ratios to other animal and plant groups to estimate total species numbers.

Current Recorded Biodiversity (Global)

Animals:

- >70% of all recorded species.

Plants:

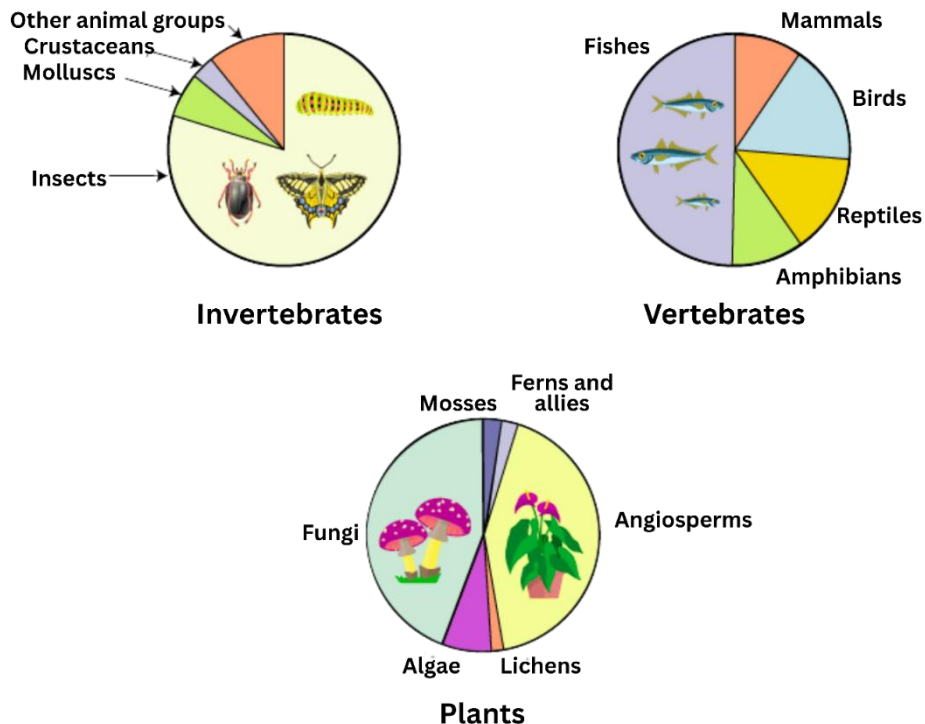
- ~22% (including algae, fungi, bryophytes, gymnosperms, and angiosperms).

Insects:

- Most species-rich animal group.
- Constitute >70% of all animal species (**7 out of every 10 animals are insects**).

Fungi:

- More species than the combined total of fishes, amphibians, reptiles, and mammals.



Representing global biodiversity: proportionate number of species of major taxa of plants, invertebrates and vertebrates

Unknown Diversity – Prokaryotes

- No reliable figures for prokaryotic species due to:
 - Limitations of traditional taxonomic methods.
 - Many species being **unculturable** in laboratory conditions.
- Using biochemical and molecular criteria, microbial diversity **may run into millions**.

Biodiversity in India

- Land area: 2.4% of the world's total.
- **Share in global biodiversity:** 8.1%.
- Recognised as one of the 12 mega-diversity countries in the world.
- Recorded species in India:
 - Plants: ~45,000 species.
 - Animals: ~90,000 species (twice the plant count).

Undiscovered Species in India

- Based on May's estimate (only **22% of species recorded** globally):
 - Plants yet to be discovered: >1,00,000 species.
 - Animals yet to be discovered: >3,00,000 species.

The Urgency of Conservation

- Completing India's biodiversity inventory is a **massive challenge** due to the manpower, expertise, and time required.
 - Many species risk extinction before discovery.
 - This situation is likened to a **burning biological library**, where books (species) are lost before they can be catalogued.

Patterns of Biodiversity

- Biodiversity is not evenly distributed across the planet.
- Instead, it shows **distinct patterns**, two of the most important being the latitudinal gradients and species–area relationships.

1. Latitudinal Gradients

Definition

- The **latitudinal gradient** refers to the general pattern in which species diversity decreases from the equator towards the poles.

Global Trends

- With few exceptions, **tropical regions** (latitudes 23.5° N to 23.5° S) harbour more species than temperate or polar areas.
- **Examples:**
 - *Colombia* (near equator): ~1,400 bird species.
 - *New York* (41° N): 105 bird species.
 - *Greenland* (71° N): 56 bird species.
 - *India* (mostly tropical): >1,200 bird species.
- **Plant Diversity Example:**
 - A tropical forest in *Ecuador* may have **10 times** more species of vascular plants than a temperate forest of the same area in the Midwest USA.
- Amazon Rainforest – World's Biodiversity Hotspot:
 - Plants: >40,000 species
 - Fishes: 3,000 species
 - Birds: 1,300 species
 - Mammals: 427 species
 - Amphibians: 427 species
 - Reptiles: 378 species

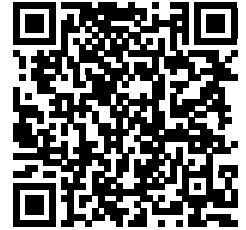


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