



# Collegedunia NCERT Notes

*The Ultimate Class 12 Biology Revision Guide — Full-colour diagrams*

## Chapter 13: Biodiversity and Conservation

Class 12 / 12th Biology — NCERT 2026-27 (Reprint)

*biodiversity and conservation class 12 notes*

Also see for this chapter: [NCERT Solutions](#) | [Formula Sheet](#) | [Exemplar Solutions](#)

### Why this chapter matters

Chapter 13 closes the Ecology unit and is one of the highest-yield chapters in NEET — 3 to 4 direct factual questions on numbers (mega-diversity countries, hotspots, biosphere reserves), names (Evil Quartet, IUCN Red List), and dates (Earth Summit 1992, Johannesburg 2002) almost every year. For boards, the species–area equation  $S = CA^Z$  and the in-situ versus ex-situ comparison are guaranteed short-answer territory. Master the numbers, the four causes of extinction, and the two conservation strategies and the chapter is yours.

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## 1 What is Biodiversity?

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If a visitor from a distant galaxy were to land on Earth, the first thing to amaze them would be the staggering diversity of life. 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** share this planet with us. Ecologists and evolutionary biologists have

spent two centuries asking the same questions: why so many species, how did they arise, and why does this richness matter?

The term *biodiversity* was popularised by the sociobiologist **Edward O. Wilson** to describe the combined diversity of life at every level of biological organisation — from molecules inside a cell to entire biomes. It is not a single number; it is a layered concept.

## 1.1 The Three Levels of Biodiversity

NCERT recognises three levels at which we measure biological diversity. Memorise all three with one well-chosen Indian example each — examiners love this triplet.

### The three layers of biodiversity (NCERT)

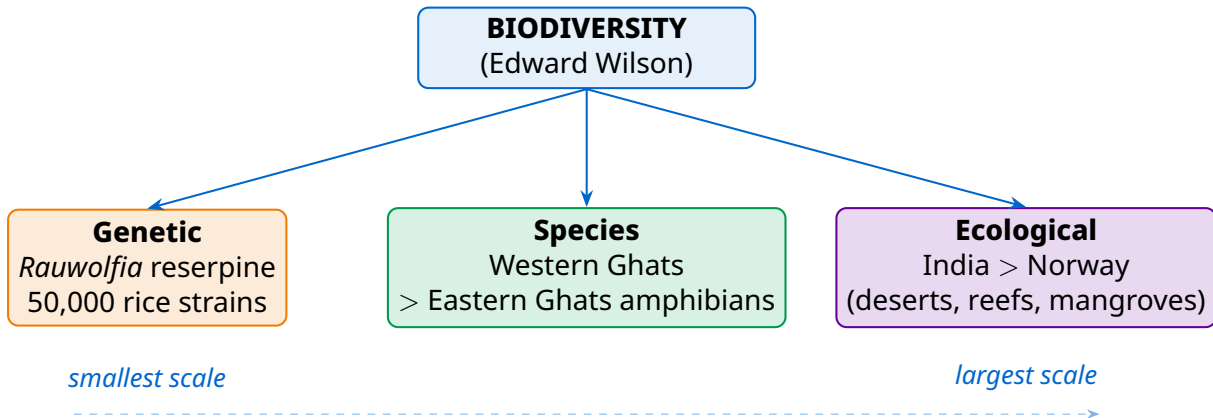
1. **Genetic diversity** — variation in genes *within* a single species across its distributional range.
2. **Species diversity** — variation in number and abundance of species *within a region*.
3. **Ecological (ecosystem) diversity** — variation at the level of ecosystems, biomes and habitats within a geographical area.

### Genetic diversity — the classic NCERT examples

- The medicinal plant *Rauwolfia vomitoria* growing in different Himalayan ranges shows genetic variation in the potency and concentration of its active alkaloid, **reserpine**.
- India has more than **50,000** genetically different strains of rice and **1,000** varieties of mango.

**Species diversity** measures how many species are found in a region and how evenly they are distributed. The classic NCERT contrast: the **Western Ghats** have a greater amphibian species diversity than the Eastern Ghats, even though the two mountain ranges lie at similar latitudes.

**Ecological diversity** compares whole ecosystems. India — with deserts, rainforests, mangroves, coral reefs, wetlands, estuaries and alpine meadows — has far greater ecosystem diversity than a Scandinavian country such as Norway, even though Norway has a larger forest cover.

**Quick Tip**

**Memory hook for the three levels:** the scale grows as you go alphabetically — **G**ene → **S**pecies → **E**cosystem fits a smallest-to-largest hierarchy. Within **G** the unit is an allele; within **S** the unit is a species; within **E** the unit is a habitat or biome.

## 1.2 How Many Species Are There on Earth and in India?

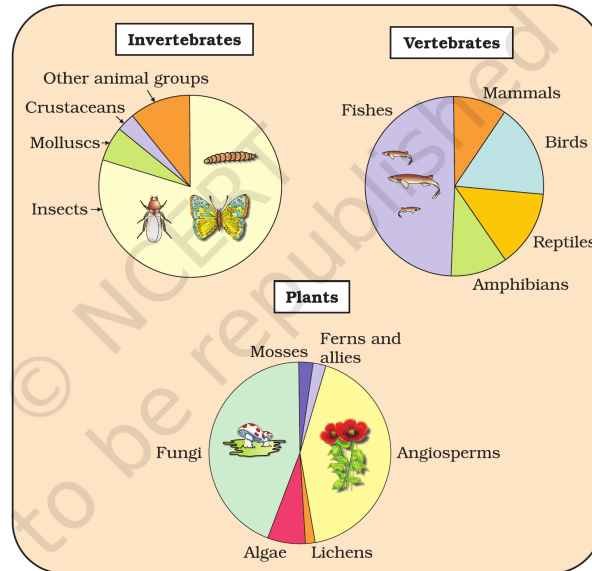
The honest answer is: *we do not know*. The IUCN catalogue (2004) records slightly more than **1.5 million** described species, but the true number is far higher. Most undescribed species live in the tropics, where taxonomists are scarce. To estimate the global total, biologists take an exhaustively studied insect group, calculate its temperate-to-tropical species ratio, and extrapolate.

### The Robert May estimate

The conservative and scientifically defensible estimate, made by **Robert May**, places the total number of species on Earth at about **7 million**. Extreme estimates range from 20 to 50 million. Only  $\approx 22$  per cent of all species have been described so far.

### Earth's biodiversity snapshot — numbers to memorise

- More than **70 per cent** of all recorded species are **animals**.
- Plants (algae, fungi, bryophytes, gymnosperms, angiosperms) make up no more than **22 per cent**.
- Of all animals, **insects** alone account for more than 70 per cent — so 7 out of every 10 animals on Earth is an insect.
- The number of **fungi** species exceeds the combined total of fishes, amphibians, reptiles and mammals.
- Prokaryotes are *not* included in these counts — they cannot be reliably species-classified by conventional methods.



**Figure 13.1** Representing global biodiversity: proportionate number of species of major taxa of plants, invertebrates and vertebrates

*Fig. 13.1 (NCERT): Representing global biodiversity — proportionate number of species of major taxa of plants, invertebrates and vertebrates. Insects dominate the invertebrate pie; mammals are a thin slice of the vertebrate pie.*

**India's share.** India occupies only **2.4 per cent** of the world's land area, but holds **8.1 per cent** of global species diversity. That makes India one of the **12 mega-diversity countries** of the world. Recorded species:  $\approx 45,000$  plants and roughly twice as many ( $\approx 90,000$ ) animals. Applying May's 22-per-cent rule, India probably still hides  $> 1,00,000$  plant species and  $> 3,00,000$  animal species waiting to be discovered. NCERT's vivid line — "*Nature's biological library is burning even before we catalogued the titles of all the books stocked there*" — captures the urgency.

#### Memorise the India numbers (2-8-12-45)

**2.4** per cent land — **8.1** per cent species — **12** mega-diversity countries — **45,000** plant species. Chant "two-eight-twelve-forty-five" once before any NEET attempt. These four numbers cover roughly half of the factual MCQs ever set on this chapter.

#### Quick Tip

When a question asks "how many species on Earth?" the textbook answer is **Robert May's 7 million**, not 1.5 million (that is only the *described* count) and not 20–50 million (extreme estimates).

## 2 Patterns of Biodiversity

Biodiversity is not spread uniformly across the planet. Two robust patterns dominate the textbook: a *latitudinal* pattern and a *species-area* pattern. NEET tests these every year.

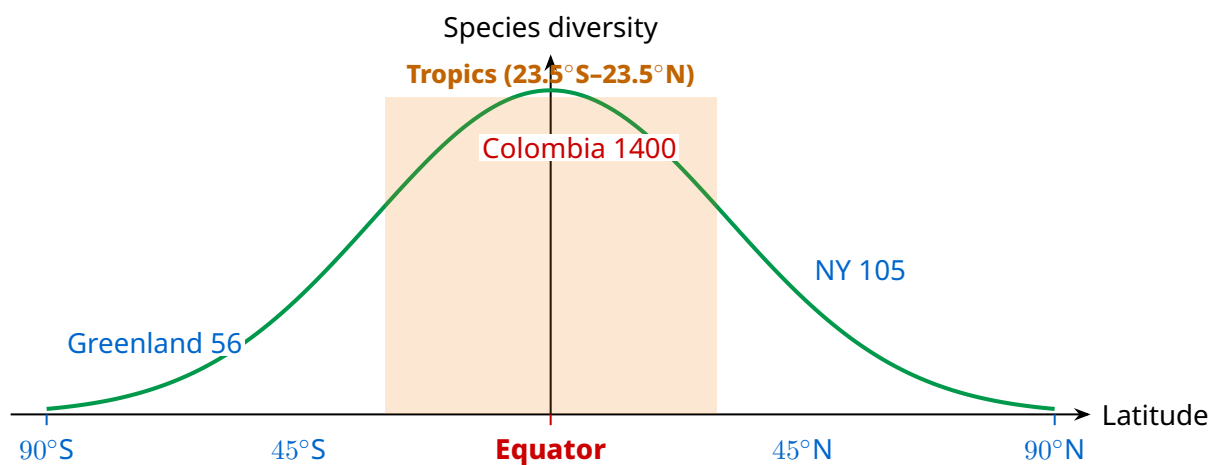
## 2.1 Latitudinal Gradients

Species diversity **decreases as we move from the equator towards the poles**. With very few exceptions, the tropics (latitude 23.5°N to 23.5°S) house more species than temperate or polar regions. NCERT cites a striking comparison:

### Bird-species count vs. latitude (NCERT data)

- **Colombia** (near the equator, 0°) — nearly **1,400** species of birds.
- **India** (much of the country in tropical latitudes) — > **1,200** species.
- **New York** (41°N) — **105** species.
- **Greenland** (71°N) — only **56** species.
- A tropical forest patch in **Ecuador** holds up to **10 times** the vascular-plant species of a temperate forest of equal area in the US Midwest.

The richest spot on Earth is the **Amazonian rainforest**, with more than 40,000 plant species, 3,000 fishes, 1,300 birds, 427 mammals, 427 amphibians, 378 reptiles and over 1,25,000 invertebrates — plus an estimated **2 million insect species** yet to be discovered.



*Latitudinal gradient: bell-shaped peak in species richness at the equator, falling steeply toward the poles.*

### Why are the tropics so rich? Three hypotheses

#### NCERT's three hypotheses for tropical richness

1. **Evolutionary time hypothesis.** Speciation is a function of time. Unlike temperate regions (which were repeatedly glaciated during the Pleistocene), tropical latitudes have stayed relatively undisturbed for millions of years — giving species long, uninterrupted time to diversify.
2. **Constant environment hypothesis.** Tropical environments are less sea-

sonal, more constant and predictable. Stable conditions promote **niche specialisation** and therefore greater species diversity.

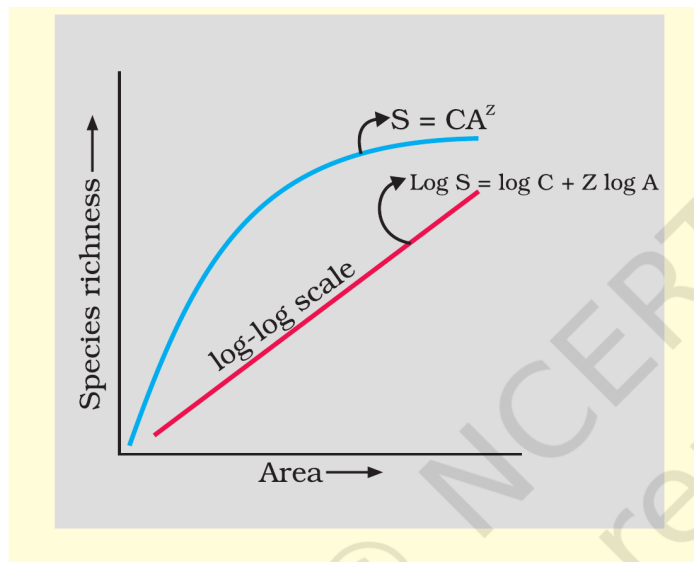
3. **Productivity hypothesis.** The tropics receive more **solar energy**, which raises primary productivity. Higher productivity can indirectly support a richer community of consumers and decomposers.

### Common Mistake

Students often write that “the tropics have higher diversity because they are hotter.” NCERT does *not* list temperature itself as a cause — it lists time, stability and solar energy/productivity. Heat alone (deserts are hot too) does not produce diversity.

## 2.2 Species–Area Relationship

While exploring the South American jungles, the German naturalist **Alexander von Humboldt** noticed that within a region, the number of species rises with the area you sample — but *only up to a limit*. Plot species richness against area for angiosperms, birds, bats or freshwater fishes and you get a **rectangular hyperbola** (Fig. 13.2).



**Figure 13.2** Showing species area relationship. Note that on log scale the relationship becomes linear

Fig. 13.2 (NCERT): Showing the species–area relationship. The relationship is a rectangular hyperbola on a linear scale ( $S = CA^Z$ ) and a straight line on a log-log scale ( $\log S = \log C + Z \log A$ ).

On a logarithmic scale the curve becomes a straight line described by:

**Species–Area equation**

$$S = C A^Z \quad (\text{linear}) \iff \log S = \log C + Z \log A \quad (\text{log-log})$$

where

- $S$  = species richness
- $A$  = area
- $C$  =  $Y$ -intercept on the log–log plot
- $Z$  = slope of the line (*regression coefficient*)

**The two key  $Z$ -value ranges**

- For **small areas within a region** (plants in Britain, birds in California, molluscs in New York state), the slope  $Z$  lies between **0.1 and 0.2**, regardless of taxonomic group or region.
- For **very large areas** (entire continents), the slope is much steeper —  $Z$  in the range **0.6 to 1.2**.
- Example: for frugivorous (fruit-eating) birds and mammals in tropical forests of different continents,  $Z = 1.15$ .

**What does a steeper slope mean?** A steeper  $Z$  tells us that as you sample bigger and bigger areas (continents instead of patches), the rate at which new species accumulate is much faster — because at the continental scale you are sampling entirely different biogeographic provinces, each with its own evolutionary history. At a small within-region scale, you mostly see members of the same regional pool.

**Quick Tip**

**Numerical trick.** On a log–log graph,  $Z = \frac{\log S_2 - \log S_1}{\log A_2 - \log A_1}$ . Boards/NEET sometimes give you two  $(A, S)$  pairs and ask you to compute  $Z$ . Plug into the slope formula — no need to redraw the graph.

**Remember the  $Z$  values**

**“Z in tens, Z in twelves.”** Within a region  $Z = 0.1$ – $0.2$  (tenths). Between continents  $Z = 0.6$ – $1.2$  (about six-to-twelve times bigger). Frugivorous birds-and-mammals in tropics:  $Z = 1.15$ .

### 3 Importance of Species Diversity

Does the *number* of species in a community matter for how the ecosystem functions? Ecologists have debated this for decades.

For many years the prevailing view was: communities with more species are more **stable**. A stable community should

- show little year-to-year variation in productivity,
- be **resistant** or **resilient** to natural and man-made disturbances, and
- resist invasions by alien species.

**David Tilman's** long-term outdoor-plot experiments provide the strongest evidence so far:

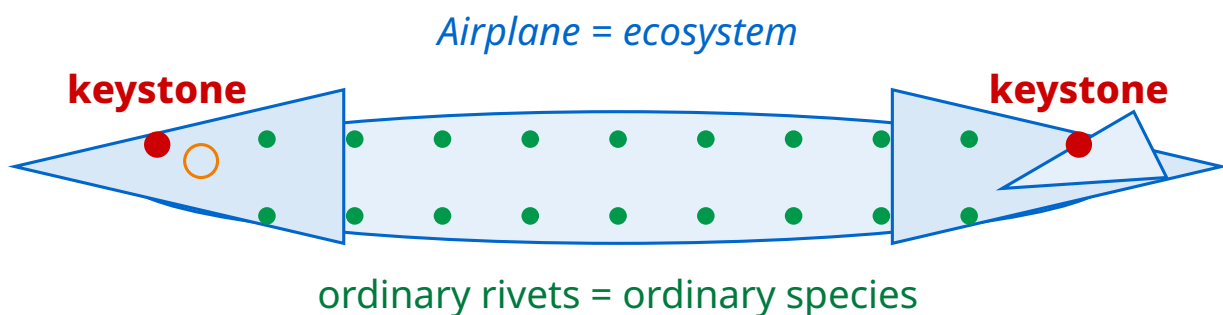
- Plots with *more species* showed **less year-to-year variation in total biomass** — diversity buffers productivity.
- Increased diversity also *raised* productivity itself.

### 3.1 The Rivet-Popper Hypothesis (Paul Ehrlich)

The Stanford ecologist **Paul Ehrlich** captured the case for biodiversity in a single analogy. Imagine an ecosystem as an **airplane** and every species as one of the thousands of **rivets** holding it together.

#### Rivet-popper hypothesis — the analogy in one line

If every passenger pops one rivet to take home (i.e. a species goes extinct), the plane (the ecosystem) flies safely *at first*. But as more rivets disappear, the plane becomes dangerously weak. And *which* rivet you pop matters: a rivet on the **wing** (a keystone species driving major ecosystem functions) is far more critical than a rivet on a **passenger seat or a window** (a less critical species).



#### Real-World Application

The 1972 ban on DDT in the US was an ecological “rivet replacement” — bald eagles, brown pelicans and peregrine falcons (high-trophic-level keystone species) had crashed because DDT thinned their eggshells. Restoring those few keystone rivets allowed entire wetland food-webs to recover within a generation.

## 4 Loss of Biodiversity

The biological wealth of our planet is shrinking fast, and the accusing finger points squarely at human activity. Some grim figures from the NCERT chapter:

### Loss of biodiversity — the numbers to remember

- Colonisation of tropical Pacific islands by humans led to the extinction of more than **2,000 species of native birds**.
- The IUCN Red List (2004) documents the extinction of **784 species** in the last 500 years — 338 vertebrates, 359 invertebrates, 87 plants.
- Recent example extinctions: **dodo** (Mauritius), **quagga** (Africa), **thylacine** (Australia), **Steller's sea cow** (Russia), and three subspecies of tiger — **Bali, Javan, Caspian**.
- In the last 20 years alone, **27 species** have disappeared.
- More than **15,500 species** world-wide currently face the threat of extinction.
- Of all bird species **12 %**, of all mammals **23 %**, of all amphibians **32 %**, and of all gymnosperms **31 %** face the threat of extinction.

### Quick Tip

**Mnemonic for the percentages threatened with extinction: "12, 23, 32, 31"**. Birds, mammals, amphibians, gymnosperms. The most vulnerable vertebrate group is *amphibians* (32 %) — their permeable skin and biphasic life cycle make them ultra-sensitive to environmental change.

### 4.1 The Sixth Extinction

Fossil records show **five episodes of mass extinction** in the past 3 billion years (the "Big Five": end-Ordovician, late-Devonian, end-Permian, end-Triassic, end-Cretaceous). The current loss is termed the **Sixth Extinction**. What makes it different is the *rate*:

Current extinction rate  $\approx 100$  to  $1000 \times$  pre-human background rate.

If trends continue, **nearly half of all species on Earth could be wiped out within the next 100 years**.

### 4.2 Consequences of Biodiversity Loss

Losing diversity in a region typically leads to:

1. Decline in plant productivity.
2. Lowered resistance to environmental perturbations such as drought.
3. Increased variability in ecosystem processes — plant productivity, water use,

pest cycles, disease cycles.

### 4.3 Causes of Biodiversity Loss — “The Evil Quartet”

Paul Ehrlich grouped the principal drivers of modern extinction into four causes. NCERT calls this set “The Evil Quartet” and it is the single most asked sub-topic of this chapter.

#### The Evil Quartet — the four horsemen of biodiversity loss

1. **Habitat loss and fragmentation** — the single most important cause.
2. **Over-exploitation** — human “need” turning into “greed”.
3. **Alien species invasions** — introduced exotics that turn invasive.
4. **Co-extinctions** — the obligate partner of an extinct species also dies out.

#### Remember the Evil Quartet — “HOAC”

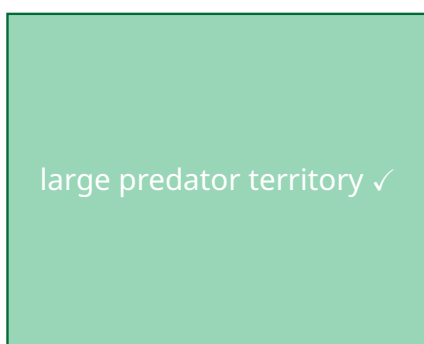
**H**abitat loss → **O**ver-exploitation → **A**lien invasion → **C**o-extinction. Or: “**H**umans **O**ften **A**ttack **C**reatures.” NCERT lists them in this order — habitat loss is the *biggest* driver, always.

#### (i) Habitat loss and fragmentation

The most dramatic example: tropical rainforests once covered more than **14 per cent** of Earth’s land surface; they now cover no more than **6 per cent**, and are still being cleared at  $\approx 1000$  hectares per chapter you read. The **Amazon rainforest** — called the “lungs of the planet” — is being cut for soya beans and cattle pasture.

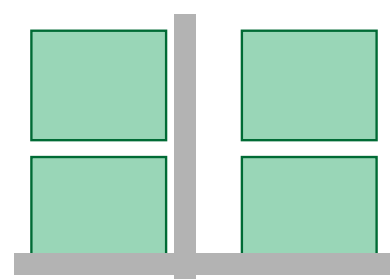
**Fragmentation**, the breaking up of large continuous habitats into small patches, is just as serious as outright loss. Animals that need large territories (large mammals, top predators) and migratory species cannot survive in small fragments, and their populations collapse.

#### Before — continuous habitat



fragmentation  
→

#### After — fragmented patches



large predators eliminated

### (ii) Over-exploitation

When need turns into greed, species collapse. Extinctions in the last 500 years driven mostly by overexploitation: **Steller's sea cow**, the **passenger pigeon**. Today, many marine fish populations (cod, tuna, sharks) are overharvested and commercial species are sliding toward economic extinction.

### (iii) Alien-species invasions

When alien species — introduced deliberately or accidentally — turn invasive, they outcompete or prey on native species. Canonical NCERT examples:

- The **Nile perch** introduced into **Lake Victoria** (East Africa) drove more than **200 species of cichlid fish** to extinction.
- Invasive weeds in India: **Parthenium** (carrot grass), **Lantana**, **Eichhornia** (water hyacinth — “Terror of Bengal”).
- Illegal introduction of the **African catfish** (*Clarias gariepinus*) for aquaculture now threatens our native catfishes.

### (iv) Co-extinctions

When a species disappears, the plant and animal species *obligately* associated with it disappear too:

- Host fish → its unique assemblage of parasites also goes extinct.
- Plant-pollinator mutualisms: extinction of one partner automatically extinguishes the other.

#### Common Mistake

Do not confuse *co-extinction* with simple competition. Co-extinction requires an **obligate** dependency — the lost partner has *no* alternative host or pollinator. The fig wasp-fig tree pairing is the textbook example of an obligate mutualism vulnerable to co-extinction.

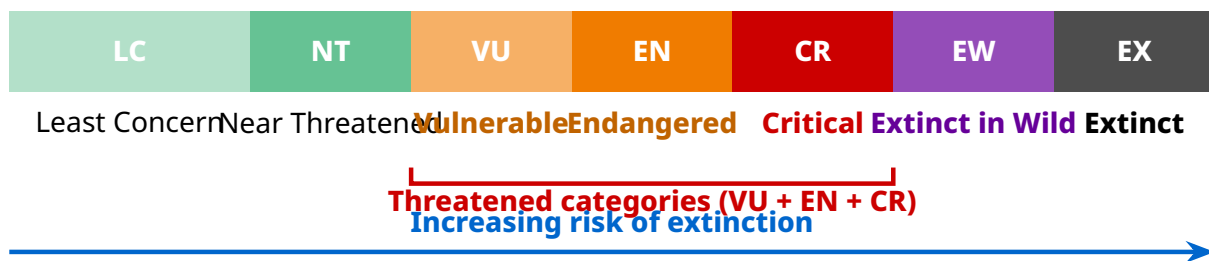
## 5 IUCN Red List Categories

The **International Union for Conservation of Nature (IUCN)** publishes the global authoritative inventory of conservation status — the **Red List**. NCERT itself does not list every category in detail, but the Red List is the universal language of conservation status and a high-frequency NEET topic.

### IUCN Red List — the nine categories, from healthiest to lost

1. **Not Evaluated (NE)** — not yet assessed.
2. **Data Deficient (DD)** — too little information for a status call.
3. **Least Concern (LC)** — widespread and abundant.
4. **Near Threatened (NT)** — close to qualifying as threatened in the near future.
5. **Vulnerable (VU)** — high risk of extinction in the wild.
6. **Endangered (EN)** — very high risk.
7. **Critically Endangered (CR)** — extremely high risk; on the brink.
8. **Extinct in the Wild (EW)** — survives only in cultivation or captivity.
9. **Extinct (EX)** — no surviving individuals.

The three categories **VU, EN and CR** are collectively called the *threatened* categories — when NCERT says “15,500 species are threatened with extinction”, it is summing these three.



#### Quick Tip

For NEET MCQs, the trick category is **Extinct in the Wild (EW)** — the species still exists *somewhere*, but only inside zoos, botanical gardens or laboratory cultures. EW is *not* the same as Extinct. **Pere David's deer** and **wild scimitar oryx** are classic EW examples.

Solve the NCERT Exercises □

## 6 Why Should We Conserve Biodiversity?

NCERT groups the reasons into three categories. You need a one-line definition and one example for each.

### The three arguments for conservation (NCERT)

1. **Narrowly utilitarian** — direct economic gain.
2. **Broadly utilitarian** — indirect “ecosystem services”.
3. **Ethical** — intrinsic value, moral duty.

## 6.1 Narrowly Utilitarian Reasons

Humans extract countless direct economic benefits from biodiversity:

- **Food** — cereals, pulses, fruits.
- **Fuel & fibre** — firewood, cotton, jute.
- **Construction material** — timber, bamboo.
- **Industrial products** — tannins, lubricants, dyes, resins, perfumes.
- **Medicinal products** — *more than 25 per cent* of drugs in the world market are derived from plants; **25,000 plant species** contribute to traditional medicines used by native peoples.

**Bioprospecting** — exploring genetic, molecular and species-level diversity for products of economic importance — is a fast-growing field. Biodiversity-rich nations stand to gain enormously.

## 6.2 Broadly Utilitarian Reasons — Ecosystem Services

The fast-dwindling Amazon forest alone is estimated to produce **20 per cent of the total oxygen** in Earth’s atmosphere through photosynthesis. Try paying a hospital oxygen cylinder bill for that volume and you grasp the scale.

### Examples of ecosystem services (broadly utilitarian)

- **Oxygen production** —  $\approx 20\%$  of atmospheric  $O_2$  from the Amazon alone.
- **Pollination** — bees, bumblebees, birds, bats; without them, no fruits or seeds.
- **Climate moderation, flood and pest control, soil formation**, nutrient cycling.
- **Aesthetic and recreational pleasures** — walking through woods, bird-song, spring flowers; impossible to price tag.

## 6.3 Ethical Reasons

We share this planet with millions of plant, animal and microbial species. Every species has **intrinsic value**, regardless of whether it has any current or future economic use to us. We have a **moral duty** to care for their well-being and pass on our biological legacy in good order to future generations.

### Real-World Application

Quantifying ecosystem services — Robert Costanza's 1997 *Nature* paper estimated global ecosystem services at **\$33 trillion per year** (more than the entire global GDP at the time). Even if you take half that, it shows "unpriceable" nature has a price the moment we try to replace it ourselves.

## 7 How Do We Conserve Biodiversity?

NCERT recognises two complementary approaches.

### The two pillars of conservation

1. **In-situ** ("on site") conservation — protect the species in its *natural* habitat. We save the entire forest to save the tiger.
2. **Ex-situ** ("off site") conservation — when an animal or plant is so endangered that on-site protection is no longer enough, take the species out of the wild and into a protected setting.

### 7.1 In-situ Conservation

#### Biodiversity hotspots

Globally, the number of species needing rescue far exceeds the resources available. Conservationists therefore identify **biodiversity hotspots** — regions with very high species richness *and* a high degree of **endemism** (species confined to that region and found nowhere else).

#### Hotspot facts — memorise the numbers

- Originally **25** hotspots identified; **9 more** added; **34** hotspots in the world today.
- Hotspots cover less than **2 per cent** of Earth's land area but hold an exceptionally high fraction of all species.
- Strict protection of hotspots alone could reduce ongoing mass extinctions by **almost 30 per cent**.
- Three of the 34 hotspots cover India's biodiversity-rich regions: **Western Ghats and Sri Lanka, Indo-Burma, and Himalaya**.

#### Three Indian hotspots — "WIH"

**Western Ghats–Sri Lanka, Indo-Burma, Himalaya**. NCERT may ask "how many of the 34 global hotspots fall in India?" — the answer is **three**.

## Legally protected areas in India

### India's in-situ protected-area network

- **Biosphere reserves: 14**
- **National parks: 90**
- **Wildlife sanctuaries: 448**
- Plus thousands of **sacred groves** (next subsection)

### Quick Tip

#### Difference between the three protected-area types (NEET trick question).

- **Biosphere reserve** — protects multiple ecosystems plus tribal life. Has core, buffer and transition zones. Largest.
- **National park** — strictly protected; no human activity (grazing, forestry) allowed. Medium.
- **Wildlife sanctuary** — protects a particular species or community; limited human activity (cattle grazing, collection of minor forest produce) sometimes permitted. Smallest.

## Sacred groves

India has an ancient tradition of religious veneration of forests. Tracts of forest set aside, with every tree and animal within them given total protection, are called **sacred groves**. They are India's earliest — and arguably most successful — form of in-situ conservation. Found in:

- **Khasi and Jaintia Hills** (Meghalaya)
- **Aravalli Hills** (Rajasthan)
- Western Ghat regions of **Karnataka and Maharashtra**
- **Sarguja, Chanda and Bastar** areas (Madhya Pradesh / Chhattisgarh)

In Meghalaya, the sacred groves are the *last refuges* for many rare and threatened plant species.

## 7.2 Ex-situ Conservation

Used when on-site protection is insufficient — the species is already too rare, the habitat too damaged, or the threats too immediate to wait. The species is taken out of the wild and placed under *special care*.

**Ex-situ techniques — old and new**

- **Classical ex-situ:** zoological parks, botanical gardens, wildlife safari parks — house and breed threatened species.
- **Modern ex-situ (biotechnological):**
  - **Cryopreservation** of gametes — preserves viable, fertile sperm and eggs at  $-196^{\circ}\text{C}$  in liquid nitrogen for long periods.
  - **In-vitro fertilisation (IVF)** — eggs fertilised outside the body, then implanted in surrogate mothers.
  - **Tissue culture** — whole plants regenerated from tiny pieces of tissue; lets a single specimen yield thousands of clones.
  - **Seed banks** — seeds of different genetic strains of commercially important plants stored at low temperature for decades.

**Real-World Application**

The **Svalbard Global Seed Vault** in Norway — carved into a mountainside near the Arctic Circle — stores duplicates of seed samples from gene banks all over the world. It is the planet's insurance policy: should a regional gene bank be destroyed by war or natural disaster, Svalbard can resupply it. Indian rice and wheat varieties are deposited there too.

### 7.3 In-situ vs. Ex-situ — the comparison table

Feature	In-situ conservation	Ex-situ conservation
Meaning	On site — species protected in its natural habitat	Off site — species removed to a protected setting
What is protected	The entire ecosystem (whole community of species)	Selected threatened species, often one at a time
Cost	Generally cheaper (preserves what already exists)	Expensive (artificial habitat, husbandry)
Genetic diversity captured	High — natural evolution continues	Limited — only the breeding population in captivity
Examples	Biosphere reserves, national parks, wildlife sanctuaries, sacred groves, hotspots	Zoological parks, botanical gardens, seed banks, cryopreservation, IVF, tissue culture
Best for	Species whose habitat still survives	Species whose habitat is destroyed or whose population is critically small

#### Common Mistake

Don't confuse *biosphere reserves* (in-situ, multi-use, with core/buffer/transition zones) with *biodiversity hotspots* (a global priority-setting concept, not a protected-area designation). Hotspots are *candidates* for protection; biosphere reserves are *already protected* areas.

## 8 International Efforts — The Earth Summit and After

Biodiversity knows no political boundaries, so its conservation has to be a collective responsibility of all nations.

### The two landmark international events — dates you MUST memorise

- **The Earth Summit** — the *Convention on Biological Diversity (CBD)*, held in **Rio de Janeiro, Brazil** in **1992**. Called upon all nations to take appropriate measures for conservation of biodiversity and sustainable utilisation of its benefits.
- **The World Summit on Sustainable Development** — held in **Johannes-**

**burg, South Africa in 2002. 190 countries** pledged commitment to achieve — by **2010** — a significant reduction in the current rate of biodiversity loss at global, regional and local levels.

#### Dates and venues — “Rio-Jo”

**Rio 1992** (CBD/Earth Summit) → **Johannesburg 2002** (190 countries, 2010 target). Both venues start with a vowel + “o”; both years end in -2; ten years apart. Almost every NEET paper asks at least one date-or-venue question from this pair.

## 9 NEET / JEE Extensions Beyond NCERT

NCERT covers the core — but NEET regularly tests a handful of extensions that students must memorise separately.

### 9.1 Famous Endemic Species of India

- **Lion-tailed macaque** (*Macaca silenus*) — Western Ghats endemic.
- **Nilgiri tahr** (*Nilgiritragus hylocrius*) — Western Ghats endemic.
- **Asiatic lion** (*Panthera leo persica*) — restricted to Gir National Park, Gujarat.
- **One-horned rhinoceros** (*Rhinoceros unicornis*) — Kaziranga, Assam.
- **Bengal florican, Indian giant squirrel, purple frog** (*Nasikabatrachus sahyadrensis*) of the Western Ghats.

### 9.2 Famous Project-style Conservation Programmes

- **Project Tiger** (1973) — now covers more than 50 tiger reserves.
- **Project Elephant** (1992) — 31 elephant reserves across India.
- **Project Rhino** — Kaziranga + Manas in Assam.
- **Crocodile Conservation Project** — gharial revival.
- **Vulture Recovery Programme** — collapse triggered by veterinary diclofenac use; multiple Indian Gyps species near-extinct.

### 9.3 Acts and bodies

- **Indian Wildlife (Protection) Act, 1972** — legal basis for national parks and sanctuaries.
- **Forest (Conservation) Act, 1980.**
- **Biological Diversity Act, 2002** — India’s domestic implementation of the CBD.
- **National Biodiversity Authority (NBA)** — set up under the 2002 Act.

## 9.4 Alpha, Beta and Gamma diversity (Whittaker)

A favourite NEET extension. **R. H. Whittaker (1972)** described three measures:

- **Alpha ( $\alpha$ ) diversity** — diversity *within* a single community or habitat (= species diversity).
- **Beta ( $\beta$ ) diversity** — diversity *between* communities along an environmental gradient (= turnover).
- **Gamma ( $\gamma$ ) diversity** — total diversity of a *landscape*, summing  $\alpha$  and  $\beta$ .

### Quick Tip

The Greek-letter mnemonic: **A**lpha = **a**t one place; **B**eta = **b**etween places; **G**amma = **g**rand total. Whittaker's framework is not in NCERT but is a common NEET extension MCQ — learn it.

## 9.5 Useful India numbers (latest IUCN/MoEFCC counts)

- Mega-diversity countries in the world: **12**. India is one of them.
- India's share of world land area:  $\sim 2.4\%$ . India's share of world species:  $\sim 8.1\%$ .
- Of the 15,500 globally threatened species, more than **650 occur in India**.

## 10 Quick Reference Summary

A one-page revision sheet for the night before the exam.

### 10.1 Key formulas and equations

#### The only equation in the chapter

$$S = C A^Z \quad \iff \quad \log S = \log C + Z \log A$$

$Z = 0.1-0.2$  for small areas within a region;  $Z = 0.6-1.2$  for large continental areas;  $Z = 1.15$  for frugivorous tropical birds and mammals.

## 10.2 Numbers and dates

Fact	Number / Date
Levels of biodiversity	3 (genetic, species, ecological)
Species described globally (IUCN, 2004)	> 1.5 million
Robert May's estimate of total species	~ 7 million
Per cent of species described so far	~ 22 %
Animals as fraction of all species	> 70 %
Plants as fraction of all species	~ 22 %
Insects as fraction of all animals	> 70 %
India's land area / species share	2.4 % / 8.1 %
Mega-diversity countries	12
Plant species recorded from India	~ 45,000
Animal species recorded from India	~ 90,000
Latitudinal tropics range	23.5°S to 23.5°N
Bird species: Colombia / India / NY / Greenland	1,400 / 1,200 / 105 / 56
Mass extinctions in fossil record	5 (we are in the 6th now)
Current extinction rate vs. pre-human	100–1000 × faster
Species extinct in last 500 years (IUCN 2004)	784
Species threatened with extinction	> 15,500
% threatened: birds / mammals / amphibians / gymnosperms	12 / 23 / 32 / 31
Tropical rainforest cover then / now	14 % → 6 % of land
Biodiversity hotspots in the world	34 (originally 25 + 9 added)
Indian hotspots	3 (Western Ghats–Sri Lanka, Indo-Burma, Himalaya)
Biosphere reserves in India	14
National parks in India	90
Wildlife sanctuaries in India	448
Earth Summit (CBD), Rio	1992
World Summit, Johannesburg	2002, 190 countries

## 10.3 Names to remember

- **Edward O. Wilson** — popularised the term *biodiversity*.
- **Alexander von Humboldt** — discovered the species–area relationship.

- **Robert May** — 7-million global species estimate.
- **David Tilman** — field-plot evidence that diversity stabilises biomass and raises productivity.
- **Paul Ehrlich** — rivet-popper hypothesis and the “Evil Quartet”.
- **R. H. Whittaker** — alpha, beta, gamma diversity (extension).

## 10.4 Lists you must reproduce verbatim

### The Evil Quartet — four causes of extinction

1. Habitat loss and fragmentation
2. Over-exploitation
3. Alien species invasion
4. Co-extinction

### Three reasons to conserve biodiversity

1. Narrowly utilitarian (direct economic)
2. Broadly utilitarian (ecosystem services)
3. Ethical (intrinsic value)

### Three hypotheses for tropical richness

1. Evolutionary time (no glaciations)
2. Constant, predictable environment → niche specialisation
3. More solar energy → greater productivity

### Conservation strategies

1. **In-situ**: biosphere reserves, national parks, sanctuaries, sacred groves, hotspots.
2. **Ex-situ**: zoos, botanical gardens, seed banks, cryopreservation, IVF, tissue culture.

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