FREE NOTES · NCERT + NEET LEVEL

Biodiversity & Conservation

Levels of biodiversity, number of species on earth and in India, patterns (latitudinal gradients, species–area relationship), importance of species diversity, loss of biodiversity and its causes, and in situ and ex situ conservation.

01 Levels of biodiversity
02 How many species?
03 Patterns of biodiversity
04 Importance of species diversity
05 Loss of biodiversity
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01 Levels of biodiversity

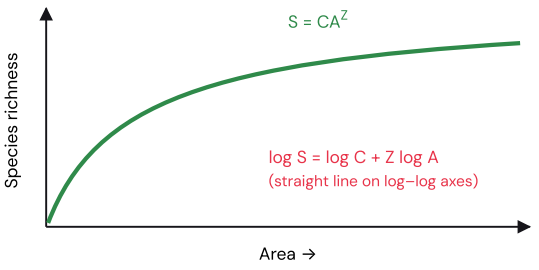
- Term popularised by **Edward Wilson**.
- **Genetic diversity**: within a species; e.g. *Rauwolfia vomitoria* (Himalayas) differs in potency of reserpine; India has 50,000+ strains of rice, 1000+ varieties of mango.
- **Species diversity**: e.g. Western Ghats have more amphibian species than Eastern Ghats.
- **Ecological diversity**: India (deserts, rain forests, mangroves, coral reefs, wetlands, estuaries, alpine meadows) has more than Scandinavia.

02 How many species?

- IUCN (2004): ~1.5 million species described. Robert May's global estimate: ~**7 million**.
- More than 70% of recorded species are animals; plants (including algae, fungi, bryophytes, gymnosperms, angiosperms) ≤ 22%. Among animals, insects are most species-rich (>70%: 7 out of 10 animals are insects). Fungi species more than all vertebrates combined.
- India: 2.4% of world land area but **8.1%** of global species diversity; one of 12 **mega diversity** countries; ~45,000 plant and twice as many animal species recorded. Estimated total ~1,00,000 plant and 3,00,000 animal species.

03 Patterns of biodiversity

- **Latitudinal gradient**: diversity decreases from equator to poles; tropics (23.5° N–23.5° S) richest. Colombia (near equator) ~1400 bird species; New York (41° N) 105; Greenland (71° N) 56. Amazon rain forest: 40,000+ plant species, 3000 fish, 1300 birds, 427 mammals, 427 amphibians, 378 reptiles, 1,25,000+ invertebrates.
- Why tropics richer: more evolutionary time (not glaciated), less seasonal, more constant and predictable environment, more solar energy ⇒ more productivity.
- **Species–area relationship** (Alexander von Humboldt): richness increases with area up to a limit. log S = log C + Z log A. Z (slope) 0.1–0.2 for most; 0.6–1.2 for very large areas (whole continents); frugivorous birds and mammals in tropical forests ~1.15.



Species–area relationship

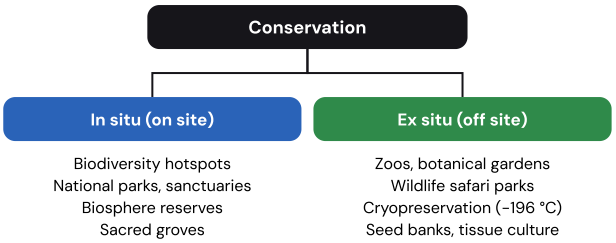
04 Importance of species diversity

- **David Tilman**: plots with more species showed less year-to-year variation in total biomass and higher productivity: diversity gives stability.
- **Rivet popper hypothesis** (Paul Ehrlich): ecosystem = aeroplane, species = rivets; losing a few may not matter, but losing key ones (on wings) is dangerous.
- Reasons to conserve: **narrowly utilitarian** (food, firewood, fibre, medicines; **bioprospecting**: >25% drugs from plants; 25,000 plant species used in traditional medicine), **broadly utilitarian** (ecosystem services: Amazon produces ~20% of earth's O_2 by photosynthesis; pollination; aesthetic pleasure), **ethical** (every species has intrinsic value; moral duty).

05 Loss of biodiversity

- IUCN Red List (2004): 784 extinctions in last 500 years (338 vertebrates, 359 invertebrates, 87 plants), e.g. dodo (Mauritius), quagga (Africa), thylacine (Australia), Steller's sea cow (Russia), Bali, Javan and Caspian tigers. 27 species lost in last 20 years. 12% birds, 23% mammals, 32% amphibians, 31% gymnosperms threatened. Current rates 100–1000 times faster than pre-human times; **sixth mass extinction** under way.
- Effects: decline in plant production, lower resilience, increased variability in productivity, altered ecosystem processes. **Co-extinctions**: host fish extinct ⇒ its unique parasites too.
- **Causes ("The Evil Quartet")**: (1) **habitat loss and fragmentation** (most important; tropical rain forests once 14% of land, now 6%; Amazon "lungs of the planet" cleared for soybeans, cattle); (2) **over-exploitation** (Steller's sea cow, passenger pigeon; marine fish overharvested); (3) **alien species invasions** (Nile perch in Lake Victoria killed 200+ cichlid species; *Parthenium*, *Lantana*, water hyacinth *Eichhornia*; African catfish *Clarias gariepinus* threatens native catfish); (4) **co-extinctions**.

06 Biodiversity conservation

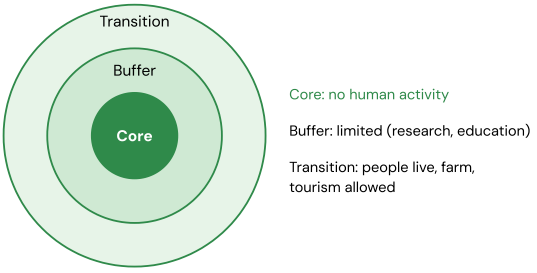


Ways of conservation

- **Biodiversity hotspots** (Norman Myers): high species richness, high endemism, threatened; 34 in world (cover <2% of land; could reduce extinctions by up to 30%). India has 3: **Western Ghats and Sri Lanka**, **Indo-Burma**, **Himalaya**.
- India: 14 biosphere reserves, 90 national parks, 448 wildlife sanctuaries (as per NCERT). **Sacred groves**: Khasi and Jaintia Hills (Meghalaya), Aravalli Hills (Rajasthan), Western Ghats (Karnataka, Maharashtra), Sarguja, Chanda, Bastar (Madhya Pradesh/Chhattisgarh).
- Ex situ: cryopreservation of gametes (viable, fertile for long), in vitro fertilisation, tissue culture, seed banks.
- International: **Earth Summit** (Rio de Janeiro, 1992; Convention on Biological Diversity); **World Summit on Sustainable Development** (Johannesburg, 2002): 190 countries pledged significant reduction of biodiversity loss by 2010.

07 Extra + tricks

- **Red Data Book / IUCN Red List**: records threatened species in categories: extinct, extinct in the wild, critically endangered, endangered, vulnerable, near threatened, least concern.
- **Endemism**: species found only in one region (many in Western Ghats).
- **Ramsar Convention** (1971): conservation of wetlands.
- Biosphere reserve zones: core, buffer, transition (figure).
- Trick for India's hotspots: **"W-I-H"** = Western Ghats–Sri Lanka, Indo-Burma, Himalaya.



Zones of a biosphere reserve

08 Important Q&A

Q1. What are the four causes of biodiversity loss (Evil Quartet)?

Habitat loss and fragmentation, over-exploitation, alien species invasions, co-extinctions.

Q2. Explain the rivet popper hypothesis.

Ehrlich compared an ecosystem to an aircraft and species to rivets; losing some rivets may be harmless but losing key ones (on wings) can cause the "flight" (ecosystem) to fail.

Q3. Why are tropics more biodiverse?

Long undisturbed evolutionary time, less seasonal and predictable environment, more solar energy and productivity.

09 Common mistakes

- Saying India has 4 hotspots (3: Western Ghats–Sri Lanka, Indo-Burma, Himalaya).
- Calling zoos in situ conservation (ex situ).
- Writing over-exploitation as the most important cause (habitat loss is).
- Mixing Tilman (stability) and Ehrlich (rivet popper).

10 Practice (NEET style)

1. Who popularised the term biodiversity?
2. India's share of global species diversity?
3. Alien fish that destroyed cichlids in Lake Victoria?
4. Value of Z for most areas?
5. Earth Summit year and place?

ANSWERS

1) Edward Wilson · 2) 8.1% · 3) Nile perch · 4) 0.1–0.2 · 5) 1992, Rio de Janeiro

11 Quick revision: 5 minutes before the exam

LEVELS

- Genetic, species, ecological
- Edward Wilson
- India 8.1%, mega diverse

PATTERNS

- Tropics richest
- $S = CA^Z$, Z 0.1–0.2
- Humboldt

LOSS

- Evil Quartet
- Nile perch, Parthenium
- Dodo, quagga, thylacine

CONSERVATION

- 3 hotspots in India
- In situ: parks, sacred groves
- Ex situ: zoos, cryopreservation

Have a doubt? Ask the AI Doubt Solver at padhaiadda.netlify.app, or take the mock test on this chapter.