FREE EDITION · NOTES + 3 SAMPLE MCQS

CUET · BIOLOGY · CLASS XII · CODE 304

Biodiversity and Conservation

CUET unit: Ecology and Environment → Biodiversity and Conservation

By **UniDrill** · NCERT-grounded study material

WWW.UNIDRILL.IN

UniDrill

📌 Snapshot

- Defines biodiversity (term popularised by Edward Wilson) and its three key levels — genetic, species and ecological diversity — with India-specific examples (50,000 rice strains, Western Ghats amphibians, varied ecosystems).
- Establishes the magnitude of global diversity (~1.5 million described; Robert May's conservative estimate ~7 million), India's share (2.4% land area but 8.1% of species), and patterns (latitudinal gradient, species–area relationship S = CA^Z).
- Explains the four causes of biodiversity loss ("The Evil Quartet": habitat loss, over-exploitation, alien species invasions, co-extinctions) and the current "Sixth Extinction" rate (100–1000× pre-human).
- Covers conservation strategies: in-situ (biosphere reserves, national parks, sanctuaries, sacred groves, biodiversity hotspots) and ex-situ (zoos, botanical gardens, seed banks, cryopreservation, in-vitro fertilisation, tissue culture).
- A favourite CUET source for numerical species-area calculations (Z values), IUCN/Earth Summit facts, and India's protected-area counts.

📖 Detailed Notes

2.1 Core concepts

- **Biodiversity** is the term popularised by sociobiologist **Edward Wilson** to describe combined diversity at all levels of biological organisation — from macromolecules within cells to biomes — and the biosphere shows immense diversity (heterogeneity) at every level, not just the species level (NCERT §13.1, p. 216–217).
- There are **three key levels of biodiversity**: (i) **Genetic diversity** — variation within a species over its distributional range; e.g., Rauwolfia vomitoria in different Himalayan ranges shows differing potency and concentration of the active chemical (reserpine); India has more than **50,000 genetically different strains of rice** and **1,000 varieties of mango** (NCERT §13.1, p. 217).
- (ii) **Species diversity** — diversity at the species level; e.g., the **Western Ghats have a greater amphibian species diversity than the Eastern Ghats** (NCERT §13.1, p. 217).
- (iii) **Ecological / ecosystem diversity** — diversity at the ecosystem level; India, with deserts, rain forests, mangroves, coral reefs, wetlands, estuaries and alpine

meadows, has greater ecosystem diversity than a Scandinavian country like Norway (NCERT §13.1, p. 217). It has taken millions of years of evolution to accumulate this wealth, but the present rate of species losses could erase it in less than two centuries (NCERT §13.1, p. 217).

- **How many species exist?** According to IUCN (2004), slightly more than **1.5 million** plant and animal species have been described so far; how many are yet to be discovered is unclear. Robert May's scientifically sound conservative estimate puts global species diversity at about **7 million**; extreme estimates range from 20 to 50 million (NCERT §13.1.1, p. 217).
- **Taxonomic share** of described species: more than **70 per cent are animals**; plants (algae, fungi, bryophytes, gymnosperms, angiosperms) make up **⩽22 per cent**. Among animals, insects are the most species-rich group (more than **70 per cent of the total animals**) — out of every 10 animals on the planet, 7 are insects. The number of fungi species is more than the combined total of fishes, amphibians, reptiles and mammals (NCERT §13.1.1, p. 218, Figure 13.1).
- **Prokaryotes** are excluded from these counts because conventional taxonomy fails (many are unculturable). On molecular criteria, prokaryote diversity alone might run into millions (NCERT §13.1.1, p. 218).
- **India's share:** India has only **2.4 per cent of the world's land area** but **8.1 per cent of the global species diversity** — making it one of the **12 mega-diversity countries**. Nearly **45,000 species of plants** and twice as many animals have been recorded; applying May's 22% recovery proportion, India probably has >1,00,000 more plant species and >3,00,000 more animal species awaiting discovery (NCERT §13.1.1, p. 219).
- **Latitudinal gradient** — species diversity decreases as we move from the equator to the poles. Tropics (between 23.5°N and 23.5°S) harbour more species than temperate or polar areas. Colombia near the equator has nearly 1,400 bird species, New York (41°N) has 105, and Greenland (71°N) only 56; India has more than 1,200. A tropical forest in Ecuador has up to 10× more vascular plant species than a temperate forest of equal area in the Midwest USA. The **Amazon rain forest** holds the greatest biodiversity — >40,000 plants, 3,000 fishes, 1,300 birds, 427 mammals, 427 amphibians, 378 reptiles and >1,25,000 invertebrates — with possibly two million insect species yet to be described (NCERT §13.1.2 (i), p. 219).
- **Three hypotheses** for greater tropical richness: (a) **Speciation is a function of time** — unlike temperate regions subjected to frequent glaciations, tropical latitudes have remained relatively undisturbed for millions of years and had a long evolutionary time for diversification; (b) tropical environments, unlike temperate ones, are **less seasonal, relatively more constant and predictable**, which promotes niche specialisation; (c) more **solar energy** is available in the tropics, which contributes to higher productivity and indirectly to greater diversity (NCERT §13.1.2 (i), pp. 219–220).

- **Species–Area relationship** (Alexander von Humboldt) — within a region, species richness increases with explored area but only up to a limit; the relationship is a rectangular hyperbola described by **S = CA^Z**, which on a log–log scale becomes **log S = log C + Z log A**, where S = species richness, A = area, Z = slope of the line (regression coefficient) and C = Y-intercept. **Z values lie between 0.1 and 0.2** regardless of taxon (plants in Britain, birds in California, molluscs in New York). Across very large areas like entire continents the slopes are much **steeper, Z = 0.6 to 1.2**; for **frugivorous birds and mammals in the tropical forests of different continents Z = 1.15** (NCERT §13.1.2 (ii), p. 220, Figure 13.2).
- **Importance of species diversity to ecosystems** — communities with more species generally tend to be more stable than those with fewer species. A stable community shows little year-to-year variation in productivity, is resistant/resilient to disturbances (natural or human-made) and resists invasions by alien species. **David Tilman's long-term outdoor-plot experiments** showed that plots with more species had less year-to-year biomass variation, and that increased diversity contributed to higher productivity (NCERT §13.1.3, p. 220–221).
- The **rivet popper hypothesis** of Paul Ehrlich uses an analogy — an airplane (ecosystem) is held together by thousands of rivets (species); losing a few may not affect flight safety initially, but progressive loss weakens the plane, and the loss of rivets on the wings (key species driving major ecosystem functions) is far more serious than loss on the seats or windows (NCERT §13.1.3, p. 221).
- **Loss of biodiversity** — the IUCN Red List (2004) documents the extinction of **784 species** (338 vertebrates, 359 invertebrates, 87 plants) in the last 500 years; recent examples are the **dodo (Mauritius), quagga (Africa), thylacine (Australia), Steller's Sea Cow (Russia)** and three subspecies (Bali, Javan, Caspian) of tiger; the last 20 years alone saw 27 species disappear (NCERT §13.1.4, p. 221).
- More than **15,500 species** are currently threatened with extinction — **12% of all bird species, 23% of mammals, 32% of amphibians and 31% of gymnosperms** (NCERT §13.1.4, p. 222).
- Earth has seen **five mass extinctions** over >3 billion years; the present "**Sixth Extinction**" differs in **rate** — currently **100 to 1,000 times faster than pre-human rates** and human-driven. Ecologists warn that nearly half of all species on Earth could be wiped out within the next 100 years (NCERT §13.1.4, p. 222).
- **Causes — The Evil Quartet:** (i) **Habitat loss and fragmentation** — the most important cause; tropical rain forests have shrunk from 14% to 6% of land surface; the Amazon (the "lungs of the planet") is being cleared for soya cultivation and cattle ranching; large habitats broken into small fragments badly hurt mammals and migratory birds; (ii) **Over-exploitation** — Steller's sea cow and passenger pigeon were exterminated this way; many commercially important marine fish populations are presently over-harvested; (iii) **Alien species invasions** — the **Nile perch** introduced into Lake Victoria led to extinction of >200 cichlid fish species; **Parthenium** (carrot grass), **Lantana** and water hyacinth (Eichhornia) damage native

plants; illegal introduction of African catfish Clarias gariepinus threatens indigenous catfish; (iv) **Co-extinctions** — when a host fish becomes extinct so does its assemblage of parasites; coevolved plant–pollinator mutualisms collapse together (NCERT §13.1.4, p. 222–223).

- **Why conserve — three arguments:** (a) **Narrowly utilitarian** — direct economic benefits: food (cereals, pulses, fruits), firewood, fibre, construction material, industrial products (tannins, lubricants, dyes, resins, perfumes) and medicines (more than **25% of drugs** currently sold are derived from plants; **25,000 plant species** contribute to traditional medicines); bioprospecting promises further gains. (b) **Broadly utilitarian** — biodiversity drives ecosystem services: the Amazon produces **20% of the Earth's total atmospheric oxygen**; pollination by bees, bumblebees, birds and bats is irreplaceable; aesthetic and intangible benefits exist too. (c) **Ethical** — every species has intrinsic value; we owe a moral duty to pass on our biological legacy to future generations (NCERT §13.2.1, p. 223–224).
- **In-situ conservation** protects the whole ecosystem (you save the entire forest to save the tiger); globally, **biodiversity hotspots** — regions of very high species richness and very high **endemism** (species confined to that region) — were identified for maximum protection. Initially 25 were named; now there are **34 hotspots** worldwide. Three of these — **Western Ghats and Sri Lanka**, **Indo-Burma**, and **Himalaya** — cover India's exceptionally rich regions. Although hotspots together cover **<2% of land**, strict protection of them could reduce ongoing mass extinctions by about **30%** (NCERT §13.2.2, p. 224).
- India has **14 biosphere reserves, 90 national parks and 448 wildlife sanctuaries** as legally protected areas. Many cultural and religious traditions also protect nature — **sacred groves** in Khasi and Jaintia Hills of Meghalaya, Aravalli Hills of Rajasthan, Western Ghat regions of Karnataka and Maharashtra, and Sarguja, Chanda and Bastar areas of Madhya Pradesh; Meghalaya sacred groves remain the last refuge for many rare and threatened plants (NCERT §13.2.2, p. 225).
- **Ex-situ conservation** takes threatened animals and plants out of their natural habitat into special settings — **zoological parks, botanical gardens, wildlife safari parks**; recent advances include **cryopreservation** of gametes in viable/ fertile condition, **in-vitro fertilisation** of eggs, **tissue culture propagation** of plants, and **seed banks** for genetic strains of commercially important plants (NCERT §13.2.2, p. 225).
- **International cooperation:** The historic **Convention on Biological Diversity ("The Earth Summit")** was held in **Rio de Janeiro, 1992**; in follow-up, the **World Summit on Sustainable Development** at **Johannesburg, 2002**, saw **190 countries** pledge to achieve by 2010 a significant reduction in the current rate of biodiversity loss at global, regional and local levels (NCERT §13.2.2, p. 225).

2.2 Definitions to memorise

Term	Definition	Page
Biodiversity	Combined diversity at all levels of biological organisation; term popularised by Edward Wilson	216–217
Genetic diversity	Diversity at the genetic level shown by a single species over its distributional range	217
Species diversity	Diversity at the species level (e.g. Western Ghats vs Eastern Ghats amphibians)	217
Ecological diversity	Diversity at the ecosystem level	217
Mega-diversity country	One of 12 countries holding a disproportionately large share of global species; India is one	219
Latitudinal gradient	General decline in species diversity from equator (tropics, 23.5°N–23.5°S) to poles	219
Species–Area relationship	log S = log C + Z log A; rectangular hyperbola on linear scale, straight line on log scale	220
Z (slope/regression coefficient)	0.1–0.2 within a region; 0.6–1.2 across continents (1.15 for frugivorous birds/mammals)	220
Endemism	Species confined to a particular region and not found anywhere else	224
Biodiversity hotspot	Region of very high species richness and high endemism; 34 globally	224
Evil Quartet	Four causes of biodiversity loss: habitat loss, over-exploitation, alien invasions, co-extinctions	222
Rivet popper hypothesis	Ehrlich's analogy — ecosystem = airplane, species = rivets	221
In-situ conservation	Conservation of species in their natural habitat (on-site)	224
Ex-situ conservation	Conservation of threatened species outside their natural habitat (off-site)	225
Sacred groves	Tracts of forest set aside and venerated; refuges for rare/threatened plants	225
Cryopreservation	Preservation of gametes of threatened species in viable, fertile condition for long periods	225
Bioprospecting	Exploring molecular, genetic and species diversity for products of economic importance	223
Sixth Extinction	Current human-driven extinction event proceeding 100–1000× faster than pre-human rates	222
Ecosystem services		223

Term	Definition	Page
	Indirect benefits from biodiversity — pollination, climate moderation, flood control, oxygen	
Co-extinction	Extinction of associated species when one extinct (e.g., host–parasite, plant–pollinator)	223
Earth Summit (1992)	Convention on Biological Diversity at Rio de Janeiro	225
World Summit on Sustainable Development (2002)	Johannesburg meeting where 190 countries pledged to cut biodiversity loss by 2010	225

2.3 Diagrams / processes to remember

- **Figure 13.1 (p. 218)** — Pie charts of global biodiversity: **Invertebrates** (insects dominate, then molluscs, crustaceans, other animal groups), **Vertebrates** (fishes largest, then birds, reptiles, amphibians, mammals), **Plants** (angiosperms largest, then fungi, algae, mosses, ferns & allies, lichens). Memorise that insects are >70% of animals and fungi outnumber the combined total of fishes, amphibians, reptiles and mammals.
- **Figure 13.2 (p. 220)** — Species–Area curve: rectangular hyperbola on linear axes (S = CA^Z); straight line on log–log axes (log S = log C + Z log A). Remember Z range: 0.1–0.2 (small/within-region) vs 0.6–1.2 (continental); 1.15 for frugivorous birds and mammals.
- **Rivet popper analogy (p. 221)** — visualise airplane parts as species; wing rivets = key species; losing a few seat rivets may be tolerated, but losing wing rivets is catastrophic.
- **Process flow — Evil Quartet (p. 222–223):** habitat loss → over-exploitation → alien species invasions → co-extinctions.
- **Process flow — conservation tiers (p. 224–225):** In-situ (hotspots → biosphere reserves → national parks → wildlife sanctuaries → sacred groves) and Ex-situ (zoos → botanical gardens → seed banks → cryopreservation → in-vitro fertilisation → tissue culture).

2.4 Common confusions / NTA trap points

- **Edward Wilson** popularised the term "biodiversity" — NOT Humboldt (who studied species–area) and NOT Robert May (who estimated global species number).
- **Z value confusion**: 0.1–0.2 is for small areas/within a region; 0.6–1.2 is for very large areas/continents. Specifically 1.15 for frugivorous birds & mammals across tropical forests.
- **Threatened percentages** (memorise exact numbers): 12% birds, 23% mammals, 32% amphibians, 31% gymnosperms.
- **India's protected-area counts**: 14 biosphere reserves, 90 national parks, 448 wildlife sanctuaries — easy to confuse the three figures.

- **Hotspots**: initially 25, now 34. Three Indian hotspots — Western Ghats & Sri Lanka, Indo-Burma, Himalaya (NOT "Eastern Ghats" or "Sundarbans" as standalone hotspots).
- **Earth Summit** = Rio de Janeiro 1992 (Convention on Biological Diversity); Johannesburg 2002 is the **World Summit on Sustainable Development** — students mix these up.
- **Robert May's estimate is 7 million** (conservative). Extreme estimates 20–50 million. Described species ~1.5 million.
- **Amazon produces ~20% of Earth's atmospheric oxygen** — not 100%, and not "all" oxygen.
- **IUCN Red List 2004 extinction figure = 784** (338 vertebrates + 359 invertebrates + 87 plants); 15,500 is the **currently threatened** count, NOT extinct count.

2.5 Numbers and classifications grounded in NCERT

Category / item	NCERT-cited figure	Page
Species described globally (IUCN 2004)	Slightly >1.5 million	217
Robert May's conservative global estimate	~7 million	217
Extreme global estimates	20–50 million	217
Animal share of described species	>70%	218
Plant share of described species	⩽22%	218
Insect share of animal species	>70%	218
India's land area share	2.4%	219
India's species diversity share	8.1%	219
India's plant species recorded	~45,000	219
Bird species — Colombia / New York / Greenland	1,400 / 105 / 56	219
Amazon plant / fish / bird / mammal counts	40,000 / 3,000 / 1,300 / 427	219
Z value within a region	0.1–0.2	220
Z value across continents	0.6–1.2	220
Z for frugivorous birds/mammals in tropical forests	1.15	220
IUCN Red List extinctions (last 500 yrs)	784 species (338 vert + 359 invert + 87 plants)	221
Species disappeared in last 20 yrs	27	221
Currently threatened species	>15,500	222
	12% / 23% / 32% / 31%	222

Category / item	NCERT-cited figure	Page
Threatened share — birds / mammals / amphibians / gymnosperms		
Current extinction rate vs pre-human	100–1,000× faster	222
Drugs derived from plants	>25%	223
Plants used in traditional medicine	25,000 species	223
Amazon's share of atmospheric oxygen	20%	223
Global biodiversity hotspots	34 (originally 25)	224
Hotspots' share of Earth's land	<2%	224
Indian biosphere reserves	14	225
Indian national parks	90	225
Indian wildlife sanctuaries	448	225
Countries that pledged at Johannesburg 2002	190	225

🎯 Practice MCQs

Q1. Who popularised the term "biodiversity" to describe combined diversity at all levels of biological organisation?

- **A.** Robert May
- **B.** Alexander von Humboldt
- **C.** Edward Wilson
- **D.** Paul Ehrlich

Q2. According to Robert May's conservative estimate, the global species diversity is approximately:

- **A.** 1.5 million
- **B.** 7 million
- **C.** 20 million
- **D.** 50 million

Q3. India occupies only 2.4 per cent of the world's land area, but its share of the global species diversity is:

A. 2.4%

B. 5.1%

C. 8.1%

D. 12.4%

🔒 **11 more MCQs + answer key**
Get UniDrill Pro · ₹199/year · unidrill.in/pricing

📊 PYQ Alignment

This chapter is a heavy-weight unit in CUET Biology — typically yielding 10–12 MCQs per year across 2023–2025 papers. Common question types include direct-recall of IUCN Red List numbers, India's protected-area counts, components of the "Evil Quartet", levels of biodiversity with examples, calculation-based items on the species–area relationship (using Z values), and identification of in-situ vs ex-situ methods (especially cryopreservation, sacred groves, and biodiversity hotspots).

CUET 2025 — Actual PYQs from this chapter

Q.32 (CUET 2025) Wildlife safari parks are example of:

- A) Ex-situ conservation
- B) In-situ conservation
- C) Biodiversity hotspots
- D) Sacred groves

Tests: aligns with §2 (biodiversity & conservation) Answer: Not in extracted key — verify against official NTA key

Q.41 (CUET 2025) Which of the following is not included in in-situ conservation?

- A) Zoological park
- B) National park
- C) Wildlife sanctuary
- D) Biosphere reserves

Tests: aligns with §2 (biodiversity & conservation) Answer: Not in extracted key — verify against official NTA key

Q.43 (CUET 2025) Which of the following might not account for the greater biological diversity in the tropics?

- A) Frequent glaciations in the past
- B) More solar energy available
- C) Less seasonal and more constant climate
- D) Undisturbed for millions of years

Tests: aligns with §2 (biodiversity & conservation) Answer: Not in extracted key — verify against official NTA key

Q.45 (CUET 2025) Which of the following hotspots does not cover India's biodiversity region?

- A) Western Ghats–Sri Lanka
- B) Amazon forests
- C) Indo-Burma
- D) Himalaya

Tests: aligns with §2 (biodiversity & conservation) Answer: Not in extracted key — verify against official NTA key

CUET 2024 — Actual PYQs from this chapter

Q.39 (CUET 2024) Which is not a gaseous pollutant?

- A) SO_2
- B) CO_2
- C) NO_2
- D) Fly ash

Tests: aligns with §2 (biodiversity & conservation) Answer: Not in extracted key — verify against official NTA key

Q.40 (CUET 2024) In eutrophication of water bodies, main nutrient responsible is:

- A) Nitrogen
- B) Phosphorus
- C) Calcium
- D) Sodium

Tests: aligns with §2 (biodiversity & conservation) Answer: Not in extracted key — verify against official NTA key

Q.41 (CUET 2024) Which biome shows highest biodiversity?

- A) Tundra
- B) Taiga
- C) Tropical rainforest
- D) Desert

Tests: aligns with §2 (biodiversity & conservation) Answer: Not in extracted key — verify against official NTA key

Q.44 (CUET 2024) The ozone hole forms mainly due to:

- A) CO_2
- B) Methane
- C) CFCs
- D) SO_2

Tests: aligns with §2 (biodiversity & conservation) Answer: Not in extracted key — verify against official NTA key

Q.45 (CUET 2024) Greenhouse gases include:

- A) CO_2
- B) CH_4
- C) N_2O
- D) All of these

Tests: aligns with §2 (biodiversity & conservation) Answer: Not in extracted key — verify against official NTA key

Q.46 (CUET 2024) Chipko movement is related to:

- A) Wildlife protection
- B) Forest conservation
- C) River conservation
- D) Soil conservation

Tests: aligns with §2 (biodiversity & conservation) Answer: Not in extracted key — verify against official NTA key

Q.47 (CUET 2024) Red Data Book contains information about:

- A) Endangered species
- B) Extinct species
- C) Both endangered and extinct species
- D) Medicinal plants

Tests: aligns with §2 (biodiversity & conservation) Answer: Not in extracted key — verify against official NTA key

Q.48 (CUET 2024) National park differs from sanctuary because:

- A) Grazing allowed
- B) Human activities strictly prohibited
- C) Hunting allowed
- D) Timber extraction allowed

Tests: aligns with §2 (biodiversity & conservation) Answer: Not in extracted key — verify against official NTA key

Q.49 (CUET 2024) Which of the following is ex-situ conservation?

- A) National park
- B) Wildlife sanctuary
- C) Botanical garden
- D) Biosphere reserve

Tests: aligns with §2 (biodiversity & conservation) Answer: Not in extracted key — verify against official NTA key

Q.50 (CUET 2024) Biodiversity conservation strategy includes:

- A) In-situ conservation
- B) Ex-situ conservation
- C) Both
- D) None

Tests: aligns with §2 (biodiversity & conservation) Answer: Not in extracted key — verify against official NTA key

CUET 2023 — Actual PYQs from this chapter

Q.37 (CUET 2023) The historic convention on Biological Diversity held in Rio de Janeiro in 1992 is called:

- A) World Summit
- B) MAB Programme
- C) Earth Summit
- D) G-16 Summit

Tests: aligns with §2 (biodiversity & conservation) Answer: Not in extracted key — verify against official NTA key

Q.38 (CUET 2023) Which area is one of India's biodiversity hotspots?

- A) Eastern Ghats
- B) Indo-Burma Plains
- C) Aravali Hills
- D) Indo-Gangetic Plains

Tests: aligns with §2 (biodiversity & conservation) Answer: Not in extracted key — verify against official NTA key

Q.39 (CUET 2023) Dobson Units (DU) are used to measure:

- A) Biodiversity index
- B) Thickness of ozone layer
- C) Sustainability index

- D) Canopy thickness

Tests: aligns with §2 (biodiversity & conservation) Answer: Not in extracted key — verify against official NTA key

Q.40 (CUET 2023) Which of the following is NOT a category of waste generated in hospitals?

- A) Radioactive waste
- B) Biodegradable waste
- C) Plastic waste
- D) Non-biodegradable waste

Tests: aligns with §2 (waste management & solid waste categories — environmental issues) Answer: Not in extracted key — verify against official NTA key