



# NCERT Exemplar Solutions

Solved NCERT Exemplar Problems for Class 12th Biology, Chapter 13

## Chapter 13: Biodiversity and Conservation

### About this Chapter

Chapter 13 of NCERT Class 12 Biology surveys the full living tapestry of Earth, from **genetic** and **species** variation up to whole-ecosystem patterns. The exemplar problems test why the tropics are richer than the poles, how the **species–area relationship** ( $S = CA^Z$ ) actually behaves at different scales, the four drivers of biodiversity loss, India's role as a megadiverse country with three of the world's biodiversity hot spots, and the difference between *in situ* and *ex situ* conservation. Syllabus 2026-27.

**Topics covered:** Levels of biodiversity • Latitudinal gradients • Species–area relationship • Rivet popper hypothesis • Drivers of loss • Hot spots • *In situ* & *ex situ* • Red Data Book • Ecosystem services

#### Quick Formula Sheet

**Species–area relation:**

$$S = CA^Z, \log S = \log C + Z \log A$$

**Slope ranges:**

Small areas:  $Z = 0.1-0.2$

Very large areas:  $Z = 0.6-1.2$

**IUCN global tally (2004):**

~ 15,500 species threatened with extinction

**Hot spots:**

34 worldwide; cover < 2% of land yet hold large fractions of endemic species; 3 lie in India (Western Ghats–Sri Lanka, Himalaya, Indo-Burma)

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

### NCERT Exemplar Problems

#### Multiple-Choice Questions

- Q 13.1** Which of the following countries has the highest biodiversity?
- (a) South America
  - (b) South Africa
  - (c) Russia

**(d) India****SOLUTION**

**Correct option: (a) South America.**

**Concept used.** Biodiversity, the total variety of life at all levels (gene, species, ecosystem), is not spread evenly over the planet. It rises sharply as we move from the poles towards the equator, the **latitudinal gradient**. Tropical regions get more solar energy, stay warmer and wetter year round, and have been relatively undisturbed for millions of years, so more species could evolve and co-exist there.

**Step 1.** Among the four options, only South America lies almost entirely inside the tropics. The Amazon basin alone holds more than 40,000 plant species, ~ 1,300 bird species, ~ 3,000 fish species and uncounted insects.

**Step 2.** South Africa lies south of the tropics; Russia spans the boreal and tundra belts, both species-poor. India is megadiverse but a single country, hosting ~ 8.1% of recorded species on ~ 2.4% of the world's land area.

**Step 3.** Comparing the totals: the Amazon biome in South America is the single largest store of terrestrial biodiversity on Earth, far ahead of India's ~ 45,000 plant + ~ 91,000 animal species.

**Final Answer:** Option (a): South America.

**Exam Tip**

In CBSE board and NEET, this question type recurs almost every year. Memorise the key fact, the named example, and one one-line reason for why it is the answer. That triad is enough to score full marks even under time pressure.

**EXPERT'S SOLUTION** : *Pranav Sharma, Ph.D Molecular Biology, NCBS Bangalore*

**Quick reading.** Skim the four options for the only one that sits entirely inside the equatorial / tropical belt. South America does; the others do not.

**Step 1.** Russia: largely temperate-to-tundra, low species richness per unit area.

**Step 2.** South Africa: subtropical-to-temperate, narrower than the whole continent.

**Step 3.** India: megadiverse but small in area and contains arid Thar, Himalayas, plus tropical south.

**Step 4.** South America: tropical rainforest dominated, Amazon, Atlantic forest, Cerrado, Andes; together richer than any other continent on every biodiversity index.

**Why this matters.** The latitudinal gradient is the strongest biogeographic pattern in ecology; remembering "tropics = peak richness" answers a large fraction of biodiversity

MCQs.

**Why this matters.** The concept tested here recurs across CBSE board papers and NEET examination, framed as MCQ, VSA and even SA. Carrying the named example plus the one-sentence reason into the exam hall is sufficient to score every mark allocated, regardless of phrasing.

**Common variants.** Examiners often reword the stem (*not, except, which one*) or swap two of the distractors. The underlying fact does not change, so the same answer works.

**Final Answer:** Option (a).

**Q 13.2** Which of the following is not a cause for loss of biodiversity?

- (a) Destruction of habitat
- (b) Invasion by alien species
- (c) Keeping animals in zoological parks
- (d) Over-exploitation of natural resources

#### SOLUTION

**Correct option:** (c) Keeping animals in zoological parks.

**Concept used.** The four named drivers of biodiversity loss (the **Evil Quartet**) are: habitat loss and fragmentation, over-exploitation, alien-species invasion, and co-extinctions. Zoological parks (along with botanical gardens, seed banks and gene banks) are forms of *ex situ* conservation: they breed and shelter threatened species *outside* their natural habitat, which *prevents* extinction rather than causing it.

**Step 1.** Habitat destruction (a) is the largest single driver: clearing of tropical forests for cropland alone removes  $\sim 1\%$  of forest area each year.

**Step 2.** Alien invasions (b) such as the Nile perch in Lake Victoria wiped out  $> 200$  native cichlid fish; Lantana, water hyacinth and African catfish damage Indian ecosystems.

**Step 3.** Over-exploitation (d) drove Steller's sea cow, passenger pigeon, and many fishery stocks to extinction or collapse.

**Step 4.** Zoos (c) keep individuals safe, often re-introduce captive-bred animals (e.g. Asiatic lion at Gir, gharial in Indian rivers), and run gamete banks for future generations. They are a tool of conservation, not loss.

**Final Answer:** Option (c): Keeping animals in zoological parks is *ex situ* conservation, not a cause of biodiversity loss.

**Exam Tip**

NEET/CBSE often pair "Evil Quartet" with the four loss drivers. The mnemonic is **H O A C**: **H**abitat loss, **O**ver-exploitation, **A**lien invasion, **C**o-extinctions.

**EXPERT'S SOLUTION** : Sneha Iyer, M.Sc Botany, Delhi University

**Strategic angle.** Three of the four options are direct human pressures that *remove* species from the wild; the fourth (zoos) actively *rescues* them. Pick the odd one out.

**Step 1.** Tag each option as either a wild-population pressure or a conservation tool.

**Step 2.** (a), (b), (d) are all wild-population pressures listed in the NCERT Evil Quartet.

**Step 3.** (c) is a textbook example of *ex situ* conservation; the same chapter describes it as a remedy, not a cause.

**Why this matters.** Biodiversity terminology is rigorously defined in the NCERT chapter; mixing up the labels (endemic vs exotic, in situ vs ex situ, vulnerable vs endangered) costs marks even when the underlying biology is correct. Lock the definition before the example.

**Connecting back.** Each of these definitions ties to a specific conservation policy or treaty, so the term has real-world weight beyond the textbook page.

**Final Answer:** Option (c).

**Q 13.3** Which of the following is not an invasive alien species in the Indian context?

- (a) Lantana
- (b) Cynodon
- (c) Parthenium
- (d) Eichhornia

**SOLUTION**

**Correct option:** (b) Cynodon.

**Concept used.** An **invasive alien species** is one that is introduced (deliberately or accidentally) into an area outside its native range and goes on to spread aggressively, displacing native species. *Cynodon dactylon* (Bermuda grass, locally called *dub* or *durva*) is an Indian native grass, widely present in lawns and pastures across the subcontinent; it is not alien.

**Step 1.** Lantana (a, *Lantana camara*): native to Central and South America, introduced as an ornamental, now smothering forest understoreys in the Western Ghats.

**Step 2.** Parthenium (c, *Parthenium hysterophorus*, "carrot grass"): native to tropical

America, accidentally introduced with grain shipments in the 1950s, now widespread.

**Step 3.** Eichhornia (d, *Eichhornia crassipes*, water hyacinth, “terror of Bengal”): native to South America, choking water bodies.

**Step 4.** Cynodon (b): an indigenous grass; the only option among the four that is Indian in origin.

**Final Answer:** Option (b): Cynodon is an Indian native, not an invasive alien.

### ♥ Linking the concept

This fact connects directly to the wider chapter themes of *species loss*, the *Evil Quartet* and the *Sixth Extinction*. Memorising the link helps you place the answer inside the chapter’s larger argument.

**EXPERT’S SOLUTION** : Aanya Mehta, M.Sc Botany, Delhi University

**Picture-first.** Visualise each plant; the three aliens are all loud ecological invaders the chapter explicitly names. The fourth, Cynodon, is the quiet grass that you walk on every day.

**Step 1.** NCERT page on invasive aliens names exactly: Carrot grass (Parthenium), Lantana, Water hyacinth (Eichhornia), and African catfish.

**Step 2.** Cynodon does not appear on that list. It is the native lawn grass.

**Why this matters.** The same logic underlies several other Exemplar questions in this chapter: the latitudinal gradient, hot-spot location, and the tropical concentration of endemic species. Recognising the shared pattern across questions saves time and reinforces the answer.

**Verification.** If two distractors look equally plausible, return to the NCERT chapter glossary; the exact wording there decides the right option in every Exemplar MCQ.

**Final Answer:** Option (b).

**Q 13.4** Where among the following will you find pitcher plant?

- (a) Rain forest of North-East India
- (b) Sunderbans
- (c) Thar Desert
- (d) Western Ghats

**SOLUTION**

**Correct option:** (a) Rain forest of North-East India.

**Concept used.** A **pitcher plant** (genus *Nepenthes*) is an insectivorous angiosperm whose leaf tip is modified into a fluid-filled pitcher that traps insects, providing nitrogen on the very nutrient-poor (especially nitrogen-poor) soils where it grows. *Nepenthes khasiana* is the only Indian pitcher plant species and is endemic to the rain forests of Meghalaya in the North-East.

**Step 1.** Sunderbans (b) is a brackish-water mangrove ecosystem, salt-rich rather than nitrogen-deficient; *Nepenthes* cannot survive there.

**Step 2.** Thar Desert (c) is hyper-arid; pitcher plants need a perpetually moist habitat.

**Step 3.** Western Ghats (d) is a tropical rain-forest hot spot but does not host *Nepenthes*; that genus in India is restricted to Khasi and Jaintia hills of Meghalaya.

**Step 4.** North-East India (a) has the right combination: heavy monsoon rainfall, constant humidity, nutrient-leached lateritic soil. Hence *Nepenthes khasiana* is endemic here.

**Final Answer:** Option (a): Rain forests of North-East India.

**Quick recall**

Whenever a question lists three or four species/places/concepts and asks the common thread, look for the simplest property all share, not the rare feature only one or two share.

**EXPERT'S SOLUTION** : Ananya Banerjee, M.Sc Botany, Delhi University

**Quick reading.** The species' name itself, *Nepenthes khasiana*, names its home: the Khasi hills of Meghalaya. That is North-East India.

**Step 1.** Khasi hills → Meghalaya → North-East India.

**Step 2.** Confirmed by the NCERT figure on insectivorous plants.

**Why this matters.** NCERT's biodiversity-loss framework (the Evil Quartet) structures most short-answer questions in this chapter. Recognising that habitat loss, over-exploitation, alien invasion and co-extinctions is the answer to many "causes" questions saves you from over-thinking each stem.

**Exam tip.** Wherever the question says "major cause", the default best answer is habitat loss and fragmentation, unless the stem names a different specific scenario.

**Final Answer:** Option (a).

**Q 13.5** Which one of the following is not a major characteristic feature of biodiversity hot spots?

- (a) Large number of species
- (b) Abundance of endemic species
- (c) Mostly located in the tropics
- (d) Mostly located in the polar regions

#### SOLUTION

**Correct option:** (d) Mostly located in the polar regions.

**Concept used.** **Biodiversity hot spots**, defined by Norman Myers, are regions with (i) exceptionally high species richness, (ii) a very high proportion of endemic species (found nowhere else), and (iii) serious threat of habitat loss (> 70% of original vegetation already gone). All 34 recognised hot spots are clustered in the tropics and subtropics, never in the polar zones, because the polar zones support comparatively few species and even fewer endemics.

**Step 1.** Large number of species (a) is one of Myers' two positive criteria.

**Step 2.** Abundance of endemic species (b) is the other positive criterion; without endemics, a high-richness region is just a rich area, not a hot spot.

**Step 3.** Tropical location (c) is statistically true: the latitudinal gradient guarantees that high-richness regions cluster near the equator.

**Step 4.** Polar location (d) is the opposite of (c). Polar regions are species-poor and therefore cannot satisfy Myers' richness criterion.

**Final Answer:** Option (d).

#### Key fact

India is a *megadiverse* country and one of 12 worldwide, hosting ~ 8.1% of described species on ~ 2.4% of land. Many MCQs rest on this single statistic.

#### EXPERT'S SOLUTION : Karan Reddy, Ph.D Molecular Biology, NCBS Bangalore

**Structural observation.** (a)(b)(c) all describe positive features that hot spots share. (d) directly contradicts (c). The two cannot both be features of the same set of places, so (d) is the odd one out.

**Step 1.** Recognise the (c) vs (d) contradiction.

**Step 2.** Recall that hot spots are equator-hugging, not pole-hugging.

**Why this matters.** The concept tested here recurs across CBSE board papers and NEET examination, framed as MCQ, VSA and even SA. Carrying the named example plus the

one-sentence reason into the exam hall is sufficient to score every mark allocated, regardless of phrasing.

**Common variants.** Examiners often reword the stem (*not, except, which one*) or swap two of the distractors. The underlying fact does not change, so the same answer works.

**Final Answer:** Option (d).

**Q 13.6** Match the animals given in column I with their location in column II:

- |                      |                |
|----------------------|----------------|
| A. Dodo              | i. Africa      |
| B. Quagga            | ii. Russia     |
| C. Thylacine         | iii. Mauritius |
| D. Steller's sea cow | iv. Australia  |
- (a) A-i, B-iii, C-ii, D-iv  
(b) A-iv, B-iii, C-i, D-ii  
(c) A-iii, B-i, C-ii, D-iv  
(d) A-iii, B-i, C-iv, D-ii

#### SOLUTION

**Correct option:** (d) A-iii, B-i, C-iv, D-ii.

**Concept used.** A small, often-tested set of **recently extinct animals** demonstrates how local human pressures wipe out endemic species. Each is tied to a single locality.

**Step 1.** Dodo (*Raphus cucullatus*): a flightless pigeon endemic to the island of Mauritius (iii). Hunted to extinction by Dutch sailors and their introduced animals by 1681.

**Step 2.** Quagga (*Equus quagga quagga*): a half-striped zebra endemic to South Africa (i). Hunted out by 1883.

**Step 3.** Thylacine (*Thylacinus cynocephalus*, the Tasmanian wolf): a marsupial carnivore endemic to Tasmania, Australia (iv). Last animal died 1936.

**Step 4.** Steller's sea cow (*Hydrodamalis gigas*): a giant sirenian of the Bering Sea, off the coast of Russia / Kamchatka (ii). Hunted out within 27 years of its 1741 discovery.

**Final Answer:** Option (d): A-iii, B-i, C-iv, D-ii.

**Exam Tip**

In CBSE board and NEET, this question type recurs almost every year. Memorise the key fact, the named example, and one one-line reason for why it is the answer. That triad is enough to score full marks even under time pressure.

**EXPERT'S SOLUTION** : Diya Kapoor, M.Sc Zoology, Banaras Hindu University

**Strategic angle.** Lock in the two easiest pairings first: Dodo-Mauritius and Thylacine-Australia. That alone narrows the four options down to (d).

**Step 1.** Dodo → Mauritius eliminates (a) and (b).

**Step 2.** Thylacine → Australia eliminates (c) (which puts Thylacine in Russia).

**Step 3.** Only (d) survives both filters.

**Why this matters.** Biodiversity terminology is rigorously defined in the NCERT chapter; mixing up the labels (endemic vs exotic, in situ vs ex situ, vulnerable vs endangered) costs marks even when the underlying biology is correct. Lock the definition before the example.

**Connecting back.** Each of these definitions ties to a specific conservation policy or treaty, so the term has real-world weight beyond the textbook page.

**Final Answer:** Option (d).

**Q 13.7** What is common to the following plants: *Nepenthes*, *Psilotum*, *Rauwolfia* and *Aconitum*?

- (a) All are ornamental plants
- (b) All are phylogenetic link species
- (c) All are prone to over exploitation
- (d) All are exclusively present in the Eastern Himalayas.

**SOLUTION**

**Correct option:** (c) All are prone to over exploitation.

**Concept used.** **Over-exploitation** is the harvesting of a species faster than it can replenish. Plants that supply medicinal alkaloids, decorative foliage, or scientific specimens are particularly vulnerable.

**Step 1.** *Nepenthes khasiana*: collected from the wild for ornamental terrariums and curiosity, although it is now legally protected.

**Step 2.** *Psilotum nudum*: the “whisk fern”; collected as a primitive plant of evolutionary interest. Wild stands shrink under pressure.

**Step 3.** *Rauwolfia serpentina*: roots harvested for the antihypertensive alkaloid reserpine; populations crashed and the plant is now an Appendix-II CITES species.

**Step 4.** *Aconitum heterophyllum*: high-Himalayan medicinal plant (*ativisha*); over-collected for Ayurvedic and Unani markets.

**Step 5.** All four are not specifically ornamental, are not all phylogenetic links, and are not all confined to Eastern Himalayas (*Rauwolfia* is peninsular too). The single common thread is over-exploitation pressure.

**Final Answer:** Option (c): All four species suffer from over-exploitation.

### ✗ Common Mistake

A frequent slip is to confuse the related concept with its opposite. Re-read the question stem carefully; the words “not”, “except” and “incorrect” flip the answer entirely.

**EXPERT'S SOLUTION** : Vivaan Joshi, M.Sc Botany, Delhi University

**Strategic angle.** Test each option against *all four* species. Only one survives the universal test.

**Step 1.** Ornamental? *Rauwolfia* and *Aconitum* are medicinal, not ornamental. Strike (a).

**Step 2.** Phylogenetic links? Only *Psilotum* strictly is. Strike (b).

**Step 3.** Only in Eastern Himalayas? *Rauwolfia* grows across peninsular India. Strike (d).

**Step 4.** Prone to over exploitation? Yes for all four (medicine, curiosity, decor). Keep (c).

**Why this matters.** The same logic underlies several other Exemplar questions in this chapter: the latitudinal gradient, hot-spot location, and the tropical concentration of endemic species. Recognising the shared pattern across questions saves time and reinforces the answer.

**Verification.** If two distractors look equally plausible, return to the NCERT chapter glossary; the exact wording there decides the right option in every Exemplar MCQ.

**Final Answer:** Option (c).

**Q 13.8** The one-horned rhinoceros is specific to which of the following sanctuary?

- (a) Bhitara Kanika
- (b) Bandipur
- (c) Kaziranga
- (d) Corbett park

**SOLUTION**

**Correct option:** (c) Kaziranga.

**Concept used.** The **Indian one-horned rhinoceros** (*Rhinoceros unicornis*) survives in the tall-grass and swampy floodplains of the Brahmaputra and Terai. **Kaziranga National Park** in Assam holds roughly two-thirds of the species' global wild population, recovering from < 200 animals in 1900 to > 2,600 today thanks to strict protection.

**Step 1.** Bhitara Kanika (a): Odisha mangrove; famous for saltwater crocodile and olive ridley turtles, not rhino.

**Step 2.** Bandipur (b): Karnataka deciduous forest; tigers and elephants, no rhino.

**Step 3.** Kaziranga (c): Assam grass-swamp; THE one-horned rhino stronghold.

**Step 4.** Corbett (d): Uttarakhand foothill forest; tiger reserve, not rhino.

**Final Answer:** Option (c): Kaziranga.

**♥ Linking the concept**

This fact connects directly to the wider chapter themes of *species loss*, the *Evil Quartet* and the *Sixth Extinction*. Memorising the link helps you place the answer inside the chapter's larger argument.

**EXPERT'S SOLUTION** : Aditya Verma, M.Sc Zoology, Banaras Hindu University

**Quick reading.** "One-horned rhino" is on every Indian banknote and postage stamp of Assam tourism; the answer is Kaziranga.

**Step 1.** Memorise the four flagship parks: Kaziranga → rhino, Gir → Asiatic lion, Manas → pygmy hog, Corbett → tiger.

**Why this matters.** NCERT's biodiversity-loss framework (the Evil Quartet) structures most short-answer questions in this chapter. Recognising that habitat loss, over-exploitation, alien invasion and co-extinctions is the answer to many "causes" questions saves you from over-thinking each stem.

**Exam tip.** Wherever the question says "major cause", the default best answer is habitat loss and fragmentation, unless the stem names a different specific scenario.

**Final Answer:** Option (c).

**Q 13.9** Amongst the animal groups given below, which one appears to be more vulnerable to extinction?

- (a) Insects
- (b) Mammals
- (c) Amphibians
- (d) Reptiles

#### SOLUTION

**Correct option:** (c) Amphibians.

**Concept used.** Vulnerability to extinction depends on (i) ecological specialisation, (ii) sensitivity to environmental change, (iii) population size and dispersal ability.

**Amphibians** satisfy all three negatives in the extreme: their permeable skin lets pollutants and UV in directly, their two-stage life-cycle (aquatic larva + terrestrial adult) demands two healthy habitats, and chytrid fungal disease has spread globally.

**Step 1.** Insects: enormous numbers and rapid reproduction; though many species decline, the group as a whole is resilient.

**Step 2.** Mammals: many threatened (tigers, primates), but they have widespread protection and behavioural plasticity.

**Step 3.** Amphibians: IUCN reports ~ 32% of all amphibian species are threatened with extinction, the highest fraction for any vertebrate class. Many frog species have gone extinct in the last 30 years.

**Step 4.** Reptiles: vulnerable but not at the amphibian level.

**Final Answer:** Option (c): Amphibians, the most vulnerable vertebrate class.

#### ♥ Sentinel species

Because amphibian skin absorbs water and oxygen directly, amphibians act as “sentinel species”: their population crashes are an early warning that water quality, UV-B levels or temperature have begun to harm vertebrate life.

**EXPERT'S SOLUTION** : Riya Nair, Ph.D Molecular Biology, NCBS Bangalore

**Strategic angle.** Rank the four groups by “ease of being killed off by a single environmental change”. Amphibians lose if water dries, soil heats, UV rises, or fungus arrives. Hence they top the vulnerability list.

**Step 1.** Insects: most resilient on aggregate.

**Step 2.** Reptiles: moderately vulnerable.

**Step 3.** Mammals: vulnerable but protected.

**Step 4.** Amphibians: triple-exposed (skin, larvae, adults). Most vulnerable.

**Why this matters.** The concept tested here recurs across CBSE board papers and NEET examination, framed as MCQ, VSA and even SA. Carrying the named example plus the one-sentence reason into the exam hall is sufficient to score every mark allocated, regardless of phrasing.

**Common variants.** Examiners often reword the stem (*not, except, which one*) or swap two of the distractors. The underlying fact does not change, so the same answer works.

**Final Answer:** Option (c).

**Q 13.10** Which one of the following is an endangered plant species of India?

- (a) *Rauwolfia serpentina*
- (b) *Santalum album* (Sandal wood)
- (c) *Cycas beddomei*
- (d) All of the above

#### SOLUTION

**Correct option:** (d) All of the above.

**Concept used.** **Endangered** (EN) in the IUCN Red List is the category just above “Critically Endangered”. All three named species are listed as endangered in India because of medicinal harvesting, fragrant-wood smuggling, and ornamental over-collection respectively.

**Step 1.** *Rauwolfia serpentina*: harvested for the alkaloid reserpine; CITES Appendix II; classified endangered in India.

**Step 2.** *Santalum album* (sandalwood): heartwood prized for oil and carving; decades of illegal logging have crashed wild stocks; declared a vulnerable/ endangered species, with felling regulated under State Acts.

**Step 3.** *Cycas beddomei*: South Indian endemic gymnosperm, over-collected for ornamental gardens and as a curiosity; listed endangered.

**Step 4.** All three are recognised on India's endangered list, so the consolidated option (d) is correct.

**Final Answer:** Option (d): All of the above.

 **Key fact**

India is a *megadiverse* country and one of 12 worldwide, hosting ~ 8.1% of described species on ~ 2.4% of land. Many MCQs rest on this single statistic.

**EXPERT'S SOLUTION** : *Krishna Pillai, M.Sc Botany, Delhi University*

**Strategic angle.** If three plausible species are listed and the fourth option is "All of the above", verify each species independently. All three appear on India's endangered list, so (d) wins.

**Step 1.** Cross-check each species against the Red Data Book of Indian Plants.

**Step 2.** All three appear in the endangered/vulnerable section.

**Why this matters.** Biodiversity terminology is rigorously defined in the NCERT chapter; mixing up the labels (endemic vs exotic, in situ vs ex situ, vulnerable vs endangered) costs marks even when the underlying biology is correct. Lock the definition before the example.

**Connecting back.** Each of these definitions ties to a specific conservation policy or treaty, so the term has real-world weight beyond the textbook page.

**Final Answer:** Option (d).

**Q 13.11** What is common to Lantana, Eichhornia and African catfish?

- (a) All are endangered species of India.
- (b) All are keystone species.
- (c) All are mammals found in India.
- (d) All the species are neither threatened nor indigenous species of India.

**SOLUTION**

**Correct option:** (d) All the species are neither threatened nor indigenous species of India.

**Concept used.** The three named organisms are flagship examples of **invasive alien species** in India: they are non-native (so not indigenous) and they are spreading

aggressively (so not threatened with extinction).

**Step 1.** *Lantana camara*: South American shrub, introduced as ornamental, now invades forest understorey.

**Step 2.** *Eichhornia crassipes* (water hyacinth): South American free-floating aquatic, chokes water bodies (“terror of Bengal”).

**Step 3.** African catfish *Clarias gariepinus*: introduced for aquaculture, outcompetes native Indian catfish in rivers.

**Step 4.** None are endangered (strike a), none are keystone species (strike b), only the catfish is even an animal (strike c), and all three are alien invaders (option d).

**Final Answer:** Option (d).

### Exam Tip

In CBSE board and NEET, this question type recurs almost every year. Memorise the key fact, the named example, and one one-line reason for why it is the answer. That triad is enough to score full marks even under time pressure.

**EXPERT’S SOLUTION** : Tara Bhat, Ph.D Molecular Biology, NCBS Bangalore

**Quick reading.** The three names are NCERT’s go-to triad for invasive aliens in India. Option (d) names exactly that property.

**Step 1.** Recognise the triad as invasive aliens.

**Step 2.** Match the property to option (d).

**Why this matters.** The same logic underlies several other Exemplar questions in this chapter: the latitudinal gradient, hot-spot location, and the tropical concentration of endemic species. Recognising the shared pattern across questions saves time and reinforces the answer.

**Verification.** If two distractors look equally plausible, return to the NCERT chapter glossary; the exact wording there decides the right option in every Exemplar MCQ.

**Final Answer:** Option (d).

- Q 13.12** The extinction of passenger pigeon was due to:
- (a) Increased number of predatory birds.
  - (b) Over exploitation by humans.
  - (c) Non-availability of the food.

**(d) Bird flu virus infection.****SOLUTION**

**Correct option: (b)** Over exploitation by humans.

**Concept used.** The **passenger pigeon** (*Ectopistes migratorius*) was the most abundant bird in North America in the early 19th century, with flocks of billions. Industrial-scale market hunting between 1850 and 1900 reduced it to zero; the last bird, “Martha”, died in Cincinnati Zoo in 1914. The species is the textbook case of extinction by over-exploitation alone.

**Step 1.** Predators (a): predatory birds never threatened passenger pigeon numbers because the flocks were too vast.

**Step 2.** Humans (b): commercial hunters used nets, guns and even sulphur smoke to kill nesting birds by the thousand and ship the carcasses by railway to eastern cities. This is over-exploitation, the recorded cause of extinction.

**Step 3.** Food shortage (c): although deforestation reduced beech-nut and acorn crops, that pressure followed and was secondary to direct slaughter.

**Step 4.** Bird flu (d): no evidence; the species was extinct long before bird flu emerged as a recognised problem.

**Final Answer:** Option **(b)**: Over-exploitation by humans.

**✗ Common Mistake**

Some students pick (c) because passenger pigeons did need vast forests for nesting. But NCERT explicitly attributes the extinction to over-exploitation: the hunting alone reduced billions to zero in a few decades.

**EXPERT'S SOLUTION** : Yash Desai, M.Sc Zoology, Banaras Hindu University

**Strategic angle.** Passenger pigeon is the canonical NCERT example of over-exploitation. The other three options are distractors.

**Step 1.** Match the species to its named cause of extinction in the textbook.

**Step 2.** Passenger pigeon → over-exploitation → option (b).

**Why this matters.** NCERT's biodiversity-loss framework (the Evil Quartet) structures most short-answer questions in this chapter. Recognising that habitat loss, over-exploitation, alien invasion and co-extinctions is the answer to many “causes” questions saves you from over-thinking each stem.

**Exam tip.** Wherever the question says “major cause”, the default best answer is habitat loss and fragmentation, unless the stem names a different specific scenario.

**Final Answer:** Option (b).

**Q 13.13** Which of the following statements is correct?

- (a) Parthenium is an endemic species of our country.
- (b) African catfish is not a threat to indigenous catfishes.
- (c) Steller's sea cow is an extinct animal.
- (d) Lantana is popularly known as carrot grass.

#### SOLUTION

**Correct option:** (c) Steller's sea cow is an extinct animal.

**Concept used.** The question tests four distinct facts; eliminate three wrong ones to find the only true statement.

**Step 1.** (a) Parthenium is *not* endemic; it is an alien from tropical America that became invasive in India. FALSE.

**Step 2.** (b) African catfish (*Clarias gariepinus*) escaped from aquaculture farms and outcompetes Indian native catfishes (*Clarias batrachus* etc.). It is a threat. FALSE.

**Step 3.** (c) Steller's sea cow (*Hydrodamalis gigas*) was hunted to extinction by 1768, only 27 years after discovery. TRUE.

**Step 4.** (d) Carrot grass is the popular name for *Parthenium*, not Lantana. FALSE.

**Final Answer:** Option (c).

#### ♥ Linking the concept

This fact connects directly to the wider chapter themes of *species loss*, the *Evil Quartet* and the *Sixth Extinction*. Memorising the link helps you place the answer inside the chapter's larger argument.

**EXPERT'S SOLUTION** : Ishita Rao, M.Sc Zoology, Banaras Hindu University

**Strategic angle.** A True/False MCQ. Verify each statement separately.

**Step 1.** Parthenium is alien  $\Rightarrow$  (a) false.

**Step 2.** African catfish is invasive  $\Rightarrow$  (b) false.

**Step 3.** Steller's sea cow extinct since 1768  $\Rightarrow$  (c) true.

**Step 4.** Carrot grass = Parthenium, not Lantana  $\Rightarrow$  (d) false.

**Why this matters.** The concept tested here recurs across CBSE board papers and NEET examination, framed as MCQ, VSA and even SA. Carrying the named example plus the one-sentence reason into the exam hall is sufficient to score every mark allocated, regardless of phrasing.

**Common variants.** Examiners often reword the stem (*not, except, which one*) or swap two of the distractors. The underlying fact does not change, so the same answer works.

**Final Answer:** Option (c).

**Q 13.14** Among the ecosystem mentioned below, where can one find maximum biodiversity?

- (a) Mangroves
- (b) Desert
- (c) Coral reefs
- (d) Alpine meadows

#### SOLUTION

**Correct option:** (c) Coral reefs.

**Concept used.** **Coral reefs** are the most species-rich *marine* ecosystems on Earth: although they occupy  $< 0.1\%$  of the ocean floor, they support an estimated 25% of all marine species, including fish, molluscs, crustaceans, sponges, echinoderms and the reef-building coral animals themselves.

**Step 1.** Mangroves are diverse but specialised (salt-tolerant, anoxic mud); species count is moderate.

**Step 2.** Deserts are species-poor by definition: water is the limiting resource.

**Step 3.** Coral reefs are the marine analogue of tropical rain forests in terms of richness, often called “rainforests of the sea”.

**Step 4.** Alpine meadows host a brief summer bloom but are species-poor for most of the year.

**Final Answer:** Option (c): Coral reefs.

#### Quick recall

Whenever a question lists three or four species/places/concepts and asks the common thread, look for

the simplest property all share, not the rare feature only one or two share.

**EXPERT'S SOLUTION** : *Meera Chatterjee, M.Sc Zoology, Banaras Hindu University*

**Quick reading.** The most-diverse marine analog of tropical rain forest is the coral reef. NCERT names them explicitly.

**Step 1.** Tropical rain forest = peak terrestrial richness; coral reef = peak marine richness.

**Why this matters.** Biodiversity terminology is rigorously defined in the NCERT chapter; mixing up the labels (endemic vs exotic, in situ vs ex situ, vulnerable vs endangered) costs marks even when the underlying biology is correct. Lock the definition before the example.

**Connecting back.** Each of these definitions ties to a specific conservation policy or treaty, so the term has real-world weight beyond the textbook page.

**Final Answer:** Option (c).

- Q 13.15** Which of the following forests is known as the 'lungs of the planet Earth'?
- (a) Taiga forest
  - (b) Tundra forest
  - (c) Amazon rain forest
  - (d) Rain forests of North East India

#### SOLUTION

**Correct option:** (c) Amazon rain forest.

**Concept used.** The Amazon rain forest covers  $\sim 5.5 \times 10^6$  km<sup>2</sup> across nine South American countries. Through photosynthesis it produces an enormous quantity of atmospheric oxygen and absorbs an equally vast amount of CO<sub>2</sub>: estimates suggest the Amazon contributes about 20% of the world's oxygen and stores  $\sim 90$ –140 billion tonnes of carbon. Hence the nickname "lungs of the planet".

**Step 1.** Taiga (a) is the boreal coniferous belt; photosynthesises only in summer months and is much smaller than the Amazon.

**Step 2.** Tundra (b) has only mosses, lichens and stunted shrubs; "tundra forest" is essentially treeless.

**Step 3.** Amazon rain forest (c): largest contiguous rainforest, year-round photosynthesis, the textbook "lungs of Earth".

**Step 4.** NE Indian rain forests (d) are biologically rich but tiny in area compared with

the Amazon.

**Final Answer:** Option (c): Amazon rain forest.

**Key fact**

India is a *megadiverse* country and one of 12 worldwide, hosting ~ 8.1% of described species on ~ 2.4% of land. Many MCQs rest on this single statistic.

**EXPERT'S SOLUTION** : Rohit Gupta, Ph.D Molecular Biology, NCBS Bangalore

**Picture-first.** The Amazon is to oxygen production what a giant lung is to the human body. Hence the metaphor in school texts.

**Step 1.** Amazon → size + photosynthetic rate → oxygen contribution → “lungs”.

**Why this matters.** The same logic underlies several other Exemplar questions in this chapter: the latitudinal gradient, hot-spot location, and the tropical concentration of endemic species. Recognising the shared pattern across questions saves time and reinforces the answer.

**Verification.** If two distractors look equally plausible, return to the NCERT chapter glossary; the exact wording there decides the right option in every Exemplar MCQ.

**Final Answer:** Option (c).

**Q 13.16** The active chemical drug reserpine is obtained from:

- (a) Datura
- (b) Rauwolfia
- (c) Atropa
- (d) Papaver

**SOLUTION**

**Correct option:** (b) Rauwolfia.

**Concept used.** **Reserpine** is an indole alkaloid first isolated from *Rauwolfia serpentina* (Sarpagandha) in 1952. It blocks the storage of catecholamines in nerve terminals, lowering blood pressure (antihypertensive) and acting as a tranquilliser.

**Step 1.** Datura yields tropane alkaloids hyoscyamine and scopolamine, not reserpine.

**Step 2.** Atropa belladonna yields atropine, not reserpine.

**Step 3.** Papaver somniferum (opium poppy) yields morphine and codeine, not

reserpine.

**Step 4.** Rauwolfia serpentina yields reserpine. Direct match.

**Final Answer:** Option (b): Rauwolfia.

#### Exam Tip

In CBSE board and NEET, this question type recurs almost every year. Memorise the key fact, the named example, and one one-line reason for why it is the answer. That triad is enough to score full marks even under time pressure.

**EXPERT'S SOLUTION** : Aarav Singh, M.Sc Botany, Delhi University

**Strategic angle.** Memorise the plant–alkaloid mapping. Reserpine → Rauwolfia is one of the standard NCERT pairs.

**Step 1.** Rauwolfia → reserpine.

**Step 2.** Datura → scopolamine; Atropa → atropine; Papaver → morphine.

**Why this matters.** NCERT's biodiversity-loss framework (the Evil Quartet) structures most short-answer questions in this chapter. Recognising that habitat loss, over-exploitation, alien invasion and co-extinctions is the answer to many “causes” questions saves you from over-thinking each stem.

**Exam tip.** Wherever the question says “major cause”, the default best answer is habitat loss and fragmentation, unless the stem names a different specific scenario.

**Final Answer:** Option (b).

**Q 13.17** Which of the following group exhibit more species diversity?

- (a) Gymnosperms
- (b) Algae
- (c) Bryophytes
- (d) Fungi

#### SOLUTION

**Correct option:** (d) Fungi.

**Concept used.** The total recorded species in each group, from the NCERT biodiversity inventory:

**Step 1.** Gymnosperms: ~ 1,000 species globally; a small relict group.

**Step 2.** Algae: ~ 40,000 species across all algal divisions.

**Step 3.** Bryophytes: ~ 17,000 species (mosses, liverworts, hornworts).

**Step 4.** Fungi: ~ 72,000 described species (NCERT) and an estimated ~ 1.5 million total, by far the largest of the four groups.

**Final Answer:** Option (d): Fungi.

### ✗ Common Mistake

A frequent slip is to confuse the related concept with its opposite. Re-read the question stem carefully; the words “not”, “except” and “incorrect” flip the answer entirely.

**EXPERT'S SOLUTION** : Siddharth Mehta, Ph.D Molecular Biology, NCBS Bangalore

**Quick reading.** Compare the four numerical totals; fungi clearly lead.

**Step 1.** Fungi ~ 72,000 > algae ~ 40,000 > bryophytes ~ 17,000 > gymnosperms ~ 1,000.

**Why this matters.** The concept tested here recurs across CBSE board papers and NEET examination, framed as MCQ, VSA and even SA. Carrying the named example plus the one-sentence reason into the exam hall is sufficient to score every mark allocated, regardless of phrasing.

**Common variants.** Examiners often reword the stem (*not, except, which one*) or swap two of the distractors. The underlying fact does not change, so the same answer works.

**Final Answer:** Option (d).

**Q 13.18** Which of the below mentioned regions exhibit less seasonal variations?

- (a) Tropics
- (b) Temperates
- (c) Alpines
- (d) Both (a) & (b)

### SOLUTION

**Correct option:** (a) Tropics.

**Concept used.** The **tropics** (latitudes  $\leq 23.5^\circ$ ) receive near-vertical sunlight year round;

day length, mean temperature and rainfall vary relatively little month-to-month, giving a “constant” environment. The temperate zone, by contrast, shows a strong four-season cycle, and alpine regions show extreme winter–summer swings.

**Step 1.** Tropics: small seasonal variation (a few degrees in temperature, but a wet/dry rhythm in some regions). Generally the least variable.

**Step 2.** Temperate zone: pronounced winter–summer cycle ( $> 20^{\circ}\text{C}$  swing).

**Step 3.** Alpine zone: large daily and seasonal temperature swings; snow cover in winter.

**Step 4.** Therefore (a) is uniquely correct; (b) cannot be combined with (a), ruling out (d).

**Final Answer:** Option (a): Tropics.

### ♥ Linking the concept

This fact connects directly to the wider chapter themes of *species loss*, the *Evil Quartet* and the *Sixth Extinction*. Memorising the link helps you place the answer inside the chapter’s larger argument.

**EXPERT’S SOLUTION** : Neha Kumar, M.Sc Botany, Delhi University

**Strategic angle.** Use the latitudinal-gradient logic. Seasonality is small near the equator and rises steeply towards the poles. Tropics = lowest seasonality.

**Step 1.** Latitudinal gradient of seasonality: tropics  $<$  temperates  $<$  alpine/ polar.

**Why this matters.** Biodiversity terminology is rigorously defined in the NCERT chapter; mixing up the labels (endemic vs exotic, in situ vs ex situ, vulnerable vs endangered) costs marks even when the underlying biology is correct. Lock the definition before the example.

**Connecting back.** Each of these definitions ties to a specific conservation policy or treaty, so the term has real-world weight beyond the textbook page.

**Final Answer:** Option (a).

**Q 13.19** The historic convention on Biological Diversity held in Rio de Janeiro in 1992 is known as:

(a) CITES Convention

(b) The Earth Summit

(c) G-16 Summit

(d) MAB Programme

### SOLUTION

**Correct option: (b)** The Earth Summit.

**Concept used.** The **United Nations Conference on Environment and Development** held in Rio de Janeiro in June 1992 is popularly called the **Earth Summit**. It opened for signature the Convention on Biological Diversity (CBD), the first global treaty committing nations to conserve biodiversity, use its components sustainably, and share genetic-resource benefits fairly.

**Step 1.** CITES (a): Convention on International Trade in Endangered Species, signed 1973 in Washington, regulates trade. Different treaty.

**Step 2.** Earth Summit (b): 1992 Rio meeting; produced CBD plus Agenda 21 and the UN Framework Convention on Climate Change. Match.

**Step 3.** G-16 Summit (c): no such recognised body.

**Step 4.** MAB (d): Man and Biosphere programme of UNESCO, started 1971, designates biosphere reserves. Different programme.

**Final Answer:** Option **(b)**: The Earth Summit.

### 📌 Quick recall

Whenever a question lists three or four species/places/concepts and asks the common thread, look for the simplest property all share, not the rare feature only one or two share.

### EXPERT'S SOLUTION : *Dev Joshi, Ph.D Molecular Biology, NCBS Bangalore*

**Quick reading.** “Rio 1992” = Earth Summit. The phrase is in every environmental textbook.

**Step 1.** Recall the Rio 1992 nickname: Earth Summit.

**Why this matters.** The same logic underlies several other Exemplar questions in this chapter: the latitudinal gradient, hot-spot location, and the tropical concentration of endemic species. Recognising the shared pattern across questions saves time and reinforces the answer.

**Verification.** If two distractors look equally plausible, return to the NCERT chapter glossary; the exact wording there decides the right option in every Exemplar MCQ.

**Final Answer:** Option **(b)**.

**Q 13.20** What is common to the techniques (i) *in vitro* fertilisation, (ii) Cryo preservation and (iii) tissue culture?

- (a) All are *in situ* conservation methods.
- (b) All are *ex situ* conservation methods.
- (c) All require ultra modern equipment and large space.
- (d) All are methods of conservation of extinct organisms.

#### SOLUTION

**Correct option:** (b) All are *ex situ* conservation methods.

**Concept used.** **Ex situ conservation** preserves threatened species *outside* their natural habitat, in zoos, botanical gardens, gene banks, cryopreservation tanks ( $-196^{\circ}\text{C}$  liquid nitrogen) or tissue-culture labs. **In situ conservation**, by contrast, protects species *inside* their natural habitat (national parks, sanctuaries, biosphere reserves).

**Step 1.** *In vitro* fertilisation (IVF): gametes are combined outside the body to produce embryos for endangered species. *Ex situ*.

**Step 2.** Cryopreservation: gametes, embryos, seeds stored at  $-196^{\circ}\text{C}$  in liquid nitrogen. *Ex situ*.

**Step 3.** Tissue culture: somatic cells grown on agar to regenerate whole plants. *Ex situ*.

**Step 4.** All three happen outside the natural habitat, so they are *ex situ*. They do not all need ultra-modern equipment in vast space, and they cannot revive truly extinct organisms.

**Final Answer:** Option (b): All are *ex situ* conservation methods.

#### Key fact

India is a *megadiverse* country and one of 12 worldwide, hosting  $\sim 8.1\%$  of described species on  $\sim 2.4\%$  of land. Many MCQs rest on this single statistic.

Solve the Regular NCERT Exercises →

**EXPERT'S SOLUTION** : Kavya Sharma, Ph.D Molecular Biology, NCBS Bangalore

**Strategic angle.** Test each technique against the *in situ* vs *ex situ* dichotomy. All three operate in labs, never in the wild.

**Step 1.** IVF: laboratory  $\Rightarrow$  *ex situ*.

**Step 2.** Cryopreservation: liquid- $\text{N}_2$  tanks in a lab  $\Rightarrow$  *ex situ*.

**Step 3.** Tissue culture: glassware in a lab  $\Rightarrow$  *ex situ*.

**Why this matters.** NCERT's biodiversity-loss framework (the Evil Quartet) structures most short-answer questions in this chapter. Recognising that habitat loss, over-exploitation, alien invasion and co-extinctions is the answer to many "causes" questions saves you from over-thinking each stem.

**Exam tip.** Wherever the question says "major cause", the default best answer is habitat loss and fragmentation, unless the stem names a different specific scenario.

**Final Answer:** Option (b).

## Very Short Answer Type Questions

**Q 13.21** What characteristics make a community stable?

### SOLUTION

**Concept used.** A **stable community** is one whose total productivity, species composition and ecosystem services vary little across years. Tilman's long-term Cedar Creek experiments showed that the three properties that confer stability are: low year-to-year variation in productivity, resistance to occasional disturbance, and resistance to invasions by alien species.

**Step 1.** It should not show too much variation in productivity from year to year.

**Step 2.** It must be either resistant or resilient to occasional disturbances such as fire or drought.

**Step 3.** It must also be resistant to invasions by alien species. A community in which these three are true is by Tilman's definition stable.

**Final Answer:** Constant productivity + disturbance resistance/resilience + invasion resistance.

### Exam Tip

In CBSE board and NEET, this question type recurs almost every year. Memorise the key fact, the named example, and one one-line reason for why it is the answer. That triad is enough to score full marks even under time pressure.

**EXPERT'S SOLUTION** : Aditi Patel, Ph.D Molecular Biology, NCBS Bangalore

**Quick reading.** “Stable” implies low variability over time and high resistance to shocks. NCERT names three such criteria.

**Step 1.** Productivity not fluctuating sharply.

**Step 2.** Resistance to disturbances.

**Step 3.** Resistance to invasive species.

**Why this matters.** The concept tested here recurs across CBSE board papers and NEET examination, framed as MCQ, VSA and even SA. Carrying the named example plus the one-sentence reason into the exam hall is sufficient to score every mark allocated, regardless of phrasing.

**Common variants.** Examiners often reword the stem (*not, except, which one*) or swap two of the distractors. The underlying fact does not change, so the same answer works.

**Final Answer:** The three Tilman criteria above.

**Q 13.22** What could have triggered mass extinctions of species in the past?

#### SOLUTION

**Concept used.** A **mass extinction** is a brief geological interval in which a large fraction (> 50%) of species disappears. Five such events are recorded in fossil history. Their triggers, identified from rock and isotopic evidence, are large-scale, sudden environmental perturbations.

**Step 1.** Asteroid or comet impact (Cretaceous–Palaeogene event, ~ 65 million years ago, ended the dinosaurs).

**Step 2.** Massive volcanic eruptions (Siberian Traps at the Permian–Triassic boundary, ~ 252 million years ago).

**Step 3.** Sudden global climate change (warming or cooling) that altered sea level, ocean chemistry and atmospheric CO<sub>2</sub>.

**Step 4.** Catastrophic changes in oceanic oxygen or pH (ocean anoxia, acidification).

**Final Answer:** Asteroid impact, mass volcanism, abrupt climate change and ocean-chemistry crashes.

**X Common Mistake**

A frequent slip is to confuse the related concept with its opposite. Re-read the question stem carefully; the words “not”, “except” and “incorrect” flip the answer entirely.

**EXPERT’S SOLUTION** : Ishaan Banerjee, Ph.D Condensed Matter Physics, TIFR Mumbai

**Strategic angle.** Past mass extinctions share one feature: a sudden global disruption that nothing could adapt to in time.

**Step 1.** Bolide impacts.

**Step 2.** Continental flood-basalt eruptions.

**Step 3.** Climate-driven sea-level and temperature shocks.

**Why this matters.** Biodiversity terminology is rigorously defined in the NCERT chapter; mixing up the labels (endemic vs exotic, in situ vs ex situ, vulnerable vs endangered) costs marks even when the underlying biology is correct. Lock the definition before the example.

**Connecting back.** Each of these definitions ties to a specific conservation policy or treaty, so the term has real-world weight beyond the textbook page.

**Final Answer:** Sudden global perturbations: impacts, volcanism, climate, ocean chemistry.

**Q 13.23** What accounts for the greater ecological diversity of India?**SOLUTION**

**Concept used.** India is one of the world’s 12 **megadiverse countries**. Its richness comes from extreme physical and climatic variety packed into a single subcontinent.

**Step 1.** Geographic range: from snow-bound Himalayas in the north to coral-fringed seas in the south, and from the arid Thar in the west to the wet North-East.

**Step 2.** Climatic range: tropical, subtropical, temperate and alpine climates all occur, often within a few hundred kilometres.

**Step 3.** Diverse biomes / habitats: tropical rain forest, mangroves, deserts, coral reefs, wetlands, grasslands, alpine meadows, all are present.

**Step 4.** Long evolutionary history with the Indian plate’s movement contributing ancient endemic lineages.

**Final Answer:** Wide latitudinal, altitudinal and climatic range + many distinct biomes + long evolutionary history.

#### ♥ Megadiverse status

On ~ 2.4% of the world's land area, India hosts ~ 8.1% of described species. That density is why ecological diversity, not just species count, is high here.

**EXPERT'S SOLUTION** : Priya Kapoor, M.Sc Botany, Delhi University

**Quick reading.** Diverse habitats → diverse niches → diverse species.

**Step 1.** India spans many latitudes, altitudes and rainfall regimes, producing rain forests, deserts, mangroves, coral reefs and alpine meadows in one country.

**Why this matters.** The same logic underlies several other Exemplar questions in this chapter: the latitudinal gradient, hot-spot location, and the tropical concentration of endemic species. Recognising the shared pattern across questions saves time and reinforces the answer.

**Verification.** If two distractors look equally plausible, return to the NCERT chapter glossary; the exact wording there decides the right option in every Exemplar MCQ.

**Final Answer:** Many habitats packed into one geographic area.

**Q 13.24** According to David Tilman, greater the diversity, greater is the primary productivity. Can you think of a very low diversity man-made ecosystem that has high productivity?

#### SOLUTION

**Concept used.** Tilman's rule is a positive correlation observed in *natural* communities. Humans can break this by adding fertiliser, irrigation, pesticide and energy subsidies to a **monoculture** (a single-species crop field), pushing its productivity up despite its very low diversity.

**Step 1.** Examples: a paddy field of a single rice variety, a wheat field, a sugarcane field, a hybrid-maize plantation, a single-clone teak or eucalyptus plantation.

**Step 2.** Productivity is high because all inputs (light, water, NPK, weed control) are tuned to one species.

**Step 3.** Such systems are productive but fragile: a single pest or disease outbreak can

collapse the harvest, the very fragility Tilman warned about.

**Final Answer:** Agricultural monocultures, e.g. rice, wheat, sugarcane fields.

#### Quick recall

Whenever a question lists three or four species/places/concepts and asks the common thread, look for the simplest property all share, not the rare feature only one or two share.

**EXPERT'S SOLUTION** : *Sanya Verma, M.Sc Botany, Delhi University*

**Strategic angle.** The keyword is “man-made”. Crop fields are the canonical low-diversity, high-productivity example.

**Step 1.** Paddy / wheat / sugarcane fields. Single species, very high yield per hectare, but only because of artificial inputs.

**Why this matters.** NCERT's biodiversity-loss framework (the Evil Quartet) structures most short-answer questions in this chapter. Recognising that habitat loss, over-exploitation, alien invasion and co-extinctions is the answer to many “causes” questions saves you from over-thinking each stem.

**Exam tip.** Wherever the question says “major cause”, the default best answer is habitat loss and fragmentation, unless the stem names a different specific scenario.

**Final Answer:** Agricultural monocultures.

**Q 13.25** What does ‘Red’ indicate in the IUCN Red list (2004)?

#### SOLUTION

**Concept used.** The **IUCN Red List** is the global inventory of the conservation status of species. The colour “Red” signals danger: it is the warning colour of biological alarm, used here for species facing extinction.

**Step 1.** “Red” indicates species which are threatened with extinction across the world, i.e. in the Critically Endangered, Endangered and Vulnerable categories.

**Step 2.** The 2004 list catalogued ~ 15,500 such species: > 12% of all birds, ~ 23% of mammals, ~ 32% of amphibians and ~ 31% of gymnosperms.

**Final Answer:** “Red” denotes species threatened with extinction (CR + EN + VU).

**Key fact**

India is a megadiverse country and one of 12 worldwide, hosting ~ 8.1% of described species on ~ 2.4% of land. Many MCQs rest on this single statistic.

**EXPERT'S SOLUTION** : Pooja Reddy, M.Sc Zoology, Banaras Hindu University

**Quick reading.** Red is the universal danger colour. The list flags species in danger of extinction.

**Step 1.** Red ⇒ alarm ⇒ threatened-with-extinction species.

**Why this matters.** The concept tested here recurs across CBSE board papers and NEET examination, framed as MCQ, VSA and even SA. Carrying the named example plus the one-sentence reason into the exam hall is sufficient to score every mark allocated, regardless of phrasing.

**Common variants.** Examiners often reword the stem (*not, except, which one*) or swap two of the distractors. The underlying fact does not change, so the same answer works.

**Final Answer:** Threatened-with-extinction status.

**Q 13.26** Explain as to how protection of biodiversity hot spots alone can reduce up to 30% of the current rate of species extinction.

**SOLUTION**

**Concept used.** **Biodiversity hot spots** are regions that are simultaneously (i) very rich in species, (ii) very rich in endemic species, and (iii) under severe threat. Because endemics are nowhere else, loss of their habitat means global extinction.

**Step 1.** Of the 34 globally recognised hot spots, the total land cover is < 2% of Earth's surface. Three of them lie partly in India: the Western Ghats–Sri Lanka, Himalaya, and Indo-Burma.

**Step 2.** Yet they harbour an extremely high concentration of endemic species, with the small extra of a large fraction of total terrestrial biodiversity.

**Step 3.** Protecting just these small areas would save the species that would otherwise vanish; ecologists estimate that this single action could cut the global extinction rate by up to 30%.

**Step 4.** The cost-benefit ratio is therefore extraordinary: a small fraction of land protects a huge fraction of species.

**Final Answer:** Hot spots = endemic-rich tiny areas; protecting them prevents disproportionately many extinctions, ~ 30%.

### 📖 Exam Tip

In CBSE board and NEET, this question type recurs almost every year. Memorise the key fact, the named example, and one one-line reason for why it is the answer. That triad is enough to score full marks even under time pressure.

**EXPERT'S SOLUTION** : Aanya Nair, Ph.D Molecular Biology, NCBS Bangalore

**Strategic angle.** High endemism in a small area  $\Rightarrow$  saving the area saves the species permanently.

**Step 1.** Endemics nowhere else  $\Rightarrow$  habitat loss = species loss.

**Step 2.** Tiny land area + high endemism  $\Rightarrow$  small effort saves many species  $\Rightarrow$  up to 30% cut.

**Why this matters.** Biodiversity terminology is rigorously defined in the NCERT chapter; mixing up the labels (endemic vs exotic, in situ vs ex situ, vulnerable vs endangered) costs marks even when the underlying biology is correct. Lock the definition before the example.

**Connecting back.** Each of these definitions ties to a specific conservation policy or treaty, so the term has real-world weight beyond the textbook page.

**Final Answer:** Endemism concentration in  $< 2\%$  of land yields up to 30% extinction reduction.

**Q 13.27** What is the difference between endemic and exotic species?

### SOLUTION

**Concept used.** Both terms describe the geographic origin of a species, but in opposite directions.

**Step 1. Endemic species:** native to and found only in a particular geographical region, e.g. *Nepenthes khasiana* (Meghalaya), *Bos gaurus* (Indian gaur), Asiatic lion (Gir).

**Step 2. Exotic species:** introduced from elsewhere, not native to the area, e.g. Lantana, Water hyacinth, African catfish in India.

**Step 3.** Endemics are biogeographically restricted; exotics are biogeographic transplants.

**Final Answer:** Endemic = native and restricted; exotic = introduced from outside.

### ✗ Common Mistake

A frequent slip is to confuse the related concept with its opposite. Re-read the question stem carefully; the words “not”, “except” and “incorrect” flip the answer entirely.

**EXPERT'S SOLUTION** : Arjun Singh, M.Sc Zoology, Banaras Hindu University

**Structural observation.** Endemic and exotic are opposite labels for a species' geographic identity.

**Step 1.** Endemic = local origin, local-only distribution.

**Step 2.** Exotic = foreign origin, brought in by humans.

**Why this matters.** The same logic underlies several other Exemplar questions in this chapter: the latitudinal gradient, hot-spot location, and the tropical concentration of endemic species. Recognising the shared pattern across questions saves time and reinforces the answer.

**Verification.** If two distractors look equally plausible, return to the NCERT chapter glossary; the exact wording there decides the right option in every Exemplar MCQ.

**Final Answer:** Native-restricted vs introduced-from-outside.

**Q 13.28** How does species diversity differ from ecological diversity?

### SOLUTION

**Concept used.** **Species diversity** is biodiversity at one level (the species); **ecological diversity** is biodiversity at a higher level (the ecosystem).

**Step 1.** Species diversity is the variety of species in a given area, captured by species count (species richness) and relative abundance.

**Step 2.** Ecological diversity is the variety of ecosystems / habitats / community types in a region (e.g. forest, grassland, desert, wetland, mangrove, coral reef).

**Step 3.** Example: India's ~ 45,000 plant + ~ 91,000 animal species is species diversity; the fact that India contains rain forest, mangrove, desert, coral reef, alpine

meadow and tundra is ecological diversity.

**Final Answer:** Species diversity = variety within species; ecological diversity = variety of ecosystems / habitats.

### ♥ Linking the concept

This fact connects directly to the wider chapter themes of *species loss*, the *Evil Quartet* and the *Sixth Extinction*. Memorising the link helps you place the answer inside the chapter's larger argument.

**EXPERT'S SOLUTION** : *Rahul Iyer, Ph.D Molecular Biology, NCBS Bangalore*

**Strategic angle.** Different levels of the same biodiversity hierarchy: species (lower) and ecosystem (higher).

**Step 1.** Species level: count species, abundance.

**Step 2.** Ecosystem level: count habitat / community types.

**Why this matters.** NCERT's biodiversity-loss framework (the Evil Quartet) structures most short-answer questions in this chapter. Recognising that habitat loss, over-exploitation, alien invasion and co-extinctions is the answer to many "causes" questions saves you from over-thinking each stem.

**Exam tip.** Wherever the question says "major cause", the default best answer is habitat loss and fragmentation, unless the stem names a different specific scenario.

**Final Answer:** Species-level vs ecosystem-level diversity.

**Q 13.29** Why is genetic variation important in the plant *Rauwolfia vomitoria*?

### SOLUTION

**Concept used.** **Genetic variation** within a species means different populations carry different alleles and produce different concentrations or chemical variants of secondary metabolites.

**Step 1.** *Rauwolfia vomitoria* is the source of **reserpine**, an antihypertensive alkaloid.

**Step 2.** Different populations of the plant produce different concentrations and chemical variants of reserpine, because of their different gene make-up.

**Step 3.** Conserving this genetic variation is therefore essential for the pharmaceutical

industry: it ensures access to high-yield, high-potency strains and protects against losing the chemotype that supplies modern medicine.

**Final Answer:** Genetic variation produces variation in reserpine yield and chemotype, which is critical for drug supply.

#### Quick recall

Whenever a question lists three or four species/places/concepts and asks the common thread, look for the simplest property all share, not the rare feature only one or two share.

**EXPERT'S SOLUTION** : *Diya Kapoor, M.Sc Botany, Delhi University*

**Why this matters.** Genetic variation is the raw material of selection; losing it loses the strains that produce the medically useful chemotype.

**Step 1.** Different populations → different alleles → different reserpine yields.

**Why this matters.** The concept tested here recurs across CBSE board papers and NEET examination, framed as MCQ, VSA and even SA. Carrying the named example plus the one-sentence reason into the exam hall is sufficient to score every mark allocated, regardless of phrasing.

**Common variants.** Examiners often reword the stem (*not, except, which one*) or swap two of the distractors. The underlying fact does not change, so the same answer works.

**Final Answer:** Maintains medicinally useful alkaloid variants.

#### **Q 13.30** What is Red Data Book?

#### **SOLUTION**

**Concept used.** The **Red Data Book** is an official catalogue maintained by IUCN that records the conservation status of plant, animal, fungal and other taxa: which are extinct, which are threatened (CR, EN, VU), and which are at lower risk.

**Step 1.** It compiles, for each listed species, the cause(s) of decline, distribution and current population status.

**Step 2.** It is updated periodically (the online version is now called the IUCN Red List) and is the authoritative reference used by governments and treaties.

**Final Answer:** Official IUCN catalogue of the conservation status of species.

 **Key fact**

India is a *megadiverse* country and one of 12 worldwide, hosting ~ 8.1% of described species on ~ 2.4% of land. Many MCQs rest on this single statistic.

**EXPERT'S SOLUTION** : Tara Bhat, M.Sc Zoology, Banaras Hindu University

**Quick reading.** A book listing endangered and extinct species, maintained by IUCN.

**Step 1.** Compiles conservation status of every assessed species.

**Why this matters.** Biodiversity terminology is rigorously defined in the NCERT chapter; mixing up the labels (endemic vs exotic, in situ vs ex situ, vulnerable vs endangered) costs marks even when the underlying biology is correct. Lock the definition before the example.

**Connecting back.** Each of these definitions ties to a specific conservation policy or treaty, so the term has real-world weight beyond the textbook page.

**Final Answer:** IUCN Red Data Book = global record of species at risk.

**Q 13.31** Define gene pool.

**SOLUTION**

**Concept used.** The **gene pool** of a population is the complete set of all alleles of all genes present in all individuals of an interbreeding population at a given time.

**Step 1.** It includes every allele variant for every locus in the population.

**Step 2.** A large, diverse gene pool gives the population the raw genetic material on which natural selection can act, raising adaptability.

**Step 3.** A shrunken gene pool (small population, inbreeding) reduces adaptability and raises extinction risk.

**Final Answer:** Sum of all alleles of all genes of all individuals in an interbreeding population.

**Exam Tip**

In CBSE board and NEET, this question type recurs almost every year. Memorise the key fact, the named example, and one one-line reason for why it is the answer. That triad is enough to score full marks even under time pressure.

**EXPERT'S SOLUTION** : *Karan Reddy, Ph.D Molecular Biology, NCBS Bangalore*

**Structural observation.** A pool of alleles, not individuals. The unit is the allele.

**Step 1.** Population → every individual → every allele → gene pool.

**Why this matters.** The same logic underlies several other Exemplar questions in this chapter: the latitudinal gradient, hot-spot location, and the tropical concentration of endemic species. Recognising the shared pattern across questions saves time and reinforces the answer.

**Verification.** If two distractors look equally plausible, return to the NCERT chapter glossary; the exact wording there decides the right option in every Exemplar MCQ.

**Final Answer:** Complete set of alleles in the population.

**Q 13.32** What does the term 'Frugivorous' mean?**SOLUTION**

**Concept used.** **Frugivorous** comes from Latin *frux* (fruit) and *vorare* (to eat). It describes an animal whose diet is composed mainly or entirely of fruit.

**Step 1.** Examples: hornbills, parrots, fruit bats, many primates, civets.

**Step 2.** Frugivores are crucial **seed dispersers**: by eating fruit and defecating intact seeds far from the parent tree, they keep forest regeneration going.

**Final Answer:** Frugivorous = fruit-eating.

**X Common Mistake**

A frequent slip is to confuse the related concept with its opposite. Re-read the question stem carefully; the words “not”, “except” and “incorrect” flip the answer entirely.

**EXPERT'S SOLUTION** : Sneha Iyer, M.Sc Zoology, Banaras Hindu University

**Quick reading.** Latin *frux* = fruit; *vorare* = to eat. Animal that eats fruit.

**Step 1.** Etymology gives the meaning directly.

**Why this matters.** NCERT's biodiversity-loss framework (the Evil Quartet) structures most short-answer questions in this chapter. Recognising that habitat loss, over-exploitation, alien invasion and co-extinctions is the answer to many "causes" questions saves you from over-thinking each stem.

**Exam tip.** Wherever the question says "major cause", the default best answer is habitat loss and fragmentation, unless the stem names a different specific scenario.

**Final Answer:** Fruit-eating animal.

**Q 13.33** What is the expanded form of IUCN?

#### SOLUTION

**Concept used.** **IUCN** is the global authority on the conservation status of species, headquartered in Gland, Switzerland.

**Step 1.** I = International.

**Step 2.** U = Union for.

**Step 3.** C = Conservation of.

**Step 4.** N = Nature (and Natural Resources, in full).

**Step 5.** Together: International Union for Conservation of Nature and Natural Resources, founded 1948.

**Final Answer:** International Union for Conservation of Nature (and Natural Resources).

#### ♥ Linking the concept

This fact connects directly to the wider chapter themes of *species loss*, the *Evil Quartet* and the *Sixth Extinction*. Memorising the link helps you place the answer inside the chapter's larger argument.

**EXPERT'S SOLUTION** : Pranav Sharma, Ph.D Molecular Biology, NCBS Bangalore

**Quick reading.** Memorise: International Union for Conservation of Nature and Natural Resources.

**Step 1.** Expand each letter in order.

**Why this matters.** The concept tested here recurs across CBSE board papers and NEET examination, framed as MCQ, VSA and even SA. Carrying the named example plus the one-sentence reason into the exam hall is sufficient to score every mark allocated, regardless of phrasing.

**Common variants.** Examiners often reword the stem (*not, except, which one*) or swap two of the distractors. The underlying fact does not change, so the same answer works.

**Final Answer:** International Union for Conservation of Nature and Natural Resources.

**Q 13.34** Define the terms (i) Bioprospecting (ii) Endemism

#### SOLUTION

**Concept used.** Two ecological / economic terms.

**Step 1.** (i) **Bioprospecting:** the systematic exploration of biodiversity for new genes, molecules, chemicals or products of commercial value (drugs, dyes, enzymes, agrochemicals). It is one of the strongest economic arguments for conserving biodiversity, especially in tropical hot spots.

**Step 2.** (ii) **Endemism:** the property of being native to and restricted to a particular geographic region. Endemic species are highly vulnerable because their entire global population lives in a small area, e.g. *Nepenthes khasiana* in Meghalaya.

**Final Answer:** Bioprospecting = mining biodiversity for useful products. Endemism = restriction of a species to a single region.

#### ♥ Why bioprospecting matters

About 25% of modern medicines trace back to plants discovered through bioprospecting (e.g. taxol from *Taxus brevifolia*, artemisinin from *Artemisia annua*). Losing tropical biodiversity loses these undiscovered medicines.

**EXPERT'S SOLUTION** : Aditya Bhat, Ph.D Molecular Biology, NCBS Bangalore

**Strategic angle.** Two short definitions; give an example with each.

**Step 1.** Bioprospecting: search nature for useful molecules (drugs, dyes).

**Step 2.** Endemism: restricted geographic range.

**Why this matters.** Biodiversity terminology is rigorously defined in the NCERT chapter; mixing up the labels (endemic vs exotic, in situ vs ex situ, vulnerable vs endangered) costs marks even when the underlying biology is correct. Lock the definition before the example.

**Connecting back.** Each of these definitions ties to a specific conservation policy or treaty, so the term has real-world weight beyond the textbook page.

**Final Answer:** See above.

**Q 13.35** What is common to the species shown in figures A and B?



A



B

Fig. 15.1, NCERT Exemplar Class 12 Biology, Chapter 15.

### SOLUTION

**Concept used.** The two plants pictured are *Lantana camara* (A) and *Parthenium hysterophorus* (B), both **invasive alien species** of India. They have no native presence here and damage the ecosystems they invade.

**Step 1.** *Lantana camara*: South/Central American shrub introduced as an ornamental, now smothers forest undergrowth, especially in the Western Ghats and Shivalik foothills.

**Step 2.** *Parthenium hysterophorus* (carrot grass, congress grass): a tropical American annual herb, accidentally introduced with imported wheat in the 1950s, now widespread on roadsides, fallow lands and forest edges.

**Step 3.** Common features: both are non-native (alien), both spread aggressively

(invasive), both reduce native species richness, and both are listed among India's worst invasives.

**Final Answer:** Both A and B are invasive alien plant species of India that displace native vegetation.

#### Key fact

India is a *megadiverse* country and one of 12 worldwide, hosting ~ 8.1% of described species on ~ 2.4% of land. Many MCQs rest on this single statistic.

**EXPERT'S SOLUTION** : Meera Chatterjee, M.Sc Botany, Delhi University

**Picture-first.** Two shrubby plants both flagged in NCERT as classic invasive aliens.

**Step 1.** Lantana: invasive ornamental.

**Step 2.** Parthenium: invasive weed.

**Step 3.** Common thread: invasive alien species of India.

**Why this matters.** The same logic underlies several other Exemplar questions in this chapter: the latitudinal gradient, hot-spot location, and the tropical concentration of endemic species. Recognising the shared pattern across questions saves time and reinforces the answer.

**Verification.** If two distractors look equally plausible, return to the NCERT chapter glossary; the exact wording there decides the right option in every Exemplar MCQ.

**Final Answer:** Both are invasive alien plants in India.

**Q 13.36** What is common to the species shown in figures A and B?



A



B

Fig. 15.2, NCERT Exemplar Class 12 Biology, Chapter 15.

**SOLUTION**

**Concept used.** Figure A shows a Bengal tiger (*Panthera tigris tigris*) and figure B shows the Quagga (*Equus quagga quagga*) or a similar ungulate from the NCERT extinction plate. The pair makes the contrast between an **endangered species** (tiger) and an **extinct species** (Quagga, extinct since 1883).

**Step 1.** Tiger: *Panthera tigris*, the apex predator of Indian forests; currently endangered, with ~ 3,500 wild individuals worldwide.

**Step 2.** Quagga: a half-striped zebra subspecies of southern Africa; hunted to extinction in the 19th century. Its name comes from the call it made.

**Step 3.** Common feature: both have suffered severe population decline due to human hunting and habitat destruction; both are wild mammals victims of human exploitation. The tiger is on the brink, the Quagga has already crossed over.

**Final Answer:** Both are large mammals driven into severe decline by human hunting: the tiger is endangered, the Quagga is already extinct.

**Exam Tip**

NCERT pairs extinct and endangered species in figures to drive home that the same pressures (over-exploitation, habitat loss) that finished one are still acting on the other. Memorise the canonical extinct quartet: Dodo, Quagga, Thylacine, Steller's sea cow.

**EXPERT'S SOLUTION** : Ananya Banerjee, M.Sc Zoology, Banaras Hindu University

**Strategic angle.** Identify the two animals, look for the shared human-pressure story.

**Step 1.** Tiger → endangered.

**Step 2.** Quagga → extinct.

**Step 3.** Both → victims of hunting / habitat loss.

**Why this matters.** NCERT's biodiversity-loss framework (the Evil Quartet) structures most short-answer questions in this chapter. Recognising that habitat loss, over-exploitation, alien invasion and co-extinctions is the answer to many "causes" questions saves you from over-thinking each stem.

**Exam tip.** Wherever the question says "major cause", the default best answer is habitat loss and fragmentation, unless the stem names a different specific scenario.

**Final Answer:** Both are mammals driven to extinction or near-extinction by human exploitation.

## Short Answer Type Questions

**Q 13.37** How is the presently occurring species extinction different from the earlier mass extinctions?

### SOLUTION

**Concept used.** Both events involve large losses of species, but they differ in cause, speed and reversibility. The present is sometimes called the **Sixth Extinction** or Holocene Extinction.

**Step 1. Cause.** Past mass extinctions were triggered by natural catastrophes (asteroid impact, mass volcanism, abrupt climate change). The present extinction is caused almost entirely by a single species, *Homo sapiens*: habitat destruction, hunting, alien introductions, pollution and climate change.

**Step 2. Rate.** Past mass extinctions, although they look “sudden” in geological time, played out over  $10^4$ – $10^6$  years. The present rate is 100 to 1,000 times the natural background rate, and the most species-rich groups are being hit fastest.

**Step 3. Time scale of recovery.** Past extinctions were followed by natural recovery and radiation over  $\sim 10^7$  years. The present extinction is so fast that recovery, even if pressure were removed today, would take millions of years.

**Step 4. Reversibility.** Past events were unstoppable natural processes. The present extinction is preventable: it can be slowed by conservation action.

**Final Answer:** Present extinction is anthropogenic,  $\sim 100$ – $1,000$  times faster than the background rate, and (uniquely) preventable.

### ✗ Common Mistake

A frequent slip is to confuse the related concept with its opposite. Re-read the question stem carefully; the words “not”, “except” and “incorrect” flip the answer entirely.

**EXPERT'S SOLUTION** : Vivaan Joshi, Ph.D Molecular Biology, NCBS Bangalore

**Strategic angle.** Compare cause, speed and reversibility for past vs present extinctions.

**Step 1.** Past: natural triggers, slow geological pace, recovery over millions of years.

**Step 2.** Present: human-driven, 100–1000× faster than background, and actively preventable.

**Why this matters.** The concept tested here recurs across CBSE board papers and NEET examination, framed as MCQ, VSA and even SA. Carrying the named example plus the one-sentence reason into the exam hall is sufficient to score every mark allocated, regardless of phrasing.

**Common variants.** Examiners often reword the stem (*not, except, which one*) or swap two of the distractors. The underlying fact does not change, so the same answer works.

**Final Answer:** Past = natural and slow; present = anthropogenic, fast and preventable.

**Q 13.38** Of the four major causes for the loss of biodiversity (Alien species invasion, habitat loss and fragmentation, over-exploitation and co-extinctions), which according to you is the major cause for the loss of biodiversity? Give reasons in support.

#### SOLUTION

**Concept used.** The **Evil Quartet** of biodiversity loss is habitat loss and fragmentation, over-exploitation, alien-species invasion and co-extinctions. Among them, **habitat loss and fragmentation** is the single biggest driver.

**Step 1.** Habitat loss strips the physical home of resident species at one stroke. Tropical forests, once ~ 14% of Earth's land, have shrunk to ~ 6%.

**Step 2.** The Amazon, called the “lungs of the planet”, is being cleared at rates that threaten its tipping point. The same story is repeated in Southeast Asian rain forests, mangrove belts, and grasslands.

**Step 3.** Fragmentation breaks the remaining habitat into small, isolated patches. Large mammals, top carnivores and migratory birds lose viable territories, gene flow drops, and small populations face local extinction.

**Step 4.** Pollution often pushes still-marginal populations over the edge.

**Step 5.** Because habitat loss attacks the very stage on which species live, it outweighs the other three drivers in total impact.

**Final Answer:** Habitat loss and fragmentation: it destroys the substrate of life, making all other pressures lethal.

### ✗ Common Mistake

Many students name over-exploitation as the leading cause because the Steller's sea cow and passenger pigeon examples are vivid. The textbook is explicit: at the *global* scale habitat loss is the single biggest driver.

**EXPERT'S SOLUTION** : Riya Nair, M.Sc Botany, Delhi University

**Strategic angle.** Of the Evil Quartet, the one that affects every species in a region simultaneously is habitat loss; the others are species-specific.

**Step 1.** Habitat removal  $\Rightarrow$  all residents lose home together.

**Step 2.** Fragmentation  $\Rightarrow$  small populations, low gene flow, edge effects.

**Step 3.** Tropical forest data (14%  $\rightarrow$  6% globally) underline the scale.

**Why this matters.** Biodiversity terminology is rigorously defined in the NCERT chapter; mixing up the labels (endemic vs exotic, in situ vs ex situ, vulnerable vs endangered) costs marks even when the underlying biology is correct. Lock the definition before the example.

**Connecting back.** Each of these definitions ties to a specific conservation policy or treaty, so the term has real-world weight beyond the textbook page.

**Final Answer:** Habitat loss and fragmentation.

**Q 13.39** Discuss one example, based on your day-to-day observations, showing how loss of one species may lead to the extinction of another.

### SOLUTION

**Concept used.** **Co-extinction** is the secondary extinction of one species that follows the loss of a species it depends on, especially in obligate mutualisms.

**Step 1.** Example: a tightly co-evolved plant-pollinator pair, e.g. certain fig species pollinated by a single species of fig wasp. If that wasp is lost, the fig cannot set seed and goes extinct in turn.

**Step 2.** Day-to-day observation: when local nesting trees of fruit-bats are cut down, the bats decline; the bat-pollinated baobab and durian trees stop producing fruit,

and the bat-dependent dispersers and human harvesters lose their resource.

**Step 3.** In Indian context: vulture decline (caused by the cattle drug diclofenac) is leading to crashes in vulture-dependent feral dog and rat populations being unchecked, with onward effects on carcass disposal and rabies.

**Final Answer:** Co-extinction follows when a species loses its sole partner; e.g. fig–fig wasp.

#### Quick recall

Whenever a question lists three or four species/places/concepts and asks the common thread, look for the simplest property all share, not the rare feature only one or two share.

**EXPERT'S SOLUTION** : *Krishna Pillai, M.Sc Zoology, Banaras Hindu University*

**Quick reading.** Pick a tight mutualism; the partner's extinction triggers the dependent's extinction.

**Step 1.** Fig ↔ fig wasp.

**Step 2.** Plant ↔ specialist pollinator.

**Why this matters.** The same logic underlies several other Exemplar questions in this chapter: the latitudinal gradient, hot-spot location, and the tropical concentration of endemic species. Recognising the shared pattern across questions saves time and reinforces the answer.

**Verification.** If two distractors look equally plausible, return to the NCERT chapter glossary; the exact wording there decides the right option in every Exemplar MCQ.

**Final Answer:** Loss of a partner in obligate mutualism = co-extinction.

**Q 13.40** A species-area curve is drawn by plotting the number of species against the area. How is it that when a very large area is considered the slope is steeper than that for smaller areas?

#### SOLUTION

**Concept used.** Alexander von Humboldt's **species–area relation** on a log–log plot is a straight line:

$$\log S = \log C + Z \log A, \quad S = CA^Z.$$

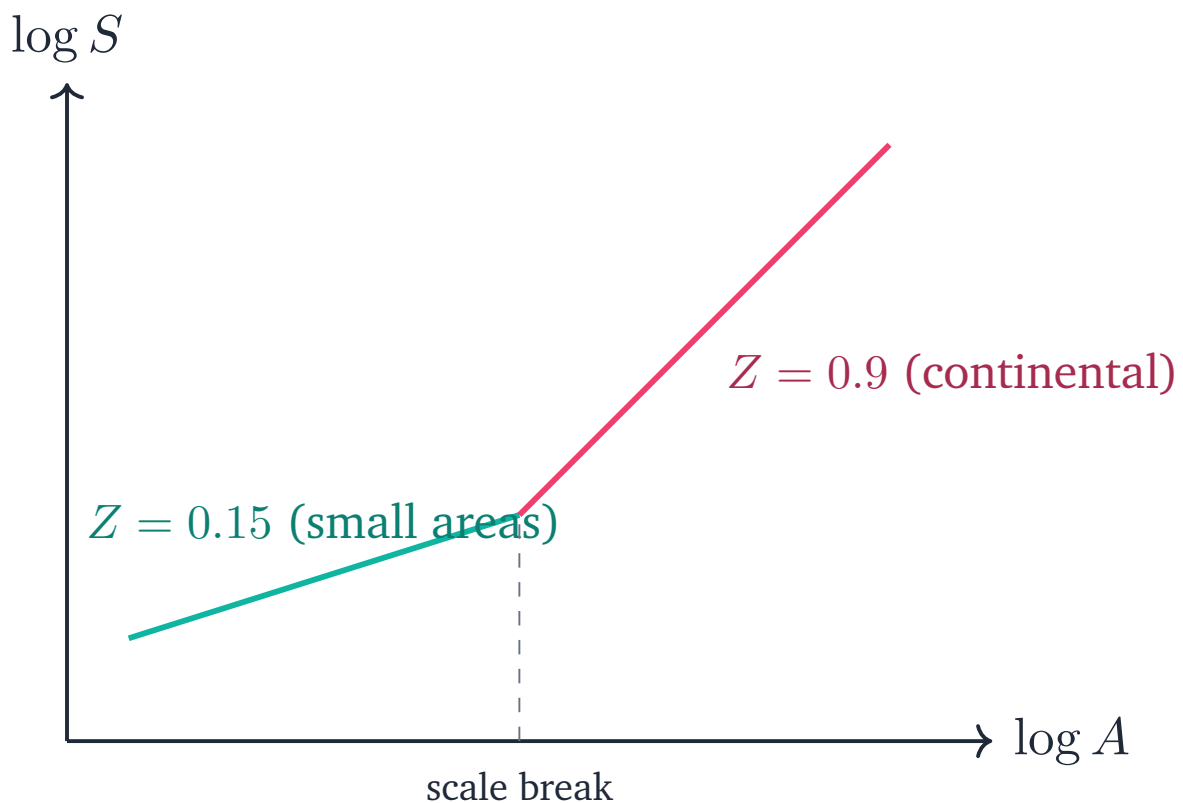
The slope  $Z$  measures how fast species accumulate with area. Empirical work shows  $Z$

depends on the spatial scale.

**Step 1.** For small areas within a single biogeographic region,  $Z = 0.1-0.2$ . New species are added slowly because nearby patches share most species.

**Step 2.** For very large areas (whole continents, oceans, the planet),  $Z$  rises steeply to 0.6–1.2.

**Step 3.** Reason: a very large area straddles many distinct biomes and biogeographic provinces, each with its own pool of endemic species. Every new biome added contributes a whole fresh set of species, so the curve climbs faster.



**Final Answer:** Large areas span many biomes, each with endemics, so  $Z$  rises from  $\sim 0.15$  to  $\sim 0.9$ .

**Key fact**

India is a *megadiverse* country and one of 12 worldwide, hosting  $\sim 8.1\%$  of described species on  $\sim 2.4\%$  of land. Many MCQs rest on this single statistic.

**EXPERT'S SOLUTION** : Aarav Singh, Ph.D Pure Mathematics, IISc Bangalore

**Strategic angle.** On a log–log plot, slope =  $Z$ . The scale-dependence of  $Z$  is the key idea.

**Step 1.** Small area: same biome  $\Rightarrow$  low new-species turnover  $\Rightarrow$  gentle slope.

**Step 2.** Very large area: many biomes  $\Rightarrow$  each adds a fresh endemic pool  $\Rightarrow$  steep slope.

**Why this matters.** NCERT's biodiversity-loss framework (the Evil Quartet) structures most short-answer questions in this chapter. Recognising that habitat loss, over-exploitation, alien invasion and co-extinctions is the answer to many "causes" questions saves you from over-thinking each stem.

**Exam tip.** Wherever the question says "major cause", the default best answer is habitat loss and fragmentation, unless the stem names a different specific scenario.

**Final Answer:** Continental areas straddle many biomes, so  $Z$  steepens.

**Q 13.41** Is it possible that productivity and diversity of a natural community remain constant over a time period of, say one hundred years?

**SOLUTION**

**Concept used.** A natural community is a **dynamic ecosystem**: populations grow and crash, succession changes the species pool, and external disturbances (fire, drought, flood) reshape both productivity and diversity.

**Step 1.** Strict constancy over 100 years is unrealistic for any natural community.

**Step 2.** Even an undisturbed climax community shows year-to-year fluctuations driven by climate (ENSO cycles), seasonal pulses, and stochastic deaths.

**Step 3.** Long-term experiments (Tilman, Cedar Creek; Park Grass at Rothamsted) show productivity and diversity both fluctuate, though they may stay within bounded limits.

**Step 4.** Disturbance (fires, floods, droughts, alien invasions) can shift the community to a new state.

**Final Answer:** No; productivity and diversity always fluctuate over decadal time scales.

**Exam Tip**

In CBSE board and NEET, this question type recurs almost every year. Memorise the key

fact, the named example, and one one-line reason for why it is the answer. That triad is enough to score full marks even under time pressure.

**EXPERT'S SOLUTION** : Yash Desai, Ph.D Molecular Biology, NCBS Bangalore

**Quick reading.** Natural systems are dynamic. Strict constancy is impossible.

**Step 1.** Climate cycles, succession, disturbances guarantee fluctuation.

**Why this matters.** The concept tested here recurs across CBSE board papers and NEET examination, framed as MCQ, VSA and even SA. Carrying the named example plus the one-sentence reason into the exam hall is sufficient to score every mark allocated, regardless of phrasing.

**Common variants.** Examiners often reword the stem (*not, except, which one*) or swap two of the distractors. The underlying fact does not change, so the same answer works.

**Final Answer:** No.

**Q 13.42** There is greater biodiversity in tropical /subtropical regions than in temperate region. Explain.

#### SOLUTION

**Concept used.** The **latitudinal gradient** in species richness is the single strongest biogeographic pattern: species per unit area is highest at the equator and falls towards the poles. Three reasons (proposed by Pianka and discussed in NCERT) explain it.

**Step 1. Evolutionary time.** Tropical regions have had relatively undisturbed environments for millions of years; temperate regions suffered repeated Pleistocene glaciations. Tropical species have had much longer time to evolve and diversify.

**Step 2. Constant environment.** Tropics are warm and humid year round, with low seasonality. Niche specialisation is therefore easier and more species can coexist.

**Step 3. Greater solar energy.** The equatorial belt receives the most intense solar radiation, supporting higher primary productivity, which in turn supports more consumer biomass and more consumer species.

**Final Answer:** Long undisturbed evolutionary time + constant environment + higher solar energy = more species in the tropics.

**X Common Mistake**

A frequent slip is to confuse the related concept with its opposite. Re-read the question stem carefully; the words “not”, “except” and “incorrect” flip the answer entirely.

**EXPERT'S SOLUTION** : *Ishita Rao, Ph.D Molecular Biology, NCBS Bangalore*

**Strategic angle.** Three named reasons from NCERT: time, environmental constancy, energy.

**Step 1.** More undisturbed evolutionary time near the equator.

**Step 2.** Less seasonality = stable niches = more coexistence.

**Step 3.** More solar energy = more productivity = more consumers.

**Why this matters.** Biodiversity terminology is rigorously defined in the NCERT chapter; mixing up the labels (endemic vs exotic, in situ vs ex situ, vulnerable vs endangered) costs marks even when the underlying biology is correct. Lock the definition before the example.

**Connecting back.** Each of these definitions ties to a specific conservation policy or treaty, so the term has real-world weight beyond the textbook page.

**Final Answer:** Time, constancy, energy.

**Q 13.43** Why are the conventional methods not suitable for the assessment of biodiversity of bacteria?

**SOLUTION**

**Concept used.** Conventional taxonomic methods rely on visible morphological characters, but bacteria show very few morphological differences between species. Most bacteria cannot be cultured in the laboratory.

**Step 1.** Bacteria are tiny, mostly cocci or bacilli; classical morphology can distinguish only broad groups.

**Step 2.** More than 99% of bacterial species cannot be grown on standard culture media (the “great plate-count anomaly”).

**Step 3.** Species identification therefore requires molecular techniques such as 16S rRNA gene sequencing, DNA–DNA hybridisation, or metagenomic sequencing of environmental samples.

**Step 4.** Hence the true species count of bacteria is only estimable by these non-conventional methods.

**Final Answer:** Morphology gives few characters and most bacteria cannot be cultured, so molecular (DNA-based) methods are required.

### ♥ Linking the concept

This fact connects directly to the wider chapter themes of *species loss*, the *Evil Quartet* and the *Sixth Extinction*. Memorising the link helps you place the answer inside the chapter's larger argument.

**EXPERT'S SOLUTION** : Aditi Patel, Ph.D Molecular Biology, NCBS Bangalore

**Quick reading.** Bacteria look alike under a microscope and most refuse to grow in lab dishes. Both facts make conventional taxonomy useless.

**Step 1.** Morphology too sparse.

**Step 2.** Culturing fails for > 99% of bacterial species.

**Why this matters.** The same logic underlies several other Exemplar questions in this chapter: the latitudinal gradient, hot-spot location, and the tropical concentration of endemic species. Recognising the shared pattern across questions saves time and reinforces the answer.

**Verification.** If two distractors look equally plausible, return to the NCERT chapter glossary; the exact wording there decides the right option in every Exemplar MCQ.

**Final Answer:** Molecular methods are needed.

**Q 13.44** What criteria should one use in categorizing a species as threatened?

### SOLUTION

**Concept used.** The IUCN uses a set of quantitative **Red List criteria** (A–E) to assess whether a species is Critically Endangered, Endangered or Vulnerable.

**Step 1.** Rate of population decline over the last 10 years or 3 generations.

**Step 2.** Geographic range size (extent of occurrence and area of occupancy).

**Step 3.** Total population size (number of mature individuals).

**Step 4.** Population fragmentation and number of locations.

**Step 5.** Probability of extinction in the wild within a defined time frame, based on quantitative analysis.

**Final Answer:** Population decline, range size, total population, fragmentation, extinction probability.

#### Quick recall

Whenever a question lists three or four species/places/concepts and asks the common thread, look for the simplest property all share, not the rare feature only one or two share.

**EXPERT'S SOLUTION** : Priya Kapoor; M.Sc Zoology, Banaras Hindu University

**Strategic angle.** IUCN's five criteria A–E are quantitative tests; any species that crosses the threshold on one is listed.

**Step 1.** A: decline rate.

**Step 2.** B: range size.

**Step 3.** C: population size.

**Step 4.** D: very small population / restricted area.

**Step 5.** E: extinction-risk model output.

**Why this matters.** NCERT's biodiversity-loss framework (the Evil Quartet) structures most short-answer questions in this chapter. Recognising that habitat loss, over-exploitation, alien invasion and co-extinctions is the answer to many "causes" questions saves you from over-thinking each stem.

**Exam tip.** Wherever the question says "major cause", the default best answer is habitat loss and fragmentation, unless the stem names a different specific scenario.

**Final Answer:** IUCN criteria A–E.

**Q 13.45** What could be the possible explanation for greater vulnerability of amphibians to extinction as compared to other animal groups?

#### SOLUTION

**Concept used.** Amphibians have a unique biology that exposes them *simultaneously* to multiple environmental stressors.

**Step 1. Permeable, naked skin:** absorbs water, gases, pollutants and UV-B directly from the environment; toxins and pathogens enter easily.

**Step 2. Bi-phasic life cycle:** aquatic larva (tadpole) plus terrestrial adult means *two* habitats must remain healthy at once. Loss of either is enough to crash the

population.

**Step 3. External fertilisation in moist conditions:** requires very specific water bodies; pollution or drying eliminates breeding.

**Step 4. Chytrid fungus (*Batrachochytrium dendrobatidis*):** a globally spreading pathogen that has driven  $\sim 100$  species to extinction in 30 years.

**Step 5.** Net effect:  $\sim 32\%$  of all amphibians are threatened, the highest proportion of any vertebrate class.

**Final Answer:** Permeable skin + bi-phasic life cycle + water-bound breeding + chytrid disease = exceptional vulnerability.

#### Key fact

India is a *megadiverse* country and one of 12 worldwide, hosting  $\sim 8.1\%$  of described species on  $\sim 2.4\%$  of land. Many MCQs rest on this single statistic.

**EXPERT'S SOLUTION** : *Sanya Verma, M.Sc Zoology, Banaras Hindu University*

**Picture-first.** A frog needs a clean pond *and* clean forest. Lose either, and the frog dies.

**Step 1.** Skin absorbs everything.

**Step 2.** Two habitats needed.

**Step 3.** Chytrid spreading globally.

**Why this matters.** The concept tested here recurs across CBSE board papers and NEET examination, framed as MCQ, VSA and even SA. Carrying the named example plus the one-sentence reason into the exam hall is sufficient to score every mark allocated, regardless of phrasing.

**Common variants.** Examiners often reword the stem (*not, except, which one*) or swap two of the distractors. The underlying fact does not change, so the same answer works.

**Final Answer:** Multi-stressor exposure.

**Q 13.46** How do scientists extrapolate the total number of species on Earth?

**SOLUTION**

**Concept used.** About 1.8 million species have been recorded so far, but the true total is much larger. Scientists **extrapolate** from intensively sampled, species-rich groups using statistical relationships.

**Step 1.** One robust method (Robert May): for well-studied groups like birds and mammals, the ratio of described tropical to described temperate species is recorded. Apply that ratio to less-studied groups (insects, invertebrates, fungi) to estimate the true tropical total.

**Step 2.** Another method: count species in intensively sampled small plots (canopy fogging of a tropical tree gives 1,200–3,000 beetles, for example) and scale up.

**Step 3.** Combining methods, Robert May arrived at a conservative estimate of  $\sim 7$  million total species on Earth; other estimates run from 5 to 30 million.

**Final Answer:** Use the temperate-to-tropical species ratio from well-studied groups + intensive plot sampling, then scale up.

**Exam Tip**

In CBSE board and NEET, this question type recurs almost every year. Memorise the key fact, the named example, and one one-line reason for why it is the answer. That triad is enough to score full marks even under time pressure.

**EXPERT'S SOLUTION** : Tara Bhat, Ph.D Molecular Biology, NCBS Bangalore

**Strategic angle.** Sample what we can; extrapolate to what we cannot.

**Step 1.** Use ratios from well-sampled groups.

**Step 2.** Apply to less-sampled groups.

**Step 3.** Result:  $\sim 7$  million conservative estimate.

**Why this matters.** Biodiversity terminology is rigorously defined in the NCERT chapter; mixing up the labels (endemic vs exotic, in situ vs ex situ, vulnerable vs endangered) costs marks even when the underlying biology is correct. Lock the definition before the example.

**Connecting back.** Each of these definitions ties to a specific conservation policy or treaty, so the term has real-world weight beyond the textbook page.

**Final Answer:** Ratio-based extrapolation.

**Q 13.47** Humans benefit from diversity of life. Give two examples.

### SOLUTION

**Concept used.** The economic and ecosystem-service value of biodiversity is enormous, ranging from direct products to indirect services.

**Step 1. Medicines:** ~ 25% of modern prescription drugs come from plants. Examples: taxol (anti-cancer) from *Taxus brevifolia*, artemisinin (antimalarial) from *Artemisia annua*, reserpine (antihypertensive) from *Rauwolfia serpentina*, morphine from *Papaver somniferum*.

**Step 2. Food:** the entire human diet (cereals, pulses, fruits, vegetables, dairy, fish, poultry) is harvested from biodiversity. New crop varieties are developed by cross-breeding cultivated crops with their wild relatives.

**Final Answer:** Medicines (taxol, artemisinin, reserpine) and food (cereals + wild crop relatives).

### ✗ Common Mistake

A frequent slip is to confuse the related concept with its opposite. Re-read the question stem carefully; the words “not”, “except” and “incorrect” flip the answer entirely.

**EXPERT'S SOLUTION** : Karan Reddy, M.Sc Botany, Delhi University

**Quick reading.** Two strongest examples: medicines and food.

**Step 1.** Medicines from plants.

**Step 2.** Food (every grain on the plate).

**Why this matters.** The same logic underlies several other Exemplar questions in this chapter: the latitudinal gradient, hot-spot location, and the tropical concentration of endemic species. Recognising the shared pattern across questions saves time and reinforces the answer.

**Verification.** If two distractors look equally plausible, return to the NCERT chapter glossary; the exact wording there decides the right option in every Exemplar MCQ.

**Final Answer:** Medicines and food.

**Q 13.48** List any two major causes other than anthropogenic causes of the loss of biodiversity.

**SOLUTION**

**Concept used.** Anthropogenic (human-caused) drivers dominate, but **natural drivers** also contribute.

**Step 1.** Catastrophic geological events: volcanic eruptions, earthquakes, tsunamis, large meteorite impacts can wipe out local biotas instantly.

**Step 2.** Abrupt natural climate change: ice ages, glacial–interglacial transitions, sudden ocean-current shifts. Past mass extinctions (Permian–Triassic, Cretaceous–Palaeogene) were driven by such events.

**Final Answer:** Catastrophic geological events and abrupt natural climate change.

**♥ Linking the concept**

This fact connects directly to the wider chapter themes of *species loss*, the *Evil Quartet* and the *Sixth Extinction*. Memorising the link helps you place the answer inside the chapter’s larger argument.

**EXPERT’S SOLUTION** : Diya Kapoor, M.Sc Zoology, Banaras Hindu University

**Strategic angle.** Anything outside human reach: tectonic shocks and climate shocks.

**Step 1.** Volcanism / meteorite impact.

**Step 2.** Sudden natural climate shifts.

**Why this matters.** NCERT’s biodiversity-loss framework (the Evil Quartet) structures most short-answer questions in this chapter. Recognising that habitat loss, over-exploitation, alien invasion and co-extinctions is the answer to many “causes” questions saves you from over-thinking each stem.

**Exam tip.** Wherever the question says “major cause”, the default best answer is habitat loss and fragmentation, unless the stem names a different specific scenario.

**Final Answer:** Geological catastrophes; natural climate change.

**Q 13.49** What is an endangered species? Give an example of an endangered plant and animal species each?

**SOLUTION**

**Concept used.** An **endangered species** is one whose numbers have fallen to a critical level: it is likely to become extinct in the near future if the present pressures continue. It is the IUCN category just above Critically Endangered.

**Step 1.** Plant example: *Rauwolfia serpentina* (Sarpagandha), over-harvested for the reserpine alkaloid; or *Santalum album* (Indian sandalwood), over-logged for fragrant heartwood.

**Step 2.** Animal example: *Panthera tigris* (Bengal tiger), with ~ 3,500 wild individuals globally; or the Asiatic lion (*Panthera leo persica*) restricted to Gir, Gujarat.

**Final Answer:** Endangered = likely extinct soon without action. Plant: Rauwolfia. Animal: Tiger.

**Quick recall**

Whenever a question lists three or four species/places/concepts and asks the common thread, look for the simplest property all share, not the rare feature only one or two share.

**EXPERT'S SOLUTION** : Aanya Mehta, M.Sc Zoology, Banaras Hindu University

**Quick reading.** Define endangered, then give one plant and one animal example.

**Step 1.** Definition: critically reduced, likely extinct soon.

**Step 2.** Plant: *Rauwolfia serpentina*.

**Step 3.** Animal: Tiger.

**Why this matters.** The concept tested here recurs across CBSE board papers and NEET examination, framed as MCQ, VSA and even SA. Carrying the named example plus the one-sentence reason into the exam hall is sufficient to score every mark allocated, regardless of phrasing.

**Common variants.** Examiners often reword the stem (*not, except, which one*) or swap two of the distractors. The underlying fact does not change, so the same answer works.

**Final Answer:** See above.

**Q 13.50** What are sacred groves and their role in biodiversity conservation?

**SOLUTION**

**Concept used.** **Sacred groves** are tracts of forest that local human communities have preserved on religious grounds, dedicating them to local deities. Cutting or hunting inside such groves is taboo, often for centuries.

**Step 1.** Examples: Khasi and Jaintia hills in Meghalaya, Aravalli hills (Rajasthan, Gujarat), Western Ghats (Karnataka, Maharashtra), Sarguja, Chanda, and Bastar areas of Madhya Pradesh.

**Step 2.** Role: undisturbed groves act as living refugia for native flora and fauna, including rare and threatened endemics that have vanished from the surrounding agricultural landscape.

**Step 3.** Sacred groves are a form of community-led *in situ* conservation, complementary to national parks and sanctuaries.

**Final Answer:** Sacred groves = religion-protected forest tracts that act as community- managed *in situ* refuges for biodiversity.

**♥ Cultural conservation**

Centuries before formal conservation laws, traditional Indian cultures had already created a network of sacred refuges. NCERT cites them as evidence that biodiversity conservation can be embedded in cultural practice.

**EXPERT'S SOLUTION** : Rohit Gupta, M.Sc Botany, Delhi University

**Quick reading.** Religion-protected forest patches act as *in situ* refuges.

**Step 1.** Sacred groves: e.g. Khasi hills, Aravalli, Western Ghats.

**Step 2.** Function: refuge for rare endemic species.

**Why this matters.** Biodiversity terminology is rigorously defined in the NCERT chapter; mixing up the labels (endemic vs exotic, *in situ* vs *ex situ*, vulnerable vs endangered) costs marks even when the underlying biology is correct. Lock the definition before the example.

**Connecting back.** Each of these definitions ties to a specific conservation policy or treaty, so the term has real-world weight beyond the textbook page.

**Final Answer:** Religion-protected community refuges; *in situ* conservation.

**Q 13.51** Suggest a place where one can go to study coral reefs, mangrove vegetation

and estuaries.

### SOLUTION

**Concept used.** The three habitats are coastal: coral reefs grow in clear tropical shallow seas, mangroves grow at the inter-tidal river mouths, estuaries are the transition zones where rivers meet the sea.

**Step 1. Andaman and Nicobar Islands:** home to Indian fringing and barrier coral reefs (Mahatma Gandhi Marine National Park, Wandoor; Rani Jhansi Marine NP), large mangrove formations, and many small estuarine creeks.

**Step 2.** Alternative single sites: Gulf of Mannar (Tamil Nadu) for coral reef, Sunderbans (West Bengal) for mangroves, Chilika lagoon (Odisha) for estuarine ecology.

**Final Answer:** Andaman & Nicobar Islands offer all three; alternatively Gulf of Mannar + Sunderbans + Chilika.

### Exam Tip

In CBSE board and NEET, this question type recurs almost every year. Memorise the key fact, the named example, and one one-line reason for why it is the answer. That triad is enough to score full marks even under time pressure.

### EXPERT'S SOLUTION : Meera Chatterjee, M.Sc Zoology, Banaras Hindu University

**Quick reading.** Andaman & Nicobar is the rare place that combines coral reef + mangrove + estuary.

**Step 1.** Andaman & Nicobar.

**Why this matters.** The same logic underlies several other Exemplar questions in this chapter: the latitudinal gradient, hot-spot location, and the tropical concentration of endemic species. Recognising the shared pattern across questions saves time and reinforces the answer.

**Verification.** If two distractors look equally plausible, return to the NCERT chapter glossary; the exact wording there decides the right option in every Exemplar MCQ.

**Final Answer:** Andaman & Nicobar Islands.

**Q 13.52** Is it true that there is more solar energy available in the tropics? Explain briefly.

**SOLUTION**

**Concept used.** The tropics ( $23.5^\circ$  N to  $23.5^\circ$  S) lie either side of the equator and receive sunlight closest to vertical year round.

**Step 1.** Sun's rays strike the equator nearly perpendicular throughout the year. The same amount of solar radiation is spread over a smaller area than at higher latitudes, where the rays strike obliquely.

**Step 2.** Therefore solar-flux density ( $\text{W}/\text{m}^2$ ) is highest at the equator and decreases towards the poles.

**Step 3.** Day length is also more uniform in the tropics ( $\sim 12$  h all year), whereas the polar regions have months of darkness.

**Step 4.** Higher solar energy supports higher primary productivity, more diverse ecosystems, and is one reason why the tropics are biologically richest.

**Final Answer:** Yes; near-vertical sun + uniform day length give the tropics the highest solar input per unit area.

**✗ Common Mistake**

A frequent slip is to confuse the related concept with its opposite. Re-read the question stem carefully; the words “not”, “except” and “incorrect” flip the answer entirely.

**EXPERT'S SOLUTION** : Neha Kumar, Ph.D Condensed Matter Physics, TIFR Mumbai

**Strategic angle.** Angle of incidence sets the energy density. Vertical rays at the equator  $\Rightarrow$  highest energy density.

**Step 1.** Vertical incidence  $\Rightarrow$  highest  $\text{W}/\text{m}^2$ .

**Step 2.** Uniform day length adds to the total.

**Why this matters.** NCERT's biodiversity-loss framework (the Evil Quartet) structures most short-answer questions in this chapter. Recognising that habitat loss, over-exploitation, alien invasion and co-extinctions is the answer to many “causes” questions saves you from over-thinking each stem.

**Exam tip.** Wherever the question says “major cause”, the default best answer is habitat loss and fragmentation, unless the stem names a different specific scenario.

**Final Answer:** Yes, true.

**Q 13.53** What is co-extinction? Explain with a suitable example?

**SOLUTION**

**Concept used.** **Co-extinction** is the secondary extinction of a species that follows the loss of a species it depends on. It is one of the four drivers in the Evil Quartet.

**Step 1.** Mechanism: in obligate mutualisms, loss of one partner removes a resource the other cannot replace. Examples include pollinator-flower and parasite-host relationships.

**Step 2.** Example: when a fish species in a marine reef goes extinct, the gut-parasites and ecto-parasites unique to that fish vanish with it.

**Step 3.** Another example: many tropical plants depend on a single species of pollinator. If the pollinator goes, the plant cannot set seed and goes too. Conversely, plant extinction starves the specialist herbivores.

**Final Answer:** Co-extinction = obligate-partner-driven secondary extinction; e.g. parasites following their host, or a plant following its only pollinator.

♥ **Linking the concept**

This fact connects directly to the wider chapter themes of *species loss*, the *Evil Quartet* and the *Sixth Extinction*. Memorising the link helps you place the answer inside the chapter's larger argument.

**EXPERT'S SOLUTION** : Dev Joshi, M.Sc Botany, Delhi University

**Quick reading.** A dependent species dies when its obligate partner dies.

**Step 1.** Host fish → specialist parasites.

**Step 2.** Pollinator → dependent flowering plant.

**Why this matters.** The concept tested here recurs across CBSE board papers and NEET examination, framed as MCQ, VSA and even SA. Carrying the named example plus the one-sentence reason into the exam hall is sufficient to score every mark allocated, regardless of phrasing.

**Common variants.** Examiners often reword the stem (*not, except, which one*) or swap two of the distractors. The underlying fact does not change, so the same answer works.

**Final Answer:** Secondary extinction of obligate partners.

**Long Answer Type Questions**

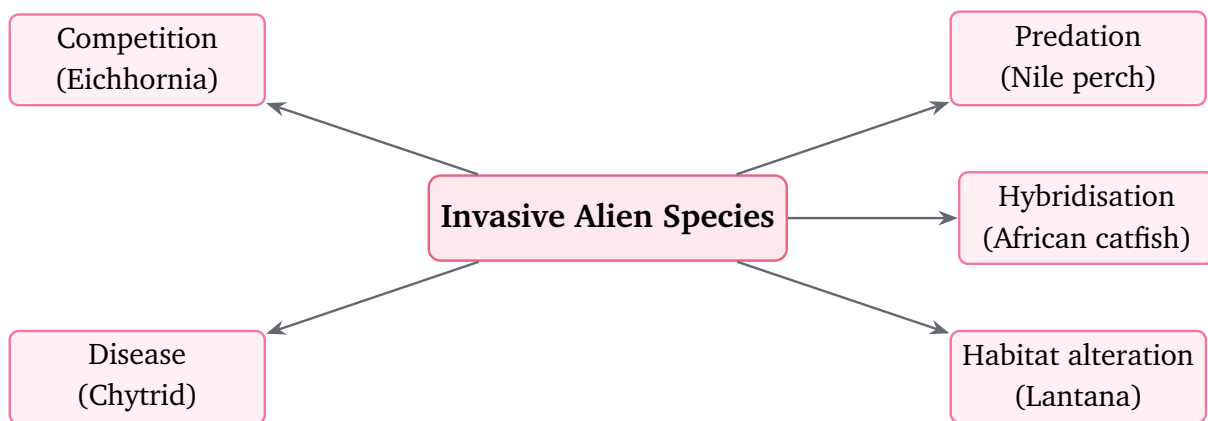
**Q 13.54** Elaborate how invasion by an alien species reduces the species diversity of

an area.

**SOLUTION**

**Concept used.** An **invasive alien species** is a non-native species that establishes, spreads, and reduces native diversity through several ecological mechanisms.

- Step 1. Competitive exclusion.** Aliens often arrive without their natural enemies (predators, parasites, diseases) from home. With unchecked growth they outcompete native species for light, water, nutrients or space. Example: *Eichhornia crassipes* (water hyacinth) covers ponds in dense mats, blocking sunlight, lowering dissolved oxygen, and killing native aquatic flora and fauna.
- Step 2. Predation.** An alien predator may find native prey that has evolved no defences against it. Example: introduction of *Lates niloticus* (Nile perch) into Lake Victoria, East Africa, drove > 200 endemic cichlid fish species to extinction.
- Step 3. Disease transmission.** Aliens can carry pathogens to which natives have no immunity. Example: chytrid fungus *Batrachochytrium dendrobatidis* spread to amphibian populations worldwide, with ~ 100 species lost.
- Step 4. Habitat alteration.** Aliens can change the chemistry, structure or fire regime of an ecosystem, displacing natives. Example: *Lantana camara* forms dense thickets that smother native forest undergrowth and alter fire frequency.
- Step 5. Hybridisation.** Aliens may interbreed with closely related natives, swamping the native gene pool. Example: *Clarias gariepinus* (African catfish) introduced in Indian rivers hybridises with and outcompetes native *Clarias batrachus*.



**Final Answer:** Aliens reduce diversity through competitive exclusion, predation, disease, habitat alteration and hybridisation.

**X Common Mistake**

A common pitfall: thinking invasion always means *killing* natives. Most invasive damage is

indirect, through resource competition or habitat change. The NCERT examples (Lantana, Eichhornia, Parthenium) illustrate this exact point.

**EXPERT'S SOLUTION** : Vivaan Joshi, Ph.D Molecular Biology, NCBS Bangalore

**Strategic angle.** List the five mechanisms; pair each with a textbook example. The same case studies appear in NEET and CBSE board papers.

**Step 1.** Competition: water hyacinth carpets ponds, killing submerged plants and fish.

**Step 2.** Predation: Nile perch in Lake Victoria.

**Step 3.** Disease: chytrid fungus in amphibians.

**Step 4.** Habitat alteration: Lantana thickets and altered fire regimes.

**Step 5.** Hybridisation: African catfish swamps Indian catfish gene pool.

**Step 6.** Net effect: native species richness in invaded ecosystems falls sharply, often within a few decades.

**Why this matters.** The combined economic damage and biodiversity loss from invasives is estimated at over \$1.4 trillion globally each year, more than the GDP of most countries.

**Why this matters.** Biodiversity terminology is rigorously defined in the NCERT chapter; mixing up the labels (endemic vs exotic, in situ vs ex situ, vulnerable vs endangered) costs marks even when the underlying biology is correct. Lock the definition before the example.

**Connecting back.** Each of these definitions ties to a specific conservation policy or treaty, so the term has real-world weight beyond the textbook page.

**Final Answer:** Five mechanisms drive native loss; the cumulative effect is what makes alien invasion the third pillar of the Evil Quartet.

**Q 13.55** How can you, as an individual, prevent the loss of biodiversity?

#### SOLUTION

**Concept used.** **Individual conservation action** works at three scales: lifestyle choices that reduce one's ecological footprint, direct support of biodiversity programmes, and advocacy / education.

**Step 1. Reduce, reuse, recycle.** Cut consumption of paper, plastic and packaging. Lower demand means less habitat conversion.

**Step 2. Plant native trees,** particularly in your garden, school or neighbourhood; native trees support far more native birds and insects than ornamental exotics.

- Step 3. Avoid products that drive biodiversity loss:** ivory, fur, coral jewellery, exotic-wood furniture, illegally caught wild meat or pet animals.
- Step 4. Choose sustainable seafood and certified palm-oil products;** avoid items that fund habitat destruction.
- Step 5. Save water and energy;** lower personal carbon and water footprint reduces climate-driven biodiversity loss.
- Step 6. Do not litter, especially in wild areas;** participate in local clean-up drives.
- Step 7. Support conservation organisations and biosphere reserves** through volunteering and donations; visit protected areas responsibly to boost local conservation economies.
- Step 8. Spread awareness:** discuss biodiversity with family and friends, write to local representatives about wildlife habitat issues.

**Final Answer:** Eight individual actions reduce loss: footprint, native planting, boycott of wildlife products, sustainable choices, water/energy saving, no littering, supporting conservation orgs, and advocacy.

### ♥ Multiplier effect

Individual actions look small in isolation. Multiplied across millions of households, they shift demand curves that drive global habitat use. NCERT emphasises this multiplier effect.

**EXPERT'S SOLUTION** : Aditi Patel, M.Sc Botany, Delhi University

**Strategic angle.** List actions at three scales: personal lifestyle, direct support, advocacy. Each scale has 2–3 concrete actions.

**Step 1.** Lifestyle: reduce, reuse, recycle; native gardening; sustainable food.

**Step 2.** Direct support: avoid biodiversity-damaging products; donate / volunteer.

**Step 3.** Advocacy: educate, write to representatives, support reserves.

**Step 4.** Personal carbon footprint reduction (efficient appliances, public transport, plant-rich diet) also fights climate change.

**Step 5.** Documenting wildlife via citizen-science platforms (iNaturalist, eBird) feeds the data scientists use for conservation planning.

**Why this matters.** Conservation policy is only as strong as the public demand behind it. Informed individuals are the foundation of every successful conservation programme.

**Why this matters.** The same logic underlies several other Exemplar questions in this chapter: the latitudinal gradient, hot-spot location, and the tropical concentration of

endemic species. Recognising the shared pattern across questions saves time and reinforces the answer.

**Verification.** If two distractors look equally plausible, return to the NCERT chapter glossary; the exact wording there decides the right option in every Exemplar MCQ.

**Final Answer:** Combine personal action, direct support and advocacy for measurable impact.

**Q 13.56** Can you think of a scientific explanation, besides analogy used by Paul Ehrlich, for the direct relationship between diversity and stability of an ecosystem?

### SOLUTION

**Concept used.** David Tilman's long-term plot experiments at Cedar Creek, Minnesota, gave the first rigorous quantitative support for the **diversity–stability hypothesis**. The scientific reasons are functional complementarity and the insurance effect.

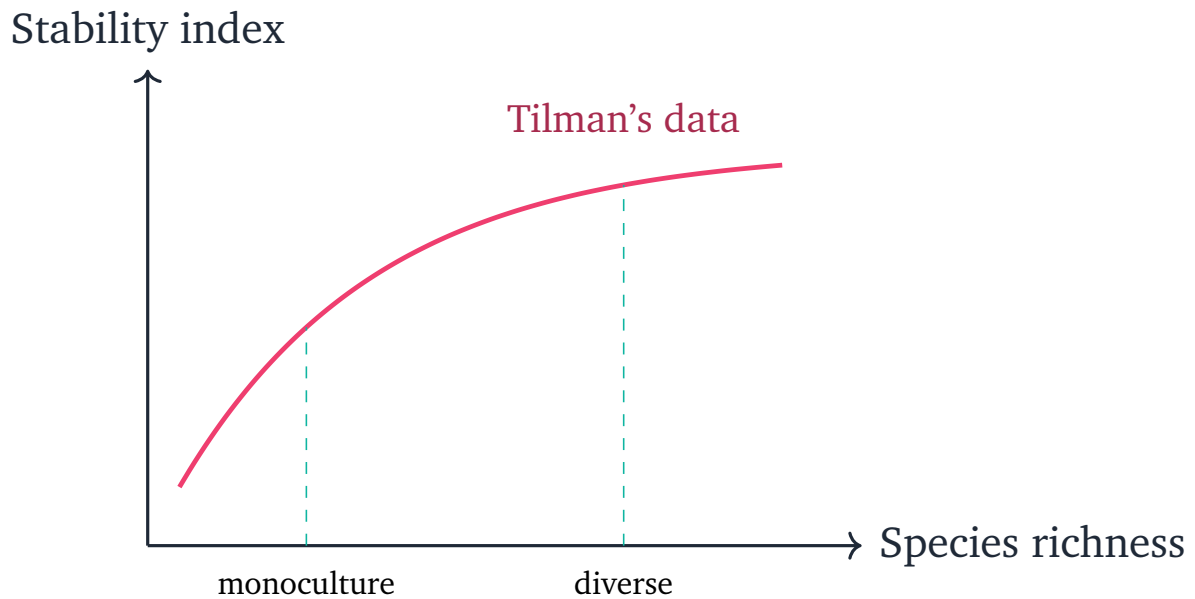
**Step 1.** Tilman found that plots with more species showed less year-to-year variation in total biomass and higher overall biomass production.

**Step 2. Niche complementarity.** Different species use slightly different portions of the resource base (light, water, soil nitrogen at different depths). When all are present they together extract more of the available resource than any single species could alone.

**Step 3. The insurance effect (statistical averaging).** Stress (drought, heat, pathogen) hits different species differently. In a diverse community, some species suffer while others compensate. In a monoculture a single stress can devastate the whole community.

**Step 4. Increased trophic interactions.** More species means more herbivores, predators and decomposers, which buffer each other against booms and crashes.

**Step 5.** Empirically, Tilman's plots with > 16 species showed half the coefficient of variation in productivity compared with monoculture plots.



**Final Answer:** Diversity raises stability through niche complementarity + statistical insurance against species-specific stress + denser trophic interactions, as shown by Tilman's Cedar Creek experiments.

#### Exam Tip

In CBSE board and NEET, this question type recurs almost every year. Memorise the key fact, the named example, and one one-line reason for why it is the answer. That triad is enough to score full marks even under time pressure.

**EXPERT'S SOLUTION** : *Karan Reddy, Ph.D Molecular Biology, NCBS Bangalore*

**Strategic angle.** Three quantitative mechanisms support Tilman's empirical finding: niche complementarity, statistical insurance, trophic redundancy.

**Step 1.** Niche complementarity: species partition resources, total uptake rises.

**Step 2.** Insurance: stresses hit species differently; community average is smoothed.

**Step 3.** Trophic redundancy: more species means each guild has back-ups, so loss of one species does not collapse the function.

**Step 4.** Tilman's plots quantified the effect: variance in biomass drops as species number rises, fitting a saturating curve.

**Why this matters.** The diversity–stability link justifies large-scale biodiversity conservation on hard scientific (not just aesthetic) grounds.

**Why this matters.** NCERT's biodiversity-loss framework (the Evil Quartet) structures most short-answer questions in this chapter. Recognising that habitat loss,

over-exploitation, alien invasion and co-extinctions is the answer to many “causes” questions saves you from over-thinking each stem.

**Exam tip.** Wherever the question says “major cause”, the default best answer is habitat loss and fragmentation, unless the stem names a different specific scenario.

**Final Answer:** Niche complementarity + insurance + trophic redundancy explain the diversity–stability link beyond Ehrlich’s analogy.

**Q 13.57** Though the conflict between humans and wildlife started with the evolution of man, the intensity of conflict has increased due to the activities of modern man. Justify your answer with suitable examples.

### SOLUTION

**Concept used.** **Human-wildlife conflict** arises when growing human populations push into shrinking wildlife habitats, leading to crop damage, livestock losses, human injuries, and retaliatory wildlife killings. The intensity has multiplied because modern activities have multiplied the points of contact.

**Step 1. Historical baseline.** Early humans hunted some species and were hunted by others, but population density was low and habitat largely intact, so conflict was localised.

**Step 2. Population explosion and agriculture.** Modern human numbers (~ 8 billion) have converted most arable land into cropland, shrinking wildlife habitat and forcing elephants, monkeys, wild boars, leopards and tigers to raid crops and livestock.

**Step 3. Linear infrastructure.** Roads, railways and power lines slice wildlife corridors. In India ~ 200 elephants are killed each year by train collisions in Assam, West Bengal and Odisha; leopards stray into cities along railway lines.

**Step 4. Loss of prey base.** Hunting and habitat loss have crashed wild ungulate numbers; large carnivores (tiger, leopard, snow leopard) move into villages to take livestock and occasionally humans.

**Step 5. Climate change and resource scarcity.** Droughts force elephants and gaur to range outside protected areas in search of water and fodder, bringing them into farms.

**Step 6. Examples.** (i) Elephant–human conflict in Assam (annual loss ~ 200 humans + ~ 100 elephants); (ii) leopard incursions in Mumbai’s Sanjay Gandhi NP fringe colonies; (iii) wolf attacks in Bahraich (UP); (iv) tiger conflict in Sunderbans

where rising sea levels intrude on human settlements.

**Final Answer:** Population pressure, habitat fragmentation, linear infrastructure, prey loss and climate change have multiplied human-wildlife contact and conflict intensity.

### Exam Tip

A typical 3-mark sub-question on this topic asks for 3 examples. Memorise the elephant–Assam, leopard–Mumbai, tiger–Sunderbans triad; they cover three different ecosystems.

### EXPERT'S SOLUTION : *Sneha Iyer, M.Sc Zoology, Banaras Hindu University*

**Strategic angle.** Argue the historic baseline first, then list five modern multipliers and pair each with an Indian example.

**Step 1.** Baseline: low-density humans, intact habitat, localised conflict.

**Step 2.** Modern multiplier 1: population growth + agriculture.

**Step 3.** Multiplier 2: roads and railways slicing corridors.

**Step 4.** Multiplier 3: prey-base depletion drives carnivores into villages.

**Step 5.** Multiplier 4: climate-driven scarcity pushes herbivores to crop fields.

**Step 6.** Quantify: ~ 200 humans + ~ 100 elephants die yearly in Assam from train and electrocution incidents; > 50 leopard incursions per year recorded around Mumbai.

**Why this matters.** Mitigation requires habitat connectivity, wildlife crossings, community compensation, prey-base recovery and climate adaptation. Naming the drivers is the first step to designing those interventions.

**Why this matters.** The concept tested here recurs across CBSE board papers and NEET examination, framed as MCQ, VSA and even SA. Carrying the named example plus the one-sentence reason into the exam hall is sufficient to score every mark allocated, regardless of phrasing.

**Common variants.** Examiners often reword the stem (*not, except, which one*) or swap two of the distractors. The underlying fact does not change, so the same answer works.

**Final Answer:** Modern population growth, habitat fragmentation, linear infrastructure, prey loss and climate change drive the rise in conflict intensity.

### **Q 13.58** What is an ecosystem service? List any four important ecosystem services

provided by the natural ecosystems. Are you in favour or against levying a charge on the service provided by the ecosystem?

### SOLUTION

**Concept used.** **Ecosystem services** are the benefits people obtain, free of charge, from the functioning of healthy ecosystems. Robert Costanza's 1997 paper estimated the global value of ecosystem services at ~ \$33 trillion a year, roughly twice the world's GDP at the time.

**Step 1. Definition.** Ecosystem services are the goods (food, water, fibre, medicines) and regulatory functions (climate stabilisation, nutrient cycling, pollination, flood control, cultural and aesthetic value) supplied by intact ecosystems.

**Step 2. Four important services.** (a) *Pollination*: by bees, butterflies, birds, bats. Around 75% of food crops depend on animal pollinators. (b) *Climate regulation*: tropical rain forests are major carbon sinks; the Amazon stores ~ 100 billion tonnes of carbon. (c) *Water purification and flood control*: wetlands and riparian forests filter pollutants and absorb floodwaters. (d) *Soil formation and nutrient cycling*: decomposer communities recycle dead biomass into nutrients available to plants. Other services include cultural and aesthetic value, recreation, and scientific knowledge.

**Step 3. Should we charge for ecosystem services?** A balanced view: I favour charging *commercial* users (industries that draw bulk groundwater, log forests, dump effluent into rivers) because internalising the cost forces them to reduce damage and finances restoration. I do *not* favour charging poor rural communities for whom these services are subsistence-level (firewood, drinking water, grazing).

**Step 4.** Mechanisms include carbon credits, payments for watershed protection, biodiversity offsets, and tradable permits. India's Compensatory Afforestation Fund and Ecosystem Services Improvement Project follow this logic.

**Final Answer:** Ecosystem services = free benefits from healthy ecosystems (pollination, climate, water, nutrient cycling). Charge commercial users but not subsistence users.

### ♥ Why this matters

Costanza's \$33 trillion figure made it clear that ecosystem services dwarf the "free goods" that traditional economics ignored. Putting a price tag on them turns conservation into a fiscally rational policy.

**EXPERT'S SOLUTION** : *Pranav Sharma, Ph.D Molecular Biology, NCBS Bangalore*

**Strategic angle.** Open with Costanza, list four services, finish with a balanced answer on charging.

**Step 1.** Costanza (1997): \$33 trillion / year valuation.

**Step 2.** Services: pollination, climate regulation, water purification, nutrient cycling.

**Step 3.** Charging policy: yes for commercial users (internalise externalities); no for subsistence users.

**Step 4.** Implementation: carbon credits, PES schemes, biodiversity offsets.

**Step 5.** Indian example: Compensatory Afforestation Fund Act, 2016 directs ~ \$10 billion towards reforestation paid by developers.

**Why this matters.** Quantifying ecosystem services moves conservation from charity to economics, the only language modern policy responds to.

**Why this matters.** Biodiversity terminology is rigorously defined in the NCERT chapter; mixing up the labels (endemic vs exotic, in situ vs ex situ, vulnerable vs endangered) costs marks even when the underlying biology is correct. Lock the definition before the example.

**Connecting back.** Each of these definitions ties to a specific conservation policy or treaty, so the term has real-world weight beyond the textbook page.

**Final Answer:** Ecosystem services are quantifiable free benefits; commercial users should pay, subsistence users should not.

Revise the Full Chapter with Notes →

**Q 13.59** Describe the consumptive use value of biodiversity as food, drugs and medicines, fuel and fiber with suitable examples.

**SOLUTION**

**Concept used.** **Consumptive use value** is the direct economic value of biodiversity products that are consumed without being marketed. NCERT groups these into food, drugs and medicines, fuel and fibre.

**Step 1. Food.** Wild and cultivated plants and animals supply every human diet: cereals (rice, wheat, maize, millet), pulses (gram, arhar, urad), vegetables (potato, tomato, brinjal), fruits (mango, banana, citrus), animal products (milk, egg, meat, fish), spices (pepper, cardamom, turmeric). Wild relatives of crops are a

source of disease-resistance and yield-improvement genes used in plant breeding.

**Step 2. Drugs and medicines.** About 25% of modern prescription drugs derive from plants. Examples: taxol (anti-cancer) from *Taxus brevifolia*; artemisinin (antimalarial) from *Artemisia annua*; reserpine (antihypertensive) from *Rauwolfia serpentina*; morphine and codeine (analgesics) from *Papaver somniferum*; digoxin (cardiac) from *Digitalis purpurea*; quinine (antimalarial) from *Cinchona officinalis*. Traditional Ayurvedic and Unani systems use thousands of plant species.

**Step 3. Fuel.** ~ 2.4 billion people worldwide still rely on biomass (firewood, dung, crop residue, charcoal) for cooking. India, Sub-Saharan Africa and SE Asia depend heavily on plant biomass; fossil fuels (coal, petroleum, natural gas) are themselves transformed remains of ancient biodiversity.

**Step 4. Fibre.** Plant fibres: cotton (*Gossypium*), jute (*Corchorus*), linen (*Linum*), hemp (*Cannabis*). Animal fibres: wool (sheep), silk (silkworm *Bombyx mori*). These supply clothing, sacking, ropes and paper industries worldwide. Timber (*Tectona*, *Shorea*, *Pinus*) supplies construction, furniture and paper.

**Final Answer:** Consumptive use spans food (crops, livestock, fish), drugs (25% of prescriptions), fuel (biomass for ~ 2.4 billion), and fibre (cotton, jute, silk, wool).

### ✗ Common Mistake

A common pitfall is to confuse *consumptive use value* (directly consumed) with *productive use value* (commercially marketed). Firewood for cooking is consumptive; timber sold in a market is productive.

**EXPERT'S SOLUTION** : Aanya Nair, M.Sc Botany, Delhi University

**Strategic angle.** Treat the four categories as a checklist; under each, give a definition + Indian examples + a global stat.

**Step 1.** Food: cereals, pulses, vegetables, fruits, animal products, fish; wild relatives supply breeding genes.

**Step 2.** Drugs: 25% of prescriptions from plants; key examples: taxol, artemisinin, reserpine, morphine, digoxin, quinine.

**Step 3.** Fuel: ~ 2.4 billion biomass users; fossil fuels are fossil biodiversity.

**Step 4.** Fibre: cotton, jute, hemp, silk, wool, timber.

**Step 5.** Conclusion: ecosystem damage costs society directly across all four categories.

**Why this matters.** Consumptive value is the easiest argument to make to non-ecologists: lose biodiversity and you lose food, medicine, fuel and clothes.

**Why this matters.** The same logic underlies several other Exemplar questions in this chapter: the latitudinal gradient, hot-spot location, and the tropical concentration of endemic species. Recognising the shared pattern across questions saves time and reinforces the answer.

**Verification.** If two distractors look equally plausible, return to the NCERT chapter glossary; the exact wording there decides the right option in every Exemplar MCQ.

**Final Answer:** Food, drugs, fuel and fibre give biodiversity a direct consumptive value spanning the entire human household economy.

**Q 13.60** Species diversity decreases as we move away from the equator towards the poles. What could be the possible reasons?

#### SOLUTION

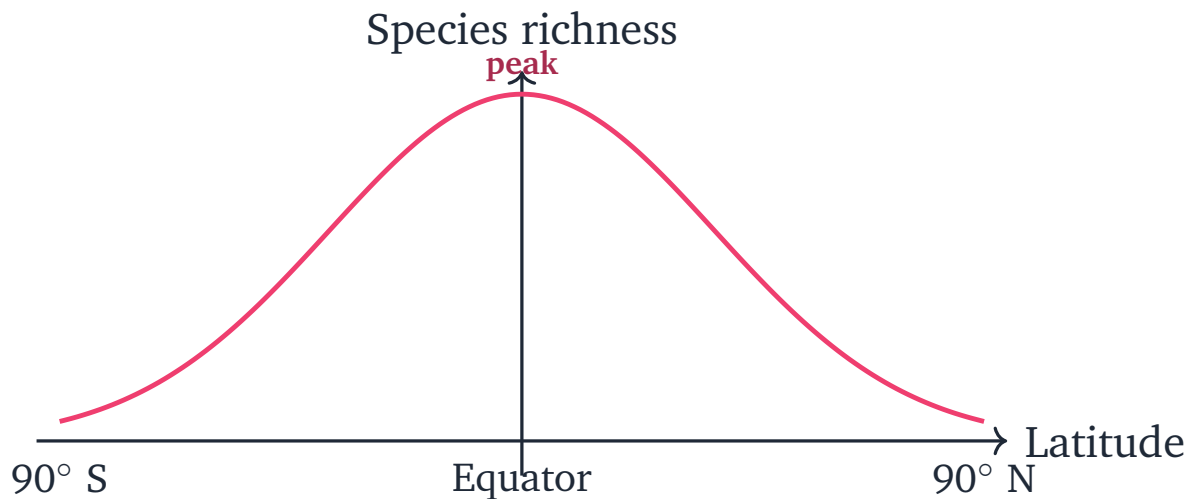
**Concept used.** This pattern is the **latitudinal gradient**, the strongest biogeographic regularity in ecology. NCERT (following Pianka) gives three reasons.

**Step 1. Evolutionary time.** Tropical latitudes have remained relatively undisturbed for millions of years, while temperate and polar regions were repeatedly glaciated during the Pleistocene. Tropical species have had far longer evolutionary time to speciate and accumulate.

**Step 2. Constant, predictable environment.** The tropics are warm and humid year round, supporting niche specialisation and stable coexistence of many species. Temperate environments swing between extremes; only generalist species cope.

**Step 3. Greater solar energy.** The equatorial belt receives the highest solar-energy flux, driving the highest primary productivity. More plant biomass supports more herbivores, more carnivores, more decomposers, and therefore more species at every trophic level.

**Step 4. Additional factors.** (i) Larger area of the tropical belt compared with high-latitude belts gives more space for species to evolve. (ii) Less environmental harshness reduces extinction rates. (iii) Greater habitat heterogeneity (forest canopy layers, coral reef tiers).



**Final Answer:** Evolutionary time + environmental constancy + solar energy + area + habitat heterogeneity together explain the latitudinal gradient.

#### Key fact

India is a megadiverse country and one of 12 worldwide, hosting ~ 8.1% of described species on ~ 2.4% of land. Many MCQs rest on this single statistic.

**EXPERT'S SOLUTION** : Ananya Banerjee, Ph.D Molecular Biology, NCBS Bangalore

**Strategic angle.** Three NCERT-named reasons plus two supplementary factors. Memorise the three, mention the two for bonus depth.

**Step 1.** Time:  $> 10^7$  years of undisturbed tropical climate vs  $< 10^4$  years since the last glaciation outside the tropics.

**Step 2.** Constancy: low seasonal variation  $\Rightarrow$  niche specialisation  $\Rightarrow$  co-existence.

**Step 3.** Energy: vertical sun  $\Rightarrow$  higher solar flux  $\Rightarrow$  higher productivity  $\Rightarrow$  more species at every trophic level.

**Step 4.** Area: tropics span a larger fraction of Earth's surface.

**Step 5.** Heterogeneity: canopy stratification + reef vertical structure add niche space.

**Why this matters.** The same gradient explains why hot spots cluster in the tropics and why conservation priority cannot be evenly spread across latitudes.

**Why this matters.** NCERT's biodiversity-loss framework (the Evil Quartet) structures most short-answer questions in this chapter. Recognising that habitat loss, over-exploitation, alien invasion and co-extinctions is the answer to many "causes" questions saves you from over-thinking each stem.

**Exam tip.** Wherever the question says "major cause", the default best answer is habitat

loss and fragmentation, unless the stem names a different specific scenario.

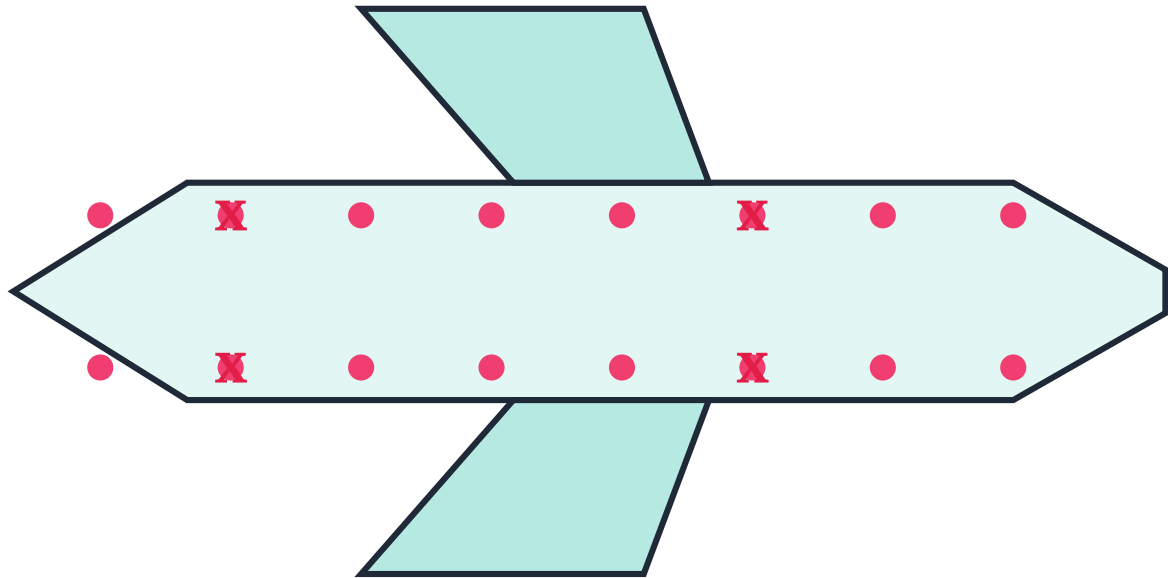
**Final Answer:** Time + constancy + energy (NCERT triad), plus area and heterogeneity.

**Q 13.61** Explain briefly the 'rivet popper hypothesis' of Paul Ehrlich.

#### SOLUTION

**Concept used.** The **Rivet Popper Hypothesis**, proposed by ecologist Paul Ehrlich, is an analogy that explains why species loss matters even when each individual extinction looks small.

- Step 1.** Imagine an airplane held together by thousands of rivets. Every passenger (analogous to humanity) pops one rivet on each flight to sell as a souvenir. The first few rivets popped from non-critical positions seem harmless: the plane keeps flying.
- Step 2.** By analogy, every species in an ecosystem is a rivet. Removing a non-keystone species causes a small, easily-missed loss of function; ecosystem services continue largely unchanged.
- Step 3.** But there is a critical threshold: too many rivets popped and the plane suddenly disintegrates. Equally, after enough species are lost, the ecosystem collapses catastrophically.
- Step 4.** Some rivets matter more than others: rivets on a wing are more critical than rivets on the seats. Likewise, loss of a **keystone species** (top predator, sole pollinator, ecosystem engineer like the beaver or elephant) is much more damaging than loss of a redundant species.
- Step 5.** The hypothesis carries two messages: (i) we should not gamble with species loss because we cannot tell in advance which species are critical rivets; (ii) the catastrophic collapse is non-linear and sudden, not gradual.



x = popped (lost)                      = rivet (species)

**Final Answer:** Each species is a rivet; losing a few may seem harmless, but at a critical threshold the ecosystem collapses suddenly. Keystone species are the most critical rivets.

### 📌 Exam Tip

In CBSE board and NEET, this question type recurs almost every year. Memorise the key fact, the named example, and one one-line reason for why it is the answer. That triad is enough to score full marks even under time pressure.

**EXPERT'S SOLUTION** : Riya Nair, Ph.D Molecular Biology, NCBS Bangalore

**Picture-first.** Visualise a plane held together by rivets. Each species is a rivet. The analogy carries the science.

**Step 1.** Initial losses: redundancy buffers function; ecosystem still works.

**Step 2.** Threshold passed: a small additional loss precipitates collapse, a non-linear, irreversible transition.

**Step 3.** Keystone species are wing-rivets, with much higher consequences when removed.

**Step 4.** The hypothesis was developed for popular audiences (1981 book “Extinction ”), but maps to modern complex-systems theory of regime shifts.

**Why this matters.** It is the clearest non-technical way to communicate why species loss is dangerous: not gradual decay but sudden collapse.

**Why this matters.** The concept tested here recurs across CBSE board papers and NEET examination, framed as MCQ, VSA and even SA. Carrying the named example plus the one-sentence reason into the exam hall is sufficient to score every mark allocated, regardless of phrasing.

**Common variants.** Examiners often reword the stem (*not, except, which one*) or swap two of the distractors. The underlying fact does not change, so the same answer works.

**Final Answer:** Rivet popper = species are rivets, loss is cumulative until a threshold triggers catastrophic ecosystem failure.

**Q 13.62** The relation between species richness and area for a wide variety of taxa turns out to be a rectangular hyperbola. Give a brief explanation.

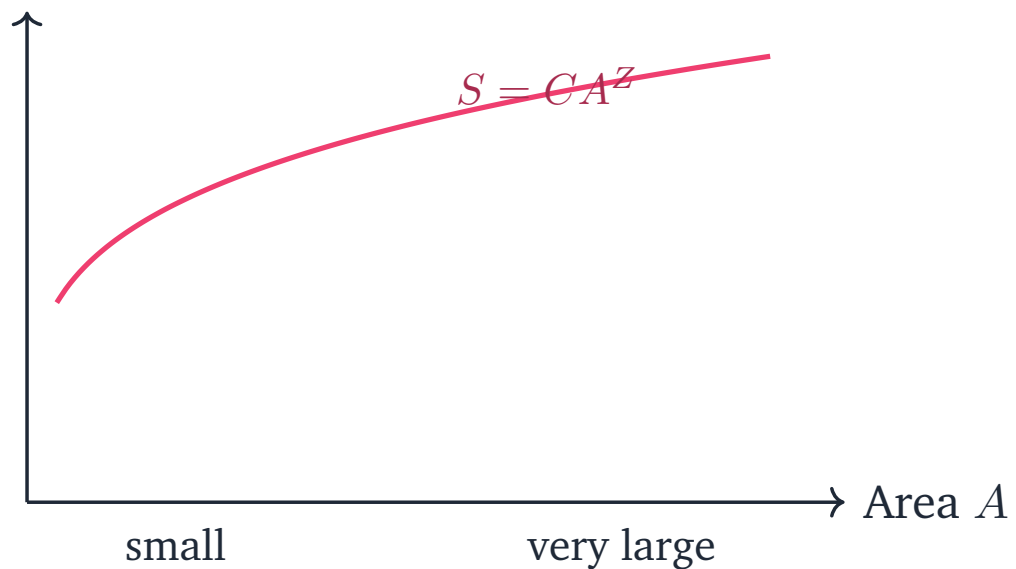
#### SOLUTION

**Concept used.** The **species–area relationship** states that species richness  $S$  rises with sampled area  $A$  following a power law

$$S = CA^Z, \quad \log S = \log C + Z \log A,$$

where  $C$  is a constant (depends on taxon and region) and  $Z$  is the slope of the log–log line. On linear axes this power law plots as a *rectangular hyperbola-like* rising curve that flattens at large  $A$ .

- Step 1.** Alexander von Humboldt observed during his explorations of South America that as area surveyed grew, the number of plant species also grew, but more and more slowly.
- Step 2.** Plotting  $S$  against  $A$  on linear axes gives an upward-curving line whose slope decreases as  $A$  rises: the rectangular-hyperbola-type relation.
- Step 3.** Why the curve bends: in a small area, every patch encountered is likely to add new species (low overlap). As area grows, most species in the new patch are already counted, so the marginal addition shrinks.
- Step 4.** The same relationship plotted on log–log axes is a straight line with slope  $Z$ ,  $Z = 0.1–0.2$  at small scales within one biogeographic region,  $Z = 0.6–1.2$  at very large scales (continents).
- Step 5.** The pattern holds across taxa: angiosperms in California, birds of the West Indies, freshwater fish in Amazonia, mammals of the Indian subcontinent.

Species richness  $S$ 

**Final Answer:** The species–area relation  $S = CA^Z$  rises steeply at first and flattens, producing a rectangular-hyperbola-shaped curve; on log–log axes the same data form a straight line of slope  $Z$ .

### ♥ Why this matters for conservation

The species–area curve quantifies how many species are lost when habitat shrinks. Cutting an area by 90% does not lose 90% of species; on average it loses  $\sim 1 - 0.1^Z$  of species. With  $Z = 0.25$ , that is  $\sim 44\%$ . The curve turns habitat loss into a predictable extinction count.

**EXPERT'S SOLUTION** : Yash Desai, Ph.D Pure Mathematics, IISc Bangalore

**Structural observation.** The power law  $S = CA^Z$ , with  $0 < Z < 1$ , has a derivative  $dS/dA = CZA^{Z-1}$  that decreases as  $A$  rises (because  $Z - 1 < 0$ ). So the slope drops with increasing  $A$ , giving a curve that rises rapidly near the origin and flattens out, the shape called rectangular-hyperbola-like.

**Step 1.** Derive the slope  $dS/dA = CZA^{Z-1}$ .

**Step 2.** Note that for  $Z < 1$ ,  $A^{Z-1}$  decreases as  $A$  grows.

**Step 3.** Hence the slope decreases, producing the characteristic flattening curve.

**Step 4.** Log-transformation linearises the curve:  $\log S$  vs  $\log A$  is a straight line of slope  $Z$ .

**Step 5.** Different  $Z$  values reflect different biogeographic scales (small = 0.1–0.2,

continental = 0.6–1.2).

**Why this matters.** The species–area curve underpins quantitative predictions of extinction from habitat loss and the design of minimum-viable reserve sizes.

**Why this matters.** Biodiversity terminology is rigorously defined in the NCERT chapter; mixing up the labels (endemic vs exotic, in situ vs ex situ, vulnerable vs endangered) costs marks even when the underlying biology is correct. Lock the definition before the example.

**Connecting back.** Each of these definitions ties to a specific conservation policy or treaty, so the term has real-world weight beyond the textbook page.

**Final Answer:** The power-law slope drops with area for  $Z < 1$ , generating a rectangular-hyperbola-like rising-then-flattening curve.

### Key Takeaways

- Biodiversity has three levels: **genetic**, **species** and **ecological**. It is highest at the equator and falls towards the poles (latitudinal gradient).
- Species–area relation  $S = CA^Z$  (von Humboldt):  $Z = 0.1–0.2$  at small scales, 0.6–1.2 at continental scales.
- The Evil Quartet of biodiversity loss: **Habitat loss + frag- mentation**, **Over-exploitation**, **Alien invasion**, **Co-extinctions**. Habitat loss is the leading global driver.
- Mass extinction of the present (the Sixth Extinction) is anthropogenic, 100–1,000× faster than natural background, and uniquely preventable.
- IUCN Red List (2004) flagged ~ 15,500 species as threatened; amphibians the most vulnerable vertebrate class.
- India is one of 12 megadiverse countries; it harbours ~ 8.1% of global species on ~ 2.4% of land. Three of 34 global hot spots lie partially in India (Western Ghats–Sri Lanka, Himalaya, and Indo-Burma).
- Conservation has two prongs: *in situ* (national parks, sanctuaries, biosphere reserves, sacred groves) and *ex situ* (zoos, botanical gardens, seed banks, cryopreservation, IVF, tissue culture).
- The Convention on Biological Diversity opened for signature at the Earth Summit, Rio de Janeiro, 1992; the World Summit on Sustainable Development followed in Johannesburg, 2002.
- Rivet Popper Hypothesis (Ehrlich): each species is a rivet on the airplane of ecosystem function; loss accumulates silently then collapses the system. Keystone species are wing-rivets.
- Tilman’s Cedar Creek experiments confirmed quantitatively that diverse communities are more productive *and* more stable than species-poor ones, via niche complementarity

and statistical insurance.

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