

13 Biodiversity and Conservation

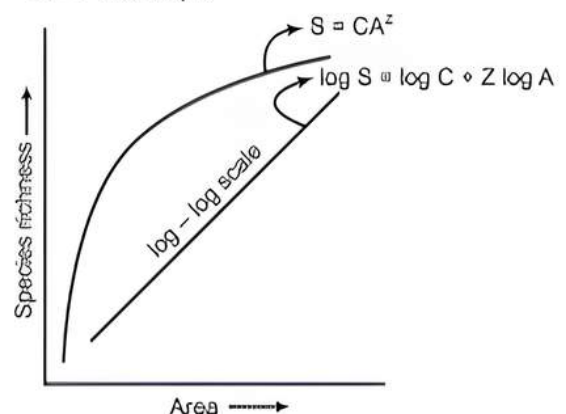
Fastrack® Revision

- ▶ In our biosphere, immense diversity (or heterogeneity) exists not only at the species level but at all levels of biological organisation (from macromolecules within cells to biomes).
- ▶ Biodiversity is a term used to describe the combined diversity at all the levels of biological organisation and is popularised by the sociobiologist, **Edward Wilson**.
- ▶ Various types of biodiversity are:
 - ▶ **Genetic Diversity:** A single species might show high diversity at the genetic level over its distributional range. For example, The genetic variation of the medicinal plant's species *Rauwolfia vomitoria* growing in Himalayan regions (in potency and concentration of chemicals).
 - ▶ **Species Diversity:** The diversity at the species level. For example, The Western Ghats have greater amphibian species diversity than the Eastern Ghats.
 - ▶ **Ecological Diversity:** Diversity at the ecosystem level. For example, Deserts, rain forests, mangroves, coral reefs, wetlands, estuaries, and alpine meadows of India have a greater ecosystem diversity than a Scandinavian country like Norway.
- ▶ **Number of Species on Earth and in India**
 - ▶ The total number of plant and animal species described so far is slightly more than 1.5 million.
 - ▶ More than 70% of all the species recorded are animals, while plants including algae, fungi, bryophytes, gymnosperms and angiosperms comprise no more than 22% of the total.
 - ▶ Among animals, insects are the most species-rich taxonomic group, making up more than 70% of the total.
 - ▶ India has only 2.4% of the world's land area and its share of the global species diversity is an impressive 8.1% and that is how makes India as one of the 12 mega diversity countries of the world.

- ▶ Colombia located near the equator has nearly 1,400 species of birds while New York at 41° N has 105 species and Greenland at 71° N has only 56 species. India, with much of its land area in the tropical latitudes, has more than 1,200 species of birds.
- ▶ The largely tropical Amazonian rain forest in South America has the greatest biodiversity on earth. It is home to more than 40,000 species of plants, 3,000 of fishes, 1,300 of birds, 427 of mammals, 427 of amphibians, 378 of reptiles and of more than 1,25,000 invertebrates.
- ▶ **Tropics have greatest biodiversity because of the following reasons:**
 - Unlike temperate regions subjected to frequent glaciations in the past, tropical latitudes have remained relatively undisturbed for millions of years.
 - Tropical environments are less seasonal, more constant and predictable which promote niche specialisation and lead to a greater species diversity.
 - There is more solar energy available in the tropics, which contributes to higher productivity, thus, contributing indirectly to greater diversity.

II. Species-Area Relationships

- ▶ **Alexander von Humboldt** observed that within a region, species richness increased with increasing explored area, but only up to a limit.
- ▶ The relation between species richness and area for a wide variety of taxa such as angiosperm plants, birds, bats, freshwater fishes turns out to be a rectangular hyperbola.
- ▶ On a logarithmic scale, the relationship is a straight line described by the equation,
 - $\log S = \log C + Z \log A$ where, S = Species richness, A = Area, Z = Slope of the line (regression coefficient), C = Y-intercept.



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Nearly 45,000 species of plants and twice as many of animals have been recorded from India.

▶ Patterns of Biodiversity

The most common biodiversity patterns are described as latitudinal gradients and species-area relationships.

I. Latitudinal Gradients

- ▶ Species diversity decreases as we move away from the equator towards the poles.
- ▶ Tropics harbour more species than temperate or polar areas.

- The species-area relationship among very large areas like the entire continents has the slope of the line much steeper (Z values in the range of 0.6 to 1.2).
- For frugivorous (fruit-eating) birds and mammals in the tropical forests of different continents, the slope is found to be 1.15.

► Importance of Species Diversity to the Ecosystem

- Communities with more species, generally, tend to be more stable than those with less species.
- A stable community should not show too much variation in productivity from year-to-year.
- David Tilman found that plots with more species showed less year-to-year variation in total biomass and increased diversity contributed to higher productivity.
- In an ecosystem, all parts are joined together using thousands of species.

► Loss of Biodiversity

- The colonisation of tropical Pacific Islands by humans is said to have led to the extinction of more than 2,000 species of native bird.
- The IUCN Red List (2004) documents the extinction of 784 species.
- Some examples of recent extinctions include the dodo (Mauritius), quagga (Africa), thylacine (Australia), Steller's sea cow (Russia) and three subspecies (Bali, Java, Caspian) of tiger.
- Loss of biodiversity in a region may lead to:
 - Decline in plant production.
 - Lowered resistance to environmental perturbations such as drought.
 - Increased variability in certain ecosystem processes such as plant productivity, water use, and pest and disease cycles.

► Causes of biodiversity losses

I. Habitat Loss and Fragmentation

- Tropical rain forests covered more than 14% of the Earth's land surface earlier. These rain forests now cover no more than 6%.
- The Amazon rain forest called as the 'lungs of the planet' harbouring probably millions of species is being cut and cleared for cultivating soyabeans or for conversion to grasslands for raising beef cattle.
- Breaking of large areas into small fragments cause biodiversity loss.

II. Over Exploitation

- Many species extinctions in the last 500 years were due to over exploitation by humans. For example, Steller's sea cow, passenger pigeon.

III. Alien Species Invasions

- When alien species are introduced, these cause decline or extinction of indigenous species.
For example, The Nile perch introduced into Lake Victoria in east Africa led eventually to the extinction of an ecologically unique assemblage of more than 200 species of cichlid fish in the lake.
- Introduction of the African catfish, *Clarias gariepinus* for aquaculture purposes is posing a threat to the indigenous catfishes in our rivers.

IV. Co-extinctions

- When a species becomes extinct, the plant and animal species associated with it in an obligatory way, also become extinct.

- When a host fish species becomes extinct, its unique assemblage of parasites also meets the same fate.

For example, In plant-pollinator mutualism, extinction of one invariably leads to the extinction of the other.

► Biodiversity Conservation

Reasons of conserving biodiversity are grouped into three categories:

I. Narrowly Utilitarian: Humans derive countless direct economic benefits from nature such as cereals, pulses, fruits, and firewood, fiber, and construction material, industrial products like tannins, lubricants, dyes, resins and perfumes.

II. Broadly Utilitarian: Biodiversity plays a major role in many ecosystem services that nature provides.

- Amazon forest is estimated to produce, through photosynthesis, 20% of the total oxygen in the earth's atmosphere.
- Bees, bumblebees, birds and bats pollinate the flowers without which plants cannot give us fruits or seeds.

III. Ethical: The ethical argument for conserving biodiversity relates to what we owe to millions of plant, animal and microbe species and with whom we share this planet.

► Ways to conserve biodiversity are:

I. *In situ* Conservation:

- The process of protecting biodiversity at all levels by conserving and protecting the whole ecosystem is called *in situ* conservation.
- **Biodiversity hotspots** are the regions with very high levels of **species richness** and high degree of **endemism**.
- Three hotspots: Western Ghats and Sri Lanka, Indo-Burma and Himalaya cover high biodiversity regions.
- Biodiversity-rich regions are legally protected as biosphere reserves, national parks and sanctuaries.

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India now has 18 biosphere reserves, 106 national parks and 565 wildlife sanctuaries.

- **Sacred groves** are the forests in which tracts of forest were set aside, and all the trees and wildlife within were venerated and given total protection. For example, Khasi and Jaintia Hills in Meghalaya, Aravalli Hills of Rajasthan etc.

II. *Ex situ* Conservation

- The process in which endangered and threatened animals are saved by taking urgent measures is called *ex situ* conservation.
- Methods include protective maintenance of threatened species in zoological parks and botanical gardens, *in vitro* fertilisation, tissue culture propagation and cryopreservation of gametes.
- In *ex situ* conservation, threatened animals and plants are taken out from their natural habitat and placed in special setting where they can be protected and given special care. For examples, Zoological parks, botanical gardens and wildlife safari parks.
- Gametes of threatened species can be preserved in viable and fertile condition for long periods using cryopreservation techniques, eggs can be fertilised *in vitro*, and plants can be propagated using tissue culture methods.
- Seeds of different genetic strains of commercially important plants can be kept for long periods in seed banks.



Multiple Choice Questions



Practice Exercise

- Q 1.** First 'Earth Summit' for 'Convention on Biological Diversity' (CBD) was held at:
- Johannesberg (2002), South Africa
 - Rio de Janeiro (1992), Brazil
 - Dehradun (1992), India
 - New York (2000), USA
- Q 2.** Which of the following countries has the highest biodiversity?
- Brazil
 - South Africa
 - Russia
 - India
- Q 3.** Alpha diversity is biodiversity present:
- within community
 - between communities
 - ranges of communities
 - None of the above
- Q 4.** India is one of the 17 megadiversity countries of the world and is being divided into biogeographical regions.
- 8
 - 10
 - 16
 - 18
- Q 5.** Which of the following statements is correct?
- Parthenium* is an endemic species of our country.
 - African catfish is not a threat to indigenous catfishes.
 - Steller's sea cow is an extinct animal.
 - Lantana* is popularly known as carrot grass.
- Q 6.** Who confirmed that communities with more species tend to be more stable than those with less species?
- Alexander von Humboldt
 - David Tilman
 - Paul Ehrlich
 - Edward Wilson
- Q 7.** Rivet Popper hypothesis was given by:
- Paul Ehrlich
 - Alexander von Humboldt
 - David Tilman
 - Robert May
- Q 8.** Which of the following is not an example of *in situ* conservation?
- Biosphere reserves
 - National parks
 - Wildlife sanctuaries
 - Zoological parks
- Q 9.** One of the *ex situ* conservation methods for endangered species is:
- wildlife sanctuaries
 - biosphere reserves
 - cryopreservation
 - national parks
- Q 10.** Cryopreservation is the preservation of germplasm at very low temperature of around:
- 121°C
 - 196°C
 - 0°C
 - 101°C
- Q 11.** What is common to the seed banks, orchards, tissue culture and cryopreservation?
- All are *in situ* conservation methods.
 - All are *ex situ* conservation methods.
 - All require ultramodern equipments and very large space.
 - All are methods of conservation of extinct organisms.
- Q 12.** The one-horned rhinoceros is specific to which of the following sanctuaries?
- Bharatpur
 - Vedanthgol
 - Kaziranga
 - Corbett park
- Q 13.** Symbol of WWF is:
- tiger
 - rhododendron
 - white bear
 - giant panda
- Q 14.** The historic convention on Biological Diversity held in Rio de Janeiro in 1992 is known as:
- CITES Convention
 - The Earth Summit
 - G-16 Summit
 - MAB Programme
- Q 15.** The IUCN Red Data List (2004) in the last 500 years documents the extinction of nearly 784 species including: (CBSE 2023)
- 330 Invertebrates
 - 338 Invertebrates
 - 359 Invertebrates
 - 362 Invertebrates
- Q 16.** The sixth extinction in progress currently is different from all previous extinctions on earth as it is: (CBSE 2023)
- 10-100 times faster
 - 100-1000 times faster
 - 100-10000 times faster
 - 1000-10000 times faster
- Q 17.** Human settlement often leads to habitat loss which leads to fragmentation, forming smaller patches of habitats. Select the statements that describe how a small patch differs from a large patch of the same habitat: (CBSE 2023)
- Invasive species will never be seen here.
 - Population of large animals decreases.
 - Biodiversity decreases.
 - Competition from surrounding habitats increases.
- (ii), (iii) and (iv) only
 - (ii) and (iv) only
 - (i) and (iii) only
 - (i), (ii) and (iii) only
- Q 18.** Which one of the following groups faces maximum threat of extinction? (CBSE 2023)
- Gymnosperms
 - Birds
 - Amphibian
 - Mammals



Assertion & Reason Type Questions

Directions (Q. Nos. 19-25): Each of the following questions consists of two statements, one is Assertion (A) and the other is Reason (R). Select the correct answer to these questions from the codes a, b, c and d as given below.

- Both Assertion and Reason are true and Reason is the correct explanation of Assertion.
- Both Assertion and Reason are true but Reason is not the correct explanation of Assertion.
- Assertion is true but Reason is false.
- Assertion is false but Reason is true.

Q 19. Assertion (A): The rate of extinction of organisms has increased in recent years.

Reason (R): Human activities like deforestation, industrialisation, etc. have destroyed the natural habitat of plants and animals.

Q 20. Assertion (A): Species diversity decreases as we ascend towards high mountains.

Reason (R): Due to drop in temperature, no seasonal variability occurs in high mountains.

Q 21. Assertion (A): Communities with more species tend

to be more stable than those with less species.

Reason (R): Communities with more species is not able to resist occasional disturbances.

Q 22. Assertion (A): Dodo, Passenger pigeon, Steller's sea cow have become extinct due to over exploitation.

Reason (R): Excessive exploitation of a species, whether animal or plant reduces size of its population so that it becomes vulnerable to extinction.

Q 23. Assertion (A): Many endemic species are seen to flourish in sacred forests.

Reason (R): Sacred forests are undisturbed forest patches and biodiversity rich areas.

Q 24. Assertion (A): Buffer zone surrounds the core area and limited human activities like resource use strategies, research and education are allowed here.

Reason (R): There is no biotic interference except in buffer zone.

Q 25. Assertion (A): Alpha diversity refers to species diversity present in a given community or habitat.

Reason (R): Alpha diversity is expressed by species richness and species evenness in a community or habitat.

Answers

1. (b) Rio de Janeiro (1992), Brazil

Earth summit at Rio de Janeiro (1992), Brazil promoted convention on biological diversity which was signed by 152 nations. Its recommendations came into effect on 29th December, 1993.

2. (a) Brazil

Brazil is the country with the highest biodiversity in the world. One-tenth of the world's overall species lives here.

India is on the eight spot whereas South Africa is the thirteenth in the list.

Russia was comparatively low biodiversity due to its climate and availability of resources.

3. (a) within community

4. (b) 10

5. (c) Steller's sea cow is an extinct animal.

6. (b) David Tilman

Ecologists believe that the communities with more species tend to be more stable than those with less species. This was confirmed by David Tilman.

7. (a) Paul Ehrlich

The Rivet Popper Hypothesis was proposed by Paul Ehrlich. The hypothesis suggests the importance of species richness in the maintenance of the ecosystem.

8. (d) Zoological parks

9. (c) cryopreservation

10. (b) -196°C

Cryopreservation is the process of freezing biological material such as germplasm at extreme low temperatures. The preferred temperature is mostly -196°C / -321°F is liquid nitrogen.

11. (b) All are *ex situ* conservation methods.

12. (c) Kaziranga

13. (d) giant panda

14. (b) The Earth Summit

15. (c) 359 invertebrates

16. (b) 100-1000 times faster

17. (a) (ii), (iii) and (iv) only

18. (c) Amphibian

19. (a) Both Assertion and Reason are true and Reason is the correct explanation of Assertion.

20. (a) Both Assertion and Reason are true and Reason is the correct explanation of Assertion.

21. (c) Assertion is true, but Reason is false.

22. (a) Both Assertion and Reason are true and Reason is the correct explanation of Assertion.

Excessive exploitation of species, whether a plant or animal reduces the size of its population, so it becomes vulnerable to extinction. Such as Dodo and Passenger pigeon have become extinct due to over exploitation by humans.

23. (a) Both Assertion and Reason are true and Reason is the correct explanation of Assertion.
 24. (c) Assertion is true, but Reason is false.
 25. (b) Both Assertion and Reason are true but Reason is not the correct explanation of Assertion.



Case Study Based Questions

Case Study 1

Species Diversity

Edward Wilson described diversity at all levels of biological organisation ranging from macromolecules inside the cells to biomes. It is of three inter-related hierarchical levels-genetic diversity, species diversity and community ecosystem diversity. Species diversity is the variety in the number and richness of the species of a region. For example, the Western ghats have a greater amphibian species diversity than the Eastern ghats.

Q 1. The number of species per unit area is called:

- a. species evenness b. species richness
 c. species equitability d. Both a. and c

Q 2. The table below gives the population in thousands of ten species (A - J) in four areas (I - IV) consisting of the number of habitats given within brackets against each. Study the table and answer the question which follows:

Area and number of habitats	Species and their population (in thousands) in the area				
	A	B	C	D	E
I(11)	23	12	0.52	6.0	—
II(11)	10.2	—	0.62	—	1.5
III(13)	11.3	0.9	0.48	2.4	1.4
IV(12)	3.3	0.8	7.3	1.3	2.1
	F	G	H	I	J
I(11)	3.1	11	9.0	—	10.3
II(11)	3.0	—	8.2	1.1	11.2
III(13)	4.2	0.8	8.4	2.2	4.1
IV(12)	3.2	10.2	1.1	4.8	0.4

Which of the following shows maximum species diversity?

- a. II b. III
 c. IV d. I

Q 3. Study the given types of population and choose the correct answer in relation to species diversity:

Population	Species	Group	Individuals
Population A	I	Mammals	3
	II	Birds	2
	III	Amphibians	2
Population B	I	Mammals	2
	II	Mammals	2
	III	Amphibians	1
Population C	I	Mammals	3
	II	Mammals	2
	III	Mammals	1

Maximum diversity

- a. Population B
 b. Population A
 c. Population A
 d. Population B

Minimum diversity

- Population C
 Population C
 Population B
 Population A

Q 4. The concept of species diversity has two components: evenness and richness. Evenness is based on the relative abundance of species. Richness is based on the total number of species present. Diversity indices combine a measure of richness and evenness. The Simpson index (D) is calculated from the following equation:

$$D = \sum_{i=1}^n (n_i / N)^2$$

where, n = total number of organisms of particular species

N = total number of organisms of all species

Below are data collected in two terrestrial plant communities that represent part of a successional chronosequence. In this case, the values were measured as per cent cover.

Early Successional Community		Late Successional Community	
Species	Per cent Cover	Species	Per cent Cover
A	85	F	24
B	5	G	20
C	9	H	18
D	2	I	23
E	1	J	15

The data indicate that, relative to the early successional community, the late successional community has which of the following characteristics?

Species Richness

- a. Higher
- b. Higher
- c. Same
- d. Same

Evenness

- Higher
- Lower
- Lower
- Higher

Q 5. Select the incorrect statement regarding species diversity:

- a. It results in polymorph formation and is useful in adaptation to changes in environmental conditions.
- b. Number of individuals of different species represents species evenness.
- c. It influences biotic interactions and stability of the community.
- d. It is a trait of the community.

Answers

1. (b) 2. (b) 3. (b) 4. (d) 5. (a)

Case Study 2

Species Invasion

Non-native or alien species are often introduced inadvertently for their economic and other uses. They often become invasive and drive away the local species. Exotic species have proved harmful to both aquatic and terrestrial ecosystems. For example, water hyacinth (*Eichhornia crassipes*) was introduced in Indian waters to reduce pollution. It clogged water bodies including wetlands at many places resulting in death of several aquatic plants and animals.

Q 1. Island water ecosystem is the most vulnerable due to:

- a. small size
- b. small number of species
- c. Both a. and b.
- d. increased reproductive capacity

Q 2. Which of the following is not an alien species?

- a. *Lantana camara*
- b. *Periplaneta americana*
- c. Nile Perch
- d. Yucca moth

Q 3. Second major cause of species extinction is:

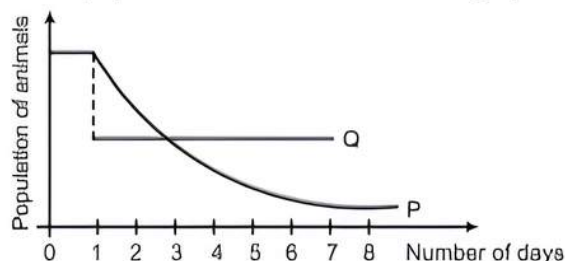
- a. habitat loss and fragmentation
- b. over exploitation
- c. alien species invasion
- d. co-extinction.

Q 4. Assertion (A): *Eichhornia crassipes* drains off oxygen from water and can be seen growing in standing water.

Reason (R): *Eichhornia crassipes* is an indigenous species of India.

- a. Both Assertion and Reason are true and Reason is the correct explanation of Assertion.
- b. Both Assertion and Reason are true but Reason is not the correct explanation of Assertion.
- c. Assertion is true but Reason is false.
- d. Assertion is false, but Reason is true.

Q 5. The population of species P in a certain community was constant until a population species Q from a distant land was subsequently introduced into that community. The interaction between the two populations is reflected in the graph below:



What could be the possible reason for the decrease in the population of species P over a number of days?

- a. Species Q is a predator of species P.
- b. Species Q is a prey species which wiped out the population of species P.
- c. Species P and Q compete for space but feeds on different food.
- d. None of the above

Answers

1. (c) 2. (d) 3. (c) 4. (c) 5. (a)

Case Study 3

IUCN Red List

IUCN maintains a Red Data Book or Red List which is a catalogue of taxa facing risk of extinction. The IUCN Red List (2004) documents the extinction of 784 species in the last 500 years. Some examples of recent extinctions include the dodo, quagga, thylacine and Steller's sea cow. The last twenty years alone have witnessed the disappearance of 27 species. Red List has eight categories of species.

Q 1. Dodo, an extinct taxon, belongs to which country?

- a. Mauritius
- b. Africa
- c. Australia
- d. Russia

Q 2. To which of the following categories of IUCN, *Berberis nilghiriensis* belongs?

- a. Extinct
- b. Extinct in wild
- c. Endangered
- d. Critically endangered

Q 3. Steller's sea cow and passenger pigeon became extinct due to:

- a. alien species invasion
- b. over-exploitation
- c. coextinction
- d. intensive agriculture

Q 4. Bali, Javan and Caspian are:

- a. species of tiger
- b. species of cheetah
- c. subspecies of cheetah
- d. subspecies of tiger

Q 5. Select the correct term for the following definitions (i, ii, iii, iv).

- (i) The taxon is liable to become extinct if not allowed to realise its full biotic potential by providing protection from exotic species/human exploitation/habitat deterioration/depletion of food.
- (ii) The taxon has been completely eliminated or died out from Earth, e.g., dodo.
- (iii) The taxon is facing a high risk of extinction in the wild in the near future due to decrease in its habitat, excessive predation or poaching.
- (iv) They are species with naturally small populations, either localised or thinly scattered, which are always at risk from pests/pathogens/predators/exotic species.

S.No.	(i)	(ii)	(iii)	(iv)
a.	Threatened	Extinct	Endangered	Rare
b.	Endangered	Extinct	Threatened	Rare
c.	Extinct	Rare	Threatened	Endangered
d.	Threatened	Extinct	Rare	Endangered

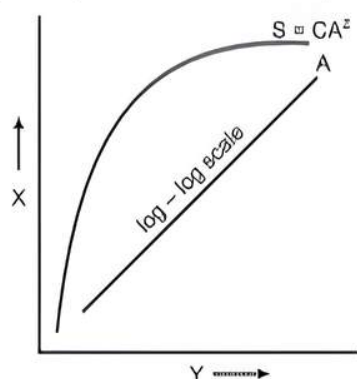
Answers

1. (a) 2. (d) 3. (b) 4. (d) 5. (a)

Case Study 4

Species Richness

Within a region, species richness increases with increasing explored area, but only upto a limit. The give explains this relationship.



Read the given passage carefully and give the answer of the following questions:

Q 1. What does the given figure show?

Ans. The given figure show Species-area relationship.

Q 2. Write the equation for relationship (A) between species richness and area.

Ans. $\log S = \log C + Z \log A$

Q 3. Name the shape of curve for relationship between species richness and areas for wide variety of taxa.

Ans. The shape of curve for relationship between species richness and areas for wide variety of taxa rectangular hyperbola.

OR

Who gave this concept of increase in species richness with increasing explored area but only upto a limit?

Ans. Humboldt.



Very Short Answer Type Questions

Q 1. India has more than 50,000 strains of rice. Mention the level of biodiversity it represents.

Ans. 50,000 strains of rice represent specific biodiversity.

Q 2. About 200 species of cichlid fish became extinct when a particular fish was introduced in Lake Victoria of Africa. Name the invasive fish.

Ans. Nile perch is the invasive fish.

Q 3. Name the type of biodiversity represented by the following:

(i) 1000 varieties of mangoes in India.

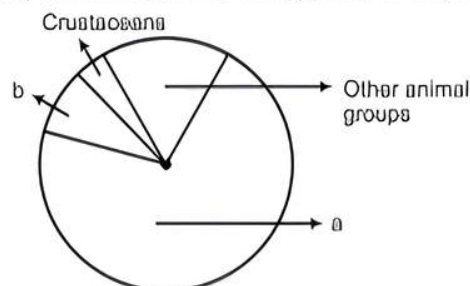
(ii) Variations in terms of potency and concentration of reserpine in *Rauwolfia vomitoria* growing in different regions of Himalayas.

Ans. (i) Genetic diversity (ii) Genetic diversity.

Q 4. What is the difference between endemic and exotic species?

Ans. Endemic species are native species restricted to a particular geographical region. On the other hand, exotic species are species which are introduced from other geographical regions into an area.

Q 5. Name the unlabelled areas 'a' and 'b' of the pie chart (given alongside) representing the global biodiversity of invertebrates showing their proportionate number of species of major taxa.



Ans. a → Insects; b → Molluscs.

Q 6. 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?

Ans. Agricultural fields like wheat field or paddy fields which are also examples of monoculture practices have high productivity.

Q 7. Name any two threatened animal species of India.

Ans. Red panda and black buck are the threatened animal species of India.

Q 8. Give two examples of extinction caused by indiscriminate hunting.

Ans. The extinction of dodo and cheetah has been caused by indiscriminate hunting.

Q 9. What is meant by alien species?

Ans. Non-native powerful species which invade a new area are known as alien species.

Q 10. Name the alien fish species which is posing a threat to the indigenous catfishes in our rivers.

Ans. Clarias gariepinus (African catfish) is posing a threat to the indigenous catfishes in our rivers.

Q 11. Which region in India has the maximum number of amphibian species?

Ans. Western Ghats have the maximum number of amphibian species.

Q 12. What is the expanded form of IUCN?

Ans. International Union for Conservation of Nature and Natural Resources.

Q 13. What is Red Data Book?

Ans. The Red Data Book is a compilation of data on species threatened with extinction and is maintained by IUCN.

Q 14. Which forest is named as the 'lungs of the Planet'?

Ans. Amazon rainforest is named as the 'lungs of the Planet.'

Q 15. What is a hotspot?

Ans. A hotspot is an area having endangered endemic species with very high levels of species richness.

Q 16. Name the Indian hotspots that extend into other countries.

Ans. (i) Western Ghats and Sri Lanka.
(ii) Indo-Burma and Himalaya.

Q 17. Why is genetic variation important in the plant *Rauwolfia vomitoria*?

Ans. Genetic variation affects the variation in potency and concentration of the drug reserpine in the medicinal plant *Rauwolfia vomitoria*.

Q 18. What are Ramsar sites?

Ans. Ramsar sites are conserved wetlands which are of international importance.

Q 19. What is a national park?

Ans. A national park is a protected area reserved for wildlife where human activities are not permitted.

Q 20. Name any two national parks of India.

Ans. Jim Corbett National Park (Uttarakhand) and Kaziranga National Park (Assam).

Q 21. What are seed banks?

Ans. The collections of seeds of many different genetic strains of commercially important plants, that are kept viable for longer periods in place are called seed banks.

Q 22. When was the Earth Summit held?

Ans. The Earth Summit was held at Rio de Janeiro (Brazil) between 3-14 June, 1992.

Q 23. Substantiate by giving two reasons as to why a holistic understanding of the flora and fauna the cropland is required before introducing an appropriate biocontrol method.

Ans. Eradication of pests will disrupt predator-prey relationships, where beneficial predatory and parasitic insects which depend upon flora and fauna as food or hosts, may not be able to survive.
Holistic approach ensures that various life forms that inhabit the field, their life cycles, patterns of feeding and the habitats that they prefer are extensively studied and considered.



Short Answer Type Questions ↘

Q 1. Suggest two practices giving one example of each that help protect rare or threatened species.

(CBSE 2017)

Ans. The two practices are:

- (i) By using cryopreservation (preservation at -196°C) technique, sperms, eggs, tissues, and embryo can be stored for long period in gene banks, seed banks etc.
- (ii) Plants are propagated in vitro using tissue culture methods.

Q 2. In the biosphere, immense biological diversity exists at all levels of biological organisation. Explain any two levels of biodiversity.

(CBSE 2018, 19)

Ans. Biodiversity is divided into three levels:

(i) **Genetic Diversity:** It is the measure of variety in genetic information contained in the organisms. It enables a population to adapt to its environment.

For example, medicinal plant *Rauwolfia vomitoria* growing in Himalayan ranges shows variation in potency and concentration of the active chemical reserpine that it produces.
There are more than 50,000 genetically different strains of rice and 1,000 varieties of mango in India.

(ii) **Species Diversity:** It is a measure of the variety of species and their relative abundance present within a region. For example, the Western ghats have greater amphibian species diversity than the Eastern ghats.

(iii) **Ecological Diversity:** It is a measure of the diversity at community and ecosystem levels. They represent the local, unique habitat and regional components of species diversity.

For example, ecological diversity is greater in India due to presence of large number of ecosystems like deserts, rainforests, coral reefs, wetlands, estuaries and alpine meadows.

(Any two)



TIP

Learn thoroughly the various types of diversity with their complete explanation as well as examples.

Q 3. Mention the kind of biodiversity of more than a thousand varieties of mangoes in India. How is it possible? (CBSE 2016)

Ans. Thousand varieties of mangoes represent genetic diversity. This is possible because:

- (i) Single species show high diversity at genetic level over its distributional range.
- (ii) Different varieties grow in different geographical areas.

Q 4. List the features that make a stable biological community.

Ans. Features of a stable biological community are as follows:

- (i) Communities should have greater biodiversity for greater stability.
- (ii) It should be able to prevent invasion by alien species.
- (iii) It should be able to restore itself in a short period of time.
- (iv) Variations should be minimal in the community.

Q 5. 'Stability of a community depends on its species richness.' Write how David Tilman showed this experimentally. (CBSE 2019)

Ans. David Tilman found that plots with more species showed less year-to-year variation in total biomass. He also showed that in his experiments, increased diversity contributed to higher productivity.

Q 6. Explain, giving one example, how co-extinction is one of the causes of loss of biodiversity. List the three other causes also (without description).

Ans. When a species becomes extinct, the plant and animal species associated with it in an obligatory way may also become extinct. This is called co-extinction. For example, when a host fish species becomes extinct, its unique assemblage of parasites also becomes extinct. The three other causes are:

- (i) Habitat loss and fragmentation
- (ii) Over-exploitation
- (iii) Alien species invasion.

Q 7. Narrowly utilitarian arguments are put forth in support of biodiversity conservation. Explain the other two arguments that are put forth in support of the same cause. (CBSE 2015)

OR

"Biodiversity plays a major role in many ecosystem services that nature provides."

(i) Describe any two broadly utilitarian arguments to justify the given statement.

(ii) State one ethical reason of conserving biodiversity. (CBSE 2023)

Ans. (i) Broadly Utilitarian Arguments: Biodiversity plays a major role in maintaining and sustaining supply of goods and services from various species as well as ecological systems.

The different ecological services provided are:

- (a) Amazon forest is estimated to contribute 20% of the total oxygen in the atmosphere on Earth.
- (b) Ecosystem provides pollinators like bees, bumble bees, birds and bats which pollinate plants to form fruits and seeds.
- (c) Aesthetic pleasures like bird watching, spring flowers in full bloom, walking through the thick forest, waking up to a bulbul's song, etc. are some other benefits of the ecosystem.

(ii) **Ethical reasons:** There are thousands of plants, animals and microbes on this Earth which are not useless. Everyone has some intrinsic value even if it is not of any economic value to us. It is, therefore, our moral duty to ensure well-being of all the living creatures for the utilisation of future generations.

COMMON ERROR

Students do not mention arguments supporting the same clause or do not provide exact explanation.

Q 8. Illustrate with the help of an example how introduction of an alien species turns invasive and causes decline of an indigenous species.

(CBSE 2023)

Ans. Alien species are non-native species which when introduced in a new area, they become invasive and compete with the native species and cause extinction of indigenous species. For example, The Nile perch introduced into Lake Victoria in east Africa led eventually to the extinction of an ecologically unique assemblage of more than 200 species of cichlid fish in the lake.

Q 9. Where would you expect more species biodiversity— in tropics or in polar regions? Give reasons in support of your answer.

Ans. More biodiversity is found in the tropics. This is because tropical regions remain undisturbed from frequent glaciations as in polar regions. Also, the tropics are less seasonal/more constant.

Q 10. Why are certain regions on the Earth called hotspots? Name any two hotspots in India.

Ans. Certain regions have been declared as hotspots for maximum protection of these regions which have high levels of species richness and high degree of endemism. Western Ghats, Sri Lanka and Himalayas are examples of hotspots.

Q 11. Justify with the help of an example where a deliberate attempt by humans has led to the extinction of a particular species.

Ans. When Nile perch, a large predator fish, was introduced in lake Victoria, it started feeding on the native fish, cichlid fish. As a result, cichlid fish became extinct and Nile perch, not finding any food for itself, died too.

Q 12. What is IUCN red list? Give any two uses of this list.

Ans. IUCN red list is a catalogue of species and subspecies that are facing the risk of extinction. The two uses of this list are:

- (i) Provides information and develops awareness about the importance of threatened species.
- (ii) Identification and documentation of endangered species.

Q 13. Interpret two effects of loss of biodiversity in a region.

Ans. The effects of loss of biodiversity in a region are:

- (i) Decline in plant production.
- (ii) Lowered resistance to environmental perturbations such as drought.
- (iii) Increased variability in certain ecosystem processes such as plant productivity, water use, and pest and disease cycles. (Any two)

Q 14. Differentiate between *in situ* and *ex situ* approaches of conservation of biodiversity.

S. No.	Basis of difference	<i>In situ</i> approach	<i>Ex situ</i> approach
(i)	Concept	It involves <u>protection of endangered species of plants and animals.</u>	It involves <u>protection of endangered species by removing them from the natural habitat.</u>

(ii)	Method	This is done by <u>protecting the natural habitat or ecosystem.</u>	This is done by <u>placing the species under special care.</u>
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Long Answer Type-I Questions

Q 1. (i) "India has greater ecosystem diversity than Norway." Do you agree with the statement? Give reasons in support of your answer.

(ii) Write the difference between genetic biodiversity and species biodiversity that exists at all the levels of biological organisation.

(CBSE 2018)

Ans. (i) Yes, I agree with the statement.

S. No.	India	Norway
(i)	Tropical region	Temperate region
(ii)	Less seasonal	More seasonal
(iii)	More constant and more predictable	Less constant and less predictable
(iv)	Promote niche specialisation	Do not promote niche specialisation
(v)	Leading to greater biodiversity	Leading to low biodiversity
(vi)	Species diversity increases as we move towards equator	Species diversity decreases as we move away from equator
(vii)	More number of species exist	Less number of species exist

(ii) **Genetic Diversity:** It is the diversity/variation within a species over its distributional range.

Species Diversity: It is the diversity/variation at a species level.

Q 2. Alien species are highly invasive and are a threat to indigenous species. Substantiate this statement with any three examples.

Ans. Exotic species are defined as species that have been introduced from another geographic region to an area outside its natural range. For example,

- (i) Parthenium, Lantana and Eichhornia are the exotic species of plants that have invaded the native species of India and caused environmental damage.
- (ii) Introduction of African catfish *Clarias gariepinus* for aquaculture purpose is posing threat to many indigenous catfish.
- (iii) Nile perch introduced into lake Victoria in East Africa led to the extinction of cichlid fish.



TIP

Learn the spellings of plant species (scientific names) to substantiate the given statement with examples.

Q 3. Differentiate between:

(i) Keystone species and Endangered species

(ii) Genetic diversity and Species diversity

Ans. (i) Keystone species and Endangered species

S. No.	Basis of difference	Keystone species	Endangered species
(i)	Abundance	It is a species of lower abundance that plays vital role in sustaining the community	It is a species of lower abundance that may or may not have a vital role in sustaining the community.
(ii)	Extinction	The species is not threatened, e.g., <u>Ficus</u> .	The species is at high risk of extinction in near future, e.g., <u>Red panda</u> .

(ii) Genetic diversity and Species diversity

S. No.	Basis of difference	Genetic diversity	Species diversity
(i)	Definition	It represents the variety of genetic information present in an organism.	It is the variety of species and their relative abundance found within a region.
(ii)	Trait	It is trait of an organism.	It is trait of a biotic community.



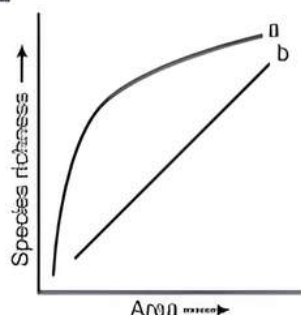
TiP

Try to provide the answer in tabular form instead of a paragraph.

Q 4. The given graph alongside shows species-area relationship. Write the equation of the curve 'a' and explain.

Ans. The equation of the curve 'a' is $S = CA^Z$.

(i) Within a region, species richness increases with increasing explored area but only up to a limit.



(ii) Relationship between species richness and area for a wide variety of taxa turns out to be rectangular hyperbola.

Q 5. Why should biodiversity be conserved? List any two ethical arguments in its support. (CBSE 2011)

Ans. The biodiversity should be conserved because of the following reasons: (Any two)

(i) Narrowly utilitarian arguments for deriving direct economic benefit from nature.

(ii) Broadly utilitarian arguments as biodiversity plays a major role in many ecosystem services.

(iii) Ethical reasons as there is a need to realise that every species has an intrinsic value and we need to pass on our biological legacy to future generations.

Q 6. Explain 'Rivet Popper' Hypothesis. Name the ecologist who proposed it.

Ans. 'Rivet Popper' Hypothesis states that in an airplane (ecosystem) all parts are joined together using thousands of rivet (species). If every passenger travelling in it starts popping a rivet to take home (causing a species to become extinct), it may not affect flight safety (proper functioning of the ecosystem) initially but as more and more rivets are removed, the plane becomes dangerously weak over a period of time. Also, which rivet is removed may also be critical like loss of rivets on the wings (key species) is more serious threat to flight safety than loss of few rivets on the seats or windows inside the plane.

Paul Ehrlich proposed the Rivet Popper Hypothesis.

Q 7. Give three reasons as to why the prokaryotes are not given any figures for their diversity by the ecologists.

Ans. Prokaryotic organisms' diversity is not given any figures by ecologist because of following reasons.

(i) Classification and Identification of vast diversity of microbes is very difficult and cannot be efficiently done with use of currently available methods.

(ii) For many microorganisms, it is difficult to culture them under laboratory condition.

(iii) According to current biochemical and molecular techniques, it is estimated that microbes diversity can range in billions with microbes inhabiting diverse habitat on earth, with enormous diversity present in air, water and soil. Hence, more advanced molecular and biochemical techniques are needed to classify and identify this enormous diversity of microbes.

Q 8. Name and describe any three causes of biodiversity losses. (CBSE 2015)

Ans. Causes of Biodiversity Losses

(i) **Habitat Loss and Fragmentation**

(a) Destruction of habitat is the primary cause of extinction of species.

(b) The tropical rainforests initially covered 14% of the land surface of earth, but now cover only 6% of land area.

(ii) Over-exploitation

- (a) When biological system is over-exploited by man for the natural resources. It results in degradation and extinction of the resources.
- (b) For example, Stellar's sea cow, passenger pigeon and many marine fishes.

(iii) Alien (exotic) Species Invasions

- (a) Some alien (exotic) species when introduced unintentionally or deliberately become invasive and cause harmful impact, resulting in extinction of the indigenous species.
- (b) Nile perch, a large predator fish when introduced in Lake Victoria (East Africa) caused the extinction of an ecologically unique species of cichlid fish in the lake.

(iv) Co-extinctions

- (a) When a species becomes extinct, the plant and animal species associated with it in an obligatory manner, also become extinct.
- (b) For example, if the host fish species becomes extinct, all those parasites exclusively dependent on it, will also become extinct. In plant-pollinator mutualism also, extinction of one results in the extinction of the other.
(Any three)

Q 9. 'In situ' conservation can help endangered/threatened species. Justify the statement.

(CBSE 2017)

Ans. In 'in situ' conservation, threatened organisms are conserved in their natural habitat or ecosystem, and such regions are legally protected. This has been carried out by identifying certain regions as hotspots, biosphere reserves, national parks, sanctuaries, sacred groves and Ramsar sites. This approach involves protection of species in their natural habitat in the following ways:

- (i) Biodiversity Hotspots:** These are regions of high levels of species richness and high degree of endemism.
- (ii) Protected Areas:** India has 14 biosphere reserves, 90 national parks and 448 wildlife sanctuaries.
- (iii) Ramsar Sites:** Ramsar sites are wetlands which are considered to be of international importance.
- (iv) Sacred Groves:** These are forest patches set aside for worship. All the trees and wildlife within are given total protection by tribal people.

Q 10. (i) The image shown below is of a sacred grove found in India. Explain how has human involvement helped in the preservation of these biodiversity rich regions.



(ii) Value of Z (regression coefficient) is considered for measuring the species richness of an area. If the value of Z is 0.7 for area A, and 0.15 for area B, which area has higher species richness and a steeper slope? (CBSE SQP 2022, Term-2)

- Ans.** (i) India's history of religious and cultural traditions emphasised the protection of nature. In many culture, tracts of forest are set aside, all the trees and wildlife within are venerated and given total protection. Sacred groves in many states are the last refuges for a large number of rare and threatened plants.
- (ii) Area A will have more species richness and a steeper slope.

Q 11. List six advantages of 'ex situ' approach to conservation of biodiversity. (CBSE 2019)

Ans. The ex situ conservation involves protection of the plants and animals away from the natural habitat. Zoological parks, botanical gardens and wildlife safari parks serve this purpose. It offers the following advantages:

- (i) The endangered organisms are protected from their exploitation and can be maintained in artificial habitats.
- (ii) Their breeding programs can be regulated and the gametes, as well as embryos, can be preserved in viable and fertile conditions.
- (iii) Seeds from different genetic strains can be made to undergo hybridisation and can be kept for future experiments.
- (iv) The health of individuals can be monitored and medical assistance can be given as required.
- (v) Modern reproductive technology can increase the chances of reproductive success.
- (vi) Research into reproductive physiology, lifestyle, and ecology of an endangered species is made easier.



Long Answer Type-II Questions

Q 1. The graph shows species-area relationship:

- (i) If 'b' denotes the relationship on log scale:
 - (a) Describe 'a' and 'b'.
 - (b) How is slope represented? Give the normal range of slope.
 - (c) What kind of slope will be observed for frugivorous birds and mammals in a tropical forest?
- (ii) Species diversity of plants (22%) is much less than that of animals (72%). Analyse the reasons for greater diversity of animals as compared to plants.

- Ans. (i) (a) a is $S = CA^Z$, b is $\log S = \log C + Z \log A$
 (b) Slope is Z (regression coefficient). Its normal value ranges from 0.6 to 1.2.
 (c) In frugivorous birds and mammals, value of $Z \approx 1.15$
 (ii) Reasons for greater diversity of animals as compared to plants are:
 (a) Animal is mobile and can avoid predator or unfavourable event.
 (b) Well-developed nervous system to receive stimuli against external factors and respond to them.

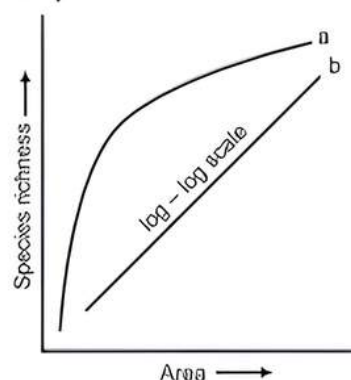
Q 2. There is a great concern all over the world to conserve biodiversity for maintaining ecological balance in nature. Explain giving three reasons. Write different ways that have helped in increasing tiger population in our country. (CBSE 2014)

- Ans. Biodiversity should be conserved for the following three reasons:
- (i) **Narrowly Utilitarian:** Humans derive countless economic benefits from nature e.g., food, firewood, fibre, Industrial products.
 - (ii) **Broadly Utilitarian:** Biodiversity plays a role in many ecological services e.g., production of O_2 , pollination.
 - (iii) **Ethical:** Every species has an intrinsic value and we have a moral duty to care for their well-being and pass on our biological legacy in good order to future generations.

The two approaches to save the tiger are:

- (a) **In situ Conservation:** Protects the natural habitat of the forest where the tiger lives/protect the whole ecosystem to save tigers.
- (b) **Ex situ Conservation:** Threatened tigers are taken out of their natural habitat and placed in special settings for protection and special care, e.g. zoological park, wildlife sanctuaries.

Q 3. The following graph shows the species-area relationship.



Answer the following questions as directed:

- (i) Name the naturalist who studied the kind of relationship shown in the graph. Write the observations made by him.
- (ii) Write the situations as discovered by the ecologists when the value of 'Z' (slope of the line) lies between:
 - (a) 0.1 and 0.2
 - (b) 0.6 and 1.2.

What does 'Z' stand for?

(iii) When would the slope of the line 'b' become steeper?

- Ans. (i) Alexander von Humboldt studied the relationship shown in the graph. He observed that within a region, species richness increased with increasing explored area but only up to a limit.
 (ii) (a) The slopes of regression lines are similar when unaffected distribution in an area is analysed.
 (b) The slope of regression is steeper when we analyse the species-area relationship among very large areas like entire continent. Z (slope of the line) is the regression coefficient.
 (iii) The slope of the line 'b' becomes steeper when species richness is more, i.e., in the range 0.62-1.2.



TIP

Study the graph of species-area relationship along with its equation and terms involved.

Q 4. Explain the efforts for the conservation of biodiversity at international level.

- Ans. The Earth Summit was held at Rio de Janeiro (Brazil) in which representatives of more than 170 countries were present. The summit promoted Convention on Biological Diversity (CBD). India became signatory to this convention in May 1994. The major objectives were:
- (i) Finding and supporting various methods to conserve biological diversity.
 - (ii) Use of biodiversity only up to sustainable limit.
 - (iii) The benefits derived from use of genetic resources should be fairly and equitably shared.

A second world summit on biological diversity was held in 2002 in Johannesburg, South Africa. In the Summit, 190 countries pledged to reduce the current rate of biodiversity loss at global, regional and local levels by 2010.

Q 5. Answer the following questions:

- (i) Why should we conserve biodiversity? How can we do it?
- (ii) Explain the importance of biodiversity hotspots and sacred groves. (CBSE 2016)

Ans. (i) Reasons for Biodiversity Conservation: There are three main reasons for conserving the biodiversity which have been classified into the following categories:

(a) Narrowly Utilitarian Arguments

Human beings derive direct economic benefits from nature, like food, firewood, fibre, construction material, industrial products (resins, gums, dyes, tannins, etc.) and medicinally important products.

(b) Broadly Utilitarian Arguments

Biodiversity plays a major role in maintaining and sustaining supply of goods and services from various species as well as ecological systems.

(c) Ethical Reasons

There are thousands of plants, animals and microbes on this earth which are not useless. Everyone has some intrinsic value even if it is not of any economic value to us.

(ii) Biodiversity Hotspots:

- (a) These are regions of high levels of species richness and high degree of endemism.
- (b) Endemic species are species confined only to a limited region.
- (c) There are 34 hotspots in the world.
- (d) In India, the three hotspots are Western ghats and Sri Lanka, Indo-Burma and Himalayas.
- (e) These reduce mass extinction by 30%.

Importance of Sacred groves:

- (a) These are forest patches set aside for worship. All the trees and wildlife within are given total protection by tribal people.
- (b) Large number of rare and threatened plants can be found in these regions.
- (c) Some of the sacred groves in India are as follows:
 - Khasi and Jaintia Hills in Meghalaya
 - Western ghat regions of Karnataka and Maharashtra
 - Aravalli Hills of Rajasthan
 - Sarguja, Chanda and Bastar areas of Madhya Pradesh.



Chapter Test

Multiple Choice Questions

- Q 1. Which of the following organisations is responsible for maintaining the Red Data Book?
 - a. IDRI
 - b. IUCN
 - c. UNESCO
 - d. USDA
- Q 2. Which of the following is a hot-spot of biodiversity in India?
 - a. Western ghats
 - b. Indo-gangatic plain
 - c. Eastern ghats
 - d. Aravalli hills
- Q 3. Which among the following is not a method of *in situ* conservation?
 - a. National park
 - b. Botanical garden
 - c. Wildlife sanctuary
 - d. Ramsar sites

- b. Both Assertion and Reason are true, but Reason is not the correct explanation of Assertion.
- c. Assertion is true, but Reason is false.
- d. Both Assertion and Reason are false.

Q 4. Assertion (A): Maximum biodiversity occurs in temperate areas.

Reason (R): Temperate areas have favourable conditions for speciation and for supporting variety and number of organisms.

Q 5. Assertion (A): The introduction of Nile perch in lake Victoria caused cichlids to become extinct.

Reason (R): Nile perch is an indigenous species of East Africa.

Assertion and Reason Type Questions

Directions (Q.Nos. 4-5): Each of the following questions consists of two statements, one is Assertion (A) and the other is Reason (R). Select the correct answer to these questions from the codes a, b, c and d as given below.

- a. Both Assertion and Reason are true and Reason is the correct explanation of Assertion.

Case Based Questions

Case Study 1

- Q 6. The Kakapo is the world's largest and heaviest parrot, found only in New Zealand. It is unusual in that it is nocturnal, flightless and ground-dwelling. It is an excellent climber of trees, has strong legs

that allow it to jog several kilometres in a single trip, and has mossy green plumage mottled with brown and yellow. The Kakapo is also critically endangered as of now, there were only few known living individuals left.

- (i) Which could be the possible reason for Kakapo to be well-adapted to its environment prior to the arrival of humans in New Zealand?
- Kakapo was active only in the night when its potential predators would not be out for hunting.
 - The Kakapo would likely be well-camouflaged among the forest foliage due to its greenish plumage.
 - It was able to effectively hunt for food in the night.
 - All of the above
- (ii) When humans started to settle in New Zealand, they took with them non-native animals, including mammals such as cats, dogs and stoats. By which of the following ways, human settlement likely contributed to a near decimation of Kakapo population in New Zealand?
- Habitat destruction
 - Alien species invasion
 - Pollution
 - Both a. and b.
- (iii) The reasons behind conserving biodiversity have been grouped into which of the following categories?
- Narrowly utilitarian
 - Broadly utilitarian
 - Ethical
 - All of these
- (iv) One of the *ex situ* conservation methods for endangered species is:
- wildlife sanctuaries
 - biosphere reserves
 - cryopreservation
 - national parks

Case Study 2

- Q 7. The IUCN Red List (2004) documents the extinction of 784 species (including 338 vertebrates, 359 invertebrates and 87 plants) in the last 500 years. Some examples of recent

extinctions include the dodo (Mauritius), quagga (Africa), thylacine (Australia), Steller's sea cow (Russia) and three subspecies (Bali, Javan, Caspian) of tiger. The last twenty years alone have witnessed the disappearance of 27 species. Careful analysis of records shows that extinctions across taxa are not random; some groups like amphibians appear to be more vulnerable to extinction.

Read the given passage carefully and give the answer of the following questions:

- What is the Importance of Red List?
- What does Red Data Book contain?
- What is the colour of Red Data Book?

OR

Name any two extinct species.

Very Short Answer Type Questions

- Q 8. Name any two sanctuaries in India.
- Q 9. What is cryopreservation?
- Q 10. Write the importance of cryopreservation in conservation of biodiversity.

Short Answer Type Questions

- Q 11. Explain how invasive species cause biodiversity loss with examples?
- Q 12. What is the significance of the slope of regression?

Long Answer Type-I Question

- Q 13. Many plant and animal species are on the verge of their extinction because of loss of forest land by indiscriminate use by the humans. As a biology student, what method would you suggest along with its advantages that can protect such threatened species from getting extinct?

Long Answer Type-II Question

- Q 14. What is biodiversity? Explain its importance for humans.

