BIOLOGY

Chapter 13: Biodiversity and Conservation

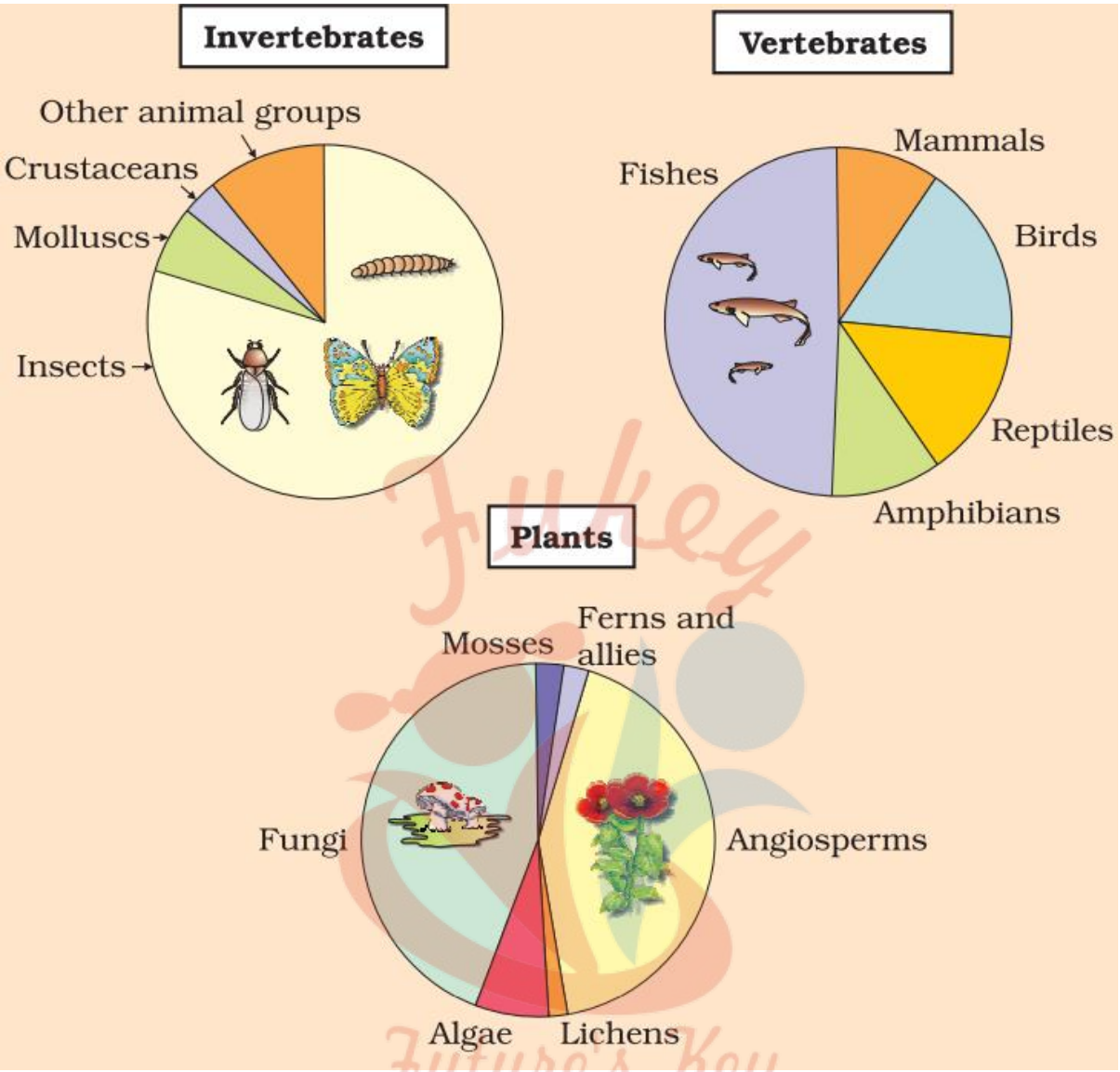
Biodiversity And Conservation

Biodiversity:

Biodiversity or biological diversity is the occurrence of different types of ecosystems, different species of organisms and their variant like biotypes, ecotypes and gene adapted to different climates and environments of different regions including their interactions and processes. This term was coined by Edward Wilson. The vast array of species of micro-organisms, algae, fungi, plants and animals occurring on the earth either in the terrestrial or aquatic habitats and the ecological complexes of which they are a part comprises biodiversity. Diversity ranges from macromolecules to biomes.

The important diversity at the levels of biological organization are:

- **Genetic Diversity:** A single species might show high diversity at the genetic level over its distributional range. Rauwolfia vomitoria shows genetic variation in terms of concentration and potency of chemical reserpine India has more than 50,000 genetically different strains of rice and 1000 varieties of mango.
- **Species Diversity:** diversity at species level for example, the Western Ghats have more amphibian species diversity than the Eastern Ghats.
- **Ecological Diversity:** deserts, rain forests, mangroves, coral reefs, wetlands, estuaries and alpine meadows are types of ecological diversity.



- Biodiversity and its conservation are vital environmental issues of international concern as more and more people around the world begin to realize the critical importance of biodiversity for survival and well-being on this planet.
- According to the IUCN, the total number of plant and animal species described so far is about 1.5 million but still many species are yet to discovered and described.
- More than 70% of all the species recorded are animals while rest are plants including algae, fungi, bryophytes, gymnosperms and angiosperms. Among animals, 70% of total are insects.
- The number of fungi species in the world is more than the combined total of the species of fishes, amphibians, reptiles and mammals.

Biodiversity In India:

- India is one of the twelve mega biodiversity countries of the world.

- India has only 2.4% of the land area of the world, it has 8.1% of the global species biodiversity.
- There are about 45,000 species of plants and about 90,000-1,00,000 species of animals.
- New species are yet to be discovered and named.
- Applying Robert May's global estimate, only 22% of the total species have been recorded, India has probably more than 1,00,000 species of plants and 3,00,000 species of animals to be discovered and described.

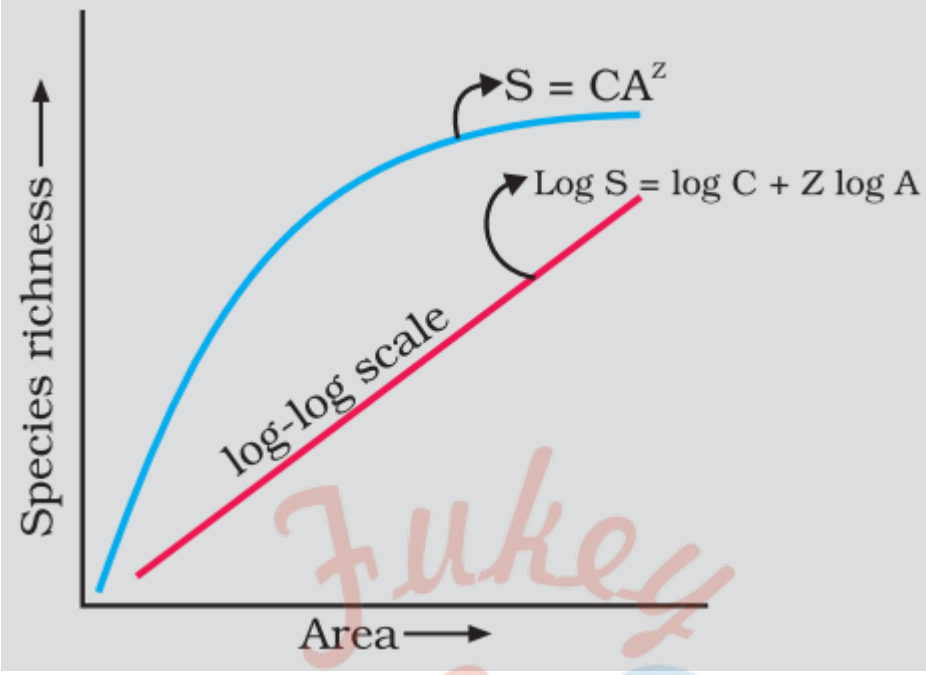
Patterns of Biodiversity:

- **Latitudinal gradients:** The diversity of plants and animals is not uniform throughout the world and shows uneven distribution. This distribution pattern is along the latitudinal gradient in diversity. Species diversity decreases as we move away from the equator towards the poles. Tropics harbor more species than temperate or polar areas. Amazonian Rainforest has the greatest biodiversity on earth. It has more than 40000 species of plants, 1,25,000 species of insects, 300 species of fish, 427 of amphibian and 378 of reptiles, 1300 species of birds and 427 of mammals. Various hypothesis has been proposed regarding this such as.
- Speciation is a function of time unlike temperate regions subjected to frequent glaciation in past, tropical latitudes have remained relatively undisturbed for millions of years and thus had long evolutionary time for species diversification.
- Tropical environments unlike temperate ones are less seasonal and more constant and predictable which promote niche specialization and lead to a greater species diversity.
- There is more solar energy available in the tropics which contribute to higher productivity this in turn contribute indirectly to greater diversity.

Species-Area relationships:

Alexander Von Humboldt has observed that within a region, species richness gets increased when explored area is increased, but only up to a limit.

The relationship between species richness and area for a number of taxa like angiospermic plants, fresh water fishes and birds is found to be a rectangular hyperbola.



On logarithmic scale, the relationship is a straight line described by the equation.

log S = log C + Z log A.

Where, S = species, A = Area, Z = slope of the line, C = Y intercept.

- Ecologists have discovered that the value of Z lies in range of 0.1 to 0.2 regardless of taxonomic group of the region.
- In very large area like continents, Z value ranges between 0.6 & 1.2.

The importance of Species Diversity to the Ecosystem:

- The communities with more species are generally more stable than those with less species. A stable community should not be show too much variation in productivity from year to year.
- Rich biodiversity is essential for ecosystem health and imperative for the very survival of human race on this planet.
- **Rivet popper hypothesis:** Given by Paul Ehrlich. In an airplane (ecosystem) all parts are joined together using thousands of rivets (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. Furthermore, which rivet is removed may also be critical. Loss of rivets on the wings (key species that drive major ecosystem functions) is obviously a more serious threat to flight safety than loss of a few rivets on the seats or windows inside the plane.

Loss of Biodiversity:

The biological wealth of our planets have been declining rapidly due to three factors Population, Urbanization and Industrialization. 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. In last 20 years, 27 species have been disappeared. In general, loss of biodiversity in a region may lead to.

- Decline in plant production.
- Lowered resistance to environmental perturbations, drought, and flood.
- Increased variability in ecosystem processes such as productivity, water use, and pest and disease cycles.

Causes of biodiversity losses:

Faster rates of species extinctions are largely due to human activities. The four major causes are called 'The Evil Quartet'.

- **Habitat loss and fragmentation:** Is the most important cause of animals and plants extinction. The amazon rain forest (lungs of the planet) having millions of species is being cut and cleared for cultivating soya beans or for conversion to grasslands. When large habitats are broken up into small fragments due to various human activities, mammals are birds requiring large territories migrate and badly affected.
- **Over-exploitation:** When biological system is over exploited by man for the natural resources, it results in degradation and extinction of the resources, e.g. Steller's sea cow, passenger pigeon etc. Many marine fish populations are over harvested, endangering the continued existence of some important species.
- **Alien species invasions:** When alien species enters intentionally or unintentionally, some of them turn invasive and cause decline or extinction of indigenous species. 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. Invasive weeds species like carrot grass (parthenium), Lantana and water hyacinth causing threats to indigenous species.
- **Co-extinctions:** When a species becomes extinct, the plant and animal species associated with it also become extinct. When a host fish species becomes extinct, its unique assemblage of parasites also becomes extinct.

Biodiversity Conservation:

We should conserve the biodiversity due to following groups of regions:

- **The narrowly utilitarian:** Human obtain countless direct economic benefits from

nature like food, firewood, fibers, construction material, medicinal plants and industrial products. With increasing resources put into 'bio-prospecting' nations endowed with rich biodiversity can expect to reap enormous benefits.

- **The Broadly Utilitarian:** Biodiversity plays a major role in ecosystem services that nature provides. Productions of Oxygen during photosynthesis, pollination without natural pollinator, pleasure from nature are priceless.
- **Ethical:** For conserving biodiversity relates to what we own to millions of plants, animals and microbes species with whom we share this planet. Every species has an intrinsic value although it may not be of current or any economic value to us. It is our moral duty to care for their well-being and pass on our biological legacy in good order to future generations.

  When whole ecosystem is conserved, all its biodiversity is also protected.

There are two ways of conservation of biodiversity:

In situ (on site) conservation: Conservationists have identified for maximum protection certain 'biodiversity hotspots' regions with very high levels of species richness and high degree of endemism, species found in that region and not found anywhere else. There are 34 biodiversity hot spots in the world. These hotspots are also regions of accelerated habitat loss. India has 14 biosphere reserves, 90 national parks and 448 wildlife sanctuaries.

Ex situ (off site) conservation: In this method, threatened animals and plants are taken out from their natural habitat and placed in special setting when they be protected and given special care. Zoological parks, Botanical Gardens and wildlife safari parks are used for this purpose. Now gametes of threatened species can be preserved in viable and fertile condition for long periods of time using cryopreservation technique. Eggs can be fertilized in vitro and plants can be propagated using tissue culture methods.

The historic convention on Biological Diversity (The Earth Summit) held in Rio de Janeiro in 1992, called upon all nations to take appropriate measures for conservation of biodiversity and the World Summit on sustainable development held in 2002 in Johannesburg, South Africa, 190 countries pledged their commitment to achieve by 2010, a significant reduction in the current rate of biodiversity loss at global, regional and local levels.

Class : 12th Biology
Chapter- 15 : Biodiversity and Conservation

Biodiversity and Conservation

- Conservation of Biodiversity
  - Reasons
    - Narrow Utilitarian
      - More than 25% of the drugs are derived from plants.
    - Broadly Utilitarian
      - Provides oxygen
      - Pollination
      - Aesthetic pleasures
    - Ethical Utilitarian
      - Moral duty to take care for biodiversity
  - Methods
    - In-situ Conservation
      - National Park
      - Sanctuary
      - Biosphere Reserves
      - Sacred Forests
      - Hotspots
    - Ex-situ Conservation
      - Zoological Parks
      - Botanical gardens
      - Gene banks
      - Genetic resource centres
- Biodiversity
  - Species- Area Relationship
    - $S = CA^Z$
    - $\log S = \log C + Z \log A$
    - log-log scale
    - Species richness
    - Area
  - log S = log C + Z log A
  - Global Species Diversity
    - Other animal groups
    - Crustaceans
    - Molluscs
    - Insects
    - Fishes
    - Mammals
    - Birds
    - Reptiles
    - Amphibians
    - Mosses
    - Ferns and allies
    - Fungi
    - Angiosperms
    - Algae
    - Lichens
  - Levels of biodiversity
    - Genetic diversity
      - Diversity show n by a single species at genetic level.
    - Species diversity
      - Diversity at the species level
    - Ecological diversity
      - Diversity at the ecosystem level
  - Patterns of biodiversity
    - Latitudinal gradients
      - Species diversity decreases from the equator towards the poles.
      - Tropics (latitudinal range of 23.5° S to 23.5° N) have more species than temperate o or polar areas.
  - Causes of loss of biodiversity
    - Habitat loss and fragmentation
    - Over-exploitation
    - Alien-species invasions
    - Co-extinctions

Important Questions

➢ Multiple Choice Questions:

1. Which of the following countries has the highest biodiversity?

(a) Brazil
(b) South Africa
(c) Russia
(d) India.

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.

3. Which of the following is not an invasive alien species in the Indian context?

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

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.

5. Which one of the following is not a major characteristic feature of biodiversity hotspots?

(a) Large number of species
(b) Abundance of endemic species
(c) Large number of exotic species
(d) Destruction of habitat.

6. What is common to the following plants: Nepenthes, Psilotum, Rauwolfia and Acontium?

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

7. The most important cause of biodiversity loss is:

(a) Over exploitation of economic species

(b) Habitat loss and fragmentation
(c) Invasive species
(d) Breakdown of plant-pollinator relationships

8. Amongst the animal groups given below, which one has the highest percentage of endangered species?

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

9. Which one of the following is an endangered plant species of India?

(a) Rauwolfia serpentina
(b) Santalum album (Sandal wood)
(c) Cycas beddonei
(d) All of the above.

10. What is common to Lantana, Eichhornia and African catfish?

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

11. 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

12. 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.

13. Among the ecosystem mentioned below, where can one find maximum biodiversity?

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

14. Which of the following forests is known as the 'lungs of the planet Earth'?

(a) Tiaga forest
(b) Tundra forest
(c) Amazon rain forest
(d) Rain forests of North East India

15. The active chemical drug reserpine is obtained from:

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

➢ Very Short Question:

1. Habitat loss and fragmentation has caused severe damage to a particular type of ecosystem. Name it.
2. What trend is observed in respect of species diversity when we move from equator to poles?
3. Which region is considered as the one with highest biodiversity on earth? What is the name given to such region.forests?
4. Ecologists have discovered that value of Z lies in range of 0.1 to 0.2 regardless of taxonomic group or region. When will the slope of line steeper in species area relationship?
5. Define cryopreservation. Why is it useful in conserving biodiversity?
6. What are hot spots?
7. Name any two threatened animal species of India?
8. Name two most biodiversity rich zones of India?
9. What is cryopreservation?
10. Write the scientific name of the plant that yields reserpine?

➢ Short Questions:

1. How many species of plants and animals have been described by IUCN in 2004? What is global species diversity according to Robert May?
2. Explain co-extinction with a suitable example.
3. Study the pie-diagram and answer the questions which follows:

   What do A, B, C and D represent in these diagrams.
4. What is IUCN red list? Give any two uses of this list?
5. “Species diversity of plants is much less than that of animals” Why?
6. “Amazonian rain forest in south America has the greatest bio-diversity on earth”. Justify the statement.

7. Sometimes introduction of an exotic species upsets native species of the ecosystem. Substantiate the statement with the help of an example?
8. What do you mean lay species diversity? Name two measures of species diversity?

➢ Long Questions:

1. What is biodiversity? Why has it become important recently?
2. Explain what is meant by species diversity?
3. What is genetic diversity? Explain.

➢ Assertion & Reason Questions:

1. For question two statements are given-one labelled Assertion and the other labelled Reason. 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.

   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.

   Assertion: Most common forest type in India is tropical dry deciduous forests.

   Reason: They are common in West Bengal.

2. For question two statements are given-one labelled Assertion and the other labelled Reason. 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.

   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.

   Assertion: There are 36 biodiversity hotspots in the world.

   Reason: High level of species richness is a criteria for selection of a biodiversity hotspot.

➢ Case Study Questions:

1. Read the following and answer any four questions from (i) to (v) given below:

   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?

a. Kakapo was active only in the night when its potential predators would not be out for hunting.
b. The Kakapo would likely be well-camouflaged among the forest foliage due to its greenish plumage.
c. It was able to effectively hunt for food in the night.
d. All of these.

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 populations in New Zealand?

a. Habitat destruction.
b. Alien species invasion.
c. Pollution.
d. Both (a) and (b).

iii. All known survived Kakapo have been relocated by the New Zealand government to three predator-free islands, where they are monitored year round by staffs and volunteers to ensure that the birds are safe, healthy and well-fed. The extremely low population of Kakapo is a hurdle to the species becoming viable in the long term, despite such dedicated conservation efforts. This is because.

a. The small population results in very small gene pool.
b. There would be very Ii mited genetic diversity among the resulting offspring.
c. Of reduced capacity of the species to adapt and survive changes in the environment.
d. All of these.

iv. The reasons behind conserving biodiversity have been grouped into which of the following categories?

a. Narrowly utilitarian.
b. Broadly utilitarian.
c. Ethical.
d. All of these.

v. One of the ex situ conservation methods for endangered species is:

a. Wildlife sanctuaries.
b. Biosphere reserves.
c. Cryopreservation.
d. National parks.

2. Read the following and answer any four questions from (i) to (v) given below:

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 hum Thus the world is facing accelerated rates of species extinctions, largely due to human interference.

i. Which of the following cause of biodiversity loss is not included in evil quartet?

a. Coextinction.
b. Pollution.
c. Alien species invasion.
d. Habitat loss and fragmentation.

ii. Identify the species that have become extinct due to over exploitation.

a. Stellar sea cow.
b. Yucca moth.
c. Blatta orientalis.
d. Nile Perch.

iii. Factors which make species susceptible to extinction are:

a. Large population size.
b. Lack of genetic variability.
c. Power status of trophic level.
d. Ability to switch over to ahem ate foods.

vi. Assertion: Pollution reduces species biodiversity.

Reason: Spillover of oil in sea causes death of several marine animals.

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. Both assertion and reason are false.

v. _____ is the first major cause of species extinction.

a. Coextinction.
b. Over exploitation.
c. Habitat destruction.
d. Alien species invasion.

✓ Answer Key-

➢ Multiple Choice Answers:

1. (a) Brazil
2. (c) Keeping animals in zoological parks
3. (b) Cynodon
4. (a) Rain forest of North-East India
5. (d) Destruction of habitat.
6. (c) All are prone to over-exploitation
7. (b) Habitat loss and fragmentation
8. (c) Amphibians
9. (d) All of the above.
10. (d) All the species are neither threatened nor indigenous species of India.
11. (b) Over-exploitation by humans
12. (b) African catfish is not a threat to indigenous catfishes.
13. (c) Coral reefs
14. (c) Amazon rain forest
15. (b) Rauwolfia

➢ Very Short Answers:

1. Tropical Rain Forest.
2. In general, species diversity decreases as we move away from the equator towards poles.
3. Amazonian rain forests. They are also called the 'Lungs of the planet'.
4. Slope of line is much steeper if one analyses the species¡Varea relationship among very large areas like entire continents.
5. Preserving a material in liquid nitrogen at – 196°C. It can be done to preserve threatened species in viable and fertile condition for long period.
6. Hot spots are the priority areas of conservation that are extremely rich in species have high endemism& under constant threat of extinction.
7. Swamp Deer & Great Indian Rhinoceros
8. Western Ghats & eastern Himalayas.
9. Cryopreservation is the storage of materials at ultra – low temperature either by rapid cooling or by grade cooling & simultaneous dehydration at low temp.

10. Rauwolfiaserpentina.

➢ Short Answer:

1. IUCN (2004) has described slightly more than 1.5 million species of plants and animals.

According to Robert Mayi¦s estimates the global species diversity is about 7 million.

2. Coextinction refers to the disappearance of species with extinction of another species of plant or animal with which it was associated in an obligatory way. e.g., Plant-pollinator mutualism.

3. A →Crustaceans B →Insects

C →Mosses D →Fungi

4. IUCN (International union of conservation of nature & natural resources) maintains a "Red datalist" which is a catalogue of taxa facing risk of extinction. The main purpose of this list:-

i) to identify & document the species with high risk of extinction.

ii) to provide awareness to the degree of threat to biodiversity.

5. The species diversity of plants is much less than that of animals because most animals possesses nervous system that control & coordinate various activities of animals. They also possess receptors to receive environmental stimuli some of these responses are adaptive & ensure survival of organism in changing environmental conditions.

6. Amazonian rain forest in south America has the greatest biodiversity on earth; it harbors about40000 species of plants, 1,25,000 species of insects, 3000 species of fishes, 427 of amphibians, 378 ofreptiles, 1300 of birds & 427 of mammals.

7. The alien species become invasive & compete with native species causing extinction of indigenous species e.g. introduction of African catfish (clariasgariepinus) for aquaculture purposes, is posing threat to our. Indigenous catfish, (clariasbacterachus).

8. Species diversity refers to the variety of species within a region. The two important measures Of specie diversity are:-

i. Species richness:- It refers to number of species per unit area.

ii. Species evenness :- It refers to relative abundance with which each species is represented in an area.

➢ Long Answer:

1. Biodiversity: The term biodiversity was coined by W.G. Rosen in 1985. It is the occurrence of different kinds of organisms and the complete range of varieties adapted to different climates, environments, and areas being constituents of food chains and food webs of biotic interrelationships. Biodiversity refers to the totality of genes, species, and ecosystems of a region. Biodiversity differs from place to place.

Significance of biodiversity: As there is a continuous loss of biodiversity due to increasing population, resource consumption, urbanization, and pollution, it is important to conserve it.

The basic reason for concern is that biodiversity is being lost even before it attains its size. Loss of biodiversity would check the evolutionary capability of biota to cope up with an environmental loss.

2. Species diversity. The diversity includes the whole range of organisms found on earth. The number of identified species worldwide is between 1.7 and 1.8 million. However, the estimates of total known species maybe 50 million. A large number of plant and animal species are yet to be identified. There are many more species present in the tropics.

The two important measures of species diversity are:

i. Species richness: It refers to the number of species per unit area.

ii. Species evenness: It refers to the relative abundance with which each species is represented in an area.

iii. The variety and number of individuals determine the level of diversity of an ecosystem.

iv. The Western Ghats have a greater diversity of amphibian species than the Eastern Ghats.

3. Genetic diversity:

i. The greater the genetic diversity among organisms of a species, the more sustenance it has against environmental perturbations. The genetically uniform populations are highly prone to diseases and harsh environments.

ii. The genetic variation shown by Rauwolfia can be in terms of the concentration and potency of the chemical reserpine.

There are more than 50,000 genetically different strains of rice and 1,000 varieties of mango in India.

➢ Assertion & Reasons Answer:

1. (c) Assertion is true but reason is false

Explanation:

The tropical monsoon deciduous forests are found in areas receiving an annual rainfall of 100 to 200cms in India, with a distinct dry and rainy season and minimum temperature. The south western ghats moist deciduous forests are a tropical moist broad leaf forest ecoregion of southern India. It covers the southern portion of the Western Ghats range and the Nilgiri Hills between 250 and 1000 meters elevation in Kerala, Karnataka and Tamil Nadu states.

2. (b) Both assertion and reason are true but reason is not the correct explanation of assertion.

Explanation:

Hotspots are areas with high density of biodiversity or megadiversity which are also the most threatened ones. Ecologically hotspots are determined by four factors.

i. Number of specieslspecies diversity.

ii. Degree of endemism.

iii. Degree of threat to habitat due to its degradation and fragmentation.

iv. Degree of exploitation.

v. Myers (1988) initially identified 12 hotspots. Today the number of hotspots identified by ecologists is 36.

➢ Case Study Answer:

1.

(i) - (d) All of these.

Explanation:

Since the Kakapo is nocturnal, it was active only in the night when its potential predators would not be out for hunting. With its greenish plumage, the Kakapo could likely be well camouflaged among the forest foliage in the daytime when it is resting hence evading detection by its predators. It was able to effectively hunt for food in the night given its ability to climb trees and travel significant distances over land despite lacking the ability to fly.

(ii) - (d) Both (a) and (b).

Explanation:

As humans settled in NewZealand,they would have cleared the land to make way for their own needs, e.g., farmland, hence shrinking the natural habitats of the Kakapo. The new mammals that were introduced into the Kakapo's habitats might have out-competed the Kakapo for the limited food resources available. The new mammals that were introduced might also have easily preyed on the Kakapo (e.g., by using their sense of smell), as the Kakapo likely lacked the necessary adaptations to defend itself given that such predators were never present in the past. For instance, many mammals such as cats are nocturnal and hence would prey on Kakapo when the latter are also active at night.

(iii) - (d) All of these.

Explanation:

The small populations results in a very small gene pool, i.e., a very limited variety of alleles I traits among surviving individuals of the species. Even if the existing birds manage to breed and multiply significantly, there would be very limited genetic diversity among the resulting offspring. This would lead to reduce capacity of the species to adapt to and survive changes in the environment. There may also be reduced fitness in the offspring given increased likelihood of homozygosity of recessive harmful/ deleterious alleles, which would result in these alleles being expressed to bring about unfavourable phenotypes.

(iv) - (d) All of these.

Explanation:

We should conserve biodiversity. The reason for this can be broadly divided into three categories: (i) Narrowly utilitarian (Humans derive a major part of their requirement from

organisms). (ii) Broadly utilitarian (Biodiversity is fundamental to ecosystem services of nature). (iii) Ethical (Every living species has an intrinsic value, it is our moral duty not to destroy them).

(v) - (c) Cryopreservation.

Explanation:

Ex situ (off site) conservation is conservation of selected rare plants/ animals in places outside their natural homes. It is a desirable approach to save threatened or endangered plant or animal species from extinction. Ex situ conservation includes offsite collections, gene banks, in vitro fertilisation, cryopreservation techniques and tissue culture.

2.

(i) (b) Pollution

Explanation:

Evil quartet, i.e., four major causes of biodiversity loss are habitat loss and fragmentation, over exploitation, alien species invasion and co-extinction.

(ii)(a) Stellar sea cow.

(iii) - (b) Lack of genetic variability.

Explanation:

Population traits which make species susceptible to extinction are: small population, higher status of trophic level and inability to switch over to alternate foods.

(iv) - (a) Both assertion and reason are true and reason is the correct explanation of assertion.

(v) - (c) Habitat destruction.