

Biodiversity and its Conservation

Biodiversity encompasses the rich tapestry of life that exists on our planet, encompassing a wide array of living organisms. It can be described as the diverse range of species, genetic variations, and habitats present in a given area. The concept of “biodiversity” was introduced by Edward Wilson, a prominent socio-biologist in 1992, to encompass the comprehensive diversity found across all levels of biological organization.

Levels of biodiversity

Levels of Biodiversity can be understood through three interconnected components or hierarchical levels of biological organization:

- A. **Genetic Diversity:** Within a single species, there exists a considerable range of genetic diversity. The greater the genetic variation among individuals of a species, the more resilient they are against environmental disturbances. This genetic diversity gives rise to sub-species, varieties, breeds, and other distinct forms.
- B. **Species Diversity:** This level of biodiversity focuses on the diversity of species and their relative abundance within a specific region. For example, the Western Ghats exhibit higher amphibian species diversity compared to the Eastern Ghats.

Species diversity is typically measured using two important factors:

- (i) Species richness, which quantifies the number of species per Unit area.
- (ii) Species evenness, which measures the relative abundance of different species within an area.

- C. **Ecological Diversity:** Ecological diversity pertains to the diversity at the ecological level. The presence of various ecosystems and habitats, such as rainforests, deserts, wetlands, mangroves, coral reefs, and alpine meadows, contributes to the overall ecological diversity. For instance, India boasts greater ecological diversity than Scandinavian countries like Norway due to its wide range of ecosystems and habitats.

Magnitude of Biodiversity

As per the International Union for Conservation of Nature (IUCN) report in 2004, the known number of described plant and animal species exceeds 1.5 million. Among these recorded species, over 70% are classified as animals, while plants account for less than 22% of the total. Interestingly, insects stand out as the taxonomic group with the highest species richness within the animal kingdom, constituting over 70% of all known animal species. In other words, for every 10 animals on Earth, approximately 7 of them are insects.

Patterns of Biodiversity

Biodiversity is not uniformly distributed across the planet; instead, it exhibits distinct patterns that can be observed when considering changes in latitude and altitude. These patterns provide valuable insights into the distribution and richness of species in different regions. The following are key patterns of biodiversity:

- A. **Latitudinal Gradients:** One of the most prominent patterns is the variation in species diversity as we move from the equator towards the poles. This phenomenon is known as latitudinal gradients of biodiversity. Generally, species diversity tends to decrease as we move away from the equatorial regions towards higher latitudes. In other words, biodiversity is typically higher in tropical regions (near the equator) compared to temperate or polar regions.

The latitudinal gradient of biodiversity has been extensively studied, and several hypotheses have been proposed to explain this pattern:

- (i) **Stability Hypothesis:** Tropical regions have experienced relatively stable environmental conditions over long periods of time. Unlike temperate regions that have been subjected to fluctuations and glaciations, the tropics have remained relatively undisturbed. This stability has allowed species to persist and diversify, resulting in higher biodiversity.
- (ii) **Environmental Conditions:** The tropical environment is characterized by less seasonality compared to temperate regions. The relatively constant environmental conditions in the tropics provide a favourable and stable habitat for a wide range of species. This enables the coexistence of numerous species with specialized adaptations.
- (iii) **Productivity Hypothesis:** The tropics receive a higher amount of solar energy, leading to increased primary productivity. This higher productivity translates into a greater availability of resources and energy for the organisms within the ecosystem. Consequently, the tropics can support a larger number of species, resulting in higher biodiversity.

B. Species-Area Relationships

Alexander von Humboldt made a significant observation regarding the relationship between species richness and explored area within a region. He found that as the explored area increased, species richness also tended to increase, but only up to a certain point. This relationship between species richness and area can be described by a rectangular hyperbola, particularly for diverse taxonomic groups like birds, bats, and freshwater fishes.

When represented on a logarithmic scale, this relationship appears as a straight line, which can be expressed by the following equation:

$$\mathbf{\text{Log}(\text{log}(S)) = C + Z \text{log}(A)}$$

In this equation:

- **S** represents species richness.
- **A** represents the area.
- **Z** is the slope of the line, also known as the regression coefficient.
- **C** represents the y-intercept.

Interestingly, regardless of the specific taxonomic group or the region being studied, the value of **Z** typically falls within the range of 0.1 to 0.2. This suggests that there is a consistent relationship between species richness and area across diverse ecosystems.

Species-area relationships provide valuable insights into the patterns and processes of biodiversity.

The Importance of Species Diversity

The Importance of Species Diversity for Ecosystems

Species diversity plays a critical role in maintaining the stability and functioning of ecosystems. A stable community exhibits several key characteristics:

- Consistency in Productivity: A stable community demonstrates relatively stable year-to-year productivity. Excessive fluctuations in productivity can disrupt the balance of the ecosystem, affecting the availability of resources and the functioning of ecological processes.
- Resilience and Resistance: A stable community is either resistant or resilient to occasional disturbances, whether they are caused by human activities or natural events. Resistance refers to the ability of an ecosystem to withstand the impacts of disturbances, while resilience describes its capacity to recover and regain its normal functioning after a disturbance.
- Protection Against Invasive Species: A stable community is resistant to the invasion of alien species. The presence of diverse species can act as a natural defense against the establishment and spread of invasive species, which can outcompete native species and disrupt the ecological balance.

David Tilman's long-term ecosystem experiments using outdoor plots have provided concrete evidence of the link between species richness and stable communities. His research has shown that communities with higher species diversity tend to exhibit more consistent productivity in terms of total biomass. Moreover, greater species diversity contributes to overall higher productivity within the ecosystem, as different species fulfill unique ecological roles and utilize resources more efficiently.

To further illustrate the contribution of diversity to ecosystem balance, **Paul Ehrlich** proposed the “**rivet popper hypothesis**.” Ehrlich analogized each species to a rivet in an airplane's body, representing the ecosystem as a whole. According to his hypothesis, removing individual species from the ecosystem is akin to removing rivets from the airplane. If too many rivets (species) are lost, the structural integrity of the airplane (ecosystem) is seriously compromised. This metaphor emphasizes the importance of preserving species diversity to maintain the stability and functioning of ecosystems.

Loss of Biodiversity

The International Union for Conservation of Nature (IUCN) was established in 1948 and is headquartered in Switzerland. It focuses on the preservation of nature and the sustainable utilization of natural resources.

One of the key initiatives of the IUCN is the compilation of the IUCN Red List, which serves as an inventory of the global conservation status of biological species and is documented in the Red Data Book. This comprehensive undertaking began in 1963.

According to the IUCN Red List from 2004, a total of 784 species have become extinct in the past 500 years. This includes 338 vertebrates, 359 invertebrates, and 87 plants. Notable examples of extinct species are the *Dodo from Mauritius*, the *Quagga from Africa*, the *Thylacine from Australia*, *Steller's Sea cow from Russia*, and three sub-species of tigers (*Bali, Javan, and Caspian*).

A. Impacts of Biodiversity “Loss

The loss of biodiversity can result in several detrimental effects, including:

- (i) Decline in plant production,
- (ii) (ii) Reduced resistance and resilience to environmental disturbances such as drought, and
- (iii) Increased variability in ecosystem processes, such as plant productivity, water utilization, and pest and disease cycles.

B. Causes of Biodiversity Loss

Human activities have greatly accelerated the rate of species extinction on Earth. Four primary causes, often referred to as the Evil Quartet, contribute to the loss of biodiversity:

- (i) Habitat Loss and Fragmentation,
- (ii) Overexploitation,
- (iii) Invasion of Alien (exotic) Species, and
- (iv) Coextinctions.

Reasons for Preserving Biodiversity

The justifications for preserving biodiversity can be categorized into three main groups:

- (i) **Narrowly Utilitarian Perspective**: Nature provides humans with numerous direct economic advantages, making it essential to conserve biodiversity. By preserving diverse ecosystems and species, we can continue to benefit from the valuable resources and services they offer.
- (ii) **Broadly Utilitarian Perspective**: Biodiversity plays a critical role in providing ecosystem services that are vital to human well-being. These services include clean air and water, pollination, climate regulation, soil fertility, and natural pest control. Therefore, conservation efforts are necessary to ensure the continued provision of these essential services.
- (iii) **Ethical Argument**: Every species holds intrinsic value, irrespective of its direct economic significance to us. It is our moral obligation to safeguard this biological heritage and pass it on to future generations in a healthy and intact state. Respecting the intrinsic worth of all species emphasizes the importance of conserving biodiversity for its own sake and for the well-being of future inhabitants of our planet.

Biodiversity Conservation

Ex Situ Conservation: Safeguarding Species Outside Their Natural Habitat

Ex situ conservation is a crucial approach that involves the protection and preservation of animals and plants outside their natural environments. This method plays a significant role in ensuring the survival of endangered species and safeguarding genetic diversity. Ex situ conservation encompasses various techniques and facilities, such as gene banks, cryopreservation, zoos, botanical gardens, and wildlife safari parks. Let's delve into the different aspects of ex situ conservation in a more detailed manner:

- **Gene Banks**: Gene banks serve as secure repositories for the genetic material of rare, endangered, and desired plants and animals. They store seeds, tissues, embryos, or other genetic resources under controlled conditions, ensuring their long-term preservation. Gene banks are vital for maintaining the genetic diversity of species and provide a valuable resource for future conservation efforts and research.

Cryopreservation: Cryopreservation is a technique used to preserve the germplasm (reproductive cells) of threatened and endangered species. The germplasm is stored at extremely low temperatures, typically around -196°C , in liquid nitrogen. By freezing the reproductive cells, cryopreservation halts biological activities, such as mitosis and genetic changes. This method enables the long-term storage and conservation of genetic material, which can be utilized for species recovery and reintroduction programs.

• **Zoos, Botanical Gardens, and Wildlife Safari Parks:** Zoos, botanical gardens, and wildlife safari parks are examples of ex situ conservation facilities. These institutions play a crucial role in preserving and showcasing a wide range of plant and animal species. They provide controlled environments where endangered species can be protected, bred, and cared for. Zoos often participate in captive breeding programs, which aim to increase population numbers and maintain genetic diversity. Botanical gardens house diverse plant species, including rare and endangered ones, for conservation, education, and research purposes. Wildlife safari parks offer protected habitats where visitors can observe and learn about animals in a near-natural setting.

Ex situ conservation efforts are essential for several reasons. They act as a safety net for species on the verge of extinction, providing protection and care outside their natural habitats. These initiatives contribute to preserving genetic diversity, which is crucial for the long-term survival and adaptability of species. Furthermore, ex situ conservation facilities serve as educational platforms, raising awareness about biodiversity and inspiring public support for conservation initiatives.

In situ Conservation: Preserving Species in their Natural Habitats

In situ conservation is a crucial process that focuses on protecting and preserving species within their natural habitats. This approach recognizes the importance of maintaining the ecological integrity of ecosystems and allowing species to thrive in their native environments. In situ conservation includes various procedures aimed at safeguarding biodiversity. Let's explore these procedures in more detail:

• **National Parks:** National parks are established by the central government to provide secure habitats for wildlife. These parks are strictly protected, prohibiting any form of human interference. Commercial activities are strictly prohibited within these areas. An example of the first Indian national park is the Jim Corbett National Park, located in Uttarakhand.

• **Wildlife Sanctuaries:** Wildlife sanctuaries are designated areas where special provisions are made to ensure the safety and well-being of fauna. While limited activities, such as the cutting of trees and collection of forest products, may be allowed for local communities, the primary focus is on providing a safe haven for wildlife.

• **Biodiversity Hotspots:** Biodiversity hotspots are regions characterized by exceptionally high levels of species richness and a significant degree of endemism. These areas also face significant threats of habitat loss. There are 34 international biodiversity hotspots globally, with three of them located in India:

- (a) Eastern Himalayan Region
- (b) Western Ghats

© Indo-Burma

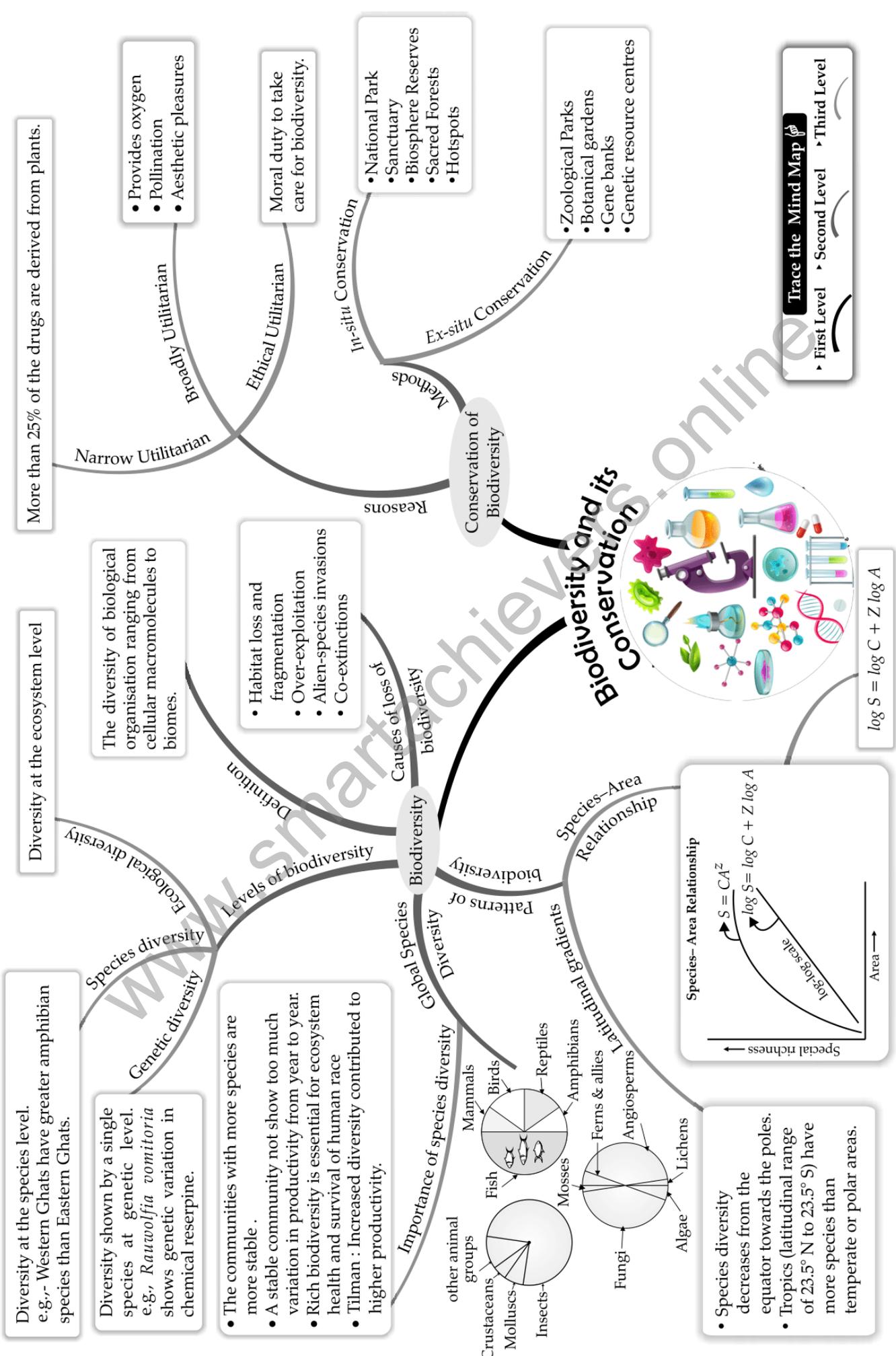
• **Biosphere Reserves:** Biosphere reserves are special protected areas that integrate human communities as an integral part of the ecosystem. These reserves are zoned for specific activities, consisting of:

- (i) Core Zone: A strictly protected area with no human activity.
- (ii) Buffer Zone: An area where limited human activities are allowed.
- (iii) Manipulation Zone: This zone permits various human activities while ensuring sustainable management practices.

• **Sacred Groves:** Sacred groves are small forested areas that hold religious and mythological significance within specific cultures. They are revered and protected due to their cultural and spiritual importance. Examples include the Aravalli Hills in Rajasthan.

In situ conservation plays a vital role in maintaining the ecological balance and preserving species in their natural habitats. It allows for the sustained functioning of ecosystems, protects biodiversity hotspots, and respects the cultural and religious values.

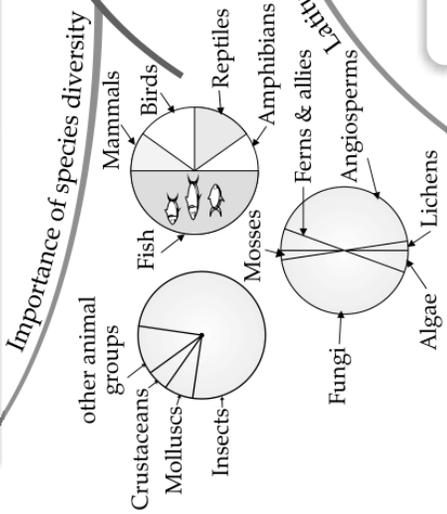
People's participation in biodiversity conservation has been evident through movements like the Chipko Movement and Appiko Movement. Biodiversity-rich countries are investing in bioprospecting, exploring diverse genetic and species-level resources for economically valuable products. This engagement aims to maximize benefits and sustainable development while preserving biodiversity.



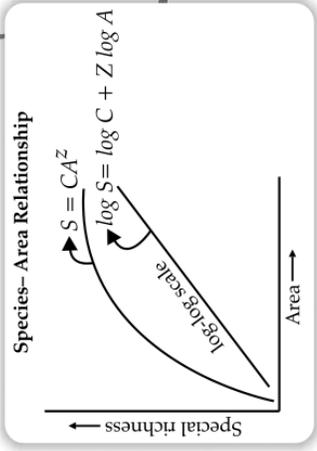
Diversity at the species level.
e.g.- Western Ghats have greater amphibian species than Eastern Ghats.

Diversity shown by a single species at genetic level.
e.g., *Rauwolfia vomitoria* shows genetic variation in chemical reserpine.

- The communities with more species are more stable.
- A stable community not show too much variation in productivity from year to year.
- Rich biodiversity is essential for ecosystem health and survival of human race
- Tilman : Increased diversity contributed to higher productivity.



- Species diversity decreases from the equator towards the poles.
- Tropics (latitudinal range of 23.5° N to 23.5° S) have more species than temperate or polar areas.



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

Diversity at the ecosystem level

The diversity of biological organisation ranging from cellular macromolecules to biomes.

- Habitat loss and fragmentation
- Over-exploitation
- Alien-species invasions
- Co-extinctions

Causes of loss of biodiversity

More than 25% of the drugs are derived from plants.

Narrow Utilitarian

- Provides oxygen
- Pollination
- Aesthetic pleasures

Broadly Utilitarian

Ethical Utilitarian

Moral duty to take care for biodiversity.

In-situ Conservation

- National Park
- Sanctuary
- Biosphere Reserves
- Sacred Forests
- Hotspots

Methods

Ex-situ Conservation

- Zoological Parks
- Botanical gardens
- Gene banks
- Genetic resource centres

Conservation of Biodiversity

Biodiversity and its Conservation



Trace the Mind Map

- ▶ First Level
- ▶ Second Level
- ▶ Third Level

Practice Questions

1. Which of the following factors contribute to the loss of biodiversity?

- (a) Habitat destruction, fragmentation, and climate change
- (b) Pollution, invasive species, and overexploitation
- (c) Genetic mutations and ecological disturbances
- (d) All of the above

2. Which type of biodiversity refers to the variety of habitats and ecosystems within a region?

- (a) Genetic diversity
- (b) Species diversity
- (c) Ecological diversity
- (d) Habitat diversity

3. The concept of biodiversity hotspots was introduced by:

- (a) Charles Darwin
- (b) Alexander von Humboldt
- (c) Jane Goodall
- (d) Rachel Carson

4. Island ecosystems are highly vulnerable due to:

- a) their small size and limited number of species,
- b) their large size and diverse array of species,
- c) their large size only,
- d) their small size only.

5. In situ conservation strategies include:

- I. National parks,
- II. Wildlife sanctuaries,
- III. Biosphere reserves,
- IV. Sacred forests/lakes.

Choose the correct option:

- a) I and II,
- b) II, III, and IV,
- c) I, II, and III,
- d) I, II, III, and IV.

6.The primary objectives of wildlife conservation are to:

- I. maintain ecological processes,
- II. enhance wildlife diversity with exotic species,
- III. prevent species migration,
- IV. preserve overall life diversity.

Select the correct answer using the codes given below:

- a) I and II, b) II and III, c) III and IV, d) I and IV.

7.The total number of recognized biodiversity hotspots in the world is:

- a) 24, b) 12, c) 34, d) 52.

8.At higher altitudes, when birds become rare or go extinct, the plants that might also disappear are:

- a) Pine, b) Oak, c) Orchids, d) Rhododendrons.

9.A species that is in danger of extinction is classified as:

- a) Endangered, b) Vulnerable, c) Rare, d) Critically endangered.

10.Pronuba and Yucca have a mutualistic relationship in nature. This situation is described as:

- a) Pollution, b) Coextinctions, c) Alien species invasions, d) Over-exploitation.

11.Genetic diversity refers to:

- a) The variety of species and their relative abundance within a region,
- b) The range of genetic information contained in organisms,
- c) The diversity of genes at community and ecosystem levels,
- d) All of the above.

12. Which of the following exhibits the highest genetic diversity in India?

- a) Rice, b) Maize, c) Mango, d) Groundnut.

13. Which of the following pairs represents endangered species?

- a) Garden lizard and Mexican poppy, b) Rhesus monkey and sal tree,
c) Indian peacock and carrot grass, d) Hornbill and Indian aconite.

14. Which of the following is not associated with wildlife conservation?

- a) IVF, b) IUCN, c) WWF, d) IBWL.

15. The largest proportion of the world's freshwater, more than 70%, is contained in:

- a) Antarctica, b) Glaciers and mountains, c) Greenland, d) Polar ice.

16. Minerals, metals, and fossil fuels are categorized as which type of energy resources?

- a) Renewable, b) Non-renewable, c) Biodegradable, d) Degradable.

17. Rajaji National Park is located in:

- a) Tamil Nadu, b) Karnataka, c) Uttarakhand, d) Rajasthan.

18. According to the National Forest Policy (1988), the recommended percentage of forest cover is:

- a) 33% for plains and 67% for hills, b) 37% for plains and 63% for hills,
c) 20% for plains and 70% for hills, d) 23% for plains and 77% for hills.

19. The number of endangered species of angiosperms in India is approximately:

- a) 487, b) 15,000, c) 5,000, d) 3,000.

20. An endemic species is defined as:

- a) a species that has been introduced to a new geographic area,
- b) a species found in many different geographic areas,
- c) a species found only on islands,
- d) a species found naturally in just one geographic area.

21. Which region possesses a significant number of endemic amphibian species?

- a) North-East Ghats,
- b) Andaman Nicobar Islands,
- c) Western Ghats,
- d) North-West Ghats.

22. What are the three levels of biodiversity?

- a) Genetic diversity, species diversity, and ecological diversity
- b) Species diversity, ecological diversity, and habitat diversity
- c) Geographical diversity, genetic diversity, and habitat diversity
- d) Ecological diversity, species diversity, and community diversity

23. What are the goals of wildlife conservation?

I. Maintaining the ecological process.

II. Enriching wildlife diversity with exotic species.

III. Preventing migration of species.

IV. Maintaining the diversity of life. Which statements are correct?

- a) I, II
- b) II, III
- c) III, IV
- d) I, IV

24. In which year was the Biodiversity Act of India passed by the Parliament?

- a) 1996
- b) 1992
- c) 2002
- d) 2000

25. Where are large woody vines more commonly found?

- a) Mangroves
- b) Tropical rainforests
- c) Alpine forests
- d) Temperate forests

26. The endangered largest living lemur, Ildri, is native to which location?

- a) Madagascar b) Mauritius c) Sri Lanka d) India

27. What is the name of the historic convention on biological diversity held in Rio de Janeiro in 1992?

- a) The Earth Summit b) Montreal Protocol
c) Geneva Convention d) Rio Convention

28. Water hyacinth (*Eichhornia crassipes*) was introduced in Indian water bodies to reduce pollution. It is an example of:

- a) Disturbance and degradation b) Coextinctions
c) Alien species invasions d) Over-exploitation

29. What factors affect biodiversity?

- a) Latitudinal gradients and species-area relationship
b) Species-area relationship and longitudinal gradients
c) Both (a) and (b)
d) Latitudinal and longitudinal gradients

30. Which statement pertains to a stable community?

- a) Productivity of the community should not vary too much from year to year
b) Community should be resistant to occasional natural and man-made disturbances
c) Community should be resistant to invasions by alien species
d) All of the above

31. Approximately 70% of the total global carbon is found in:

- a) Grasslands b) Argo-ecosystems c) Oceans d) Forests

32. In which part of the biosphere reserves, human settlement is permissible?

- a) Transition zone b) Buffer zone c) Core zone d) Settlement not allowed

33. Which of the following is the correct estimation about the numbers of national parks, biosphere and the wildlife sanctuaries of India

- A) 158, 62, 10 b) 58, 412, 10 c) 96, 412, 10 d) 90, 14, 448

34. Which one of the following is an example of ex situ conservation?

- a) Wildlife sanctuary b) Seed bank c) Sacred groves d) National Park

35. The dolphin found in Chilka lake is

- a) Delphinus b) Irrawaddy c) Sotalia d) Tursiops

36. Communities with more species tend to be more stable than those with less species. This was confirmed by

- a) Alexander von Humboldt b) David Tilman
c) Paul Ehrlich d) Edward Wilson

37. Some of the nutrient cycles are labelled as below

- I. Sulphur cycle II. Phosphorus cycle
III. Carbon cycle IV. Nitrogen cycle

Of these, the sedimentary cycle is represented by

- a) I only b) II only c) III only d) I and II

38. Wildlife is

- a) Any living organism in any habitat
b) Predatory animals in their natural habitat
c) Any living organisms in its natural habitat
d) Economically important animals and plants

39. Tiger is not resident in which one of the following national parks?

- a)Ranthambhore b)Sunder bans c)Gir d)Jim Corbett

40. The number of species of birds in Columbia, located near the equator is

- a)2,400 b)1,400 c)2,000 d)2,500

41. The Western Ghats have a greater amphibian's diversity than the Eastern Ghats. It is an example of

- a) Species diversity b) Genetic diversity c) Ecological diversity d) None of these

42. Red list in India completed by

- a) Botanical survey of India b) Zoological survey of India
c) Geological survey of India d) None of the above

43. Which of the following is conservation?

- a) Banning of Akhard Sikar in Similipal b) Breeding of animals in Nandan Kanha
c) Protecting migration of birds in Chilka lake d) Protecting fishing in Bhitarkanika

44. In the species area relationship, 'S' represents

- a) Species richness b) Slope of the line c) Specific area d) Special species

45. The species listed in Red Data Book are

- a) Threatened b) Endangered c) Rare d) All of these

46. Excessive accumulation of organic matter in water bodies leads to

- a) Decrease in species diversity b) Increase in species diversity
c) Greenhouse effect d) No effect on species diversity

47.. The medicinal plant produces a chemical called

- a) Opine
- b) Reserpine
- c) Vinblastin
- d) Reserpine

48. What is the sustainable use of resources?

- a) Protected strips of the land that allows organisms to migrate from one wilderness area to another
- b) A law that makes it illegal to do harm to the species that are listed as endangered or threatened
- c) The ability to use natural resources in a way that helps people to protect the ecosystem
- d) The study of the methods to help protect biodiversity

49. Annual variations in the intensity and duration of temperature and 50 and 250 cm annual variation in precipitation, account for the formation of a major biome as

- A) Temperate forest
- b) Coniferous forest
- c) Tropical Forest
- d) Grassland

50. All the following are included under in situ conservation except

- a) Botanical garden
- b) Biosphere reserve
- c) National Park
- d) Sanctuary

Answers

1. The correct answer is (d) All of the above. Habitat destruction, fragmentation, and climate change contribute to the loss of biodiversity by destroying natural habitats and disrupting ecosystems. Pollution, invasive species, and overexploitation also have negative impacts on biodiversity by introducing harmful substances, competing with native species, and depleting resources.

2. The correct answer is © Ecological diversity. Ecological diversity refers to the variety of habitats and ecosystems within a region. It encompasses the different types of forests, grasslands, wetlands, deserts, and other ecosystems present in an area.

3. The correct answer is (b) Alexander von Humboldt. Alexander von Humboldt, a renowned naturalist and explorer, introduced the concept of biodiversity hotspots in his works. He identified certain regions with high species richness and endemism that are under significant threat and require conservation efforts.

4. The correct answer is (a) their small size and limited number of species. Island ecosystems are highly vulnerable due to their small size and limited number of species. These factors make them more susceptible to ecological disturbances, invasive species, and habitat loss. The small population size of species on islands also increases the risk of inbreeding and genetic drift.

5. The correct answer is (d) I, II, III, and IV. In situ conservation strategies involve protecting species and their habitats within their natural range. National parks, wildlife sanctuaries, biosphere reserves, and sacred forests/lakes are examples of in situ conservation strategies aimed at preserving biodiversity and ecosystem integrity.

6. The correct answer is (a) I and II. The primary objectives of wildlife conservation are to maintain ecological processes and enhance wildlife diversity. This involves protecting habitats, promoting species conservation, and ensuring the balance of ecological interactions. The introduction of exotic species is generally discouraged as it can disrupt native ecosystems.

7. The correct answer is (a) 24. There are currently 24 recognized biodiversity hotspots in the world. These hotspots are regions of high biological diversity and endemism that face significant threats and require conservation efforts to preserve their unique species and ecosystems.

8. The correct answer is (d) Rhododendrons. At higher altitudes, when birds become rare or go extinct, the plants that might also disappear are rhododendrons. Birds play a crucial role in pollinating rhododendron flowers, and their absence can negatively impact the reproductive success of these plants.

9. The correct answer is (a) Endangered. A species that is in danger of extinction is classified as endangered. This classification indicates that the species faces a very high risk of extinction in the wild if the threats and pressures on its population are not mitigated.

10. The correct answer is (b) Coextinctions. Pronuba and Yucca have a mutualistic relationship in nature. This means that they rely on each other for survival and reproduction. If one of the species, such as Pronuba, were to go extinct, it could lead to the coextinction of the other species, in this case, Yucca. Coextinctions occur when two or more species are interdependent, and the loss of one species leads to the extinction of the other(s).

11. The correct answer is (b) The range of genetic information contained in organisms. Genetic diversity refers to the variety and variability of genes within a species or population. It encompasses the range of genetic information contained in individuals of a species, including variations in genes, alleles, and DNA sequences. Genetic diversity is important for the adaptability and long-term survival of a species, as it provides the potential for individuals to possess different traits that may be advantageous in changing environments.

12. The correct answer is © Mango. Among the options given, mango exhibits the highest genetic diversity in India. India is known for its rich mango biodiversity, with a wide range of mango varieties and cultivars found across the country. This diversity is attributed to the long history of mango cultivation in India and the selection and breeding of different varieties by farmers over generations.

13. The correct answer is (d) Hornbill and Indian aconite. Hornbill and Indian aconite represent endangered species. Hornbills are large, charismatic birds that are threatened due to habitat loss and hunting. Indian aconite is a plant species that is endangered and faces threats from habitat destruction and overcollection. The other options do not represent endangered species.

14. The correct answer is (a) IVF. IVF stands for In Vitro Fertilization, which is a technique used in human reproductive medicine. It is not directly associated with wildlife conservation. The other options, IUCN (International Union for Conservation of Nature), WWF (World Wildlife Fund), and IBWL (Indian Board for Wildlife), are all organizations that are involved in wildlife conservation efforts.

15. The correct answer is (b) Glaciers and mountains. The largest proportion of the world's freshwater, more than 70%, is contained in glaciers and mountains. These sources of freshwater store vast amounts of ice and snow, which gradually melt and contribute to rivers, lakes, and groundwater, thus forming crucial freshwater resources.

16. The correct answer is (b) Non-renewable. Minerals, metals, and fossil fuels are categorized as non-renewable energy resources. Non-renewable resources are finite in quantity and cannot be easily replenished within a short span of time. Once they are depleted, they cannot be readily replaced in the natural environment.

17. The correct answer is © Uttarakhand. Rajaji National Park is located in Uttarakhand, a state in northern India. The park is spread across the Shivalik range of the Himalayas and is known for its diverse flora and fauna, including elephants, tigers, leopards, and various bird species.

18. The correct answer is (a) 33% for plains and 67% for hills. According to the National Forest Policy (1988) in India, the recommended percentage of forest cover is 33% for plains and 67% for hills. This policy aims to ensure a minimum percentage of forest area in different geographical regions to maintain ecological balance, conserve biodiversity, and promote sustainable development.

19. The correct answer is (a) 487. The approximate number of endangered species of angiosperms (flowering plants) in India is 487. Angiosperms form the largest group of plants and play a vital role in ecosystems and human life. However, many species are threatened by habitat loss, fragmentation, pollution, invasive species, and other human activities.

20. The correct answer is (d) A species found naturally in just one geographic area. An endemic species is defined as a species that is found naturally and exclusively in a specific geographic area or region. Endemic species have a limited distribution and are often highly adapted to their unique habitats.

21. The correct answer is © Western Ghats. The Western Ghats region in India possesses a significant number of endemic amphibian species. The Western Ghats is a mountain range that runs parallel to the western coast of the Indian peninsula. It is recognized as a global biodiversity hotspot and is known for its high levels of species richness and endemism, including a large number of unique amphibian species.

22. The correct answer is (a) Genetic diversity, species diversity, and ecological diversity. The three levels of biodiversity are genetic diversity, species diversity, and ecological diversity. Genetic diversity refers to the variety of genes and genetic information within a species. Species diversity refers to the variety of different species in a particular area or ecosystem. Ecological diversity refers to the diversity of habitats, ecosystems, and ecological processes present in a region.

23. The correct answer is (a) I, II. The goals of wildlife conservation are maintaining the ecological process and maintaining the diversity of life. Wildlife conservation aims to protect and sustain the functioning of ecosystems, preserve biodiversity, and ensure the survival of species in their natural habitats. Enriching wildlife diversity with exotic species and preventing migration of species are not goals of wildlife conservation as they can have negative impacts on native species and ecosystems.

24. The correct answer is (b) 1992. The Biodiversity Act of India was passed by the Parliament in 1992. The act provides a legal framework for the conservation, sustainable use, and equitable sharing of biological resources and associated traditional knowledge. It aims to protect and manage India's rich biodiversity and ensure its sustainable utilization for the benefit of present and future generations.

25. The correct answer is (b) Tropical rainforests. Large woody vines are more commonly found in tropical rainforests. These vines, often referred to as lianas, are climbing plants that have adapted to the unique conditions of rainforest ecosystems. They play important ecological roles by providing structural support, serving as pathways for animal movement, and contributing to the overall biodiversity of the rainforest.

26. The correct answer is (a) Madagascar. The endangered largest living lemur, Indri indri, is native to Madagascar. Lemurs are primates found only on the island of Madagascar and are known for their unique adaptations and ecological roles. The Indri indri is the largest of all lemurs and is critically endangered due to habitat loss and fragmentation.

27. The correct answer is (a) The Earth Summit. The historic convention on biological diversity held in Rio de Janeiro in 1992 is commonly known as The Earth Summit. The summit brought together world leaders to address global environmental issues, including biodiversity conservation, sustainable development, and climate change. The Convention on Biological Diversity (CBD) was one of the key outcomes of the summit.

28. The correct answer is © Alien species invasions. Water hyacinth (*Eichhornia crassipes*) being introduced in Indian water bodies to reduce pollution is an example of alien species invasion. Water hyacinth is a non-native plant species that can rapidly spread and dominate aquatic ecosystems, leading to ecological disruptions and negative impacts on native species. While it may have been introduced with good intentions, its invasive nature makes it a problem in many water bodies.

29. The correct answer is (a) Latitudinal gradients and species-area relationship. Factors that affect biodiversity include latitudinal gradients and species-area relationship. Latitudinal gradients refer to the patterns of biodiversity changing with latitude, where higher biodiversity is often observed in tropical regions. The species-area relationship states that larger areas tend to have higher species richness due to the availability of more habitats and resources.

30. The correct answer is (d) All of the above.

31. The correct answer is © Oceans. Approximately 70% of the total global carbon is found in oceans. The oceans play a crucial role in the carbon cycle and act as a major carbon sink, absorbing and storing carbon dioxide from the atmosphere. Marine plants, such as phytoplankton, contribute significantly to carbon fixation through photosynthesis, while other processes like ocean circulation and sedimentation also play a role in carbon storage.

32. The correct answer is (b) Buffer zone. In the biosphere reserves, human settlement is permissible in the buffer zone. Biosphere reserves are designated areas that aim to conserve biodiversity while promoting sustainable development. They consist of three zones: the core zone (strictly protected for conservation purposes), the buffer zone (where limited human activity is allowed), and the transition zone (where sustainable activities and research are conducted).

33. The correct answer is (d) 90, 14, 448. The estimation of the numbers of national parks, biosphere reserves, and wildlife sanctuaries in India is approximately 90 national parks, 14 biosphere reserves, and 448 wildlife sanctuaries. These protected areas play a crucial role in conserving the country's biodiversity and providing habitats for a wide range of species.

34. The correct answer is (b) Seed bank. Seed bank is an example of ex situ conservation. Ex situ conservation involves the conservation of species outside their natural habitats. Seed banks store and preserve seeds of different plant species, ensuring their genetic diversity and serving as a backup in case of species extinction or habitat loss.

35. The correct answer is (b) Irrawady. The dolphin found in Chilka lake is the Irrawady dolphin. The Irrawady dolphin is a species of dolphin that inhabits coastal areas and certain freshwater regions in Southeast Asia, including Chilka lake in India. It is known for its distinctive appearance and behavior.

36. The correct answer is (b) David Tilman. The finding that communities with more species tend to be more stable than those with fewer species was confirmed by David Tilman. Tilman is an ecologist known for his research on biodiversity and ecosystem functioning. His work provided evidence for the positive relationship between species richness and ecosystem stability.

37. The correct answer is (d) I and II. The sedimentary cycle is represented by the Sulphur cycle (I) and the Phosphorus cycle (II). In the sedimentary cycle, these nutrients are released from rocks and minerals through weathering processes and enter the soil and water systems. Unlike the Carbon cycle (III) and the Nitrogen cycle (IV), which involve atmospheric exchange and biological transformations, the Sulphur and Phosphorus cycles primarily involve geological processes.

38. The correct answer is (c) Any living organisms in its natural habitat. Wildlife refers to any living organisms in their natural habitat. It encompasses a wide range of species, including animals, plants, and microorganisms, and includes both terrestrial and aquatic ecosystems. Wildlife plays a vital role in maintaining ecological balance and contributes to the overall biodiversity of the planet.

39. The correct answer is (b) Sunder bans. Tigers are not resident in Sunder bans National Park. Sunder bans National Park is a UNESCO World Heritage Site located in the Sundarbans delta in India and Bangladesh. It is known for its mangrove forests and rich biodiversity, including various species of wildlife. However, tigers are not found in this particular national park.

40. The correct answer is (d) 2,500. The number of species of birds in Colombia, located near the equator, is approximately 2,500. Colombia is known for its remarkable avian diversity, being one of the most biodiverse countries in the world in terms of bird species.

41. The correct answer is (a) Species diversity. The statement that the Western Ghats have a greater amphibian diversity than the Eastern Ghats is an example of species diversity. Species diversity refers to the variety and abundance of different species within a particular area or ecosystem. In this case, comparing the amphibian diversity between two geographic regions demonstrates the differences in species composition and rich India.

42. The correct answer is (b) Zoological survey of India. The Red List in India is completed by the Zoological Survey of India. The Red List is a comprehensive inventory of the conservation status of various species in a given region or country. It assesses the risk of extinction and categorizes species into different threat categories, such as critically endangered, endangered, and vulnerable. The Zoological Survey of India plays a key role in monitoring and documenting the status of India's fauna.

43. The correct answer is © Protecting migration of birds in Chilka lake. Among the given options, protecting migration of birds in Chilka lake is an example of conservation. Conservation refers to the protection, management, and sustainable use of natural resources and biodiversity. It involves efforts to preserve and restore ecosystems, protect endangered species, and promote sustainable practices to maintain ecological balance.

44. The correct answer is (a) Species richness. In the species-area relationship, 'S' represents species richness. The species-area relationship describes the pattern that as the size or area of a habitat or ecosystem increases, the number of species it can support also increases. 'S' denotes the total number of species present in a given area or habitat, reflecting the species richness or biodiversity of that area.

45. The correct answer is (d) All of these. The species listed in the Red Data Book are threatened, endangered, and rare species. The Red Data Book is a compilation of species that are facing the risk of extinction or have a vulnerable status. It includes species that are critically endangered, endangered, and vulnerable, providing information on their conservation status and the need for protective measures.

46. The correct answer is (a) Decrease in species diversity. Excessive accumulation of organic matter in water bodies can lead to a decrease in species diversity. When organic matter, such as nutrients from agricultural runoff or wastewater, accumulates in water bodies, it can cause eutrophication. Eutrophication leads to an overgrowth of algae and other aquatic plants, resulting in reduced oxygen levels and changes in water chemistry, which can negatively impact the diversity of aquatic species.

47. The correct answer is (b) Reserpine. The medicinal plant produces a chemical called reserpine. Reserpine is a naturally occurring chemical compound found in certain plant species, particularly in the roots of the *Rauwolfia serpentina* plant. Reserpine has been used in traditional medicine and modern pharmacology for its antihypertensive and tranquilizing properties.

48. The correct answer is (c) The ability to use natural resources in a way that helps people protect the ecosystem. Sustainable use of resources refers to utilizing natural resources in a manner that balances human needs and economic development with the long-term conservation and protection of the ecosystem. It involves using resources efficiently, promoting renewable energy sources, adopting sustainable agricultural practices, and minimizing environmental impacts to ensure the continued availability of resources for future generations.

49. The correct answer is © Tropical forest. Annual variations in temperature intensity and precipitation account for the formation of a major biome, specifically the tropical forest. Tropical forests are characterized by high temperatures, high annual precipitation (around 200-250 cm), and little seasonal variation. These climatic conditions support the growth of diverse and dense vegetation, making tropical forests one of the most biodiverse biomes on Earth

50. The correct answer is (a) Botanical garden. In situ conservation refers to the conservation of species within their natural habitats or ecosystems. While (b) Biosphere reserves, (c) National parks, and (d) Sanctuaries are examples of in situ conservation because they protect and preserve species within their natural habitats, a botanical garden is not typically considered in situ conservation because it involves the cultivation and display of plant species outside their natural habitats.

www.smartachievers.online

