Biodiversity and Conservation

OBJECTIVE TYPE QUESTIONS

Multiple Choice Questions (MCQs)

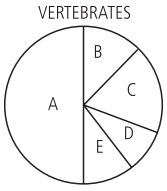
1. Western Ghats have a large number of plant and animal species that are not found anywhere else. Which of the following terms will you use to notify such species?

(a) Endemic (b) Vulnerable
(c) Threatened (d) Keystone

2. Which is the National Aquatic Animal of India?

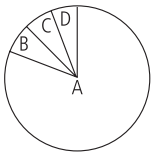
(a) Blue whale (b) Sea-horse
(c) Gangetic shark (d) River dolphin

3. Given below is the representation of the extent of global diversity of vertebrates. What groups does the portions represent?



	A	B	C	D	E
(a)	Birds	Reptiles	Fishes	Mammals	Amphibians
(b)	Mammals	Birds	Fishes	Amphibians	Reptiles
(c)	Fishes	Amphibians	Mammals	Birds	Reptiles
(d)	Fishes	Mammals	Birds	Reptiles	Amphibians

4. Given here is a pie chart representation of the extent of global diversity of invertebrates. What groups the four portions (A-D) represent respectively?



	A	B	C	D
(a)	Insects	Crustaceans	Other animal groups	Molluscs
(b)	Crustaceans	Insects	Molluscs	Other animal groups
(c)	Molluscs	Other animal groups	Crustaceans	Insects
(d)	Insects	Molluscs	Crustaceans	Other animal groups

5. Which of the following represent maximum number of species among global biodiversity?

(a) Fungi (b) Mosses and Ferns
(c) Algae (d) Lichens

6. Which of the following has maximum genetic diversity in India?

(a) Mango (b) Wheat
(c) Groundnut (d) Rice

7. Choose the right one which denotes genetic diversity.

(a) Chromosomes → Nucleotides → Genes → Individuals → Populations
(b) Populations → Individuals → Chromosomes → Nucleotides → Genes
(c) Genes → Nucleotides → Chromosomes → Individuals Populations
(d) Nucleotides → Genes → Chromosomes → Individuals → Populations

8. Biodiversity of a geographical region represents

(a) endangered species found in the region
(b) the diversity in the organisms living in that region
(c) genetic diversity in the dominant species of the region
(d) species endemic to the region.

9. The species diversity of plants on earth will be

(a) 2.4% (b) 22%
(c) 8.1% (d) 85%

10. Alexander von Humboldt described for the first time

(a) laws of limiting factor
(b) species area relationships
(c) population growth equation
(d) ecological biodiversity

11. Identify the ecologist from the given hints.
(i) He carried out long-term ecosystem experiments using outdoor plots.
(ii) In his experiments he showed that "increased diversity contributed to higher productivity".
(a) Ahmed Khan (b) David Tilman
(c) Stanley Cohen (d) Ernest Chain

12. Species area relationship curve had been proposed by
(a) David Tilman (b) Edward Wilson
(c) Paul Ehrlich (d) von Humboldt.

13. The relation between species richness and area is described on a logarithmic scale by the equation_____ [where S = species richness, A = area, Z = slope of the line (regression coefficient), C= Y-intercept].
(a) log S = log C – Z log A
(b) log S = Z log A
(c) log S = log C + Z log A
(d) log S = log C

14. Which of the following is the most important for animals and plants being driven to extinction?
(a) Alien species invasion
(b) Habitat loss and fragmentation
(c) Drought and floods
(d) Economic exploitation

15. Decline in the population of indian native fishes due to introduction of *Clarias gariepinus* in river Yamuna can be categorised as
(a) co-extinction
(b) habitat fragmentation
(c) over exploitation
(d) alien species invasion.

16. Which of the following is correctly matched?
(a) Aerenchyma – *Opuntia*
(b) Age pyramid – Biome
(c) *Parthenium hysterophorus* – Threat to biodiversity
(d) Stratification – Population

17. Red list contains data or information of
(a) all economically important plants
(b) plants whose products are in international trade
(c) threatened species
(d) marine vertebrates only.

18. Read the statements regarding a stable community and choose the correct option.
(i) Must be resistant to occasional disturbances.
(ii) Should show much variation in productivity from year to year.
(iii) Must be resistant to invasions by alien species.
(a) (i) and (ii) are correct.
(b) (i), (ii) and (iii) are correct.
(c) (ii) and (iii) are correct.
(d) (i) and (iii) are correct.

19. With respect to *Eichhornia*:
Statement X : It drains off oxygen from water and is seen growing in standing water.
Statement Y : It is an indigenous species of our country.
(a) Only statement X is correct and Y is wrong.
(b) Both statements X and Y are correct.
(c) Only statement Y is correct and X is wrong.
(d) Both statements X and Y are wrong.

20. A species facing extremely high risk of extinction in the immediate future is called
(a) vulnerable (b) endemic
(c) critically endangered
(d) extinct.

21. The organisation which publishes the Red list of species is
(a) ICFRE (b) IUCN
(c) UNEP (d) WWF.

22. In IUCN Red List (2004) documents the extinction of 784 species includes
(a) 335 vertebrates, 360 invertebrates and 89 plants
(b) 337 vertebrates, 362 invertebrates and 88 plants
(c) 338 vertebrates, 359 invertebrates and 87 plants
(d) 340 vertebrates, 357 invertebrates and 87 plants.

23. One of the chief reasons among the following for the depletion in the number of species making it endangered is
(a) over-hunting and poaching
(b) greenhouse effect
(c) competition and predation
(d) habitat destruction.

24. Select the incorrect statement.
(a) Species diversity increases as we move away from the equator towards the poles.
(b) Stellar's sea cow and passenger pigeon got extinct due to over exploitation by man.
(c) *Lantana* and *Eichhornia* are invasive weed species in India.
(d) The historic convention on biological diversity was held in 1992.

25. Which is referred to as 'Lungs of the Planet Earth'?

(a) Western Ghat (b) Lake Victoria
(c) Greenland (d) Amazon rainforest

26. The alien species introduced into Lake Victoria that was responsible for the extinction of Cichlid fishes is

(a) African catfish (b) water hyacinth
(c) carrot grass (d) Nile perch

27. The Earth Summit held in Rio de Janeiro in 1992 was called

(a) for immediate steps to discontinue use of CFCs that were damaging the ozone layer
(b) to reduce CO_2 emissions and global warming
(c) for conservation of biodiversity and sustainable utilization of its benefits
(d) to assess threat posed to native species by invasive weed species.

28. Which one of the following is not a method of *in situ* conservation of biodiversity ?

(a) Sacred grove (b) Biosphere reserve
(c) Wildlife sanctuary (d) Botanical garden

29. Pollen grains can be stored for several years in liquid nitrogen having a temperature of

(a) –120°C (b) –80°C
(c) –196°C (d) –160°C.

30. All of the following are included in '*ex-situ* conservation' except

(a) wildlife safari parks (b) sacred groves
(c) botanical gardens (d) seed banks.

31. Which one of the following is related to *ex-situ* conservation of threatened animal and plants?

(a) Biodiversity hotspots
(b) Amazon rainforest
(c) Himalayan region
(d) Wildlife safari parks

32. The region of biosphere reserve which is legally protected and where no human activity is allowed is known as

(a) buffer zone (b) transition zone
(c) restoration zone (d) core zone.

33. How many hotspots of biodiversity in the world have been identified till date by Norman Myers?

(a) 17 (b) 25
(c) 34 (d) 43

34. Which of the following National Parks is home to the famous musk deer or hangul?

(a) Keibul Lamjao National Park, Manipur
(b) Bandhavgarh National Park, Madhya Pradesh
(c) Eaglenest Wildlife Sanctuary, Arunachal Pradesh
(d) Dachigam National Park, Jammu and Kashmir

35. World summit on sustainable development was held in

(a) 2002 (b) 1990
(c) 1960 (d) 1970.

36. One of the following statements is incorrect with reference to biodiversity. Identify it.

(a) The areas with very few plant and animal species (low species richness) with no threatened species are called biodiversity hotspots.
(b) Biodiversity increases from higher altitudes to lower altitudes.
(c) Biodiversity decreases from the equator to polar regions.
(d) Depletion in genetic diversity of crop plants is mainly due to the introduction of better varieties with high yield, disease resistance, etc.

37. Which one of the following is not an *in situ* conservation method?

(a) National parks (b) Wild life sanctuary
(c) Biosphere reserves (d) Zoological parks

38. Find the wrongly matched pair.

(a) Endangered species – Species confined to a region and not found anywhere else
(b) Hotspots – Western Ghats
(c) Sacred groves – Jaintia hills of Rajasthan
(d) *Ex situ* conservation – Zoological parks

39. Which of the following is not an *ex-situ* conservation?

(a) Cryopreservation (b) Seed bank
(c) Biosphere reserves (d) Botanical garden

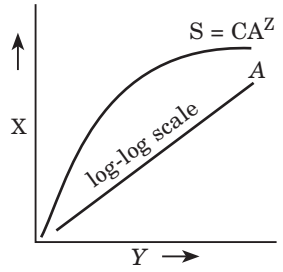
40. Conservation of organisms in natural habitat is called

(a) *ex situ* conservation
(b) *in situ* conservation
(c) both (a) and (b)
(d) none of these.

Case Based MCQs

Case I : Read the following passage and answer the questions from 41 to 45 given below.

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



41. What does the given figure show?

(a) Rivet-popper hypothesis
(b) Species-area relationship
(c) Proportionate number of species of major taxa
(d) α-ecological diversity

42. Equation for relationship (A) between species richness and area is

(a) log S = log C + Z log A
(b) log C = log S + Z log A
(c) Z log A = log S + log C
(d) log S = log C + log A.

43. What is the value of slope of line or regression coefficient Z for frugivorous birds?

(a) 0.1-0.2 (b) 1.15
(c) 0.01-0.1 (d) 0.6-1.2

44. The shape of curve for relationship between species richness and areas for a wide variety of taxa is

(a) straight line
(b) parabola
(c) rectangular hyperbola
(d) bell shaped.

45. Who gave this concept of increase in species richness with increasing area?

(a) Humboldt (b) Odum
(c) Edward Wilson (d) Paul Ehrlich

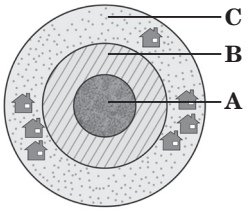
Case II : Read the following passage and answer the questions from 46 to 50 given below.

Biosphere reserves are multipurpose protected areas which are meant for preserving genetic diversity in representative ecosystems of various natural biomes and unique biological communities by protecting wild populations, traditional life style of tribals and domesticated plant/animal genetic resources. Each biosphere reserve has three zones-core, buffer and transition zone.

46. Which of the following is similar to biosphere reserve in terms of conservation?

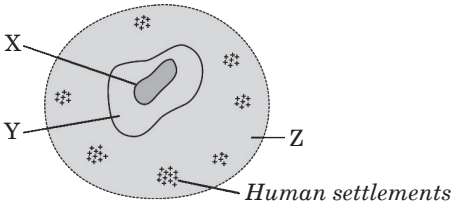
(a) Gene banks
(b) Offsite collection
(c) Orchards
(d) Hotspots

47. Refer to the given figure representing different zones of a biosphere reserve and select the correct option regarding it.



(a) A-Limited human activity is allowed such as for research and education.
(b) B-An active co-operation occurs between reserve management and local people for activities like cropping, settlements, etc.
(c) C-No human activity is allowed.
(d) None of these

48. Refer to the given diagrammatic representation of a biosphere reserve.



Select the incorrect statement regarding X, Y and Z.

(i) X is devoted to strict protection of wildlife and no human activity is allowed in this zone.
(ii) In Y, only limited human activity (compatible with conservation) is allowed.
(iii) In X, commercial exploitation of natural resources is allowed.

(iv) Tourism is allowed in Y zone only.

(v) Zone Y helps to maintain the lifestyle of the tribal people living in the area.

(a) (iii), (iv) and (v) only
(b) (ii), (iii) and (v) only
(c) (i), (iii) and (iv) only
(d) (ii), (iii) and (iv) only

49. Biosphere reserves differ from national parks and wildlife sanctuaries because in the former

(a) human beings are not allowed to enter
(b) people are an integral part of the system
(c) plants are paid greater attention than the animals
(d) living organisms are brought from all over the world and preserved for posterity.

50. MAB Programme means

(a) Man and biosphere programme
(b) Man and biodiversity conservation programme
(c) Manually aided biosphere conservation programme
(d) none of these.

Assertion & Reasoning Based MCQs

For question numbers 51-58, 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) Assertion is false but reason is true.

51. Assertion : The rate of extinction of organisms have increased in recent years.
Reason : Human activities like deforestation, industrialisation, etc., have destroyed the natural habitat of plants and animals.

52. Assertion : Buffer zone surrounds the core area and limited human activities like resource use strategies, research and education are allowed here.
Reason : There is no biotic interference except in buffer zone.

53. Assertion : Species diversity decreases as we ascend towards high mountains.
Reason : Due to drop in temperature, no seasonal variability occurs in high mountains.

54. Assertion : Alpha diversity refers to species diversity present in a given community or habitat.
Reason : Alpha diversity is expressed by species richness and species evenness in a community or habitat.

55. Assertion : Dodo, Passenger pigeon, Steller's sea cow have become extinct due to over exploitation.
Reason : Excessive exploitation of a species, whether animal or plants reduces size of its population so that it becomes vulnerable to extinction.

56. Assertion : Alpha diversity is said to be higher if the dissimilarity between communities is higher.
Reason : Alpha diversity is dependent upon species richness and evenness / equability.

57. Assertion : Maximum biodiversity occurs in temperate areas.
Reason : Tropical areas have favourable conditions for speciation and for supporting variety and number of organisms.

58. Assertion : Many endemic species are seen to flourish in sacred forests.
Reason : Sacred forests are undisturbed forest patches and biodiversity rich areas.

SUBJECTIVE TYPE QUESTIONS

Very Short Answer Type Questions (VSA)

1. What is an exotic species?

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

3. Name any three sites of sacred groves.

4. *Eichhornia crassipes* is an alien hydrophyte introduced in India. Mention the problems posed by this plant.

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

6. Who proposed Rivet popper hypothesis?

7. Name the type of biodiversity represented by the following:
(a) 1000 varieties of mangoes in India.
(b) Variations in terms of potency and concentration of reserpine in *Rauwolfia vomitoria* growing in different regions of Himalayas.

8. Name the three zones of biosphere reserves.

9. Mention one application of pollen bank. How are pollens stored in a bank?

10. Sometimes introduction of an exotic species upsets native species of the ecosystem. Substantiate the statement with two examples from India.

Short Answer Type Questions (SA-I)

11. (a) "India has greater ecosystem diversity than Norway". Do you agree with the statement? Give reasons in support of your answer.
(b) Write the difference between genetic biodiversity and species biodiversity that exists at all the levels of biological organisation.

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

13. Differentiate between *in situ* and *ex situ* approaches of conserving biodiversity.

14. What is beta diversity in an ecosystem? What is the significance of large genetic diversity in a population ?

15. What is alpha diversity in an ecosystem?

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

17. Giving two reasons explain why there is more species biodiversity in tropical latitudes than in temperate ones.

18. Mention the kind of biodiversity more than a thousand varieties of mangoes in India represent. How is it possible?

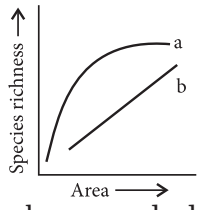
19. Why are sacred groves highly protected?

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

Short Answer Type Questions (SA-II)

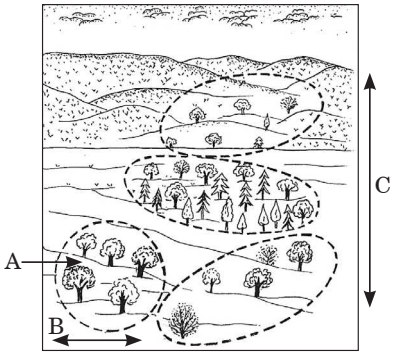
21. "Stability of a community depends on its species richness." Write how did David Tilman show this experimentally.

22.



The above graph show species-area relationship. Write the equation of the curve 'a' and explain.

23. Study the given figure and answer the following questions.



(a) Identify the figure and the types of diversity labelled as A, B and C in it.

(b) Give a brief description of diversity labelled as A and C.

(c) Which of the diversities labelled as A, B and C will face maximum competition, adjustments and interrelationships amongst the members of the same community?

24. White Bengal tigers are protected in special settings in zoological parks. Tiger reserves are maintained in Western Ghat.

(a) How do these two approaches differ from each other? Mention the advantages of each one.

(b) What is the significance of cryopreservation technique?

25. The following graph shows the species-area relationship. Answer the following question as directed.

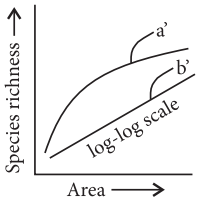
(a) Name the naturalist who studied the kind of relationship shown in the graph. Write the observation made by him.

(b) Write the situation as discovered by the ecologists when the value of 'Z' (slope of the line) lies between

(i) 0.1 and 0.2 (ii) 0.6 and 1.2

What does 'Z' stand for?

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



26. Since the origin of life on Earth, there were five episodes of mass extinction of species.
(a) How is the 'Sixth Extinction', presently in progress, different from the previous episodes?
(b) Who is mainly responsible for the 'Sixth Extinction'?
(c) List any four points that can help to overcome this disaster.

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

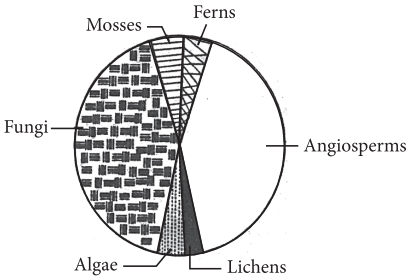
28. (a) Explain the concept of endemism.
(b) Name four regions in an around our country that are considered hotspots.

29. Name and describe any three causes of biodiversity losses.

30. The sacred groves of Aravalli Hills and Ooty botanical garden both aim at biodiversity conservation. How do they differ in their approaches? Explain.

31. List any four techniques where the principle of *ex situ* conservation of biodiversity has been employed.

32.



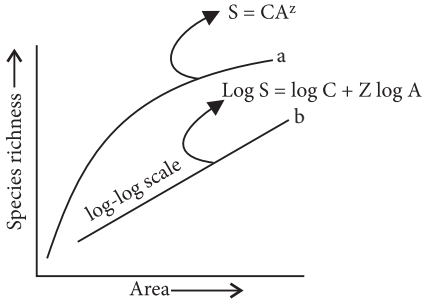
Observe the global biodiversity distribution of major plant taxa in the above diagram and answer the questions that follow.
(a) Which group of plant are most endangered?
(b) Why are mosses/ferns so few? Give reason.
(c) How do fungi that are heterotrophs sustain themselves as a large population?
(d) Which group of plant is most advanced and which one is most primitive?

33. '*In-situ*' conservation can help endangered/ threatened species. Justify the statement.

34. 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 Questions (LA)

35. (a) Explain the species-area relationship using the graphical representation given below.



(b) Explain giving reasons why there is greater biodiversity in tropical regions of the Earth.

36. Explain the narrowly utilitarian, broadly utilitarian and ethical arguments in favour of conservation of biodiversity.

37. (a) Why should we conserve biodiversity? How can we do it?
(b) Explain the importance of biodiversity hotspots and sacred groves.

38. (a) According to ecologists, tropical regions in the world account for greater biological diversity. Justify.
(b) Why are habitat loss and alien species invasion considered as the causes of biodiversity loss? Explain with the help of an example of each.

ANSWERS

OBJECTIVE TYPE QUESTIONS

1. (a)

2. (d) : River dolphin, found in holy river Ganga, Brahmaputra, Indus and their tributaries, is the National aquatic animal of India. Presence of river dolphin in Ganga indicates pure and fresh water.

3. (d) **4. (d)** **5. (a)**

6. (d) : Genetic diversity is the diversity in the numbers and types of genes as well as chromosomes present in different species and the variations in the genes and their alleles in the same species. *Oryza sativa* (rice) has 32,000-50,000 genes.

7. (d) **8. (b)**

9. (b) : The number of known species in India is 1,42000 or roughly 8.1 % of the total though India has only 2.4% land area. The most interesting aspect of biodiversity is that more than 70% of all species are animals while plants account for only 22%.

10. (b) : Alexander von Humboldt described species area relationship for the first time. He observed that within a region, species richness increases with increasing explored area, but only upto a limit.

11. (b)

12. (d) : German naturalist and geographer Alexander von Humboldt while exploring the wilderness of South American jungles found that within a region the species richness increased with increasing area but upto a certain limit. On this basis, he proposed species area relationship curve. The relationship between species richness and area turned out to be rectangular hyperbola for a wide variety of taxa whether they are birds, bats, freshwater fish or flowering plants. On a logarithmic scale, it is a straight line. It is described by the equation: $\log S = \log C + Z \log A$

Here S is species richness, Z is slope of line or regression coefficient, C is Y intercept and A is area.

13. (c) : *Refer to answer 12.*

14. (b) : Habitat loss and fragmentation is the most important cause driving animals and plants to extinction. When large habitats are broken into small fragments due to various human activities, mammals and birds requiring large territories and certain animals with migratory habitats are badly affected, leading to population declines. The same can be applicable to the plant (forest) loss and degradation as millions of species are being cut and cleared for the expansion of agricultural land, harvesting timber, as well as overgrazing.

15. (d)

16. (c) : *Parthenium hysterophorus* is commonly known as congress grass or carrot weed. It is herbaceous annual plant of Family Asteraceae. It is a deadly invasive, noxious weed infesting cropped and non-cropped areas. It rapidly colonises area replacing the native vegetation and causes a number of human health related problems such as skin allergy, rhinitis and eye irritations. Also, being toxic and unpalatable it causes fodder scarcity. Hence, it is considered a threat to the biodiversity.

17. (c) : A red data book or red list is a catalogue of taxa facing risk of extinction. Red data book or red list was initiated in 1963.

18. (d) : Climax community is the stable, self perpetuating and final biotic community that develops at the end of biotic succession and is in perfect harmony with the physical environment. Climax community has maximum diversity and niche specialization. It should not show too much variation in productivity from year to year.

19. (a) : *Eichhornia* is an alien or exotic species. This plant was introduced in India because of its beautiful flowers and shape of leaves. It can propagate vegetatively at a phenomenal rate and spread all over the water body in a short period of time. It drains off oxygen from water, which leads to death of fishes. It is also known as "Terror of Bengal".

20. (c) : The taxon under critically endangered category are facing very high risk of extinction in the wild and can become extinct at any moment in the immediate future.

21. (b) : IUCN is International Union of Conservation of Nature and Natural Resources which is now called World Conservation Union (WCU). It has its headquarters at Morges, Switzerland. It maintains a red data book or red list which is a catalogue of taxa facing risk of extinction. Red data book or red list was initiated in 1963. The Red list of year 2000 has made assessment of 18,000 species.

22. (c)

23. (d) : Destruction of natural habitats causes the most serious threat to the biodiversity, endangering many animals. Habitats are destroyed/fragmented by many human activities like developmental work, deforestation, pollution, etc. Over hunting and poaching also have harmful effect.

24. (a) : Species diversity on earth is not uniformly distributed but shows interesting patterns. It is generally highest in the tropics and decreases towards the poles. Important explanations for the species richness of the tropics are: tropics had more evolutionary time they provide a relatively constant environment and they receive more solar energy which contributes to greater productivity.

25. (d) : Amazon rainforest is referred to as 'Lungs of the planet Earth' because they regulate global climate patterns and help mitigate negative effects of climate change, specifically global warming. They serve as storage of global biodiversity, specifically plant and animal diversity.

26. (d) : Nile Perch (a predator fish) was introduced in lake Victoria of Africa. It killed and eliminated ecologically unique assemblage of over 200 native species of small Cichlid fish.

27. (c) : 'The Earth Summit' held in Rio de Janeiro in 1992, called upon all nations to take appropriate measures for conservation of biodiversity and sustainable utilisation of its benefits.

28. (d) : Botanical garden comes under *ex situ* method of conservation of biodiversity.

29. (c) : Pollen grains can be stored for several years in liquid nitrogen at –196°C. This is known as cryopreservation.

30. (b) : Sacred groved come under *in situ* conservation and represent the pristine forest patches around places of worship which are held in high esteem by tribal communities. Cutting of trees and branches is prohibited due to religious reasons. Wildlife safari parks, botanical gardens and seed banks come under *ex-situ* conservation.

31. (d) : *Ex-situ* conservation is conservation of selected rare or threatened animals and plants in places outside their natural homes. It includes offsite collections like botanical gardens, zoological parks, cryopreservation, tissue culture, wildlife safari parks and gene banks, etc.

32. (d) : Core zone or natural zone area of a biosphere reserve is undisturbed and legally protected ecosystem. No human activity is allowed in this zone. Little human activity is allowed in the buffer zone whereas in transition zone, an active cooperation is present between reserve management and local people for activities like settlements, cropping, etc. Restoration region is degraded area which is selected for restoration to near natural form.

33. (c) : Biodiversity hotspots are a method to identify those regions of the world where attention is needed to address biodiversity loss and to guide investments in conservation. The idea was first developed by Norman Myers in 1988 to identify tropical forests hotspots characterised both by exceptional levels of plant endemism and serious habitat loss which he then expanded to a more global scope. Currently, 34 biodiversity hotspots have been identified most of which occur in tropical forests.

34. (d)

35. (c) : The World Summit on sustainable development was held in 2002 in Johannesburg, South Africa.

36. (a) : Biodiversity hotspots are areas of high endemism and high level of species richness.

They are determined mainly by three factors:

(i) Number of species/species diversity

(ii) Degree of endemism

(iii) Degree of threat

37. (d) : Zoological parks, wildlife safari parks, botanical gardens, etc., are *ex situ* form of conservation of biodiversity.

38. (a) : An endangered species is one which is liable to become extinct if not allowed to realise its full botic potential by providing protection from exotic species/human exploitation/habitat deterioration/depletion of food.

39. (c) **40. (b)**

41. (b)

42. (a) : On a logarithmic scale, the relationship between species richness and area is a straight line. It is described by the equation $\log S = \log C + z \log A$

43. (b) : The regression coefficient Z have a value of 1.15 for frugivorous birds and mammals of tropical forests of different continents.

44. (c)

45. (a) : While exploring the wilderness of South American jungles, Alexander von Humboldt found that within a region, the species richness increased with increasing area but upto a certain limit.

46. (d) : Biosphere reserves and hotspots are *in-situ* methods of conservation.

47. (d)

48. (a) : In the given figure, X, Y and Z represent core zone, buffer zone and transition zone of biosphere reserve, respectively. No commercial exploitation of natural resources is allowed in core zone. Tourism is allowed in transition zone of biosphere reserve. Transition zone helps to maintain the lifestyle of the tribal people living in the area.

49. (b) : Biosphere reserves have a transition zone where participation of local people for activities like settlements, cropping, recreation, forestry, etc. take place.

50. (a) **51. (a)** **52. (c)**

53. (a) **54. (b)** **54. (c)**

55. (a)

56. (d) : Diversity at the level of community and ecosystem has three perspectives which are called Alpha, Beta and Gamma diversity. Alpha diversity (within - community diversity) refers to the diversity of organisms sharing the same community/habitat. A combination of species richness and equitability/evenness is used to represent diversity within a community or habitat. Species richness is the number of species per unit area. The number of species increases with the area of the site. Generally, greater the species richness, greater is the species diversity. However, number of individuals among the species may also vary, resulting into differences in evenness or equitability and consequently in diversity.

Species frequently change when habitat or community

changes. The rate of replacement of species along a gradient of habitats or communities is called beta diversity (between - community diversity). There are differences in species composition of communities along environmental gradients, *e.g.*, altitudinal gradient, moisture gradient, etc. Higher the heterogeneity in the habitats in a region or greater the dissimilarity between communities, higher is the beta diversity. Diversity of the habitats over the total landscape or geographical area is called gamma diversity.

57. (d) : There is little biodiversity at the poles. It increases in temperate areas but reaches the maximum in tropics. The tropical rain forests have favourable environmental conditions for speciation and for support the variety and number of organisms.

58. (a) : Sacred forests are forest patches around places of worship which are held in high esteem by tribal communities. These are the most undisturbed forest patches. As a result many endemic species can be seen to flourish here.

SUBJECTIVE TYPE QUESTIONS

1. New species entering a geographical region are called exotic species.

2. Nile perch

3. (i) Khasi and Jaintia hills in Meghalaya.

(ii) Aravall Hills of Rajasthan

(iii) Sarguja, Chanda and Bastar areas of Madhya Pradesh

4. *Eichhornia crassipes*, an alien hydrophyte was introduced in Indian waters due to aesthetic value but it turned out to be a problematic species. It has clogged water bodies resulting in death of aquatic plants and animals.

5. When species show high diversity at the genetic level over its distributional range then the biodiversity is at genetic diversity level. The 50,000 strains of rice differ at genetic level.

6. The Rivet popper hypothesis was proposed by Stanford ecologist Paul Ehrlich.

7. (a) Genetic diversity (b) Genetic diversity

8. Biosphere reserves have three zones:

Core or natural zone: Undisturbed and legally protected area where no human activity is allowed.

Buffer zone: Limited human activity like research, education and resource utilisation strategies are allowed.

Transition zone: Outermost region where human activity like recreation, cropping, forestry, etc., are allowed.

9. Pollen banks are used to maintain stocks of biodiversity. Pollens are stored in a bank at a very low temperature of –196°C in liquid nitrogen, *i.e.,* by cryopreservation.

10. Exotic species often become invasive and drive away the local species. Water hyacinth was introduced in Indian waters due to its aesthetic value. However, it has clogged water bodies resulting in death of several aquatic plants and animals. *Eupatorium odoratum* has reduced the population of *Tectona grandis* in North-East.

11. (a) Yes, India has a greater ecosystem diversity than Norway as India comes under the tropical region whereas, Norway lies in temperate region. Tropical regions account for greater biological diversity as they have deserts, rainforests, mangroves, coral reefs, wetlands, estuaries and alpine meadows than temperate regions. In tropical region, more solar energy is available that also promotes higher productivity and increased biological diversity.

(b) Differences between genetic and species biodiversity are as follows :

	Genetic biodiversity	Species biodiversity
(i)	It is related to the number of genes and their alleles found in organisms.	It is related to number and distribution of species found in an area.
(ii)	It is trait of the species.	It is trait of a community.
(iii)	It influences the adaptability and distribution of a species in diverse habitats.	It influences biotic interactions and stability of the community.
(iv)	Example : India has more than 50,000 genetically different strains of rice and 1,000 varieties of mango.	Example : Western ghats have a greater amphibian species diversity as compared to Eastern ghats.

12. IUCN red list is a catalogue of taxa facing risk of extinction. The two uses of this list are:

(i) It provides awareness to the degree of threat to biodiversity.

(ii) It is useful in identification and documentation of species which are at high risk of extinction.

13. Differences between in *situ* and *ex situ* conservation are:

	In *situ* Conservation	Ex *situ* Conservation
(i)	It is conservation of endangered species in their natural habitats.	It is conservation of endangered species outside their natural habitats.
(ii)	The endangered species are protected from predators.	The endangered species are protested from all adverse factors.
(iii)	The depleting resources are augmented.	They are kept under human supervision and provided all the essentials.
(iv)	The population recovers in natural environment.	Offspring produced in captive breeding are released in natural habitat for acclimitisation.

14. Beta diversity is diversity which develops due to change in habitat or community along environmental gradients

like altitude, latitude, moisture gradient, etc. Higher beta diversity indicates the presence of unique habitats or unique communities in the region.

Genetic diversity enables a population to adapt to its environment and the changes occurring in the environment. Genetic diversity within a species is the basis of speciation or formation of new species.

15. Alpha diversity is diversity present in organisms sharing the same community present in an area of more or less uniform habitat. Alpha diversity determines the stability of the community, as more diversity indicates better adjustment and interrelationships amongst the members of the community.

16. Tropics have more species biodiversity than the polar regions because of favourable environmental conditions as compared to polar regions where harsh conditions are prevalent. The reasons behind the maximum biological diversity of tropical regions are:

(i) Prolonged evolutionary time : Speciation is generally a function of time, unlike polar regions subjected to frequent glaciations in the past, tropical latitudes have remained relatively undisturbed for millions of years and thus, had a long evolutionary time for species diversification.

(ii) High productivity : There is more solar energy available in the tropics, which contributes to higher productivity; this in turn might contribute indirectly to greater diversity.

17. The two reasons for more species biodiversity in tropical latitudes than in temperate ones are:

(i) Temperate region was subjected to frequent glaciations in the past, while tropical latitudes have remained relatively undisturbed for millions of years and thus, had a long evolutionary time for species diversification.

(ii) Tropical environments, unlike temperate ones, are less seasonal, relatively more constant and predictable. Such constant environments promote niche specialisation and lead to a greater species diversity.

18. "More than a thousand varieties of mango in India" exhibit genetic diversity. Genetic diversity represents the diversity in number and types of genes as well as chromosomes present in different species and variations in the genes and their alleles in the same species.

The reason for this genetic diversity is the occurrence of variations in environmental parameters and use of horticulture techniques like grafting, breeding, etc.

19. Sacred groves are forest patches around places of worship, held in high esteem by tribal communities. They are most undisturbed forest patches which are often surrounded by highly degraded landscapes. Not a single branch is allowed to be cut from these forests and as a result, many endemic species which are rare or have become extinct elsewhere can be seen to flourish here. *E.g.*, Jaintia and Khasi hills in Meghalaya.

20. Extinction of species due to human activities is known as anthropogenic extinction. Various human activities have led to extinction of particular species. The most common example is Nile perch, a large predator fish introduced in Lake Victoria for commercial purpose turned out to be a problematic species. It started feeding on the native fish cichlid fish, which results in extinction of ecologically unique assemblage of over 200 native species of small cichlid fish.

21. Communities with more species tend to be more stable than those with less species as it is able to resist occasional disturbance. This has been confirmed experimentally by David Tilman. He raised plots with different diversities in Minesota grassland and subjected them various stresses. He 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.

22. The equation of curve 'a' is $S = CA^Z$ where,

S = Species richness

C = Y – intercept

A = Area

Z = Slope of the line (regression coefficient).

The graph on species- area relationship shows that within a region, species richness increases with increasing explorable area, but only upto a certain limit. The relation between species richness and area for a wide variety of taxa turns out to be rectangular hyperbola.

23. (a) The given figure is of ecological diversity. Here, A is alpha diversity, B is beta diversity and C is gamma diversity.

(b) Alpha diversity (A) is a species diversity in a given community or habitat. Alpha diversity is dependent upon species richness and evenness/equitability. Gamma diversity (C) is a diversity present in ranges of communities as represented by diversity of habitats/ecosystems over a total landscape or geographical area.

(c) Alpha diversity (A) will face maximum competition, adjustments and interrelationships amongst the members of the same community.

24. (a) In zoological parks, white Bengal tigers are protected outside their natural habitats. It is a mode of *ex situ* conservation. Animals are kept under human supervision and are protected against all adverse factors.

Western ghats are hot-spots, *i.e.*, areas of high endemism and high level of species richness. It is a mode of *in situ* conservation. Endangered species in Tiger reserves are conserved in their natural habitat. These are protected from predators.

(b) Cryopreservation is *ex situ* conservation technique in which tissues, organs, embryos, seeds, etc., are stored at very low temperature of –196°C. At this temperature the living material can be stored indefinitely in compact, low maintenance refrigeration units. It can be revived as and when required.

25. (a) Alexander von Humboldt studied species-area relationship. He observed that within a region, the species richness increased with increasing area but upto a certain limit.

(b) (i) Ecologists have discovered that the value of Z lies in the range of 0.1–0.2 regardless of taxonomic group or region, *i.e.*, whether it is plants in Britain, birds in California or molluscs in New York, the slopes of the regression line are similar.

(ii) When the species-area relationship is considered for a very large area like a whole continent, regression coefficient Z or slope of the line become steeper with Z values in the range of 0.6 –1.2.

(c) Slope of line b, would become steeper when the value of Z ranges from 0.6 to 1.2 as for mammals of tropical forests of different continents, the slope is found to be 1.15.

26. (a) Sixth extinction, *i.e.*, the current species extinction is 100 – 1000 times faster than extinctions in pre-human times.

(b) Human activities like settlements, hunting, over-exploitation and habitat destruction are mainly responsible for 'Sixth extinction'.

(c) This disaster can be overcome by the following ways:

(i) Planting large number of trees on road sides and where space is available.

(ii) Avoid introduction of invasive alien species.

(iii) Conserving biodiversity by maintaining national parks, zoos, etc.

(iv) Deforestation and fragmentation of forested areas should be stopped.

27. Non-native or alien species are often introduced inadvertently by man for their economic and other uses. They often become invasive and drive away the local species. For example:

(i) Water hyacinth (*Eichhornia crassipes*) was introduced in Indian waters due to its aesthetic value but it turned out to be a problematic species. It has clogged water bodies including wetlands at many places resulting in death of several aquatic plants and animals.

(ii) Nile Perch (a predator fish) was introduced in lake Victoria of East Africa. It killed and eliminated ecologically unique assemblage of over 200 native species of small cichlid fish.

(iii) African catfish (*Clarias gariepinus*) introduced for aquaculture in India possess threat to indigenous catfishes.

28. (a) Endemism is the ecological state of a species being unique to a defined geographical location such as an island, nation, country or other defined zone. *E.g.*, The Tasmanian Devil is the largest carnivorous marsupial in the world and found only on the Australian island state of Tasmania.

(b) Western Ghats and Sri Lanka, Indo-Burma and Himalayas are hotspots in India. Others include mountains of southwest China, Caribbean Island hotspot, etc.

29. The three major causes of biodiversity loss are :

(i) Habitat loss and fragmentation - Over-population, urbanisation and industrialisation require additional land every year. It can come through destruction or fragmentation of natural habitats through filling wetlands, ploughing grasslands, cutting down trees, burning a forest and clearing some area of vegetation. Loss of habitat results in annihilation of species of endemic plants, microorganisms and forcing out of animals which in alien lands die out after some time. Migrating animals would go astray and get killed.

(ii) Over-exploitation – Excessive exploitation of a species, whether a plant or an animal, reduces size of its population so, that it becomes vulnerable to extinction. Due to over-exploitation by humans, Dodo, three subspecies of tiger and Steller's sea cow have become extinct in the last 500 years.

(iii) Alien species invasions – Non-native or alien species are often introduced by man for their economic and other uses. They often become invasive and drive away the local species. For example, water hyacinth (*Eichhornia crassipes*) was introduced in Indian waters due to its aesthetic value but turned out to be a problematic species. It clogged water bodies including wetlands at many places resulting in death of several aquatic plants and animals.

30. Sacred groves are undisturbed forest patches, surrounded by highly degraded landscapes where not even a single branch of tree is allowed to be cut. As a result, many endemic species which are rare or have become extinct, seen to flourish here. While botanical gardens are areas where many species of plants, are conserved outside their natural habitats. They help to restore endangered species, whose chances of survival are very small. Thus, sacred groves of Aravalli Hills are sites of *in-situ* conservation, where endangered species are protected in their natural habitat whereas Ooty Botanical gardens are sites of *ex-situ* conservation, where the endangered species are protected outside their natural habitats.

31. Four techniques where principles for $ex\ situ$ biodiversity conservation has been employed are:

(i) Orchards – Plants with recalcitrant seeds are grown in orchards where all possible strains and varieties are maintained, *e.g.*, litchi.

(ii) Cryopreservation – Cells, embryos, tissues are preserved at – 196°C.

(iii) Seed banks – Storing viable seeds at low temperature, and germinating them to obtain fresh seeds.

(iv) Tissue culture – Production of large number of plants through callus culture, pollen grain culture, embryoids, etc.

32. (a) As per the given pie chart lichens are least in number, also lichens are pollution sensitive so with increasing globalisation we can assume that in near feature lichens will be subject to extinction and hence may be considered as most endangered among the given taxas.

(b) Mosses and ferns grow in shady and humid places or wet places and need water for fertilisation. Hence, they are few in numbers.

(c) Fungi can live as saprotrophs or parasites. As saprotrophs, they depend on only organic matter and hence survive in any environment. They produce a number of thick walled spores, which can withstand the unfavourable conditions and germinate when conditions become favourable. This helps fungi in sustaining a large population.

(d) Angiosperms are the most advanced whereas fungi are the most primitive.

33. '*In-situ*' conservation helps endangered and threatened species by protecting them in their natural habitats along with their ecosystem and its biodiversity. For example, National parks are the areas maintained by the government for better conservation of wildlife. It is a place where cultivation, grazing, forestry and habitat manipulation are restricted. Sanctuaries are places where wild animals can take refuge without being hunted. Activities like collection of forest products, private ownership land, tilling of land, etc., are allowed but animal hunting is prohibited. Biosphere reserves are meant for preserving genetic diversity in representative ecosystems of various natural biomes and unique biological communities by protecting wild populations, traditional life style of tribals and domesticated plant/animal genetic resources.

34. Conservation of biodiversity is protection, uplift and scientific management of biodiversity so as to maintain it at its optimum level and derive sustainable benefits for the present as well as future generations. There are two types of conservation strategies – *in situ* (on site) and *ex situ* (offsite).

In situ conservation is conservation and protection of the whole ecosystem and its biodiversity at all levels in their natural habitat in order to protect the threatened species. It involves hotspots and protected areas. Hotspots are areas of high endemism and high level of species richness. Protected areas are ecological/biogeographical areas where biological diversity along with natural and cultural resources is protected, maintained and managed through legal or other effective measures. Protected areas include national parks, sanctuaries and biosphere reserves.

Ex situ conservation is conservation of threatened plants and animals in places outside their natural homes under full protection and supervision. It includes offsite collections and gene banks.

35. (a) Alexander von Humboldt studied species-area relationship. He observed that within a region, the species richness increased with increasing area but upto a certain limit.

Ecologists have discovered that the value of Z lies in the range of 0.1–0.2 regardless of taxonomic group or region, *i.e.*, whether it is plants in Britain, birds in California or molluscs in New York, the slopes of the regression line are similar.

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(b) Tropics have more species biodiversity than the polar regions because of favourable environmental conditions as compared to polar regions where harsh conditions are prevalent. The reasons behind the maximum biological diversity of tropical regions are:

(i) Prolonged evolutionary time : Speciation is generally a function of time, unlike polar regions subjected to frequent glaciations in the past, tropical latitudes have remained relatively undisturbed for millions of years and thus, had a long evolutionary time for species diversification.

(ii) High productivity : There is more solar energy available in the tropics, which contributes to higher productivity; this in turn might contribute indirectly to greater diversity.

The two reasons for more species biodiversity in tropical latitudes than in temperate ones are:

(i) Temperate region was subjected to frequent glaciations in the past, while tropical latitudes have remained relatively undisturbed for millions of years and thus, had a long evolutionary time for species diversification.

(ii) Tropical environments, unlike temperate ones, are less seasonal, relatively more constant and predictable. Such constant environments promote niche specialisation and lead to a greater species diversity.

36. I. There are a number of reasons to conserve biodiversity which can be grouped as:

(a) Narrowly Utilitarian : Human derive a major part of their requirement from organisms. Their direct benefits are countless, like (i) Food : Pulses, fruits, vegetables, milk, egg, meat comes from plants and animals (ii) Fats and oils are obtained from plants and animals. (iii) Firewood as a source of energy for cooking and heating. (iv) Fibres, *e.g.*, cotton, flax, silk, wool. (v) Industrial products like tannins, lubricant,dyes, resins, and perfumes. (vi) Drugs: Nearly 25% of drugs being used by us are directly coming from plants.

(b) Broadly Utilitarian : Biodiversity is fundamental to ecosystem services of nature. For example (i) Oxygen: Through their photosynthetic activity plants are replenishing oxygen of the atmosphere. Amazon rain forest is estimated to contribute 20% of it. (ii) Pollination: Bees, bumble bees,

butterflies, moths, beetles, birds and bats are engaged in pollination of plants which is essential for formation of fruits and seeds. (iii) Climate regulation: Forest and oceanic systems regulate global climate. (iv) Aquifers: Plant cover is essential for retention of rain water, its percolation and storage in aquifers and reservoirs. (v) Flood and erosion control: Plant cover protects the soil from wind and water erosion. Run off of rain water is reduced so that flood water is rarely formed. (vi) Nutrient cycling : It is essential for continued availability of nutrients to plants without which there would be no photosynthetic activity.

Ethical Human beings share the biosphere with over a million species of plants, animals and microbes. They have evolved just as we have evolved. Every living species has an intrinsic value though it may not have any direct economic value. It is therefore, our moral and ethical duty not to destroy them. Instead we should take care of their well being so as to pass the rich biological legacy to future generations.

37. (a) Conservation of biodiversity is the protection, uplift and scientific management of biodiversity so as to maintain it at its optimum level and derive sustainable benefits for the present as well as future strategies. The maintenance of a high level of biodiversity is important for the stability of ecosystem. The main reasons to conserve the biological diversity can be grouped in three categories :

- Narrowly utilitarian (useful products for humans like food, fibres, drugs and medicines etc.)
- Broadly utilitarian (ecosystem services like provision of pollination, climate regulation, flood and erosion control, ecological balance through nutrient cycling, microbial waste treatment, biological pest control, aesthetic and cultural values).
- Ethical (every living species has an intrinsic value though it may not have any direct economic value, and also, every species has the right to live).

The two types of conservation strategies are *in situ* (on site) and *ex situ* (off site).

In situ conservation is conservation and protection of the whole ecosystem and its biodiversity at all levels in their natural habitat in order to protect the threatened species. It involves hotspots and protected areas. Hotspots are areas of high endemism and high level of species richness. Protected areas are ecological/biogeographical areas where biological diversity along with natural and cultural resources is protected, maintained and managed through legal or other effective measures. Protected areas include national parks, sanctuaries and biosphere reserves.

Ex situ conservation is conservation of threatened plants and animals in places outside their natural homes under full protection and supervision. It includes offsite collections and gene banks.

(b) 'Biodiversity hotspots' are the regions which are characterised by very high levels of species richness and high degree of endemism. India has three hotspots – Indo-Burma (North-East India), Himalayas, and Western Ghats. Importance of hotspots are as follows:

- Maintaining genetic diversity of all present species and varieties.
- Maintaining viable populations of native species, subspecies and varieties.
- Maintaining resilience in species/habitats/ecosystems to adapt to environmental changes.
- Maintaining the various types of communities/ ecosystems/habitats both in number and distribution.
- Checking human aided introduction of alien/exotic species.

Sacred forests or sacred groves are forest patches around places of worship which are held in high esteem by tribal communities. They are the most undisturbed forest patches (island of pristine forests) which are often surrounded by highly degraded landscapes. They are found in several parts of India, *e.g.*, Karnataka, Maharashtra, Rajasthan (Aravalli), Chandigarh (Sarguja, Chanada and Bastar), Kerala, Meghalaya. Temples built by tribals are found surrounded by deodar forests in Kumaon region. In Meghalaya scared groves are found in Jaintia and Khasi hills. Not a single branch is allowed to be cut from these forests. As a result, many endemic species which are rare or have become extinct elsewhere can be seen to flourish here. Bishnois of Rajasthan protect *Prosopis cineraria* and Black Buck religiously. Some water bodies are also held sacred in certain places, *e.g.*, Khecheopalri in Sikkim. Their aquatic flora and fauna are naturally preserved.

38. (a) On the land, maximum primary productivity is found in tropical rainforest. Various factors which contribute to high productivity in tropics are discussed ahead. Maximum light is available in tropics. Due to this photosynthesis is maximum and net primary productivity is highest in tropics. Climate of tropics is warm and humid. Appropriate temperature, rain and humidity increase productivity of tropics. Moreover, ecosystem with higher biodiversity are more productive.

(b) Loss of habitat results in annihilation of plants, microorganisms and forcing out of animals which in alien lands die out after sometime due to unfavourable conditions. Fragmentation of habitats results in disruption of complex interactions among species and animals requiring large territories are badly affected. *E.g.*, mammals and birds.

Alien species often become invasive and drive away the local species. They have proved harmful in both aquatic and terrestrial ecosystems. *E.g.*, water hyacinth was introduced in Indian waters to reduce pollution. It clogged water bodies at many places resulting in death of several plants and animals.