13. Organisms and Populations

Question 1. How is diapause different from hibernation?

Answer: Diapause is a condition of suspended development exhibited by species of zooplankton and insects. This is done so that they can pass over the unfavorable conditions which are present during their development.
Whereas hibernation also known as winter sleep is a resting stage shown by bats, squirrels and rodents. This is done to escape the winter season by slowing down their metabolism. Therefore they enter a stage of inactivity by hiding them in shelters.

Question 2. If a marine fish is placed in a fresh water aquarium, will the fish be able to survive? Why or why not?

Answer: Marine water fishes will not be able to survive in fresh water because marine water fishes are adapted to live in salt water conditions. If they are shifted to freshwater, the process of osmoregulation in them will be affected. Due to the internal high salt condition in fish, the freshwater will come inside the body of fish causing fishes to swell up, ultimately bursting.

Question 3. Most living organisms cannot survive at temperature above 45 degree C. How are some microbes able to live in habitats with temperatures exceeding 100 degree C?

Answer: Most living organisms cannot survive at temperature above 45°C because very high temperature causes denaturation of their enzymes. But certain bacteria, cyanobacteria, shelled protozoans, etc. are known to survive even in thermal springs. Tolerance power to the extremes of temperature varies from species to species e.g. Certain bacteria and cyanobacteria have thermal-resistant enzymes and peculiar cell wall.

Question 4. List the attributes that populations possess but not individuals.

Answer: A population can be defined as a group of individuals of the same species residing in a particular geographical area at a particular time and functioning as a unit. For example, all human beings living at a particular place at a particular time constitute the population of humans.

The main attributes or characteristics of a population residing in a given area are:-
(a) Birth rate (Natality): It is the ratio of live births in an area to the population of an area. It is expressed as the number of individuals added to the population with respect to the members of the population.

(b) Death rate (Mortality): It is the ratio of deaths in an area to the population of an area. It is expressed as the loss of individuals with respect to the members of the population.

(c) Sex ratio: It is the number of males or females per thousand individuals.

(d) Age Distribution: It is the percentage of individuals of different ages in a given population. At any given time, the population is composed of individuals that are present in various age groups. The age distribution pattern is commonly represented through age pyramids.

(e) Population density: It is defined as the number of individuals of a population present per unit area at a given time.

Question 5. If a population growing exponentially double in size in 3 years, what is the intrinsic rate of increase (r) of the population?

Answer: A population grows exponentially if enough food resources are available to the individual.
Exponential growth equation:
Nt= No ert
Where,
Nt= Population density after time t
Nt= Population density at time zero
r = Intrinsic rate of natural increase
e = Base of natural logarithms (2.71828)
From the above equation, we can calculate the intrinsic rate of increase (r) of a population.
Now, as per the question,
Present population density = x
Then,
Population density after two years = 2x
t = 3 years
Substituting these values in the formula, we get:
$\Rightarrow 2x = x\ e3r$
$\Rightarrow 2 = e3r$

Applying log on both sides:

$\Rightarrow \log 2 = 3r \log e$

$$\Rightarrow \frac{\log 2}{3 \log e} = r$$

$$\Rightarrow \frac{\log 2}{3 \times 0.434} = r$$

$$\Rightarrow \frac{0.301}{3 \times 0.434} = r$$

$$\Rightarrow \frac{0.301}{1.302} = r$$

$$\Rightarrow 0.2311 = r$$

Hence, the intrinsic rate of increase for the above-illustrated population is 0.2311.

Question 6. Name important defence mechanisms in plants against herbivory.

Answer: Several plants have evolved various mechanisms both morphological and chemical to protect themselves against herbivory.

Morphological defence mechanisms:

Cactus leaves (*Opuntia*) are modified into sharp spines (thorns) to deter herbivores from feeding on them. Sharp thorns along with leaves are present in Acacia to deter herbivores. In some plants, the margins of their leaves are spiny or have sharp edges that prevent herbivores from feeding on them.

Chemical defence mechanisms:

All parts of Calotropis weeds contain toxic cardiac glycosides, which can prove to be fatal if ingested by herbivores. Chemical substances such as nicotine, caffeine, quinine, and opium are produced in plants as a part of self-defence.

Question 7. An orchid plant is growing on the branch of mango tree. How do you describe this interaction between the orchid and the mango tree?

Answer: The interaction presents between the orchid and the mango tree is an example of commensalism as one species is benefited and other remains unaffected. An orchid plant that is growing on the branch of a mango tree is considered as an epiphyte. So, Epiphytes are the plants which grows on other plants but do not derive nutrition from them. In the given case the orchid is considered

as an epiphyte as it gets support and the mango tree remains unaffected.

Question 8. What is the ecological principle behind the biological control method of managing with pest insects?

Answer: The principle behind using of various biological control methods is the use of predator to control the growth of pest. Predation can be termed as a biological interaction between the two species in which one organism feed on other. The organism that feed on other is termed as predator and the other one is termed as prey. The predators help in regulating the population of preys in a given habitat and helps in the management of pest insects thus preventing the crop from getting damaged. This ecological principle is used in integrated pest management where instead of chemical pesticides, the population of the insect in a farm is controlled by its ecological enemy. This will also not let the insect species to increase to a level where it can damage the crop or decrease to a level where it may disturb the ecological balance.

Question 9. Distinguish between the following:

(a) Hibernation and Aestivation

(b) Ectotherms and Endotherms

Answer: **(a)** Hibernation and Aestivation

Hibernation	**Aestivation**
Hibernation is a state of reduced activity in some organisms to escape cold winter conditions.	Aestivation is a state of reduced activity in some organisms to escape desiccation due to heat in summers.
Bears and squirrels inhabiting cold regions are examples of animals that hibernate during winters.	Fishes and snails are examples of organisms aestivating during summers.

(b) Ectotherms and Endotherms

Ectotherms	**Endotherms**

Ectotherms are cold blooded animals. Their temperature varies with their surroundings.	Endotherms are warm blooded animals. They maintain a constant body temperature.
Fishes, amphibians, and reptiles are ectothermal animals.	Birds and mammals are endothermal animals.

Question 10. Write a short note on

(a) Adaptations of desert plants and animals

(b) Adaptations of plants to water scarcity

(c) Behavioral adaptations in animals

(d) Importance of light to plants

(e) Effect of temperature or water scarcity and the adaptations of animals.

Answer:

(a)Adaptations of desert plants and animals:

(i) Adaptations of desert plants:

Plants found in deserts are well adapted to overcome the harsh desert conditions such as water scarcity and scorching heat.to tap underground water, plants have an extensive root system. They bear thick cuticles and sunken stomata on the surface of their leaves to reduce transpiration. In Opuntia, the leaves are entirely modified into spines and photosynthesis is carried out by green stems. An special pathway that is C4 pathway is found to synthesize food. It enables the stomata to remain closed during the day to reduce the loss of water through transpiration.

(ii) Adaptations of desert animals:

Adaptations of desert animals are done for the same purpose as adaptation in desert plnts. It is done to conserve the water. For example Animals found in deserts such as desert kangaroo rats, lizards, snakes, etc. are well adapted to their habitat. The kangaroo rat found in the deserts of Arizona never drinks water in its life. It has the ability to concentrate its urine to conserve water.

(b) Adaptations of plants to water scarcity:

Plants found in deserts are well adapted to cope with water scarcity and scorching heat of the desert. Plants have an extensive root system to tap underground water. They bear thick cuticles and sunken stomata on the surface of their leaves to reduce transpiration. In Opuntia,the leaves are modified into spines and the process of photosynthesis is carried out by green stems. Desert plants have special pathways to synthesize food, called CAM (C4 pathway). It enables their stomata to remain closed during the day to reduce water loss by transpiration.

(c) Behavioural adaptations in animals

Various organisms are affected by various environmental conditions. To overcome the situation, organisms undergo adaptations such as migration, hibernation, aestivation, etc. These adaptations in the behaviour of an organism are called behavioural adaptations. For example, ectothermal animals and certain endotherms exhibit behavioral adaptations. Ectotherms are cold blooded animals such as fish, amphibians, reptiles, etc. Their temperature varies with their surroundings. For example, the desert lizard basks in the sun during early hours when the temperature is quite low. However, as the temperature begins to rise, the lizard burrows itself inside the sand to escape the scorching sun. Similar burrowing strategies are exhibited by other desert animals.

(d) Importance of light to plants:

The ultimate source of energy for plants is sunlight. Plants are autotrophic organisms, which need light for carrying out the process of photosynthesis. Plants need the sun because sunlight is made up of electromagnetic radiation which is given off as energy as the sun burns through its stores of hydrogen many millions of miles away from Earth. The electromagnetic radiation that plants receive from the sunlight that reaches Earth and penetrates its atmosphere is the key ingredient in a process that is called photosynthesis. Photosynthesis is important because it is the way in which plants derive their energy.

(e) Effects of temperature or water scarcity and the adaptations of animals:

The most important ecological factor is temperature. From one place to another the average temperature is varies. These variations in temperature affect the distribution of animals on the Earth. Animals which can tolerate a narrow range of temperature are called stenothermal animals. Those which can tolerate a narrow range of temperature are called stenothermal animals. Animals also undergo adaptations to suit their natural habitats. For example, animals found in colder areas have shorter ears and limbs that prevent the loss of heat from their body. Also, animals found in Polar regions have thick layers of fat below their skin and thick coats of fur to prevent the loss of heat.
Some organisms exhibit various behavioural changes to suit their natural habitat. These adaptations present in the behaviour of an organism to escape environmental stresses are called behavioural adaptations. For example, desert lizards are ectotherms. This means that they do not have a temperature regulatory mechanism to escape temperature variations
Water scarcity is another factor that forces animals to undergo certain adaptations to suit their natural habitat. Adaptations of desert animals are done for the same purpose as adaptation in desert plnts. It is done to conserve the water. For example Animals found in deserts such as desert kangaroo rats, lizards, snakes, etc. are well adapted to their habitat. The kangaroo rat found in the deserts of Arizona never drinks water in its life. It has the ability to concentrate its urine to conserve water.

Question 11. List the various abiotic environmental factors.

Answer: Abiotic environmental factors are formed by all the non-living components of an ecosystem which includes the following:

Temperature –

It is one of the most significant factors which varies seasonally on land, progressively decreases from the equator towards the poles, from plains to the mountain tops. From sub-zero levels in polar areas to temperatures greater than 50 degree Celsius in tropical deserts in summers, their range is wide. Some unique habitats such as deep sea hydrothermal vents, thermal springs sees average temperature exceeding more than 100 degree Celsius. Entities who can withstand a range of temperatures are termed as eurythermals example – birds and mammals whereas stenothermals are entities who can bear a narrow range of temperature, example – polar bears.

Water –

Life cannot sustain without water. For marine entities, pH, water temperature, chemical composition etc is significant. It is also affected by water salinity that is less than 5 parts per thousand in inland water, 30-35 parts per thousand in sea etc

Euryhaline are entities which can bear a wide salinity range whereas stenohaline are entities that can tolerate a narrow range of salinity. Most of the fresh water animals cannot sustain in sea water for long due to osmotic issues that arise due to high salinity and vice-versa

Soil –

Properties and nature of soil varies from place to place, depending on the following factors

-climate

-soil development process

-Weathering process

Characteristics such as grain size, aggregation, soil composition determine the water holding capacity and percolation of soil. Along with these, some other features such as pH, topography, mineral composition etc determine the type of plant that can grow in a specific habitat.

Light –

All autotrophs depend on light to carry out photosynthesis, releasing oxygen during the process. In forests, small herbs and shrubs are adapted to photosynthesis under very low light intensities as they are overshadowed by tall trees. Also, most plants depend on sunlight to meet their photoperiodic necessities for flowering. Several animals are dependent on diurnal and seasonal differences in light intensity as prompts for timing their reproductive, foraging and migratory activities. Light availability on land is closely associated with that of temperature, as Sun is the ultimate source. In deep oceans, it is dark perpetually. Spectral quality of solar radiation is necessary for life. For many entities, UV component of light is harmful. Different components of visible spectrum is available for marine plants active at different oceanic depths. Hence, different algae types such as brown, green and red algae occur at various depths in the middle, upper and lowest levels of water respectively.

Question 12. Give an example for:

(a) An endothermic animal

(b) An ectothermic animal

(c) An organism of benthic zone

Answer:
(a) Endothermic animal: Birds such as crows, sparrows, pigeons, cranes, etc. and mammals such as bears, cows, rats, rabbits, etc. are endothermic animals.

(b) Ectothermic animal: Fishes such as sharks, amphibians such as frogs, and reptiles such as tortoise, snakes, and lizards are ectothermic animals.

(c) Organism of benthic zone: Decomposing bacteria is an example of an organism found in the benthic zone of a water body.

Question 13. Define population and community.

Answer: A population is a group of individuals of one species that interbreed together in a particular living place. Members of the one species have the capacity to interbreed and produce fertile offspring.

The community represents all of the living organisms found living together in a particular area or habitat.

Question 14. Define the following terms and give one example for each:

(a) Commensalism

(b) Parasitism

(c) Camouflage

(d) Mutualism

(e) Interspecific competition

Answer:
(a) Commensalism:- Commensalism is an interaction between two species in which one species gets benefited while the other remains unaffected. An orchid growing on the branches of a mango tree and

barnacles attached to the body of whales are examples of commensalisms.

(b) Parasitism:- It is an interaction between two species in which one species (usually smaller) gets positively affected, while the other species (usually larger) is negatively affected. An example of this is liver fluke. Liver fluke is a parasite that lives inside the liver of the host body and derives nutrition from it. Hence, the parasite is benefited as it derives nutrition from the host, while the host is negatively affected as the parasite reduces the host fitness, making its body weak.

(c) Camouflage:- It is a strategy adapted by prey species to escape their predators. Organisms are cryptically coloured so that they can easily mingle in their surroundings and escape their predators. Many species of frogs and insects camouflage in their surroundings and escape their predators.

(d) Mutualism:- It is an interaction between two species in which both species involved are benefited. For example, lichens show a mutual symbiotic relationship between fungi and blue green algae, where both are equally benefited from each other.

(e) Interspecific competition:- It is an interaction between individuals of different species where both species get negatively affected. For example, the competition between flamingos and resident fishes in South American lakes for common food resources i.e., zooplankton.

Question 15. With the help of suitable diagram describe the logistic population growth curve.

Answer: No population of any species in nature has its disposal unlimited resources to permit exponential growth. This leads to competition between individuals for limited resources. Eventually, the 'fittest' individual will survive and reproduce.
A population growing in a habitat with limited resources show initially a lag phase, followed by phases of acceleration and deceleration and finally an asymptote when the population density reaches the carrying capacity.

Since resources for growth for most animal populations are finite and become limiting sooner or later, the logistic growth model is considered a more realistic one.

A plot of N in relation to time (t) results in a sigmoid curve. This type of population growth is called Verhulst-Pearl Logistic Growth and is described by the following equation:

$$dN/dt = rN\left(\frac{K-N}{K}\right)$$

Where N = Population density at time t r = Intrinsic rate of natural increase K = Carrying capacity
Lag phase: Initially, the population is very small because of the presence limited resource in the habitat.

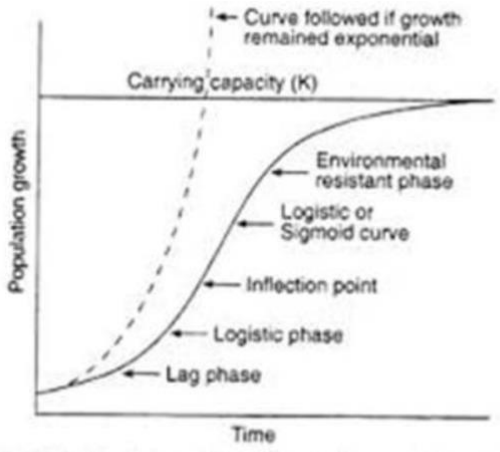

Fig. 4.42 : Logistic or sigmoid growth curve. The total size of the population grows in an S shape

Positive acceleration phase: During this phase, the organism starts adapting to its new environment and the population starts increasing. However, at the beginning of this phase, the is still limited.

Exponential phase: During this phase, the population organisms grows exponentially due to the availability of sufficient food resources, constant environment, and the absence of any interspecific competition. So, the population grows rapidly, the curve rises steeply upwards.

Negative acceleration phase: During this phase, due to increase in the environmental resistance, the growth rate of the population decreases. Increased competition among the organisms for their food and shelter is the factor responsible for the decline in the growth.

Stationary phase: During this phase, the population becomes stable. The population of the species has reached its nature's carrying-capacity in its habitat and cannot increase any further.

Question 16. Select the statement which explains best parasitism.

(a) One organism is benefited.

(b) Both the organisms are benefited.

(c) One organism is benefited, other is not affected.

(d) One organism is benefited, other is affected.

Answer: (d) One organism is benefited, other is affected.
In parasitism, one organism lives on the body of another. In this interaction, the parasite gets benefitted while the host is negatively affected.

Question 17. List any three important characteristics of a population and explain.

Answer: A population can be defined as a group of individuals of the same species, residing in a particular geographical area at a particular time and functioning as a unit. For example, all human beings living at a particular place at a particular time constitute the population of humans.
Three important characteristics of a population are:

- Birth rate (Natality): It is the ratio of live births in an area to the population of an area. It is expressed as the number of individuals added to the population with respect to the members of the population.
- Death rate (Mortality): It is the ratio of deaths in an area to the population of an area. It is expressed as the loss of individuals with respect to the members of the population.
- Age Distribution: It is the percentage of individuals of different ages in a given population. At any given time, a population is composed of individuals that are present in various age groups. The age distribution pattern is commonly represented through age pyramids.