Chapter-13-
Organisms and Population.

1. Important Terms

**Habitat**: Living place of an organism that provides it suitable conditions and food to survive and reproduction.

**Ecology**: It is the branch of science that deals with interaction among organisms and its physical environment.

**Population**: Group of individuals of any species that live in a well defined geographical area, share or compete for similar resources and interbreed called population.

**Community**: Group of populations interacting with each other in a particular area.

**Homeotherm**

**Eurythermal Organism**: the organism that can tolerate and thrive in a wide range of temperatures.

**Stenothermal Organism**: the organism that can tolerate and thrive in a narrow range of temperatures.

**Euryhaline organism**: the organism that can tolerate a wide range of salinity.

**Steno haline organism**: the organism that can tolerate a narrow range of salinity.

**Homeostasis**: It is process of maintaining constant internal environment despite the variations in external environmental conditions.

**Thermoregulation**: It is the maintenance of constant internal body temperature. e.g. Human being maintain 37°C by sweating and cooling in summer and shivering to raise the body temperature in winters.

**Conformers**: Organisms in which the internal environment can change with the changing external environment.

**Diapause**: a stage of suspended development.

**Hibernation**: avoiding the stress of low temperature during winter by becoming inactive by animals or winter sleep.

**Aestivation**: avoiding the stress of high temperature and desiccation during summer by becoming inactive by animals or summer sleep.

**Adaptation**: It is physiological, morphological or behavioural change /attribute that enables an organism to survive and reproduce in its habitat. E.g. Succulents are drought resistant plants which have adaptations like – leaves reduced to spines, stems modified to fleshy structures.

**Populations Ecology**: It is the branch of Biology that links ecology to population genetics and population evolution.

**Carrying Capacity**: Maximum number of individual of a population that can be sustained by given habitat.

**Population Density**: It indicates the number of individual or the size of population found in a unit area or space at a given time.
**Natality or Birth Rate:** It is the average number of new individuals added per unit population due to births, hatchings and germinations.

**Mortality or Death Rate:** It is the average number of natural deaths per unit population per unit time.

**Immigration:** It is the permanent inward coming of individuals from outside into existing population.

**Emigration:** It is the permanent outward movement of individuals from a population for settling into new area.

**Population growth:** It is the increase in the size of population over a period of time.

**Parasitism:** It is an interaction in which an organism of small size called parasite obtains nourishment from a larger organism called host for short time or even for whole life.

**Ectoparasite:** parasites that feed on the external surface of the host organism.

**Endoparasite:** parasites that live inside the host body at different sites like kidney, liver, lungs, blood etc.

**Brood Parasitism:** In this case one parasitic bird lays its eggs into the nest of the other bird called host who incubates the eggs of parasitic bird. E.g. Crow act as parasitic bird and lays eggs into the nest of cuckoo for incubation.

**Mutualism:** It is obligatory physically closed and mutually beneficial relationship that occurs between two interacting organisms. Both the interacting organisms fail to show normal growth in the absence of this association.

**IDENTICAL TERMS:**

Eurythermal/ Stenothermal

Euryhaline/ Stenohaline

Natality/ Mortality

Immigration/Emigration

Poikilotherms/ Homeotherms

Regulation/ Conformation

Osmoregulators/ Osmoconformers

Mutualism/ Commensalism

Predation/ Parasitism

Ectoparasite/ Endoparasite

Hibernation/ Aestivation

Diapause/ Hibernation
Points to Remember:

Ecology: Branch of science that studies the relationship between organisms and their physical & biological environment.

Level of Organization:

- Organisms
- Population
- Community
- Biomes.

Environment: Sum total of biotic and abiotic factors.

The seasonal variations and annual variation in precipitation lead to the formation of major biomes.

The major biomes are:

- Arctic & alpine tundra
- Coniferous forest
- Temperate forest
- Grasslands
- Tropical Forest
- Desert.

The most important abiotic factors of the environment are temperature, water, light and soil.

Biotic factors are pathogens, parasites, predators, competitors etc.

Temperature: The physiological functions and geographical distribution of organisms is governed by temperature.

Some organisms are eurythermal while others are stenothermal

Global warming poses problems to organisms both in survival and distribution.

Water: Important factor influence the life of organisms.

The productivity and distribution depends on water.

For aquatic organisms, chemical composition, pH, salinity and temperature of water are important.
Organisms may be euryhaline or stenohaline on their range of tolerance of salinity.

**Light:** small herbaceous plants and some shrubs live under the canopy of forest trees are adapted to photosynthesis under very low light intensities, called sciophytes.

Animal use the diurnal and seasonal variations in the light intensity and photoperiod as cues for timing of forage, reproduction and migration.

The distribution of red, green and brown algae at difference depths of water depends on the light, red algae can live in very deep water.

**Soil:** Nature and properties of soil depends on climate, weathering process, type of soil i.e. sedimentary or transported and soil development.

The physical and chemical properties of soil determine the type of plants that can grow in a particular habitat and the characteristics of the bottom sediments of aquatic environment determine type of benthic animals that can live there.

**How do Organisms Live in Their Environment?**

The organisms have four possibilities, they are:

i) **Regulation:** Organisms maintain homeostasis and ensure constant body temperature, osmotic concentration.

ii) **Conformation:** Animal and plants whose body temperature changes with ambient temperature. Osmotic concentration of body fluids changes with ambient water or osmotic concentration, animals called osmoconformers.

Thermoregulation is energy-expensive process, heat loss or gain is a function of surface area, so small animals are not found in polar region.

iii) **Migration:** Organisms can move away temporarily from stressful conditions to another habitat.

iv) **Suspension:** Organisms that cannot migrate and suspend their metabolic functions during stressful period and resume at the return of favourable condition. E.g. Hibernation, aestivation, Diapuse.

**Bears, Frogs, Lizards undergo hibernation.** Snails and Pelagic fish undergo aestivation whereas Diapause is shown by Zooplankton species.

**Adaptation:** Adaptations have evolved over a long period of time and are genetically controlled.

A few examples of adaptations in plants are:

a) **Desert Plants:** have thick cuticle on leaf surface, sunken stomata, CAM pathway, leaves modified into spines. Due to CAM pathway photosynthesis the stomata remain closed during the day.

   In *Opuntia* the leaves are modified into spines.

b) **Aquatic Plants:** Have evolved aerenchyma for buoyancy and floating, have waxy covering.
Kangaroo rat an animal living in the desert of North America meets its water requirement at the time of water scarcity through its internal fat oxidation (in which water is the by product). It is also able to concentrate its urine so that the minimal volume of water is lost during excretion.

**Allen’s Rule:** In colder climates, the mammals have shorter ears and limbs to minimize the heat loss.

In Polar regions, the seals have a thick layer of fat below the skin that acts as insulator.

Altitude sickness is caused at high altitudes as the body does not get enough oxygen due to low atmospheric pressure.

Body solves the problem of altitude sickness by increasing the no. of RBCs, decreasing the binding affinity of hemoglobin and by increasing breathing rate.

Desert Lizards keep their body temperature constant by behavioral adaptation. They bask in the sun and absorb the heat when their body temperature decreases below the comfort zone and then move to the shade when the temperature of surroundings increases.

Burrowing habit also helps to protect desert animals from high temperature.

**Population:**

**Population attributes:** A population has certain attributes, they are:

- Birth rate, Death Rate, Sex Ratio, Population density

A population at any given time is composed of individuals of different age/age group,

Age groups are: Pre-reproductive, Reproductive and Post- reproductive.

If the age distribution is plotted for the population, the resulting structure is called as age pyramid.

For human population, the age pyramids show the age distribution of males and females in a combined diagram.

The shape of pyramids reflects the growth status of the population i.e. an expanding/ growing population, a stable population, a declining population.

**Population Growth:** The size of any population keeps changing with the time depending on the factors like:

- Food available;
- weather,
- predator pressure and
- Competition.
The density of a population in a given habitat during a given period changes due to four basic processes: Natality (N), Mortality (M), Immigration (I) and Emigration (E).

While Natality and immigration contribute to an increase in the size and density of a population, mortality and emigration contribute to a decrease in them.

So the equation for the population growth is: \[ N_{t+1} = N_t + [(B+I) - (D+E)] \]

**Population Growth Models:**

There are two models of population growth:

i) **Exponential Growth Model:** When the resources availability is unlimited in the habitat, the population grows in an exponential or geometric fashion.

   The equation is: \( \frac{dN}{dt} = (b-d)N \)

   Let \( b-d = r \), then the equation is, \( \frac{dN}{dt} = rN \)

   When a population shows exponential growth, the curve plotted with N in relation to time, assume J shape.

ii) **Logistic growth Model:** No population can continue to grow exponentially, as the resource availability become limiting at certain point of time.

   It si described by the equation:

   \[ \frac{dN}{dt} = rN\left(1-\frac{N}{K}\right) \]

   \( N = \) population density at time

   \( r = \) intrinsic rate of natural increase

   \( K = \) carrying capacity

**Life History Variations:** Evolution of populations aims at improving the reproductive fitness to the maximum in their habitats.

Most birds and mammals breed many times during their life time.

According to ecologists life history traits of an organism have evolved in relation to the constraints imposed by the biotic and abiotic factors in their habitats.

**Population Interactions:**

Living organisms cannot live in isolation and they do interact in various ways to form biological communities.

Interspecific interactions are those interactions of population of two different species.
Such interactions are of the following types:

i) Beneficial to both as in mutualism.

ii) Beneficial to one and harmful/detrimental to the other as in parasitism and predation.

iii) Beneficial to one and neutral to the other as in commensalism

iv) Detrimental to both as in competition.

v) Detrimental to one and neutral to the other as in Amensalism

**Predation:**

- It is an interspecific interaction, where one animal called Predator kills and consumes the other animal called Prey.

- Predation is a way to transfer the energy from one animal to other.

- Predators are important in an ecosystem as

  They act as ‘conduits’ for energy transfer to higher trophic levels.

  They keep the prey population under control, which otherwise reach very high population density and cause imbalance in the ecosystem.

  They help in maintaining species diversity in a community by reducing the intensity of competition among the competing prey species.

  Sometimes they are used as biological control for pests e.g. Cactus feeding Moth was used to control Cactus in Australia.

- Prey species have evolved various defence mechanisms to reduce the impact of predation; e.g.

  Certain insect species and frogs have camouflage (Cryptic coloration)

  Some animals like Monarch Butterfly is very distasteful to its prey, a bird. It has a special chemical in its body. This chemical is produced during its caterpillar stage by feeding on poisonous weeds.

- Herbivores are the predators for plants.

- The problem of predation is more severe for plants than animals as they cannot move.

- About 25% of the known insects are the Phytophagus and feed on the plant sap.

- Plants have developed certain morphological and chemical defense mechanism against herbivores. E.g.
Thorns in *Bougainvillea* and Spines in *Acacia* are the examples of morphological adaptations.

Certain chemicals produced by the plants act for defense. They may make them sick, inhibit them from feeding or digestion or may kill them (*Calotropis* produces a highly poisonous Glycoside that is a cardiac poison).

Nicotine, Caffeine, Quinine, Strychnine, Opium etc are the chemicals produced by the plants against herbivores which graze or browse them.

**Competition:**

- Competition is a type of interaction among the individuals of same species (Intraspecific) or between individuals of different species (Interspecific).
- Competition between the individuals of closely related species takes place as they compete for the same resources that are limited.
- But there are exceptions to this belief. E.g. In certain shallow lakes of South America, the visiting Flamingoes and native fishes compete for the same zooplankton as their food.
- Resources need not be limiting for competition to occur, the feeding efficiency of one species might be reduced due to the interfering and inhibitory presence of the other species, even if the resources are in plenty. E.g. Abingdon tortoise in Galapagos Island became extinct within a decade after goats were introduced into the island; was due to the fact that the goats had greater browsing efficiency than the tortoise.
- Another evidence for competition is competitive release, a phenomenon in which a species whose distribution is restricted to a small geographical area due to presence of a competitively superior species, expands its distributional range when the competing species is experimentally removed.
- Gause’s Competitive Exclusion Principle states that two closely related species competing for the same resources cannot exist together as the competitively inferior will be eliminated; but this will happen only when the resources are limited and not otherwise.
- Resource Partitioning: a mechanism meant for co-existence of species. According to this, if two species compete for the same resource, they could avoid competition by choosing. E.g. MacArthur showed that five closely related species of Warbles living on the same tree were able to coexist and avoid competition by having behavioral differences in their foraging activities.

**Parasitism:**

- Parasitism is the interspecific interaction where one of the species (Parasite) depends the other species (Host) for food and shelter.
- Host gets damaged due to parasite whereas parasite gets benefitted.
• Parasites are host-specific and parasite and its host tend to co-evolve.

• Co-evolve means that if the host evolves a special mechanism to reject or resist the parasite, the parasite has to evolve the mechanisms to counteract and neutralize them, in order to be successful with the same host species.

• Parasites evolve adaptations in accordance with their life styles like loss of sense organs, presence of suckers or clinging organs to cling on to host, loss of digestive system and high reproductive capacity.

• Parasites have complex life cycle and generally have one or two intermediate host.

• Intermediate hosts act as vectors which facilitates parasitisation of host.

• Human liver fluke has two intermediate hosts: a snail and a fish

• Malaria Parasite has one intermediate host (mosquito) to spread to other host.

• Human lice and ticks are ectoparasites

• Copepods are the ectoparasites on some marine fish.

• Cuscuta is a parasitic plant that grows on the trees or hedges has lost its chlorophyll and leaves during evolution. It derives its nutrition from the host plants.

• Endoparasite has more complex life cycle and have simple morphological and anatomical features.

**Commensalism:**

• It is the interspecific interaction in which one species benefits and the other is neither harmed nor benefitted.

• Epiphytes (Orchids growing on a tree branch) and Barnacles growing on the back of whales are the examples of commensalism.

• Association between Egret and grazing cattle is commensalism. He Egrets always forage close to where the cattle are grazing because the insects from the vegetation are flush out as the cattle, move, and stir it up. They are caught by the egrets otherwise it is difficult for them to detect and catch.

• The Clown fish living among the sea anemones has also show commensalism. He clown fish get protection from predators, which stay away from the stinging tentacles of the sea anemone.

**Mutualism:**

• It is the interspecific interaction in which both the interacting species are benefitted. E.g.
• Lichens show an intimate relationship between Fungus and Algae/ Cyanobacteria

• Mycorrhiza – an association of Fungus with roots of higher plants. Fungi help to absorb nutrients from the rocks and plants provide energy yielding carbohydrates to fungi.

• Plants depend on insects for pollination and in return they give them nectar or pollens to eat.

• Animals help the plants in seed dispersal and in return they give fruits to animals as food.

• In many species of Fig trees, there is a tight close relationship between fig tree and pollinator species of wasp. It means that a given fig species can be pollinated by its partner wasp only.

• The female wasp uses the fruit of fig as egg laying site (Oviposition) and nourish the larvae with the developing seeds within the fruit. Wasp pollinates the fig inflorescence while searching the suitable site for egg laying.

• Mediterranean orchid, Ophrys uses ‘Sexual Deceit’ to get pollinated by a species of bee. One petal of this flower bears an uncanny resemblance to the female bee in size, colour, and making; the male bee gets attracted to it as it perceives it a female. It pseudocopulates with the flower, and during this process it gets dusted with the pollens and when it sits on other flower for pseudocopulation, it transfers the pollens to other flower.

• In Mutualism, both species co-evolve. E.g. if the bee slightly change its colour pattern due to any reason during evolution, pollination success will reduce unless the orchid Ophrys flower co-evolves to maintain the resemblance of its petal to the female bee.

1. **Mark Questions**

1. Write the four levels of biological organisms with which ecology is basically concerned?

   Four levels of Ecology are: Organism, Population, Community and Biome

2. Write four major abiotic factors of the environment for survival of organism.

   Temperature, Light, Water and Soil

3. Define homeostasis.

   It is process of maintaining constant internal environment despite the variations in external environmental conditions

4. Give the season includes in following

   a) Hibernation
b) Aestivation

Winter for hibernation and Summer for aestivation.

5. List any three important characteristics of a population.

Birth rate, Death Rate, Sex Ratio, Population density


**Allen’s Rule:** In colder climates, the mammals have shorter ears and limbs to minimize the heat loss.

7. Write the symptoms include in altitude sickness.

Nausea, Fatigue and Heart Palpitation

8. What is the reason of success of mammals as evolved organisms?

Their ability to maintain a constant body temperature.


It is the branch of science that deals with interaction among organisms and its physical environment.

10. How do we thermo-regulate the body temperature in summer?

During summers, our body sweat profusely. Sweat evaporates which causes cooling.

11. Name an animal that hibernates?

Frog, Polar Bear

12. Give an example of behavioral adaptation.

Organisms living at very high temperature or at very low temperature.

13. How size of any population can be measured?

Measured by the Population Density.

14. From the given ecological pyramid representing pre-reproductive, reproductive and Post – reproductive stages of human population. Out of A, B and C which is the declining population?
2 Marks Questions

1. Give equation for logistic growth with symbols representation.

2. Which growth model is realistic and which type of growth curve is sigmoid?

3. What does competitive exclusion principle states?

4. How light is important for living organisms?

5. Why does the variable external environment affect most of the organisms?

6. Give any two adaptations found in parasites.

7. Why the relationship between sea anemone and clown fish is said to be commensalism.

8. Define the ectoderm and endotherm.

9. Give an example of sexual deceit.

10. What are mutualism, predation and parasitism.

11. Define the words emigration and immigration.

12. What are succulents? How they are adopted to their environment.

13. How population density can be calculated at any time (+1)?

14. If a population change is represented by \((dN/dt) = rN\) then plot the graph.

15. Identify the biome distribution with respect to annual temperature and precipitation from the following graph answer the A, B, C&D.
16. What does the graph A, B&C represent with reference to organismic response to Homeostasis?

Answer: A - Regulators
B - Conformers
C – Partial Regulator

17. From the following ecological pyramid find out the pyramid showing stable population. Why?

Answer: B.

18. Name the type of population interaction A,B,C, D between the species A and B as per the tabular column given below.
3 Marks Questions

1. Give reasons for the following:-
   
i) Mango trees do not and cannot grow in temperate countries.

2. Differentiate B/W predator and parasites. (At least six differences).

3. Differentiate B/w exponential and logistic growth. (At least six difference).

4. What does this graph represent w.e.f. to organism response for homeostasis.
In the above graph

1. What does ‘K’ means?

   ii) What are the conditions for ‘a’ and ‘b’

   ii) Give equations representing ‘a’ and ‘b’ curve.

5. Explain parasitism. Also define ectoparasite and endoparasite.

6. Define predation and write a note on it.

7. What does the competition among species mean? Also explain its types.

8. What is the difference between natality and mortality?

9. Distinguish between camouflage and mimicry.

10. Explain:-
i) Mimicry
ii) Acclimatization
iii) Migration.

11. Give few adaptations of hydrophytes and aquatic animals.

12. Explain various adaptations in Homeotherms and poikilotherms.

13. Write a short note on mutualism.

5 Marks Questions

1. Describe environmental factors and their importance to animal and plants.

2. What are the different types of adaptations in animals? Explain with examples.

HOTS Questions

1. What do you mean by summer sleep and winter sleep?

2. How does Kangaroo rat fulfill its water needs?

3. Where and how thermal stratification occurs?

4. Name various thermal strata.

5. What is the significance of thermal stratification in deep temperature aquatic bodies?

6. Why the thermoregulation is more effectively achieved in larger animals than in smaller ones?

7. Why do animals migrate?

8. Why do small mammals of the polar region have short ears and short limbs?

9. Why is temperature considered as the most ecologically relevant environmental factor?

10. It is a common sight in rural areas where cattle egrets and grazing cattle are found in close association, what kind of interaction do they shoe? Explain.

11. The Mediterranean orchid *Ophyrs* employs sexual deceit to get its flower pollinated. Explain what is meant by this statement.

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