Organisms and Populations

- **Ecology:** It is the field of science that deals with the interrelationship between biotic and abiotic factors.
  - It includes four levels of biological organisation: **organisms, populations, communities and biomes.**
  - **Major abiotic factors:** Light, temperature, water, air, soil, etc.
  - **Eurythermal:** Organisms that can tolerate wide range of temperature
  - **Stenothermal:** Organisms that live in a narrow range of temperature
  - **Euryhaline:** Organisms that can tolerate wide range of salinity
  - **Stenohaline:** Organisms that live in a narrow range of salinity
- **Responses of organisms to abiotic factors –**
- **Regulators** are organisms that have the ability to maintain their constant body temperature. Example: birds and mammals
- **Conformers** are organisms that cannot maintain their constant body temperature with respect to their surrounding environment.
  - The heat gain or heat loss from the body of an organism is the function of the body surface area relative to volume.
  - Therefore, the smaller organisms have larger surface area relative to their volume, and tend to lose body heat at a faster pace. Hence, small-bodied animals are rarely found in the Polar Regions.
- **Migration** is the ability of an organism to move away temporarily from a stressful habitat to a hospitable habitat
  - Example: migratory birds
- **Suspend** involves suspension of metabolic activities of organisms during unfavourable conditions. It includes:
  - **Hibernation (winter sleep):** Example, Polar bear.
  - **Aestivation (summer sleep):** Example, some snails and fishes.

- **Diapause (stage of suspended development):** Example, many zooplanktons.

- **Adaptations**
  - Adaptation is the process of adjustment which enables an organism to adapt to its new environment.

- There are three types of adaptations –
  - **Physiological adaptation:** Example, kangaroo rat producing highly concentrated urine
    Morphological adaptation: Example, presence of a thick cuticle on the leaf surface of desert plants

  - **Behavioural adaptation:** Example, desert lizard basking in the sun to absorb heat, to maintain its body temperature

Population

- It is a group of organisms inhabiting a given area.

- Attributes of population are –

- Birth rate
- Death rate
- Sex ratio
- Age distribution

- **Age pyramid:** It shows the age distribution pattern for a population.

- Age pyramid for human population shows –

- **Expanding population:** Has a broader base, representing more number of individuals in pre-reproductive (young individuals) age group

- **Stable population:** Has almost equal number of individuals in the pre-reproductive and reproductive age groups, converging at the post-reproductive age group

- **Declining population:** Has lesser number of individuals in the pre-reproductive group and greater number of individuals in the reproductive age group

Demography

- The Statistical study of human population considering the following factors:

- Distribution of population
- Size and Density of population
- Birth rate
- Death rate

- Growth rate of population

- **Population density fluctuates due to –**
- Natality (B)
- Mortality (D)
- Immigration (I)
- Emigration (E)

  So,
  $N_{t+1} = N_t + [(B + I) - (D + E)]$

  Where, N_t is the population density at time t and N_{t+1} is the population density at time t+1

- **Population growth curve**

- When resources are unlimited, the growth curve is known as exponential growth curve.

- **Exponential growth equation:**
- $Nt = N0\ ert \Rightarrow$
  Where,
  N_t = Population density after time t
  N_0= Population density at time 0
  r = Intrinsic rate of natural increase
  e = Base of natural logarithm

- When resources become limiting, the growth curve is said to be logistic growth curve.

- **Verhulst–Pearl logistic growth equation:**

  Where,
  N = Population density at time t
  r = Intrinsic rate of natural increase
  K = Carrying capacity

  Population interaction

- There are six types of population interaction –

  1. **Mutualism**: It is a symbiotic association between two species where both of them are benefited. Example, fungi and roots of higher plants

  2. **Competition:** It is a type of interaction where both the species are negatively affected. Example, Abingdon tortoise getting extinct due to the introduction of goat

  - **Gause's competitive exclusion principle** states that two or more closely related species having identical patterns of resource use cannot coexist in a stable

environment; one which will be better adapted will out-compete or otherwise eliminate the inferior one.

1. **Predation and Parasitism:** It is the population interaction where one species is positively affected while the other species is negatively affected.
   Example, *Pisaster* hunting on sea urchin is an example of predation
   while *Cuscuta* deriving nutrition from its host represents parasitism. Parasitism is of two types –

- Endoprasitism: Example, tapeworms and roundworms in the human body
- Ectoparasitism: Example, lice on the human skin and ticks on dogs

1. **Commensalism:** It is the population interaction where one species gets positively affected while the other remains unaffected. Example, clown fish living in the poisonous tentacles of sea anemone

2. **Ammensalism:** It is the population interaction where one species gets negatively affected while the other remains unaffected.