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:**

- $Nt = N0\ ert \Rightarrow dN/dt = rN$

Where,

N_t = Population density after time t

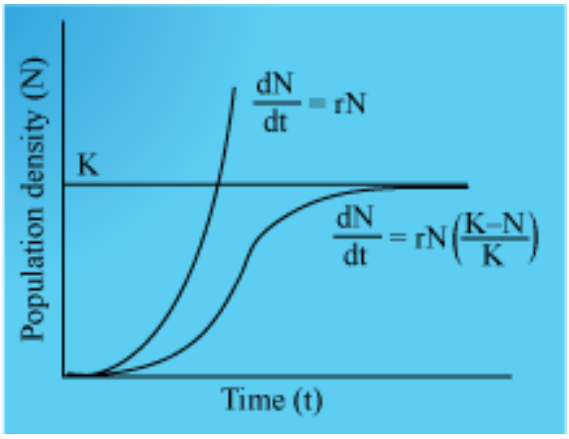
N_0= Population density at time 0

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

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



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.