13. ORGANISMS AND POPULATIONS

ORGANISM AND ITS ENVIRONMENT

Adaptations

Adaptation is the morphological, physiological & behavioural attribute that enables an organism to survive and reproduce in its habitat.

Adaptations of kangaroo rat in North American deserts:

- Internal **fat oxidation** gives water as byproduct if there is no external source of water.
- Ability to **concentrate urine** so that minimal volume of water is used to remove excretory products.

Adaptations of desert plants:

- Presence of **thick cuticle** on leaf surfaces.
- **Sunken stomata** minimise water loss due to transpiration.
- **CAM photosynthetic pathway** enables their stomata to remain closed during day time.
- Desert plants like *Opuntia* have **no leaves** (they are reduced to spines). Photosynthesis is done by stems.

Adaptations of mammals:

- Mammals from colder climates have shorter ears and limbs to reduce heat loss. This is called **Allen's Rule.**
- Aquatic mammals like seals have a thick layer of fat **(blubber)** below their skin that acts as an insulator and reduces loss of body heat.

Physiological and biochemical adaptations:

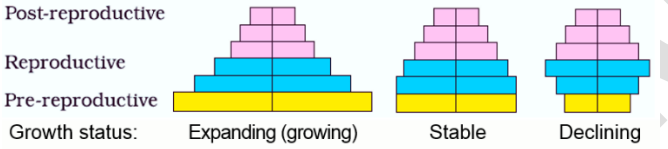
- At a high-altitude place (>3,500 m) we feel ***altitude sickness*.** Its symptoms are nausea, heart palpitations & fatigue. This is due to low atmospheric pressure. So the body does not get enough O_2. Gradually, we acclimatize the situation and the body compensates low O_2 availability by increasing RBC & breathing rate and decreasing the binding capacity of hemoglobin.

POPULATIONS

Population Attributes

- **Age pyramid:** It is the structure obtained when the age distribution (% individuals of a given age or age group) is plotted for the population.

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



Representation of age pyramids for human population

- **Population size or population density (N):** It is the number of individuals of a species per unit area or volume. E.g. population density of Siberian cranes at Bharatpur wetlands in any year is <10. It is millions for *Chlamydomonas* in a pond.

  Population size is also measured in **% cover or biomass.** E.g. In an area, 200 *Parthenium* plants and a huge banyan tree are seen. In such cases, measuring % cover or biomass is meaningful to show importance of banyan tree.

  Total number is a difficult measure for a huge population. In such cases, **relative population density** (without knowing absolute population density) is used. E.g. Number of fish caught per trap indicates its total population density in the lake.

POPULATION GROWTH

The population size changes depending on factors like food availability, predation pressure & weather.

4 basic processes that fluctuate the population density:

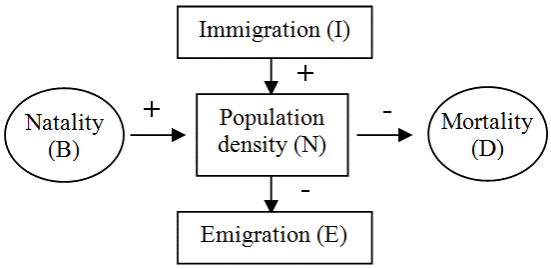
a. **Natality (B):** It is the number of births in a population during a given period.

b. **Mortality (D):** It is the number of deaths in a population during a given period.

c. **Immigration (I):** It is the number of individuals of the same species that have come into the habitat from elsewhere during a given time period.

d. **Emigration (E):** It is the number of individuals of the population who left the habitat and gone elsewhere during a given time period.

Natality & immigration increase the population density and mortality & emigration decrease the population density.



- If N is the population density at time t, then its density at time t +1 is

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

Population density increases if B+I is more than D+E. Otherwise it will decrease.

Population Interactions

- Interaction between two species is called **Interspecific interactions.** They include

Name of interaction	Species A	Species B
Mutualism: Both species are benefitted (+)	+	+
Parasitism: One (parasite) is benefitted. Other (host) is harmed	+	-
Commensalism: One is benefitted. Other is unaffected (0)	+	**0**

Parasitism

- Many parasites are **host-specific** (they can parasitize only a single host species). They tend to **co-evolve.** i.e., if the

host evolves special mechanisms against the parasite, the parasite also evolves mechanisms to counteract them to remain with the same host species.

- **Adaptations of parasites:** Loss of sense organs, presence of adhesive organs or suckers to cling on to the host, loss of digestive system, high reproductive capacity etc.
- Life cycles of parasites are often complex. E.g.
  - Human liver fluke depends on 2 intermediate hosts (a snail & a fish) to complete its life cycle.
  - Malarial parasite needs mosquito to spread to other hosts.

Types of parasites:

1. Ectoparasites

- Parasites that feed on the external surface of host. E.g.
  - Lice on humans.
  - Ticks on dogs.
  - Ectoparasitic Copepods on many marine fishes.
  - *Cuscuta* plant on hedge plants.
- Female mosquito is not considered a parasite, because it needs our blood only for reproduction, not as food.

2. Endoparasites

- Parasites that live inside the host body at different sites.
- They have simple morphological & anatomical features and high reproductive potential.

Brood parasitism in birds:

- Here, the parasitic birds lay eggs in the nest of its host and lets the host incubate them.
- During evolution, eggs of the parasitic bird have evolved to resemble the host's egg in size and colour. So the host bird cannot detect and eject the foreign eggs easily.
- E.g. Brood parasitism between **cuckoo and crow.**

Commensalism

Examples:

- Orchid (+) growing as *epiphyte* on a mango branch (0).
- Barnacles (+) growing on the back of a whale (0).
- Cattle egret (+) & grazing cattle (0). The egrets forage close to where the cattle are grazing. As the cattle move, the vegetation insects come out. Otherwise it is difficult for the egrets to find and catch the insects.
- Sea anemone (0) & clown fish (+). Stinging tentacles of sea anemone gives protection to fish from predators.

Mutualism

Examples:

- **Lichen:** It is a mutualistic relationship between a fungus & photosynthesizing algae or cyanobacteria.
- **Mycorrhizae:** Associations between fungi & the roots of higher plants. The fungi help the plant in the absorption of essential nutrients from the soil while the plant provides the fungi with carbohydrates.
- **Mutualism b/w plant & animal through pollination and seed dispersion:**

  Examples:

  1. **Fig trees & wasps.** The fig species is pollinated only by its 'partner' wasp species. Female wasp pollinates the fig inflorescence while searching for suitable egg-laying sites in fruits. The fig offers the wasp some developing seeds, as food for the wasp larvae.
  2. **Orchids** show diversity of floral patterns. They can attract the right pollinator insect **(bees & bumblebees)** to ensure pollination. Not all orchids offer rewards.
  3. **'Sexual deceit' of *Ophrys*** (Mediterranean orchid). One petal of its flower resembles female bee in size, colour & markings. So male bee 'pseudocopulates' with the flower and is dusted with pollen. When this bee 'pseudocopulates' with another flower, it transfers pollen to it.

     If the female bee's colour patterns change slightly during evolution, pollination success will be reduced unless the orchid flower co-evolves to maintain the resemblance of its petal to the female bee.