

**ORGANISMS AND POPULATIONS**

**Ecology:** It is a branch of biology which studies the interactions i) among organisms and ii) between the organism and its physical ( abiotic) environment.

**Organism:** Individual of a species.

**Population:** Population is a group of individuals of the same species which can interbreed among themselves and live in a localized area.

**Biome:** The largest ecological regions distinguishable by characteristic plants and animals. Eg. tundra, conifer, deciduous forest, grassland, tropical, and desert.

**Alpine tundra:** Alpine tundra is located on mountains throughout the world at high altitude where trees cannot grow. The growing season is approximately 180 days. The night time temperature is usually below freezing. Unlike the arctic tundra, the soil in the alpine is well drained.

**Group of animals that live in Alpine tundra:**

Mammals: mountain goats, sheep

Insects: beetles, grasshoppers, butterflies

**Coniferous forests:** Coniferous forests are made up mainly of cone-bearing or coniferous trees, such as spruces, hemlocks, pines and firs. The leaves of these trees are either small and needle-like or scale-like and most stay green all year around (evergreen). All are softwoods able to survive cold temperatures and acidic soil.

**Temperate Forests:** The term 'temperate forest' is very broad. It covers the forests found between the tropical and subtropical regions and the barren, treeless lands of the far north and extreme south.

**Tropical forest:** "Tropical forests" encompass the idyllic rainforest, the remote cloud forest, and the lesser-known but equally endangered dry forest, pine savanna and much, much more. They are not one ecosystem, but millions of unique ecosystems.

**Deciduous forest:** The average annual temperature in a deciduous forest is 50° F. The average rainfall is 30 to 60 inches a year. The deciduous forest has four distinct seasons, spring, summer, autumn, and winter. In the autumn the leaves change color. During the winter months the trees lose their leaves.

- Temperature, water, light, soil.

**Temperature**

- Average temperature varies seasonally
- Organisms may be Eurythermal or Stenothermal
- Eurythermal- **wide range** of temperature tolerance
- Stenothermal-**Narrow range** of temperature tolerance

**Water**

- Influences life of organisms. No life without water.
- Productivity and distribution of plants are water dependent.
- Organisms may be Euryhaline or Stenohaline.
- Euryhaline:**Wide range** of salinity tolerance
- Stenohaline:**Narrow range** of salinity tolerance.

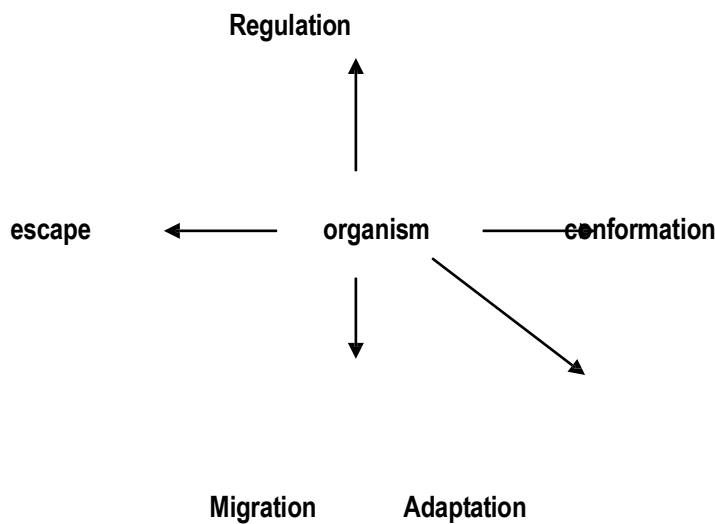
**Light**

- Photosynthesis and release of oxygen light dependent.
- Sciophytes need to use diurnal and seasonal light intensity of forage, migration and reproduction.

**Soil**

- Nature and proportion of soil in a place depends on climate, weathering process and types of soil.
- Soil composition, grain size and aggregation determine percolation and water holding capacity of soil.
- Physical and chemical properties determine type of plants and Animals that survive in a habitat.

**Response of organisms to environmental condition**



### Regulation

- Organisms maintain homeostasis achieved by physiological and behavioral means
- Thermo regulation and osmoregulation.

### Conformation

- Cannot maintain constant internal Environment
- Body temperature and osmotic concentration of body changes with ambient temperature and concentration of medium.-Thermo conformer and osmo-conformer

### Migration

- Organism moves away temporarily to another habitat in stressful condition. e.g.- Migratory birds like Siberian crane

### Suspension

- Organisms suspend their metabolic activities during stressful condition
- Resume their function at the return of favorable conditions.

E.g. **Hibernation** (winter sleep) of Frog, Reptiles, Polar Bear etc

- **Aestivation** (summer sleep) in Snail and Fish.
- **Seed dormancy.**

### Adaptation

- Morphological, physiological and behavioral changes that enable organisms to adjust to the ever changing environment .

E.g. Kangaroo rat survives in desert conditions through internal oxidation of fat, removing concentrated urine of limited quantity.

- Allen's rule-cold climate mammals have shorter ears and limbs to minimize heat loss.
- Polar mammals like seals have **blubber** to prevent heat loss.
- Burrowing habit to escape from heat
- Higher count of RBC, Hb (haemoglobin) at high altitudes.

### Population attributes

- Birth Rate – Number of individuals born per thousand per year.

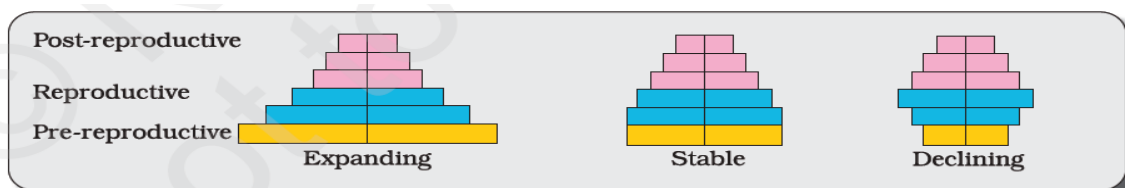
- Death Rate – Number of individuals die per thousand per year
- Sex Ratio – Ratio of male-female in the population.

- Population density. - the number of individual organisms per unit area (appropriate measure – total number-sometimes difficult to determine or meaningless because 4 factors **N+I-M+E** are concerned w.r.t habitat concerned )

### Age pyramids

- If the age distribution (per cent individuals of a given age or age group) is plotted for the population, the resulting structure is called an age pyramid.
- Three ecological ages:
  - Pre-reproductive, Reproductive and Post-Reproductive
  - High proportion pre-reproductive individuals occur in **Expanding** population
  - Pre-reproductive individuals are uniform in **Stable** population.
  - Pre-reproductive individuals are less in **Declining** population.

### Representation of " age pyramids" for human population



### Population growth

#### Factors that affect the size of population

Food

availability

Weather

Predation pressure

Competition

Density of population at any time at a given

place depends on Natality, Mortality, Emigration

Immigration

- MEASURING DENSITY
- Population Density – Number of individuals per unit of area.
- Population will grow if  $B+I > D+E$
- Population will shrink if  $B+I < D+E$
- Population will be in equilibrium if  $B+I=D+E$

## POPULATION GROWTH MODELS

- I. **Exponential Growth( geometric growth)** : Applicable when the resources are unlimited.  
Mathematical expression:  $dN/dt= rN$  Where 'r' is called the 'intrinsic rate of natural increase'.
  - The value of 'r' for the Norway rat = 0.015
  - The value of 'r' for the floor beetle=0.0205
  - Population density(N) and Time graph result in a J-shaped curve.
  - Integral form of the exponential equation:  $N_t = N_0e^{rt}$
- II. **Logistic Growth ( Verhulst-Pearl Logistic Growth)**: Applicable when the resources are limited. In nature, a given habitat has enough resources to support a maximum possible number, beyond which no further growth is possible.This limit is called as nature's '**Carrying capacity'(K)** for that species in that habitat.
  - A plot of N in relation to time (t) results in a sigmoid curve.
  - Mathematical expression:  $dN/dt=rN(K-N/K)$  where  $(K-N/K)$  is environmental resistance.

### Types of population interactions

| INTERACTIONS | SPECIES – all | SPECIES – bll |
|--------------|---------------|---------------|
| Mutualism    | +             | +             |
| Predation    | +             | -             |
| Parasitism   | +             | -             |
| Competition  | -             | -             |
| Commensalism | +             | 0             |
| Amensalism   | -             | 0             |

**Mutualism:** Both species are benefited.

**Lichens:** Relationship between Non-photosynthetic Fungi and photosynthetic Algae or Cyanobacteria.

**Mycorrhiza:** Association between Fungi and Higher Plants like Pinus. Plants and insects for pollination  
Orchid ophrys and male bee a good example for co-evolution of plants and animals.

### PREDATION

*One species gets benefited and the other harmed.*

Snake and Frog Herbivores and plants

## Competition

*Both the species are harmed.*

Flamingoes and resident fishes compete for the common food zooplankton in South American lakes.

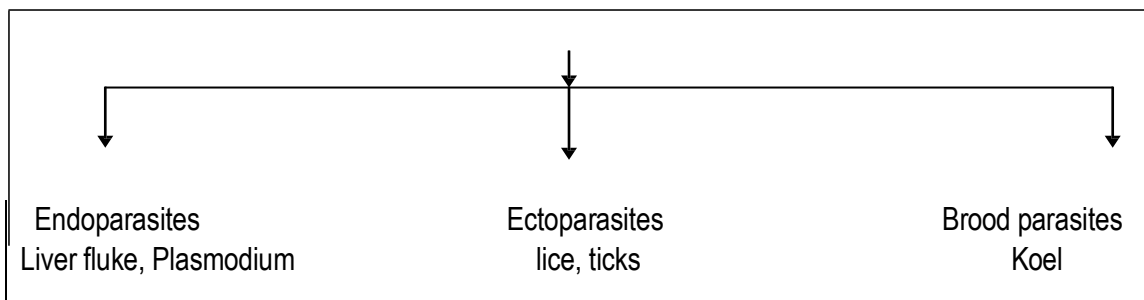
Abington Tortoise and goats in Galapagos Islands for food.

**Gause's Competitive Exclusion Principle**-Two closely related species competing for the same resource cannot co-exist indefinitely and the competitively inferior one will be eventually eliminated.

## Parasitism

One species gets benefit and the other is harmed.

Parasites



### Adaptations of parasites

- Loss of sense organs
- Presence of adhesive organs or suckers
- Loss of digestive system
- High reproductive capacity.

### Ammensalism

One species hurts the other but the other is not affected.

Penicillium secretes Penicillin and kill Bacteria but by this Penicillium does not benefit. Algal bloom leads to death of fishes, but the death of fishes is of no use to the algal bloom.

### Commensalism

One species benefits and the other neither harmed nor benefited.

The cattle egret catches the insects disturbed by moving cattle, but the cattle neither harmed nor benefited.

### Another example

Clown fish gets protection from predators by close association with sea anemone, but the sea anemone is not effected.

## SHORT QUESTIONS AND HOTS FOR PRACTICE

1. Why is temperature considered to be the most relevant abiotic factor that influences the life of organisms?

- Because it affects the enzyme activity.

2. During global warming which type of organism can cope up better – Eurythermal or stenothermal? Why?

- Eurythermal as it can tolerate wide range of temperature.

3. Why does the logistic growth curve becomes S shaped?

- Sigmoid curve, population becomes stable due to environmental resistance.

**Short answer type questions (3 marks)**

1. What is brood parasitism? Give an example. What adaptation has evolved in this phenomenon?

Ans. One species lays eggs in the nest of another bird, lets the host incubate them. e.g. Cuckoo lays eggs in the nest of a crow.

The Eggs of the parasite resemble the eggs of the host in colour, size. Reduce chances of the host bird detecting the foreign eggs and ejecting them from nest.

2. Name and explain the kind of interaction in the following.

Ans. 1. Algae and Fungi in Lichens

2. Head Louse Humans

3. Hermit Crab and Sea Anemone

(i) Interaction of mutualism where the two species are equally benefited. Fungus provides protection, helps in absorption of water and minerals, Algae provide food for the Fungus.

(ii) This is case of Parasitism where the louse is an ectoparasite. Parasite takes shelter on humans and also derives nutrition.

(iii) It is commensalisms where one species is benefited and the other is neither benefited nor affected. Sea

Anemone is benefited as it does not have to move to places rich in nutrients, while hermit crab is neither

benefited nor harmed.

3. How does Ophrys get pollinated by bees?

Ans. 1. Sexual deceit.

2. One petal resembles female.

3. Male pseudocouplates with the flower.

4. Pollen grain transferred from one flower to another.

4. Biomass is a more meaningful measure of population size. Explain with an example.

Ans. (i) Population large Total number is not an easily adoptable measure. Counting takes long time or practically impossible

(ii) There is no need to know the absolute population size for some investigations.

(iii) Number may sometimes be misleading eg. In a given area there are 200 *Parthenium* plants and a single banyan tree. Here biomass size of the banyan tree is much more than those of 200 *Parthenium* plants.

5. Give example of how plant protects themselves from the predators.

Ans. (i) Thorns.eg. – Rose, babool etc.

(ii) Chemicals that can kill the animals. eg.- Calotropis etc.

6. What is interference competition? Define competitive exclusion principles.

Ans. (i) Feeding efficiency may be reduced due to interference of another species. eg. –Tiger and deer.

(ii) Two closely related species need same resource can not co-exist indefinitely.

**(5 Marks) Questions:**

1. What are the different types of population growth pattern? Mention their differences.

Ans: a. Logistic and Exponential growth

b. S Shaped curve, J shaped curve, Limiting Factors, No-limiting Factors  
2. With the help of age pyramids explain the nature of a population.

Ans: a. Pre-reproductive/ re-productive/ post-reproductive

b. increasing population/ stable population/ declining population