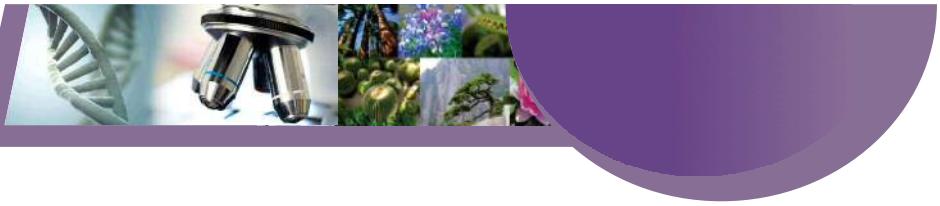


Chapter - 13

Organisms And Population

Ecology : A branch of science that studies interactions among organisms and their physical environment. Ecology is basically concerned with four levels of biological organisation— Organisms, population, communities and biomes.

Ramdeo Mishra is called as the Father of Ecology in India.

Organisms : Organisms form the basic unit of study in ecology.

Species : Organisms with similar features and the potential to interbreed among themselves and produce fertile offspring, constitute a species.

Populations : Population is a group of individuals of the same species, inhabiting in a given area. Interspecific competition for basic needs operate among the individuals of population.

Biological Community : Biological community is constituted by an assemblage of the populations of all different species that live in an area and interact with each other. A biotic community has a distinct species composition and structure.

Ecosystem : Is a biological system in nature and composed of a biotic community integrated with its physical (abiotic) environment through the exchange of energy and recycling of the nutrients.

Biomes : Biomes is a very large unit, constituting of a major vegetation type and associate fauna found is a specified zone. Annual Variations is the intensity, duration of temperature and precipitation account for the formation of major biomes like desert, rain, forest and Tundra.

Major Biomes of India : Tropical rain forest, deciduous forest, desert, sea coast. Regional and local variations within each biome lead to formation of a wide variety of habitats.

Habitat : Habitat is the place where an organism lives.

Niche : The ecological niche of an organism represents the range of conditions that it can tolerate the resources it utilises and its functional role in the ecological system. Each species occupies a distinct niche and no two species occupy the same niche.

Biosphere : It is the sum total of all the biomes on the earth.

Environment : Environment is a sum total of all biotic and abotic factors that surround and potentially influence an organism. Temperature, water, light and soil are the major abiotic factors.

Major Abiotic factors

1. Temperature : It significantly affects the (a) Latitudinal and Attitudinal distribution of organisms (b) Enzyme kinetics and basal metabolism.

Eurythermal : Organisms which can tolerate and thrive a wide range of temperatures e.g. : Mammals, birds.

Stenothermal : Organisms which can tolerate and thrive a restricted narrow range of temperature. e.g. : Polar bears, penguins.

2. Water : Quantity and quality of water significantly affects the distribution of organism, pH, Salinity and chemical composition is important to aquatic organisms.

Euryhaline : Organisms which tolerate a wide range of salinites e.g. *Salmon*.

Stenohaline : Organisms which are restricted to a narrow range of salinites e.g. : Shark.

3. Light : Light affects significantly the production in autotrophs, photoperiodism and behavioural and physiological adaptations in organisms living in low in intensities. For example dense forest with tall canopied trees and at the depth of oceans. It also affects diurnal and seasonal variations.

4. Soil : Soil is an important factor affecting the distribution of organisms. Properties of soil like grain size, mineral content, percolation, pH are significant in distribution of plants and animals.

5. Homeostasis : Is the ability of an organism to maintain consistent internal environment (for e.g. constant body temperature).

Population Attributes :

A population has certain attributes that an individual does not possesses. Important characterstics of a population are :

(i) Population density : Population density of a species is the number of individuals of a species per unit area or volume

$$\text{Population density} = \frac{\text{Number of individual in a region (N)}}{\text{Number of unit area in a region (S)}}$$

(ii) Birth rate or Natality Rate : It is expressed as the number of births per thousand individuals of a population per year

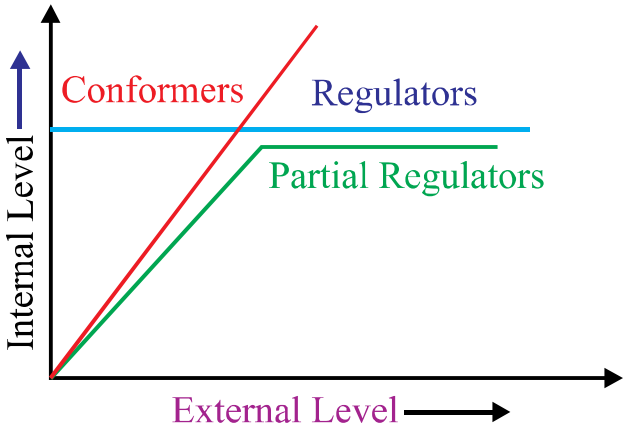
(iii) Death rate or Mortality rate : It is expressed as the number of deaths per thousand individual of a populations during a given period.

(iv) Sex ratio : It is expressed as the number of females per 1000 males of a population in given time.

Response to Abiotic Factors

(i) Regulators : Some organisms are able to maintain homeostastis by physiological (Some times behavioural) means which ensures body temperature, constant osmotic concentration. All birds and mammals, a very few lower vertebrates and invertebrates are regulators (Thermoregulation and osmoregulation). For example, human beings maintain their body temperature by sweating in summer and shivering during winter season. Plants do not have such mechanisms to maintain internal temperatures.

(ii) Conformers : Majority of animals and nearly all plants cannot maintain a constant internal environment. Their body temperature changes with the ambient temperature. In aquatic animals the osmotic concentration of the body fluids change with that of the ambient water and osmotic concentration. Some species have evolved the ability to regulate, but only over a limited range of environmental conditions, beyond which they simply conform.



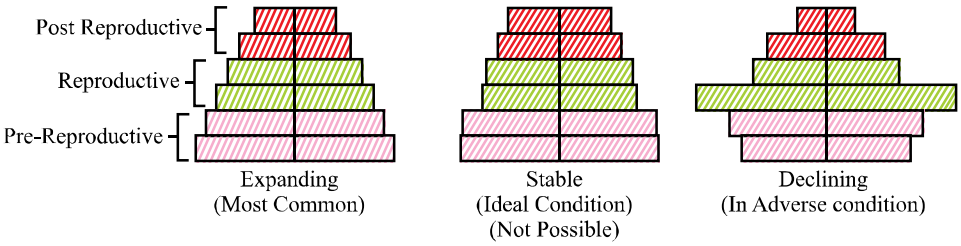
(iii) Partial regulators : Hairs on the body acts as heat insulator. Surface area and volume ratio. In smaller organisms the surface area is large as compared to the volume. But in large animal this ratio is small. So, the larger animals effectively controls the body temperature.

(iv) Migration : The organisms can move away temporarily from the stressful habitat to a more comfortable area and return when stressful period is over.

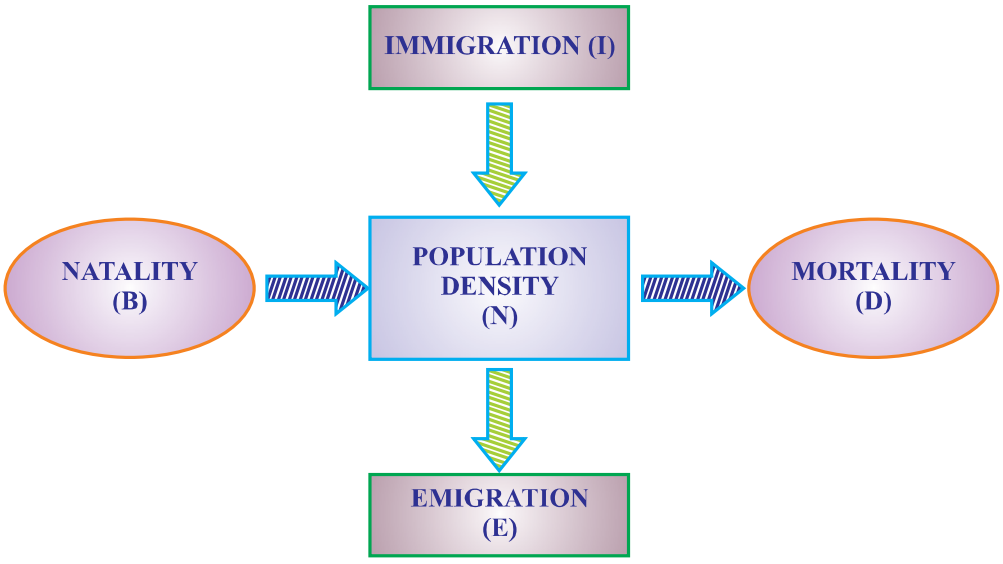
(v) Suspend : The organisms may avoid the stress by escaping in time. Bears go into hibernation during winter (winter sleep). Some snails and fish go into aestivation in summer (summer sleep).

Diapause (Stage of suspended development) in zooplankton, thick walled spores in bacteria, fungi and lower plants.

Age Pyramids of Populations : A population at any given time is composed of individuals of different ages. If the age distribution is plotted for the population, the resulting structure is called an age pyramid. The shape of the pyramids reflects the growth status of the populations. Whether (a) it is growing (expanding) (b) Stable or (c) Declining. The pyramids for human population (males and females) are presented below :



Population Growth : If 'N' is the population density at time t' then its density at time t + 1 is : $N_{t+1} = N_t + [B + I) - (D + E)]$



Immigration : Number of individuals of the same species that have come into the habitat from elsewhere during a given period.

Emigration : Number of individuals of the population who have left the habitat and gome elsewhere during a given time period.

Growth Models : The two growth models are :

(i) **Exponential growth model** : If food and space for a population are unlimited and each species has the ability to grow, then the population grows in exponential or geometric fashion.

Exponential Growth Equation is $N_t = N_0 e^{rt}$

Where,

N_t = Population density after time t

N_0 = Population density at time zero

r = intrinsic rate of natural increase

e = the base of natural logarithms (2.71828)

Exponential growth : 'J' shape curve is obtained.

- When resources are not limiting the growth.
- Any species growth exponentially under unlimited resources conditions can reach enormous population densities in a short time.
- Growth is not so realistic.

(ii) **Logistic growth model :** A population growing in a habitat with limited resources (food and space) shows logistic growth :

Verhulst-Pearl Logistic Growth is described by the following equations :

$dN/dt = rN (K-N / K)$

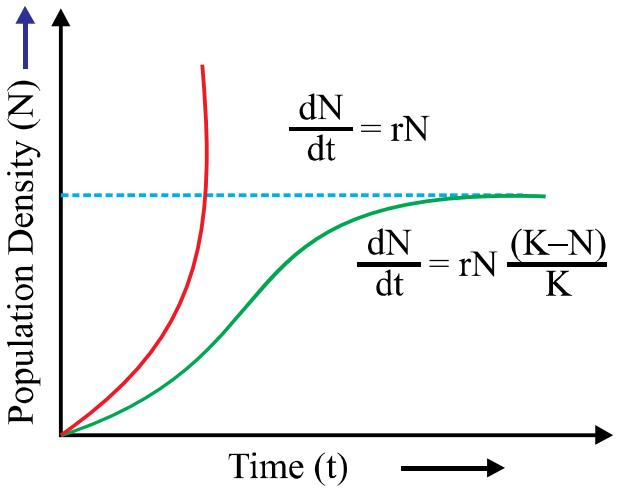
Where, N = Population density at time t

r = Intrinsic rate of natural increase

K = Carrying capacity

Logistic Growth (Sigmoid curve is obtained)

- When resources are limiting the Growth.
- Resources for growth for most animal populations are finite and become limiting.
- The logistic growth model is a more realistic one.



Population Interactions :

Predation : Interaction between species involving killing and consumption of prey is called predation. The species which eats the other is called the predator and the one consumed is termed as the prey. The predator keeps check on prey population. The reduction in predator population may lead to increase in prey population.

- Predators play important roles in ecosystem :
  - (a) Transfer of energy across trophic levels.
  - (b) Keep prey population under control : The invasive prickly pear cactus was brought under control by introduction of a cactus-feeding predator (moth) in Australia.
- Biological pest control methods : Used in agricultural are based on the ability of predator to regulate prey population.
- Maintain species diversity in a community.

Examples of Predation :

(i) Biological control methods to control pests

(ii) Carnivorous animals like tiger eating deers, snake eating frog

(iii) Insectivorous plants like *Nepenthes*, *Drosera*, *Utricularia*

Competition : In this fitness of one species is significantly lower in presence of another species.

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

Parasitism : Parasitism is a kind of relationship between two species in which one derives its food from the other (host). Parasitism also involves shelter, in addition to food obtained by a parasite. Parasites may be ectoparasites or endoparasites. Ectoparasites live on the surface of their host while endoparasites live inside the body of the host.

Examples of Parasitism

(i) Cuscuta growing on shoe flower plant

(ii) Head lice and humans

(iii) *Ascaris*, *Taenia*, *Plasmodium* causing diseases in humans

Example of Brood parasitism

(i) Koel laying its eggs in crow's nest.

Mutualism : In mutualism both the interacting species are benefited mutually. It is also known as symbiosis.

Examples of Mutualism

(i) Mycorrhiza living in roots of higher plants

(ii) *Rhizobium* in root nodules of legumes

(iii) Algae and fungi in lichens

(iv) Orchid *Ophrys* and bee for pollination

Co-evolution : (1) Fig species and wasp. Female wasp uses the fruit as an Oviposition (egg-laying) and also uses the developing seeds within the fruits for nourishing its larvae. Wasp pollinates the fig inflorescence while searching for egg laying site, in return fig offers developing seeds as food for developing larvae. (2) Mediterranean orchid Ophrys and bee.

Amensalism : Interaction between two different species, in which one species is harmed and the other is neither benefited nor harmed.

Example of Amensalism

(i) *Penicillium* whose toxin kills many bacteria is neither benefitted nor harmed

Commensalism : This is the interaction in which one species is benefited and the other is neither harmed nor benefited under normal conditions.

Examples of Commensalism

(i) Clown fish living among tentacles of sea anemone

(ii) Pilot fish (*Remora*) accompanies sharks

(iii) Orchid growing on mango tree

(iv) Sea anemone on the shell of hermit crab

(v) Barnacles on back of whales

(vi) Egret and grazing cattle

Questions

VSA **(1 Mark)**

1. Fresh water animals are unable to survive for long in sea water. Give reason.
2. Calculate the death rate if 6 individuals in a laboratory population of 60 fruiflies died during a particular week.
3. An organism has to overcome stressful condition for a limited period of time. Which strategies can it adopt to do so ?
4. What do phytophagous insects feed on ?

SA-I **(2 Marks)**

5. Differentiate between stenohaline and euryhaline organisms.
6. List four features which enable the Xeric plants to survive in the desert conditions.
7. How do stenothermal organisms differ from eurythermal organisms ?
8. Why do clown fish and sea anemone pair up ? What is this relationship called ?

SA-I **(3 Marks)**

9. How will you measure population density in following cases ?
   (i) fish in a lake
   (ii) tiger census in a national park
   (iii) single huge banyan tree with large canopy.

LA **(5 Marks)**

10. What is attitude sickness? What its causes and symptoms ? How does human body try to overcome altitude sickness ?
11. Orchid flower, Ophrys co-evolves to maintain resemblance of its petal to female bee. Explain how and why does it do so ?

Answers

VSA **(I Mark)**

1. Due to osmotic problems
2. 6/60 = 0.1 individuals per fruitfly per week.
3. (i) Migration
   (ii) Suspension of active life by hibernation/aestivation/spore formation.
4. Plant sap and other parts of the plant.

SA-I **(2 Marks)**

5. **Euryhaline :** Organisms tolerant in wide range of salinities.
   Stenohaline : Organisms tolerant to narrow range of salinities.
6. (i) thick cuticle
   (ii) Stomata in deep pits
   (iii) Stomata closed during day time
   (iv) leaves modified into spines (CAM photosynthetic pathway).
7. **Eurythermal :** Organisms that can tolerate and thrive in wide range of temperatures
   Stenothermal : Organisms restricted to a narrow range of temperature.

8. Clown fish lives in tentacles of sea Anemone and gets protection from predators.

Interaction-commensalism.

SA-II **(3 Marks)**

9. (a) fish caught per trap.

(b) number per unit area

(c) percentage cover in biomass.

10. Breathlessness at high attitudes.

Cause : Low atmospheric pressure at high altitudes due to which body does not get enough oxygen.

Symptoms : Nausea, fatigue and heart palpitations. Body adapts by :

(a) increasing red blood cell production

(b) decreasing binding affinity of haemoglobin

(c) by increasing breathing rate.

11.
- employs 'sexual deceit'
- one petal bears uncanny resemblance to female of the bee.
- Male bee is attracted to what it perceives as a female 'pseudo-copulates,' during which pollen dusted on male bee's body.
- Male bee transfers pollen to another flower when the same been pseducopulates with another flower.
- *Ophrys* does so because pollination success will be reduced unless it co-evolves with female bee.

❑❑