CHAPTER 13

ORGANISMS AND POPULATIONS

POINTS TO REMEMBER

Adaptation : Any attributes of the organism (morphological, physiological, behavioural) that enables the organism to survive and reproduce in its habitat.

Aestivation : Strategy to escape in time during summers (summer sleep). E.g., Snails and some fishes.

Allen's Rule : Mammals from colder climates generally have shorter ears and limbs to minimise heat loss.

Carrying Capacity : Maximum number of individuals of a population which can be provided with all the necessary resources for their healthy living.

Commensalism : One organism is benefitted while the other is neither harmed nor benefitted except to a negligible extent.

Competition : Rivalry between two organisms for obtaining the same resources.

Ectoparasite : Parasites which live on the surface of their host.

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

Exponential Growth Curve : Shows that 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 ratio.

Hibernation : Strategy to escape in time during winters (winter sleep). E.g., Polar bears.

Homeostasis : Maintaining constancy of internal environment despite varying external environmental conditions.

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

Ecology : A branch of science that studies the reciprocal relationships between organism and their physical environment. Ecology is basically concerned with four levels of biological organisation– organisms, populations, communities and biomes.

Organisms : Organisms form the basic unit of study in ecology. Organisms with similar features and the potential 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 a 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.

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

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

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

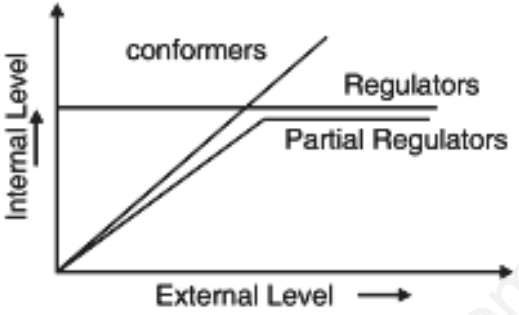
Response to Abiotic Factors :

(i) **Regulators :** Some organisms are able to maintain homeostasis 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.

A diagrammatic representation of organismic response is shown below.

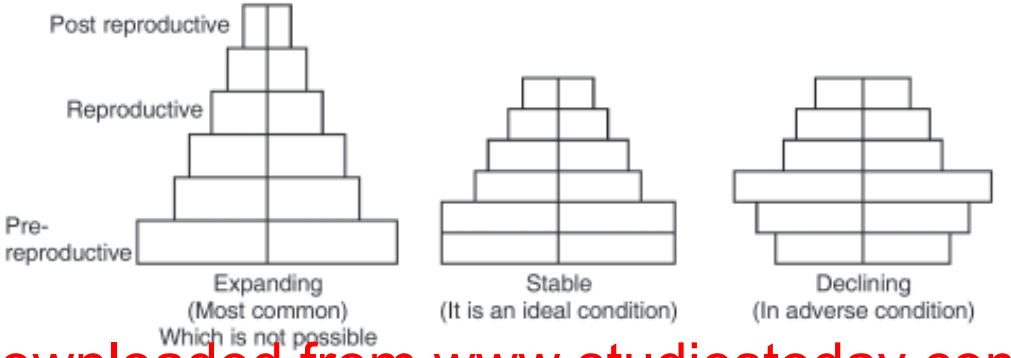


(iii) **Partial regulators :** Hair on the body – Hair on body acts as heat insulator. Surface area and volume ratio – In smaller organisms the surface area is large as compared to the volume. But in large animal this ratio is small. So, the larger animals effectively controls the body temp erature.

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

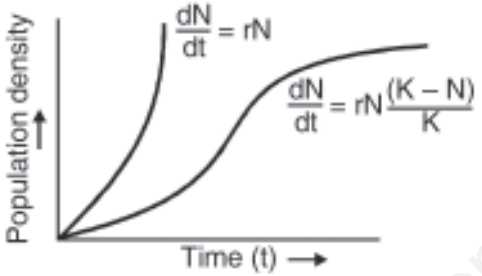
(v) **Suspend :** The organisms may avoid the stress by escaping in time. Bears go into hibernation winter, some snails and fish go into aestivation in summer.

Age Pyraminds 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 (a) Whether it is growing (expanding) (b) Stable or (c) Declining. A pyramids for human population (males and females) are represented below.



Population Growth : If 'N' is the population density at time 't', then its density at time t + 1 is :

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



Where B = The number of births

I = The number of immigrants

D = The number of deaths

E = The number of Emigrants.

N = Population Density

r = Intrinsic rate of natural increase

t = Time period

K = Carrying capacity (The maximum population size that an environment can sustain)

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 the prey. The predator keeps check on prey population. The reduction in predator population may lead to increase in prey population.

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

Competitive release – A species whose distribution is restricted to a small geographical area because of a competitively superior species, is found to expand its distributional range when the competing species is experimentally removed

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

Resource partitioning – If two species compete for the same reasource, they could avoid competition by choosing different times for feeding.

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

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.

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

Co-evolution – 1) Fig species and wasp. Female wasp uses the fruit as an qviposition (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 big offers developing seeds as food for developing larvae. 2) Mediternanean orchid Ophrys and bee.

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

Examples of Parasitism :

(i) Cuscuta growing in shoe flower plant

(ii) Head louse and humans

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

Examples of Brood parasitism :

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

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

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 *Ophyrs* and bee for pollination (employs sexual deceit)

Example of Amensalism

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

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

Growth Models : The two growth models are :

(i) Exponential growth model

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

Where

Nt = Population density after time t
N0 = Population density at time zero
r = intrinsic rate of natural increase
e = the base of natural logarithms (2.71828)

(ii) **Logistic growth model**

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

$dN/dt = rN (K–N / N)$

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

(i) **Exponential growth** ('J' shape curve is obtained).

* When responses 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 (Sigmoid curve is obtained)

* When responses 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.

QUESTIONS

VSA (1 MARK)

1. Which are the factor responsible for the wide variety of habitat formed within each biome?
2. Fresh water animals are unable to survive for long in sea water. Give reason.
3. With which population growth model is the Verhulst Pearl equation associated?
4. Define diapause. Which organisms exhibit it?
5. Calculate the death rate if 6 individuals in a laboratory population of 60 fruit flies died during a particular week.
6. In biological control method, one living organism is used against another to check its uncontrolled growth. Which kind of population interaction is involved in this?
7. An organism has to overcome stressful condition for a limited period of time. Which strategies can it adopt to do so?
8. Write what do phytophagous insects feed on?

SA-II (2 MARKS)

9. What are the four levels of biological organisation with which ecology basically deals?
10. Differentiate between stenohaline and euryhaline organisms.
11. List four features which enable the Xeric plants to survive in the desert conditions.
12. Mention the attributes which a population has but not an individual organism.
13. Differentiate between stenothermal and eurythermal organisms.
14. What are the four ways through which the living organisms respond to abiotic factors?
15. Why do clown fish and sea anemone pair up? What is this relationship called?

SA-I (3 MARKS)

16. How does the shape of age pyramid reflect the growth status of a population?
17. Darwin showed that even a slow growing animal like elephant could reach enormous number in absence of checks. With the help of your understanding of growth models, explain when is this possible? Why is this notion unrealistic?
18. 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.
19. Species facing competition might evolve mechanism that promotes co-existence rather than exclusion. Justify this statement in light of Gause's competitive exclusion principle, citing suitable examples.

LA (5 MARKS)

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

ANSWERS

VSA (1 MARK)

1. Regional and local variations
2. Due to osmotic problems.
3. Logistic Growth.
4. A stage of suspended development, zooplanktons.
5. 6/60 =0.1 individuals per fruitfly per week.
6. Predation.
7. (i) Migration
   (ii) Suspension of active life by hibernation/aestivation/spore formation.
8. Plant sap and other parts of plant.

SA-II (2 MARK)

9. Organisms, population, communities and biomes.

10. **Euryhaline :** Organisms tolerant in wide range of salinities.

    Stenohaline : Organisms tolerant to narrow range of salinities.

11. (i) thick cuticle

    (ii) Stomata in deep pits

    (iii) Stomata closed during day time

    (iv) leaves reduced to spines (CAM photosynthetic pathway).

12. Birth rate, Death rate, Sex ratio, age groups.

13. **Eurythermal :** Organisms that can tolerate and thrive in wide range of temperatures

    Stenothermal : Organisms restricted to a narrow range of temperature.

14. (i) Regulate (ii) Conform (iii) migrate (iv) Suspend

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

    Interaction – commeasalisn.

SA-I (3 MARKS)

16. Shape of pyramids reflects growth statusof the population (a) growing (b) Stable (c) declining.

    Refer page 227, Fig. 13.4, NCERT book, Biology - XII

17. Possible if the growth model is Exponential, i.e., having unlimited resources. Its an unrealistic situation because resources are limited. Hence, it follows logistic growth model.

18. (a) fish caught per trap.

    (b) number per unit area

    (c) percentage cover in biomass.

19. State Gause's competitive exclusion principle. Mechanisms is resource partitioning. E.g., experiment of Mac Arthur on Warblers (Refer page 325, NCERT book, Biology - XII).

LA (5 MARKS)

20. 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.

21. ❑ employs 'Sexual deceit'

❑ one petal bears uncanny resemblance to female of the bee.

❑ Male bee is attracted to what it perceives as a female 'pseudocopulates,' during which pollen dusted on male bee¡¦s body.

❑ Male bee transfers pollen to another flower when the same bee pseudocopulates with another flower.

❑ *Ophrys* does so because pollination success will be reduced unless it co-evolves with female bee.