



ORGANISMS AND POPULATION

I. Introduction

1. **Ecology:** Branch of biology that deals with the study of interaction between organisms and their environment is called as **ecology**.
2. Ecology is basically concerned with four levels of biological organisation-**organisms, population; communities and Biomes**.

II. Organism and its Environment

1. **Population:** It is defined as the total number of individuals of a species in a specific geographical area.
2. **Biome:** It is a large regional or sub-continental biosystem, which consists of many ecosystems.
3. **Major biomes of India:** Tropical rain forests, Deciduous Forest, Desert, Sea coast.
4. **Habitat:** It is a specific place (or) locality where a community resides (lives).
5. **Ecological Niche:** It is a specific part of habitat occupied by individuals of a species. It has distinct functional role in Ecosystem.

III. Major Abiotic Factors

1. Four types of Abiotic (or) Physical factors are Temperature, Water, Light and Soil.
2. **Temperature** is the most important ecologically relevant environmental Factor.
3. Temperature decreases progressively from the equator towards the poles and from plains to the mountain tops.
4. It ranges from subzero levels in polar areas and high altitudes to $> 50^{\circ}\text{C}$ in tropical deserts in summer.
5. In thermal springs and deep-sea hydrothermal vents where average temperatures exceed 100°C .
6. In plants, temperature affects various processes like **photosynthesis, respiration, reproduction and flowering, mineral and water absorption, growth and development**.
7. In animals, temperatures affects **metabolic activities, distribution, sex ratio, colouration, growth various processes like photosynthesis, respiration, and development and behaviour**, etc.
On the basis of thermal tolerance, animals are divided into following categories.
8. **Eurythermal animals:** These can tolerate a wide range of temperature fluctuations.
e.g. **Cyclops, Toad, Wall lizard, Man, Cow, Dog** etc
9. **Stenothermal organisms:** These can tolerate only a small range of temperature. eg. Corals, Polar bear, Snails and Fishes.
10. **Water** is the most important factor influencing the life of organisms. It is an important factor for **photosynthesis**.
11. The **productivity and distribution** of plants is also heavily dependent on water.
12. Salt concentration is less than 5 ppt in inland waters, 30-35 ppt in sea water and > 100 ppt in some hypersaline lagoons.
13. Organisms that can tolerate wide range of salinities are Organisms restricted to narrow range of salinities are (Euryhaline) e.g: Salmon Fish
14. Organisms restricted to narrow range of salinities are _____. (stenohaline) e.g: Shark.
15. **Light** is the basic source of energy for photosynthetic organisms.
16. Plants that require high intensity of light are called **Heliophytes**.
17. Plants that require low intensity of light are called **Sciophytes**.
18. Plants also depend on light for **photoperiodic requirement for flowering**.
19. Animals use the **diurnal and seasonal variations** in light intensity and duration (Photoperiod) as signals for **foraging** (food collection/feeding action), **reproduction and migration**.
20. **Soil** is the loose superficial layer of earth's crust. It is formed by a process called **weathering**.
21. Various characteristics of the soil such as **soil composition, soil grain size and aggregation** determine the percolation and water holding capacity of the soils.
22. **Humus** is a dark coloured amorphous substance, slightly acidic, colloidal and acts as reservoir of nutrients.



III. Responses to Abiotic Factors

1. **Homeostasis:** A process by which the organism keeps the internal environment constant despite of drastic changes in the external environmental conditions is called as **homeostasis**.
2. **Regulate:** The organisms are able to maintain a constant body temperature and osmotic concentration despite changes in external environment. They are called as **regulators**.
eg: Birds, Mammals, Few invertebrates and lower vertebrates.
3. **Thermoregulation:** Keeping the body temperature constant is called thermoregulation. It is best observed in birds and mammals. These animals so called warm-blooded animals.
4. **Osmoregulation:** It involves the regulation of osmotic concentration of the body fluids by regulating the water level in them.
5. Humans maintain a constant body temperature of 37°C.
6. In summer, when outside temperature is more than our body temperature, we sweat.
7. profusely. The result of evaporative cooling brings down the temperature.
8. In winter when the temperature is much lower than 37°C, we start to shiver, a kind of exercise which produces heat and raises the body temperature.
9. **CONFORM:** Most of the animals and all plants cannot maintain a constant internal environment and their body temperature changes with the change in environmental temperature. These are called as **conformers**.
10. **Osmo conformers:** Animals in which, the osmotic concentration of the body fluids changes with that of the ambient water osmotic concentration are known as Osmo conformers. eg. All marine vertebrates, Hag fish.
11. Animals like shrews and hummingbirds have large surface area relative to their volume which helps them to lose their extra heat rapidly when it is cold outside. Hence small animals are rarely found in polar areas.
12. **MIGRATE:** The organisms can move temporarily from the unfavourable habitat to a more favourable areas and return to their original habitat when unfavourable conditions are over is known as migration. e.g. Birds like Siberian cranes, American golden plover etc.
13. Every year thousands of migratory birds of **Siberia** and other extremely cold Northern regions reach the famous **Keolado National Park in Bharatpur** (Rajasthan) during winter months.
14. **SUSPEND:** Organisms avoid unfavourable environment by escaping in time is known as suspend.
15. **Dormancy** seeds maintain dormancy to escape unfavourable conditions in higher plants,
16. **Hibernation (Winter sleep):** It is the period of dormancy during winter months.
eg: Frogs, lizards, snakes, shrews, bats, ground squirrel etc.
17. **Aestivation (Summer sleep):** It is the period of dormancy during summer months so as to escape scorching heat of sun. e.g. Lung fishes, Lady-bird beetles, Bugs, Snails
18. **Diapauses:** It is a special type of aestivation in which morphological growth and development remain suspended to avoid summer related problems. eg: Many insects, Crustaceans, Mites, Zooplanktons species

IV. Adaptations

1. Any change in the structure or functioning of an organism that makes it better suited to its environment is known as **adaptation**.
2. **Kangaroo rat** meet there water requirements by oxidation of internal fats. It has the ability to concentrate its urine to minimise water loss due to excretion.
3. Adaptations in desert plants for reducing rate of transpiration **thick cuticle, sunken stomata Crassulacean acid metabolism** and Leaves are modified into spines.
4. **Allen's rule:** Mammals living in colder areas have shorter ears and limbs.
5. The low atmospheric pressure of high altitudes resulting in nausea, fatigue and heart palpitations and body does not get sufficient oxygen is known as **altitude sickness**.
6. The body compensates low oxygen availability by increasing red blood cell production decreasing the binding affinity of haemoglobin and by increasing breathing rates.
7. **Desert lizard** bask in sun increases body temperature during winter season

V. Populations

1. **Population** may be defined as a group of organisms of the same species occupying a particular space. Population are individual organisms that can potentially interbreed.
2. **Demography:** Study of population size is called **demography**.
Human demography: Human population in a given area like-village, city etc.



3. **Population ecology:** All aspects of a population including density, size, natality, mortality, immigration, emigration etc is called **population ecology**.

VI. Population Growth

1. The basic characteristic of a population is its size or density which is affected by four primary population parameters such as **Natality (N), Mortality (M), Immigration (I) and Emigration (E)**.
2. **Natality/Birth rate:** Number of organisms born per unit of population per unit time.
3. **Mortality rate/Death rate:** Rate of loss of individuals of a unit population per unit time.
4. **Emigration:** Moving out of individuals. It results in decrease of population size.
5. **Immigration:** Moving in of individuals. It results in increase in size of population.
6. Therefore, if N is population density at time t , then its density at time $N_t + 1$ is $N_{t+1} = N_t + (B + I) - (D + E)$
7. **Population size:** Number of individuals in a population.
8. **Population density:** Number of individuals available per unit space in a given time.
9. **Total fertility rate (TFR):** Total number of off springs born per female during her lifetime.
10. **Population dispersal or Migration:** Movement of individuals in or out of population is called **migration**. It may be in order to get food, space, shelter, job, to avoid predator.
11. **Age pyramids or Age distribution:** Graphical representation of various age groups in humans is known as age pyramid.
12. Three major age groups are **Pre-reproductive** (Juvenile or dependent phase), **Reproductive** (Adult phase). **Post reproductive** (Old age).
13. **Expanding population:** If number of pre-reproductive individuals is more than reproductive. Post reproductive individuals are lesser than these two, then in future the population size will increase. Shape of the pyramid is triangular shape.
14. **Stable population:** If number of individuals in pre-reproductive and reproductive group are almost same then in future population size will remain unchanged i.e., zero population. Shape of the pyramid is bell shape.
15. **Declining population:** When individuals of pre-reproductive group are lesser than reproductive and post reproductive group, then in future the population size will deplete. Shape of the pyramid is urn shape.
16. **Exponential Growth Model:** The population growth occurs in exponential or geometric fashion, when there is unlimited resource availability in the habitat.
17. The maximum reproductive potential of a population under unlimited environmental resources is known as **biotic potential**.
18. This growth curve is represented by following equation, $\frac{dN}{dt} = rN$.
19. The shape of curve is J as the growth rate is positive.
20. Integral form of exponential growth equation will be: $N_t = N_0 e^{rt}$
21. **Logistic Growth Model:** The resources availability becomes limiting at certain of time, so, no population can continue to grow exponentially.
22. In nature, in a given habitat there are enough resources to support a particular maximum number of individuals. This limit is called **carrying capacity K**.
23. The shape of the curve is **S shaped or Sigmoid**.
24. It is represented with the following equations. $\frac{dN}{dt} = rn \left(\frac{K - N}{K} \right)$
25. This type of population is called as **Verhulst pearl logistic growth**.
26. **Darwinian Fitness:** Populations evolve to maximise their reproductive fitness is known as Darwinian Fitness (higher value).

VII. Population Interactions

1. **Intraspecific interactions:** Interaction between individuals of same species.
2. **Interspecific interactions:** Interaction between individuals of different species.
The interactions may be positive (mutualism or symbiosis and commensalism) or negative (amensalism, competition, parasitism and predation).
3. **Predation:** A kind of direct food-relationship between two species of animals called predator attacks, kills and feeds on the smaller species, called prey.



4. **Biological control:** Control of weeds and pests is largely based on predator prey relationship.
e.g. Control of *Opuntia* (Prickly pear) which spread over millions of hectares of rangeland in Australia in the early 1920s. In Australia by using its natural herbivore cochineal insect-Cactoblastis (a cactus feeding predator).
5. **Defence mechanism of prey to lessen the impact of predation:** Some species of insects and frogs are cryptically coloured called camouflage to avoid being detected easily by the predator
6. Some are poisonous and therefore avoided by the predators. e.g. The Monarch butterfly is highly distasteful to its predator (bird) because of a special chemical present in its body. Insect butterfly acquires this chemical during its caterpillar stage by feeding on a poisonous weed.
7. For plants, herbivores are the predators, some insects are known to be phytophagous. Therefore plants have evolved an astonishing variety of morphological and chemical defences against herbivores. e.g. Thorns: In Acacia, Cactus these are the most common morphological means of defence.
8. **Competition:** A negative interaction in which two or more members of same species or two or more members of different species of same trophic level compete for common resource like light, moisture, nutrients is known as Competition.
9. **Evidences of competitions** In shallow South American lakes visiting flamingos and resident fishes compete for their food i.e zooplankton in the lake.
10. **Competitive release:** A weaker species expands its distribution at range dramatically when the competitive superior species is removed from that area is known as **Competitive release**.
eg:- It was shown that the larger and competitively superior barnacle *Balanus* causes extinction of smaller Barnacle *Chthamalus* from rocky sea coast of Scotland.
11. **Competition exclusion principle:-** when two closely related species with similar requirements occur in same environment, they use different food or become active at different periods or occupy, different niches to avoid competition otherwise, one of them will be eliminated is known as **Competition exclusion principle**.
12. **Gause hypothesis (or) Principle of competitive exclusion:** Two closely related species competing for the same resources cannot coexist indefinitely and the inferior one will be eliminated eventually is known as **Gause hypothesis**.
13. **Resource partitioning:** Two species compete for the same resources, they could avoid competition by choosing different times for feeding (or) different foraging activities, is known as **Resource partitioning**.
e.g. Mac Arthur showed that five closely related species of warblers living on the same tree were able to avoid competition and co-exist due to behavioural differences in their foraging activities.
14. **Parasitism:** The antagonistic interspecific interaction in which smaller partner derives food and shelter from the host called parasite is known as Parasitism.
15. **Endoparasites:** Endoparasites live inside the body of the host. eg: Taenia, Ascaris, Entamoeba present in the Intestine of man.
16. **Ectoparasites:** Ectoparasites live on the external surface of the host organism. e.g: Lice on humans, Ticks on dogs, Many marine fishes infested with ectoparasitic copepods.
17. **Brood Parasitism:** The parasitic birds lay eggs in the nests of host birds and let the host incubate them. The eggs of the parasitic birds resemble the host birds eggs in terms of size, colour and shape. eg: Laying eggs by koel (cuckoo) in crow's nest.
18. **Commensalism:** An interaction in which one species is benefited while the other is neither harmed nor benefited is known as **Commensalism**. It is a neutral interaction, e.g: **Orchid** growing as an epiphyte on Mango branch and Barnacles growing on the back of a whale get benefited while neither the Mango tree nor the whale do not have any benefit.
19. **Mutualism or Symbiosis:** A interaction in which both the species are benefited is known as **Mutualism or Symbiosis**. It is a positive interaction. eg: **Lichen** is a symbiotic relationship between Algae and Fungi.
20. **Pseudocopulation:** The Mediterranean orchid **Ophrys** employs sexual deceit to get pollination done by a species of bee, one petal of its flower resembles the female bee in size, colour and markings. The male bee is attracted by the flower, Pseudocopulates with the flower and in this process, pollination occurs.

