ORGANISMS AND POPULATIONS

Introduction:

- Our living world is fascinatingly diverse and amazingly complex. We can try to understand its complexity by investigating processes at various levels of biological organisation–macromolecules, cells, tissues, organs individual organisms, population, communities and ecosystems and biomes. At any level of biologica organisation we can ask two types of questions – for example, when we hear the bulbul singing early morning in the garden, we may ask – 'How does the bird sing? Or, 'Why does the bird sing?' The 'how-type' questions seek the mechanism behind the process while the 'why- type' questions seek the significance of the process. For the first question in our example, the answer might be in terms of the operation of the voice box and the vibrating bone in the bird, whereas for the second question the answer may lie in the bird's need to communicate with its mate during breeding season. When you observe nature around you with a scientific frame of mind you wil certainly come up with many interesting questions of both types - Why are night-blooming flowers generally white? How does the bee know which flower has nectar? Why does cactus have so many thorns? How does the chick recognise her own mother?, and so on.
- **Ecology :** It is study of relationships between organisms and their environment.
- The term ecology was first of all coined by **E. Haeckel**.
- According to **Haeckel** it is study of reciprocal relations between organisms and environment.
- **H. Reiter** authentically used the term ecology for first time.
- **Warming** employed it for the study of plants.
- **R Mishra**, a famous Indian ecologist **(father of Indian Ecology)** defined the ecology as "the study of interactions of forms" functions and factors.
- According to **Odum**, It is the study of structure and function of nature.
- In modern time, **Alexendor Von Humbolt** is considered as **"Father of Ecology".**

Levels of Organisation:

Organisms → Populations (species) → Communities → Ecosystem → Landscape → Biome → Biosphere

Fig : Ecological hierarchy

(i) Organism : An organism is a living unit in nature which performs all the life processes in its body.

(ii) Population : This is a group of individuals of a species growing in a given area at a particular time.

*** Species :** Species is formed by all the populations of same kind of organisms.

(iii) Community : Collectioin of populations of different species that live in a particular area is called community.

(iv) Ecosystem : It is the sum total of interacting biotic & abiotic factors that are capable of independent existence.

(v) Landscape : It involves different patches of different ecosystems in an area.

(vi) Biome : Biome represents large sized ecosystem delimited by specific climate having flora and fauna.

(vii) Biosphere : Any part of earth, where living beings live is called biosphere. The latter involves atmosphere, hydrosphere and lithosphere.

Branches of ecology :

Two main branches of ecology are as follow

(1) Autecology / species ecology : It is relationship of individual / population of individual plants species and environment.

(2) Synecology : Study of relations between communities and their environment.

Some other branches of ecology are as follow

Organisms and its environment:

Sum total of all biotic and abiotic factors, substances and conditions that surround and potentially influence organisms without becoming their constituent part.

❖ You may have learnt in earlier classes how the rotation of our planet around the Sun and the tilt of its axis cause annual variations in the intensity and duration of temperature, resulting in distinct seasons. These variations together with annual variation in precipitation (remember precipitation includes both rain and snow) account for the formation of major biomes such as desert, rain forest and tundra.

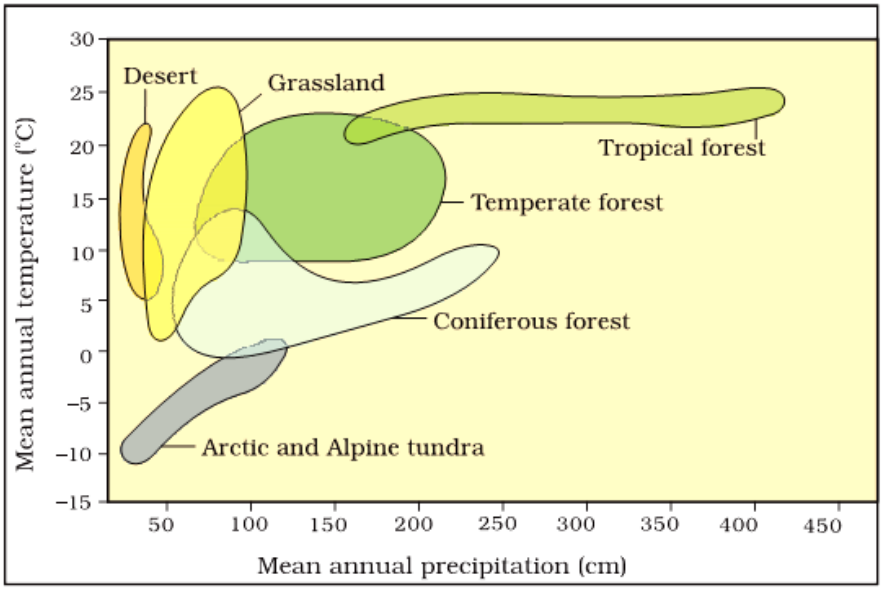


Figure - Biome distribution with respect to annual temperature and precipitation (AIIMS-2018)

Major biomes of India: 1. Tropical rain forest 2. Deciduous forest 3. Desert 4. Sea cost

❖ We assume that over a period of time, the organism had through natural selection, evolved adaptations to optimise its survival and reproduction in its habitat.

❖ Each organism has an invariably defined range of conditions that it can tolerate, diversity in the resources it utilises and a distinct functional role in the ecological system, all these together comprise its niche.

Environmenntal Factors:

They directly or indirectly affect the form and functioning of organisms in any specific way. They are two types.

(I) Abiotic Factors

(II) Biotic Factors

(I) Abiotic Factors: They are of four types.

(1) Climatic **(2) Edaphic** **(3) Topographic** **(4) Fire**

(1) Climatic Factors :

Light, temperature, humidity, air, precipitation, involve in this catagory.

(A) Light :

- Sunlight is the main natural source of light. About **1%** of light coming from the sun is utilized by plants.
- The visible range of electromagnetic spectrum is about 390 nm to 760nm. Out of them wavelength of **photosynthetically active radiation (PAR) is 400–700 nm** that is effective in photosynthesis in plants.
- **Solar constant :** Just before entering the mesosphere, the energy content of solar radiatons is **2 cal/ cm^2 /min.**
- Sunlight involves ultraviolet rays, light spectrum and infrared rays.
- Ultraviolet rays are of three types

S.No.	Type of UV rays	Wavelength of UV rays
1	UV-C	100 - 280 nm
2	UV-B	280 - 320 nm
3	UV-A	320 - 400 nm

UV-C is lethal while UV-B is quite harmful. UV-C and 50% of UV-B are absorbed by ozone layer.

- Light influences many activities like Photosynthesis, Growth, Pigmentation, Movements, Daily Rhythm in Animals, Photoperiodism.
- Since plants produce food through photosynthesis, a process which is only possible when sunlight is available as a source of energy, we can quickly understand the importance of light for living organisms, particularly autotrophs. Many species of small plants (herbs and shrubs) growing in forests are adapted to photosynthesise optimally under very low light conditions because they are constantly overshadowed by tall, canopied trees. Many plants are also dependent on sunlight to meet their photoperiodic requirement for flowering. For many animals too, light is important in that they use the diurnal and seasonal variations in light intensity and duration (photoperiod) as cues for timing their foraging, reproductive and migratory activities. The availability of light on land is closely linked with that of temperature since the sun is the source for both. But, deep (>500m) in the oceans, the environment is dark and its inhabitants are not aware of the existence of a celestial source of energy called Sun. What, then is their source of energy? The spectral quality of solar radiation is also important for life. The UV component of the spectrum is harmful to many organisms while not all the colour components of the visible spectrum are available for marine plants living at different depths of the ocean. Among the red, green and brown algae that inhabit the sea, which is likely to be found in the deepest waters? Why?

Resonate the Concept

Light Zones in Aquatic habitats (lake) :

(1) Littoral Zone : Shallow coastal region. Producers occur throughout from surface to bottom.

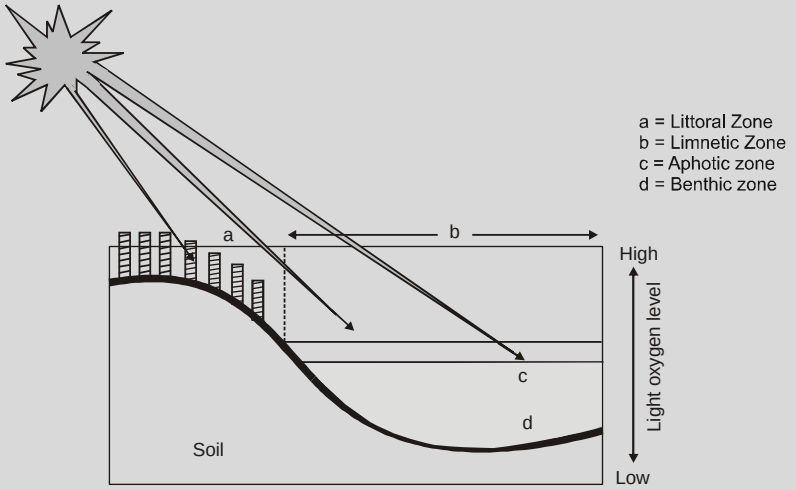


Fig: Zones in deep lake and ocean

(2) Limnetic Zone : Open water zone. Amount of oxygen and light decreases with depth. It involves two part

(i) Euphotic zone : Maximum light above light compensation point is receive by it.

(ii) Disphotic zone (Twilight zone) : It absorbs diffuse light below or at light compensation point.

(3) Aphotic zone (profundal zone) : It lies below the photic or limnetic zone. Light does not penetrate producers are absent only consumers are present.

(4) Benthic zone : Bottom of water body.

(B) Temperature :

- It is the most relevant environmental factor. It affects geographical distribution of many plants and animals, functioning of enzymes and other physiological functions of the organisms.
- You are aware that the average temperature on land varies seasonally, decreases progressively from the equator towards the poles and from plains to the mountain tops. It ranges from subzero levels in polar areas and high altitudes to >50°C in tropical deserts in summer. There are, however, unique habitats such as thermal springs and deep-sea hydrothermal vents where average temperatures exceed 100° C. It is general knowledge that mango trees do not and cannot grow in temperate countries like Canada and Germany, snow leopards are not found in Kerala forests and tuna fish are rarely caught beyond tropical latitudes in the ocean.
- **Temperature gradient over earth's surface is called lapse rate** that **is 6.4 – 6.5ºC per 1000m altitude**.
- On the basis of occurrence in different climatic zones, the plants are classified into four groups, according to their surrounding temperature.
  - **(i) Megatherms :** In this zone, plants grow in high temperature throughout the year. **e.g. Tropical rain forest**
  - **(ii) Mesotherms :** Growth of plants takes place in alternate high and low temperature **e.g. Tropical deciduous forest**.
  - **(iii) Microtherms :** Plants grow in low temperature **e.g. Temperate needle forest**.
  - **(iv) Hekistotherms :** Plants grow in very low temperature **e.g. alpine vegetation**.

- On the basis of ability of organisms to tolerate variations in surrounding temperature, organisms are of two types.
  - **(i) Stenothermal :** They live within narrow range of temperature throughout the year. **e.g. Polar Bear**, **lizards, amphibians, plants like Picea, Abies, coconut.**
  - **(ii) Eurythermal :** These organisms can tolerate a wide range of temperature variations, **e.g. Most mammals & birds**.

Effect of Temperature on animals :

- **(i) Allen's Rule :** Extremities like tail, ears, feet of animals of colder areas are shorter then animals of warmer areas.
- **(ii) Bergaman's Rule :** Birds and mammals of colder areas are larger in size as compared to their equivalents in warmer areas.
- **(iii) Jordon's Rule :** Cold water fishes have more vertebrae than fishes of warm water.
- **(iv) Rensche's rule :** Birds of colder areas have narrow and acuminate wings while those of warmer areas have broader wings.
- **(v) Gloger rule :** Homeothermal animals of tropical region or hot and humid area are more darker in colour than cold area.

Thermoperiodicity :

- Regular change in temperature at specific intervals of time is called thermoperiodicity it involves two types
  - **(a) Diurnal Thermoperiodicity :** Temperature is higher during the day and cooler during night. The response of organisms to change of temperature is called diurnal thermoperiodicity.
  - **(b) Seasonal Periodicity :** Organisms show different responses in different seasons of the year.That is called seasonal periodicity that favour different aspects of plants and animal life or **phenology**.

Resonate the Concept

Thermal stratification in lakes :

Usually three zones are found in water body.

- **(i) Epilimnion :** It is upper zone of water body it is warmer in summer and colder in winter.
- **(ii) Metalimnion :** It is found between epilimnion and hypolimnion as transitional zone. It shows maximum temperature fluctuations its middle part is called **thermocline.**

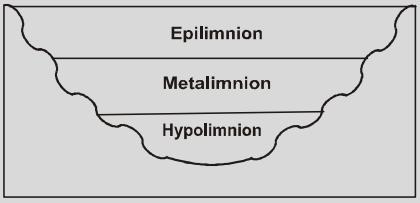


Fig :- Thermal Stratification in Lakes

- **(iii) Hypolimnion :** It is lower zone of water body temperature changes are usually less. Circulation of oxygen and nutrients twice a year, in spring and autumn in temperate lakes. These lakes are called **dimictic**. Abundant growth of phytoplanktons takes place during these periods due to warming of surface water during spring and cooling during autumn. Both summer and winter have little phytoplanktons.

(C) Water : Water is another the most important factor influencing the life of organisms. In fact, life on earth originated in water and is unsustainable without water. Its availability is so limited in deserts that only special adaptations make it possible for organisms to live there. The productivity and distribution of plants is also heavily dependent on water. You might think that organisms living in oceans, lakes and rivers should not face any water-related problems, but it is not true. For aquatic organisms the quality (chemical composition, pH) of water becomes important. The salt concentration (measured as salinity in parts per thousand), is less than 5 in inland waters, 30-35 in the sea and > 100 in some hypersaline lagoons. Some organisms are tolerant of a wide range of salinities (euryhaline) but others are restricted to a narrow range (stenohaline). Many freshwater animals cannot live for long in sea water and vice versa because of the osmotic problems, they would face.

❖ **Many freshwater animals cannot live for long in sea water and vice versa because of the osmotic problems, they would face.**

(2) Edaphic Factor or soil:

❖ It is upper weathered humus containing part of earth's surface which involve both living or non living materials

❖ The study of the soil is called **pedology or edaphology**.

Formation of Soil:

It involves two processes

(a) Weathering **(b) Pedogensis**

(a) Weathering :

❖ It is breaking of rocks into fine powder by environmental changes.

❖ Weathering is of three types

(i) Physical weathering : It is due to mechanical forces – temperature, gravity, water.

(ii) Chemical weathering : It occurs due to chemical changes – hydration, hydrolysis, oxidation, reduction etc.

(iii) Biological weathering : It occurs by activity of living organisms– lichens, bacteria, fungi.

(b) Pedogensis :

The weathered mineral matter is converted to soil by a process that is called pedogensis.

❖ **Residual soils :** Develop in situ.

❖ Transported soils : That are transported by various agencies such as by running water (alluvial), wind (eolian = aeolian), gravity (colluvial), Glacier (Glacial soil).

Soil profile :

❖ Vertical section of the soil in which various layers or horizons are visible.

❖ Soil horizons are of following types

(i) O-Horizon : Surface layer of organic matter that lies above the true soil. It bears two subhorizons.

(a) A_{00} or O_1 : Upper subhorizon having freshly deposited fallen leaves, twigs, bark, animal remains and animal excretions.

(b) A_0 or O_2 : It lies below the A_{00} containing organic matter in various stages of decomposition.

(ii) A-Horizon :

❖ It is also called **topsoil**. It is the uppermost horizon of the soil that is rich in humus, mineral matter and microorganisms.

- It is light weight, spongy and dark in colour.
- Roots of most of the plants are restricted in this horizon.
- It is sub divided into three zones namely **A_1, A_2, A_3**.
- A_1 zone is dark coloured and has fully decomposed organic matter (humus) and minerals.
- A_2 zone is also the area of maximum leaching or **eluviation** or podsol region. It is light coloured zone.

(iii) B-Horizon :

- It receives different types of materials from top soil. Thus it is considered as area of deposition of materials or **illuviation**.
- It is also called **subsoil**.
- The two horizons A and B together constitute the **solum**.

(iv) C-horizon : It has irregular rock fragments. Biological activity is nil.

(v) 'R' Horizon : It consists of unweathered parent rock material (bed rocks)

- **Eluviation and illuviation :** They help in transport and deposition of materials in the soil. Washing down of materials from upper strata is called **Eluviation**. Deposition of minerals in lower strata is called **illuviation**.

Soil Composition :

It consists of following components

(a) Mineral matter – 40%
(b) Organic matter – 10%
(c) Soil water – 25%
(d) Soil air – 25%

(a) Mineral matter or inorganic matter :

- They are derived by the weathering of the rocks. there are following types of mineral particles.

S. No.	Name of particle / soil type	Size of Soil particle
1	Gravel	2–5 mm
2	Coarse Sand	0.2–2.0
3	Fine Sand	0.02–0.2
4	Silt	0.002–0.02
5	Clay	Less than 0.002

- The relative proportion of soil particles determines the soil texture.
- **Sandy soil :** Sandy soil is porous, loose, good aeration but poor water holding capacity, **inorganic nutrients It contains 80% sand ,10% clay,10% silt.**
- **Clay soil :** Compact, chemically fertile, poor aeration, good water holding capacity. It contains **40% clay, remaining silt with little sand.**
- **Loam soil :** It is ideal for plant growth having good aeration ,good water holding capacity. Soils bear **40% sand, 40% silt and 20% clay.**

(b) Organic matter :

It is derived from plant debris (fallen leaves, fruits, flowers, twigs etc,), dead bodies of animal and their excreta. It lies in three forms.

(i) Litter : Undecomposed organic matter/ plant debris is called litter.
(ii) Duff : Partially decomposed litter is called duff.

(iii) Humus : Partially decomposed organic matter is called humus, that is amorphous, dark coloured and rich in nutrients. Process of formation of humus is called **humification**. Humus is of two types.

(1) Mor humus **(2) Mull humus**

(c) Soil water :

The main source of soil water is rainfall.

Types of soil water :

(i) Run-off or run away water : A part of rain or irrigation water flows over the soil as run-away water.

(ii) Gravitational water : The water that goes down due to gravity and accumulates to form ground water is called gravitational water. It is available to the plant for absorption.

(iii) Capillary water : It is found between the spaces of the soil particles forming a system of capillaries. It is called capillary water. It is available to the plant for absorption.

(iv) Hygroscopic water : This type of water lies around the soil particles as thin film.

(v) Chemical water or combined water : It is chemically combined with minerals and is present in soil particles.

- **Only Capillary water is readily available to the plants.**
- **Field capacity :** It is the amount of water retained by the soil after the removal of gravitational water.
  Field capacity = Capillary water + hygroscopic water + combined water.
- **Water potential** at field capacity of common soil is **– 0.01 MPa (= – 0.1 bar)**.
- **Permanent wilting percentage (PWP) or cofficient (PWC) -** It involves percentage of water per unit of dry soil when the plants growing in it undergo permanent wilting.
- The **water potential** at permanent wilting is **– 1.5 MPa (= – 15 bars)**.

(d) Soil Air :

- In a good soil 25% of total volume of the soil is filled with air. It is essential for respiration of root. Poor soil aeration supresses root hair development and may reduce the rate of absorption of water and minerals.

Test your Resonance with concept

1. The term ecology was proposed by
(1) Haeckel (2) Odum (3) Daubenmire (4) Reiter

2. What ecological factors are most strong determinants of various biomes?
(1) Soil and wind (2) Light and wind
(3) Temperature and precipitation (4) pH and humidity

3. Which soil is best for plant growth?
(1) Clay soil (2) Loamy soil (3) Sandy soil (4) Gravel

4. Edaphology is connected with
(1) Plant and biosphere (2) Soil and living microorganisms
(3) Animals and ecosystem (4) Soil and biosphere

5. Biosphere is made of
(1) Living beings and their remains
(2) Living beings + Lithosphere + hydrosphere + atmosphere
(3) Living beings + Lithosphere
(4) Living organisms + Lithosphere + Hydrosphere

Answers

1. (4) **2.** (3) **3.** (2) **4.** (2) **5.** (2)

- Responses to Abiotic Factors: For NEET

- Different environmental Conditions prevail at different period of time. All the factors are integrated.
- The maintenance of constant internal environment by an organism in its body despite drastic changes in external conditions is called **homeostasis**. Biochemical reactions and physiological functions proceed maximal efficiency in the presence of internal environment that increase the overall fitness of the species.
- Living organisms use some methods to tolerate stressful conditions.

(i) Regulaters : Several organisms are able to maintain homeostasis by thermoregulation and osmoregulation despite changes in the external environment **e.g. Mammals, birds, few lower vertebrates and invertebrates.** These are called regulators. Evolutionary biologists believe that success of mammals is due to maintenance of homeostasis.

(ii) Conformers : These organisms are unable to maintain constant internal body environment. **e.g. 99% animals and plants**. These animals and plants can not maintain constant body temperature & osmotic concentration in ambient conditions. these are called **conformers**. The efficiency of latter is reduced understressful conditons.

Thermoregulation is energetically expensive for many organisms. This is particularly true for small animals like shrews and humming birds. Heat loss or heat gain is a function of surface area. Since small animals have a larger surface area relative to their volume, they tend to lose body heat very fast when it is cold outside; then they have to expend much energy to generate body heat through metabolism. This is the main reason why very small animals are rarely found in polar regions. During the course of evolution, the costs and benefits of maintaining a constant internal environment are taken into consideration.

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 : Some organisms have the ability to regulate body functions to a limited extent beyond which they become conform. These organisms are called **partial regulators**. **e.g. Cray fishes**.

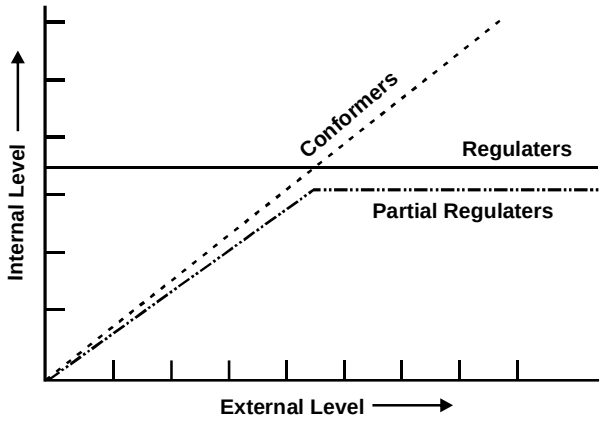


Fig:- Diagrammatic representation of ways or organismic response.

(iv) Migrate : Temporary movement of organisms from the unfavourable habitat to more favourable area for obtaining food, climate, shelter, breeding and comeback during favourable conditions. For **e.g. Migration of siberian crans from siberia to the keoladeo Ghana national park Bharatpur (Raj.) in winter.**

(v) Suspend : Unfavourable conditions of environment are passed by organisms through the changes in their behaviour.

e.g. (1) polar bears undergo **hibernation** during winter to escape extreme cold.

Diapause : A stage of suspended development under unfavourable conditions **e.g. Many Zooplanktons**

Ecological Adaptations:

- Adaptation is any quality of the organism that enables the organisms to survive and reproduce in its habitat.
- **Phenotypic adaptations :** These are favourable changes in morphology and physiology which develop in response to changes in environmental conditions.
- **Phenotypic plasticity :** It is the ability of a genetically similar populations to undergo phenotypic changes in response to variations in environment.
- **Ecotypes :** Genotypically adopted local population is called Ecotype. The intermediate form between two ecotype is called **ecocline**.
- **Ecophene or ecads :** Genetically similar varied local populations that differ in morpho:physiological traits to suit particular environment.

(I) Plant Adaptations :

- The ecological factors affect the vegetation of particular area. Plants develops various types of adaptation to protect itself from these factors.

- **Warming & schimper** classified plants into following groups on the basis of availability of water.

(1) Hydrophyte (2) Xerophyte (3) Halophyte (4) Mesophyte

(1) Hydrophyte :

They are of following types

(i) Submerged hydrophytes : They are of two types.

(a) Submerged suspended hydrophytes: They fully live inside the water. **e.g. Najas, Ceratophyllum, Utricularia.**

(b) Submerged rooted hydrophytes : They are fixed in the bottom of water bodies **e.g. Hydrilla, Vallisnaria, Potamogeton.**

(ii) Floating hydrophytes : They are of two types

(a) Free floating hydrophytes : They swim freely on the surface of water **e.g. Wolffia, Lemna, Eicchornia, Pistia, Spirodella.**

(b) Fixed floating hydrophytes : They are fixed by roots in the bottom of water body **e.g. water chestnut or Trapa, Nymphea, Nelambo nucifera (Lotus)**

(iii) Emergent hydrophytes or Amphibian hydrophytes : They live in shallow water. They show the heterophylly. Some parts like roots, rhizome are submerged and a part of shoot is aerial **e.g. Ranunculus, Limnophylla, Sagittaria.** In some hydrophytes entire stem is aerial **e.g. scirpus, Typha, Eleochorus**.

Adaptations of Hydrophytes:

(a) Morphological adaptations :

(i) Roots are absent in some hydrophytes **e.g. Wolffia, Utricularia**

(ii) In some hydrophytes roots lack root hairs and root cap **e.g. Lemna, pistia**.

(iii) In some hydrophytes, roots cap is replaced by **root pocket e.g. Pistia, Eicchorinia.** It maintains balance of plant in water.

(iv) In some plants roots contain chlorophyll that perform photosynthesis. These are called **Assimilatory roots.**

(v) Stem is weak, delicate, hollow, green or yellow.

(vi) Leaves are dissected or ribbon shaped **e.g. Vallisnaria,** In some plants wax deposits on the the upper surface of leaves for protecting the leaves from physical, chemical and biological injury.

(vii) Long & spongy petiole occurs in some plants **e.g. Pistia, Eicchornia.**

(b) Anatomical Adaptations :

(1) Deficiency of Protective tissues :

(i) Epidermis contains chlorophyll thus it performs photosynthesis along with absorption.

(ii) Thick cuticle is absent on the epidermis.

(iii) Stomata are either absent or nonfunctional.

(iv) Hypodermis is thin or absent.

(v) Root hairs on root and stem hairs on stem are absent.

(2) Abundance of aerenchyma :

In stem and root cortex, large air spaces are bounded by thin walled parenchymatous cells that are called aerenchyma. The latter provide buoyancy to the plant.

(3) Deficiency of mechanical tissues :

(i) Sclerenchyma and collenchyma are absent.

(ii) Secondory growth is absent.

(iii) In leaf mesophyll does not differentiate into palisade tissue and spongy parenchyma.

(4) Deficiency of vascular tissue : Xylem and phloem are less develop.

(c) Physiological adaptations :

(i) Osmotic pressure is either low or equal to the water of water body.

(ii) Reproduction takes place through vegetative propagation.

(2) Xerophytes:

- These plants are found in dry habitats. These plants have specific type of adaptation for absorption of higher amount of water and to avoid the loss of water.
- On the basis of habitat, xerophytes are of following types.
  - **(a) Oxylophytes :** That grow in acidic soil.
  - **(b) Lithophytes :** They grow on rocks.
  - **(c) Psammophytes :** They grow on sand.
  - **(d) Cryophytes :** They grow on ice or poles.
  - **(e) Halophytes :** These plants grow in saline soil.
- On the basis of tolerance of dryness, Xerophytes are of following types.
  - **(A) Ephemeral plants or Drought escaping plants:** They complete their life cycle during rainy season and in the resting time they live as seeds. **e.g. Cassia tora, Argemone mexicana, Achyranthus, Indigophora, Tribulus**.
  - **(B) Annuals or Drought Evaders:** The plants live for months evenafter stopase of rains. They have some modification to reduce transpiration. **e.g. Echinops echinatus, Solanum surattense**.
  - **(C) Succulents or Drought Resistants:** They bear succulent organs due to storage of water and mucilage. Fleshy stems **(chylocauly) e.g. Opuntia, Asparagus,** Fleshy roots **(chylorhizy) e.g. Asparagus,** fleshy leaves **e.g. Aloe, Agave.**

They bear some **adaptations**

(i) In **opuntia**, stems are green and photosynthetic, that are called **phylloclades.**

(ii) Thick cuticle.

(iii) Sunken Stomata that open during night only.

(iv) They show crassulacean acid metabolism **(CAM).**

Resonate the Concept

(1) The plants that have succulent leaves are called **malacophilous plants e.g. Aloe, Bryophyllum.**

(2) Member of **family Cactaceae and Crassulaceae** are succulent.

(D) Non-Succulents or Drought Endurers: They actually tolerate drought conditions hence they are **true xerophytes**.

They bear some **adaptations.**

(i) Roots system is very extensive. In some xerophytes, the roots are very deep and reach the water table. these are called **phreatophytes. e.g. Tamarix, prosopis**.

(ii) In some plants Lamina fall down in early stage, while petiole enlarges green and perform photosynthesis it is called **phyllode e.g. Australian Acacia.**

(iii) Chaperonins are **heat shock proteins** that provide protection to the **other proteins from denaturisation at high temperature.**

(iv) Osmotic potential and water potential is maintained by **proline**.

Resonate the Concept

A green alga **Dunaliella** found in hypersaline lakes, have a lot of glycerol in its cells for **osmoregulation**.

(2) Halophytes :

- These plants are found in saline habitats like saline soils, mangroves, coastal dunes and tidal marshes.
- They bear following adaptations.
  - **(i) Osmotic pressure is quite high (40 bars).**
  - **(ii)** They have succulence in both leaves and stems for the storage of water and mucilage.
  - **(iii)** Many halophytes secrete lime or salts by chalk or salt glands **e.g. Atriplex**.
  - **(iv)** Stomata of leaves are scotoactive.

Mangrove plants: These are found in saline marshy areas of sea-shores and near estuaries. Marshy places are physiologically dry due to the presence of salts. They show some specific adaptations.

(i) Pneumatophores : These are **negative geotropic roots** found in marshy places where oxygen is not available for the respiration of roots. These roots have **lenticels** for gaseous exchange **e.g. Rhizophora, Avicennia, Sonneratia.**

(ii) Vivipary : Seed germination start while attached to plants. **e.g. Rhizophora, Aegiceras, Ceriops, Salicornia, Avicennia, Sonneratia**.

Resonate the Concept

Plant Adaptations to Light Regime – Sun and Shade plants:

Differences between Heliophytes & Sciophytes		
S.No.	**Heliophytes (Sun plants)**	**Sciophytes (Shade plants)**
1	They grow in bright light	They grow in low intensity of light
2	Stems bear shorter and thicker internodes	stems bear large internodes
3	Leaves are smaller, thicker & pale green in colour	Leaves are larger, thinner & bright green in colour
4	Palisade tissue is more developed & spongy parenchyma is weakly developed	Palisade tissue is less developed & spongy parenchyma is well developed
5	Mechanical tissues are well developed	they are moderately developed
6	There is abundant flowering and fruiting.	Vegetative growth is more while flowering and fruiting are less.
7	Stomata are generally sunken and found on lower surface.	Stomata are present in level with surface and found on both the surfaces.

(II) Animal adaptations : Animals possess several adaptations.

(i) Migration :

- Two way movement of animals for food, climate, breeding and other reasons. It involve three types.
  (a) Daily : e.g. Sparrow.
  (b) Seasonal : e.g. Arctic fern, Golden plover.
  (c) Periodic : e.g. locusts.

(ii) Camouflage (Cryptic Appearance) :

- It is the ability of animals to blend with the background.
- It allows the animals to remain unnoticed from a distance for protection or aggression. **e.g. Praying mantis (Mantis religiosa) , Stick Insect (Carausius marosus) , leaf Insect (Arantia rectifolia).**

(iii) Mimicry :

- It is resemblance of one species of animals with other species.
- The species that is imitated is called **model** whereas the animal that imitates is called **mimic or mimictic**.
- Mimicry is of two types
  (1) Batesian Mimicry **(2) Mullerian Mimicry**

(iv) Adaptations to excessive cold (Cold hardening) :

- Cold hardiness is gained by developing extra solutes in the body fluids and special ice nucleating proteins in the extracellular spaces.
- **Glycerol and antifreeze proteins** prevent freezing by lowering the freezing point of body fluids. **e.g. Ice Fish or Antarctic Fish** remains active even in extremely cold sea water due to this hardiness.

(v) Echolocation : Bats produce high frequency sound that generates echoes after striking various objects on the principle of sonar. Echoes help to know path.

(vi) Adaptation of water Scarcity:

- Animals of arid or desert areas have two types of adaptations – (a) ability to tolerate dry conditions (b) Reducing water loss. **For Example Kangaroo rat / Desert Rat seldom drinks water.** Its 90% water requirement is completed by metabolic water & 10% is got from food. Camel also shows some adaptations.

(vii)Phenotypic adaptations :

- In many wild organisms, some phenotypic adaptations develop to respond unfavourable condition for example we feel **altitude sickness** at high altitude (– > 3500 m). Its symptoms include **nausea, fatigue and heart palpitations** due to low atmospheric pressure of high altitude. The body compensates low oxygen availability by incereasing red blood cell production, decreasing the binding capacity of haemoglobin and by increasing breathing rate.

(viii) Hibernation and Aestivation:

- **Ectothermal (cold blooded) animals like frogs** shows **hibernation (winter sleep) and aestivation (summer sleep)** for the maintenance of body temperature.
- Some organisms show behavioural responses to cope with variations in their environment. Desert lizards lack the physiological ability that mammals have to deal with the high temperatures of their habitat, but manage to keep their body temperature fairly constant by behavioural means. They bask in the sun and absorb heat when their body temperature drops below the comfort zone, but move into shade when the ambient temperature starts increasing. Some species are capable of burrowing into the soil to hide and escape from the above-ground heat.

Test your Resonance with concept

1. Oxalophytes grow on
(1) Dry soil (2) Alkaline coil (3) Acidic soil (4) Wet soil

2. In aquatic animals, the osmotic concentration of the body fluids change with that of ambient water osmotic concentration. These animals & plants are called
(1) Regulaters (2) Conformers (3) Partial regulaters (4) None of the above

3. **Assertion :** Mimicry is a device adopted to protect the organism from its enemies
Reason : Independent food chain is not found in nature.
(1) (2) (3) (4)

4. **Assertion :** Water logged soils are physiologically dry.
Reason : When the soil is logged with water there is no space for oxygen in the soil atmosphere.
(1) (2) (3) (4)

Answers

1. (3) **2.** (2) **3.** (1) **4.** (1)

For AIIMS & NEET

Populations:

- Total number of interbreeding individuals of a species found in a particular area is called population.
- The Scientific study of human population is called **Demography**.

Population Characteristics:

(i) Population Density : Number of individuals of a species present in per unit area/space at given time is called population density (D). **e.g. 200 Parthenium plants in an area. Single huge banyan tree with a large canopy.** In such cases, the percent cover or biomass is a more meaningful measure of the population size.

Population density (D) = $\frac{N}{S}$ N = Number of individuals

S = Space

(ii) Age Pyramids : It is graphic representation of different age groups in a population. Three types of age pyramids have been recognized – Triangular, Bell shaped, Urn shaped age pyramids.

(a) Triangular age pyramid : In this type of age pyramids, population is growing in which the number of pre-reproductive individuals is very large as compared to the reproductive individuals and post-reproductive individuals.

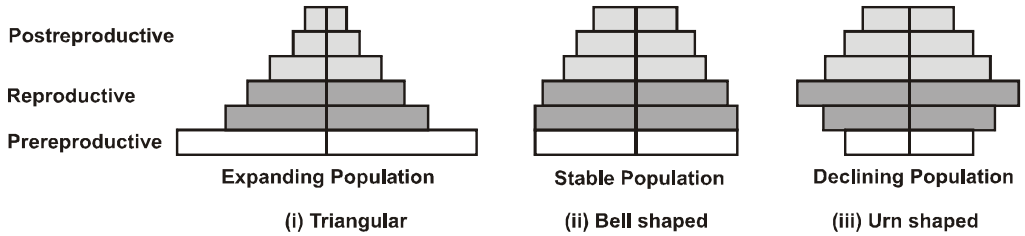


Fig: Human population – Representation of age pyramids

(b) Bell shaped age pyramid : Pre-reproductive and reproductive individuals are almost equal in number and the individuals of post-reproductive age are fewer. Thus population is stable.

(c) Urn shaped age pyramids : Population of Reproductive age group is more than prereproductive age group. Number of postreproductive individuals is also sizeable. Thus population shows negative growth.

(iii) Population growth : It depends upon various factors.

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

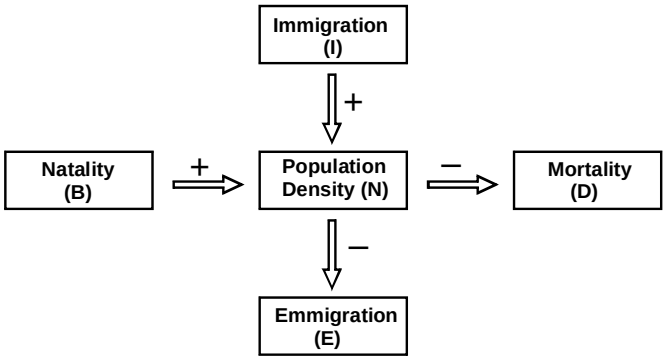
(b) Mortality : Number of deaths in the population during a given period is called mortality.

(c) Immigration : It is permanent inward movement of some individuals into a local population.

(d) Emigration : It is permanent outgoing of some individuals from a local population during the time period. Therefore, if Nt is the population density at time t, then its density at time t + 1 is.

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

B = Number of Birth
I = Number of immigrants
D = Number of deaths
E = Number of emigrants



(iv) Growth Models : Population shows growth in specific pattern with time. It is of two types

(1) Exponential growth :

- When the resources are unlimited, the population shows exponential or geometric growth.
- **r is intrinsic rate of natural increase** that is important parameter selected for assessing impacts of any biotic or abiotic factor on population growth.
- If N = size of population, b = per capita birth rates, d = per capita death rates then any increase or decrease in a population N during time t (dN/dt) will be.

  dN / dt = (b – d) × N

  If (b – d) = r then dN/dt = rN

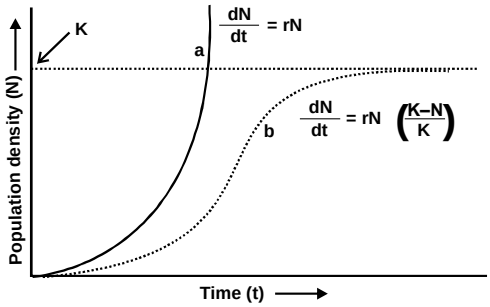


Fig: Population growth curve.

- **dN/dt = rN** represents **geometric or exponential growth** pattern of a population that can be described as **J-shaped curve**. Population is suddenly declined due to deficiency of resources or environmental resistance.
- The above equation describes the exponential or geometric growth pattern of a population and results in a J-shaped curve when we plot N in relation to time. If you are familiar with basic calculus, you can derive the integral form of the exponential growth equation as

  $N_t = N_0 e^{rt}$

  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)

(2) Logistic growth:

- In nature, habitat has certain limit of resources to support a certain number of individuals of a population, beyond which growth is not possible. This limit is called **carrying capacity (K).**
- In the presence of limited resources, growing population undergoes initially a lag phase followed by phases of increase and decrease and finally the population density reaches the carrying capacity. It is called **Verhulst-pearl logistic growth** that can be described as.

$$dN/dt = r \quad N \quad \left(\frac{K-N}{K}\right)$$

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

❖ It is also called **S or sigmoid growth form (AIPMT 2015)**. Thus logistic growth model is more realistic.

Resonate the Concept

- **Environmental resistance :** It is the sum total of environmental factors that limits the population size.

Life History Variation

Populations evolve to maximise their reproductive fitness, also called Darwinian fitness (high r value), in the habitat in which they live. Under a particular set of selection pressures, organisms evolve towards the most efficient reproductive strategy. Some organisms breed only once in their lifetime (Pacific salmon fish, bamboo) while others breed many times during their lifetime (most birds and mammals). Some produce a large number of small-sized offspring (Oysters, pelagic fishes) while others produce a small number of large-sized offspring (birds, mammals). So, which is desirable for maximising fitness? Ecologists suggest that life history traits of organisms have evolved in relation to the constraints imposed by the abiotic and biotic components of the habitat in which they live. Evolution of life history traits in different species is currently an important area of research being conducted by ecologists.

Population Interactions : Interspecific interactions are quite common between two different species in a habitat. According to modern biologists, they are involved in symbiosis. These interactions may be beneficial, harmful or neutral for one of the species or both.

(a) Positive interactions (+,+ or +, 0) : One or both partner are benefitted**.**

(i) Commensalism (+,0) :

❖ In this type of interaction of two living individuals of different species, one is benefitted while the other is neither harmed nor benefitted.

e.g. (1) Pilot fish & Sucker fish with shark.
(2) Epiphytes like orchids on the trees like mango.
(3) E.coli in human intestine.
(4) Lianas in the tropical rain forest.
(5) Barnacles developing on the back of whale.
(6) Cattle egret birds and grazing cattles.
(7) Clown fish & sea anemone.

(ii) Mutualism (+, +) :

❖ In this types of interaction of two living individuals of different species in which both are mutually benefitted and it is essential for their survival on earth (Obligatory mutualism).

e.g. (1) Mycorrhiza– between fungus (e.g. Boletus) and a root (e.g. Pinus)
(2) mutualistic nitrogen fixation– between legume plant and Rhizobium bacteria.
(3) Lichen.
(4) Relationship of Fig and wasp
(5) Relationship of ophrys orchid and Bumble bee

The Mediterranean orchid *Ophrys* employs 'sexual deceit' to get pollination done by a species of bee. One petal of its flower bears an uncanny resemblance to the female of the bee in size, colour and markings. The male bee is attracted to what it perceives as a female, 'pseudocopulates' with the flower, and during that process is dusted with pollen from the flower. When this same bee 'pseudocopulates' with another flower, it transfers pollen to it and thus, pollinates the flower. Here you can see how co-evolution operates.

(iii) Protocooperation or facultative mutualism (+,+) :

❖ Both living organisms of different species are mutually benefitted but they can independently survive without each other. It is nonobligatory relation.

e.g. (1) Red-blilled Ox pecker and Black rhinoceros
(2) Crocodile bird and crocodile.

(b) Negative interactions or antagonism (–,– or –, 0, or +,–) : One partner is harmed.

❖ It is of two types

(A) Exploitation **(B) Amensalism**

(A) Exploitation :

❖ For obtaining food or shelter or support directly or indirectly, Individual of one species is harmful for the individual of other species. It involves following types.

(i) Predation (+,–) :

❖ In this type of interaction, individual of one species captures, kills and eats up individual of other species (Predator destroys the prey).

e.g. (1) Carnivorous animals (lion, tiger, wolf, snake) eat up other animals.
(2) Insectivorous plants like, Nepenthes, Utricularia, Dionea, Drosera.

A sparrow may eat seeds of plants (as herbivores) or insects (as - predator or consumer) - Thus we can say sparrow may bear two different trophic levels - AIPMT main 2011

Resonate the Concept

(1) **Opuntia** turned out to be serious weed in Australia. It was brought under control when its natural herbivore predator moth – Cochineal insect **(Cactoblastis cactorum)** was introduced.

(2) Some species of insects and frogs are **cryptically coloured (camouflage)** to avoid being detected easily by the predator. Some are poisonous and, therefore, avoided by the predators. **e.g. Monarch butterfly is unpalatable to its predator birds.**

(3) Predators also help to maintain species diversity in a community by reducing the intensity of competition among competing prey species. **e.g.** Removal of **starfish pisaster** in american pacific coast ina field experiment were removed more than 10 species of invertebrates within a year.

(4) Calotropis **: It contains toxic cardiac glycosides - that is why you never see any cattle or goat - browsing on this plant.**

(5) Predator acts as 'Conduit' between two successive trophic levels for transferring energy.

(ii) Parasitism (+,–) :

❖ In this types of interaction, one organism of a species called **parasite** obtains its food directly from living organism of other species called **host**. The host is always larger than the parasite.

Types of Parasite :

❖ On the basis of parasites position on the host, the parasites are classified into two categories.

(a) Ectoparasite : They live on the surface of host **e.g. Lice, Bedbug, mosquito, Leech,**

(b) Endoparasite : They live inside the host **e.g. Plasmodium, Entamoeba, Tapeworm, Roundoworm**

On the basis of duration of attachment over host, parasites have been classified into two categories.

(i) Permanent parasites : They are attached with host through out the life **e.g. Ascaris, Entamoeba, lice**

(ii) Temporary Parasites : They are attached with host for some time or attached during feeding time only **e.g. Leech, mosquito, Bedbug.**

Other form of parasites are as follow

(1) Holoparasites and Hemiparasites: Holoparasites are those parasites which are completely dependent on the host for all their requirements, **e.g. Cuscuta, (Total stem parasite), Rafflesia (total root parasite)**.

Hemiparasites are partially dependent on the host. **e.g. Viscum & Loranthus (both are partial stem parasite), santalum (Partial root parasite)**.

(2) Hyperparasite : This type of parasite lives on another parasite, **e.g. bacteriophages, Cicinnobolus cesatii on powdery mildew.**

(3) Brood parasitism : Parasitic bird lays its eggs in the nest of its host or other animal **e.g. Cuckoo lays its eggs in the nest of crow**.

(iii) Competition (–,–) :

- It is found between two or more organisms for obtaining the same resources.
- Competition is of two types–
  (1) Intraspecific : It takes place between individuals of same species.
  (2) Interspecific : It takes place between individuals of different species.
- When Darwin spoke of the struggle for existence and survival of the fittest in nature, he was convinced that interspecific competition is a potent force in organic evolution.
- In interference competition, the feeding efficiency of one species might be reduced due to the interfering and inhibitory presence of the other species.
- **Competitive release :** A species whose distribution is restricted to a small geographical area because of the presence of a competitively superior species it is considered as Competitive release. Connell's elegant field experiments showed that on the rocky sea coasts of Scotland, the larger and competitively superior barnacle Balanus dominates the intertidal area, and excludes the smaller barnacle Chathamalus from that zone.
- **Gause's competitive exclusion principle:** According to this hypothesis, no two organisms of two closely related species can have the same niche. One of the two is eliminated. Gause found that out of two species of **Paramecium** grown together one is eliminated.
- Strong and persuasive circumstantial evidence does exist however in some cases. The **Abingdon tortoise** in Galapagos Islands became extinct within a decade after **goats** were introduced on the island, apparently due to the greater browsing efficiency of the goats.
- **Some times competing species may coexist due to different specilizations like difference in feeding time. It is called resource partitioning e.g. 14 species of finches to coexist in Galapagos islands due to development of different feeding habits. Similarly, five species of Warblers birds coexist same tree by changing the time of feeding. It is called resource partitioning.**

(B) Amensalism (0,–):

- In this type of interaction an organism of a species does not allow the organism of other species to grow or live near it for this purpose the former secretes some chemicals called **allochemics**.

e.g. (1) Smoother crops likes barley, sorghum and sunflower do not allow the weeds to grow nearby.
(2) Black Walnut (Juglans nigra) secretes juglone that inhibits the growth of apple, tomato.
(3) Marigold (Tagetes) secretes chemicals toxic to soil nematodes.
(4) Penicillium does not allow the growth of Staphylococcus bacterium.

Resonate the Concept

- **Allelopathy :** The process of preventing growth of other organisms through secretion of toxic chemicals is called **allelopathy**. **e.g. Transcinnamic acid** is secreted by **Parthenium** that prevents the growth of other plants like Cassia tora and Vinca rogia.
- **Scavenger :** One individual feeding on flesh of an animal which has died naturally or has been killed by another animal. The former is called **scavenger e.g. Vultures, Crow, ants, jackals, hyenas.**

Biotic Community:

- It represents group of interacting populations of different species live in a particular area.
- It involves plant community, animal community, microbe community.

Characteristics of a community:

(i) Keystone Species: A species which make up only a small proportion of total biomass of a community yet has a huge impact on the community's organisation and survival. **e.g. In tropical rain forests, figs** acts as **keystone species** because it provides fruits to a number of animals like monkeys, birds, during the periods of food scar.

(ii) Critical link species : These species are helpful in supporting network species by functioning as dispersal agents, pollinators, absorption or circulation of nutrients, **e.g. Mycorrhiza, bees**.

(iii) Ecotones and Edge Effect : Ecotone is transition area between two communities. It is rich in species diversity. The increased number of species in the area of ecotone border is called **edge effect** and the species that spend most ot their time in ecotone boundary are called **edge species**.

Resonate the Concept

(1) Ecological Equivalents : Organisms that occupy the same ecological niche in different geographical areas are called Ecological equivalents.

(2) Biotope : A clearly demarcated unit of environment showing uniformity of principal habitat conditions is known as biotope.

(3) Antibiosis : An association of two organisms which is harmful to one of them.

(4) Probiosis : Opposite of antibiosis, as stimulating growth of useful intestinal flora.

(5) Eremophytes : Desert plants, found in deserts and steppes.

(6) Psychrophytes : Plants growing in cold soils.

(7) Chasmophytes : (Chasmaphils). Plants growing in rock crevices.

(8) Chersophytes : Plants growing in shallow soils or waste land.

(9) Hexicology : Term used by **Mivart (1894)** for ecology.

(10) Bioecology : This term used by shelford and Clements for study of both plant and animal ecology.

(11) Terms **autoecology and synecology** coined by **schroeter and kirchner (1896)**.

(12) According to **Malthus** in his book **'Essay on the principle of population'**. Population tends to increase in geometric manner while food supply increase in arithmetic manner.

Test your Resonance with concept

1. Which of the following pair is incorrect –
(1) Clown fish & sea anemone – Mutualism
(2) Abingdon tortoise & Goat – Competition
(3) Orchid ophrys & species of bees – Co-evolution
(4) Opuntia – Cochineal insect

2. In an open population, intrinsic rate of natural increase (r) is equal to–
(N = Natality, M = Mortality, I = Immigration, E = Emigration)
(1) (M + I) – (N + E) (2) (N + I) – (M + E)
(3) (N + E) – (M + I) (4) M × E) – (M × I)

3. Hyperparasite is a parasite which
(1) Kills its host (2) Completes life cycle in one host
(3) Uses host machinery for reproduction (4) None of the above

4. Fungal association of roots of higher plants in mycorrhiza is
(1) Parasitism (2) Hyperparasitism (3) Mutualism (4) Commensalism

5. In commensalism
(1) Both partners are benefitted
(2) Both partners are harmed
(3) Weaker is benefitted while stronger is unharmed
(4) None of the above

Answers

1. (1) **2.** (2) **3.** (4) **4.** (3) **5.** (3)