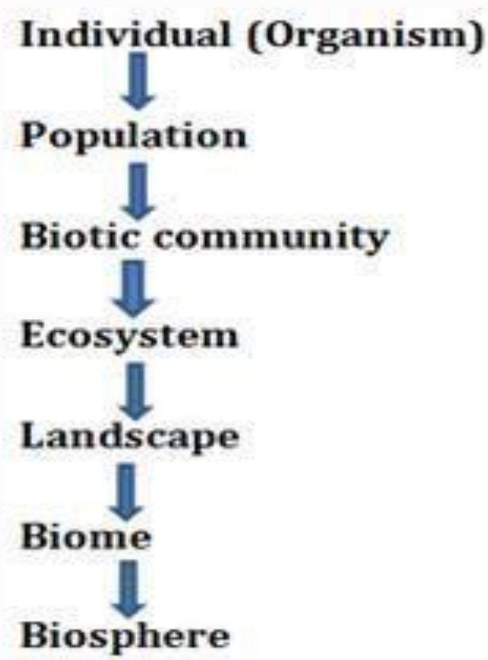
CHAPTER - 13

ORGANISM AND POPULATIONS

INTRODUCTION

ECOLOGY

- Ecology is the subject which studies the interactions among organisms and between the organism and its physical (abiotic) environment.
- Study of ecology is important to strike a balance between development and maintenance of natural environmental and biotic communities, use and conservation of resources, solve local, regional and global environmental problems.
- Ecological hierarchy or ecological level of organization connected with ecological grouping of organisms.

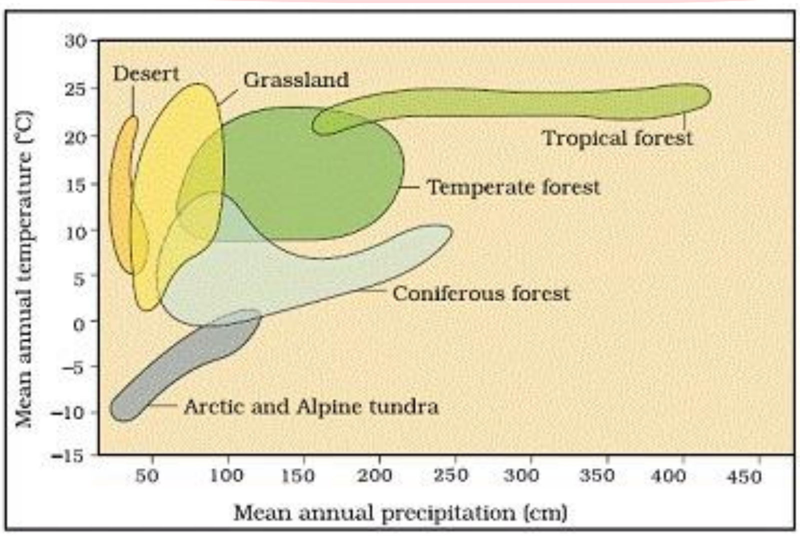


- There are four levels of biological organization:
  - organisms
  - populations
  - communities
  - biomes

ORGANISM AND ITS ENVIRONMENT

- An **organism** refers to a contiguous living system that lives in an environment and has the ability to adapt and retain certain structure and behaviour. It includes fungi, bacteria, plants, animals, and humans. An organism collectively forms a population. The population forms a community which operates the ecosystem.
- The sum total of all biotic and abiotic factors, substances and conditions that surround and potentially influence organisms without becoming their constituent part is called **environment**.
- All organisms possess the ability to adapt to different environmental conditions due to genetic variations. This increases their chances of survival. The polar bear has different characteristic traits that help them to adapt to extremely cold climate of Antarctica. The dense fur coats protect them from cold and predators. The waxy coat repels water and keeps the body warm. These features help them to adapt to the cold.

- Ecology at the organismic level is essentially physiological ecology which tries to understand how different organisms are adapted to their environments in terms of not only survival but also reproduction.
- Organisms get adapted to their environment for their survival and reproduction.
- The rotation of the earth about its axis brings about changes in the environment, leading to different seasons. The variation in the intensity and duration of temperature along with annual variations in precipitation results in formation of major biomes like desert, rain forest and tundra.

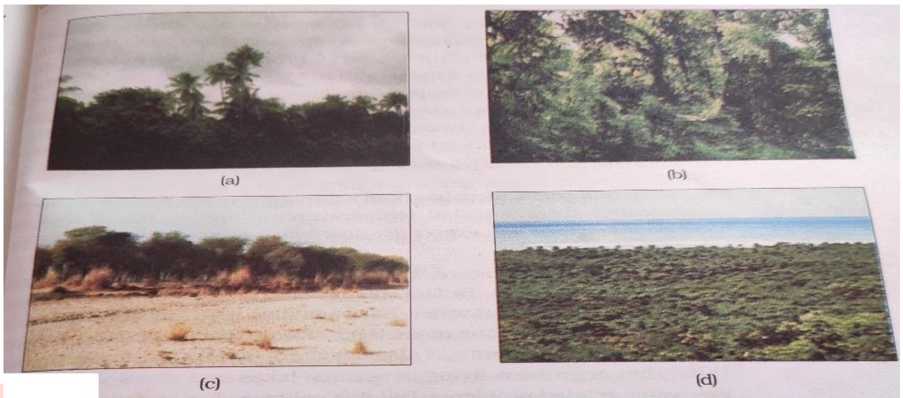


- **Biome**: a community of plants and animals that have common characteristics for the environment they exist in.

  Formation of a Biome depends upon:

- Annual variations in the intensity and duration of temperature
- Annual variation in precipitation

- Life not only exists in favorable habitats but also in harsh and extreme conditions.On planet Earth, life exists not just in a few favourable habitats but even in extreme and harsh habitats-scorching Rajasthan desert, perpetually rain soaked Meghalaya forests, deep ocean trenches, torrential streams, permafrost polar regions, high mountain tops, boiling thermal springs and stinking compost pits, to name a few.



Major biomes of India : (a) Tropical rain forest; (b) Deciduous forest; (c) Desert; (d) Sea coast

Components of Ecosystem:

- Physico-chemical (abiotic) component:
- Temperature, water, light, and soil
- Biotic components
- Pathogens, parasites, predators, and competitors

MAJOR ABIOTIC FACTOR

Temperature:

- The average temperature of land varies seasonally.
- It 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 >50^0 C in tropical deserts in summer.
- There are also unique habitats such as thermal springs and deep sea hydrothermal vents where average temperatures exceed 100 ^{0}C.
- That is why mango trees do not and cannot grow in temperate countrieslike Canadaand Germany, snow leopards are not found in Kerala forests and tuna fish are rarely caught beyond tropical latitudes in the ocean.

- **Eurythermal**: organisms that can tolerate and thrive in a wide range of temperatures. (Few organisms)
- **Stenothermal**: organisms that can tolerate and thrive in a narrow range of temperatures (Most of the organisms).

Water:

- The productivity and distribution of plants in a geographical area is heavily dependent on water.
- The quality of water is dependant on the chemical composition, pH.
- For aquatic organisms, the quality of water, salinity, and temperature is very important.
- The salt concentration in water is measured as salinity in parts per thousand.

- Inland waters: Less than 5
- Sea: 30-35
- Hypersaline lagoons: More than 100

- **Euryhaline**: Organisms those are tolerant of a wide range of salinities.
- **Stenohaline**: Organisms those are tolerant of a narrow range of salinities.

Light:

- It plays an important role in the physiology and survival of autotrophs as it helps them to prepare food via photosynthesis.
- Many species of small plants that are overcrowded by tall plants are adapted to photosynthesize optimally under very low light conditions.
- Light plays a key role in flowering in many plant species as it helps in meeting their **photoperiodic** requirement.
- Many animals use the diurnal and seasonal variations in light intensity and duration (photoperiod) to time 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.
- The UV component of the spectrum is harmful to many organisms.
- But, deep (>500 m) in the oceans, the environment is perpetually dark and its inhabitants are not aware of the existence of a celestial source of energy called sun.

Soil:

- The quality of soil (percolation and water holding capacity) is determined by the following components:
  - Soil composition
  - Grain size
  - Aggregation
- The nature and properties of soil depend on the following factors:
  - Climate
  - Weathering process
  - Whether soil is transported or sedimentary
  - How soil development has occurred
- Vegetation in an area to a large extent depends on soil parameters like:
- Percolation and water holding capacity
- pH
- Mineral composition
- Topography
- In the aquatic environment, the sediment-characteristics often determine the type of benthic animals that can thrive there.

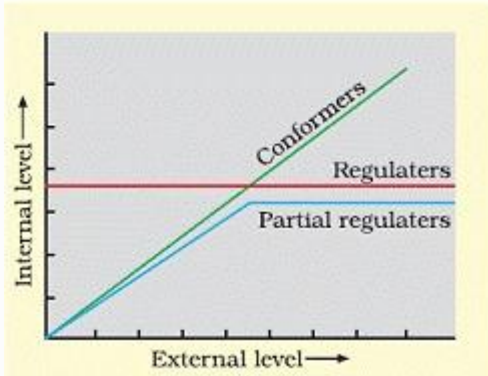
RESPONSES TO ABIOTIC FACTORS

- Many species have evolved relatively constant internal (within the body) environment that permits all biochemical reactions and physiological functions to proceed with maximal efficiency and thus, enhance the overall fitness of the species.
- **Homeostasis**: The ability to maintain a constant body temperature by an organism despite varying external environmental conditions.
- **Analogy:**
- Suppose a person is able to perform his/her best when the temperature is 25^0 C and wishes to maintain it so, even when it is scorchingly hot or freezingly cold outside.
- It could be achieved at home, in the car while traveling, and at the workplace by using an air conditioner in summer and heater in winter.
- Then his/her performance would be always maximal regardless of the weather around him/her.
- Here the person's homeostasis is accomplished, not through physiological, but artificial means.

HOW DO LIVING ORGANISMS COPE WITH VARYING ENVIRONMENTAL CONDITIONS?

- The various possible ways the organisms cope up with the changing environment:
- Regulate
- Conform

- Migrate
- Suspend



Regulate:

- Organisms maintain homeostasis by physiological means which ensures
- Constant body temperature (**Thermoregulation**)
- Constant osmotic concentration (**Osmoregulation)**
- Eg.: All birds and mammals, a very few lower vertebrate and invertebrate species are indeed capable of such regulation.
- Evolutionary biologist believes that the success of mammals is largely due to their ability to maintain a constant body temperature and thrive whether they live in Antarctica and Sahara desert.

Mechanism:

- Humans maintain a constant body temperature of 37^0C.
- When outside temperature is more than body temperature, we sweat profusely and the resulting evaporative cooling brings down the body temperature.
- When the outside temperature is much lower than 37^0C, we shiver, that produces heat and raises the body temperature.
- The mechanism in other organisms is similar to what is seen in humans.

Conform:

- Conformers involve organisms that cannot maintain a constant body temperature.
- Their body temperature changes with the ambient temperature.
- Exhibited by: 99% of animals and nearly all plants.

Aquatic animals:

- The osmotic concentration of body fluids changes with that of the ambient water osmotic concentration.

Why are very small animals like shrews and hummning birds e rarely found in polar region?

- Thermoregulation is energetically expensive for many organisms.
- Heat loss or heat gain is a function of surface area.
- The 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.

Migrate:

- It is a mechanism where the organism moves away temporarily from the stressful habitat to a more hospitable area and return when the conditions are favorable.
- Person moving from Delhi to Shimla for the duration of summer.
- Birds undertake long-distance migrations in winter.
- Every winter the Keoladeo National Park at Bharatpur in Rajasthan hosts thousands of migratory birds coming from Siberia and other extremely cold northern regions.

Suspend:

- This is a mechanism employed by bacteria, fungi, lower plants and some animals to survive the unfavorable condition.
- Thick-walled **spores** are produced by bacteria, fungi, and lower plants. The spore can germinate under favorable conditions.
- Seeds of higher plants germinate under favorable conditions (favorable moisture and temperature conditions). During unfavorable conditions, they go into a state of "**Dormancy**", where the metabolic activities are reduced.
- If animals cannot migrate under unfavorable conditions, they might avoid the stress by escaping in time.
  - **Hibernation:** Seen in Bear (In winter)
  - **Aestivation:** Seen in snails and fish (In summer)
  - **Diapause:** Seen in zooplankton species, (a stage of suspended development)

ADAPTATIONS

- **Adaptation** is any attribute of an organism (morphological, physiological, behavioral) that enables the organism to survive and reproduce in its habitat.
- **Adaptation- Kangaroo rat:**
- Kangaroo rat in North American deserts is capable of meeting all its water requirements through its internal fat oxidation.
- **Adaptation- Desert plants:**
- They minimize water loss through transpiration by:
- Arrangement of stomata in deep pits

- Presence of a special photosynthetic pathway (CAM) that enables their stomata to remain closed during the daytime.
- Some desert plants like Opuntia, have no leaves – they are reduced to spines–and the photosynthetic function is taken over by the flattened stems.

Adaptation in Mammals in Cold Climate:

- Presence of shorter ears and limbs to minimise heat loss. (***Allen's Rule***)
- Seals: Have a thick layer of fat (blubber) below their skin that acts as an insulator and reduces the loss of body heat.

Adaptation in Humans at High Altitude:

- Moving to high altitude place (> 3500m Rohtang Pass near Manali and Mansarovar, in China occupied Tibet), there is experience of altitude sickness.
- Because of the low atmospheric pressure of high altitudes, humans at high altitude experience altitude sickness (nausea, fatigue and heart palpitations).

Adaptation to this situation:

- The body compensates low oxygen availability by increasing red blood cell production.
- Decrease in the binding affinity of hemoglobin and by increasing breathing rate.

Adaptation in Desert Lizard:

- They exhibit behavioral responses.
- They lack the physiological ability to deal with the high temperatures of their habitat.

Adaptation:

- They bask in the sun and absorb heat when their body temperature drops below the comfort zone.
- Move into the shade when the ambient temperature starts increasing.

POPULATIONS

Population Attributes

- **Population** refers to organisms living in groups in a well-defined geographical area, sharing or competing for similar resources and potentially interbreeding. All the cormorants in a wetland, rats in an abandoned dwelling, teakwood trees in a forest tract, bacteria in a culture plate and lotus plants in a pond, are examples of a population.

- **Population ecology** links ecology to population genetics and evolution.

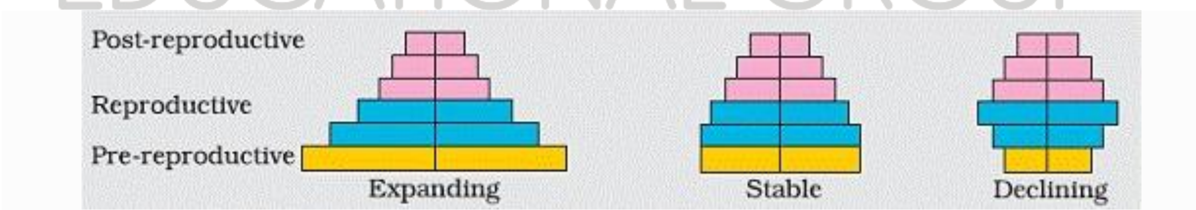
Characteristics of a population:

- **Birth rate:** Number of births per 1000 individuals in a population. If in a pond there are 20 lotus plants last year and through reproduction 8 new plants are added, taking the current population to 28, birth rate=8/20=0.4.
- **Death rate**: Number of death per 1000 individuals in a population.4 individuals in a laboratory population of 40 fruit flies died during a specified time interval, say a week, the death rate in populationduring that period is 4/40=0.1 individuals per fruitfully per week.
- **Sex ratio**: The ratio of males to females in a population. An individual is either a male or female but a population has sex ratio e.g., 60 per cent of the population are females and 30 percent males.

Age Pyramids of Human Population:

- **Age Pyramids** refers to the structure representing the age distribution for a population.
- The shape of the pyramids reflects the growth status of the population. The size of population tells us a lot about its status in the habitat.

- whether it is growing
- stable
- declining



- The age pyramids generally show age distribution of males and females in a combined diagram.
- It also gives information on the ratio of the post-reproductive, reproductive and pre-reproductive individuals in the population.

Population Density:

- **Population size or population density (N)** is measured in terms of number but it may sometime not appropriate.
- The size, in nature, could be as low as <10 (Siberian cranes at Bharatpur wetlands in any year) or go to millions (*Chlamydomonas* in a pond). In an area, if there are 200 *Parthenium* plants but only a single huge banyan tree with a large canopy, stating that population

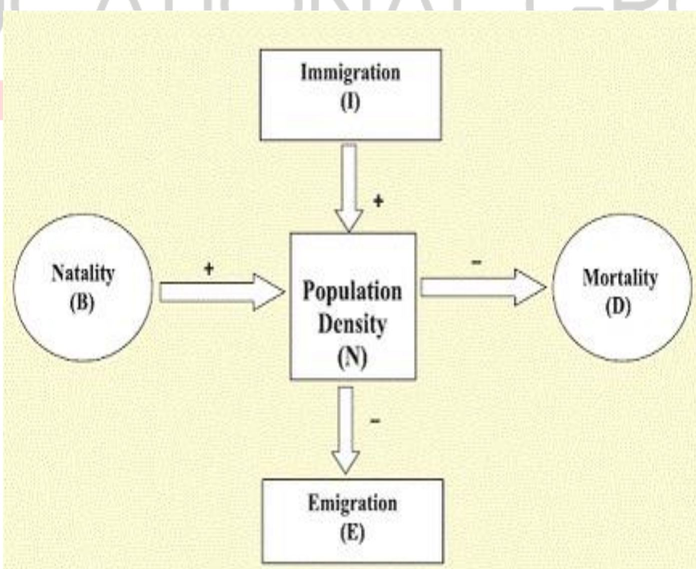
density of banyan is low relative to that of *Parthenium* amounts to underestimating the enormous role of the Banyan in that community.

- Number of individuals of a species per unit area.
- Designated as ‘N’.
- Calculation of Population density:
  - For Fish- the number of fish caught per trap
  - For Tiger- based on the pug marks and fecal pellets.

POPULATION GROWTH

- The size of a population which keeps on changing depends on various factors:
  - Food availability
  - Predation pressure
  - Weather condition over a period of time
- Fluctuation in the population density is due to changes in four basic processes.

- **Natality**: Number of births during a given period in the population that are added to the initial population density.
- **Mortality**: Number of deaths in the population during a given time period.
- **Immigration**: Number of individuals of the same species that have come into the habitat from elsewhere during a specific time period.
- **Emigration**: Number of individuals of the population who left the habitat and gone elsewhere during the time period under consideration.



- Representing Population Density
  - $\mathbf{N_{t+1}=N_t + [(B+I) - (D+E)]}$

- N_t = Population density at time t
- N_{t+1}= Population density at time t+1
- B = Birth rate
- I = Immigration
- D = Death rate
- E = Emmigration
- Population density will increase if the number of births plus the number of immigrants (B + I) is more than the number of deaths plus the number of emigrants (D + E), otherwise, it will decrease.

Population Growth Models:

- The growth models can be used to predict the growth of a population with time. Growth of population takes place according to availability of food, habit condition and presence of other biotic and abiotic factors.
- There are two growth models:
  - Exponential growth
  - Logistic Growth

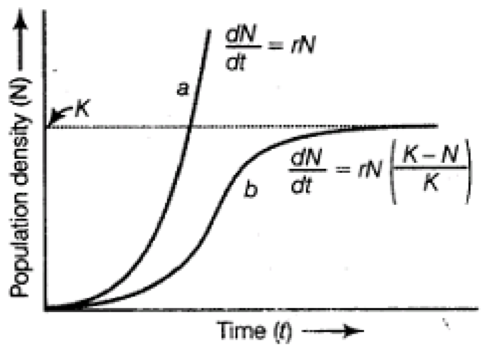
Exponential growth:

- In this kinds growth occurs when food and space is available in sufficient amount. While resources in the habitat are unlimited, each species has the ability to realize fully its innate potential to grow in number. The population grows in an exponential or geometric fashion. Equation for exponential growth:

- dN/dt = (b – d) × N
- Let (b–d) = r, then
- dN/dt = rN
- N= Population size
- b = Birthrate
- d = Death rate
- r = intrinsic rate of natural increase
- When N in relation to time is plotted in graph, it results in a J-shaped curve.
- It can also be represented as:
- **$N_t = N_0 e^{rt}$**
- 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)

- Darwin showed how even a slow growing animal like elephant could reach enormous numbers in the absence of cheeks.



Population growth curve

- a-when responses are not limiting the growth, plot is exponential.
- b-when responses are limiting the growth, the plot is logistic.
- k-carryingcapacity

Logistic growth:

- None of the population have unlimited resources at their disposal to support the exponential growth.
- Populations with limited resources leads to competition among individuals for the resources.
- Eventually, the 'fittest' individual will survive and reproduce.

Carrying capacity (K):

- It states that a given habitat has enough resources to support a maximum possible number, beyond which no further growth is possible.
- A population growing in a habitat with limited resources exhibit initially a lag phase, followed by phases of acceleration and deceleration finally an asymptote when the population density reaches K.
- A plot of N in relation to time (t) results in a sigmoid curve and is also called as Verhulst-Pearl Logistic Growth.
- The logistic growth can be represented by the following equation:
- **dN/dt = rN [(K-N)/K]**
- N = Population density at time t

- r = Intrinsic rate of natural increase
- K = Carrying capacity

- Since resources for growth for most animal populations are finite and become limiting sooner or later, the logistic growth model is considered a more realistic one.

LIFE HISTORY VARIATION

- Populations have evolved to maximise their reproductive fitness, also called Darwinian fitness (high r-value), in the habitat in which they live.
- Some organisms breed only once in their lifetime (Pacific salmon fish, bamboo).
- Some others breed many times during their lifetime (most birds and mammals).
- Some produce a large number of small-sized offspring (Oysters, pelagic fishes).
- Some others produce a small number of large-sized offspring (birds, mammals).
- 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.

POPULATION INTERACTIONS

- In nature, animals, plants, and microbes do not and cannot live in isolation but interact in various ways to form a biological community.
- These interactions may be:
  - Beneficial (represented by + sign)
  - Detrimental (represented by – sign)
  - Neutral (represented by 0 sign)
- Interspecific interactions are the interaction of populations of two different species.
- The different types of interactions are predation, competition, parasitism, commensalism, mutalism.

Species A	Species B	Name of Interaction
+	+	*Mutualism*
–	–	*Competition*
+	–	*Predation*
+	–	*Parasitism*
+	0	*Commensalism*
–	0	*Amensalism*

Predation:

- It is an interspecific interaction where species A (predator), kill and consumes another species B (Prey).

Roles of predators:

- Transfer energy from plants to higher trophic levels (position of organism in food chain) so acts as '**conduits'** for energy transfer across trophic levels.
- Control Prey population – Prickly pear cactus- moth
- Biological control of Agricultural pest
- Maintain species diversity by reducing intensity of competition among competing prey species.
- Over exploitation of prey by the predators results in extinction of prey and predator. Predators in nature are 'prudent'.

Examples:

- Prickly pear cactus introduced into Australia in the early 1920's caused havoc by spreading rapidly into millions of hectares of rangeland (Grassland, shrublands, woodlands, wetlands, and deserts that are grazed by domestic livestock or wild animals).The invasive cactus was brought under control only after a cactus-feeding predator (a moth) from its natural habitat was introduced into the country.

Experiment to show predator-prey inter-relationship:

- In the rocky intertidal communities of the American Pacific Coast, the starfish*Pisaster* is an important predator.
- In an experiment, when all the starfish were removed, more than 10 species of invertebrates became extinct within a year, because of interspecific competition.
- If a predator is too efficient and overexploits its prey, then the prey might become extinct following it, the predator will also become extinct for lack of food.

Adaptations developed by the prey:

- Some species of insects and frogs are cryptically-colored (camouflaged) to avoid being detected easily by the predator.
- The Monarch butterfly is highly distasteful to its predator (bird) because of a special chemical present in its body.
- Nearly 25 percent of all insects are known to bephytophagous-feeding on plant sap and other parts of plants.
- Presence of thorns in certain plant species (*Acacia, Cactus*).
- Production and storage of toxic chemicals by plants.
- Calotropis produces highly poisonous cardiac glycoside.

- Nicotine, caffeine, quinine, strychnine, opium, etc., are produced by various plants.

Competition:

- Competition occurs when closely related species compete for the same resources that are limiting. Interaction either among individuals of some species or between individuals of different species. Occurs among closely related species but not always true.
  - **Firstly-Totally unrelated species could also compete for the same resource**- In some shallow South American lakes visiting flamingoes and resident fishes compete for their common food, the zooplankton in the lake.
  - **Secondly**-Resources always need not be **limiting for competition to occur**.
  - The feeding efficiency of one species might be **reduced** due to the interfering and I inhibitory presence of the other species, even if resources (food and space) are abundant.
    - Example: 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.

Competitive release:

- A species whose distribution is restricted to a small geographical area because of the presence of a competitively superior species is found to expand its distributional range dramatically when the competing species is experimentally removed.
- Example: 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. In general, herbivores and plants appear to be more adversely affected by competition than carnivores.
- Competition is best defined as a process in which the fitness of one species (measured in terms of its 'r' the intrinsic rate of increase) is significantly lower in the 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 eventually.

Resource partitioning:

- If two species compete for the same resource, they could avoid competition by choosing.
- Different times for feeding or different foraging patterns.
- **Eg.**: **MacArthur** showed that five closely related species of warblers could live on the same tree and were able to avoid competition and co-exist due to behavioral differences in their foraging activities.

Parasitism:

- In this type of interaction where one of the two interacting species (parasite) depends on the other species (host) for food and shelter.
- Majority of the parasites harm the host.
- They may reduce the survival, growth, and reproduction of the host and reduce its population density.
- They might render the host more vulnerable to predation by making it physically weak.

Adaptation by the Parasite:

- Loss of unnecessary sense organs
- Presence of adhesive organs or suckers to cling on to the host
- Loss of digestive system
- High reproductive capacity

Parasitic life cycle involving one or two intermediate hosts:

- The human liver fluke (a trematode parasite) depends on two intermediate hosts (a snail and a fish) to complete its life cycle.
- The malaria parasite needs a vector (Mosquito) to complete its life cycle.

Ectoparasites:

Parasites that feed on the external surface of the host organism.

- Example: Lice on human, Tick on dogs, Cuscuta: derives its nutrition from the host plant (hedge plants, which has lost its chlorophyll and leaves in the course of evolution).

Endoparasites :

These are parasites that live inside the host body at different sites (liver, kidney, lungs, red blood cells, etc.).

- The life cycles of endoparasites are more complex because of their extreme specialization. Their morphological and anatomical features are greatly simplified while emphasizing their reproductive potential.
- Examples: Tapeworm, Liverfluke, *Plasmodium,* Hookworm

Brood Parasitism:

- Observed in birds.
- The parasitic bird lays its eggs in the nest of its host and lets the host incubate them.

- The eggs of the parasitic bird have evolved to resemble the host's egg in size and color to reduce the chances of the host bird detecting the foreign eggs and ejecting them from the nest.
- Eg:-Cuckoo (koel) and crow (breeding season-spring to summer)

Commensalism:

- In this kind of interaction one species benefits and the other is neither harmed nor benefited.
- Example:
- An orchid growing as an *epiphyte* on a mango branch
- Barnacles growing on the back of a whale
- The cattle egret and grazing cattle
- The cattle egrets are benefitted by the cattle to detect insects because cattle stir up the bushes and insects gets flushed out from the vegetation, to be detected by the cattle egrets.
- The Clownfish and Sea Anemone
- The fish gets protection from predators which stay away from the stinging tentacles of the Sea Anemone.
- In the above examples, the mango tree, whale, cattle and Sea anemone – neither of them derives any benefit by hosting other organisms, nor do they get any harm.

Mutualism:

- In this kind of interaction both the interacting species derive benefits from each other.
- Mediterranean orchid- sexual deceit for pollination- appears as female bee
- Examples:
- **Lichens**: An Intimate mutualistic relationship between a fungus and photosynthesizing algae or cyanobacteria.
- **Mycorrhizae**: Associations between fungi and the roots of higher plants.
- Fungi help the plant in the absorption of essential nutrients from the soil.
- The plant provides the fungi with energy-yielding carbohydrates.
- **Pollination:**
- Plants need the help of animals for pollinating their flowers and dispersing their seeds.
- Animals obviously have to be paid 'fees' for theservices that plants expect from them. Plants offer rewards in the form of pollen and nectar for pollinators and juicy and nutritious fruits for seed dispersers.
- But the mutually beneficial system should also be safeguard against 'cheaters', for example, animals that try to steal nectar without aiding in pollination.

Co-Evolution of Mutualists:

- In many species of **Fig** trees, there is a tight one-to-one relationship with the pollinator species of **wasp**.

(a) (b)

Mutual relationship between fig tree and wasp: (a) Fig flower is pollinated by wasp; (b) Wasp laying eggs in a fig fruit

- Fig species can be pollinated only by its 'partner' wasp species and no other species.
- The female wasp uses the fruit not only as an oviposition (egg-laying) site but uses the developing seeds within the fruit for nourishing its larvae.The wasp pollinates the fig inflorescence while searching for suitable egg-laying sites.
- **Pseudocopulation: *(Co-evolution)*:**
- The Mediterranean orchid *Ophrys* employs 'sexual deceit' to get pollination done by a species of bee.

Showing bee-a pollinator on orchid flower

- One petal of its flower bears an uncanny resemblance to the female of the bee in size, color, and markings.
- The male bee is attracted to what it perceives as a female, 'pseudo-copulates' with the flower, and during that process is dusted with pollen from the flower. When this same bee psedocopulate with another flower, it transfers the pollen to it and thus pollinates the flower. If the female bee's colour patterns change even slightly for any reason during evolution, pollination success will be reduced unless the orchid flower co-evolves to maintain the resemblance of its petal to the female bee.

Amensalism:

- Interaction between two different species, in which one species is harmed and the other species is neither harmed nor benefited. Example: Bacterial culture, after few days fungus growth will be there on it like Pencillium , and its secretions of chemical will kill bacteria, but no benefits to fungi.

IMPORTANT TERMS-CHP-13-ORGANISM AND POPULATION

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- **Biome**: a community of plants and animals that have common characteristics for the environment they exist in.
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- **Stenothermal**: organisms that can tolerate and thrive in a narrow range of temperatures (Most of the organisms).
- **Euryhaline**: Organisms those are tolerant of a wide range of salinities.
- **Stenohaline**: Organisms those are tolerant of a narrow range of salinities.
- **Homeostasis**: The ability to maintain a constant body temperature by an organism despite varying external environmental conditions
- **Thermoregulation** :Constant body temperature (**Thermoregulation**)
- **Osmoregulation**: Osmotic concentration (**Osmoregulation)**
- **Adaptations:** Adaptation is any attribute of an organism (morphological, physiological, behavioral) that enables the organism to survive and reproduce in its habitat
- **Birth rate:** Number of births per 1000 individuals in a population.
- **Death rate**: Number of death per 1000 individuals in a population.
- **Sex ratio**: The ratio of males to females in a population.
- **Age Pyramids:** refers to the structure representing the age distribution for a population.
- **Natality**: Number of births during a given period in the population that are added to the initial population density.
- **Mortality**: Number of deaths in the population during a given time period.
- **Immigration**: Number of individuals of the same species that have come into the habitat from elsewhere during a specific time period.
- **Emigration**: Number of individuals of the population who left the habitat and gone elsewhere during the time period under consideration.

- **Parasitism:** In this type of interaction where one of the two interacting species (parasite) depends on the other species (host) for food and shelter.

- **Commensalism:** In this kind of interaction one species benefits and the other is neither harmed nor benefited.
- **Mutualism:** In this kind of interaction both the interacting species derive benefits from each other.
- **Amensalism:** Interaction between two different species, in which one species is harmed and the other species is neither harmed nor benefited