13 Organisms and Populations

Can you recall?

1. What is an ecosystem?
2. What are the abiotic and biotic components of an ecosystem?

Natural world around us shows amazing diversity of forms and complexity of relations. To understand these, we have to study levels of organization in the living world *viz.* macromolecules, cells, tissues, organs, individual organism, population, communities, ecosystems and biomes.

You have already studied in school, that ecology is a study of the interactions among organisms and between the organisms and their physical (abiotic) environment. Term ecology was first used by Reiter but E. Haeckel gave substance to the term (introduced) ecology.

Ecological grouping of organisms is nothing but ecological hierarchy. There are four sequential levels with increasing complexity of ecological (biological) organizations viz, Organism, Populations, Communities and Biomes. Individual **organism** is the basic unit of ecological hierarchy. Organisms of same kind inhabiting a geographical area constitute **population**. Several populations of different species in a particular area constitute **community** that interact with one another in several ways. **Biome** constitutes a large regional terrestrial unit delimited by a specific climatic zone having major vegetation zone (plant communities) and the associated fauna. There are six major groups of terrestrial biomes. We shall explore first two levels viz, organism and populations.

13.1 Organisms and the environment around:

Ecology at the level of organism is basically the study of animal or plant physiology which helps us to understand how the organisms are adapted to their environments, not only for their survival but also for propagation (multiplication).

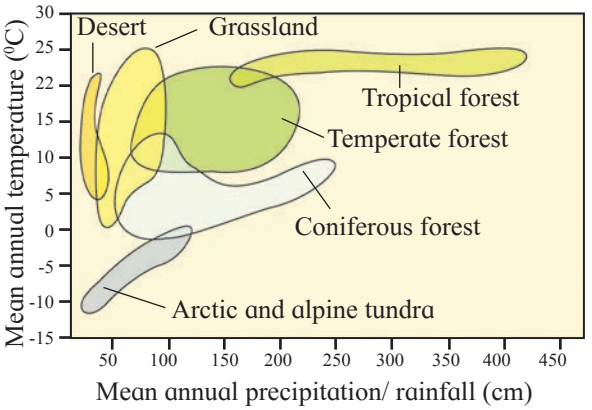

Fig. 13.1 : Distribution of major Biomes with respect to annual temperature and precipitation

You have studied in earlier classes about the rotation of earth around the Sun and the tilt of its axis, cause seasons. These seasons with annual variation in precipitation in the form of rain and snow, gives rise to formation of major biomes of the earth like desert, rain forest, grassland, tundra, etc.

Regional and local variations within each biome lead to the formation of a variety of habitats. Major biomes of earth are shown in Fig. 13.1. On the Earth, life exists even in extreme and harsh habitats like scorching deserts of Rajasthan, perpetually rain-soaked forests of North Eastern states and high mountain tops of Himalayas.

Find out

What are the key differences that make such a great variation in the physical and chemical conditions of different habitats?

Here, we must remember that it is not only the physico-chemical (abiotic) components that make up the habitat of an organism, but the habitat also includes biotic components like

plants, pathogens, parasites, and predators of the organism. We assume that over a period of time, the organism had through natural selection, evolved adaptations to optimize its survival and reproduction in its habitat.

Do you know ?

Ethology - The term was coined by Hilaire (1854) but was popularised by W. M. Wheeler (1902). The term denotes (speaks for) the study of behaviour of animals in relation to their environment.

Ecology - The term was introduced by E. Haeckel (1865) for the relationship of animals and plants with their surroundings.

Bionomics - Lankester (1890) coined this term for the study of relation between organisms to their environment.

Environmental biology (modern ecology) - The term was introduced in 20th century (G. L. Clarke 1964, Odum 1969) giving emphasis on the functional or physiological interrelationships between the organism and their surroundings.

Biosphere - All the ecosystems on earth constitute biosphere.

Habitat and Niche :

Habitat is a place or the set of environmental conditions around the organism to which it must adapt to survive and prosper. The term **Niche** is used to denote the functional role played by an organism in its environment (J. Grinnell 1917). Niche includes various aspects of the life of an organism like diet, shelter, etc.

A habitat defines the physical space of an organism with the other living or non-living factors, while niche describes how that organism is linked with its physical and biological environment. In colloquial language habitat is a postal address while niche is the profession of organism.

Table 13.2 : The differences between Habitat and Niche can be summarized as :

Habitat	Niche
A habitat is an area, where a species lives and interact with the other factors and prosper.	A niche is a concept, of how an organism lives or survives in the environmental conditions.
Habitat consists of numerous niches.	Niches do not contain such components.
Effect of temperature, rainfall and other abiotic factors.	Flow of energy from one organism to other through ecosystem.
Habitat supports numerous species at a time.	Niche supports a single species at a time.
Habitat is a physical place.	Niche is an activity performed by organisms.
Habitat is not species specific.	Niche is species specific.

Definition of Habitat :

Place or area where a particular species lives, is its habitat. Factors like the sunlight, average rainfall, annual temperatures, type of soil present and other abiotic (topographic) factors, affect the presence of organisms. These factors help in determining the presence of the particular type of species in the environment.

Pond, river, ocean, etc. are the examples of habitat as many organisms are found in the same place or habitat. These habitats can be arboreal, terrestrial, aerial, aquatic, etc. The immediate surrounding of an organism, sometimes also referred to as **microhabitat,** is an important concept to remember when working with sedentary or weakly motile organisms.

Definition of Niche :

The term niche was first time used by 'J. Grinnell'. The term ecological niche is still not well understood and is sometimes even misused.

Niche is described as a position of a species in the environment like, what they do for their survival? how they fulfill their needs of shelter, food? etc. Niche deals with the flow of energy from one organism to another and hence, it is important to understand, what an organism eats, how it interacts with other organisms, etc. As soon as the niche is left vacant, other organisms fill that position. The niche is specific to each species, which means no two species can share the same niche.

If the species creates its own unique niche in an ecosystem, it would be helpful in reducing competition for resources among species. By taking an example of a bird, it can be understood that how these birds differ in their eating habits, where some birds eat only insects, some only fruits and some can eat both and anything they come across. So here we can conclude that these birds living in the same habitat differ in their niches because of different eating habits.

Three types of niches are found:

a. Spatial or habitat niche : It deals with the physical space occupied by the organisms.

b. Trophic niche : It is on the basis of trophic level of an organism in a food chain.

c. Multidimensional or hypervolume niche: It considers number of environmental factors (both biotic and abiotic), the resulting space will be a hypervolume**;** not something that can be perceived by the human mind. This space is called the **hypervolume niche**. Alternatively, it is the position of an organism in the environmental gradient.

For every species, there is a fundamental niche and a realized niche. **Fundamental niche** is the niche in the absence of all competitors, this is highly improbable in nature. Hence, **realized niche** is more realistic approach, in the presence of competition for the resources available in the habitat.

We have seen earlier in the chapter that each habitat type is regulated by a number of abiotic or physico- chemical factors.

Key abiotic factors that influence any habitat are ambient temperature, availability of water, light and type of soil.

13.2 Major Abiotic Factors :

Temperature:

It is the most ecologically relevant environmental factor. Average temperature on land varies from subzero levels in polar areas and high altitudes, upwards upto 50°C in tropical deserts in summer. Temperature also varies seasonally. It decreases progressively from the equator towards the poles and from plains to the mountain tops. There are some unique habitats such as hot springs (80 to 100°C) and deep-sea hydrothermal vents where average temperatures usually 400° C. Ambient temperature affects the enzyme kinetics of the cell and thus, the entire metabolism, activity and other physiology of the organism.

Only few organisms can tolerate and thrive in a wide range of temperatures (eurythermal), but, a vast majority of them are restricted to a narrow range of temperatures (stenothermal).

Find out

1. Give names of eurythermal and stenothermal animals and plants?
2. What will be the effect of increasing global temperatures on the different habitats and the organisms found in those habitats?

Water: Availability of water is an important factor affecting the organisms. As we know, life on earth originated in water, its availability is so limited in deserts that only special adaptations are required to survive there. The productivity and distribution of plants are also heavily dependent on water.

Organisms living in water bodies such as oceans, lakes and rivers, have their own water-related problems. For aquatic organisms the chemical composition and pH of water are important.

The dissolved salt concentration (measured as salinity in parts per thousand), is less than 5ppt in fresh waters of streams , lakes and rivers, and 30-35ppt in the seas and oceans. It may go up to 100ppt in some hypersaline lagoons.

Some organisms are tolerant for a wide range of salinities (euryhaline) but others are restricted to a narrow range (stenohaline). Many fresh water animals cannot live for long in sea water and vice versa because of the osmotic problems, they would face.

Find out

Give examples of an animal and plant that can survive in fresh water as well as sea water?

Light: Plants use light for photosynthesis, which is only source of energy for the entire ecosystem. Photosynthesis can occur only in presence of sunlight. Many species of small plants (herbs and shrubs) growing on forest floor are adapted to perform photosynthesis optimally under very low light conditions because they are constantly overshadowed by tall trees.

For animals too, diurnal and seasonal variations in light intensity and duration (photoperiod) are clues 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.

Find out

What is the source of energy for the life in deep ocean trenches where sunlight does not reach?

Soil: The nature and properties of soil are dependent on the climate, the weathering process.

Various characteristics of the soil such as soil composition, grain size, determine the percolation and water holding capacity of the soil. These characteristics along with pH, mineral composition and topography, determine the vegetation of an area. Vegetation in turn dictates the type of animals.

The abiotic factors that determine the type of habitat, also show considerable diurnal and seasonal variations. The plants and animals must adapt to these changes in order to survive and flourish in the habitat. During the course of their evolution, many species have evolved a relatively constant 'internal' environment that permits all biochemical reactions and physiological functions to proceed with optimum rate, and allow the species to flourish. The organisms try to maintain the constancy of its internal environment (homeostasis) despite variations in the external environmental conditions. To survive and flourish in any environment, organisms must adapt to the changes in the environment for which there are following possibilities :

i. **Regulate:** Some organisms are able to maintain homeostasis by physiological and behavioural changes which ensure constant body temperature, constant osmotic concentration, etc. All birds and mammals are capable of such regulation (thermoregulation and osmoregulation).

ii. **Conform:** Most of animals and plants cannot maintain a constant internal environment. Their body temperature changes with the ambient temperature. In aquatic animals, the osmotic concentration of the body fluids changes with that of the ambient water osmotic concentration. These animals and plants are simply conformers.

Some species have evolved the ability to regulate, within a limited range of environmental conditions, beyond which they simply conform. If the stressful environment is localized or only for a short period of time, the organism may migrate or suspend its activities.

iii. **Migrate:** The organism can move away temporarily from the stressful habitat to a more hospitable area and return when stressful period is over. Many animals, particularly birds, during winter undertake long-distance migrations to more hospitable areas.

iv. **Suspend:** In plants, seeds serve as means to tide over periods of stress; they germinate to form new plants under favourable moisture and temperature conditions. They do so by reducing their metabolic activity and going into a state of '**dormancy**'. In animals, the organism, if unable to migrate may go into **hibernation** during winter e.g. polar bear. Some snails and fish go into **aestivation** to avoid summer heat.

Internet my friend

Find out the difference between hibernation and aestivation.

Do you know?

1. Adaptation of plants for aquatic and desert habitats.
2. Adaptations of animals for aquatic and desert habitats.

13.3 Adaptation :

To cope up with extreme variations in their environment, some organisms respond through physiological adjustments, while others do so behaviourally (like migration). These are their adaptations. Therefore, we can say that adaptation is an attribute of the organism (morphological, physiological, and behavioural) that enables the organism to survive and reproduce in its habitat.

Many desert plants have a thick cuticle on their leaf surfaces and have their stomata in deep pits to minimize loss of water through transpiration. They also have a special photosynthetic pathway (CAM - Crassulacean acid metabolism) that enables their stomata to remain closed during daytime. Some desert plants like *Opuntia*, have their leaves reduced (modified) to spines and the photosynthetic function is taken over by the flattened stems.

Mammals from colder climates generally have shorter snout, ears, tail and limbs to minimize the loss of body heat (Allen's Rule.) In the polar seas, aquatic mammals like seals have a thick layer of fat (blubber) below their skin acting as an insulator to reduce loss of body heat.

Can you tell?

1. What is homeostasis?
2. Why do animals need to maintain homeostasis?
3. What are the adaptations in animals living under crushing pressure at great depths of ocean?

Some organisms show behavioural responses to cope with variations in their environment. Desert lizards manage to keep their body temperature fairly constant by behavioural adaptations. 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 burrow into the sand to hide and escape from the heat.

13.4 Population :

In nature, we rarely find isolated, single individuals. They live in groups in a well-defined geographical area, share or compete

for similar resources, potentially interbreed and thus form a population.

Although, it is an individual organism that has to cope with changes in the environment, it is at the population level that natural selection operates to evolve the desired traits. **Population ecology** is, therefore, an important area of ecology because it links ecology to population dynamics, genetics and evolution.

A population has certain attributes of its own, which are different from those of an individual. Basic physical characteristics of population are - its **size** and **density**. Size speaks for the number of individuals in a population while density tells us number of individuals present per unit space, in a given time. Besides size and density, the other characteristics include natality, mortality, immigration, emigration, age pyramids, expanding population, population growth forms and biotic potential. An individual has birth and death, but a population has birth rate and death rate.

Natality is the birth rate of a population. It has the greatest influence on a population's growth. Natality is a crude birth rate or specific birth rate. **Crude birth rate** is used when calculating population size (number of births per 1000 population/year), whereas **specific birth rate** is used relative to a specific criterion such as age. E.g. If in a pond, there were 200 carp fish last year and through reproduction 800 new fish are added, taking the current population to 1000, we calculate the birth rate as 800/200 = 4 offspring per carp per year.

- **Absolute Natality** : the number of births under ideal conditions (with no competition, abundance of resources such as food and water, etc.).
- **Realized Natality** : the number of births when environmental pressures come into play.

It must be remembered, that absolute natality will be always more than realized natality.

Mortality is the death rate of a population. Mortality rate or death rate, is a measure of the number of deaths (in general, or due to a specific cause) in a particular population, in proportion to the size of that population, per unit of time. Mortality rate is typically expressed in deaths per 1,000 individuals per year. Thus, a mortality rate of 9.5 (out of 1,000) in a population of 1,000 would mean 9.5 deaths per year in that entire population, or 0.95% out of the total.

- **Absolute Mortality :** the number of deaths under ideal conditions (with no competition, abundance of resources such as food and water, etc.).
- **Realized Mortality :** the number of deaths when environmental pressures come into play.

It must be remembered that absolute mortality will be always less than realized mortality.

Sex ratio: The sex ratio of the population affects and is reciprocally affected by birth, death, immigration, and emigration rates. It is measured as the ratio of the number of individuals of one sex to that of the other sex. The males and females in a ratio of 1:1 is generally the most common **evolutionary stable strategy (ESS)**.

Can you tell?

What can be the causes of deviation from 1: 1 sex ratio in natural habitat?

Internet my friend

1. Find out the sex ratio of Indian population and the state of Maharashtra.
2. What are the reasons behind deviation of sex ratio among Indian population?

Age distribution and Age pyramid:

A population is composed of individuals of different ages. If the age distribution (per cent individuals of a given age or age group) is plotted for the population, the resulting structure is called an **age pyramid**. For the purpose of simplicity, the entire population is divided into three age groups as **Pre-Reproductive** (age 0-14 years), **Reproductive** (age 15-44 years) and **Post- reproductive** (45-85+ years).

Use your brain power

From the age pyramids given below (Fig.13.3)- what will be your forecast for 15 years from now for the populations of 1. Kenya, 2. Australia, 3. Italy and 4. Hungary.

The size of the population it can support tells us a lot about its status in the habitat. The population size, in natural habitat, could be as low as less than 10 (Siberian cranes in bird sanctuary) or go into millions (*Chlamydomonas* in a pond).

Population size, more technically called population density (designated as N), need not necessarily be measured in numbers only. Although total number is generally the most appropriate measure of population density, it is in some cases either meaningless or difficult to determine.

In an area, if there are millions of termites / ants but only a few animals which feed on them, stating that the population density of these predators is low, will be misleading.

In such cases, the biomass is a more meaningful measure of the population size. Total number is again not an easily adoptable measure, if the population is huge and counting is impossible or very time-consuming. Sometimes, for certain ecological investigations, there is no need to know the absolute population densities; relative densities serve the purpose equally well. For instance, the number of birds / insects caught per trap is good enough measure of their total population density. We are mostly obliged to estimate population sizes indirectly, without actually counting them or seeing them. The tiger census in our national parks and tiger reserves is often based on pug marks and fecal pellets.

Population Growth :

The size of a population for any species is a dynamic parameter. It keeps changing with time, depending on various factors including food, predation pressure and adverse weather. In fact, these changes in population density that give us some idea whether it is flourishing or declining.

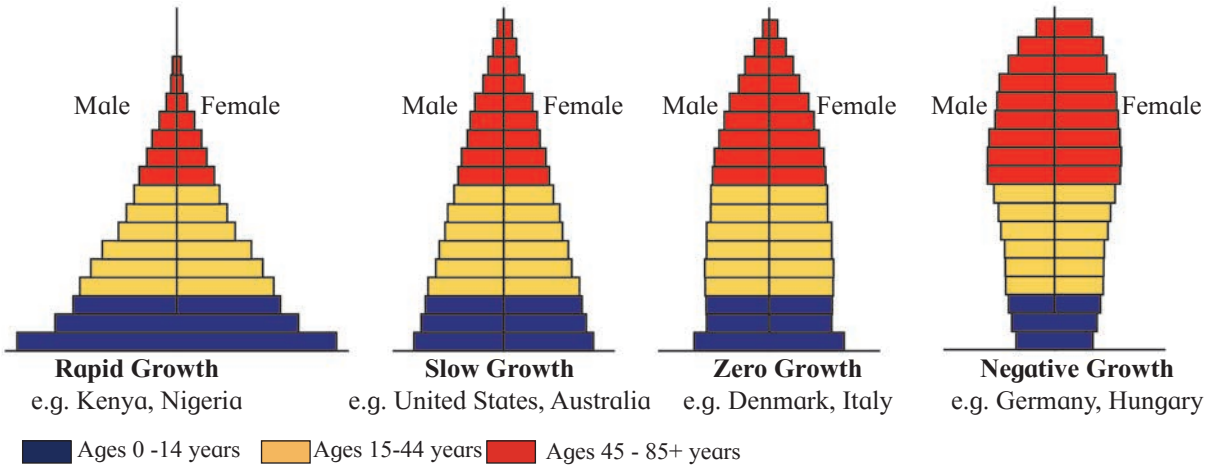

Fig. 13.3 : Age pyramids for countries with rapid, slow, zero and negative population growth rates.

Density of population in a habitat during a given period, fluctuates due to changes in four basic processes. New births (B) and Immigration contribute to an increase in population density. Deaths (D) and Emigration lead to decrease in population density. **Immigration** (I) is the number of individuals of the same species that have come into the habitat from elsewhere during the time period under consideration. **Emigration** (E) is the number of individuals of the population who left the habitat during the time period.

So, if N is the population density at time 't', then its density at time 't +1' can be calculated as,

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

Growth Models: Does the growth of a population with time show any specific and predictable pattern? We have been concerned about unbridled human population growth and problems created by it in our country and it is therefore natural for us to be curious if other animal populations in nature behave the same way or show some restraint on growth.

i. Exponential growth:

Resources like food, space are essential for any growth of a population. Ideally, when resources in the habitat are unlimited, each species has the ability to fully realize its innate potential to grow in numbers. Then the population grows in an exponential or geometric proportion.

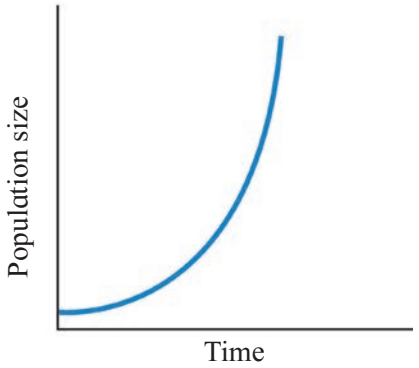

Fig. 13.4 : Exponential growth curve of population

Every species is capable of growing exponentially under unlimited resource conditions, and reach enormous population densities in a short time. Darwin showed how even a slow growing animal like elephant could reach enormous numbers. (provided food and space remain unlimited).

But resources like food and space are not always unlimited. They may be in the beginning; but as the population density increases, so does the competition for those resources, resulting in slowdown in the rate at which the original population was growing. This results in logistic or sigmoid growth curve.

ii. Logistic growth: competition between individuals for limited resources will weed out the 'weaker' ones. Only the 'fittest' individuals will survive and reproduce. In nature, a given habitat has enough resources to support a maximum possible number, beyond which no further growth is possible. Let us call this limit as nature's carrying capacity (K) for that species in that habitat.

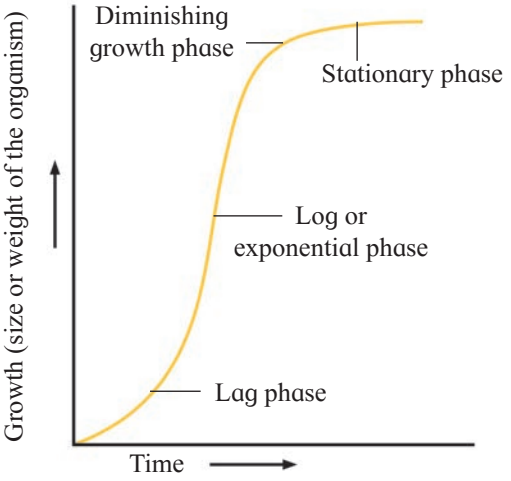

Fig. 13.5 : Logistic growth curve of population

A population growing in a habitat with limited resources show initially a lag phase, followed by phases of acceleration and deceleration and finally an asymptote, when the population density reaches the carrying capacity. A plot of population density (N) in

relation to time (t) results in a sigmoid curve. This type of population growth is called Verhulst-Pearl Logistic Growth.

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.

Internet my friend

Gather from Census-data the population figures for India for the last 100 years, plot them and check which growth pattern is evident?

Think about it

1. What will happen when carrying capacity of any habitat is exceeded?
2. What could be the reasons behind enormous increase in human population?

Under a particular set of selection pressures, organisms evolve towards the most efficient reproductive strategy. Some produce a large number of small-sized offspring (Oysters, pelagic fishes) while others produce a small number of large-sized offspring (birds, mammals).

Think about it

What can be the reason behind the different reproductive strategies adopted by monocot plants like cereals/ pulses and dicot plants like mango?

13.5 Population Interactions :

There is no natural habitat, which has only one species or animals or plants. For any species, the minimal requirement is another species as food. Even a plant species, which has photosynthetic abilities, cannot survive alone; it needs soil microbes to break down the organic matter in soil and release the inorganic nutrients.

It is obvious that in nature, animals, plants and microbes do not and cannot live in isolation but interact in myriad ways to form a biological community. Interactions may be **intraspecific** i.e. existing between organisms of same population, and **interspecific** -between members of different species. The interspecific interactions occur between minimum two organisms- plants/ animals/ plant and animal. Such interaction may be classified as four types viz, neutralism, negative (harmful), positive (benificial), and both positive and negative interactions. Even in simplest communities, many interactions exist, not all may be easily seen. Interspecific interactions arise from the interaction of populations of two different species. These interactions could be beneficial, detrimental or neutral (neither harm nor benefit) to one of the species or both.

Table 13.6 : Interspecific Interactions

Sr. no.	Type of interactions with subdivisions	Species	
		A	B
I	Neutralism - no significant effect	O	O
II	Negative interactions		
	a. Competition - direct interference type	-	-
	b. Competition - resource - use type	-	-
	c. Amensalism	-	O
III	Positive interactions		
	a. Symbiosis (Mutualism)	+	+
	b. Commensalism	+	O
	c. Protocooperation	+	+
IV	Both positive and negative interactions		
	a. Parasitism	+	-
	b. Predation	+	-

+ = benifited
- = inhibited
O = not affected

The various types of interactions are classified as per the nature of these interactions to one or both the species. Both the species are benefited in **mutualism** and both are harmed in **competition**.

In **parasitism** and **predation** only one species benefits (parasite and predator, respectively) and the interaction is detrimental to the other species (host and prey, respectively). The interaction where one species is benefitted and the other is neither benefitted nor harmed is called **commensalism**. In **amensalism**, on the other hand one species is harmed whereas the other is unaffected.

Mutualism:

This interaction is obligatory and interdependent. It benefits both the species. Lichens represent an intimate, mutualistic relationship between a fungus and photosynthetic algae or cyanobacteria. The most spectacular and evolutionarily fascinating examples of mutualism are found in plant-animal relationships. Plants need the help of animals for pollinating their flowers and dispersing their seeds. Animals obviously have to be rewarded in the form of pollen and nectar for pollinators and juicy and nutritious fruits for seed dispersers.

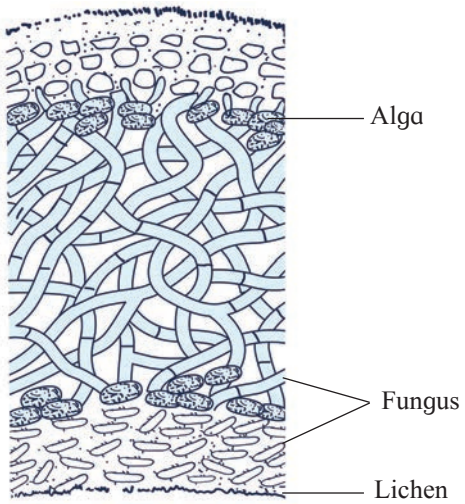

Fig. 13.7 : V. T. S. of Lichen thallus showing Algal and fungal components

But the mutually beneficial system should also be safeguarded against 'cheaters', for example, animals that try to steal nectar without aiding in pollination. Plant-animal interactions often involve co-evolution of the mutualists, that is, the evolutions of the flower and its pollinator species are tightly linked with one another.

Competition:

Competition is the type of interaction where both the species are at a loss. Totally unrelated species may compete for the same resource e.g. in shallow creeks on the west coast of Mumbai, visiting flamingos and resident fish compete for their common food, the zooplankton. Secondly, resources need not always be limiting for competition to occur. In competition, the feeding efficiency of one species is reduced due to the interference or inhibitory presence of the other species, even if resources (food and space) are abundant, e.g. Leopards do not hunt in close proximity of lion pride. Therefore, competition is best defined as a process in which the fitness of one species is significantly lower in the presence of another species.

Fig. 13.8 : Co-evolution of humming birds and plants

Gause's 'Competitive Exclusion Principle' states that two closely related species competing for the same resources cannot co-exist indefinitely and the competitively inferior one will be eliminated eventually. This may be

true if resources are limiting, but not otherwise. In interspecific competition with sufficient resources, species facing competition will evolve mechanisms that promote co-existence rather than exclusion. One such mechanism is 'resource partitioning'. If two species compete for the same resource, they could avoid competition by choosing different times for feeding.

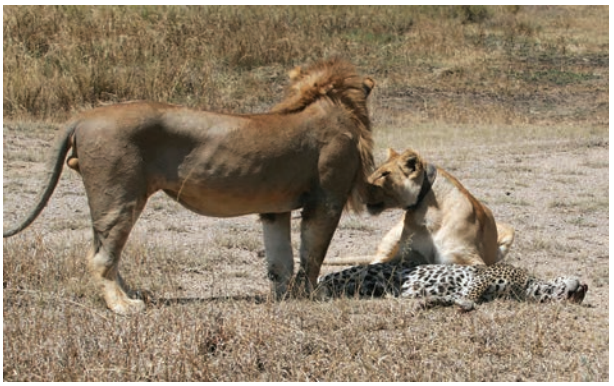

Fig. 13.9 : Lion standing over dead leopard- removing competition

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 range when the competing species is removed.

Parasitism:

Parasitism has evolved in so many taxonomic groups from plants to higher vertebrates. Many parasites have evolved to be host-specific (they can parasitize only a single species of host) in such a way that both host and the parasite tend to co-evolve, against each other. In accordance with their life styles, endoparasites evolved special adaptations such as the loss of unnecessary sense organs, presence of adhesive organs or suckers to cling on to the host, loss of digestive system and high reproductive capacity.

The life cycles of parasites are often complex, involving intermediate hosts or vectors to facilitate transfer to the host. The malarial parasite *Plasmodium vivax* needs a vector (mosquito) to spread to other hosts. Majority of the parasites harm the host. They may reduce the survival, growth and reproduction of the host and may lead to death of the host, thus reducing its population density. They might render the host more vulnerable to predation by making it physically weak.

Use your brain power

1. Should an ideal parasite be able to thrive within the host without harming it?
2. Why didn't natural selection lead to the evolution of such totally harmless parasites?

Parasites that feed on the external surface of the host organism are called **ectoparasites**. The most familiar examples of this group are the lice on humans and ticks on dogs. Many marine fish are infested with ectoparasitic copepods. *Cuscuta*, a parasitic plant that is commonly found growing on hedge plants, has lost its chlorophyll and leaves in the course of evolution. It derives its nutrition from the host plant which it parasitizes.

Brood parasitism in birds is a fascinating example, in which the parasitic bird lays its eggs in the nest of its host bird and lets the host bird incubate them. During the course of evolution, the eggs of the parasitic bird have evolved to resemble the host's egg in size and colour to reduce the chances of the host bird detecting the foreign eggs and ejecting them from the nest. Eggs of the parasitic bird (Asian koel) hatch before that of its host (Common Indian crow).

Fig. 13.10 : Crow feeding Asian Koel hatching in its own nest.

Predation:

When we think of predator and prey, most probably it is the tiger and the deer that readily come to our mind, but a sparrow eating any seed is no less a predator.

Although grazers are animals eating plants, classified as herbivores, they are, not very different from predators. Predators play many important roles. They keep prey populations under control. Without them, prey species would reach very high population densities and cause ecosystem instability e.g. in absence of frogs, locusts increase in density and destroy large tracts of agricultural lands. Biological control, methods adopted in agricultural pest control are based on the ability of the predator to regulate prey population. Predators also help in maintaining species diversity in a community, by reducing the intensity of competition among competing prey species.

When certain exotic species are introduced accidentally or intentionally into a new geographical area, they become invasive and start spreading rapidly due to absence of natural predator, e. g. zebra mussels in the intertidal zone of North America.

Internet my friend

Name the invasive species of plants and animals in India.

If a predator over exploits its prey, then the prey might become extinct and following it, the predator will also become extinct for lack of food. This is the reason why predators in nature are 'prudent'.

Prey species have evolved various defenses to reduce the impact of predation. It is a kind of 'evolutionary arms race'. Better camouflage for concealment, faster speed for escape are for the prey and the predator has to counter these, by its own means. Some species of insects and frogs are cryptically coloured (camouflaged) to avoid being detected easily. The Monarch butterfly is highly distasteful to its predator (bird) because of a special chemical present in its body. Interestingly, the butterfly acquires this chemical during its caterpillar stage by feeding on a poisonous weed.

Fig. 13.11 : Adult Monarch butterfly displaying warning colour pattern

For plants, herbivores are the predators. Plants therefore have evolved variety of morphological and chemical defenses against herbivores. Thorns (*Acacia*, Cactus) are the most common morphological means of defense. Many plants produce and store chemicals that make the herbivore sick. When chemicals/ produce are eaten, they inhibit feeding or digestion of predator and disrupt reproduction or even kill it. *Calotropis* growing in abandoned fields, produces highly poisonous cardiac glycosides and that is why you never see any cattle or goats browsing on this plant. A wide variety of chemical substances that we extract from plants on a commercial scale, (nicotine, caffeine, quinine, strychnine, opium, etc.,) are secondary metabolites produced by them actually as defences against grazers and browsers.

Commensalism:

This is the interaction in which one species benefits and the other is neither harmed nor benefited. An orchid growing as an epiphyte on

a branch of mango tree, will get benefit while the mango tree derives no benefit. The cattle egret and grazing cattle in close association, is a classic example of commensalism. Cattle egrets always forage close to cattle, as cattle move they flush out insects that might be difficult for the egrets to find and catch.

Another example of commensalism is the interaction between sea anemone that has stinging tentacles and the clown fish that lives among them.

The fish gets protection from predators which stay away from the stinging tentacles. The anemone does not appear to derive any benefit by hosting the clown fish.

Do you know ?

The instrument used to measure the hight of forest trees is called hypsometer.

World Environment day - 5th June

World Population day - 11th July

World Earth day - 22nd April

World Ozone day - 16th September

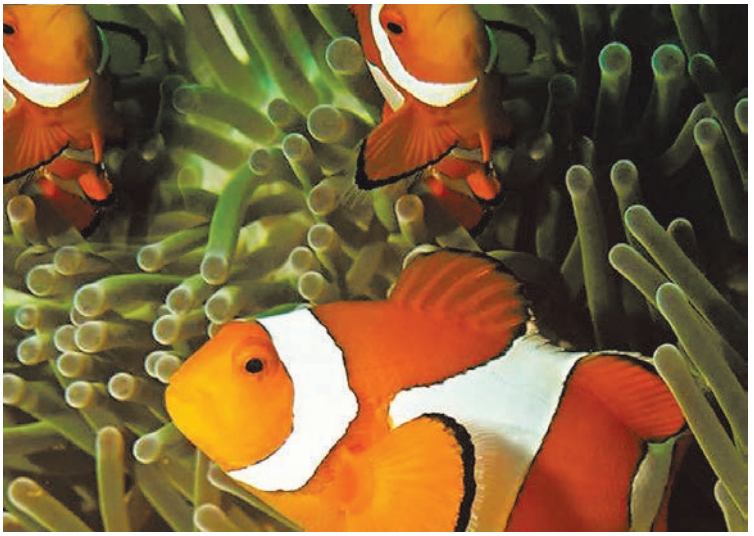

Fig. 13.12 : Commensalism- Cattle egret with buffalo and Clown fish in the tentacles of Sea anemone

Activity :

Prepare chart for various interactions existing in the plant community or animal community around you and paste the photographs of the same.

Exercise

Q. 1 Multiple choice questions.

1. Which factor of an ecosystem includes plants, animals and microorganisms?
   a. Biotic factor b. Abiotic factor
   c. Direct factor d. Indirect factor
2. An assembladge of individuals of different species living in the same habitat and having functional interactions is .....
   a. Biotic community
   b. Ecological niche
   c. Population
   d. Ecosystem
3. Association between sea anemone and Hermit crab in gastropod shell is that of .....
   a. Mutualism b. Commensalism
   c. Parasitism d. Amensalism
4. Select the statement which explains best parasitism.
   a. One species is benefited.
   b. Both the species are benefited.
   c. One species is benefited, other is not affected.
   d. One species is benefited, other is harmed.
5. Growth of bacteria in a newlly innoculated agar plate shows .....
   a. exponential growth
   b. logistic growth
   c. Verhulst-Pearl logistic growth
   d. zero growth

Q. 2 Very short answer questions.

1. Define the following terms :
   a. Commensalism b. Parasitism
   c. Camouflage
2. Give one example for each :
   a. Mutualism
   b. Interspecific competition
3. Name the type of association:
   a. Clown fish and sea anemone
   b. Crow feeding the hatchling of Koel
   c. Humming birds and host flowering plants
4. What is the ecological process behind the biological control method of managing with pest insects?

Q. 3 Short answer questions.

1. How is the dormancy of seeds different from hibernation in animals?
2. If a marine fish is placed in a fresh water aquarium, will it be able to survive? Give reason.
3. Name important defense mechanisms in plants against herbivores.
4. An orchid plant is growing on the branch of mango tree. How do you describe this interaction between the orchid and the mango tree?
5. Distinguish between the following:
   a. Hibernation and Aestivation
   b. Ectotherms and Endotherms
   c. Parasitism and Mutualism
6. Write a short note on
   a. Adaptations of desert animals
   b. Adaptations of plants to water scarcity
   c. Behavioural adaptations in animals
7. Define Population and Community.

Q. 4 Long answer questions.

1. With the help of suitable diagram describe the logistic population growth curve.
2. Enlist and explain the important characteristics of a population.

Project :
Study the age pyramid of human population in your area