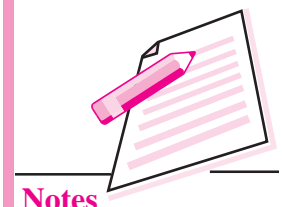
MODULE - IV
ENVIRONMENT AND HEALTH



Notes

25

PRINCIPLES OF ECOLOGY

Earth is the only planet in the solar system that supports life. This is because of the three physical systems on it that is, soil, water and air which provide material essential for life. All the living beings differ from each other but they are all interdependent and interact with each other as also with, their environment directly or indirectly. In this lesson we study the earths own life support system, the organisational levels of living beings and their characteristics.

OBJECTIVE

After completing this lesson, you will be able to:

- *define environment, ecology and biosphere;*
- *list the various components of the environment;*
- *name the biotic and abiotic components of the environment;*
- *mention the various levels of organisation of life.*
- *define terms related to environment or ecology like habitat, niche, population community, an biome.*
- *discuss inter-relationship between plants and animals in an ecosystem;*
- *describe food chain and food web;*
- *trace the path of energy flow through the food chain;*
- *differentiate between food chain and food web;*
- *pinpoint the position of human beings in a food chain;*
- *define biome;*
- *list the various biomes and their characteristics (flora and fauna);*
- *describe the biogeochemical cycles such as Carbon, Phosphorus and water cycles.*

Notes

25.1 ENVIRONMENT, ECOLOGY AND BIOSPHERE

25.1.1 Environment

The term environment denotes all the physical, chemical and biotic conditions surrounding and influencing a living organism. Favourable environmental conditions are required to sustain life on earth.

The environment can be divided into two main components : Non Living and Living

1. **Abiotic or Non-living components include** the physical (climatic), edaphic (nature of soil) and chemical. For example temperature, light, pressure, humidity, precipitation, wind, mineral elements of soil and composition of air. Some of these environmental factors serve as **resources** (air, soil and water) while others act as **regulatory factors** (light, temperature and pressure etc).
2. **Biotic or Living components include** All living organisms found in the environment including plants, animals and microorganisms.

25.1.2 Ecology

Ecology is the scientific study of the relationship and interactions between organisms and their environment. The term ecology is derived from a Greek word *Oekologie* where "*oikos*" meaning "household"and "*logos*" means "the study of".

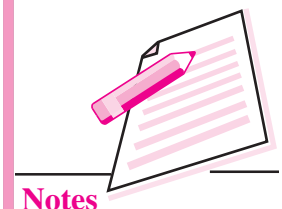
25.1.3 Organisation of Life

Various levels of organization exist in the living systems starting from the molecules such as DNA (genes) to the whole **biosphere**. The **levels of organization** are as follows :

Genes → Cell → organ → organism → Species Population → Community → Ecosystem → Biome → Biosphere

25.1.4 Levels of biotic organizations show direct impact of the environment

- An organism is a self reproducing system capable of growing and maintaining itself and is directly influenced by the surrounding environment.
- A population is an assemblage of similar organisms belonging to the same species, living together at one place at a given time. A population always lives a specific place known as its *habitat*. Habitat is thus the physical environment in which an organism lives. The environment provides for its needs. For example, the environmental requirement of an elephant would be a forest and not the ocean. Many different species with similar requirements may share a habitat. For example, a single ocean as a habitat may support a whale, a sea-horse, seal, phytoplankton, sea weeds and many other kinds of organisms. Forest, ocean, river etc. are some examples of **'habitat'** which in common language are the



'addresses' of organisms. The features of the habitat can be represented by its structural components (Fig. 1), namely:

1. Space
2. Food
3. Water
4. Cover or Shelter

Earth has four major habitats-(1) Terrestrial (2) Freshwater (3) Estuarine (where rivers meet the ocean) and (4) Oceanic. The human gut is the habitat of a tapeworm and the rotting log, a habitat of a fungus.

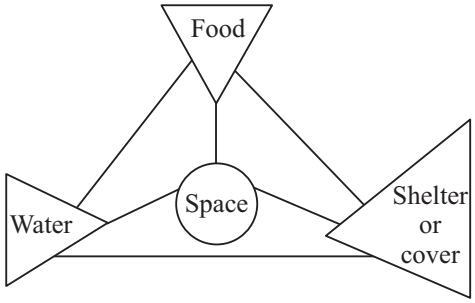


Fig. 25.1: Structural components of a habitat

Niche and Organism

In nature, many species occupy the same habitat but they perform different functions. The functional characteristics of a species in its habitat is referred to as "**niche".** While habitat of a species is like its 'address' (i.e. where it lives), niche can be thought of as its "profession" (i.e. activities and responses specific to the species). The term **niche means the sum of all the activities and relationships of a species by which it uses the resources in its habitat for its survival and reproduction.**

A niche is unique for a species (Fig. 25.2) while many species may share the same habitat. No two species in a habitat can have the same niche. This is because, if two species occupy the same niche they will compete with one another until one is displaced. For example different species of insects may be pests of the same plant but they can co-exist as they feed on different parts of the same plant that is because their niches are different (Fig. 25.3).

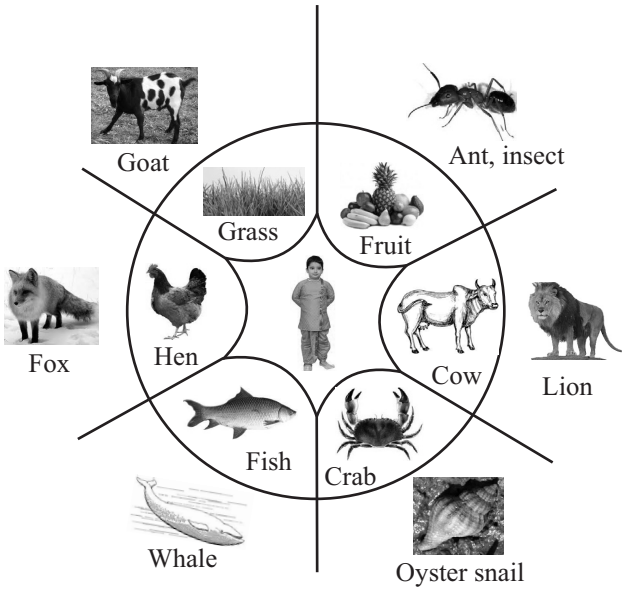


Fig. 25.2: The ecological niche of human being

Another such example is the vegetation of the forest. The forest can support a large number of plant species as they occupy different niches: the tall trees, the short trees, shrubs, bushes and grasses. Their heights vary and they differ in their requirements for sunlight and nutrients and so they can all survive together (Fig. 4)

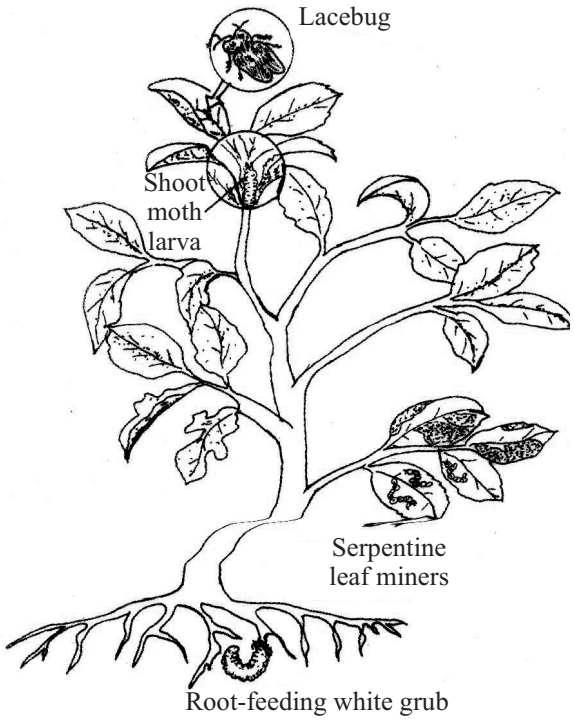


Fig. 25.3: Different species of insects feeding on different parts of the same plant

Fig. 25.4: Stratification a Tropical Rain Forest (Forest Ecosystem)

The most important resources available in the niches of animals are food and shelter while in case of plants, they are moisture and nutrients (phosphorus and nitrogen).

Adaptation

Every organism is suited to live in its particular habitat. You know that coconuts are adapted for growing in water while a camel is adapted for life in the desert.

An adaptation is thus, "the appearance or behaviour or structure or mode of life of an organism that allows it to survive in a particular environment".

Presence of gills and fins are examples of adaptation of fish to aquatic habitat. In aquatic flowering plants, absence of wood formation and highly reduced root system are adaptations to aquatic environment. Adaptations can be observed in structure or behaviour or physiology of an organism. Adaptations have a genetic basis and have been evolved and perfected through the evolutionary process.

Following are examples of basic adaptations that help animals and plants to survive in their respective environments.

- Shape of bird's beak suited to the kind of food it needs to procure. (Fig. 25.5a)
- The thickness or thinness of fur depends on the elimate in which the animal lives.
- Presence of feathers and wings in birds for movement in air.
- Presence of thorns on leaves and stems for protection, from herbivores (Fig. 25.5b).

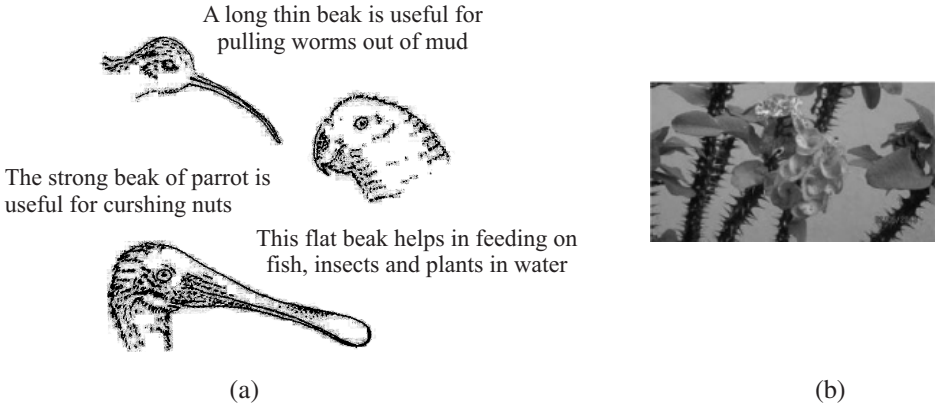


Fig. 25.5: (a) Adaptation in the types of beaks in birds: The beaks of different birds are adapted for feeding on different kinds of food (b) Plant with thorns for protection

Notes

INTEXT QUESTIONS 25.1

1. Name the various levels of organizations.

   .....

2. Define the term ecology.

   .....

3. What are the three physical systems that support life on earth?

   .....

4. Name the major components of the environment.

   .....

5. Enumerate the various physical factors of the environment

   .....

6. Why is habitat called the address of organisms and its niche 'the profession'? Justify.

   .....

7. What do we mean by 'fins are an adaptation of fish to aquatic life'? Explain.

   .....

Species

If you bring the sunfish from two different ponds and put them together in one pond, they can interbreed. So both the populations of sunfish belong to one species. *A **species** is defined as a group of organisms which can interbreed and reproduce successfully. These organisms may be separated in space and time into smaller groups called **populations**.* For example human populations live in different geographical areas but all belong to the species, *Homo Sapiens*.

25.4 POPULATION

'Population' is defined as a group of freely interbreeding individuals of the same species present in a specific geographical area at a given time.

A population has traits of its own which are different from those of the individuals forming the population. For example (i) An individual is born and dies but a population continues. Population may change in size depending on birth and death rates of the population. (ii) An individual is either female or male, young or old but a population has a sex ratio which means, the ratio of male to female in the population which also has (iii) age structure, which means the various age groups into which the population may be divided.

The **characteristics of any population** depends on the following factors.

(i) density of the population, (ii) natality (birth rate), (iii) mortality (death rate), (iv) dispersal, (v) biotic potential (vi) age distribution (vii) dispersion and (viii) growth form.

Density: The number of individuals per unit area at a given time is termed population density which may vary from time to time and place to place.

For example, you may notice more plant and animal species in the garden during the monsoon season.

Density of a particular organism in a region is determined by selecting random samples from an area of particular dimension (size) called quadrat from that region.

In case of large mobile animals like tigers, leopards, lions, deer etc, the density may be determined by counting individual animals directly or by the pugmarks (foot imprints) left by the animals in a defined area (Fig. 25.6).

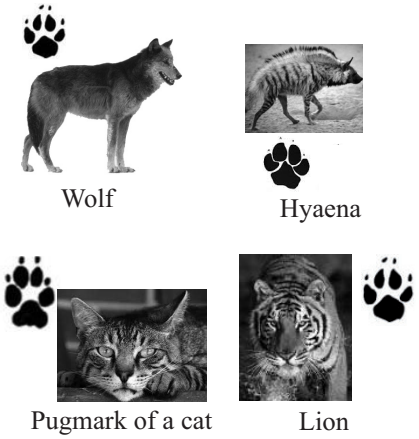


Fig. 25.6: Pugmarks (Foot prints of soft padded feet) of wild animals

Counting of human population is called **census** and is carried out by the Indian government every 10 years. In census however each individual is physically counted.

Birth Rate or Natality: The rate at which new individuals are born and added to a population under given environmental conditions is called natality.

In case of humans, natality or birth rate is usually expressed in terms of births per thousand per year.

Death Rate or Mortality: Loss of individuals from a population due to death under given environmental conditions is called mortality.

Mortality rate in human population may be expressed in terms of number of persons dead per thousand per year.

Dispersal: The movement of individuals of a population out of a region on a permanent basis is termed **emigration**. **Immigration** refers to the movement of individuals into a new area. Dispersal includes both emigration (going away permanently from an area) and immigration (influx of new individuals into the area).

The density of a population thus basically depends on four factors: (i) natality, (ii) mortality, (iii) immigration and (iv) emigration (Fig. 25.7)

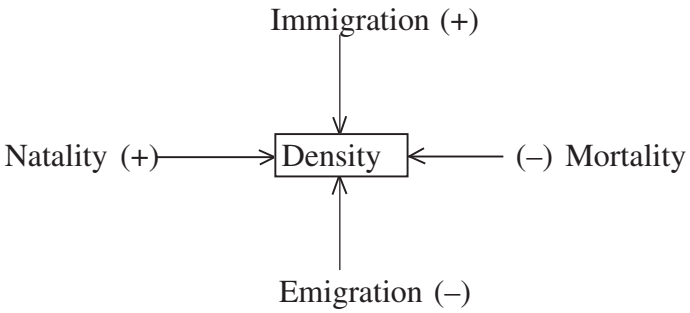


Fig. 25.7: Parameters of population.

Age distribution: Natural populations include individuals of all age groups. **Age distribution refers to the proportion of individuals of different age groups in a population**.The population may be broadly divided into three age groups:

- **pre-reproductive group**: comprising of juvenile individuals or children,
- **reproductive group**: consisting of individuals capable of reproduction ,
- **post-reproductive group**: contains aged individuals who are incapable of reproduction.

A rapidly growing population will usually contain a large proportion of individuals in the reproductive age group; a stationary population (where there is no increase or decrease in population) contains an even distribution of all age groups, and a declining population contains a large proportion of old or individuals of post-reproductive age.

Sex ratio: Sex ratio is an important aspect of population. It refers to the ratio between female and male individuals in a population.

Population Growth

The growth, stability or decline in number of individuals in a population is influenced by its relationship with the environment. Populations have characteristic patterns of growth with time, which is depicted by population growth curves. Two basic forms of population growth curves can be identified:

(i) 'J'shaped growth curve

(ii) 'S' shaped or sigmoid growth curve.

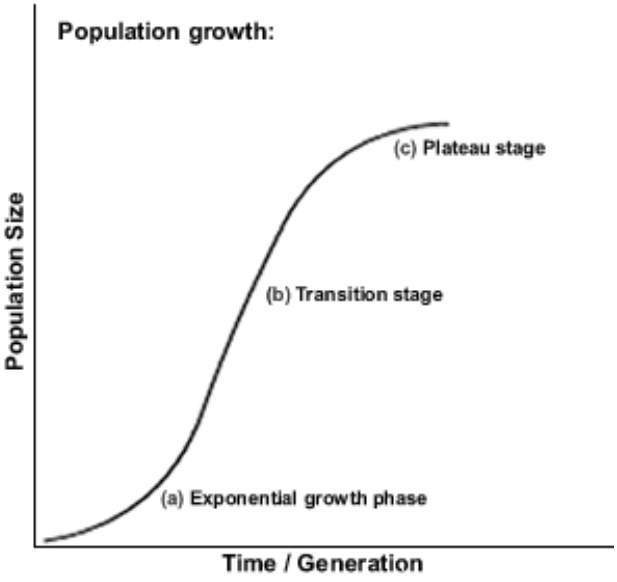


Fig. 25.8

The 'J' shaped growth curve is typical of the species which reproduce rapidly and which are greatly affected by seasonally fluctuating environmental factors such as light, temperature and rainfall. In this type of curve, population density increases rapidly in exponential (geometric) progression (total number doubles at regular intervals of time). **This type of exponential growth occurs in nature when a population has abundant supply of resources**. After reaching a peak there is a sudden crash or decline due to environmental or other factors. Such type of growth may be exhibited by insect populations which show explosive growth during the monsoon season and then abruptly disappear at the end of the season.

S-shaped curve or sigmoid growth curve has a lag phase, growth phase and a stable phase as shown in the figure, when few organisms occupy a hitherto unoccupied area reproduction occurs after some time (lag phase). Natality and mortality remain small. When growth phase begins, rapid increase in size of population occurs as there is plenty of food and no competition. Eventually, food or water or some source (e.g. nutrients in soil for plants) becomes limiting and population enters stable phase (plateau). Natality and mortality then become almost equal.

INTEXT QUESTIONS 25.2

1. A population with equal number of births and deaths will show:
   (a) Acceleration phase of growth (b) Plateau phase
   (c) Exponential growth phase (d) Initial phase of growth
2. When population reaches carrying capacity:
   (a) Mortality rate = Birth rate (b) Mortality rate > Birth rate
   (c) Mortality rate < Birth rate
3. Human population shows:
   (a) S-shaped growth curve (b) J-shaped growth curve
   (c) Z-shaped growth curve

- **Biological community** refers to the populations of different species occupying a common place of living. For example all the living organisms in a pond belong to one community. A biological community along with its nonliving environment of energy and matter makes an **ecosystem** (Fig. 25.9). Ecosystem can range in size from a puddle of water to a stream or a patch of wood to entire forest or desert.

The study of groups of organisms in relation to their environment is called ***synecology***.

Biosphere

A thin layer on and around the earth which sustains life is called **biosphere**. Life exists in the diverse forms of living organisms. All these living organisms of the biosphere are directly or indirectly dependent on one another as well as on the physical components of the earth. The three physical components of the earth are **atmosphere, lithosphere** and **hydrosphere** (air, land and water).

The **atmosphere** is a gaseous envelope surrounding the earth's surface, It is made up of nitrogen, oxygen, carbon dioxide and many other gases in very small amounts.

Hydrosphere is all the water supply to the earth which exists as liquid, vapour or frozen form of fresh and salt water.

Lithosphere comprises the soil and rock of the earth's crust.

Recently the term ecosphere is being used more commonly. It is used to denote biosphere (living components) along with its three abiotic components –atmosphere, hydrosphere and lithosphere of the earth as one entity (unit).

Ecosphere = Biosphere + Lithosphere + Hydrosphere + Atmosphere)

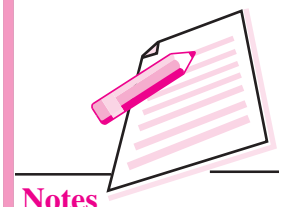
25.3 ECOSYSTEM

Ecosystem is a self sustaining unit of nature. It is defined as a functionally independent unit (of nature) where living organisms interact among themselves as well as with their physical environment. In nature two major categories of ecosystems exist : **terrestrial** and **aquatic**.

Forests, deserts and grasslands are examples of terrestrial ecosystem.

Ponds, lakes, wet lands and salt water are some example of aquatic ecosystem. Crop lands and aquarium are the example of man made ecosystems.

The interaction between the living organisms and their environment can be studied in a puddle of water or a hole in a tree, which are very small ecosystems or in large ecosystems such a forest, river or ocean. Irrespective of their sizes all ecosystems share many common characteristics. Let us study moderate sized pond ecosystem to understand its structural and functional components.



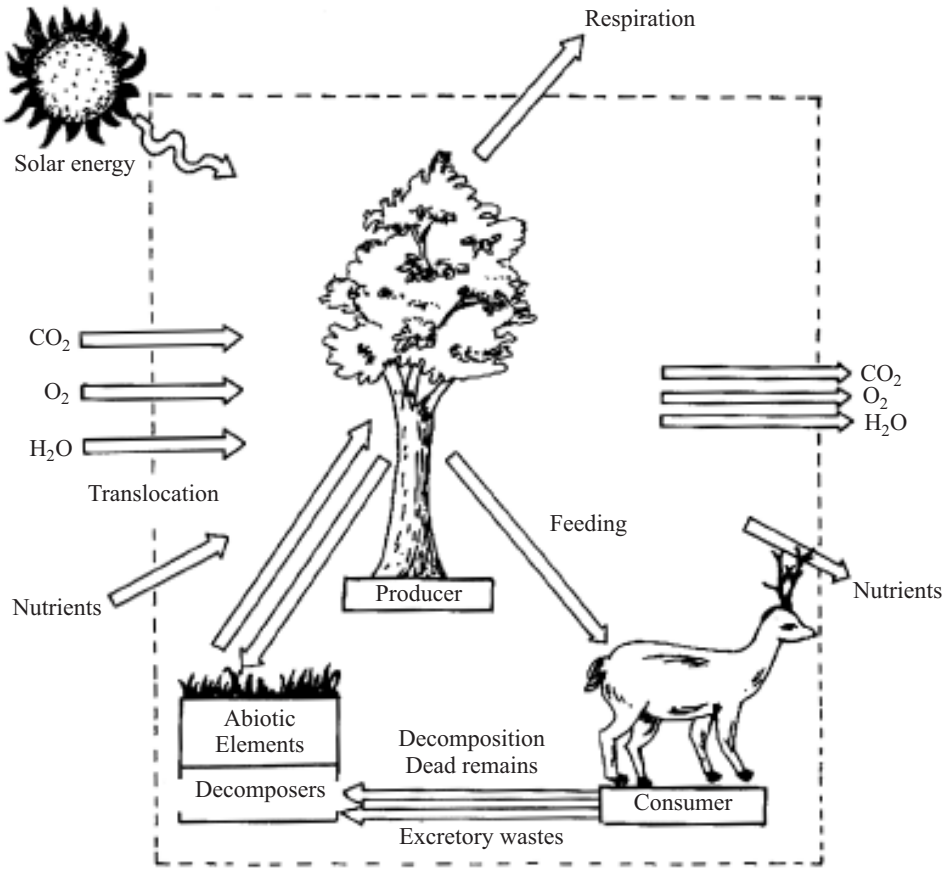


Fig. 25.10: Components of an ecosystem.

In the Fig. 25.2 (pond ecosystem), you can see that it is a shallow body of water. Sun's light can penetrate into it. It has sediment as a substrate at the bottom that is a source of nutrition for living organisms. The living organisms in it are small floating plants, submerged vegetation and rooted plants. There are animals of various sizes ranging from microscopic to large fishes. All these components of the pond ecosystem can be arranged to give it a definite structure.

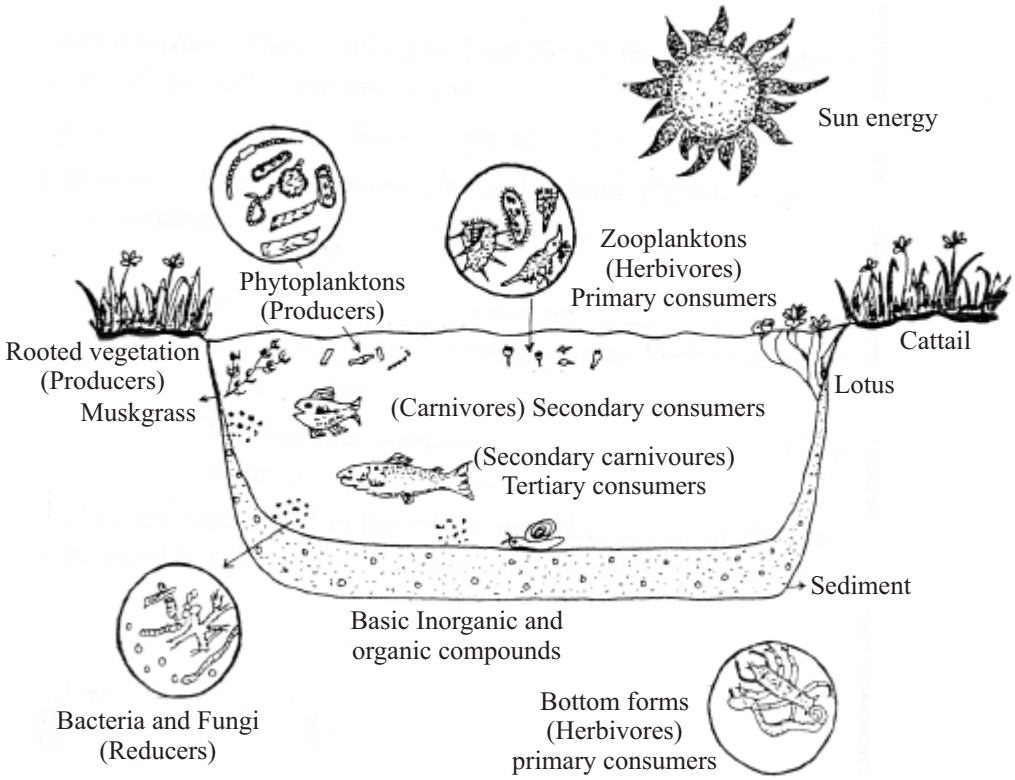


Fig. 25.11: Pond ecosystem

25.3.1 Structure of Pond Ecosystem

Abiotic Components

1. **Physical or climatic regime :** Pond receives solar radiation, which provides it heat and light energy to sustain life.

   (a) **Light :** In case of shallow ponds with clear water sun light can penetrate up to the bottom . In deep ponds penetration of light depends on the transparency of water The amount of dissolved/suspended particles, nutrients and number of animals and plants determine the transparency of water and control the penetration of light in it.

   (b) **Temperature :** Heating effect of solar radiation leads to diurnal (day and night) or seasonal temperature cycles. In the tropical regions there are not much temperature variations. At higher latitudes there are remarkable seasonal temperature variations.

2. **Inorganic substances :** These are water, carbon, nitrogen, phosphorus, calcium and a few other elements like sulphur or phosphorus depending on the location of the pond. O_2 and CO_2 are in the dissolved state in water. All animals and plants depend on water for their food and exchange of gases.

3. **Organic compounds :** The commonly found organic matter in the pond is amino acids and humic acids and the breakdown products of dead animal and plant tissues. They are partly dissolved in water and the remaining are accumulated in sediment.

Biotic Components

1. **Producers or Autotrophs :** They synthesize food for all the heterotrophs of the pond. They are of the following two types.

   (a) Floating plants (b) Rooted plants

   (a) **Floating plants :** They are called **phytoplankton** ("phyto"- plants, "plankton" - floating.) for example, *Spirogyra*, *Ulothrix*, diatoms and *Volvox*.

   (b) **Rooted plants :** These plants occur in concentric layers from periphery to the deeper zones. Some examples of rooted plants are *Typha bulrushes*, *Sagittaria*, *Hydrilla*, *Rupia*, *Chara.*

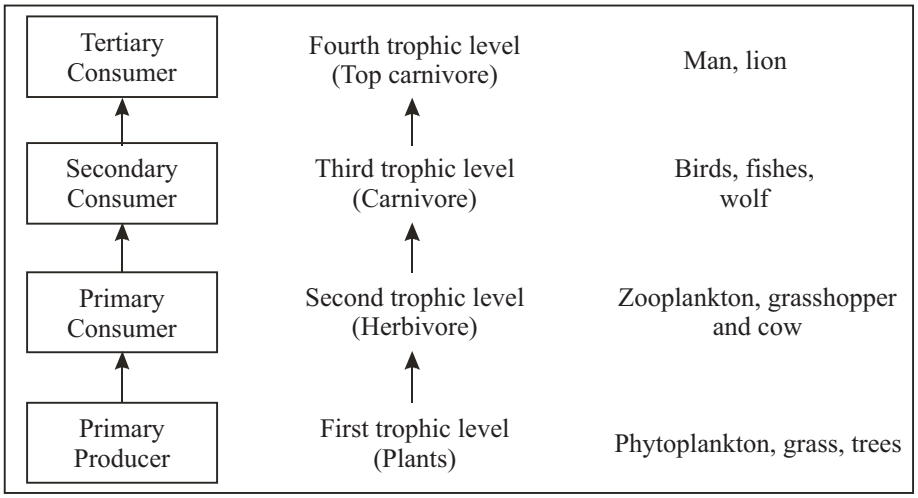
2. **Consumers or Heterotrophs :** Animals, which feed directly on autotrophs (e.g. insect larvae, tadpole, snails) or on other animals (sunfish and bass)

3. **Decomposers :** They are distributed in the whole pond but are most abundant at the bottom of the pond in the sediment e.g. bacteria and many different types of microbes.

25.4 ECOSYSTEM : STRUCTURE AND FUNCTION

You have already learnt that ecosystems are capable of persisting as independent units of nature. In the following part of the lesson you will learn about the structure and functions of ecosystem. Interaction between biotic and abiotic components results in a physical structure characteristic of each type of ecosystem. The important structural features are **species composition** (types of plants and animals) and **stratification** (vertical and horizontal distribution of various species occupying different levels). Another way of looking at the structural components is through food relationships of producers and consumers. Several **trophic levels** exist in the ecosystem. These feeding relationships can be studied as food chain, food web and standing crops. These structural components function as a unit and produce certain functional aspects of ecosystem. Some of these aspects are :

- Productivity, energy flow, nutrient cycle



Diagrammatic representation of trophic levels in an ecosystem

25.4.1 Species Composition

A community is an assemblage of many populations that are living together at the same place and time. For example a tropical forest community consists of trees, vines, herbs and shrubs along with large number of different species of animals. This is known as species composition of tropical forest ecosystem. Each ecosystem has its own species composition depending upon the suitability of its habitat and climate. If you compare animal and plant populations of a forest they are entirely different from those of a grass land. Not only are the types of species different in these two ecosystems but even their total number and biomass varies. A forest ecosystem supports much larger number of species of plants and animals than a grassland. The total number and types of species in a community determine its stability and **ecosystem balance** (ecosystem equilibrium).

25.4.2 Stratification

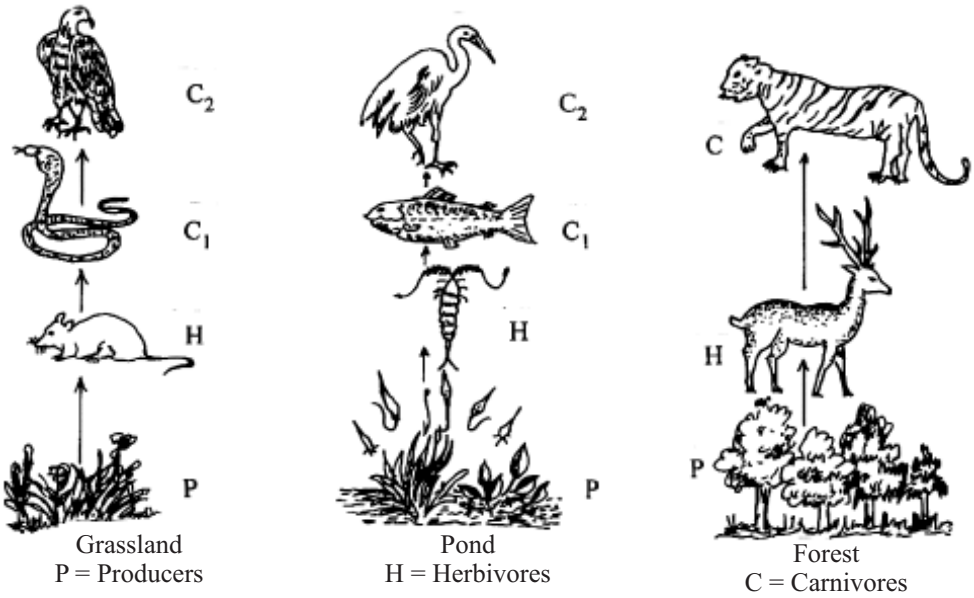
The vertical and horizontal distribution of plants in the ecosystem is called **ecosystem stratification**. You would have observed that the plants are of different heights in forests. Tallest trees make the top canopy. This is followed by short trees and shrubs and then the forest floor is covered with herbs and grasses. Some burrowing animals live underground in their tunnels or on the roots of the plants. Each layer from the tree top to the forest floor has its characteristic fauna and flora. This is termed as vertical stratification of forest ecosystem. On the other hand desert ecosystem shows low discontinuous layers of scant vegetation and animals with some bare patches of soil showing a type of horizontal stratification.

25.4.3 Food Chain

Transfer of food from the plants (producers) through a series of organisms with repeated eating and being eaten is called a food chain e.g.

Grasses → Grasshopper → Frogs → Snakes → Hawk/Eagle
1 2 3 4 5

1. Each step in the food chain is called trophic level. In the above example grasses are first and eagle represents the fifth trophic level.
2. Some more examples of food chain are given in Fig. 25.13.



Grassland
P = Producers

Pond
H = Herbivores

Forest
C = Carnivores

Fig. 25.13: Some examples of food chain.

Three important features that you can note in these chains are :

- Weaker organisms are attacked by the stronger organisms
- Number of organisms is reduced at each higher level but the size of organisms is increases.
- The number of steps in a food chain is limited to 4-5.

A. A food chain consists of the following trophic levels :

(i) **(Producers) Autotrophs :** They produce food for all other organisms of the ecosystem. Autotrophs represent the first trophic level. They are largely green plants they convert inorganic substances by the process of photosynthesis into food (organic molecules) in the presence of sun light. The total rate at which the radiant energy is stored by the process of photosynthesis in the green plants is called Gross Primary Productivity (GPP). This is also known as total photosynthesis. A part of the gross primary productivity is utilized by the plants for their own metabolism, maintenance and reproduction. Energy required for all these functions is produced by the process of respiration. The remaining is stored by them as Net Primary, Productivity (NPP) and is available to the heterotrophs or consumers, (The next trophic level)

$$GPP = NPP + R \quad \text{or} \quad GPP - R = NPP$$

Productivity in the biological system is a continuous process but it is different in different ecosystems.

(ii) **Primary consumers Herbivores** : These are animals which feed directly on the plants. They are first level consumers and therefore they are also known as primary consumers and make the second trophic level in the food chain e.g. grasshopper in the above example. Other examples are insects, birds, rodents and ruminants. Herbivores are capable of converting energy stored in the plant tissue into animal tissue and therefore they are also known as key industry. They can digest high cellulose diet.

(iii) **Secondary consumer Carnivores :** Carnivores are the animals that feed on other animals or its tissues. Therefore they are secondary, tertiary or quaternary level consumers. Frog is secondary level consumers as it feeds on herbivorous grasshopper. Snake is tertiary level consumer since it consumes other carnivore that is frog. Frog, snake, dog, cat and tiger are all carnivores. Generally the size of the carnivore/ increases at each trophic level.

(iv) **Decomposers :** They make up the final trophic level in a food chain. Decomposers are the organisms that feed on dead organic matter called detritus of all the trophic levels and help in recycling the nutrients. Examples of decomposers are bacteria, fungi, mites, millipedes, earthworms, nematodes, slugs, crabs and molluscs.

Special feeding groups (Consumers)

(i) **Scavengers** : These are the animals that feed on the dead plants and animals. e.g. termites and beetles feed on the decaying wood, and many marine invertebrates. Vultures, gulls and hyena are other examples of scavengers.

(ii) **Omnivores :** Omnivores consume both plants and animals as source of their food e.g. human beings. Some of the omnivores like the red fox feeds on berries small rodents as well as on dead animals. Thus it is a herbivore, carnivore and also a scavenger.

(iii) **Parasites :** They live and feed on/in other living organisms called *host*. Parasites not only feed on their host but they also cause lethal or nonlethal disease in it.

B. Position of human beings in the food chain ; Human beings are consumers and may occupy

Primary, secondary or tertiary levels. Vegetarian people are 'primary consumers; when they consume small fish chicken or goat meat they are 'secondary' consumers and when they consume big fishes they are 'tertiary' consumers. Can you explain why big fishes feed upon small fishes and other smaller aquatic animals?

25.4.4 Food Web

In nature the food chains are not isolated sequences but they are interconnected with one another. *A net work of food chains which are interconnected at various trophic levels of the food chain to form a number of feeding connections is called a food web*. In a food web one trophic level may be connected to more than one

food chain. A snake can feed on frog or rat or any other small rodent. In the figure given below sunfish consumes zooplanktons as well as bloodworms.

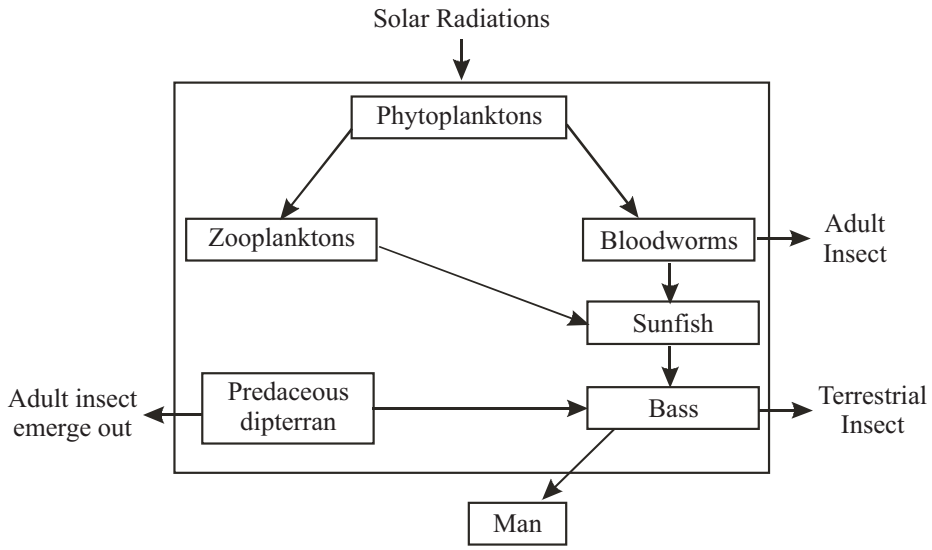


Fig 25.14: Simple food web in a pond ecosystem.(modified from Odum)

INTEXT QUESTIONS 25.3

1. Define an ecosystem.

   .....

2. What are the main components of an ecosystem?

   .....

3. Give reason, why are decomposers necessary in an ecosystem?

   .....

4. What is the role of decomposers in nature?

   .....

5. Why are plants called autotroph and animals called heterotrophs?

   .....

6. Give one example of food chain.

   .....

7. Name the trophic level frog belongs to.

   .....

8 Snake can be both a secondary as well as tertiary consumer Justify.

   .....

25.4.5 Energy flow through an ecosystem

The energy enters into the ecosystem in the form of solar radiation and is converted into food (plant biomass) by the producers. Food stored by the plants and their biomass (matter) is the chemical form of energy. From the producers this chemical

form of energy passes through various trophic levels in the food chain. *This process of transfer of energy through various trophic levels of the food chain is known as flow of energy.*

All the functions of ecosystem depends on the flow of energy through it. In figure 25.5, boxes represent the trophic level and the pipes depict the energy flow in and out of each trophic level. The quantity of energy flowing through the successive trophic levels decreases as indicated by the reduced size of the boxes and thickness of pipes in the figure. This is because all the energy entering at each trophic level is not used for production of biomass due to the following two reasons.

- Firstly a part of the energy (not utilized) as and lost as heat.
- Secondly a part of it is used up by the organisms and lost as heat for their own metabolism through the process of respiration.

If herbivores consumes 1000 kcal. of plant energy in the form of food, only 100 kcal. is converted into herbivore tissues, and 10 kcal. into first level carnivore and only 1 kcal into second level carnivore. This is known as 10% law (or ecological rule of thumb) where by only 10% of the energy is transferred to the next higher trophic level.

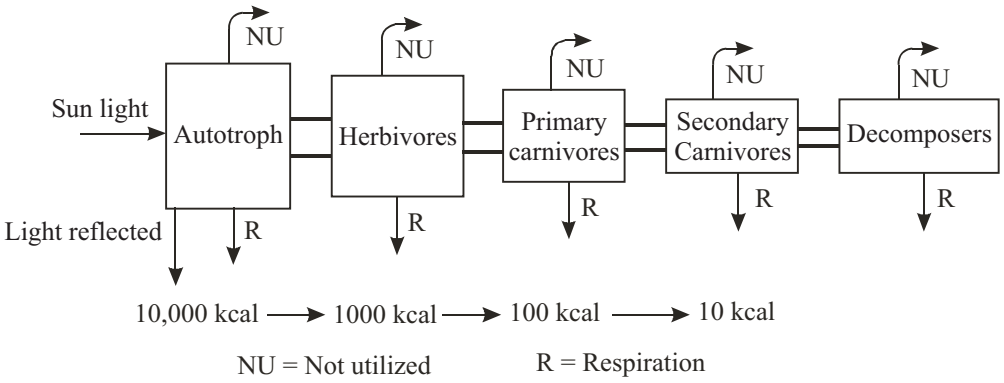


Fig. 25.15: Energy flow in a ecosystem. Boxes indicate the standing crop biomass and pipes indicate the energy flowing

The entire process of energy flow can be summarized in the following four steps:

- The flow of energy in an ecosystem is always linear or one-way.
- At every step in a food chain the energy received by the organism is also used for its own metabolism and maintenance. The left over is passed to next higher trophic level. Thus energy flow decreases with successive trophic levels.
- It follows the ecological thumb rule of 10%.
- The number of steps is limited to four or five in a food chain for the transfer of energy.

25.4.6 Ecological Pyramids

Standing crop is the amount of biomass or energy present in different trophic levels at any given time. This is another important characteristic of an ecosystem. It can be expressed in terms of

- biomass,

- number or
- total energy fixed at each step at each trophic level.

These three parameters give a definite trophic structure to the ecosystem. It is represented with the producers at the base and the subsequent trophic levels as the tiers. This gives a gradually sloping pyramidal shape.

This graphical representation of the standing crop expressed as number, biomass or energy is called pyramid of number, pyramid of biomass and pyramid of energy respectively. Collectively they are known as ecological pyramids. Some examples

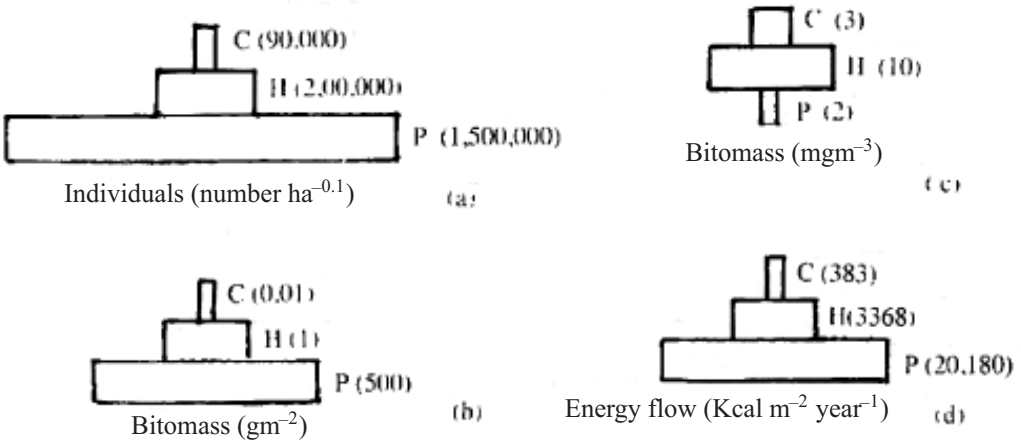


Fig. 25.16: Ecological Pyramids (P = producer; C1 Herbivores; C2 Primary carnivores; C3 secondary carnivores)

INTEXT QUESTIONS 25.4

1. What can be the maximum number of steps in a food chain?

   .....

2. Why is energy flow linear in ecosystem?

   .....

3. Define : (a) biomass (b) pyramid of number.

   .....

4. What is meant by community stratification?

   .....

25.5 TYPES OF ECOSYSTEMS – NATURAL AND HUMAN MODIFIED

You have already learnt about the components, structure and functions of an ecosystem. Now you can easily identify and study a few ecosystems around you. Ecosystems are classified as natural and human modified depending upon whether they are fully dependent on the solar radiation and other natural sources of energy or on fertilizers and fossil fuels. Natural ecosystems are such as ponds, lakes,

Notes

meadows, marshlands, grasslands, desert and forests. They are our natural resources and provide us food, fuel, fodder and medicines. Human modified ecosystem are made and managed by human beings for their better living. Urban ecosystem, rural ecosystem, agro-ecosystems, aquaculture and spaceship aquarium terrarium, are some examples of the human modified ecosystems.

BIOTIC INTERACTIONS IN ECOSYSTEMS

The biological community in an area or ecosystem is a complex network of interactions.

The interaction that occurs among different individuals of the same species is called **intraspecific interaction** while the interaction among individuals of different species in a community is termed as **interspecific interaction.**

Interactions between organisms belonging to the same trophic level often involve **competition**. Individuals of a population may compete for food, space and mates. For example if a mouse has been eaten by a cat, other cats competing for this resource would have one less mouse to prey on. The snake another predator of the mice would also have fewer mice to eat during the night if the cat has succeeded. Direct competition, though, between the cat and snake is not much as they prey at different times. They also eat a variety of different foods. So competition may be intraspecific as well as interspecific.

Interspecific relationship may be direct and close as between a lion and deer or indirect and remote as between an elephant and a beetle. This is because interactions between two species need not be through direct contact. Due to the connected nature of ecosystems, species may affect each other through intermediaries such as shared resources or common enemies. Specific terms are applied to interspecific interactions depending upon whether the interaction is beneficial, harmful or neutral to individuals of the species. The various possible interactions between two species are given in Table 1

Table 1: Possible biological interactions between two species

S.No.	Type of interaction	Result of one species on the other	Effects of interaction
I.	**Negative Interactions**		
(i)	Amensalism	0	One species is inhibited while the other species is unaffected
(ii)	Predation	+	Predator-prey relationship: one species (predator) benefits while the second species (prey) is harmed and inhibited.

(iii)	Parasitism	+		Beneficial to one species (parasite) and harmful to the other species (host).
(iv)	Competition	0		Adversely affects both species
II.	**Positive Associations**			
(i)	Commensalism	+	0	One species (the commensal benefits, while the other species has neutral Interactions)
(i)	Neutralism	0	0	Neither species affects the other(the host) is neither harmed nor inhibited
(ii)	Mutualism	+	+	Interaction is favourable to both species
III.	**Neutral Interactions**			
(i)	Neutralism	0	0	Neither species affects the other

+ = beneficial; – = harmful; 0 = unaffected neutral

Interactions may be of various kinds

1. **Amensalism**: This is a negative association between two species in which one species harms or restricts the other species without itself being adversely affected or harmed by the presence of the other species. Organisms that secrete antibiotics and the species that get inhibited by the antibiotics, together form example of amensalism. For example the fungus called bread mould or *Pencillium* produces penicillin, an antibiotic, which inhibits the growth of a variety of bacteria. *Pencillium* benefits apparently by having greater availability of food when in the competition bacteria are removed.
2. **Predation**: In this type of interaction, predator captures, kills and eats an animal of another species called the prey. The predator naturally benefits from this relationship; while the prey is harmed. Predators like leopards, tigers and cheetahs use speed, teeth and claws to hunt and kill their prey.
3. **Parasitism**: In this type of interaction, one species is harmed and the other benefits. Parasitism involves small sized organisms or parasites living in or on another living species called the host from which the parasite gets its nourishment and often shelter.

   The parasite is benefited and the host is harmed. Many organisms like, bacteria and viruses are parasites of plants (Fig. 10a) and animals (Fig. 10b). Plants like dodder plant (*Cuscuta*) (Refer again to Fig. 10a) and mistletoe (*Loranthus*) are

parasites that live on flowering plants. Tape worm, round worm, malarial parasite, many bacteria, fungi, and viruses are common parasites of humans.

(a) (i)

Dodder, a parasitic plant is eating up a bush

(ii)
Dodder, a leafless parasitic plant, growing on the leaf of a grass tree

(b) *Ascaris lumbricoides* infections. A mass of large round worms from a human infestatic

Fig. 25.16: Parasite-host relationship (a) Plant parasite: Dodder (*Cuscuta)* plant is a parasitic weed that obtains moisture and nourishment by attaching to a green, living plant. (b) Animal parasite: *Ascaris* or round worms are internal parasites found in the human intestine

4. **Competition**: This is an interaction between two populations in which both species are harmed to some extent. Competition occurs when two populations or species, both need a vital resource that is in short supply. The vital resource could be food, water, shelter, nesting site, mates or space. Such competition can be: (i) **interspecific competition**-occurring between individuals of two different species occurring in a habitat and (ii) **intraspecific competition**-occurs between individuals of same species.

   Intraspecific competition occurs between members of the same species and so it is very intense.

5. **Commensalism:** In this relationship one of the species benefits while the other is neither harmed nor benefited. Some species obtain the benefit of shelter or transport from another species. For example sucker fish, remora often attaches to a shark by means of its sucker which is present on the top of its head. This helps remora get protection, a free ride as well as a meal from the left over of the shark's meal.The shark does not however get any benefit nor is it adversely affected by this association. Another example of commensalism is the relationship between trees and epiphytic plants. Epiphytes live on the surface of other plants like ferns, mosses and orchids and use the surface of trees for support and for

obtaining sunlight and moisture.The tree gets no benefit from this relationship nor are they harmed.

6. **Mutualism**: This is a close association between two species in which both the species benefit. For example the sea anemone, a cnidarian gets attached to the shell of hermit crab for benefit of transport and obtaining new food while the anemone provides camouflage and protection by means of its stinging cells to the hermit crab (Fig. 11).

Fig. 25.17: Sea anemone, attached to a shell inhabited by a hermit crab

However, some examples of mutualism are such that the interacting species can no longer live without each other as they depend totally on each other for survival. Such close associations are termed **symbiosis**. An example of such close mutualistic association is that of termite and their intestinal flagellates. Termites can eat wood but have no enzymes to digest it. However, their intestine contains certain flagellate protists (protozoans) that have the necessary enzymes to digest the cellulose of the wood eaten by termites and convert it into sugar. The flagellates use some of this sugar for their own metabolism while enough is left for the termites. Both termite and flagellates cannot survive without each other. Another familiar example of symbiosis is seen in pollination of flowers where flowering plants are cross pollinated by the bees which benefit by getting nectar from the plants. Both cannot survive without the other.

INTEXT QUESTIONS 25.5

1. Fill in the blanks

   (a) The relationship between two organisms where one receives benefits at the cost of other is known as .....

   (b) A group of several species living together with mutual tolerance or adjustment and beneficial interactions in a natural area is known as .....

   (c) A force that acts against maximum population growth is .....

   (d) Association between insect polinated flowers and pollinating insect is an association termed as .....

25.6 BIOMES

When you travel long distances in a train from one part of the country to the other you enjoy watching outside. Your train passes through the thick forests, grasslands deserts, croplands and some times mountains. If you look at the earth from a distance it shows beautiful kaleidoscopic patterns. All these patterns are because of the different types of plants that grow in these regions. The plant growth is determined by physical, edaphic and geographical characteristics of a place. These are the natural broad biotic zones of the biosphere called, **Biomes**. Each biome is characterized by uniform life form of vegetation such as grass, desert plants, deciduous trees or coniferous trees. A Biome is a large ecosystem which is embracing the large land scape, characterised by specific flora and fauna. Biomes can be classified as :

A. Terrestrial : These are the biomes found on land e.g,, Tundra, forest, deserts, grasslands

B. Aquatic. These are the biomes found in water. These can be :

(i) Fresh waters, such as pond, lake and river

(ii) Marine as oceans, shallow sea

25.6.1 Terrestrial Biomes

A. Forests : Forests are one of the largest plant formations, densely packed with tall and big trees. Forests are of many different types, depending on the climatic regime in which they are found. Three main forest types are:

1. Tropical rain forests
2. Temperate deciduous forests
3. Boreal or north coniferous forests

1. Tropical Rain (Evergreen) Forest : These are in the tropical region of very high rain fall. Such forests are well developed over the western coast of India and North eastern Himalayas and scattered in south east Asia, west Africa and north cost of South America.

Main characteristics

- Temperature and light intensity are very high
- Rain fall is greater than 200 cm. per year.
- Soil of these regions is rich in humus,
- The rate of **turnover** of the nutrients is very high leading to high productivity and have highest standing crop and biomass.

- The vegetation includes broad evergreen trees of about 200 feet like bamboos, ferns, shrub etc. Epiphytes and woody wines (liannas) are also abundant. Many tree species show buttresses (swollen stem bases) and leaves with drip tips.

These forests have rich invertebrate and vertebrate fauna. Snails, centipedes, millipedes and many insect species are common near the forest floor. *Rhacophorus* (flying frog), aquatic reptiles, *Chameleon* and many birds are common in these forests. Mammals of these forests are sloths , monkeys, ant eaters, leopards, jungle cats and giant flying squirrels.

2. **Temperate Deciduous Forests :** Trees of deciduous forests shed their leaves in autumn and a new foliage grows in spring. They occur mostly in northwest, central and eastern Europe, eastern north America, north China, Korea, Japan, far eastern Russia and Australia.

   Climate : These forests occur in the areas of moderate climatic conditions such as

   - Annual rainfall is 75 to 150 cm
   - Winter lasts for four to six months.
   - Temperature ranges between 10 to 20°C.
   - Soil is brown and rich in nutrients.

   Flora and fauna : Commonly found trees in this ecosystem are oak, birch heath, chest nuts, pitch pine, cyprus. Invertebrate fauna comprises green oak moth, bark beetle, green flies, aphids, sapflies, moths and butterflies. Prominent grazers are grass eating rodents, deer and bison. Rodents play a very important role in these forests. They feed on the seeds, fruits and leaves of the trees and consume much more food than the large sized grazers. Common carnivores in temperate forests are wild cat, wolves, foxes, tawny owl and sparrow hawk. Black bear, raccoons and skunks are the omnivorous animals of these forests.

3. **Coniferous forests :** Coniferous forests are also known as **Taiga** or **Boreal** forests. They extend as a continuous belt across north America and north Eurasia below the arctic tundra. In the Himalayas, these are distributed above 1700 to 3000 metre altitude. They also occur at high altitude below the alpine tundra and tree line.

   Climate : Climate is cold.

   - Long and harsh Winters is for more than six months. Mean annual temperature is below 0°C,
   - Soil is poor in nutrients and acidic in nature.

   Flora and fauna : Coniferous forests are characterized by conifers (gymnosperms). They are evergreen, drought resistant and woody. In many species the canopy is cone shaped. The common species of trees of these forests are Spruce, fir and pine trees. The productivity is much less than other

ecosystem. There are very few animals in these forests. The herbivores are red squirrel, deer, goat, mule, moose etc. The carnivores are timber wolves, lynxes, wolverine, weasels mink and bear. Some common birds are cross bill, thrushes, warblers, flycatchers, robin and sparrow.

B. Grasslands

Distribution : Grasslands are dominated by the grasses. They occupy about 20% of the land on earth's surface. They occur in both tropical and temperate regions where environmental conditions are better than that of the desert but rainfall is not enough to support the growth of trees. Grasslands represent an **ecotone** (a zone in between two ecosystems) and are found between forest on one side and deserts on the other. They are subjected to greater variation of temperature, moisture, wind and light intensity of the sun.. Grasslands are known by various names in different parts of the world. For example they are called prairies, steppes, savannas and pampas.

Tropical grasslands are commonly called Savannas. They occur in eastern Africa South America, Australia and India. Savannas form a complex ecosystem as they contain grasses with groups of trees. Soil of grassland is rich and fertile.

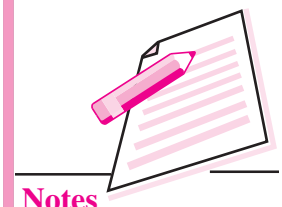
Flora and fauna : Grasses are the dominating plants with scattered drought resistant trees in the tropical grasslands. Trees are less than 10 m in height. Animals are much reduced in grasslands because there is no shelter. The large herbivores of this biome are bison, proghorn (North America) wild horse, ass, saiga (Eurasia) , zebra and antelope (South Africa). Carnivores are quite small in number and size They are coyotes, weasels, badgers foxes and ferrets . Hawks, lark sparrows, warblers, Great Indian Bustard and peafowl are the common birds found in grassland. Grasslands are very rich in reptilian and insect fauna.

C. Deserts

Distribution : Deserts are waterless barren regions of the earth. They occupy about one-seventh of the land on earth's surface. Deserts form an extreme condition in sequence of ecosystems with respect to the climatic condition . They occur in two belts that encircle the northern and southern hemispheres roughly centered over the tropics of Cancer and Capricorn. Sahara deserts of Africa are the largest Indian Thar deserts are an extensions of Sahara deserts through Arabian and Persian deserts.

Climate:

- Annual rain fall is very little. It may be less than 25 cm per annum. At some places if it is high it is unevenly distributed.
- Temperature may be very high in subtropical deserts and very low in cold deserts e.g. Ladakh.
- Winds have high velocity.



Flora and fauna : Cacti, *Acacia, Euphorbia* and prickly pears are some of the common desert plants. Desert animals are insects, reptiles, and burrowing rodents. Desert shrew, fox, kangaroo, wood rat, rabbit, armadillo are common mammals in desert. Camel is known as the ship of the desert as it can travel long distances without drinking water for several days.

D. Tundra

The word tundra means a "barren land" since they are found in those regions of the world where environmental conditions are very severe. There are two types of tundra **arctic** and **alpine**.

Distribution

- **Arctic tundra** extend as a continuous belt below the polar ice cap and above the tree line on the northern hemisphere. It occupies the northern fringe of Canada Alaska, European Russia, Siberia and island group of arctic ocean.
- **Alpine tundra** occur at high mountain peaks above the tree line. Since mountains are found at all latitudes therefore alpine tundra show day and night temperature variations

Climate

- A permanently frozen subsoil called **permafrost** is found in the arctic and antarctic tundra. The summer temperature may be around 15°C and in winter it may be as low as –57°C in arctic tundra A very low precipitation of less than 400 mm per year
- A short vegetation period of generally less than 50 days between spring and autumn frost
- Productivity is low

Flora and fauna : Typical vegetation of arctic tundra is cotton grass, sedges, dwarf heath, willows birches,and lichens. Animals of tundra are hurepian reindeer, musk ox, arctic hare, caribous, lemmings and squirrel. Their body is covered with fur for insulation, Insects have short life cycles which are completed during favourable period of the year.

INTEXT QUESTIONS 25.6

1. Define alpine tundra ecosystems.

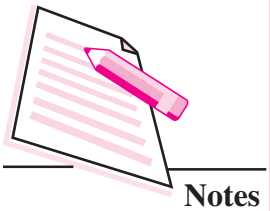
   .....

2. Give two examples of plants of tundra.

   .....

3. Give two common characteristics of tundra and desert biome.

   .....



Notes

4. Names of three main types of forests.

.....

5. Where are savannas found?

.....

6. What are deciduous trees?

.....

25.6.2 Aquatic Biomes

Aquatic ecosystems are constituted by water bodies . Water covers about one third of the earth's surface. Origin of life took place in aquatic ecosystem. Therefore, these ecosystems make an important component of our biosphere. Aquatic ecosystems are classified on the basis of salinity into following two types:

1. Freshwater 2. Marine

1. Fresh Water Ecosystem

Water on land which is continuously cycling and has low salt content is known as fresh water. The study of fresh water ecosystem is known as **limnology**. Fresh waters are classified into two types:

(i) Standing or still water **(Lentic)** e.g. pond, lake, bogs and swamps.

(ii) Running water **(Lotic)** e.g.. springs, mountain brooks, streams and rivers.

Commonly found flora in ponds and lakes include

(i) Phytoplankton (freely floating microscopic plants) such as algae, diatoms

(ii) Floating plant : *Pistia,* water hyacinth, *Lemna, Azolla*

(iii) Rooted plant : Hydrilla, *Vallisnaria*, trapa and water lily.

The common animals in ponds and lakes include

(i) Zooplankton (freely floating microscopic animals) such a protozoans and crustaceans;

(ii) Actively swimming fishes, frogs, tortoises.

(iii) Bottom dwellers like hydra, worms, prawns crabs, snails.

(iv) Birds such as herons, water fowls and ducks occurs in and around water.

Wetlands are between aquatic and terrestrial ecosystem *They show an* ***edge effect*** *and form a* ***ecotone****. Ecotone is a transitional zone between two ecosystems.* Examples of wet zone are swamps, marshes and mangroves.

2. Marine Ecosystem

Distribution : Marine ecosystem covers nearly 71 % of the earth's surface with an average depth of about 4000 m. Fresh water rivers eventually empty into ocean. Salinity of open sea is 3.6 percent and is quite constant Sodium and chlorine make

up nearly 86 percent of the sea salt and the rest is due other elements such as sulphur, magnesium, potassium and calcium

Temperature : The range of temperature variation is much less in sea than on the land although near the surface it is considerable from –2°C in antarctic ocean to 27°C in the warmer waters of pacific ocean. In the deeper layers temperature is constant at about 2°C.

Light : The light reaches upto a certain depth only. Deeper regions are permanently dark.

Pressure : Pressure increases with depth in oceans. It is 1 atmosphere near the surface and 1000 atmosphere at greatest depth.

Tides : The gravitational pulls of the sun and the moon cause tides in oceans. At the time of full moon and new moon tides are high and are called **spring tides**. At quarter moon the tides are exceptionally low and are known as low tide or **neap tides**

Flora and fauna : Life in the oceans is limited but its biodiversity is very high as compared to terrestrial ecosystems. Almost every major group of animals occur somewhere or the other in the sea. except for insects and vascular plant which are completely absent in marine ecosystem.

INTEXT QUESTIONS 25.7

1. What are plankton?

   .....

2. Name two phytoplanktons and two bottom dwellers in fresh water ecosystem.

   .....

3. What is the maximum pressure in ocean.

   .....

4. Give an example of (a) wet land (b) lotic type of ecosystem.

   .....

25.7 ECOLOGICAL SUCCESSION

Biotic communities are dynamic in nature and change over a period of time. **The process by which communities of plant and animal species in an area are replaced by another over a period of time is known as ecological succession**. Both the biotic and abiotic components are involved in this change. This change is brought about both by the activities of the communities as well as by the physical environment of that particular area.

The physical environment often influences the nature, direction, rate and optimal limit of changes. During succession both the plant and animal communities undergo

change. There are two types of successions (i) Primary succession and (ii) Secondary succession.

Primary Succession

Primary succession takes place over bare or unoccupied areas such as rock outcrop, newly formed deltas and sand dunes, emerging volcano islands and lava flows as well as glacial moraines (muddy area exposed by a retreating glacier) where no community has existed previously. The plants that invade the bare land, where soil is initially absent for the first time are called **pioneer species**. The assemblage of pioneer plants is collectively called **pioneer community**. A pioneer species generally shows high growth rate but short life span (Fig 8)

Primary succession is much more difficult to observe than secondary succession because there are relatively very few places on earth that do not already have communities of organisms. The community that initially inhabits a bare area is called **pioneer community**. The pioneer community after some time gets replaced by another community with a combination of different species. This second community gets replaced by a third community. This process continues sequence-wise in which a community is replaced by another community.

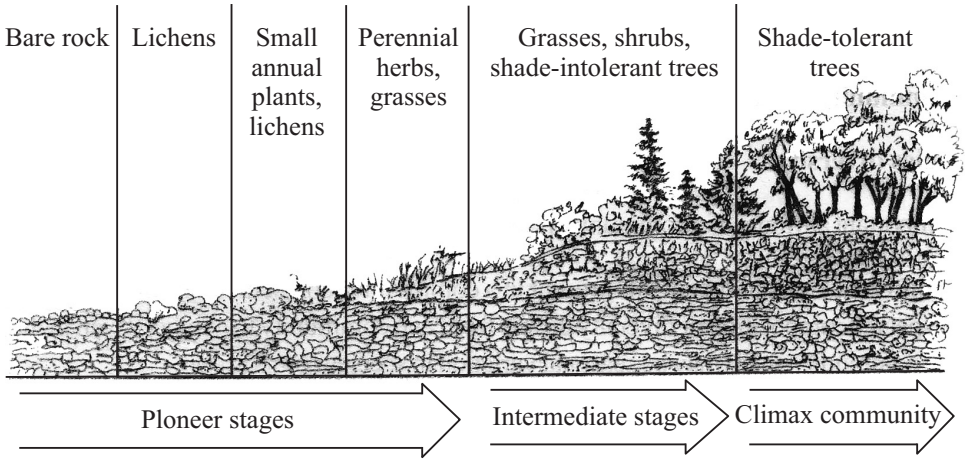


Fig. 25.18: The orderly sequence of primary succession

Each transitional (temporary) community that is formed and replaced during succession is called a stage in succession or a **seral community** (Fig. 9). The terminal (final) stage of succession forms the community which is called **climax community**. A climax community is stable, mature, more complex and long lasting. The entire sequence of communities in a given area, succeeding each other, during the course of succession is termed **sere** (Fig 9).

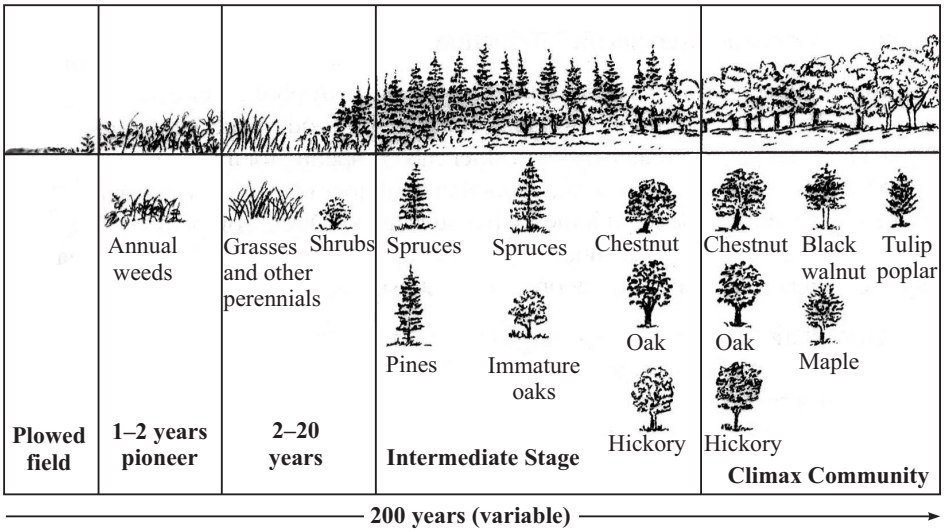


Fig. 25.19: Secondary succession on land

The animals of such a community also exhibit succession which to a great extent is determined by plant succession. However, animals of such successional stages are also influenced by the types of animals that are able to migrate from neighbouring communities. A climax community as long as it is undisturbed, remains relatively stable in dynamic equilibrium with the prevailing climate and habitat factors. Succession that occurs on land where moisture content is low such as on bare rock is known as **xerarch**. Succession that takes place in a water body, like ponds or lake is called **hydrarch**.

Secondary Succession

Secondary succession is the development of a community which forms after the existing natural vegetation that constitutes a community is removed, disturbed or destroyed by a natural event like hurricane or forest fire or by human related events like tilling or harvesting land.

A secondary succession is relatively fast as the soil has the necessary nutrients as well as a large pool of seeds and other dormant stages of organisms.

INTEXT QUESTIONS 25.8

1. What does the following sequence represent:

Blue green algae ⟶ Crustose lichens
↓
shrubs ⟵ mosses ⟵ Foliose lichens
↓
Dicotyledonous trees

Notes

(a) Ecological succession

(b) Genetic drift

(c) Phylogenetic trend

(d) A food pyramid

2. A community which starts succession in a habitat is:

(a) Pioneer community

(b) Social community

(c) Biotic community

(d) Ecosere

3. In ecological succession, beginning from pioneer and ending in climax community, the biomass shall

(a) decrease

(b) increase and then decrease

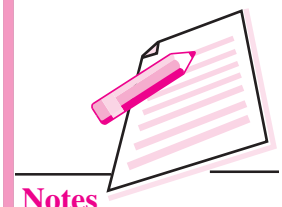
(c) decrease and then increase

(d) Increase continuously

25.7 BIOGEOCHEMICAL CYCLES

You have already learnt that living organisms required several chemical elements for their life processes. There may be used as part of their structural component or as parts of enzymes which influence various life processes unlike energy which flows unidirectionally, nutrients are continuously exchanged between the organisms and their physical environment.

("Bio" - living, "Geo" - rock, "Chemical" - element). The cycling of the nutrients in the biosphere is called **biogeochemical or nutrient cycle**. It involves movement of nutrient elements through the various components of an ecosystem. There are more than 40 elements required for the various life processes by plants and animals. These elements are continuously cycling in the ecosystem through the biogeochemical cycles and the planet earth has no input of these nutrients. The nutrients (matter) from the dead remains of organisms are recovered and made available to the producers by decomposers. Thus the nutrients are never lost from the ecosystems.



A. Carbon cycle

Atmospheric carbon dioxide is the source of all carbon in both living organisms as well as in the fossils (used as fossil fuel). It is highly soluble in water. Oceans also contain large quantities of dissolved carbon dioxide and bicarbonates.

The carbon cycle Fig. 25.17 comprises the following processes

Photosynthesis

Terrestrial and aquatic plants utilize CO_2 for photosynthesis. Through this process the inorganic form of carbon is converted into organic matter in the presence of sunlight and chlorophyll. The carbon dioxide is thus fixed and assimilated by plants. It is partly used by them for their own life processes and the rest is stored as their biomass which is available to the heterotrophs as food.

Respiration

Respiration is a metabolic process reverse of photosynthesis in which food is oxidized to liberate energy (to perform the various life processes) and carbon dioxide and water. Thus the carbon dioxide of the atmosphere is recovered through this process.

Decomposition

After the death of the organisms the decomposers break down the remaining dead organic matter and release the left over carbon back into the atmosphere.

Combustion

Fossil fuel such as crude oil, coal, natural gas or heavy oils on burning releases carbon dioxide and carbon monoxide into the atmosphere. Forests make a large amount of fossil fuel. *Fossil fuel is product of complete or partial decomposition of plants and animals as a result of exposure to heat and pressure in the earth's crust over millions of years.*

Forests also act like carbon reservoirs as carbon fixed by them cycles very slowly due to their long life. They release CO_2 by forest fires.

Impact of human activities

Carbon dioxide is continuously increasing in the atmosphere due to human activities such as industrialization, urbanization and increased use of automobiles. This increase in atmospheric CO_2 is bading to green house effect and global warming.

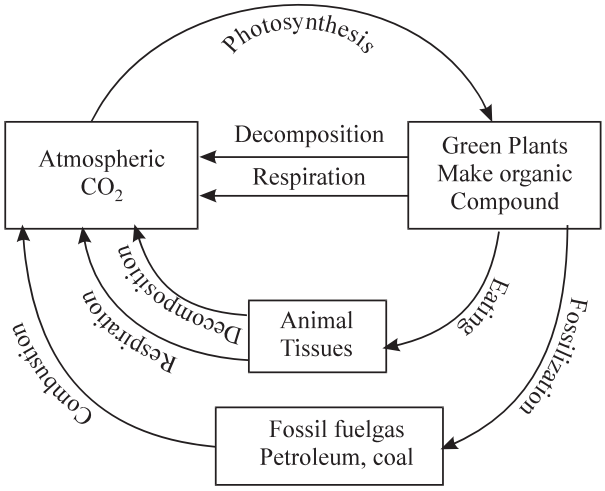


Fig. 25.18: Carbon cycle

(Arrows indicate the processes of the carbon cycle and compartments are the sites of these processes or the store houses of carbon in the reservoir pool and ecosystem)

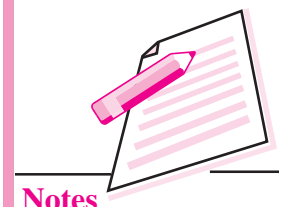
B. Water cycle

This is also known as hydrologic cycle. You have already studied that earth is a watery planet of the solar system but a very small fraction of this is available to animals and plants. Water is not evenly distributed throughout the surface of the earth. Major percentage of the total water on the earth is chemically bound to rocks and does not cycle. Out of the remaining, nearly 97.3% is in the oceans and 2.1% exists as polar ice caps. Thus only 0.6% is present as fresh water in, the form of atmospheric water vapors, ground and soil water. The ice caps and the water deep in the oceans form the reservoir.

Solar radiation and earth's gravitational pull are the main driving forces of water cycle.

Evaporation, condensation and precipitation are the main processes involved in water cycle these processes alternate with each other

Water from oceans, lakes, ponds, rivers, streams and soil surface evaporates by sun's heat energy. Plants also transpire huge amounts of water through their leaves. Water remains in the vapour state in air and forms clouds, which drift with the wind. Clouds meet with the cold air in the mountainous regions above the forests and condense to form rain, which falls due to gravity.



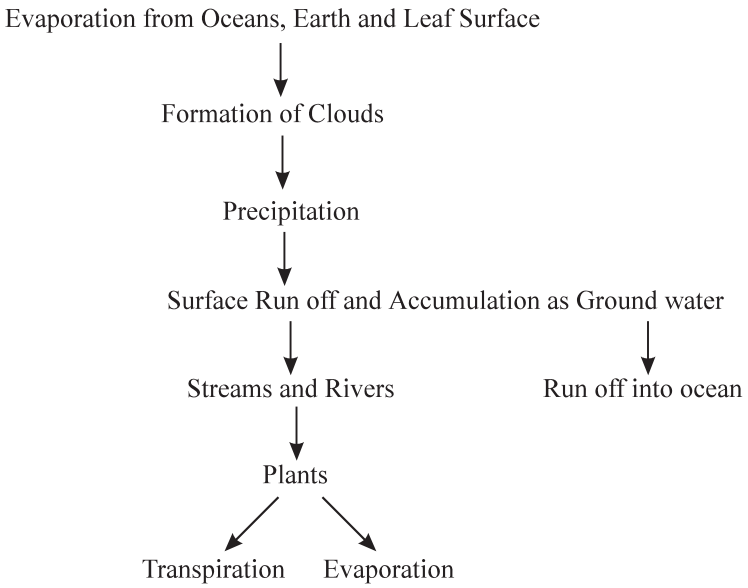
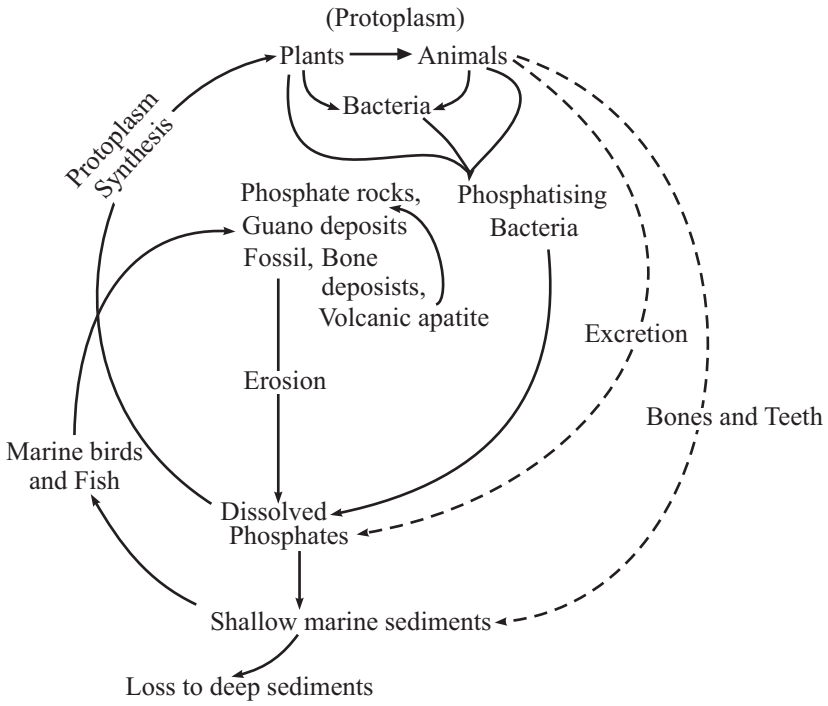


Fig. 25.8 Water cycle

On an average 84% of the water is lost from the surface of the oceans by evaporation. While 77% is gained by it from precipitation. The remaining 7% of the ocean evaporation is balanced by water run off through the rivers from the land.

C Phosphorus Cycle

We all know that phosphorus is a necessary and important constituent of the protoplasm in the living organisms. The reservoirs of phosphorus are the rocks or other deposits that have been formed in the past geological ages. The erosion of these deposits release phosphates in the ecosystem. However, much of it escapes into the sea where part of it is lost to the deep sediments and some of it deposited in the shallow marine sediments. Plants take up inorganic phosphate as orthophosphate ions. Animals (consumers) that feed on these plants in turn take up phosphate from them. After the death of the plants and animals, the decomposers act on them and the phosphate is returned in the ecosystem in the dissolved form. The excreta of the animals also return some phosphorus to the cycle. Bones and teeth of animals are resistant to weathering and this accounts for some loss of phosphorus. Sea birds play an important role in bringing back phosphorus to the cycle through their guano deposits. Marine fishes also return some of the phosphorus to the cycle. A study of phosphate cycle reveals that the return of phosphate to the cycle is inadequate to compensate the loss. It is human beings who have hastened the rate of loss of phosphorus.



PHOSPHORUS CYCLE

Fig. 25.9 Phosphorus Cycle

INTEXT QUESTIONS 25.9

1. Define nutrient cycle.

   .....

2. Where are the bulk of nutrient stored in an ecosystem?

   .....

3. Name the nutrient cycle where atmosphere acts as the main reservoir.

   .....

4. List any two human activities that have led to increase in atmospheric CO_2.

   .....

5. Name the reservoirs for water cycle.

   .....

6. How do humans affect the phosphorus cycle?

   .....

7. How do the sea birds contribute to the phosphorus cycle?

   .....

WHAT YOU HAVE LEARNT

- Earth is the only planet to support life. Earth provides soil, water and air to support it.
- Environment is defined as the physical, chemical and biotic conditions that surround and influence on living organisms.
- The abiotic components of environment are temperature, light, humidity, precipitation, wind minerals and the composition of air.
- Biotic components include plants, animals and microorganisms.
- Ecology is defined as the study of relationship between organisms and their environment. Ecology deals with various form of interaction between the organisms and their environment.
- The levels of organisation in the living system starting from genes to community.
- The three physical components of earth are atmosphere, lithosphere and hydrosphere.
- Ecosystem is defined as functionally independent unit of nature where living organisms interact among themselves as well as with their physical environment.
- Terrestrial and aquatic ecosystems are the two categories of natural ecosystems. Croplands and aquarium are the examples of artificial ecosystem.
- Light, temperature, inorganic and organic compounds constitute the abiotic components of ecosystem whereas produces consumers and decomposers are its biotic components.
- These biotic components of ecosystem interact with each other to give a physical character. These represent structural features of an ecosystem to an ecosystem.
- The important structural features of an ecosystem may be represented by its species composition, stratification, food relationship (trophic level food chain an food web).
- The structural components interact in a unit and produce certain functional aspects of an ecosystem such as productivity, energy flow and nutrient cycle etc.
- Humans occupy both primary and secondary levels of consumers.
- Transfer of food from the plants (producers) through a series of organisms with repeated eating and being eaten is called food chain.
- A network of a connected food chains interrelated form a food web.

- The process of transfer of energy through various trophic levels of the food chain is known as flow of energy.
- The quantity of energy flowing through the successive trophic level decreases. This is because a part of the energy is lost as heat and a part of energy used by the organism for its metabolism.
- Only 10% of the energy that enters the trophic level is transferred to the next trophic level. This is known 10% law. The flow of energy in an ecosystem is always linear.
- The number of trophic level in a food chain is limited in number (4 or 5).
- The graphical representation of standing crop expressed as number biomass or energy is called pyramid of number. Pyramid of biomass and pyramid of energy respectively. These are collectively known as ecological pyramid.
- A biome is a large ecosystem which is embracing the large landscape. Each biome is characterised by a specific flora and fauna.
- The cycling of the nutrients in the biosphere is called biogeochemical or nutrient cycle. Carbon cycle and water cycle are two such example.
- Photosynthesis, respiration, decomposition and combustion are the important processes in carbon cycle.
- Evaporation, condensation and precipitation are the important processes in water cycle.

TERMINAL EXERCISES

1. What are the three physical life support systems on the planet earth?
2. Name the various biotic and abiotic components of the environment
3. Give differences between natural and human modified ecosystem
4. Why is the number of trophic levels restricted to four or five in a food chain?
5. Give only two differences between fresh water and marine biome.
6. What will happen if all the floating animals are removed from a lake ecosytem?
7. What are the benefits of natural ecosystems?
8. Give two differences between energy flow and biogeochemical cycle in an ecosystem.

ANSWERS TO INTEXT QUESTIONS

25.1 1. Ernst haeckel
2. Genes → Cell → Organ → Organism → Population → Community
3. Study of animals and plants in relation to their habit and habitat.
4. Atmosphere, lithosphere and hydrosphere

25.2 1. (i) Abiotic (ii) Biotic

2. light, temperature, humidity, precipitation, pressure and soil profile

3. Helps in recycling of nutrients in the environment.

4. Plants are capable of capturing solar energy and transforming it into food energy. Thus they produce their own food. Animals depend upon plants or other animals for food as they cannot produce their own food.

25.3 1. Ecosystem is a unit to study ecology/functionally independent unit to stud. The interrelation between biotic and abiotic components.

2. Main components

Biotic	Abiotic
(Producers)	light
Consumers	Temperature
Decomposers	Inorganic substances
organic compounds	

3. to breakdown products of dead animals and plants tissue.

25.4 1. Grass → Grasshopper → Frog → Snake → Hawk/eagle

2. Secondary level consumer

3. Snake can feed on a rat and then it is a secondary consumer. It can also feed on a frog and then it is a tertiary consumer.

25.5 1. Upto five (5)

2. Energy from solar radiation is fixed in the form of food by the producer. This energy is passed on to the consumers of different trophic level. At each trophic level energy is used by the member for metabolism and only left over energy is passed on each trophic level (10%).

3. See text

4. Vertical and horizontal distribution of plants in the ecosystem.

25.6 1. Its an ecosystem that occurs high mountain peak above the tree line. Environmental conditions are very severe and show day and night temperature variation.

2. Cotton grass, sedges, dwarf leath, willows, birches and lichens (any two).

3. 1. both of them have very harsh climatic conditions.

2. Scarce vegetation.

4. 1. Tropical rain forest temperature.
   2. Deciduous boreal or north.
   3. Coniferous rain forest.
5. Eastern Africa, South America, Australia and India (any two).
6. Trees which shed their leaves in autumn and grow new foliage during spring.

25.7

1. Free floating microscopic organisms
2. diatoms, algae, prawn, crabs, snail (any two)
3. 1000 atmosphere
4. (a) swamps, marshes and mangroves (any one)
   (b) streams, rivers, springs (any one)

25.8

1. Movement of nutrient elements through the various components of an ecosystem is called nutrient cycle.
2. In the Reservoirs pool
3. Gaseous cycle
4. Industrialization, urbanization, increased used of automobiles (any two)
5. Polar ice caps and water present deep in the oceans.