

# ENVIRONMENT

Definition, Scope and Importance - Concepts of Ecology - Ecological Factors : Soil, Air and Water - Eco System : Pond and Forest Eco System - Human Population Growth.

## Introduction

The life supporting environment of the Earth is called Biosphere. All types of life forms, plants and animals both microscopic and macroscopic are present in biosphere. This biosphere is spread over three main medium - air, water and soil.

Every organism is surrounded by its own specific environment. A continuous interaction and adaptation is present between the organism and its environment. There is a complete interdependent, inseparable interrelationship present between organisms and their environment. Any slight alteration in the constituents of the environment disrupts the fine delicate balance between the organism and its environment leading to the degradation and destruction of the environment.

Man is himself an organism with in an environment. He is influenced by the physical aspects of his environment. He is dependent upon his environment and other species for survival.

Through his intelligence, man always has a modifying influence on the environment. But in his zeal to improve his standard of living, man often has destructive effects on the environment. Some of these are as follows.

- Human activities are polluting all three medium of environment i.e., air, water and soil.
- Industrial pollution, unplanned urbanization and commercial exploitation of environment and life forms is threatening the vital and fragile balance of the environment.
- Rapid rate of multiplication of human population and the growing population demands have resulted in fatal threat of scarcity of wide life, food, open space, and of survival.

Thus, human greed, ignorance and mismanagement of environment has landed the mankind at the thresh hold of an *environmental crisis*.

To solve this crisis and to preserve the components of environment *for now and for future*, knowledge of functional aspects of environment and the organism is desired. This desire has lead to the development of concept called *environmental studies*.

### Definition

Study of functional intricacies of environment in relation to an organism can be called as *environmental study*.

### Scope and Importance of Environmental Studies

- Environmental studies deals with the study of fundamentals of environmental and social sciences.
- Environmental studies provides an holistic view of the environment and human - environment relationship.
- It gives an insight into the understanding of mechanisms of delicate, intricate inter relationship between organisms and environment.
- It provides an opportunity to understand major environmental issues and to arrive at possible solutions for the same.
- Environmental studies gives an insight into the anthropogenic problems of environment and ways to tackle it.
- Environmental studies provides more knowledge about ecosystems and other ecological problems.

This assumes importance as future of human life on earth demands more knowledge about the ecosystems and other ecological problems.

### Multi Disciplinary Nature of Environmental Studies

For the understanding of the working of the environment, knowledge from wide ranging fields are required. Thus, environmental studies is a multi disciplinary science which depends on a variety of disciplines such as *physics, zoology, botany, chemistry, statistics, sociology, economics, mathematics, geography, demography, physiology, agricultural science, forestry, genetics, meteorology*, etc.

All these disciplines help in the better understanding of the ecological situations / principles.



# ECOSYSTEMS

## Introduction to Ecology

Ecology is a Greek word. In Greek, "*Oikos*" means "home" and "*logos*" means "study of". The term "home" here refers to the Environment. The term ecology was first used by **Reiter**.

In the 19th century, German biologist **Ernst Haeckel** developed the concept of Ecology.

According to **Ernst Haeckel**, Ecology can be defined as the 'scientific study of inter relationship between organisms (plants, animals) and their environment'.

**Eugene P. Odum**, American biologist defined ecology as the 'study of structure and functions of an ecosystem'.

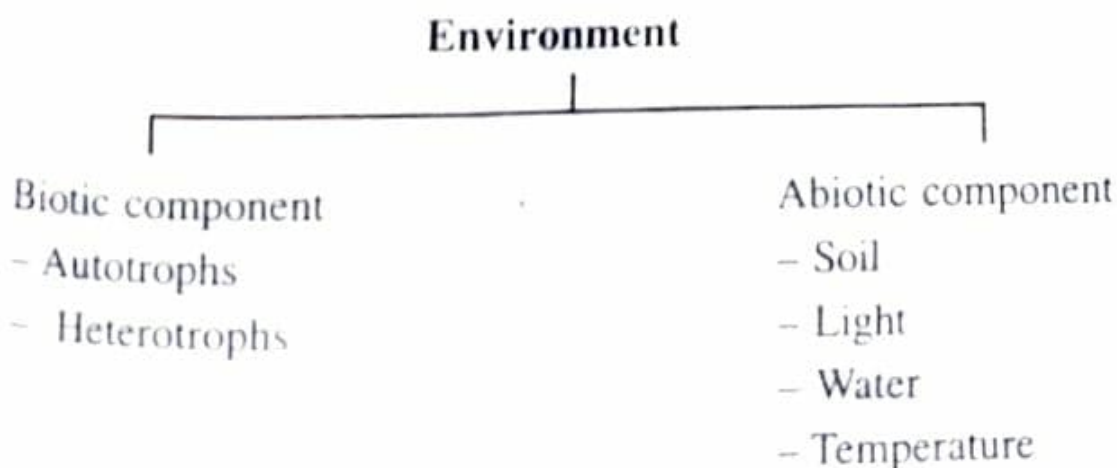
According to **Charles H. Southwick**, 'ecology is the scientific study of relationships of living organisms with each other and with their environment'.

Ecology is also known as **Environmental biology** or **Environmental Science**.

## Environment

According to **S.C. Kendeigh**, **Environment** is the sum total of physical and biotic conditions influencing the responses of the organism.

The term **Environment** includes all that surrounds an organism. The organism is surrounded by the living and the non-living components. Thus, the environment has two components.



The living organisms that are present surrounding an organism is called the Biotic component. Autotrophs (fn1 organisms that can synthesise food by using solar energy, water and carbon dioxide) and heterotrophs (fn2 The organisms that are unable to produce their food and hence dependent on autotrophs directly or indirectly for survival) are the biotic components present in an environment.

The non-living components namely soil, light temperature and water forms the abiotic components of an environment.

### Subdivisions of Ecology

The study of ecology includes a wide variety of animals, plants and their environment. Earlier ecologists had subdivided ecology into **plant ecology** and **animal ecology**. This subdivision doesn't consider the interaction between plants and animals. Moderns subdivision of ecology considers this interdependent, inseparable interrelation between plants and animals. Ecology now is often divided into **autecology** and **synecology**.

Autecology deals with the study of an individual organism and its relationship with its environment.

Synecology deals with the study of group of organism and their relationship to the environment.

Further, ecology has specialized branches like

1. **Habitat ecology** : It deals with the study of different types of terrestrial, aquatic habitat.

2. **Community ecology** : Study of composition of different organisms, their dependence and interaction with one another is community ecology.

3. **Population ecology** : Growth rate and structure of populations of different organisms of the community study is called population ecology.

4. **Taxonomic ecology** : Study of ecological interactions of different taxonomic categories of organism is known as taxonomic ecology.

5. **Paleoecology** : Study of ancient environment is called Paleaecology.

6. **Ethology** : Study of animal behaviour in their natural conditions is ethology.



7. **Pedology** : This branch deals with the study of soil formation, types of soil.

8. **Applied ecology** : The branch of ecology deals with resource conservation, pollution control, land use, wild life management and agricultural forestry.

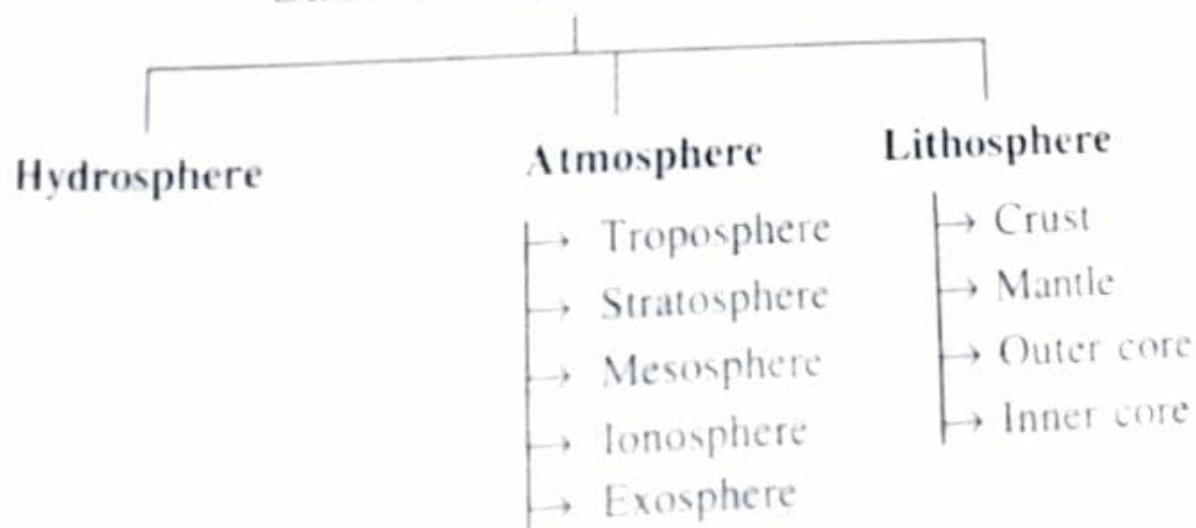
9. **Ecological energetics** : The study of food production and energy flow pattern of an ecological system is ecological energetics.

### Ecological Units :

In order to understand ecology, the life on earth is divided into units called ecological units. Following are the four levels of ecological units, i.e. a) *population* b) *community* c) *Ecosystem* and d) *Biosphere*.

- a) **Population** : All the individuals of a particular type of organism present in a specific area at a specific time is called population.
- b) **Community** : Assemblage of all the populations of organisms occupying a given area at a given time is community. **Karl Mobius**, German ecologist used the term *biocoenosis* to refer community.
- c) **Ecosystem** : The *functional unit* of ecology is Ecosystem. It includes the living organisms and their abiotic environment. The biotic and the abiotic components of an ecosystem are inter related and influence each other.
- d) **Biosphere** : The area of the earth that contains and supports life is biosphere. It includes the soil or the lithosphere, fresh and salt water or the hydrosphere and the air surrounding the earth or the atmosphere.

### Sub-divisions of Biosphere



- **Troposphere** - It is the lowest region of atmosphere. Cloud formation, thunder, lightening, thunder storm formation takes place in this region. Temperature gradually decrease with height at the rate of  $6.5^{\circ}\text{C}$  per km.
- **Stratosphere** - Next to troposphere, Stratosphere is present. Clouds are absent in this region. Ozone formation occurs in this region. Temperature increases upto  $90^{\circ}\text{C}$  due to ozone formation.
- **Mesosphere** - It is the third zone of the atmosphere. In mesosphere, temperature decreases upto  $80^{\circ}\text{C}$ .
- **Ionosphere** - The atmosphere above mesosphere upto the height of about 300 Km above earths surface is ionosphere.
- **Exosphere** - The final frontier of atmosphere is exosphere. Outer space begins from here.

**Core** is the central fluid or vapourised sphere with a diameter of about 2500 Kms from the centre.

From the core for about 2900 Kms above in molten state mantle is present.

Crust is the solid zone above the mantle. The surface of the crust is covered with soil.

## Ecosystem

The term ecosystem was first used by the British ecologist Sir Arthur G Tansley in 1935.

According to **Lindeman** (1942), ecosystem is "a system composed of physical-chemical-biological processes active with in a space-time unit of any magnitude".

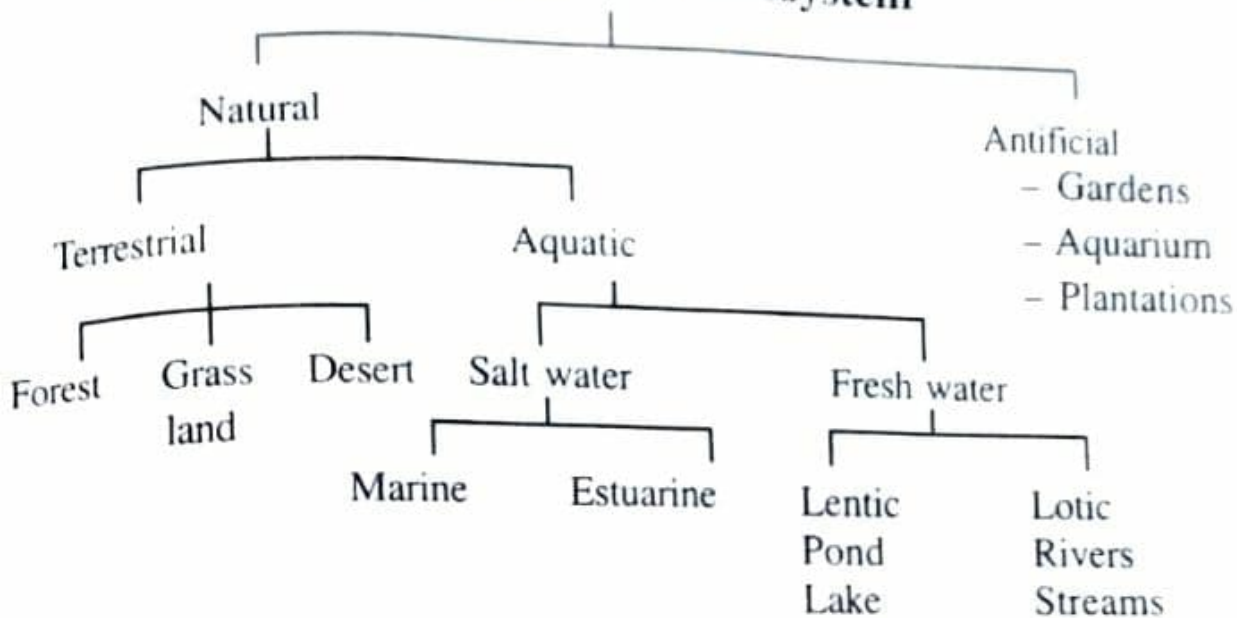
According to **Odum** (1963), ecosystem is 'the basic functional unit of nature including boths organisms and their non living environment, each ineractiong with other and influencing each other's properties and both necessary for maintenance and development of the system.'

## Classification of Ecosystem

Primarily ecosystems can be broadly classified into two major divisions : natural and artificial



# Classification of Ecosystem



Ecosystems as occurring in nature are natural ecosystems. Depending on the habitat, (fn : Environment in which an organisms live) natural ecosystems are classified into (1) *Terrestrial* or *land based ecosystems* and (2) *Aquatic* or *water based ecosystems*.

Ecosystems cosntructed by human beings like gardens, plantations or aquariums are called *artificial* or *agro ecosystems*.

## 1. Terrestrial Ecosystem

Land based ecosystems are known as terrestrial eco systems. Three major types of terrestrial ecosystems are present : a) *Forest ecosystem* b) *Grass land ecosystem* and c) *Desert ecosystem*.

## 2. Aquatic Ecosystem

Water based ecosystems are called aquatic ecosystem. Based on the salt content of water, aquatic ecosystem is classified into two types namely a) The salt water ecosystem b) The fresh water ecosystem

## STRUCTURE OF AN ECOSYSTEM

In an ecosystem, there are two major interacting structural components present : a) Abiotic component and b) Biotic component

### A) Abiotic Component

It comprises of non living component of the environment. Light, soil, air and water are the abiotic components.

The energy of sunlight is essential for the basic physiological processes such as photosynthesis, (fn : Process of formation of food by organisms using sunlight, water and carbon dioxide) transpiration, (fn : evaporation of water from the aerial parts of the plants), germination and flowering.

Physical and chemical processes of weathering (fn : process of break down of bigger rock particles into smaller mineral particles with water and air in the spaces) is responsible for the formation of the soil. Microscopic and macroscopic plants and animals of wide variety reside in the soil playing an important role in the functioning of the ecosystem.

Air is a mixture of nitrogen, oxygen, carbon dioxide and traces of inert gases. About 78% by volume of nitrogen is present in the atmosphere. Where as oxygen and carbon dioxide are present in about 20% and 0.032% by volume respectively. Oxygen is vital for the survival of the organisms. Carbondioxide is one of the raw material for photosynthesis.

Water covers 79% of earth's surface and is the medium for aquatic life. Growth of the plants are dependent on the availability of water. Plants and animals living in water are called as aquatic organisms. Aquatic organisms are of two types - fresh water and marine.

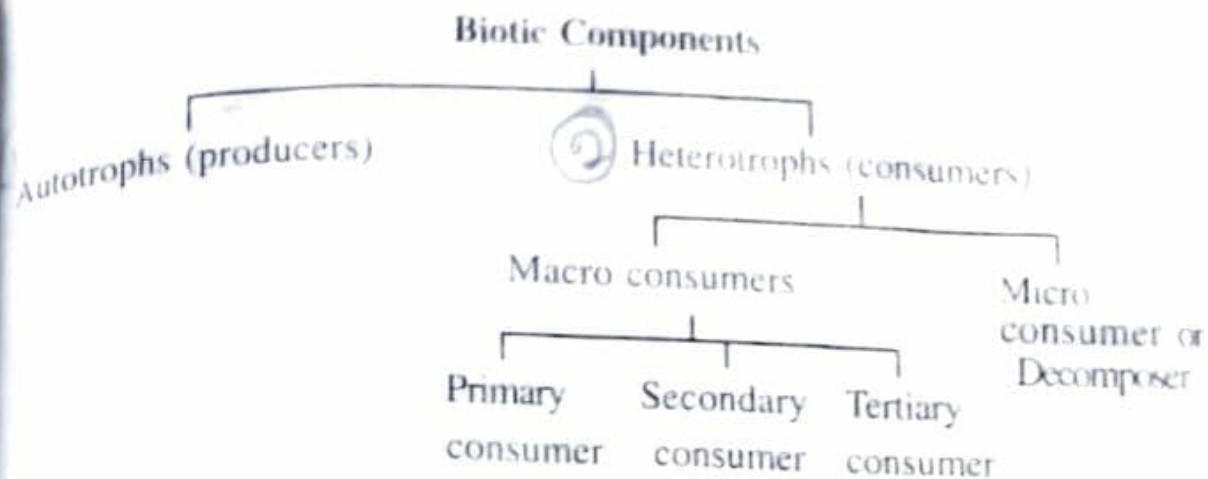
The major component of the protoplasm of the cell is water. It is essential for the metabolic reactions occuring in the organisms.

Besides the above, the climatic factor like temperature gases dissolved in water such as oxygen and carbon dioxide etc, salts of phosphorous, calcium etc and organic compounds such as amino acids, carbohydrates etc, form the important abiotic constituents.

## **B) Biotic Component**

It consists of living components of the environment. Microscopic and macroscopic plants and animals form the biotic components of an ecosystem. These are grouped into two categories - **Autotrophs** and **Heterotrophs**.





**Autotrophs** : Autotrophs are organisms that are capable of producing the food using the green pigment chlorophyll from sunlight, carbondioxide and water. Since food is produced by autotrophs, they are also called as the **producers**. The energy needed for the existance of ecosystem is produced by the autotrophs. Large trees, grasses, rooted and floating plants, the microscopic algae and diatoms are some of the examples of autotrophs.

**Heterotrophs** : Heterotrophs are organisms who are unable to produce the food as they do not have the chlorophyll. For survival, they are dependent on the autotrophs *directly* or *indirectly*. Hence, the heterotrophs are known as the **consumers**.

The consumers are of two types (a) Macroconsumers or phagotrophs and (b) Micro consumers /Decomposers or Osmotrophs.

**a) Macro consumers** : They are large sized consumers with a digestive system capable of enzymatically digesting larger food molecules into smaller food molecules. The macro consumers are further grouped into three typess (i) Primary consumers (ii) Secondary consumers and (iii) Tertiary consumers.

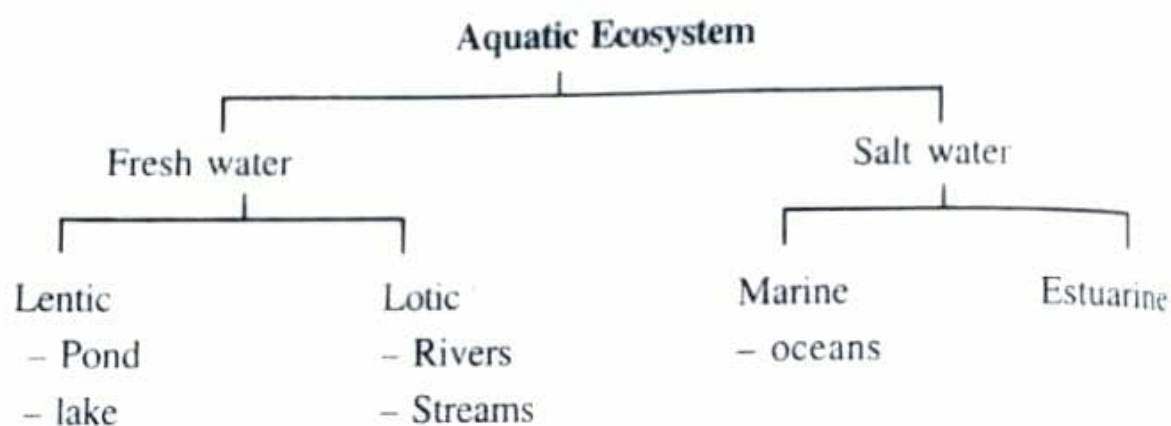
- (i) **Primary consumers** : A primary consumer is directly dependent on the producer for food. These are also known as *herbivores*.
- (ii) **Secondary consumer** : These are the organisms that feed on primary consumer. A secondary consumer is also called a *primary carnivore*.
- (iii) **Tertiary consumer** : These are the organisms, that obtain their food by feeding on either primary or secondary consumers.

**b) Micro consumers / Decomposers** : These are microscopic bacteria and fungi. They decompose excreta of animals and dead parts of plants and dead bodies of animals. They are also called *detrivores* - dirt eaters. Sometimes they are referred to as the **natural scavengers** of the ecosystem.

## Aquatic Ecosystems

Water covers about three quarters of the earth's surface. This is either in the form of oceans or fresh water. Thus the aquatic ecosystems are broadly classified into two types ;

A) *Fresh water ecosystem* and B) *Saltwater ecosystem*



**Fresh water ecosystems** are divided into two groups based on the nature of fresh water - *Lentic* and *Lotic*. In lentic freshwater ecosystem, the water is standing still. Ponds, lakes, bogs, swamps etc are examples of lentic. In the lotic, the water is running in nature i.e it is in continuous motion. Rivers, Streams are examples of lotic.

**The salt water ecosystem** includes the marine and estuarine habitats. Estuary represents transitional zone between a river and the sea. It has dissolved contents intermediate between those of fresh water and salt water.

**Lentic ecosystems** - All standing fresh water habitats such as ponds, lakes, bogs, swamps etc. are examples of lentic ecosystem.

Inland depressions containing standing water are called lakes. They vary in size from small ponds of less than a hectare to large water areas covering thousands of square kilometer. The depth varies from a few centimeters to over 1600 meters.



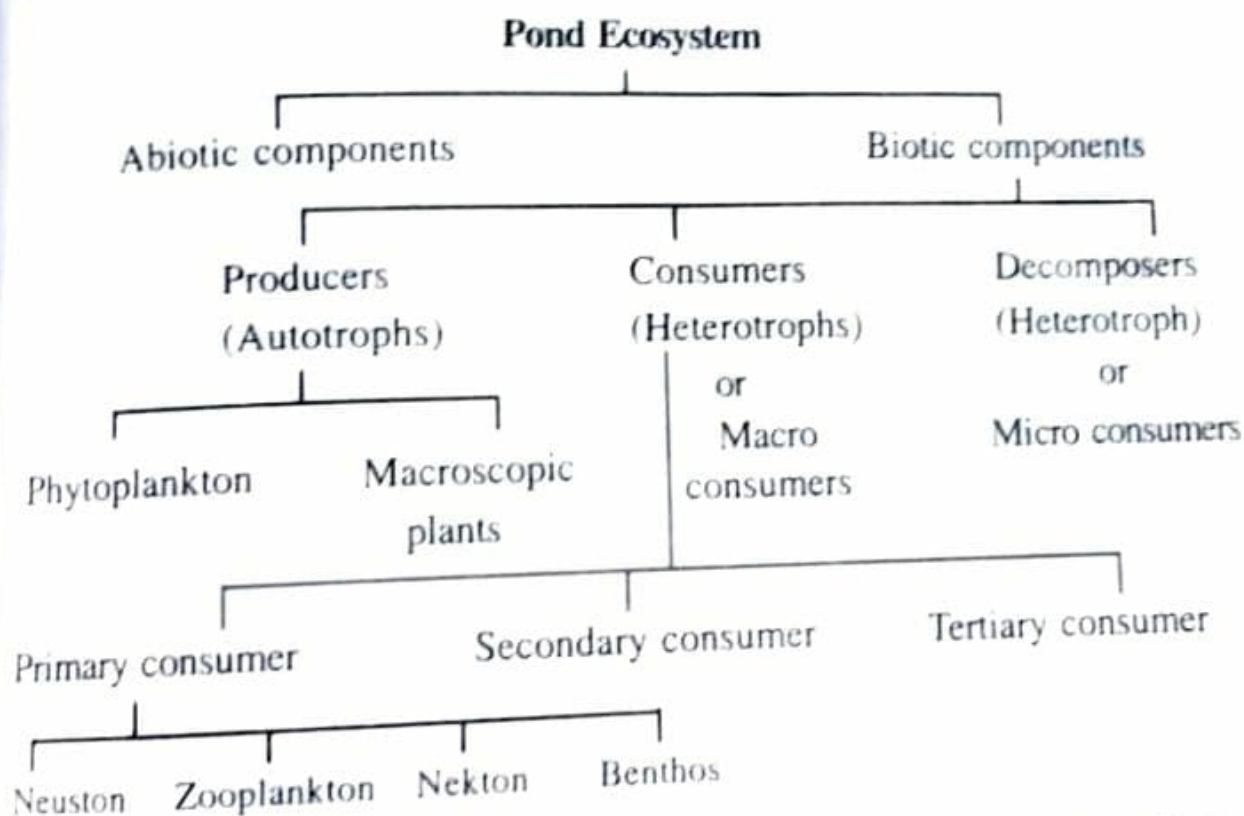
Ponds are small bodies of standing water. In relation to light intensity, vertical stratification is seen in ponds and lakes. There are three well-recognised strata namely :

1. **Littoral zone** - It is the shallow water near the shore.
2. **Limnetic zone** - It is open water zone away from the shore.
3. **Profundal zone** - It is the deep-water area below the limnetic zone.

Besides these, an **abyssal zone** is present in deep lakes. It begins at about 2,000 meters from the surface.

### Structural and Functional Components of Pond Ecosystem

The pond ecosystem has two major interacting components namely Abiotic components and Biotic components.



**Abiotic Components**-It is also known as the non-living component. The abiotic components of pond ecosystem includes :

1. **Light** - Sunlight is the most important abiotic component. It provides the energy needed for the photosynthesis leading to the production of food by the producers.

2. **Water** - Water forms the habitat of the organisms. Water also contains dissolved salts of Calcium, Potassium, Sodium etc. Dissolved gases like oxygen, carbon dioxide, nitrogen etc are also present in water.

Apart from these, the climatic factors like temperature is also an important abiotic factor.

## Biotic Component

It is also known as the living components of the ecosystem. They are grouped into two categories i.e I. **Autotrophs** and II. **Heterotrophs**.

I. **Autotrophs** are also known as the **producers** of the ecosystem. They use sunlight, water, carbon dioxide and green pigment chlorophyll to produce the food. Autotrophs forms the first trophic level of the ecosystem. There are two types of autotrophs present in pond ecosystem.

- a) **Phytoplankton** : Minute floating plants such as algae and diatoms present throughout the area of pond are called phytoplankton. Eg : Blue-green algae, Green algae, Diatom etc.
- b) **Macroscopic plants** : These are the large water plants also known as hydrophytes. It consists of emergent vegetation (fn : plants rooted in the shallow regions of the bank. Leaves emerge out of water) submerged vegetation (fn : plants completely submerged under water) & free floating vegetation. Eg : - Saggitaria, Jussiaea, Hydrilla, Pistia, Vallisneria etc.

II. **Heterotrophs** are the animals that cannot produce their own food. They are dependent on producers for the food energy. They are of two types :

### 1. Consumers and 2. Decomposers

1. **Consumers** : Consumers are relatively large sized with a digestive system. These are further grouped into following types : a) *Primary consumers* b) *Secondary consumers* and c) *Tertiary consumers*

a) **Primary consumers** : These depend directly on producers for food. Primary consumers form the trophic level II. Primary consumers are of following types :

- (i) **Neuston** - Unattached organisms that live at the air-water interface are called Neuston. It contains floating plants like duckweed and animals such as water striders. Insects such as diving beetles, larvae, tadpole etc. also are other examples of neuston.



- (ii) **Zooplankton** - The animals that drift on water surface controlled by the water current are called Zooplankton. Eg : - Cyclops, Daphnia etc
- (iii) **Nekton** - These are the aquatic swimming animals. They can swim independent of wave and water current as they possess locomotary organs. Eg : - Insect larvae, Insects etc.
- (iv) **Benthos** - These are the organisms living at the bottom of the pond. They may be either found living in the sediment or found at the interface of water - sediment. Eg : - Crustaceans, Molluses etc.

**b) Secondary Consumers** : These are the organisms that feed on the primary consumer. Secondary consumers form the trophic level III. It is also called as a primary carnivore.

Eg : Water scorpion (Ranatra)  
Water bug (Belostoma)  
Fishes etc.

**c) Tertiary Consumers** : The animals that feed on the secondary consumers are called tertiary consumers. The tertiary consumers forms the trophic level IV. Eg : - Cat fish, water snakes etc

**2. Decomposers or Microconsumers** : These form the trophic level V of the pond ecosystem. It consists of aquatic bacteria and fungi. They decompose the dead bodies and excreta of the consumers. This helps in recycling of minerals in the pond ecosystem. This recycling is essential for the stability of the ecosystem.

## FUNCTIONAL ASPECT OF POND ECOSYSTEM

Producers by photosynthesis synthesise food. This energy present in the producers is passed on sequentially from primary, secondary to tertiary consumers. Decomposers are responsible for the recycling of the minerals in the ecosystem. Thus all the different components of the ecosystem interact and influence one another.

**Lake ecosystem** - Lakes are large bodies of standing water. Like pond ecosystem, lake also has 3 zones- *Littoral*, *Limnetic* and *profundal zone*. The lake ecosystem has two major interacting components namely abiotic components & biotic components.

Sunlight, water, dissolved gases and salts in water and temperature are some of the abiotic component of lake ecosystem.

Biotic components of lake ecosystem consists of :

**I. Autotrophs** - These are the producers of food of the ecosystem

It consists of *phytoplankton*, Eg : Diatoms, Volvox, Spirogyra etc and various types of *macroscopic plants* : free floating plants, and submerged plants such as Pistia, Eichhornia, Hydrilla etc.

**II. Heterotrophs** - These are the consumers that are dependent on the producers for their food. It consists of

- *Zooplankton* (Eg : Protozoa, water flees) etc
- *Neuston* (water boatman, water spiders etc)
- *Nekton* (Eg : larval stages, amphibians, water snakes etc) &
- *Benthos* (Eg : - Crabs, Prawns, Snails etc)

These organisms are present in the littoral zone.

In the limnetic zone, fishes are present in the profundal area, decomposers bacteria & fungi are present.

Many birds such as ducks, cranes, kingfishers visit the lake to feed on fish & other animal life.

**Lotic Ecosystem** - All flowing water habitats such as rivers and streams are examples of lotic ecosystem. Streams and springs in hill region have a high speed. So in these regions, plant growth is little. In the plains, the water flow is less turbulent. In these regions phytoplankton, algae, mosses are present i.e. producers are fewer in number. Several types of fishes, crustaceans, crocodiles and some mammals are present in the river ecosystem as the consumers.

Decomposers are large in number. They obtain their food from the dead and living organisms that accidentally fall or brought down by rain water.

**Forest Ecosystem** - *Forest* is a Latin word. In Latin, '*Foris*' means *outside*. Here outside refers to the village boundary and includes the uncultivated & uninhabited land. Depending on the climatic conditions different types of forests occur such as north coniferous, temperate deciduous, temperate evergreen, tropical deciduous, tropical rain forests etc.



The forest ecosystem has two interacting components :

I. *Abiotic component* and II. *Biotic component*.

**I. Abiotic component :** The non-living components are called abiotic components. It includes water, temperature, light and soil. The forest floor contains the fallen leaves called *leaf litter*. The fungi and bacteria present in the soil convert this litter into organic matter called '*humus*'. Humus increases the fertility of soil.

**II. Biotic components :** The living components form the biotic components. It includes :

**a) Producers :** The producers of the forest ecosystem are green plants. These plants are present in the form of distinct layers to get the sunlight. This phenomenon of arrangement of vegetation in distinct layers is called *stratification*. These layers are :

- (i) **Canopy** - It is the uppermost layer of the forest. It contains the tall and large trees. Trees such as Rosewood, Teakwood, Jack, Acacia etc. form this layer.
- (ii) **Understory** - It is the layer next to canopy. It casts additional shade on the layers below. It contains variety of small trees and woody plants with multiple stems.
- (iii) **Ground layer** - It is on the forest floor. It contains the non-woody plants like fern, grass, creeping shrubs etc
- (iv) **Forest floor** - It is lowest layer of forest ecosystem.

It is composed of humus and top soil.

**b) Consumers** - These are the organisms that depend on producers for their food. It consists of

- (i) **Primary consumers** - These are the herbivores that feed on the leaves of the producers.  
Deer, Elephant, Birds, Monkeys, Flies, Bugs etc are examples of primary consumer.
- (ii) **Secondary consumers** - These are the carnivores that feed on primary consumers. Frogs, Jackals, Hyaenas etc are examples of secondary consumer. It is also known as primary carnivore.

(iii) ***Tertiary consumer*** - These are the carnivores that either feed on primary or secondary consumer. Tigers, Leopards etc are examples of tertiary consumer.

***c) Decomposers*** : These are bacteria, fungi, present in the soil. They decompose the dead and decaying remains of the producers and consumers. This process helps in the recycling of minerals back into the environment. It is also responsible for the decomposition of leaf litter and to produce humus.