**DEPARTMENT OF PHYSICS**

**23CHT103-Environmental Science and Sustainability**

# ECO SYSTEM

## 2.1 CONCEPT OF ECOLOGY AND ECOSYSTEM

### 2.1.1 Ecology

- All living organisms, whether plant or animal or human being are surrounded by the environment, from which they derive their needs for survival.
- Each living component interacts with non-living components for their basic requirements form different ecosystem.

**Definition**

- *Ecology is the study of interactions among organisms or group of organisms with their environment.*
- *The environment consists of both biotic components (living organisms) and a biotic components (non-living organisms).*

**(or)**

- *Ecology is the study of ecosystems.*

## 2.1.2 Ecosystem

- **Ecosystem is the basic functional unit of ecology. The term ecosystem is coined from a Greek word meaning study of home.**

### Definition

- ***A group of organisms interacting among themselves and with environment is known as ecosystem.***
- ***Thus, an ecosystem is a community of different species interacting with one another and with their non-living environment exchanging energy and matter.***


- ***Animals cannot synthesis their food directly but depend on the plants either directly or indirectly.***

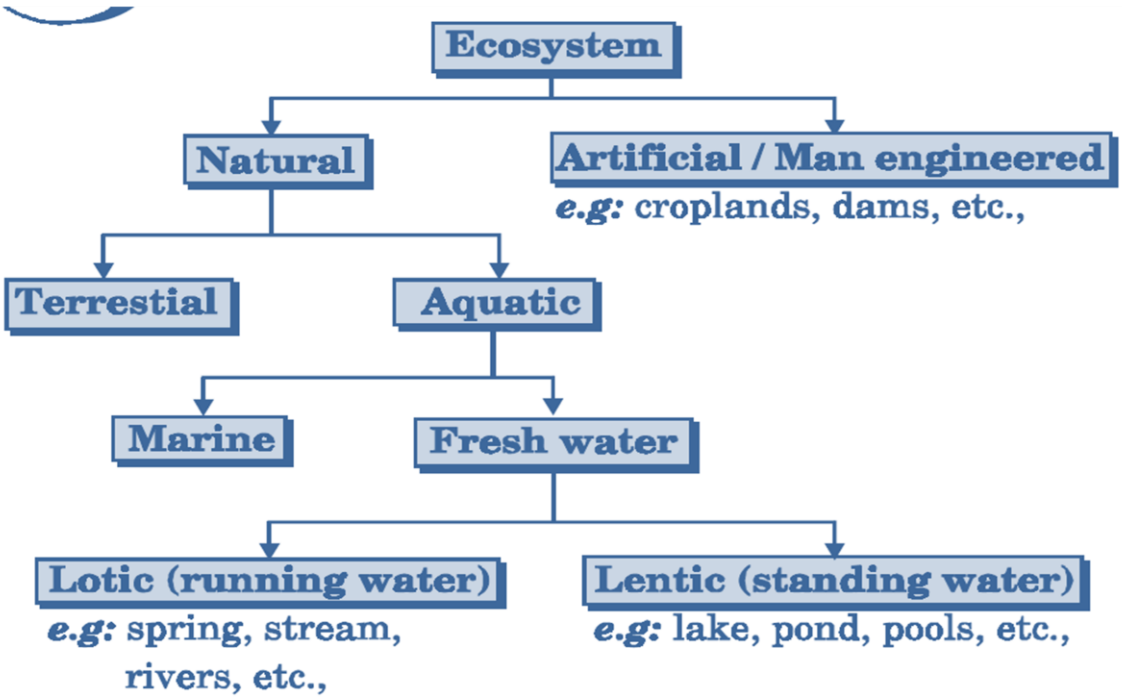
## 2.1.3 Biome (Small Ecosystem)

- **A kind of organisms which can live in a particular ecosystem depends on their physical and metabolic adoptions to the environment of that place.**

- **On earth *there are many sets of ecosystems which are exposed to same climatic conditions and having dominant species with similar life cycle, climatic adoptions and physical structure. This set of ecosystem is called a biome.***

- ***Thus, the biome is a small ecosystem with in an ecosystem.***

## 2.2 TYPE OF ECOSYSTEM



## 2.2.1 Natural ecosystem

- Natural ecosystems operate themselves under natural conditions. Based on habitat types, it can be further classified into three types.

### 1. Terrestrial ecosystem

- This ecosystem is related to land and types of vegetation.


*Grassland ecosystem, forest ecosystem, desert ecosystem, etc.,*

### 2. Aquatic ecosystem

**This ecosystem is related to water, it is further sub classified into two types based on salt content.**

#### (i) Fresh water ecosystem.

(a) Running water ecosystems.


*Rivers, streams.*

(b) Standing water ecosystems.


*Pond, lake.*

### (ii) Marine ecosystem


*Seas and sea shores.*

## 2.2.2 Man-made (or) Artificial ecosystems

**Artificial ecosystem is operated (or) maintained by man himself.**


*Croplands, gardens.*

# 2.3 STRUCTURE (OR) COMPONENTS OF AN ECOSYSTEM

- **The term structure refers to various components. So the structure of an ecosystem explains the Relationship between abiotic (non-living) and biotic (living) components.**
- **An ecosystem has two major components**

1. **Abiotic (non-living) components.**
2. **Biotic (living) components.**

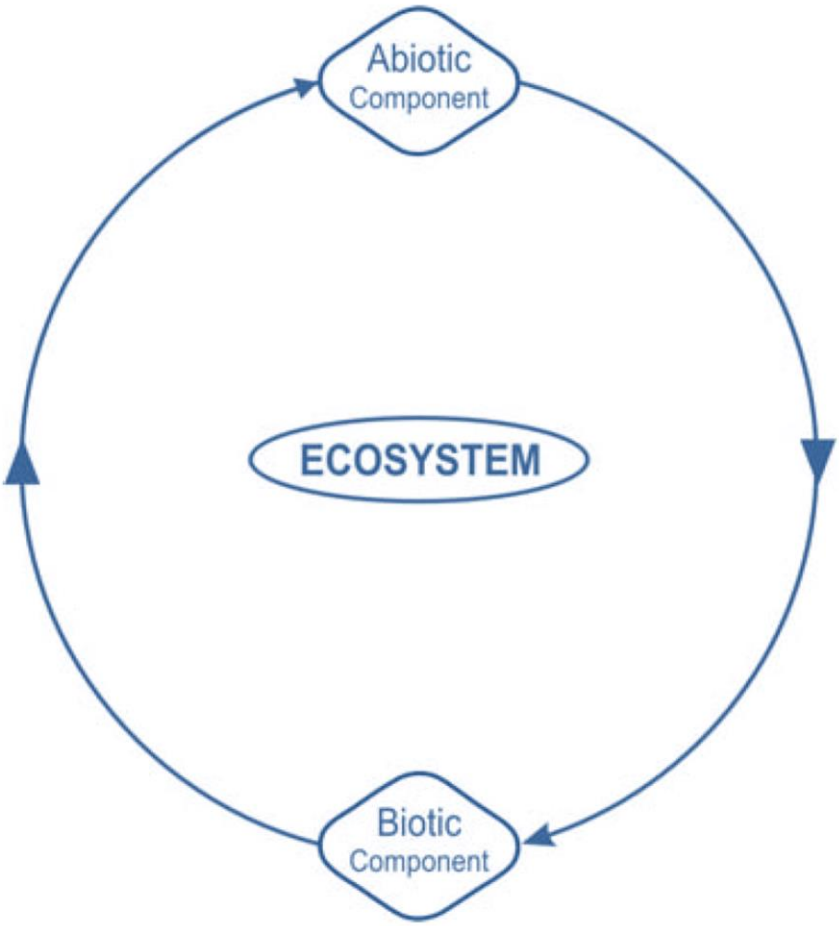



**Fig. 2.1 Components of an ecosystems and their relationship**

## 2.3.1 Abiotic (non-living) components

- **Non-living components (physical and chemical) of an ecosystem collectively form a community called abiotic components (or) abiotic community. It includes**


***Climate, soil, water, air, energy, nutrients, etc.,***

1. **Physical components: It includes the energy, climate, raw materials and living space that the biological community needs. It is useful for the growth and maintenance of its member.**


*Air, water, soil, sunlight, etc.,*

2. **Chemical Components: It is the sources of essential nutrients.**


*(i) Organic substances: Protein, lipids, carbohydrates, etc.,*

*(ii) Inorganic substances: All micro (Al, Co, Zn, Cu) and macro elements (C, H, O, P, N, P, K) and few other elements.*

## 2.3.2 Biotic components

- Living organisms (or) living members in an ecosystem collectively form its community called biotic components (or) biotic community.

- The living components are made of many different species. These species are distinguished on the basis of their nutritional (feeding) relationship. It includes

1. **Autotrophic components:** ***The members of autotrophic components are producers,*** which are autotrops (self-nourishing organisms). They derive energy from sunlight and make organic compounds from inorganic substances.

   
   
   ***Green plants, algae, bacteria, etc.,***

2. **Heterotrophic components:** ***The members of heterotrophic components are consumers and decomposers,*** which are heterotrophs (dependent on others for food).

- ***They consume the autotrophs (producers). The heterotrophs are***

**(a) Macro consumers: These are herbivores, omnivores (or) carnivores.**

**(b) Saprotrophs (micro consumers): These are decomposers (bacteria, fungi, etc).**

## Members of biotic components of an ecosystem (or) Classification of biotic components

- **The members of biotic components of an ecosystem are grouped into three groups based on how do they get their food.**

1. **Producers (Plants).**
2. **Consumer (Animals).**
3. **Decomposers (Micro-organisms).**

1. **Producers (Autotrophs):** Producers synthesize their food themselves through photosynthesis.


*All green plants, trees.*

## Photosynthesis

- The green pigments, called chlorophyll, present in the leaves of plants, converts $CO_2$ and $H_2O$ in the presence of sunlight into carbohydrates.

$$6CO_2 + 12H_2O \xrightarrow[\text{Chlorophyll}]{h\nu} C_6H_{12}O_6 + 6O_2 + 6H_2O$$

This process is called photosynthesis.

2. **Consumers (heterotrophs):** Consumers are organisms, which cannot prepare their own food and depend directly or indirectly on the producers.

- **They cannot make organic compounds, but can transform one form of organic compounds into other form of organic compounds.**


*(i) Plant eating species*

***Insects, rabbit, goat, deer, cow, etc.,***

*(ii) Animals eating species*

***Fish, lions, tiger, etc.,***

## Types of consumers

**Consumers are of the following types.**

### *(i) Primary consumers (Herbivores) (plant eaters)*

❖ **Primary consumers are also called herbivores, they directly depend on the plants for their food. So they are called plant eaters.**


***Insects, rat, goat, deer, cow, horse, etc.,***

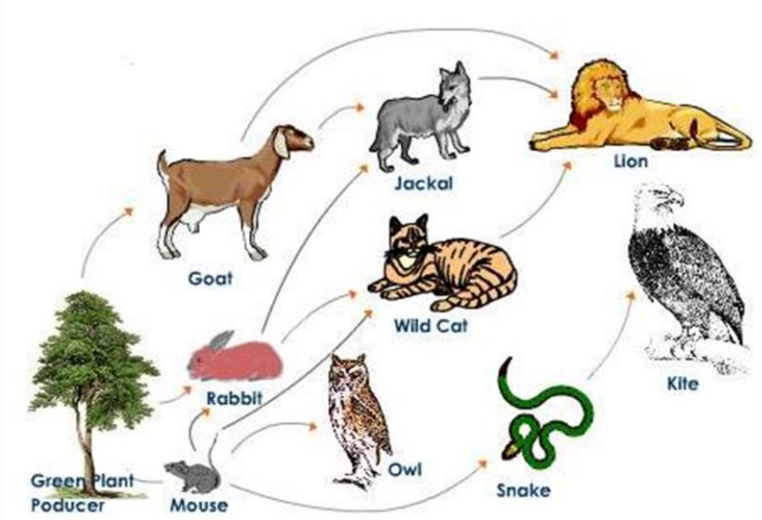
## *(ii) Secondary consumers (primary carnivores) (meat eaters)*

❖ **Secondary consumers are primary carnivores, they feed on primary consumers. They directly depend on the herbivores for their food.**

**Examples** ***Frog, cat, snakes, foxes, etc..,***

## *(iii) Tertiary consumers (Secondary carnivores) (Meat eaters)*

Tertiary consumers are secondary carnivores, they feed on secondary consumers. They directly depend on the primary carnivores for their food.




**(Producers) → (Primary Consumer) → (Secondary Consumer) → (Tertiary consumer)**
**(Producers) → (Herbivores) → (Primary carnivores) → (Secondary Carnivores)**

**Examples** ***Tigers, lions, etc.,***

**3. Decomposers:** Decomposers are those organisms which feed on dead organisms, plants and animals and decompose them into simpler compounds.

- During the decomposition inorganic nutrients are released. These inorganic nutrients together with other organic substances are then utilized by the producers for the synthesis of their own food.


*Microorganisms like bacteria and fungi.*

## Meanings

***(i) Herbivores:*** ***Animals that eat only plants are called*** **herbivores. (vegetarian)**

***(ii) Carnivores:*** ***Animals that eat other animals are called carnivores. (non-vegetarian)***

***(iii) Omnivores:*** ***Animals that eat both animals and plants. (Vegetarian and non-vegetarian)***

# 2.4 FUNCTIONS OF AN ECOSYSTEM

➢ To understand clearly the nature of ecosystem, its functioning should be thoroughly understood.

➢ The function of an ecosystem is to allow flow of energy and cycling of nutrients.

## 2.4.1 Types of Functions

Functions of an ecosystem are of three types.

1. **Primary function (or) primary production:** Primary function of all ecosystems is manufacture of starch (photosynthesis).

2. **Secondary function (or) secondary production:** Secondary function of all ecosystem is distributing energy in the form of food to all consumers (or) the energy stored by the consumer

3. **Tertiary Function:** All living systems die at a particular stage. These dead systems are decomposed to initiate the third function of ecosystems namely "cycling".

- **Functioning of an ecosystem may be understood by studying the following terms.**

  **(a) Energy and material flow.**

  **(b) Food chains.**

  **(c) Food webs.**

  **(d) Food pyramids.**

## 2.5 ENERGY FLOW IN THE ECOSYSTEMS

- **Energy is the most essential requirement for all living organisms. Solar energy is the only source to our planet earth.**
- **Solar energy is transformed to chemical energy in photosynthesis by the plants (called as primary producers).**
- **Though a lot of sunlight falls on the green plants, only 1% of it is utilized for photosynthesis.**

- This is the most essential step to provide energy for all other living organisms in the ecosystem.

- Some amount of chemical energy is used by the plants for their growth and the remaining is transferred to consumers by the process of eating.

- Thus the energy enters the ecosystem through photosynthesis and passes through the different tropic levels (feeding levels).

## 2.5.1 Energy flow through atmosphere to an ecosystem

- Sun is the ultimate source of energy, its radiations travel through the space in the form of waves and reaches the earth's atmosphere.

- The atmosphere absorbs 50% of the radiations and allow the remainings to reach the earth surface.

- Of the solar radiations, reached the earth's surface, some of which is absorbed by organisms (primary producers) to produce organic matter through photosynthesis.

## Photosynthetic equation

$$\underset{\text{carbon dioxide}}{CO_2} + \underset{\text{water}}{2H_2O} \xrightarrow[\text{sunlight}]{} \underset{\text{carbohydrate}}{CH_2O} + \underset{\text{oxygen}}{O_2} + \underset{\text{water}}{H_2O}$$

- **The plants (producers) are used by herbivores and herbivores are used by carnivores as their food.**
- **In this way energy is transfered from one organism to another and so on. The conversion of solar energy is governed by law of thermodynamics.**

## 1. Ist law of thermodynamics

***It states that, "energy can neither be created nor destroyed, but it can be converted from one form to another."***

**Illustration: Energy for an ecosystem comes from the sun. It is absorbed by plants, wherein it is converted into stored chemical energy.**

i.e., Solar energy in converted into chemical energy.

Solar energy $\rightarrow$ Chemical energy (plants)

## 2. IInd law of thermodynamics

***It states that, "whenever energy is transformed, there is a loss of energy through the release of heat."***

**Illustration: This occurs when energy is transferred between tropic levels. There will be a loss of energy (about 80-90%) in the form of heat as it moves from one tropic level to another tropic level.**

- **The loss of energy takes place through respiration, running, hunting etc.,**

### Respiration equation

$$\underset{\text{carbohydrate}}{CH_2O} + \underset{\text{oxygen}}{O_2} \longrightarrow \underset{\text{carbondioxide}}{CO_2} + \underset{\text{water}}{H_2O}$$

- **Net production of biomass is only about 0.5% of the total incident radiation (3000 k.cal/$m^2$/day) and 1.0% of energy absorbed and the remaining gets wasted.**

## 2.5.2 Relationship between structure and function (flow model)

- **From the above it is clear that, the biotic components and abiotic components are linked together through energy flow and nutrient cycling as shown in the following figure 2.2.**

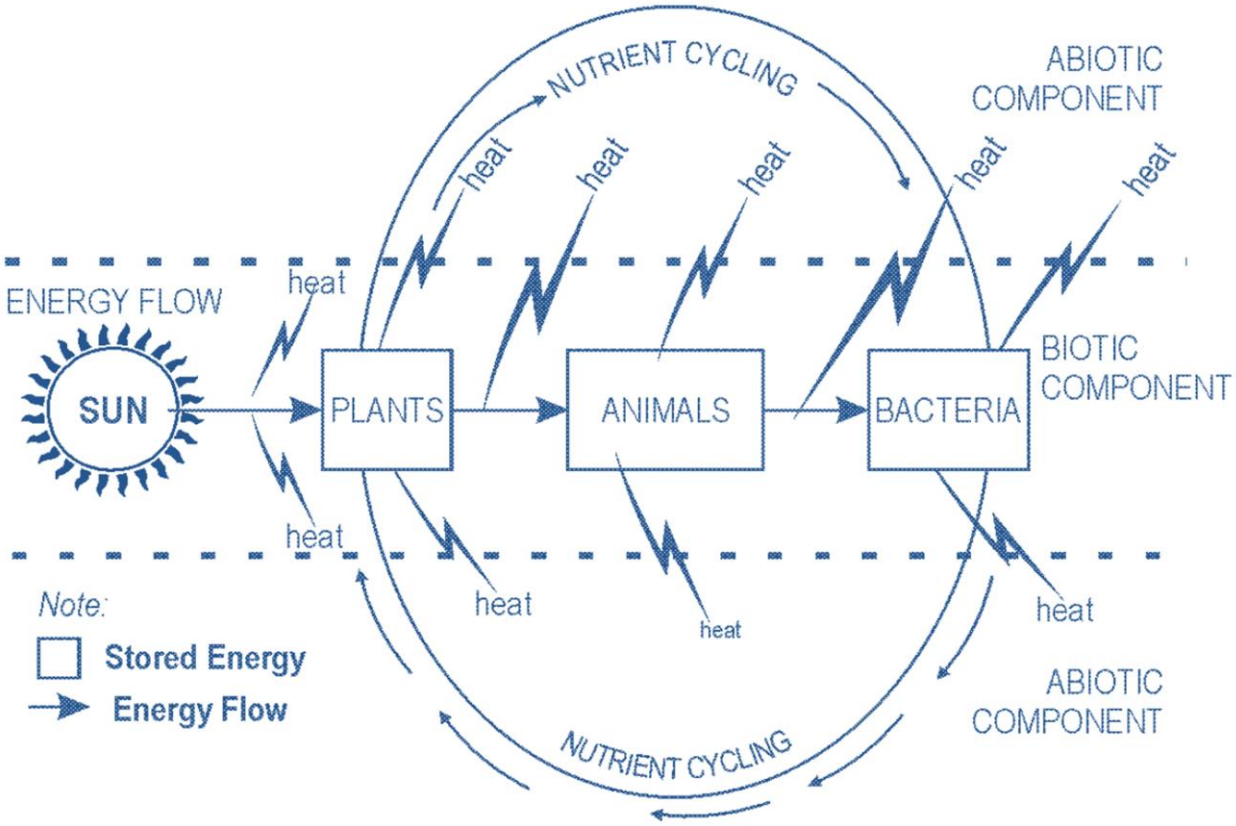



**Fig.2.2 Flow of energy and nutrient cycling from abiotic to biotic and vice versa.**

# 2.6 NUTRIENT FLOW (OR) NUTRIENT CYCLING(OR) BIOGEOCHEMICAL CYCLE IN THE ECOSYSTEM

## 2.6.1 Nutrients

**Elements, which are essential for the survival of both plants and animals are called nutrients.**

1. **Macronutrients: The elements needed in large amounts are called macronutrients.**

Examples ***Oxygen, nitrogen, carbon, calcium, magnesium and phosphorus.***

2. **Micronutrients: The elements, needed in small amounts are called micronutrients.**

Examples ***Boron, cobalt, strontium, zinc, copper.***

## 2.6.2 Nutrient cycles

- ***Cyclic flow of nutrients between the biotic and abiotic components is known as nutrient cycle (or) biogeochemical cycles.***

- **Nutrients enter into the producers and move through food chain and ultimately reach the consumer.**

- **The bound nutrients of the consumers, after death, are decomposed and converted into inorganic substances, which are readily used up by the plants (producers) and again the cycle starts.**

- **The major nutrients like C, H, O and N are cycled again and again between biotic and abiotic component of the ecosystem.**

### Hydrological Cycle

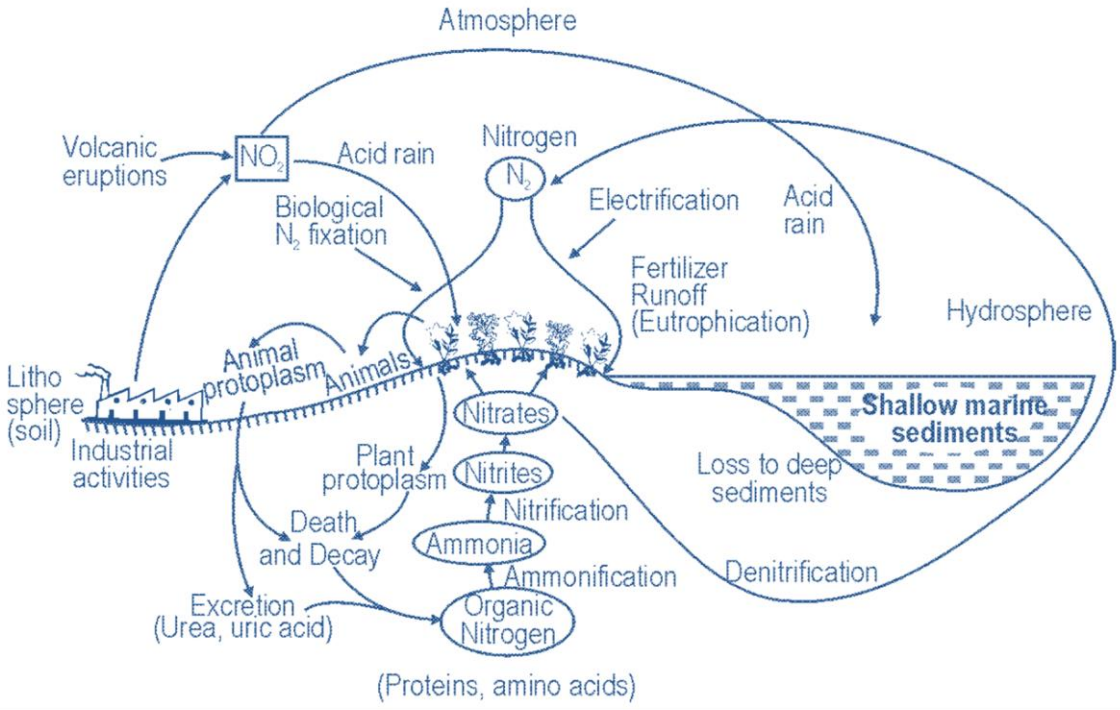
- ***Movement of water in a cyclic manner is known as hydrological cycle.***

## 2.6.3 Nitrogen cycley

- ✓ **Nitrogen is present in the atmosphere as $N_2$ in large amounts (78%).**

- ✓ **The nitrogen is present in all biotic components in different forms as food.**


***Proteins, vitamins, amino acids, etc.,***




## Fig. 2.3 Nitrogen cycle

- **$N_2$ from the atmosphere is taken up by the green plants as a raw material for biosynthesis of different foods (amino acids, proteins, vitamins) and used in metabolism.**

- **These food move through the food chain. After death of the plants and animals, the organic nitrogen in dead tissues is decomposed by several micro organisms (ammonifying and nitrifying bacteria) into ammonia, nitrites and nitrates, which are again used by the plants.**

- **Some bacteria convert nitrates into molecular nitrogen ($N_2$), which is again released back into atmosphere and the cycle goes on.**

- **$N_2$ from the atmosphere is taken up by the green plants as a raw material for biosynthesis of different foods (amino acids, proteins, vitamins) and used in metabolism.**

- **These food move through the food chain. After death of the plants and animals, the organic nitrogen in dead tissues is decomposed by several micro organisms (ammonifying and nitrifying bacteria) into ammonia, nitrites and nitrates, which are again used by the plants.**

- **Some bacteria convert nitrates into molecular nitrogen ($N_2$), which is again released back into atmosphere and the cycle goes on.**

### Nitrification

- ***Conversion of ammonia into nitrates is termed as nitrification. This is brought about by nitrifying bacteria.***

Examples ***Nitrobacter, Nitrosomonas.***

### Denitrification

- ***Conversion of nitrates into nitrogen ($N_2$) is termed as denitrification. This process is brought about by denitrifying bacteria.***

Examples ***Pseudomonas, fluorescence.***

## 2.6.4 Oxygen cycle

- **Oxygen cycle is the cycle that helps move oxygen through three main regions of the earth.**

**ie.,**

**1. The atmosphere (air).**

**2. The biosphere (sum of all ecosystem).**

**3. The lithosphere (earth's crust).**

### 1. The atmoshpere

- **It is the region of gases that lies above the earth's surface. It is the largest reservoirs of free oxygen on earth. In the atmosphere oxygen is released by the process called photosynthesis.**

- **Plants mark the beginning of the oxygen cycle. During photosynthesis, plants convert carbondioxide and water into carbohydrate and oxygen.**

$$6CO_2 + 6H_2O + h\nu \longrightarrow C_6H_{12}O_6 + 6O_2$$

**This means that plants "breathe" in carbondioxide and "breathe" out oxygen.**

## 2. The biosphere

- **Biosphere is the sum of all the earth's ecosystem. In the biosphere the main cycles are respiration and photosynthesis.**

- **Animals and humans breathe in oxygen and breath out carbondioxide.**

$$6O_2 + C_6H_{12}O_6 \longrightarrow 6CO_2 + 6H_2O + \text{energy}$$

## 3. The Lithosphere

- **The largest reservoir of oxygen is lithosphere. Here oxygen is present as silicates and oxides.**

- **When oxygen bearing mineral is exposed to the elements, a chemical reaction occurs that wears it down and produces free oxygen.**

- **Thus, these are the main oxygen cycles and each play an important role in helping to project and maintain life on the earth.**

Respiration

$$6O_2 + C_6H_{12}O_6 \longrightarrow 6CO_2 + 6H_{12}O + \text{energy}$$

Photo synthesis

$$6CO_2 + 6H_2O + \text{enegy} \longrightarrow C_6H_{12}O_6 + 6O_2$$

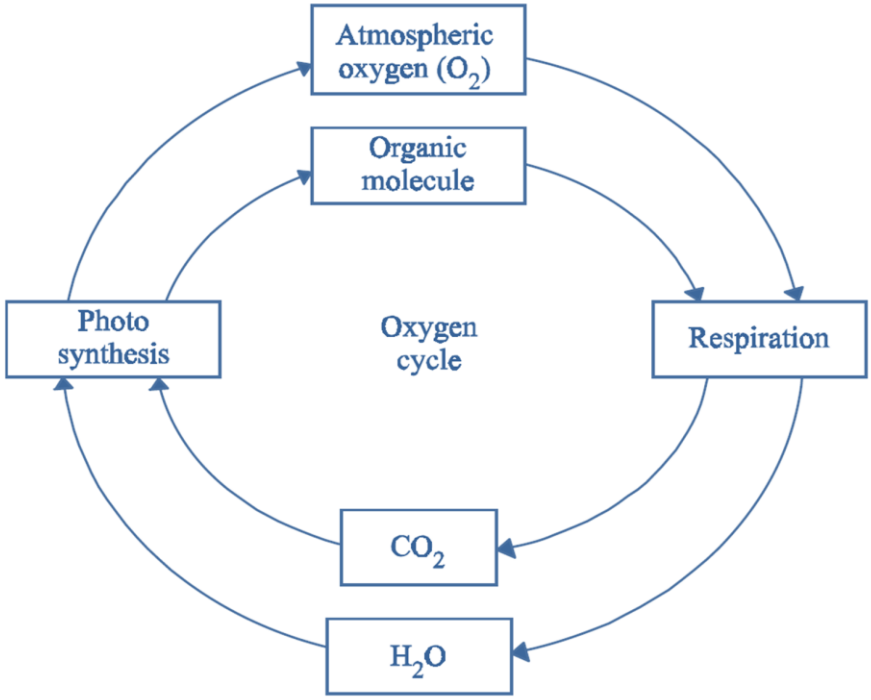



**Fig. 2.4 Oxygen cycle**

# 2.7 ECOLOGICAL SUCCESSION

- In an area one community may be replaced by another community or by a series of communities.
- Thus *the progressive replacement of one community by another till the development of stable community in a particular area is called ecological succession.*

## 2.7.1 Stages of ecological succession

### 1. Pioneer community

- First group of organism, which establish their community in the area is called 'Pioneer' Community.

### 2. Seres (or) Seral stage

- Various developmental stages of a community is called 'seres'.

***Community***

- It is the group of plants or animals living in an area.

## 2.7.2 Types of ecological succession

- Ecologists recognize two types of ecological succession, based on the conditions present at the beginning of the process.

1. **Primary succession:** It involves the gradual establishment of biotic communities on a lifeless ground.

*(a) Hydrarch (or) Hydrosere: Establishment starts in a* watery area like pond and lake.

*(b) Xerarch or Xerosere: Establishment starts in a dry area* like, desert and rock.

2. **Secondary succession:** It involves the establishment of biotic communities in an area, where some type of biotic community is already present.

## 2.7.3 Process of Ecological Succession

- Process of ecological succession can be explained in the following steps.

1. **Nudation:** It is the development of a bare area without any life form.
2. **Invasion:** It is the establishment of one or more species on a bare area through migration followed by establishment.
   - (a) **Migration:** *Migration of seeds is brought about by wind,* water or birds.
   - *(b)* ***Establishment:*** *The seeds then germinate and grow on* the land and establishes their **pioneer communities.**

3. **Competition:** As the number of individual species grows, there is a competition with the same species and between different species for space, water and nutrients.

4. **Reaction:** The living organisms, take water, nutrients and grow and modify the environment is known as reaction. Thismodification becomes unsuitable for the existing species and favour some new species, which replace the existing species. This leads to **seral communities.**

5. **Stabilizations:** It leads to stable community, which is in equilibrium with the environment.

# 2.8 FOREST ECOSYSTEM

## 2.8.1 Introduction

- A forest ecosystem is the one in which a tall and dense trees grow that support many animals and birds. The forests are found in undisturbed areas receiving moderate to high
rainfall.

- The forest occupies nearly 40% of the world's land area. In India it occupies only 19% of its total land area.

## 2.8.2 Types of forest ecosystem

- Depending upon the climate conditions, forests can be classified into the following types.

1. Tropical rain forests.
2. Tropical deciduous forests.
3. Tropical scrub forests.
4. Temperate rain forests.
5. Temperate deciduous forests.

## 2.8.3 Features of different types of Forests

1. **Tropical rain forests:** They are found near the equator. They are characterized by high temperature. They have broad leaf trees like teak and sandal and the animals like lion, tiger and monkey.

2. **Tropical deciduous forests:** They are found little away from the equator. They are characterized by a warm climate and rain is only during monsoon. They have different types of deciduous trees like maple, oak and hickary and animals like deer, fox, rabbit and rat.

3. **Tropical scrub forests:** These are characterised by a dry climate for longer time. They have small deciduous trees and shrubs and animals like deer, fox, etc.,

4. **Temperate rain forests:** They are found in temperate areas with adequate rainfall. They are characterized by coniferous trees like pines, red wood etc., and animals like squirrels, fox, cats, bear etc.,

5. **Temperate deciduous forests:** They are found in areas with moderate temperatures. They have major trees including broad leaf deciduous trees like oak, hickory and animals like deer, fox, bear, etc.,

## 2.8.4 Characteristics of forest ecosystems

1. Forests are characterised by warm temperature and adequate rainfall, which make the generation of number of ponds, lakes etc.,
2. The forest maintains climate and rainfall.
3. The forest supports many wild animals and protect biodiversity.
4. The soil is rich in organic matter and nutrients, which support the growth of trees.
5. Since penetration of light is so poor, the conversion of organic matter into nutrients is very fast.

## 2.8.5 Structure (Components) and Function of forest ecosystem

### I. Abiotic components

Examples ***Climatic factors (temperature, light, rainfall) and minerals.***

- Abiotic components are physical components (inorganic and organic substances) found in the soil and atmosphere. In addition to minerals, the occurrence of litter is characteristic features of majority of forests.

## II. Biotic components

### 1. Producers

Examples ***Trees, shrubs and ground vegetation.***

❖ **The plants absorb sunlight and produce food through photosynthesis.**

### 2. Consumers

***(a) Primary consumers (herbivores)***

Examples ***Ants, flies, insects, mice, deer, squirrels.***

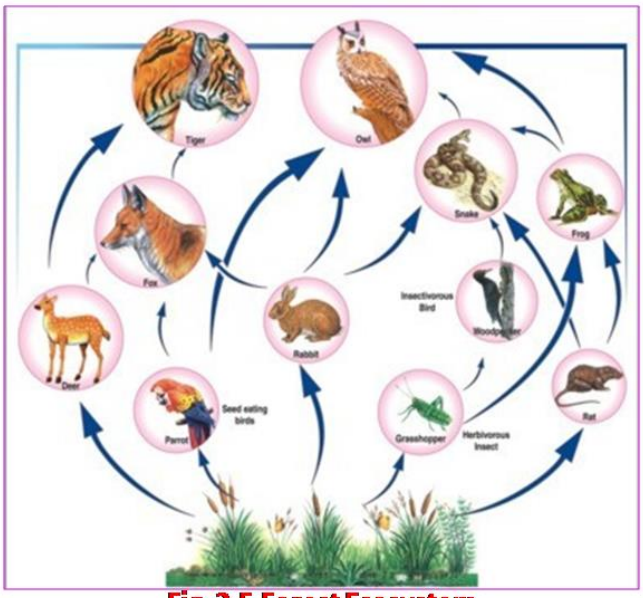



**Fig. 2.5 Forest Ecosystem**

**They directly depend on the plants for their food.**

*(b) Secondary consumers (primary carnivores)*

Examples *Snakes, birds, fox.*

- They directly depend on the herbivores for their food.

*(c) Tertiary consumers*

Examples *Animals like tiger, lion, etc.,*

- They depend on the primary carnivores for their food.

**4. Decomposers**

Examples *Bacteria and fungi.*

❖ They decompose the dead plant and animal matter. Rate of decomposition in tropical and subtropical forests is more rapid than in the temperate forests.

# 2.9 GRASSLAND ECOSYSTEM

## 2.9.1 Introduction

- Grassland occupies about 20% of earth's surface. In addition to grass species, some trees and shrubs are also present in grasslands.
- Limited grazing helps to improve the net primary production of the grasslands. But, overgrazing leads to degradation of these grasslands resulting in desertification.

## 2.9.2 Types of grassland ecosystem

- Depending upon the climate conditions grassland can be classified into three types

1. Tropical grasslands.
2. Temperate grasslands.
3. Polar grasslands.

## 2.9.3 Features of different types of grassland

### 1. Tropical grasslands

- They are found near the borders of tropical rain forests. They are characterized by high temperature and moderate rainfall (40 to 100 cm). It is also known as Savanna-type.
- They have tall grasses with scattered shrubs and stunted trees and animals like zebras, giraffes, antelopes, etc.,

### 2. Temperate grasslands

- They are usually found in the centers of continents, on flat, sloped hills. They are characterized by very cold winters and hot summers. Intense grazing and summer fires, do not allow shrubs or trees to grow.

### 3. Polar grasslands

- They are found in arctic polar regions. They are characterised by severe cold and strong winds along with ice and snow.
- In summers several small annual plants grow. They have animals like arctic wolf, weasel, arctic fox, etc.,

## 2.9.4 Characteristics of Grassland Ecosystems

1. Grassland ecosystem is a plain land occupied by grasses.
2. Soil is very rich in nutrients and organic matter.
3. Since it has tall grass, it is ideal place for grazing animals.
4. It is characterized by low or uneven rainfall.

## 2.9.5 Structure and function of the Grassland Ecosystems

### I. Abiotic Components

Examples *Nutrients, C, H, O, N, P, S, etc.,*

- These abiotic components are supplied by $CO_2$, $H_2O$, nitrates, phosphates and sulphates.

### II. Biotic Components

#### 1. Producers

Examples *Grasses, forbs and shrubs.*

- They produce food.

#### 2. Consumers

*(a) Primary consumers (herbivores)*

Examples *Cows, buffaloes, deer, sheep, etc.,*

- ❑ They depend on grasses for their food.

*(b) Secondary consumers (carnivores)*

Examples *Snakes, lizards, birds, Jackals, fox, etc.,*

- ❑ They feed on herbivores.

*(c) Tertiary consumers*

Examples *Hawks, eagles, etc.,*

- ❑ They feed on secondary consumers.

### 3. Decomposers

Examples **Fungi and bacteria.**

- They decompose the dead organic matter.

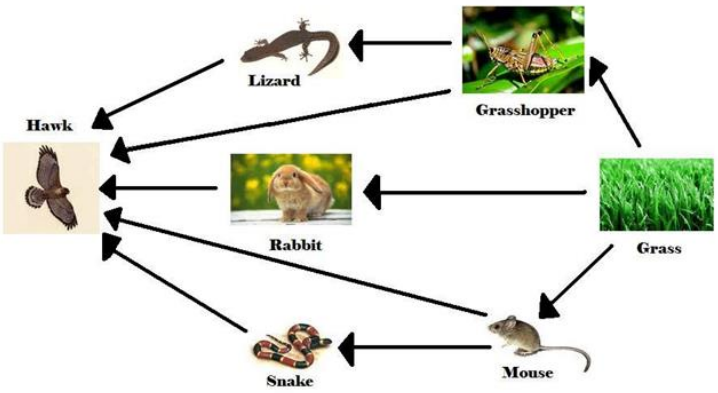



**Fig. 2.6 Grassland Ecosystem**

## 2.10.DESERT ECOSYSTEMS

### 2.10.1 Introduction

- Desert occupies about 35% of our world's land area. It is characterised by less than 25 cm rainfall. The atmosphere is dry and hence it is a poor insulator.

### 2.10.2 Types of desert ecosystems

- Based on the climatic conditions, deserts are classified into three types.
  1. Tropical deserts.
  2. Temperate deserts.
  3. Cold deserts.

## 2.10.3 Features of different types of deserts

### 1. Tropical deserts

Tropical deserts are found in

*(i) Africa: Sahara desert.*

*(ii) Rajasthan: Thar desert.*

- They are characterized by only few species. Wind blown sand dunes are very common.

### 2. Temperate deserts

They are found in

*South California: Majave.*

- They are characterized by very hot summer and very cool winter time.

### 3. Cold deserts

They are found in

*China: Gobi desert.*

- They are characterized by cold winters and warm summers.

## 2.10.4 Characteristic features of Forest ecosystems

1. The desert air is dry and the climate is hot.
2. Annual rainfall is less than 25 cm.
3. The soil is very poor in nutrients and organic matter.
4. Vegetation is poor.

## 2.10.5 Structure and functions of the desert Ecosystems

### I. Abiotic Components

Examples *Temperature, rainfall, sunlight, water, etc.,*

- The temperature is very high and the rainfall is very low. The nutrient cycling is also very low.

## II. Biotic Components

### 1. Producers

**Examples** *Shrubs, bushes, some grasses and few trees.*

- In deserts mostly Succulent (e.g., cacti) plants are found available. They have water inside them to stay alive. They have waxy layer on the outside to protect them from the sun.

### 2. Consumers

**Examples** *Squirrels, mice, foxes, rabbits, deer and reptiles.*

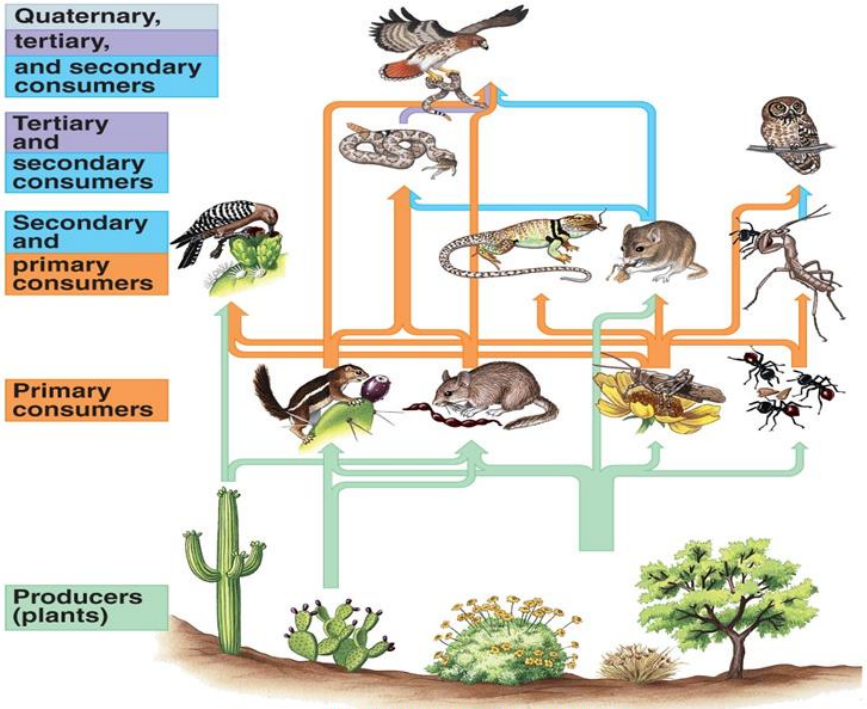



Fig. 2.7 Desert Ecosystem

- These animals dig holes in the ground to live in. They come out at night to find food. Most of the animals can extract water from the seeds they eat.

**3. Decomposers**

Examples *Fungi and bacteria.*

- Desert has poor vegetation with a very low amount of dead organic matter. They are decomposed by few fungi and bacteria.

# 2.11 AQUATIC ECOSYSTEMS

## 2.11.1 Introduction

- The aquatic ecosystem deals with water bodies. The major types of organisms found in aquatic environments are determined by the water's salinity.

## 2.11.2 Types of aquatic life zone

Aquatic life zones are divided into two types.

**1. Fresh water life zones**

Examples *Ponds, streams, lakes, rivers.*

**2. Salt water life zones**

Examples *Oceans, estuaries.*

***I. FRESH WATER ECOSYSTEMS***

# 2.12 POND ECOSYSTEM

## 2.12.1 Introduction

- A pond is a fresh water aquatic ecosystem, where water is stagnant. It receives enough water during rainy season. It contains several types of algae, aquatic plants, insects, fishes and birds.

## 2.12.2 Characteristic features of pond ecosystem

1. Pond is temporary, only seasonal.
2. It is a stagnant fresh water body.
3. Ponds get polluted easily due to limited amount of water.

## 2.12.3 Structure and functions of pond ecosystem

**I. Abiotic Components**

Examples *Temperature, light, water and organic and inorganic compounds.*

## II. Biotic Components

### 1. Producers

- These include green photosynthetic organisms. They are of two types.

*(a) Phytoplankton*

- These are microscopic aquatic plants, which freely float on the surface of water.

Examples — *Algae, small floating plants like volvox, pandorina, anabaena, cosmarium.*

*(b) Microphytes*

Examples — *Large floating plants and submerged plants like hydrilla, Jussiaea, wolfia, demna.*

### 2. Consumers

*(a) Primary consumers (Zooplanktons)*

- These are microscopic animals which freely float on the surface of water.

Examples — *Protozoa, very small fish, ciliates, flagellates and protozoans.*

**Fig. 2.8 Pond Ecosystem**

- **Zooplanktons are found along with phytoplankton. They feed on plants (phytoplankton).**

***(b) Secondary consumers (Carnivores).***

***Examples*** ***Insects like water beetles and small fish.***

- **They feed on zooplankton.**

***(c) Tertiary consumers***

***Examples*** ***Large fish like game fish.***

- **They feed on smaller fish.**

### 3. Decomposers

Examples *Fungi, bacteria and flagellates.*

- They decompose the dead plant and animal matter and their nutrients are released and reused by the green plants.

## 2.13. LAKE ECOSYSTEM

### 2.13.1 Introduction

- Lakes are large natural shallow water bodies. Lakes are used for various purposes. Lakes are supplied with water fromrainfall, melting snow and streams.

### 2.13.2 Some important types of lakes are

1. Oligotrophic lakes: They have low nutrient concentrations.
2. Eutrophic lakes: They are overnourished by nutrients like N and P.
3. Dystrophic lakes: They have low pH, high humic acid content and brown waters.
4. Volcanic lakes: They receive water from magma after volcanic eruptions.
5. Meromictic lakes: They are rich in salts.
6. Artificial lakes

- They are created due to construction of dams.

## 2.13.3 Zones of Lake

- **Depending upon their depth and distance from the shore, lakes consists of four distinct zones.**

1. **Littoral zones: It is the top layer of the lake.It has a shallow water.**
2. **Limnetic zone: Next to the littoral zone is limnetic zone, where effective penetration of solar light takes place.**
3. **Profundal zone: The deep open water, where it is too dark.**
4. **Benthic zone: This zone is found at the bottom of the lake.**


**Fig. 2.9 Zones of Lake**

## 2.13.4 Characteristic features of lake ecosystem

1. Lake is a shallow fresh water body.
2. It is a permanent water body with large water resources.
3. It helps in irrigation and drinking.

## 2.13.5 Structure and function of lake ecosystem

### I. Abiotic Components

Examples — *Temperature, light, proteins and lipids, turbidity, $O_2$ and $CO_2$.*

### II. Biotic Components

#### 1. Producers

- They are green plants, may be submerged, free floating and amphibious plants.

Examples — *Phytoplanktons, algae and flagellates.*

#### 2. Consumers

(a) Primary Consumers (Zooplanktons)

Examples — *Cilictes, protozoans, etc.,*

- They feed on phytoplankton.

*(b) Secondary consumers (carnivores)*

Examples *Insects and small fishes.*

- They feed on zooplankton.

*(c) Tertiary consumers*

Examples *Large fishes like game fish.*

- They feed on smaller fish.

**3. Decomposers**

Examples *Bacteria, fungi and actinomycetes.*

- They decompose the dead plants and animals.

# 2.14 RIVER (OR) STREAM ECOSYSTEM

## 2.14.1 Introduction

✓ The running water of a stream or a river is usually well oxygenated, because it absorbs oxygen from the air. The number of animals are low in river or stream.

## 2.14.2 Characteristic features of River or Stream

1. It is a fresh water, and free flowing water systems.
2. Due to mixing of water, dissolved oxygen content is more.
3. River deposits large amount of nutrients.

## 2.14.3 Structure and function of River or Stream Ecosystem

### I. Abiotic Components

Examples *Temperature, light, pH, nutrients, organic and inorganic compounds.*

### II. Biotic Components

#### 1. Producers

- Phytoplankton, algae, water grasses, aquatic masses and other amphibious plants.

#### 2. Consumers

*(i) Primary consumers*

Examples *Water insects, snails, fishes.*

- They feed on phytoplankton.

*(ii) Secondary Consumers*

Examples *Birds and mammals.*

- They feed on primary consumers.

*(iii) Decomposers*

Examples *Bacteria and fungi.*

- They decompose the dead animals and plants.

## II. SALT WATER ECOSYSTEMS

# 2.15 OCEAN (MARINE) ECOSYSTEMS

## 2.15.1 Introduction

- Oceans cover more than two thirds of the earth's surface. The ocean environment is characterized by its high concentration of salts and minerals.

- It supplies huge variety of sea-products and drugs. It also provides us iron, magnesium, phosphorus, natural gas.

## 2.15.2 Zones of Oceans

- The oceans have two major life zones.

1. **Coastal zone:** It is relatively warm, nutrient rich shallow water. It is the zone of high primary productivity because of high nutrients and sunlight.

2. **Open sea:** It is the deeper part of the ocean. It is vertically divided into three regions.

*(a) Euphotic zone: It receives abundant light and shows high* photosynthetic activity.

*(b) Bathyal zone: It receives dim light and is usually* geologically active.

*(c) Abyssal zone: It is the dark zone and is very deep (2000* to 5000 metres).

## 2.15.3 Characteristic features of Ocean Ecosystem

1. It occupies a large surface area with saline water.
2. Since ship, submarines can sail in ocean, commercial activities may be carried out.
3. It is rich in biodiveristy.
4. It moderates the temperature of the earth.

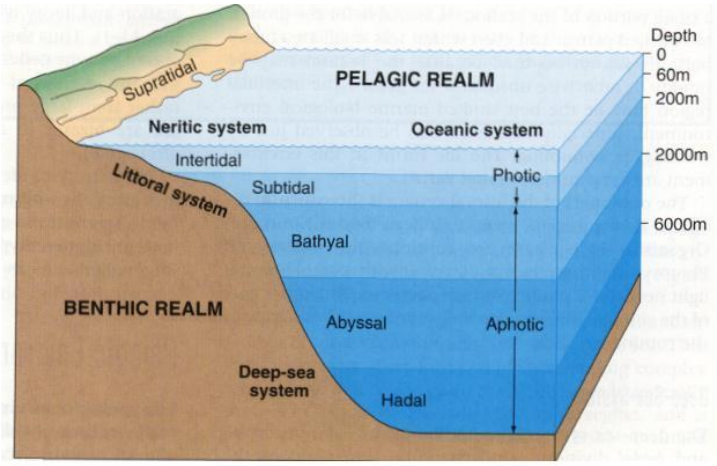



**Fig. 2.10 Ocean (marine) Ecosystem**

## 2.15.4 Structure and function of Ocean Ecosystems

### I. Abiotic Components

Examples *Temperature, light, NaCl, K, Ca, and Mg Salts, alkalinity.*

### II. Biotic Components

#### 1. Producers

Examples *Phytoplanktons (diatoms, unicellular algae, etc.,) and marine plants (sea weeds, chlorophyceal, phaeophyceae).*

#### 2. Consumers

- These are heterotrophic macro consumers. They depend on producers for their nutrition.

*(i) Primary consumers (herbivores)*

Examples *Crustaceans, moiluscs, fish.*

- They feed on producers.

*(ii) Secondary consumers (carnivores)*

Examples *Herring sahd, mackerel, etc.,*

- They feed on herbivores.

*(iii) Tertiary Consumers*

Examples *Cod, Haddock, etc.,*

- They are the top consumers. They feed on small fishes.

**(3) Decomposers**

Examples *Bacteria and some fungi.*

- They decompose the dead organic matter

# 2.16 ESTUARINE ECOSYSTEM

## 2.16.1 Introduction

- *An estuary is a partially enclosed coastal area at the mouth of a river, where river joins the sea. It is strongly* affected by tidal action.

- Estuaries are generally abundant of nutrients. Estuaries are useful to human beings due to their high food potential. It is essential to protect the estuaries from pollution.

## 2.16.2 Characteristics of Estuarine ecosystem

1. **Estuaries are transition zones, which are strongly affected by tides of the sea.**

2. **Water characteristics are periodically changed.**

3. **The living organism in estuarine ecosystems have wide tolerance.**

4. **Salinity remains highest during the summer and lowest during the winter.**

## 2.16.3 Structure and function of Estuarine Ecosystem

### I. Abiotic Components

Examples ***Temperature, pH, sodium and potassium salts and various nutrients.***

### II. Biotic Components

**(a) Producers**

Examples ***Marsh grasses, seaweeds, seagrasses and phytoplankton.***

**(b) Consumers**

Examples *Oysters, crabs, seabirds, small fishes.*

**(c) Decomposers**

Examples *Bacterias, fungi and actenomycetous.*

# 2.17 FIELD STUDY OF SIMPLE ECOSYSTEMS

## 2.17.1 Pond Ecosystem in Melmaruvathur town, Tamil Nadu

- A field study was carried out with a group of students. A nearby pond in Melmaruvathur town, Tamil nadu was visited. The observations noted are given below.

### I. Abiotic Components

- Light, temperature, hydrogen-ion, inorganic substances like $CO_2$, $H_2$, $O_2$, $N_2$ and organic substances like carbohydrates, proteins, lipids, etc.,

## II. Biotic Components

### 1. Producers

- Green plants, which are submerged, free floating plants like hydrilla, vallisneria, pistia, sagittaria.

### 2. Consumers

***(i) Primary Consumers***

1. Zooplanktons like insects, dragon fly larvae, crustaceans etc.
2. Larvae of insects, beetles, fishes, molluscs, etc.,

***(ii) Secondary Consumers:*** *Insects like water beetles, frogs,* fishes which feed on primary consumers.

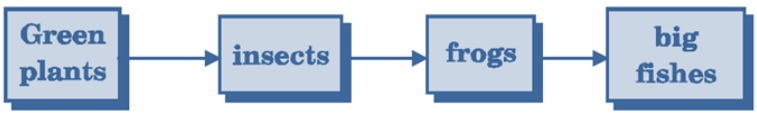
***(iii) Tertiary Consumers:*** *These are big fishes, kingfisher* and other water birds that feed on fishes.

Bacteria, fungi, actinomycetes

### (3) Decomposers

**Food Chain**

Phytoplanktons → Zooplanktons → Secondary Consumer → Tertiary Consumer.



## 2.17.2 Grassland ecosystem in Tindivanam Village, Tamil Nadu

➢ A field study was carried out with a group of students. A nearby grass land in Tindivanam village, Tamilnadu, was visited. The observations noted are given below.

### I. Abiotic Components

Soil, gases present in atmosphere, water.

### II. Biotic Components

**1. Producers**

Grass varieties, herbs and trees.

**2. Consumers**

*(i) Primary Consumers: Grazing animals like cow, sheep,* deer, etc.

*(ii) Secondary Consumers: Fox, Jackals, snakes, frogs, birds.*

*(iii) Tertiary Consumers: Hawks, wolves.*

**(3) Decomposers**

**Food Chain**

Bacterias, moulds and fungi.