Ecosystem (Unit-2)

Ecology: The study of the basic relationship of organisms and with their environment is called Ecology.

The word ecosystem was coined by A.G.Tansley in 1935. This term is derived from two words namely eco and system. Eco refers to environment and system refers to a complex co-ordinated unit.

An ecosystem is a basic functional unit of the ecology. It consists of living organisms (Biotic factors) and nonliving substances (Abiotic factors).

It is an interacting system where the biotic and abiotic factors interact to produce an exchange of materials between the living and non-living factors.

* **Definition of ecosystem:** An ecosystem is a functional unit of the biosphere in which members of the community interact among themselves and with the surrounding environment.

Biotic components of an ecosystem are broadly classified in to three types.

1) Producers

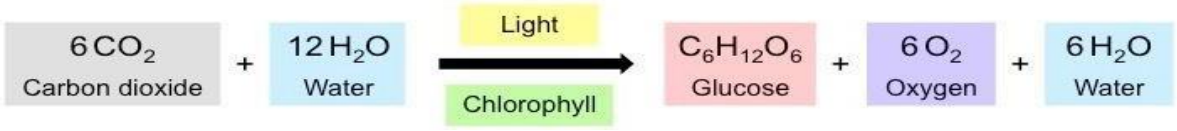
2) Consumers

3) Decomposers

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

Ex: All plants.

Photosynthesis: The green pigments called chlorophyll, present in the leaves of plants convert CO_2 and H_2O in the presence of sunlight in to carbohydrates.



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.

Ex: **Plant eating species:** Insects, rabbit, goat, deer, cow etc.,
Animal eating species: Fish, lions, tigers etc.,

Consumer are broadly classified in to three types.

a) Primary consumers (Herbivores or Plant eaters): Primary consumers are also called herbivores, they directly depend on the plants for their food. So they are called plant eaters.

Ex: Insects, goat, deer, cow, horse etc.,

b) Secondary consumers (Primary carnivores or meat eaters): Secondary consumers are primary carnivores, they feed on primary consumers. They directly depend on the herbivores for their food.

Ex: Frog, cat, snake, foxes etc.,

c) Tertiary consumers (Secondary carnivores or meat eaters): Tertiary consumers are secondary carnivores, they feed on secondary consumers. They directly depend on the primary carnivores for their food.

Ex: Tigers, lions etc.,

3) Decomposers: Decomposers attack the dead bodies of producers and consumers and decompose them in to 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.

Ex: Microorganisms like bacteria, fungi, algae etc.,

* Food chain:

The sequence of eating being eaten in an ecosystem is known as food chain.

The biotic factors of the ecosystem are linked together by food. For example, the producers form food for the herbivores. The herbivores form food for the carnivores.

The various steps through which food energy passes in an ecosystem is called as trophic levels.

Owing to repeated eating being eaten, the energy is transferred from one trophic level to another trophic level. This transfer of energy from one trophic level to another is called energy flow.

A typical food chain can be seen in a pond ecosystem. The algae and phytoplankton are eaten by the zooplankton. The zooplankton is eaten by fishes. The fishes are eaten by snakes.

Ex: Phytoplankton → Zooplankton → Fish → Snake

The food chains are of two types, namely 1. Grazing food chain and 2. Detritus food chain.

1. Grazing food chain:

This food chain starts from green plants, goes through herbivores and ends in carnivores.

This type of food chain depends on the autotrophs which capture the energy from solar radiation. A few chains are given below:

Grass → Rat → Snake → Eagle

Grass → Grasshopper → Frog → Snake → Eagle

Grass → Deer → Tiger

2. Detritus food chain:

It starts from dead organic matter and ends in inorganic compounds. There are certain groups of organisms which feed exclusively on the dead bodies of animals and plants. These organisms are called detritivores.

The detritivores include algae, bacteria, fungi, insects, ducks etc.. These organisms ingest and digest the dead organic materials.

Some amount of energy is trapped and the remainder is excreted in the form of simple organic compounds. These are again used by another set of detritivores until the organic compounds are converted in to inorganic compounds.

Ex: Dead organic matter → Decomposer → Inorganic matter

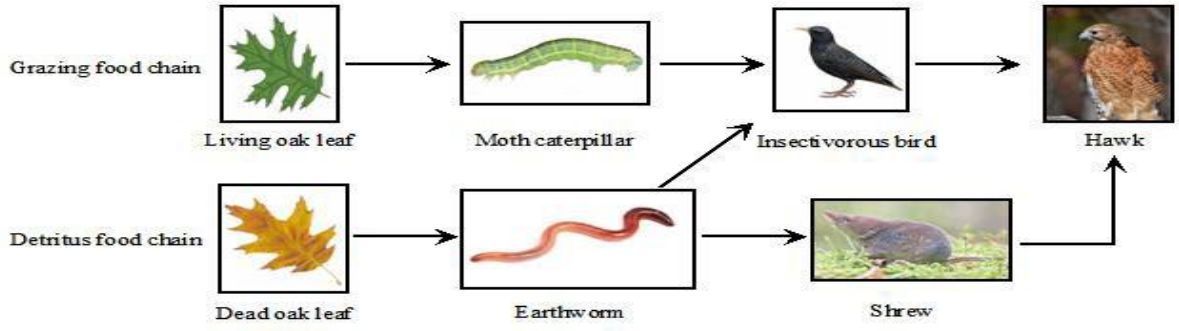
<u>Linking of Grazing and Detritus food chain:</u>

The two main food chains cannot operate independently. They are interconnected at various levels.

According to Wilson and Bossert, the stability of the ecosystem is directly proportional to the number of such links.

The detritus feeders obtain energy from the dead bodies of animals and plants which are components of the grazing food chain.

Again some of the detritus feeders are eaten by the consumers of the grazing food chain. For example, in a pond ecosystem earthworms belonging to the detritus food chain are eaten by fishes belonging to the grazing food chain.



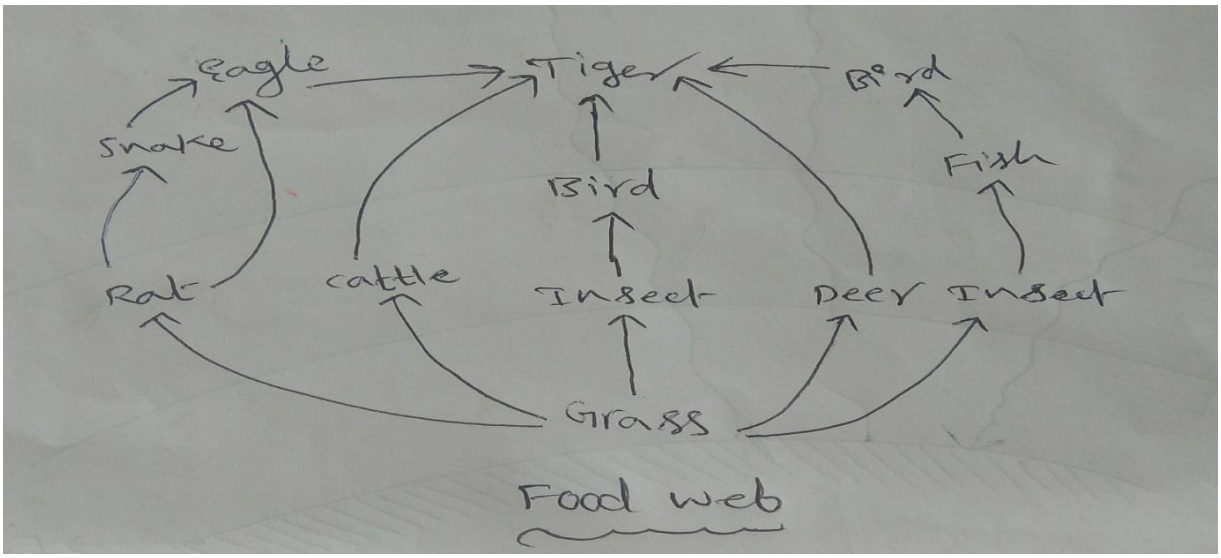
Linking of Grazing and Detritus food chain

* Food web:

The interlocking of many food chains is called food web.

In a food web many food chains are interconnected, where different types of organisms are connected at different trophic levels, so that there is a number of opportunities of eating and being eaten at each trophic level.

For example: In a grassland ecosystem, grass is eaten by insect, cattle, deer and rat. Insect is eaten by fish, bird which is eaten by tiger. Cattle, deer and eagle is eaten by tiger. Rat is eaten by eagle. Rat is eaten by snake which is eaten by eagle. In addition, eagle also directly eats rat. Thus five linear food chains which are interconnected to form a food web.



This is a very simple food web. But in any ecosystem the food web is more complex. For example, in the grassland ecosystem itself, in addition to eagle, there are many other carnivores such as vulture, crow, wolf, fox, man etc.....

Difference between Food chain and Food web:

In a linear food chains, if one species get affected (or) becomes extinct, then the species in the subsequent trophic levels are also affected.

But, in a food web, if one species gets affected, it does not affect other trophic levels so seriously. There are number of options available at each trophic level.

Significance of Food chains and Food webs:

1) Food chains and Food webs play a very important role in the ecosystem. Energy flow and nutrient cycling takes place through them.

2) They maintain and regulate the population size of different trophic levels, and thus help in maintain ecological balance.

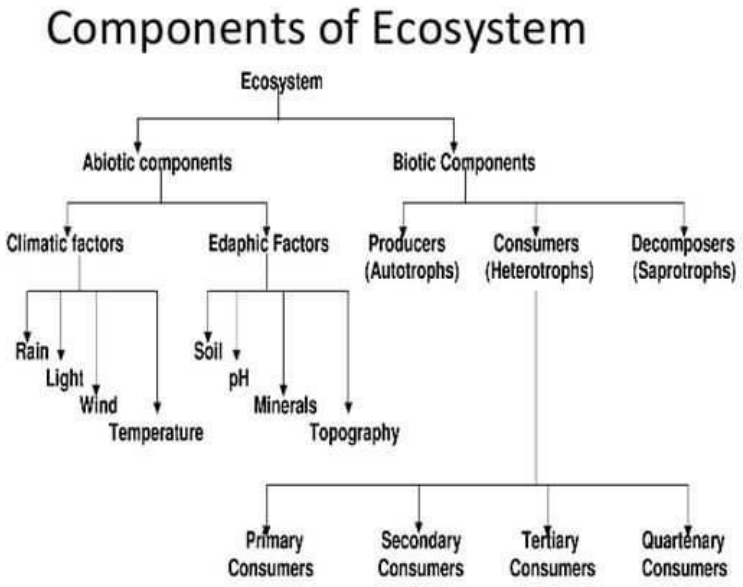
* Structure or Components of an ecosystem

The term structure refers to the various components. So the structure of an ecosystem explains the relation between the abiotic (non-living) and the biotic (living) components.

An ecosystem has two components.

1) Biotic (living) components.

2) Abiotic (non-living) components.



A) Biotic components:

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

Example: Producers, Consumers and Decomposers

Biotic components of an ecosystem are broadly classified in to three types.

1) Producers

2) Consumers

3) Decomposers

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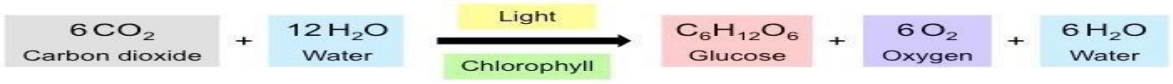

This process is called photosynthesis.

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Ex: Microorganisms like bacteria, fungi, algae etc.,

B) Abiotic components:

The non-living components (physical and chemical) of an ecosystem collectively form a community called abiotic components (or) abiotic community.
Examples: Climate, soil, water, air, energy, nutrients etc.,

i) Physical components: They include the energy, climate, raw materials and living space that the biological community needs. They are useful for the growth and maintenance of its member.
Example: Air, water, soil, sunlight etc..

ii) Chemical components: They are the sources of essential nutrients.

- **Organic substances:** Proteins, lipids, carbohydrates etc.
- **Inorganic substances:** All micro (Al, Co, Zn, Cu) and macro elements (C, H, O, P, N, P, K) and few other elements.

* Function of an ecosystem

To understand clearly the nature of an ecosystem, its functioning should be thoroughly understood. The function of an ecosystem is to allow flow of energy and cycling of nutrients.

Types of Funtions:

Function of an ecosystem are of three thypes.

i) Primary function: The primary function of all ecosystems is manufacture of starch (Photosynthesis).

ii) Secondary function: The secondary function of all ecosystems is distributing energy in the form of food to all consumers.

iii) Tertiary function: All living systems die at a particular stage. These dead systems are decomposed to initiate the third function of ecosystems namely cycling of nutrients.

The functioning of an ecosystem may be understood by studying the following terms.

a) Flow of energy
b) Cycling of nutrients
c) Food chains
d) Food webs
e) Food pyramids (or) Ecological pyramids

* Ecological Pyramid/Food Pyramid

- The pyramidal representation of trophic levels of different organisms based on their ecological position (producer to final consumer) is called as an ecological pyramid.
- Each of the bars that make up the pyramid represents a different trophic level, and their order, which is based on who eats whom, represents the flow of energy. Energy moves up the pyramid, starting with the producers, or autotrophs, such as plants and algae at the very bottom, followed by the primary consumers, which feed on these plants, then secondary consumers, which feed on the primary consumers, and so on. The height of the bars should all be the same, but the width of each bar is based on the quantity of the aspect being measured.

The ecological pyramids are of three categories.

1. **Pyramid of numbers,**
2. **Pyramid of biomass,** and
3. **Pyramid of energy**

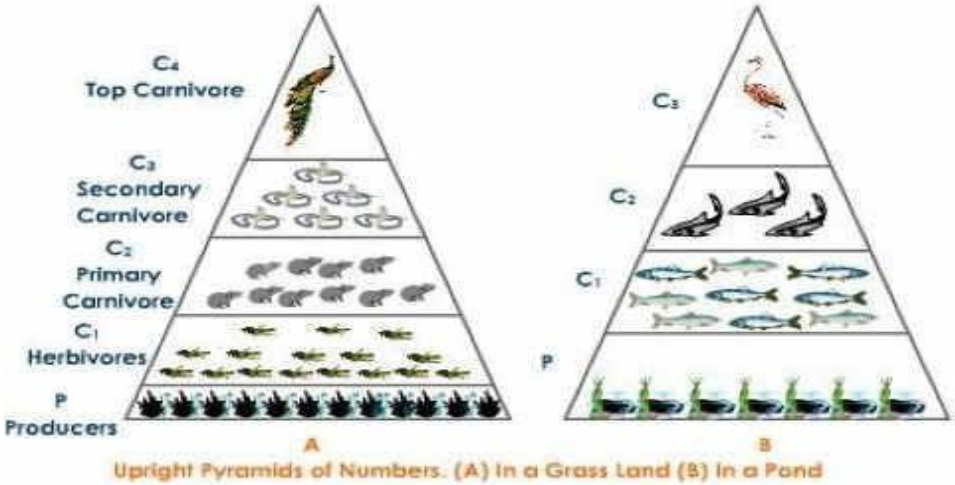
1. Pyramid of number: Pyramid of number represents the **total number of individuals of different species** (population) at each trophic level.

Depending upon the size, the pyramid of numbers may not always be upright, and may even be completely inverted.

It is very difficult to count all the organisms, in a pyramid of numbers and so the pyramid of number *does not completely define the trophic structure for an ecosystem*.

Pyramid of numbers – upright

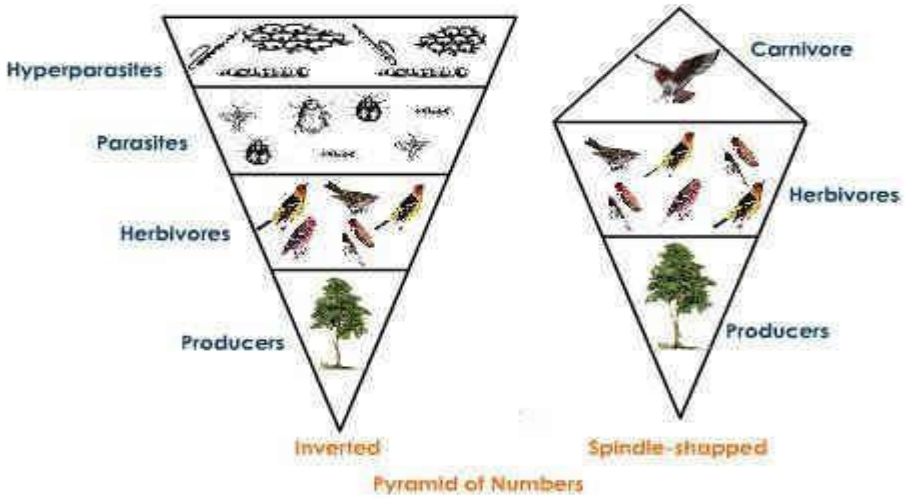
- In this pyramid, the number of individuals is decreased from lower level to higher trophic level. Eg: Grassland ecosystem.



Upright Pyramids of Numbers. (A) In a Grass Land (B) In a Pond

Pyramid of numbers – inverted

- In this pyramid, the number of individuals is increased from lower level to higher trophic level. E.g. Tree ecosystem.



Pyramid of Biomass:

It represents the total amount of biomass (mass or weight of biological material or organism) present in each trophic level.

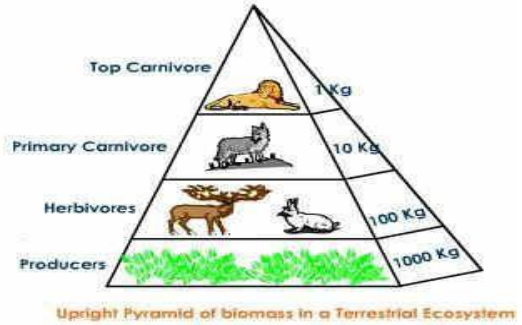
Pyramid of biomass is usually determined by collecting all organisms occupying each trophic level separately and measuring their **dry weight**.

The biomass of a species is expressed in terms of fresh or dry weight. Measurement of biomass in terms of dry weight is more accurate.

Pyramid of Biomass – Upright (Eg: Forest ecosystem)

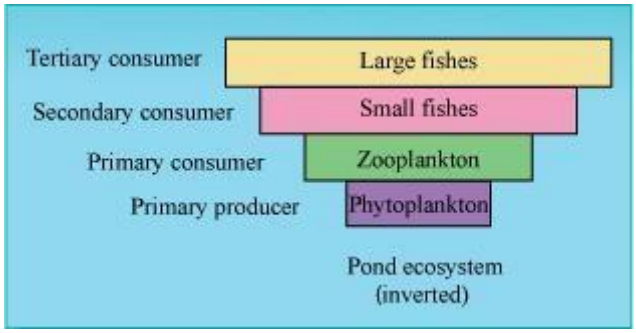
For most ecosystems on land, the pyramid of biomass has a large base of primary producers with a smaller trophic level perched on top.

The biomass of producers (autotrophs) is at the maximum. The biomass of next trophic level i.e. primary consumers is less than the producers. The biomass of next higher trophic level i.e. secondary consumers is less than the primary consumers. The top, high trophic level has very less amount of biomass.



Pyramid of Biomass – Inverted (Eg: Pond ecosystem)

In contrast, in many **aquatic ecosystems**, the pyramid of biomass may assume an inverted form.

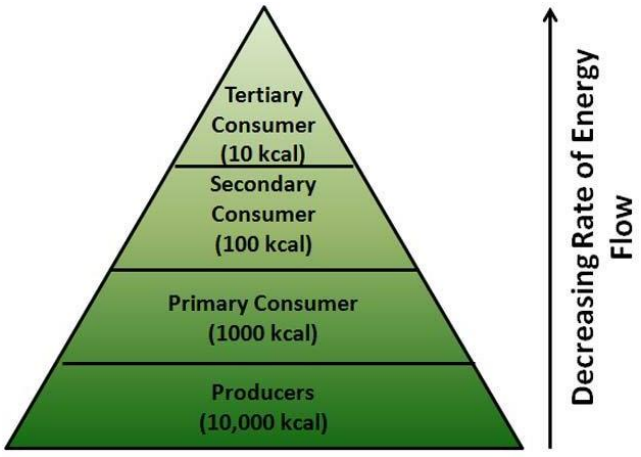


Pyramid of Energy:

An energy pyramid represents the amount of energy at each trophic level and loss of energy at each transfer to another trophic level. Hence the pyramid is always upright, with a large energy base at the bottom.

To compare the functional roles of the trophic levels in an ecosystem, an energy pyramid is most suitable.

At every successive trophic level, there is a heavy loss of energy (about 90%) in the form of heat. Thus at each next trophic level only 10% of the energy is transferred. Hence, there is a sharp decrease in energy at each and every successive trophic level as we move from producers to top carnivores.



Pyramid of Energy

* Forest Ecosystem

Introduction:

A forest ecosystem is one in which a tall and dense trees grow, that support many animals. 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 21% of its total land area.

Types of Forest Ecosystem:

Depending up on the climatic conditions forests are broadly classified in to following types.

1) Tropical forests: They are found near the equator. They are characterised by high temperature, high humidity, high rainfall and climate is constant throughout the year. The trees have broad leaves.

2) Temperate forests: They are found in areas with adequate rain fall. Seasonal climate is found in temperate forests. Monsoons play important role in temperate forests. They have broad leaves. They shed leaves during winter season.

3) Alpine forests or Taiga: They have needle like leaves. They are also called coniferous forests. They contain pine trees and are evergreen. They occur in low rainfall areas.

Characteristics of Forest Ecosystems:

1) Forests are characterised by warm temperature and adequate rainfall, which make generation of number of ponds, lakes etc.

2) The forest maintains climate and rainfall.

3) The forest support 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 in to nutrients is very fast.

Structure and Function of Forest Ecosystem:

1) Abiotic components: The minerals present in the forest and all organic (litter, debris) and inorganic substances present in the soil and the atmosphere constitute the abiotic components.

Eg. Nutrients, minerals, climatic factors (temperature, light, rainfall).

2) Biotic components: All living organisms, viz. producers, consumers and decomposers constitute the biotic components of the forest.

a) Producers: The plants absorb sunlight and produce food through photosynthesis.

Eg; Trees, shrubs, herbs and ground vegetation.

b) Consumers:

i) Primary consumers (Herbivores-Plant eaters): They directly depend on the producers for their food.

Eg. Insects, mice, deer, rabbit etc.

ii) Secondary consumers (Primary carnivores-Meat eaters): They directly depend on the herbivores for their food.

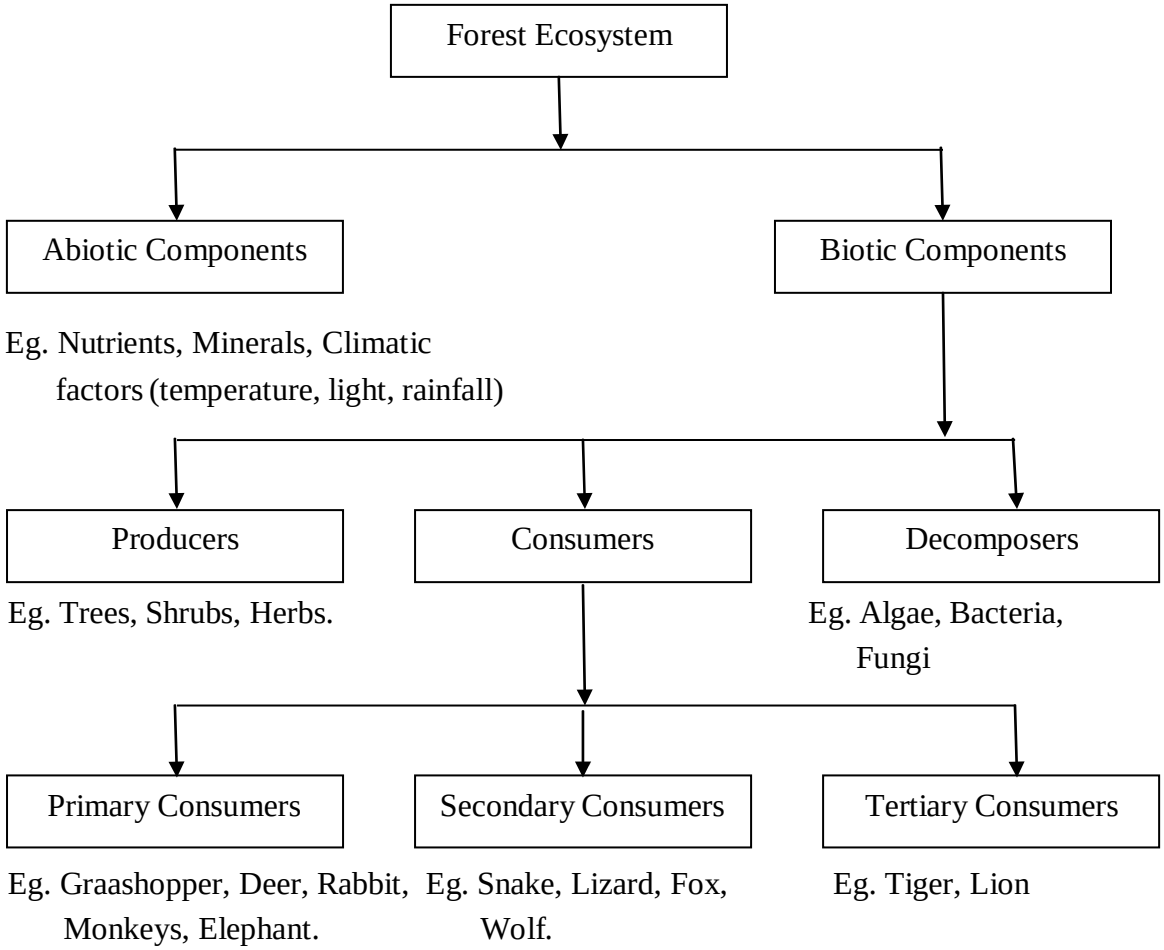
Eg. Snakes, birds, fox, wolf etc.

iii) Tertiary consumers (Secondary carnivores-Meat eaters): They directly depend on the secondary consumers for their food.

Eg. Tiger, lion etc.

c) Decomposers: They decompose the dead plant and animal matter. During the decomposition inorganic nutrients are released in to the soil which is again used by the producers.

Eg. Bacteria, fungi, earthworms etc.



Structure and Function of Forest Ecosystem

* Grassland Ecosystem

Introduction:

Grasslands are areas where the vegetation is dominated by grasses. In addition to grass species some trees and shrubs are also present in grasslands. Grasslands occupy about 20% of the earth's surface. They have enough average rainfall for growing of grass. Grasses grow where there is not enough moisture to support trees, where rainfall is from 10-30 inches a year.

Types of Grassland Ecosystems:

Depending up on the climatic conditions grasslands are broadly classified in to following types.

1) Tropical grasslands: They are found near the borders of tropical rain forests. They are characterized by high temperature and moderate rainfall. 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 centres of continents, on flat, slopped 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 characterized 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.

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.

Structure and Function of Grassland Ecosystem:

1) Abiotic components: The minerals present in the grassland and all organic (litter, debris) and inorganic substances present in the soil and the atmosphere constitute the abiotic components.

Eg. Nutrients, minerals, climatic factors (temperature, light, rainfall).

2) Biotic components: All living organisms, viz. producers, consumers and decomposers constitute the biotic components of the grassland.

a) Producers: The plants absorb sunlight and produce food through photosynthesis.

Eg; Grasses, trees, shrubs.

b) Consumers:

i) Primary consumers (Herbivores-Plant eaters): They directly depend on the producers for their food.

Eg. Insects, cows, buffaloes, deer, sheep etc.

ii) Secondary consumers (Primary carnivores-Meat eaters): They directly depend on the herbivores for their food.

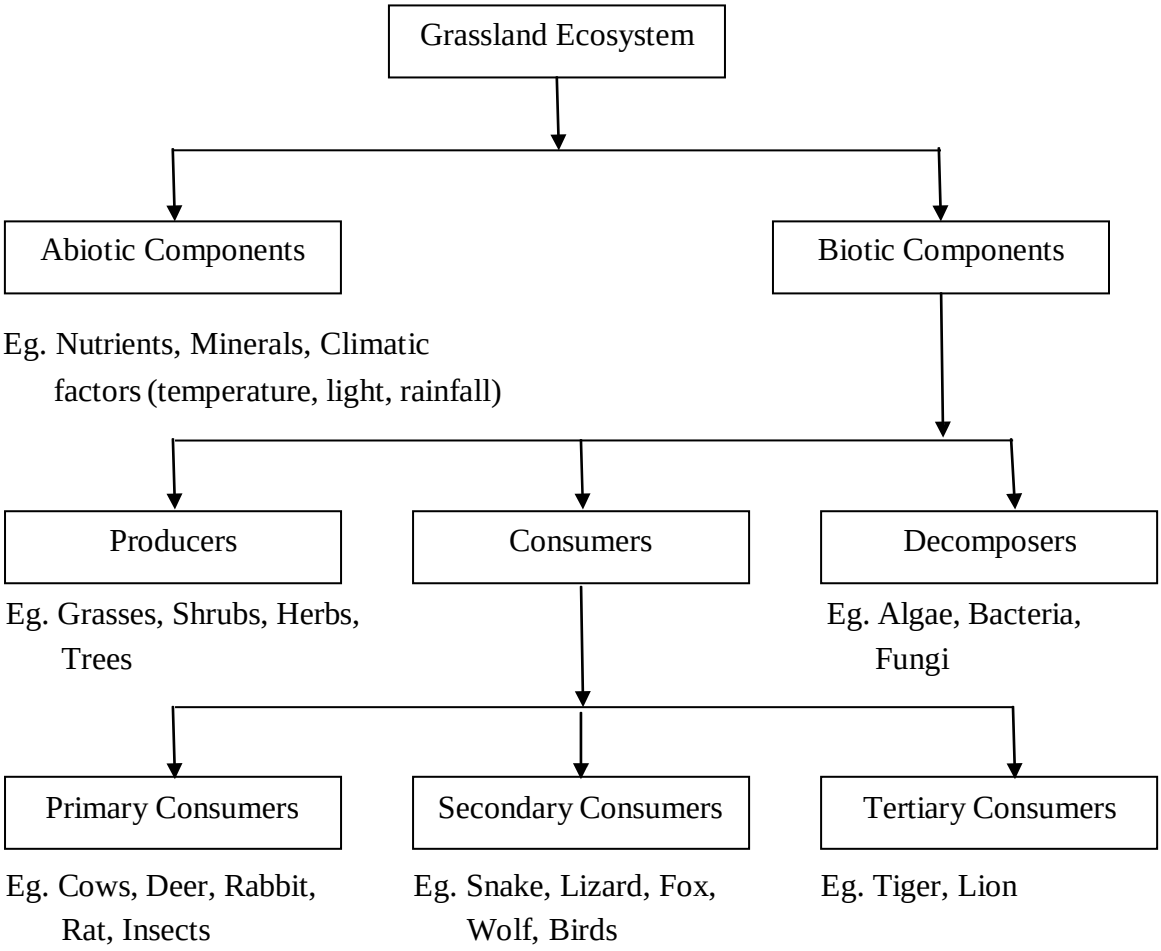
Eg. Snakes, birds, fox, wolf etc.

iii) Tertiary consumers (Secondary carnivores-Meat eaters): They directly depend on the secondary consumers for their food.

Eg. Tiger, lion etc.

c) Decomposers: They decompose the dead plant and animal matter. During the decomposition inorganic nutrients are released in to the soil which is again used by the producers.

Eg. Bacteria, fungi etc.



Structure and Function of Grassland Ecosystem

* Desert Ecosystem

Introduction:

Desert occupies about 17% of the land. It is characterized by less than 25 cm rainfall. The atmosphere is dry and hence it is poor insulator. Due to scarcity of water and high temperature, the biota is poorly present in desert ecosystem.

Types of Desert Ecosystems:

Depending up on the climatic conditions deserts are broadly classified in to following types.

1) Tropical deserts: They are characterized by only few species, windblown and sand dunes are very common.

Eg. Sahara desert, Thar desert etc.

2) Temperate deserts: They are characterized by very cool winters and very hot summers.

Eg. Mojave desert in Southern California.

3) Cold deserts: They are characterized by cold winters and warm summers.

Eg. Gobi desert in china.

Characteristics of Desert 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.

Structure and Function of Desert Ecosystem:

1) Abiotic components: The temperature is very high and rainfall is very low. The nutrient cycling is also very low.

Eg. Temperature, light, rainfall, water.

2) Biotic components: All living organisms, viz. Producers, consumers and decomposers constitute the biotic components of the desert.

a) Producers: Producers are mainly shrubs, bushes, some grasses and a few trees.

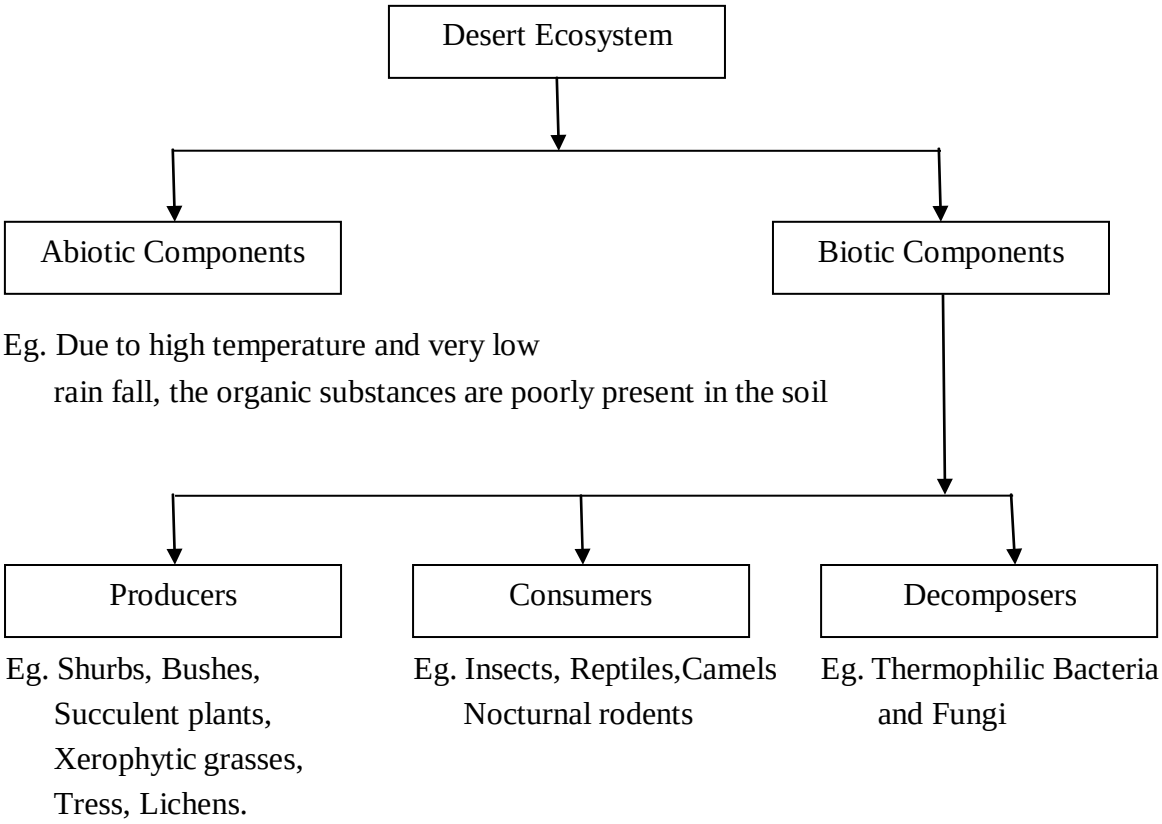
Eg; Succulent plants, Xerophytic plants, shrubs, bushes.

b) Consumers: They include animals which are capable of living in xeric conditions.

Eg. Insects, reptiles, nocturnal rodents, birds etc.

c) Decomposers: In a desert ecosystem, decomposers are very few due to less vegetation and very low amount of dead organic matter.

Eg. Thermophilic Bacteria, fungi etc.



Structure and Function of Desert Ecosystem

* Lake Ecosystem

Introduction:

Lakes are large natural shallow fresh water bodies. Lakes are used for various purposes. Lakes are supplied with water from rainfall, melting snow and streams.

Types of Lake Ecosystems: 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 eruption.

5) Meromictic lakes: They rich in salts.

6) Artificial lakes: They are created due to construction of dams.

Characteristics 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 purpose.

Zones of lake

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

1) Littoral Zone: It is 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.

Structure and Function of Lake Ecosystem:

1) Abiotic components: Minerals, Inorganic nutrients, organic substances, oxygen, carbon dioxide, water, temperature, light etc., are abiotic components of a lake ecosystem.

Eg. Nutrients, minerals, temperature, light etc.

2) Biotic components: All living organisms, viz. producers, consumers and decomposers constitute the biotic components of the lake.

a) Producers: They are green plants, submerged, free floating and amphibious plants.

Eg; Phytoplanktons, algae etc.

b) Consumers:

i) Primary consumers (Zooplanktons-Plant eaters): They directly depend on the phytoplantons for their food.

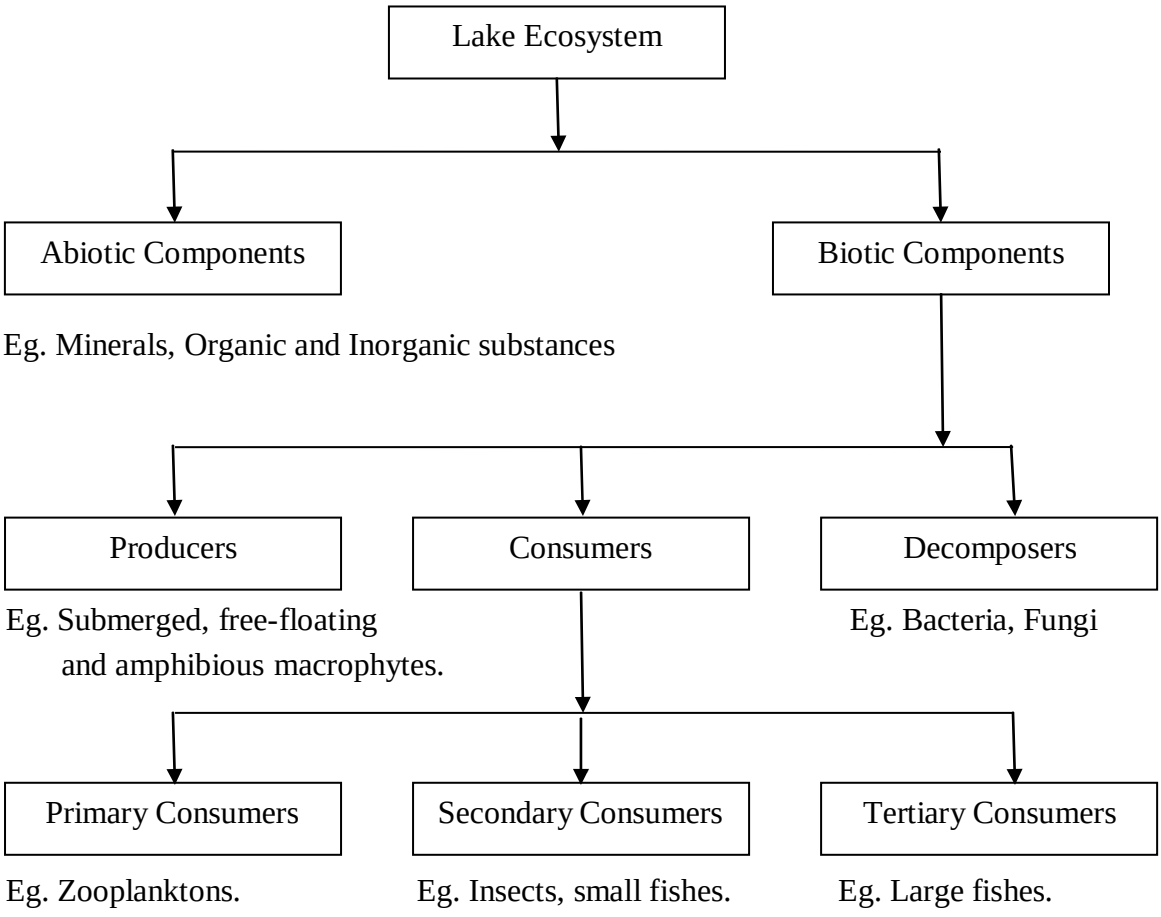
Eg. Protozoans, copepod etc.

ii) Secondary consumers (Primary carnivores-Meat eaters): They directly depend on the primary consumers for their food.

Eg. Small fishes etc.

iii) Tertiary consumers (Secondary carnivores-Meat eaters): They directly depend on the secondary consumers for their food.
Eg. Large fishes etc.

c) Decomposers: They decompose the dead plant and animal matter in to inorganic nutrients which is again used by the producers.
Eg. Bacteria, fungi etc.



Structure and Function of Lake Ecosystem

* River Ecosystem

Introduction:

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

Characteristics of River Ecosystem:

1) It is a fresh water and free flowing water system.

2) Due to mixing of water, dissolved oxygen content is more.

3) River deposits large amount of nutrients.

Structure and Function of River Ecosystem:

1) Abiotic components: Minerals, inorganic nutrients, organic substances, oxygen, carbon dioxide, water, temperature, light etc., are abiotic components of a river ecosystem.

Eg. Nutrients, minerals, temperature, light etc.

2) Biotic components: All living organisms, viz. producers, consumers and decomposers constitute the biotic components of the lake.

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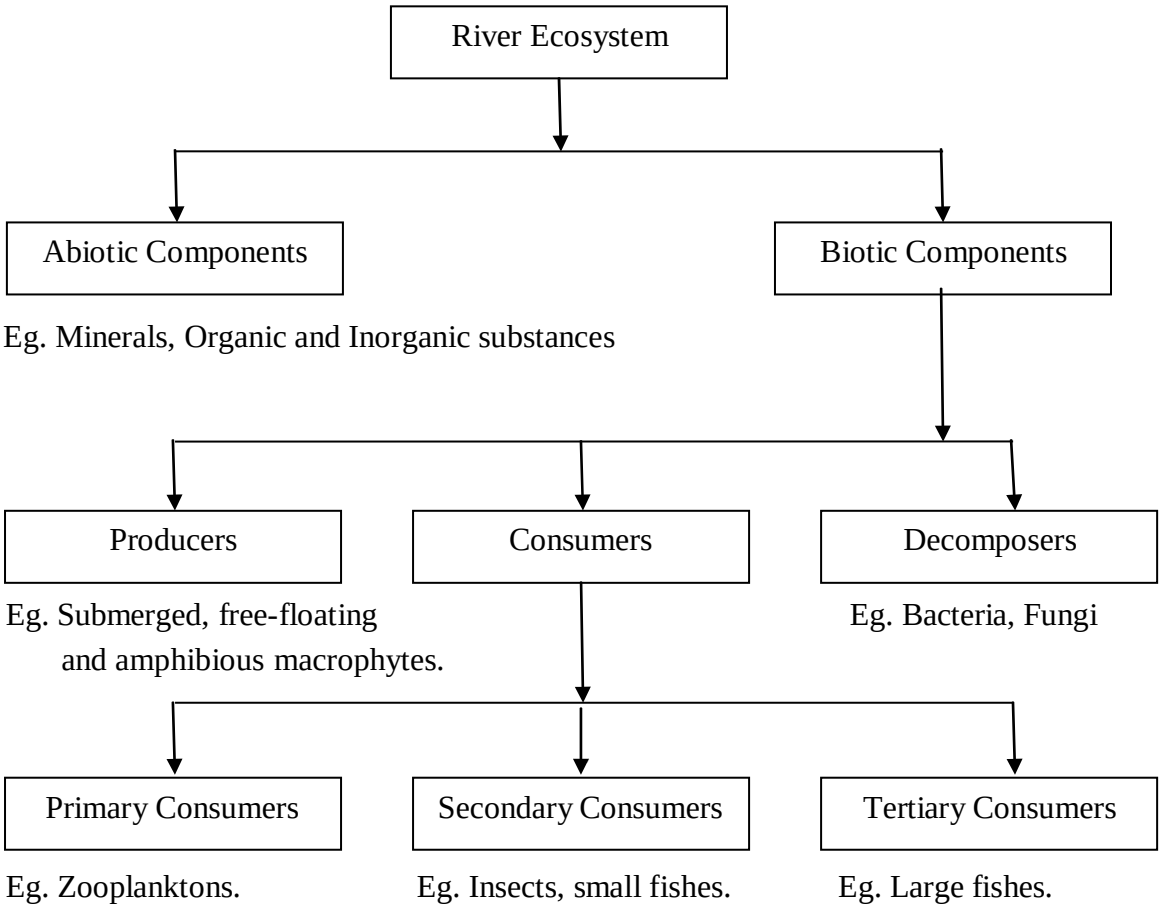
c) Decomposers: They decompose the dead plant and animal matter in to inorganic nutrients which is again used by the producers.

Eg. Bacteria, fungi etc.



Structure and Function of River Ecosystem

* Ocean Ecosystem

Introduction:

Ocean cover more than two third 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.

Characteristics of Ocean Ecosystems:

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 biodiversity.

4) It moderates temperature of the earth.

Zones of Oceans

The Ocean have two major 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 in to three regions.

i) Euphotic zone: It receives abundant light and shows high primary productivity. (0 to 200 meters)

ii) Bathyal zone: It receives dim light and is usually geologically active. (200 to 2000 meters)

iii) Abyssal zone: It is the dark zone and is very deep. (2000 to 5000 meters)

Structure and Function of Ocean Ecosystem:

1) Abiotic components: Minerals, inorganic nutrients, organic substances, oxygen, carbon dioxide, water, temperature, light etc., are abiotic components of Ocean ecosystem.

Eg. Nutrients, minerals, temperature, light etc.

2) Biotic components: All living organisms, viz. producers, consumers and decomposers constitute the biotic components of the ocean.

a) Producers: The plants absorb sunlight and produce food through photosynthesis.

Eg; Phytoplanktons, sea weeds etc.

b) Consumers:

i) Primary consumers (Zooplanktons-Plant eaters): They directly depend on the phytoplantons for their food.

Eg. Crustaceans, molluscs etc.

ii) Secondary consumers (Primary carnivores-Meat eaters): They directly depend on the primary consumers for their food.

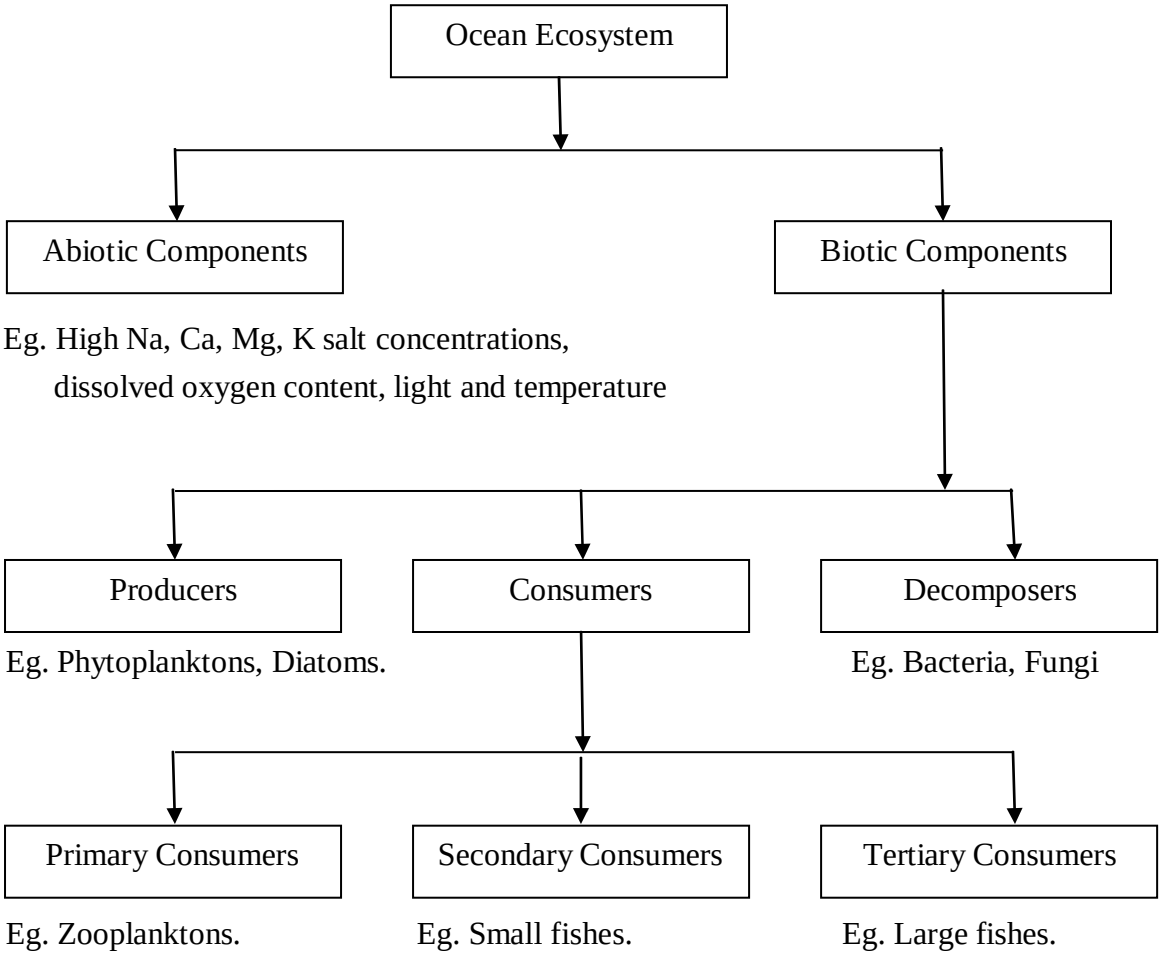
Eg. Small fishes etc.

iii) Tertiary consumers (Secondary carnivores-Meat eaters): They directly depend on the secondary consumers for their food.

Eg. Large fishes etc.

c) Decomposers: They decompose the dead plant and animal matter in to inorganic nutrients which is again used by the producers.

Eg. Bacteria, fungi etc.



Structure and Function of Ocean Ecosystem

* Estuarine Ecosystem

Introduction:

An estuary is a partially enclosed coastal area at the mouth of a river, where sea water mixes with fresh water. 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.

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.

Structure and Function of Estuarine Ecosystem:

1) Abiotic components: A mixture of fresh and marine ecosystems.

Eg. Nutrients, minerals, temperature, light, pH etc.

2) Biotic components: All living organisms, viz. producers, consumers and decomposers constitute the biotic components of the ocean.

a) Producers: The plants absorb sunlight and produce food through photosynthesis.

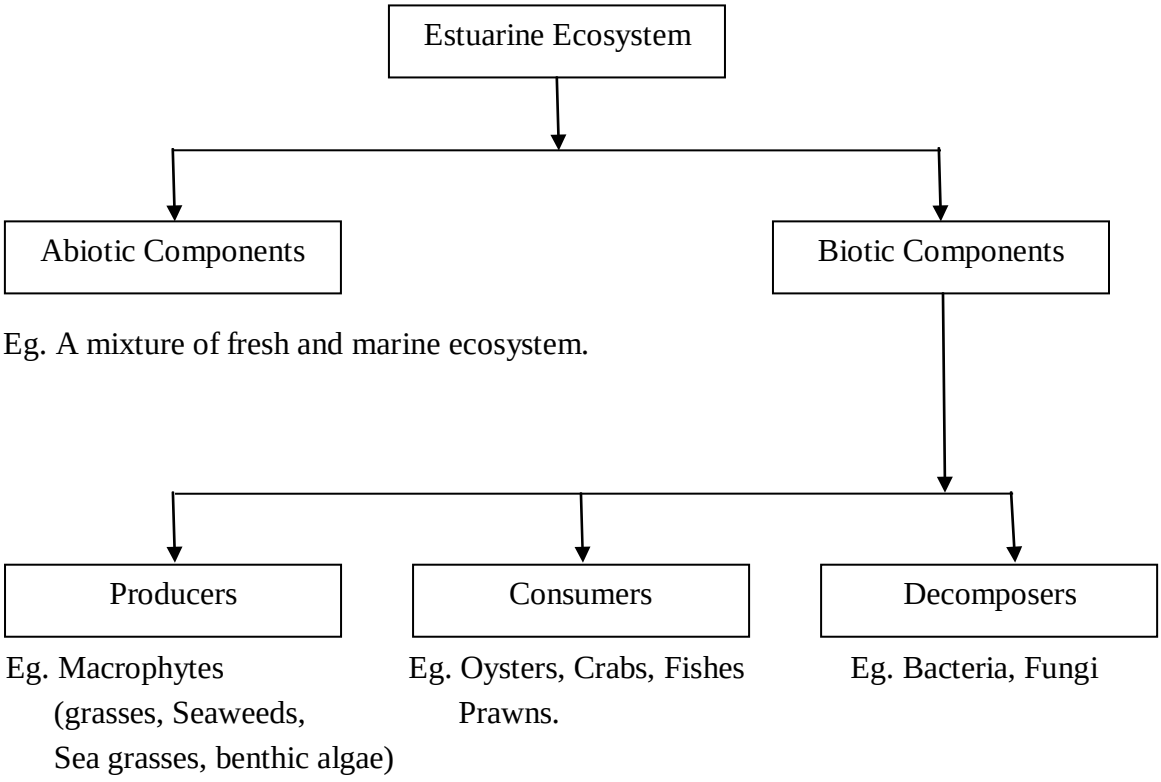
Eg; Phytoplanktons, sea weeds etc.

b) Consumers: They include animals which are capable of living under wide fluctuations.

Eg. Oysters, Crabs, Fishes, Prawns etc.

c) Decomposers: They decompose the dead plant and animal matter in to inorganic nutrients which is again used by the producers.

Eg. Bacteria, fungi etc.



Structure and Function of Estuarine Ecosystem

* Pond Ecosystem

Pond is a freshwater aquatic ecosystem where water is stagnant. It receives enough water during rainy season. It contains several types of algae, aquatic plants, insects, fish and birds.

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

STRUCTURE AND FUNCTION OF POND ECOSYSTEM

Abiotic components

The non living components of the ecosystem collectively called abiotic components.

Ex: Temperature, light, water, organic and inorganic components

Biotic components

The living components of the ecosystem collectively called biotic components. They are producers, consumers and decomposers.

1. **Producers:** They are green photosynthetic organisms and are of two types. phytoplanktons are microscopic aquatic plants that freely float on the surface of water. Ex: Algae, small floating plants like volvox, pandorina, anabena and cosmarium. Microphytes are large floating plants and submerged plants. Ex: Hydrilla, Jussiaea, wolfina and demna.

2. **Consumers:** Primary consumers are microscopic animals that freely float on the surface of water. They are called zooplanktons and they feed on phytoplanktons. Ex: Protozoa, very small fish, ciliates, flagellates and protozoans.Secondary consumers feed on zooplanktons. Ex: Insects like water beetles and small fish. Tertiary consumers feed on small fish. Ex: Large fish.

3. **Decomposers**: They decompose the dead plant and animal matter thereby releasing the nutrients to be reused by green plants. Ex: Fungi, Bacteria and flagellates.

* Stream ecosystem

Running water in a stream is usually well oxygenated as it absorbs oxygen from the air. Stream is full of life with aquatic life.

CHARACTERISTICS:

1. It is fresh and freely flowing water system
2. Due to constant mixing of water during the flow of water in a river, the dissolved oxygen content is high
3. Rivers deposit large amount of nutrients.

STRUCTURE AND FUNCTION:

1. **Abiotic components** Temperature, light, pH, nutrients, organic and inorganic compounds
2. **Biotic components**

1. Producers: Phytoplankton, algae, water grass, aquatic mass and other amphibious plants

2. Consumers: Primary consumers feed on phytoplankton. Ex: Water insects, Snails, Fish.

   Secondary consumers feed on primary consumers. Ex: Birds and mammals.

3. Decomposers: They decompose the dead plants and animals. Ex: Bacteria and Fungi.

Biodiversity and its conservation (Unit-2)

* **Biodiversity:** The variety and variability among all groups of living organisms and the ecosystem in which they occur is called Biodiversity.

* **Types of Biodiversity/Levels of biodiversity/Classification of Biodiversity:**

Biodiversity is generally classified into three types.

i) Genetic diversity

ii) Species diversity

iii) Ecosystem (or) Community diversity

i) Genetic diversity: Within individual species, there are number of varieties, which are slightly different from one another. These differences are due to differences in the combination of genes. Genes are the basic units of hereditary information transmitted from one generation to other.

Examples: Rice varieties, Teak wood varieties etc....

ii) Species diversity: Species diversity is the diversity between differed species. The sum of varieties of all the living organisms at the species level is known as species diversity.

Examples: Apple, mango, grapes, wheat, rice etc...

iii) Ecosystem (or) Community diversity: It is a set of biotic components (plants, animals and microorganisms) interacting with one another and with abiotic components (Soil, air, water etc..).

The diversity at the ecological or habitat level is known as ecosystem diversity. A large region with different ecosystems can be considered as ecosystem diversity.

Examples: River ecosystem, pond ecosystem etc....

* Biogeographical classification of India

India has different climate and topography in different parts and hence is termed as a mega diversity country. India occupies 10th place among plant rich countries of the world. It is essential to acquire knowledge about the distribution and environmental interaction of flora and fauna of India.

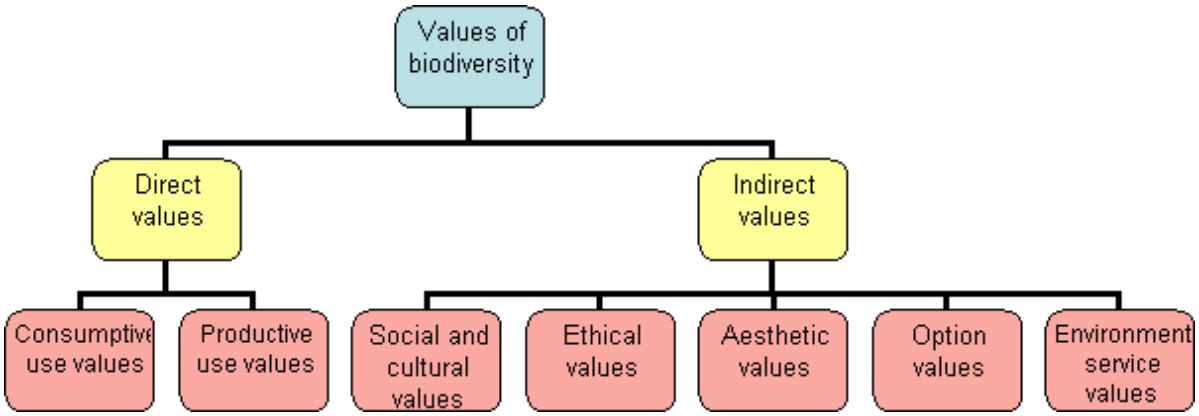
Biogeographers have classified India into ten biogeographic zones with each zone having characteristic climate, soil and biodiversity. These zones are described below:

1. **Trans-Himaylayas** The trans-himalayas is an extension to the Tibetean plateau. This region harbors the high-altitude cold desert in ladakh (Jammu and Kashmir) and Lahaul Spiti (Himachal Pradesh). It accounts for 5.7% of the country's landmass.

2. **Himayalas** The Himalayas are the northern boundaries of India. The entire mountain chain is running from Kashmir in the North-west to Assam in the north-east. The Himalayas comprise of a diverse range of biotic provinces and biomes. The himalayas cover 7.2% of the country's landmass
3. **Desert** The extremely dry area west of the Aravalli hill range, is comprising both the salty desert of Gujarat and the sandy desert of Rajasthan. Deserts occupy around 6.9% of the country's land mass. The kinds of deserts found in India are:
    1. The desert of western Rajasthan
    2. The desert ofGujarat
    3. The high-altitude cold desert of Jammu & Kashmir and Himachal Pradesh. The Indian deserts have more diversified fauna.
4. **Semi-arid** This zone lies between the desert and the Deccan plateau. It includes the Aravalli hill range. It overs approximately 15.6% of the country's landmass.
5. **Western Ghats** The western ghats are a mountain range that runs along the western cost of India. They are a range extending north-south from southern tip of Gujarat in the north to Kanyakumari in the south.The mountains cover an area of about 160,000 sq. km. This ghat section covers an extremely diverse range of biotic provinces and biomes. It covers about 5.8% of the country's landmass.
6. **Deccan plateau** It is a large triangular plateau south of the Narmada valley. Three sides of the plateau are covered by mountains slopes towards east. Satpura mountains cover the north while western ghats cover the west side and eastern ghats cover the eastern side of the plateau. It is the one of largest zones covering the southern and south-central plateau with mostly deciduous trees. It covers 4.3% of the country's land mass.
7. **Gangetic plain** This plain covers the area between the south himalayas to the tropic of cancer. These plains were formed by the Ganges river system and are relatively homogeneous. This region experience 600 mm rainfall annually. *Sunderbans* forests are located in this region and it covers 11% of the country's land mass.
8. **North-east India** These are pains and non-himalayan ranges of northeastern India and have a wide variety of vegetation. It covers around 5.2% of the country's land mass.
9. **Islands** The Andaman and Nicobar Islands in the Bay of Bengal has almost 300 big and small islands. Among these, only five islands are inhabited. Only tribes are found in the island of Nicobar. These islands have a highly diverse set of biomes and occupy 0.03% of the country's biomass.
10. **Coasts** India has a large coastline distributed both to the east and west with distinct differences between the two. The Lakshwadeep islands are included in this but the area of these islands is negligible.

* Values of Biodiversity:

Biodiversity is vital for healthy biosphere. Biodiversity is must for the stability and proper functioning of the biosphere. Definition and estimation of the value of biodiversity is not easy. The value of biodiversity is classified into direct and indirect values as shown in the below diagram.



i) Direct values:

The direct values are of two types (i) Consumptive use value and (ii) Productive use value.

a) Consumptive use value: These are the direct use values where the biodiversity products can be harvested and consumed directly. Example: Food, fuel and drugs. These goods are consumed locally and do no figure in national and international market.

b) Productive use values: These are the direct use values where the product is commercially sold in national and international market. Many industries are dependent upon these values. Example- Textile, leather, silk, paper and pulp industry etc. Although there is an international ban on trade of products from endangered species like tusks of elephants, wool from sheep, fur of many animals etc. These are traded in market and fetch a booming business.

ii) Indirect values

Biodiversity provides indirect benefits to human beings which support the existence of biological life and other benefits which are difficult to quantify. These include social and cultural values, ethical values, aesthetic values, option values and environment service values.

a) Social and cultural value: Many plants and animals are considered holy and sacred in India and are worshipped like Tulsi, peepal, cow, snake etc. In Indian society great cultural value is given to forest and as such tiger, peacock and lotus are named as the national animal, bird and flower respectively.

b) Ethical: These values are related to conservation of biodiversity where ethical issue of 'all life forms must be preserved' is laid down. There is an existence value which is attached to

each species because biodiversity is valuable for the survival of human race. Moreover all species have a moral right to exist independent of our need for them.

c) Aesthetic value: There is a great aesthetic value which is attached to biodiversity. Natural landscapes at undisturbed places are a delight to watch and also provide opportunities for recreational activities like bird watching, photography etc. It promotes eco-tourism which further generates revenue by designing of zoological, botanical gardens, national parks, wild life conservation etc.

d) Option values: The optional values are the potentials of biodiversity that are presently unknown and need to be known. The optional values of biodiversity suggests that any species may be proved to be a valuable species after someday.

e) Environment service values: The most important benefit of biodiversity is maintenance of environment services which includes

- Carbon dioxide fixation through photosynthesis.
- Maintaining of essential nutrients by carbon (C), oxygen (O), Nitrogen (N), Sulphur (S), Phosphorus (P) cycles.
- Maintaining water cycle and recharging of ground water.
- Soil formation and protection from erosion.
- Regulating climate by recycling moisture into the atmosphere.
- Detoxification and decomposition of waste.
- Maintenance of habitats
- Greenhouse gas reduction
- Flood mitigation by vegetation slowing run off

*** Hot-spots of biodiversity:**

Definition: The area which is rich in plant and animal species of which many are endemic and endangered species is called hot-spots of biodiversity.

The concept of identifying biodiversity hotspots was introduced in the year 1988 by British ecologist Norman Myers. These hot-spots were selected on basis of the number of threatened endemic species (Species that are found nowhere else) within them. At the global level, these are the areas of high conservation priority, if these species lost, they can nerve be replaced (or) regenerated.

Two hotspots are found in India. These are two distinct areas.

1. The Eastern Himalayas

2. The Western Ghats

1. The Eastern Himalayas: Geographically these are comprises Nepal, Bhutan and neighbouring states of Northern India. There are 35,000 plant species found in the Himalayas, of which 30% are endemic.

The Eastern Himalayas are also rich in wild plants of economic value.

Examples: Rice, banana, citrus, ginger, chilli, jute etc.....

i) The taxol yielding plant is also sparsely distributed in the region.

ii) 63% mammals are from Eastern Himalayas.

2) 60% of the Indian birds are from North East.

3) Huge wealth of fungi, insects, mammals, birds have been found in this region.

2. The Western Ghats:

The area comprises Maharastra, Karnataka, Tamilnadu and Kerela. Nearly 1500 endemic, dicotyledones plant species are found from Western ghats. 62% amphibians and 50% lizards are endemic in Western Ghats.

It is reported that only 6.8% of the original forest are existing today while the rest has been deforested or degraded.

* Threats to biodiversity:

Definition: The causes for loss of biodiversity is said to be threat to biodiversity.

Any disturbance in an natural ecosystem tend to reduce its biodiversity. Any change in the system leads to a major imbalance and threatens the biodiversity. Causes for loss of biodiversity (or) various threats to biodiversity are

i) Habitat loss

ii) Poaching of wildlife

iii) Man-wildlife conflicts

i) Habitat loss: The loss of species is caused by habitat loss. Habitat loss threatened a wide range of animals and plants.

Factors influencing habitat loss are,

a) Deforestation: The forests are the natural homes of thousands of species, which disintegrate due to loss of their natural habitat (loss of forest).

b) Destruction of wetlands: The wetlands, estuaries and mangroves are destroyed due to draining, filling and pollution, which causes huge biodiversity loss.

c) Habitat fragmentation: Sometimes the habitat is divided into small and scattered patches. This phenomenon is known as habitat fragmentation. Due to this many wild species are vanishing.

d) Raw materials: For the production of hybrid seeds, the wild plants are used as raw materials. As a result many plant species become extinct.

e) Production of drugs: Many pharmaceutical companies collect wild plants for the production of drugs. As a result many plant species become extinct.

f) Illegal trade: Illegal trade on wild life also reduce the biodiversity.

g) Developmental activities: Construction of massive dams in the forest areas, discharge industrial effluents which kill the biodiversity.

ii) Poaching of wild life: poaching means killing of animals (or) commercial hunting. It leads to loss of animal biodiversity.

a) Subsistence poaching: Killing animals to provide enough food for their survival is called subsistence poaching.

b) Commercial poaching: Hunting and killing animals to sell their products is called commercial poaching.

iii) Man-Wildlife conflicts:

Human–wildlife conflict refers to the interaction between wild animals and people and the resultant negative impact on people or their resources, or wild animals or their habitat. It occurs when growing human populations overlap with established wildlife territory, creating reduction of resources or life to some people and/or wild animals.

Significance of the biodiversity:

The following points represent the significance of the biodiversity.

- Increase ecosystem productivity; each species in an ecosystem has a specific niche—a role to play.
- Support a larger number of plant species and, therefore, a greater variety of crops.
- Protect freshwater resources.
- Promote soils formation and protection.
- Provide for nutrient storage and recycling.
- Aid in breaking down pollutants.
- Contribute to climate stability.
- Speed recovery from natural disasters.
- Provide more food resources.
- Provide more medicinal resources and pharmaceutical drugs.
- Offer environments for recreation and tourism.

* Conservation of biodiversity:

Definition: The maintenance and preservation of biodiversity is called conservation of biodiversity.

Biodiversity is one of the important tool for sustainable development. The enormous value of biodiversity due to their commercial, medical, genetic, aesthetic and ecological importance emphasizes the need to conserve biodiversity.

There are two types of biodiversity conservation.

i) In-situ conservation (within habitat, on-site)

ii) Ex-situ conservation (Outside habitat, off-site)

i) In-situ conservation: It involves protection of different species within its natural habitat, where the species normally occurs is called in-situ conservation.

In-situ conservation methods:

a) Biosphere reserves

b) National parks

c) Wildlife sanctuaries

d) Gene sanctuary

a) Biosphere reserves:

It covers large area, more than 5000 sq.km. It is used to protect both plant and animal species for long time.

Role of Biosphere reserve:

- It gives long term survival of evolving ecosystem
- It protects endangered species
- It protects maximum number of species and communities
- It serves as site of recreation and tourism
- It is also useful for educational and research purposes.
- It remains and functions as an open system and changes in land use are not allowed.

Restriction: No tourism and explosive activities are permitted in the biosphere reserves.

Examples: Nilgiri: Karnataka, Kerala, Tamilnadu

Gulf of Mannar: Tamil Nadu

Sundarbans: West Bengal

b) National Parks: It is usually a small reserves covering an area of about 100 to 500 sq.kms. within the biosphere reserves, one or more National Parks are also exists.

Role of a National park: It is used to protect, propagate and develop the wildlife. It also used for enjoyment through tourism, without affecting the environment.

Restrictions: Grazing of domestic animals, all private rights and forestry activities are prohibited within a national park.

Examples: Bandipur: Karnataka; Periyar: Kerala, Kziranga: Assam

c) Wildlife sanctuaries: A wildlife sanctuary is an area, which is reserved for the conservation of animals only.

Role of wildlife sanctuaries: It protects animals only. It allows the operations such as harvesting of timber, collection of forest products, private ownership rights and forestry operations provided, but these activities should not affect the animals adversely.

Restrictions: Killing, hunting, shooting or capturing of wildlife is prohibited except under the control of higher authority.

d) Gene sanctuary: A gene sanctuary is an area, where the plants are conserved.

i) One gene sanctuary for citrus (Lemon family) and

ii) One gene sanctuary for pitcher plant (an insect eating plant)

Examples: In Northern India, two gene sanctuary are found available.

Advantages of In-situ conservation: It is cheap and convenient method. The species gets adjusted to the natural disasters like drought, floods, forest fires.

Disadvantages In-situ conservation: A large surface area of the earth is required to preserve the biodiversity. Maintenance of the habitats is not proper, due to shortage of staff and pollution.

ii) Ex-situ conservation: The protection of different species outside their natural habitats is called Ex-situ conservation.

Role of Ex-situ conservation:

i) It involves maintenance and breeding of endangered plant and animal species under controlled conditions

ii) It identifies those species which are at more risk of extinction.

iii) It prefers the species, which are more important to man in near future among the endangered species.

Important methods of Ex-situ conservation: Botanical gardens, Zoological gardens, seed banks, microbial culture collections, museums etc...

Examples: National Bureau of Plant Genetic Resources – New Delhi.

National Bureasu of Animal Genetic Resources – Karnal (Haryana).

Advantages Ex-situ conservation:

i) Survival of endangered species is increasing due to special care and attention

ii) In captive breeding animals are assured food, shelter, water and also security and hence longer life span.

iii) It is carried out in cases of endangered species, which do not have any chances of survival, in the wild.

Disadvantages Ex-situ conservation:

i) It is expensive method.

ii) The freedom of wildlife is lost.

iii) The animals cannot survive in natural environment.

* Factors affecting Biodiversity:

i) Biodiversity is generally disturbed by human activities such as construction of dams in forest areas, release of Industrial wastes, using pesticides and insecticides in the crop fields, urbanisation etc...

ii) Poaching of wild animals, over exploitation of natural resources, degradation of habitats affect biodiversity.

iii) The marine ecosystem is also disturbed due to oil spills and discharge of effluents.

iv) The climatic factors like global warming, ozone depletion, acid rain also affect the biodiversity.

* Advantages/Need of Biodiversity conservation:

i) Drugs, herbs, food, and other important raw materials can be derived from plants andanimals.

ii) It provides immediate benefits to the society such as recreation and tourism.

iii) It also preserves the genetic diversity of plants and animals.

iv) Ensures the sustainable utilization life supporting systems on earth.

v) It leads to conservation of essential ecological diversity and life supporting systems.

vi) Since the biodiversity loss results in ecological and environmental deterioration, it isessential to conserve the biodiversity.