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Forest Ecosystem



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Forest Ecosystem:

- ❖ A forest is an area with a high density of trees and undisturbed areas.
- ❖ Receives high annual rain fall.
- ❖ We can observe wide variety of plants and animals.
- ❖ World's total land area is 13,076 million hectares - (Source: FAO; 1989)
- ❖ Of which total forests account for about 31% of the world's land area.
- ❖ In India, the forest cover is roughly 11% of the total land area.
- ❖ The forest ecosystem are of great concern from the environmental point of view.



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Forest types in India

- The forest type depends upon the abiotic factors such as climate and soil characteristics of a region.
- Forests in India can be broadly divided into:
 - **Coniferous forests**
 - **Broadleaved forests.**
- They can also be classified according to the nature of their tree species –
 - **evergreen,**
 - **deciduous,**
 - **xerophytic or thorn trees,**
 - **mangroves, etc.**
- They can also be classified according to the most abundant species of trees such as Sal or Teak forests



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- Coniferous forests grow in the Himalayan mountain region, where the temperatures are low.
- These forests have tall stately trees with needlelike leaves and downward sloping branches so that the snow can slip off the branches.
- Broadleaved forests have several types, such as evergreen forests, deciduous forests, thorn forests, and mangrove forests.
- Broadleaved forests have large leaves of various shapes.



Coniferous forest



Broadleaved forest



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- Evergreen forests grow in the high rainfall areas of the Western Ghats, North Eastern India and the Andaman and Nicobar Islands.
- These forests grow in areas where the monsoon lasts for several months. Some even get two monsoons, such as in Southern India.
- Evergreen plants shed a few of their leaves throughout the year.
- Deciduous forests are found in regions with a moderate amount of seasonal rainfall that lasts for only a few months.
- Most of the forests in which Teak trees grow are of this type.
- The deciduous trees shed their leaves during the winter and hot summer months. In March or April they regain their fresh leaves just before the monsoon, when they grow vigorously in response to the rains.





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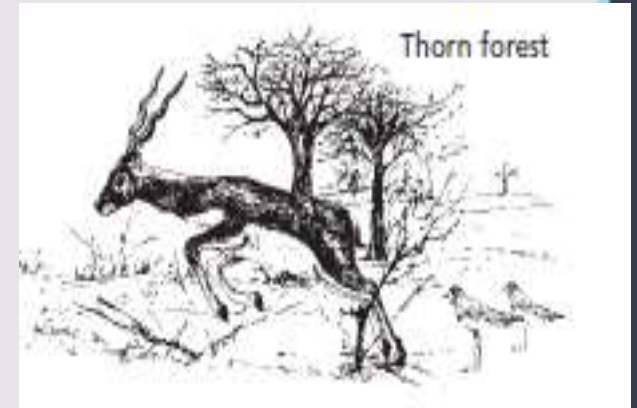
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Thorn forests

found in the semi- arid regions of India. The trees, which are sparsely distributed, are surrounded by

open grassy areas.

- Thorny (stiff sharp-projected woody projection on the stem or other part of a plant) plants are called xerophytic species and are able to conserve water.
- Some of these trees have small leaves, while other species have thick, waxy leaves to reduce water losses during transpiration.
- Thorn forest trees have long or fibrous roots to reach water at great depths. Many of these plants have thorns, which reduce water loss and protect them from herbivores.



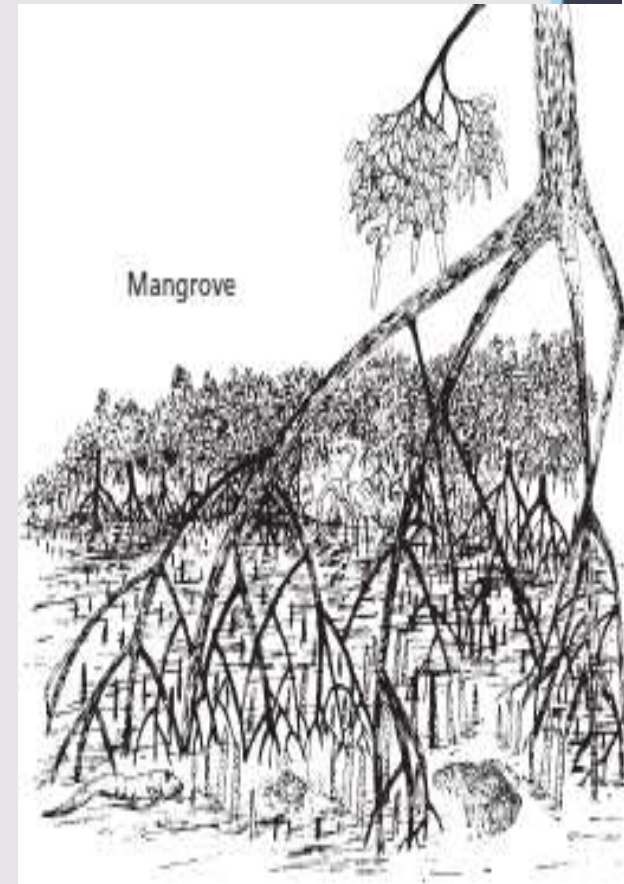


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Mangrove forests grow along the coast especially in the river deltas. These plants are able to grow in a mix of saline and fresh water.

They grow luxuriantly in muddy areas covered with silt that the rivers have brought down.

The mangrove trees have breathing roots that emerge from the mudbanks.





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Characteristic Features

- ❖ The various components of a Forest Ecosystem are:
- ❖ Biotic components: The various biotic components, representatives from the three functional groups, of a forest ecosystem are:
 - 1) Producer Organisms:
 - ❖ In a forest, the producers are mainly trees.
 - ❖ Trees are of different kinds depending upon the type of forest developed in that climate.



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- ❖ Apart from trees, climbers, epiphytes, shrubs and ground vegetation.
- ❖ Dominant species of trees in major types of forest ecosystems are:
 - ❖ *Tectona grandis*, Acer, Betula, Picea, Pine, Cedrus.

2) Consumers:

- ❖ In a forest, consumers are of three main types;

a) Primary Consumers:

- ❖ These are Herbivores which feed directly on producers. E.g.
 - ❖ Ants, Beetles, Bugs, spiders etc. feeding on tree leaves.
 - ❖ Larger animals such as Elephants, Deer, giraffe etc. grazing on shoots and/or fruits of trees.

b) Secondary Consumers:

- ❖ These are carnivores and feed on primary consumers.
 - ❖ These include Birds, Lizards, Frogs, Snakes, Foxes, etc.

c) Tertiary Consumers:

- ❖ These are secondary carnivores and feed on secondary consumers
 - ❖ These include top carnivores like Lion, Tiger, etc.



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3) Decomposers:

- ❖ These include wide variety of saprotrophic micro- organism like;
 - ❖ Bacteria (*Bacillus Sp.*, *Clostridium sp.*, *pseudomonas*, etc.)
 - ❖ Fungi (*Aspergillus sp.*, *Ganoderma sp.*, *Fusarium*, etc.)
 - ❖ Actinomycetes (*Streptomyces*, etc).
- ❖ They attract the dead or decayed bodies of organisms & thus decomposition takes place.
- ❖ Therefore, nutrients are released for reuse.
- ❖ Abiotic components:
 - ❖ Depending upon the geographical features (Hills/ mountains/ river valleys etc) , climatic conditions (temperature rainfall and solar energy) and soil type will leads to different types of forest such as coniferous, broad leave forests.



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FOREST COMMUNITIES/TYPES

| TYPE OF FOREST | PLANTS | COMMON ANIMALS | RARE ANIMALS |
|---|--------------|--|---|
| HIMALAYAN CONIFEROUS | PINE, DEODAR | WILD GOATS AND SHEEP, HIMALAYAN BLACK BEAR | SNOW LEOPARD, MUSK DEER, HIMALAYAN WOLF |
| EVER GREEN NORTH-EAST, WESTERN GHATS, ANDAMAN & NICOBAR | JAMUN, FICUS | TIGER, LEOPARD, HORNBILL, TREE FROGS | RHINO, LION-TAILED MACAQUE |



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It provides numerous environmental services like;

- ❖ **Nutrient cycling**
- ❖ **Maintaining biodiversity**
- ❖ **Providing wildlife habitat**
- **Affecting rainfall patterns**
- **Regulating stream flow**
- **Storing water**
- **Reducing flooding**
- **Preventing soil erosion**
- **Reclaiming degraded land & many more....**



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❖ Forest Ecosystem:

- ❖ Apart from environmental values, forest ecosystems have some traditional values as well.
- ❖ Examples are:
 - Fire Wood & Timber.
 - Fruits.
 - Gums.
 - Herbs & drugs.



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Threats to the forest ecosystem

Overutilization of forest resources due to **rapid population growth, urbanization, and industrialization** in an unsustainable way leads to highly disturbed ecosystem – **unsustainable consumption pattern**.

India's forest cover has decreased from about 33% to 11% in the last century.

Loss of forests by mining and dam construction.

Exploitation of forest resources beyond their production capacity – ecosystem degradation

Extinction of plant and animal species in forest by fragmented into small patches.



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Consequences of forest ecosystem degradation

Survival of tribal people becomes difficult – they depend upon forest resources for food, fuel wood and other products.

Agricultural and Urban people do suffer from various reasons (such as fuel wood, small timber, etc. for making houses, food from agricultural areas) which in turn depend on neighboring forest ecosystems.

Rain fall on deforested land flows directly into nearby rivers – **no ground water recharge**

Rapid soil erosion - agriculture is seriously affected.

Wild animals lose their habitat - **extinction of species**.

Reduction in the agricultural yield – loss of bees , butterflies, moths



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Conservation of forest ecosystem

Careful utilization of forest resources - alternate sources of energy instead of fuel wood.

Afforestation - need to grow more trees than that are cut down from forests.

Natural forests with diverse species must be protected as National Parks and Wildlife Sanctuaries.

Scientists suggested that at least 10% of ecosystem is left as Protected area



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Aquatic Ecosystems



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Aquatic Ecosystems:

- ❖ Aquatic ecosystems deal with biotic community and abiotic components present in water bodies.
- ❖ In terrestrial ecosystem, carbon dioxide & oxygen are present in gaseous form **whereas in aquatic ecosystem, these are available in dissolved state.**
- ❖ Depending upon the quality and nature of water, the aquatic ecosystem are categorized into:
 - ❖ Freshwater Ecosystem and
 - ❖ Marine Ecosystem.
 - ❖ Estuarine



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Freshwater Ecosystems:

- ❖ Freshwater ecosystems cover **0.8%** of the Earth's surface and contain **0.009%** of its total water.
- ❖ Freshwater ecosystems contain **41%** of the world's known fish species.
- ❖ Aquatic ecosystems perform many important environmental functions. For example:
 - They recycle nutrients, purify water, attenuate floods, recharge ground water and provide habitats for wildlife.
 - Aquatic ecosystems are also used for human recreation, and are very important to the tourism industry, especially in coastal region.
- ❖ There are three basic types of freshwater ecosystems:
 - Lentic:** slow-moving water, including **Pools, Ponds, and Lakes**.
 - Lotic:** rapidly-moving water, for example **Streams and Rivers**.
 - Wetlands:** areas where the soil is saturated with water or inundated for at least part of the time



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Freshwater ecosystems are further of standing type (lentic) like ponds and lakes or free-flowing type (lotic), like rivers. Let us consider some important aquatic ecosystems.



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(i) Pond ecosystem:

It is a small freshwater aquatic ecosystem

where water is stagnant. Ponds may be seasonal in nature i.e. receiving enough water during rainy season.

Ponds are usually shallow water bodies which play a very important role in the villages, where most of the activities center around ponds.

They contain several types of algae, aquatic plants, insects, fishes and birds.

The ponds are, however, very often exposed to tremendous anthropogenic (human-generated) pressures.



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It is used for washing clothes, bathing, swimming, cattle bathing and drinking etc. and therefore get polluted.

It exhibits self sufficient and self-regulating system.



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ii) Lake ecosystems:

Lakes are usually big freshwater bodies with standing water.

They have a shallow water zone called Littoral zone,

an open-water zone where effective penetration of solar light takes place, called Limnetic zone .

A deep bottom area where light penetration is negligible, known as profundal zone



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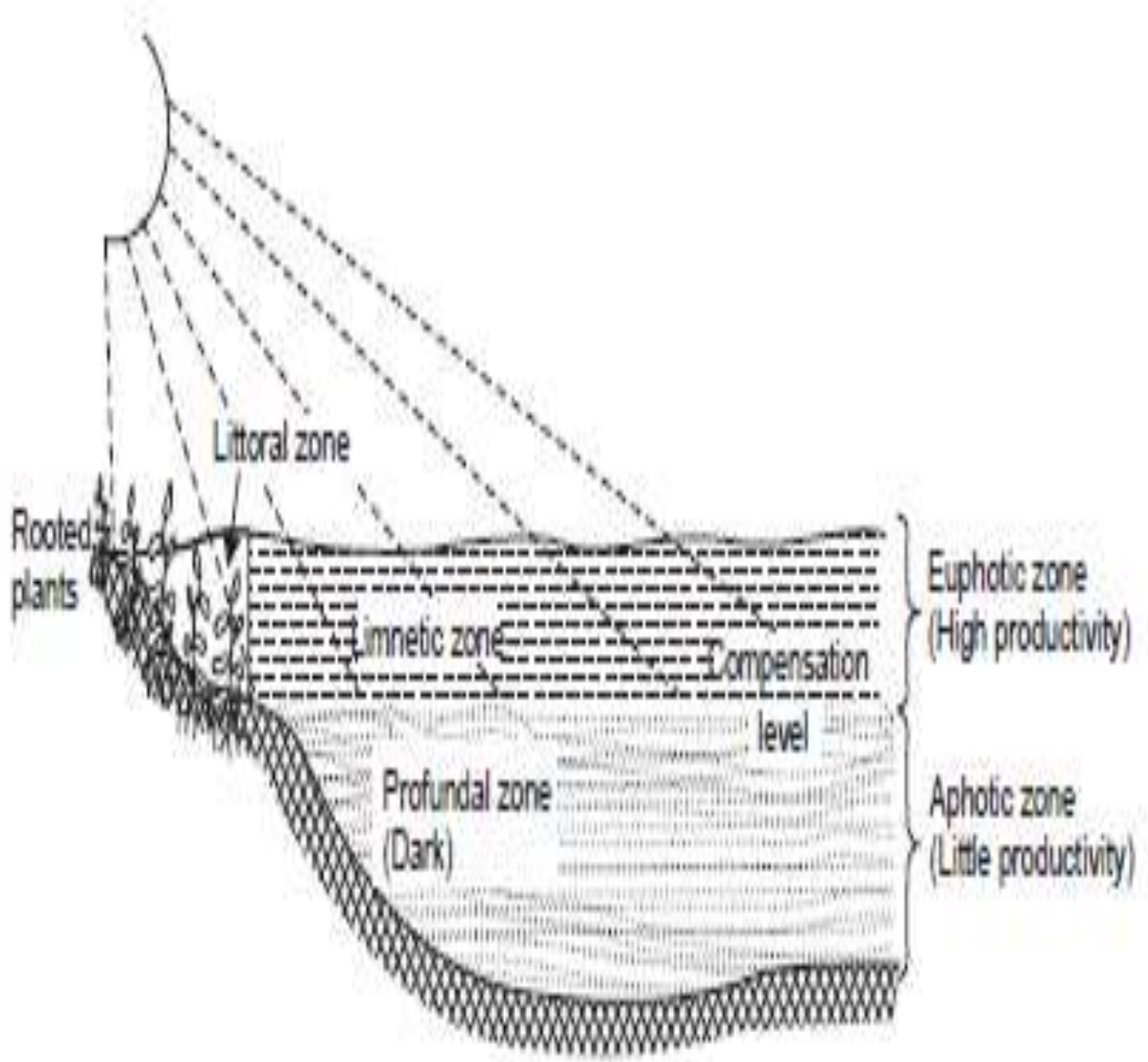


Fig. 3.16. Zonation in a lake ecosystem.



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Producers: macrophytes (rooted plants, partly or completely submerged, floating) and phytoplanktons (minute, floating or suspended lower plants (filamentous algae))

Consumers: are heterotrophs which depend on the organic food manufactured by green plants.

i) benthos: animals associated with living plants and bottom forms; which feed upon the plant remains lying at the bottom of pond; called as detritivores. Ex: fish, insect larvae, beetles, mites, crustaceans etc.,



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ii) zooplankton: feed on phytoplankton, Ex: protozoans

Secondary consumers(carnivores): feed on primary consumers, insects and fish which feed on zooplankton.

Tertiary consumers(carnivores): some large fish feed on small fish and thus become the Tertiary (top) consumers. thus in a pond fish may occupy more than one trophic levels.

The small fish(herbivores) feed on phytoplankton while some fish feed on zooplankton at carnivore level



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Decomposers or Macro consumers: brings the decomposition of complex dead organic matter of both plants and animals to simple forms.

they are also called as Macro consumers because they absorb only a fraction of the decomposed organic matter.

These play an important role of recycling the mineral elements again to the medium of the pond. Ex: bacteria, actinomycetes and fungi.



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River Ecosystem:

Flowing water ecosystem in which all the living forms are specially adapted to different rates of flow.

The community of flora and fauna of rivers depends on the clarity, flow and oxygen content as well as the nature of their beds.

The river can have a sandy, rocky or muddy bed, each type having its own species of plants and animals.



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❖ Biotic components:

1) Producers: It includes phytoplanktons.

2) Consumers:

a) Primary consumers: These are herbivores and feed directly on producers.

b) Secondary consumers: These are carnivorous fishes.

c) Tertiary consumers: These are top carnivorous fishes.

3) Decomposers: These are micro – organisms like bacteria, fungi

❖ Abiotic components:

❖ Variable dissolved oxygen content, light & temperature



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Marine Ecosystem

- ❖ Marine ecosystems in India - the Indian Ocean, the Arabian Sea and the Bay of Bengal.
- ❖ Producers - Vary from microscopic algae to large seaweeds. There are millions of zooplankton and a large variety of invertebrates on which fish, turtles and marine mammals live on.



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Ocean Ecosystem:

- ❖ Marine ecosystems are among the Earth's aquatic ecosystems. They include: Oceans, Estuaries and Lagoons, Mangroves and Coral reefs, the Deep sea and the Sea floor.
- ❖ These are the gigantic reservoirs of water covering approximately 71% of the Earth's surface (an area of some 361 million square kilometers).
- ❖ These ecosystem is different from freshwater ecosystem mainly because of its salty water.
- ❖ The salt concentration in an open sea is usually 3.5% (30-50 g/L).
- ❖ Average temperature of Marine ecosystem is 2-3 °C, devoid of light.



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❖ Biotic components:

1) Producers: It includes phytoplanktons (diatoms, dinoflagillates), large seaweeds (mainly algae like chlorophyceae, phaeophyceae & rhodophyceae; angiosperms like *Ruppia*, *Zostera*, *posidonia* etc.), and mangrove vegetation (like *Rhizophora*, *Carapa* etc.)

2) Consumers:

a) Primary consumers: These are herbivores and feed directly on producers (Crustaceans, Mollusks, fish etc.)

b) Secondary consumers: These are carnivorous fishes(Herring, Sahd and Mackerel)

c) Tertiary consumers: These are top carnivorous fishes (Cod, Haddock, etc.)

3) Decomposers: These are micro – organisms like bacteria, fungi

❖ Abiotic components:

❖ High Na, Ca, Mg and K salt concentration, variable dissolved oxygen content, light & temperature make a unique physiochemical conditions in marine water.



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Threats to aquatic ecosystems

Water pollution due to sewage and poorly managed solid waste in urban areas.

Excessive use of fertilizers causes an increase in nutrients, which leads to eutrophication.

Eutrophication - destroys life in the water as the **oxygen content is severely reduced**.

Pesticides - pollute water and kills off its aquatic animals.

Chemical pollution from industry kills a large number of life forms in adjacent aquatic ecosystems.

Contamination by heavy metals and other toxic chemicals affects the health of people who live near these areas as they depend on this water.

Over exploitation of Resources



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Conservation of aquatic ecosystem

For sustainable use of an aquatic ecosystem, water pollution must be prevented.

Changing the nature of the aquatic ecosystem (from a flowing water ecosystem to a static ecosystem) destroys its natural biological diversity.

Example: construction of dams across rivers decrease the population of species that require running water.

Protecting wet lands: conversion to agriculture lands