COURSE: B Sc (Hons) ,Part -3

PAPER – 1- VI(Biodiversity)

TOPIC- Genetics

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Topic-1

Conservation of Biodiversity

Nature with its rich resource has showered this planet with variety of living beings which is called as Biodiversity. Biological diversity' means the variability among living organisms from all sources including, inter alia, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are a part; this includes diversity within species, between species and of ecosystems.To manage such a huge number and types of Bio diversities it was essential to design a suitable platform with a common perspective, plan and motto. There was an urgent need to conserve the Biodiversity which was gradually replenishing. Conservation of biological diversity and sustainable use of its components came into the limelight in 1972 (United Nations Conference on Human Environment; Stockholm). In 1973, UNEP identified conservation of biodiversity as a priority area, hence there was need to get the legal mandate for conservation of world resources. There were negotiations for a legally binding instrument to address biological diversity and its loss to enhance fairness and equity in sharing of the benefits of biodiversity; this led to the opening of the Convention on Biological Diversity in 1992; Rio de Janeiro under the United Nations Conference on Environment and Development (UNCED)/ Earth Summit. The convention was inspired by the growing concern all over the world for sustainable development. The convention objectives were:

• Conservation of the biological diversity;

• Sustainable use of its components;

• A fair and equitable sharing of its benefits.

This was the first global comprehensive agreement that addressed all the aspects of biological

diversity; genetic resources, species diversity and ecosystem diversity.

Edward Wilson coined this term for the first time. Conservation of biodiversity can be studied in different segments. They are:

Genetic diversity

Species diversity

Ecological/Ecosystem diversity

This incorporates the preservation, maintenance, sustainable use (conservation), recovery and

enhancement of the components of biological diversity.

Sustainable development

This refers to development that meets the needs of the current generation without compromisingthe ability of future generations to meet their needs; it simply refers to intra and intergenerational equity.A balance between the environment, development and society results to sustainable development which ensures biodiversity conservation. This is only possible in the presence of good enforced and implemented policies/ conventions, environmental institutions and political stability among others conservation measures of biodiversity

Types of Conservation:

Conservation can broadly be divided into two types:

1. In-situ conservation

2. Ex-situ conservation

1. In-situ conservation

In-situ conservation is on site conservation or the conservation of genetic resources in natural populations of plant or animal species, such as forest genetic resources in natural populations of tree species. It is the process of protecting an endangered plant or animal species in its natural habitat, either by protecting or cleaning up the habitat itself, or by defending the species from predators.It is applied to conservation of agricultural biodiversity in agro forestry by farmers, especially those using unconventional farming practices. In-situ conservation is being done by declaring area as protected area.This also refers to conservation of ecosystems and natural habitats including maintenance and recovery of viable populations of species in their natural habitats.

In order to conserve Biodiversity as In situ conservation various measures have been undertaken. This constitutes:

a) Development of Protected areas as National Park. Wild life sanctuaries and Biosphere reserve

b) Sacred forests and reserves

INDIA has over 600 protected areas, which includes over 90 national parks, over 500 animal sanctuaries and 15 biosphere reserves.

1. National Parks:

A national park is an area which is strictly reserved for the betterment of the wildlife and where activities like forestry, grazing on cultivation are not permitted. In these parks, even private ownership rights are not allowed. Corbett National Park, Uttarakhand

2. Wildlife Sanctuaries:

A sanctuary is a protected area which is reserved for the conservation of only animals

Ghana Bird Sanctuary.Rajasthan

3. Biosphere Reserves:

It is a special category of protected areas where human population also forms a part of the system. Nanda Devi, Uttarakhand.

2. Ex-situ conservation

Ex-situ conservation is the preservation of components of biological diversity outside their natural habitats. This involves conservation of genetic resources, as well as wild and cultivated or species, and draws on a diverse body of techniques and facilities. Such strategies include establishment of botanical gardens, zoos, conservation strands and gene, pollen seed, seedling, tissue culture and DNA banks. This also refers to conservation of components of biodiversity outside their natural habitats, e.g. zoos, museums, gene banks, botanic gardens/arboretums; Used for threatened and endangered species to avoid their extinction; also known as captive conservation. This also includes development of Tissue culture lab and Lab for cryoconservation of germplasm.

1. Seed gene bank:

These are cold storages where seeds are kept under controlled temperature and humidity for storage and this is easiest way to store the germ plasma of plants at low temperature.

2. Gene bank:

Genetic variability also is preserved by gene bank under normal growing conditions. These are cold storages where germ plam are kept under controlled temperature and humidity for storage; this is an important way of preserving the genetic resources.

3. Cryopreservation:

. This type of conservation is done at very low temperature (196°C) in liquid nitrogen.

4. Tissue culture bank:

Cryopreservation is a method where organelles, tissues, organs susceptible for damage are preserved by cooling at very low temperature. Long term culture of excised roots and shoots are maintained. Meristem culture is very popular in plant propagation as it’s a virus and disease free method of multiplication.

5. Long term captive breeding:

The method involves capture, maintenance and captive breeding on long term basis of individuals of the endangered species which have lost their habitat permanently or certain highly unfavorable conditions are present in their habitat.

6.. Botanical gardens:

A botanical garden is a place where flowers, fruits and vegetables are grown. The botanical gardens provide beauty and calm environment. Most of them have started keeping exotic plants for educational and research purposes.

7. Zoological Gardens:

In zoos wild animals are maintained in captivity and conservation of wild animals (rare, endangered species) takes place. In India, the 1st zoo came into existence at BARRACKPORE in 1800. In world there are about 800 zoos. Such zoos have about 3000 species of vertebrates. Some zoos have undertaken captive breeding programmes.

Advantages of in-situ conservation and Ex –situ conservation

The flora and fauna live in natural habitats without human interference. In-situ conservation provides the required green cover and its associated benefits to our environment. It is less expensive and easy to manage. Ex-situ conservation is useful for declining population of species. Endangered animals on the verge of extinction are successfully breeded. Threatened species are breeded in captivity and then released in the natural habitats. Ex-situ centers offer the possibilities of observing wild animals, which is otherwise not possible.. It is extremely useful for conducting research and scientific work on different species.

TOPIC-2

TYPES OF BIODIVERSITY

The term Biodiversity was coined in 1985 – a contraction of "biological diversity" – but the huge global biodiversity losses now becoming apparent represent a crisis equalling – or quite possibly surpassing – climate change.

More formally, biodiversity is comprised of several levels, starting with genes, then individual species, then communities of creatures and finally entire ecosystems, such as forests or coral reefs, where life interplays with the physical environment. These myriad interactions have made Earth habitable for billions of years.

Biodiversity includes three main types: diversity within species (genetic diversity), between species (species diversity) and between ecosystems (ecosystem diversity).

Genetic Diversity. ..

. It is basically the variety of species expressed at the genetic level by each individual in a species. No two individuals belonging to the same species are exactly similar. For example, in the species of human beings, each human shows a lot of diversity in comparison to another human. People living in different regions show a great level of variation.

Species Diversity. ...

It is the biodiversity observed within a community. It stands for the number and distribution of species. The number of species in a region varies widely depending upon the varied environmental conditions.. There are approximately 391,000 different species of plant on the planet, although some are at risk of becoming extinct and many have not yet been discovered..

Ecological Diversity.

It defines the diversity observed among the ecosystems in a particular region. Different ecosystems like mangroves, rainforests, deserts, etc., show a great variety of life forms residing in them. The major habitat types from which all other smaller ecosystems derive are called terrestrial, marine and aquatic ecosystems.

Ecological diversity has following three types:

1. Alpha Diversity:

It is the biodiversity within a particular area, community or ecosystem. It is usually expressed by the number of species (i.e., species richness) in that ecosystem. This can be measured by

counting the number of taxa (distinct groups of organisms) within the ecosystem (e.g., families, genera, and species).

2. Beta Diversity:

Beta diversity (β-diversity) is a measure of biodiversity which works by comparing the species diversity between ecosystems or along environmental gradients. This involves comparing the number of taxa that are unique to each of the ecosystems

3. Gamma Diversity:

It refers to the total species richness over a large area or region. It is a measure of the overall diversity for the different ecosystems within a region. It is the product of a diversity of component ecosystems and the diversity between component ecosystems.

TOPIC-3

Hot Spot

*T*here are places on Earth that are both biologically rich — and deeply threatened. For our own sake, we must work to protect them.

Conservation International was a pioneer in defining and promoting the concept of hotspots. In 1989, just one year after scientist Norman Myers wrote the paper that introduced the hotspots concept.. A biodiversity hotspot is a biogeographic region that is both a significant reservoir of biodiversity and is threatened with destruction. The term biodiversity hotspot specifically refers to 25 biologically rich areas around the world that have lost at least 70 percent of their original habitat.

Biodiversity hotspots are areas that support natural ecosystems that are largely intact and where native species and communities associated with these ecosystems are well represented. They are also areas with a high diversity of locally endemic species, which are species that are not found or are rarely found outside the hotspot.

The advantage of Hot Spots

1. **Maintaining balance of the ecosystem**: Recycling and storage of nutrients, combating pollution, and stabilizing climate, protecting water resources, forming and protecting soil and maintaining ecobalance.

2. Provision of biological resources: Provision of medicines and pharmaceuticals, food for the human population and animals, ornamental plants, wood products, breeding stock and diversity of species, ecosystems and genes.

3.Social benefits: Recreation and tourism, cultural value and education and research.

4. **Provision of biological resource..**

Biodiversity underpins all life on Earth. Without plant species, there would be no air to breathe, no food to eat, no water to drink. There would be no human society at all. Earth where the most biodiversity is under threat, hotspots are critical to human survival.

Geologists have identified some 40–50 such hotspots around the globe. Those under Hawaii, Réunion, Yellowstone, Galápagos Islands, are the most active at present.

India has four biodiversity hotspots, i.e., Eastern Himalayas, Western Himalayas, Western Ghats and Andaman and Nicobar Islands.

Hot spot of the world

There are 34 areas around the world which are qualified as Biodiversity hotspots. These hotspots represent only 2.3% of the total Earth's land surface. THESE HOT SPOTS ARE:

1.Africa:

1. Eastern Afro-Montane 2. The Guinean forests of Western Africa 3. Horn of Africa4. Madagascar and the Indian Ocean Islands 5. Maputoland, Podoland, Albany hotspot 6. Succulent Karou7. East Malanesian islands 8. South Africa's Cape floristic hotspot9. Coastal forests of Eastern Africa

2 Asia and Australia:

1. Himalayan hotspot 2. The Eastern Himalayas 3. Japan biodiversity hotspot 4. Mountains of South-West China 5. New Caledonia 6. New Zealand biodiversity hotspo7. Philippine biodiversity hotspot 8. Western Sunda (Indonesia, Malas and Brunei) 9. Wallace (Eastern Indonesia) 10. The Western Ghats of India and Islands of Sri Lan 11. Polynesia and Micronesian Islands Complex including Hawaii 12. South-Western Australia

3. North and Central America: 1. California Floristic Province 2. Caribbean islands hotspot 3. Modrean pine-oak wood lands of the USA and Mexico border 4. The Mesoamerican forests

4. South America:1. Brazil's Cerrado 2. Chilean winter rainfall (Valdivian) Forests 3. Tumbes-Choco-Magdalena 4. Tropical Andes 5. Atlantic forest

5.Europe and Central Asia: 1. Caucasus region 2. Iran-Anatolia region 3. The Mediterranean basin and its Eastern Coastal region 4. Mountains of Central Asia

Four Biodiversity Hotspots in India

Some of these biodiversity hotspots are present in India which includes:

1. The Western Ghats

These hills are present along the western edge of peninsular India. Since they are situated near the ocean, they are likely to receive a good amount of rainfall. Most of the deciduous, as well as rainforests, are present in this region. Around 77% of the amphibians and 62% of the reptiles found here cannot be spotted elsewhere in the world. Sri Lanka in South India is a country which is rich in species too. It is connected to India through a land bridge which has a width of nearly 140 km.

2. The Himalayas

This region comprises of Bhutan, Northeast India, and Southern, Central and Eastern Nepal. These Himalayan Mountains are the highest in the world and abode to some of the highest peaks

of the world including Mount Everest and K2. Some of the major rivers in the world originate from the Himalayas. The Himalayas comprise of more than 100 mountains beyond 7200 meters.

3. Indo-Burma Region

This region consists of numerous countries including North-Eastern India (to the south of the Brahmaputra River), Myanmar, and China's Yunnan provinces southern part, Lao People's Democratic Republic, Vietnam, Cambodia, and Thailand. It is spread over a distance of 2 million square kilometres.

4. Sundaland

This region lies in South-East Asia and includes Thailand, Singapore, Indonesia, Brunei, and Malaysia. The Nicobar Islands represent India. These islands were declared as the world biosphere reserve in 2013 by the United Nations. These islands have a rich terrestrial as well as marine ecosystem including mangroves, seagrass beds, and coral reefs. Species such as dolphins, whales, turtles, crocodiles, fishes, prawns, lobsters and seashells comprise the marine biodiversity. In case the marine resources are over-used, it can pose a serious threat to biodiversity.

Topic- 4

Ecological succession

Ecological succession is the gradual process by which ecosystems change and develop over time. Nothing remains the same and habitats are constantly changing. There are two main types of succession, primary and secondary.

According to Clements, succession is a process involving several phases: Nudation: Succession begins with the development of a bare site, called Nudation (disturbance). Migration: refers to arrival of propagules. Ecesis: involves establishment and initial growth of vegetation.

Succession can be described under two headings:

a) The Primary succession

b) The secondary succession

a) The primary succession

Primary succession, type of ecological succession in which plants and animals first colonize a barren, lifeless habitat. Species that arrive first in the newly created environment are called pioneer species, and through their interactions they build a simple initial biological community. This community becomes more complex as new species arrive. Primary succession is distinguished from secondary succession, which is the recovery of an existing biological community after a disturbance sets back the community's ecological structure to an earlier stage. In secondary succession, an area that was previously occupied by living things is disturbed, then re-colonized following the disturbance.Primary succession occurs following an opening of a pristine habitat, for example, a lava flow, an area left from retreated glacier, or abandoned strip mine.

b) The Secondary succession

In contrast, secondary succession is a response to a disturbance, for example, forests fire, tsunami, flood, or an abandoned field.

The process of Primary Ecological succession can be discussed under following heading:

1) Nudation: It is the development of bare site uninhabited by any organisms. Mainly Autotrophs because of :

a) Topographic change- Soil erosion, land slide.

b) Climate change- Dry condition, movement of glaciers.

c) Biotic forest destruction, Agricultural changes due to disease epidemics.

2) Invasion or Migrarion- This process helps in arrival of spores ,seeds or vegetatively propagating structures.

3) Ecesis: Initial establishment of plant community. The stage is also called as colonization.

4) Aggregation,- This is development of the plant community which becomes established.

5) Competition: With development of array of plant community inter or intra competition begins.

6) Reaction: With the onset of plant community and its ultimate establishment conditions get modified. This gives way to another habitat with the subsequent loss of primary plant species.

7). Stabilization: This is the ultimate process of succession which allows permanent establishment of a plant community in the area.

Secondary succession

Whereas, Primary succession is a time consuming process secondary succession is a much faster process due to availability of resources.

Ecological succession in a pond

Hydrosere

Hydrosere or Hydrarch succession occurs in a pond and its community is converted into a land community.

Characteristics of Hydrosere:

In the initial stage, phytoplankton(cyanobacteria), green algae (Spirogyra,Oedogonium) are the pioneer colonizers. They are consumed by zooplankton (protozoans asAmoeba, Euglena, Paramecium etc), fish such as sun fish, blue gill fish etc.

Gradually these organisms die and increase the content of dead organic matter in the pond.

This is then utilized by bacteria and fungi, and minerals are released after decomposition.

Nutrient rich mud supports rooted hydrophytes growth as *Elodea, Hydrilla, Ceratophyllum* etc in the shallow water zone.

This submerged stage is also inhabited by animals such as may flies. Dragon flies etc and *Crustaceans asDaphnia, Cypris, Cyclops* etc.

The hydrophytes die and decomposed by micro organisms and thus release nutrients.

Due to silting, water depth is reduced and at the margin of pond grows rooted floating vegetation.Example- *Nelumbo nucifera, Monochoria, Trapa* etc.

In floating stage faunal living space is increased and diversified. Example- frogs, salamander, hydra,diving beetles etc inhabit such conditions. Some turtles and snake also invade the pond. Gradually, the water depth decreases due to water evaporation and organic matter decomposition.

Free floating plants as *Lemna, Azolla, Pistia, Spirodella, Wolffia* etc increase in number as availability of high nutrient is there.When these die, they build up the pond ecosystem, resulting in further build up of the substratum.Pond becomes a Swampy ecosystem.

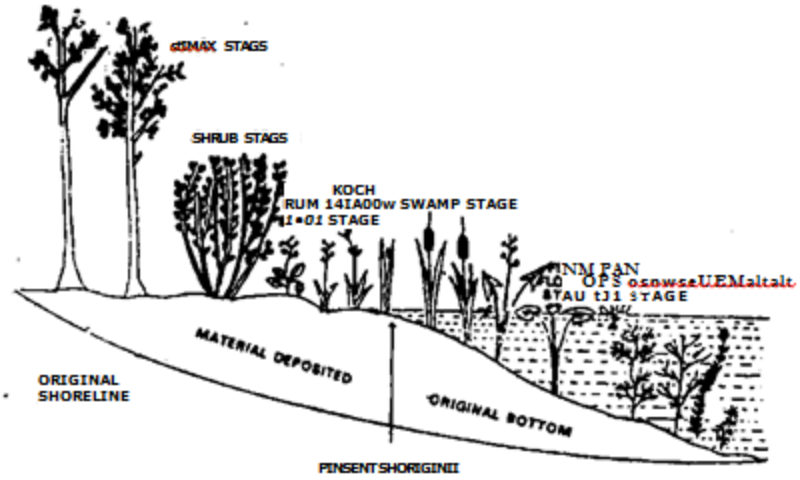
The reed swamp species, such as *Scirpus, Typha or Phragmites* and sedges as *Juncus, Carex, Cyperus e*tc invade the pond and gradually replaced by mesic communities.Gradually, land plants as shrubs (*Salix* and *Cornus*) and trees (*Almus, Populus*) invade ending in the climax community as deciduous forest.

The aquatic fauna also changes and ultimately gets replaced by land animals.

. **Sedge Marsh or Meadow stage:** the plants well adapted to new habitat begin to appear in the pre-existing community in mixed state. Important plants that are well suited to marshy habitat are the members of cyperaceae and gramineae. The species of sedge (*Carex*) and rushes *(Juncus),* species of Themeda, Iris,

Woodland stage: In the beginning some shrubs and later medium sized trees form open vegetation or woodland. The prominent plants of woodland community are species of *Acacia, Cassia, Terminalia, Salix*,

Climax forest: In the climax forest well adapted self-maintaining and self-reproducing, nearly stable and uniform plant community consisting mostly of woody trees develops in the form of mesophytic forest. This consists of all types of plants like Herbs, shrubs, mosses and shade loving plants.



Stages in the succession in a pond

Xerosere

Xerosere or Xerarch succession begins on exposed parent rocks (lithosere) or dry sand (psammosere).

A lithosere involves following stages-

1 crustose lichen stage (pioneers) :This is represented by crustose lichen which remains closely associated to rocky material. They have small rhizoids which secretes acid which helps in breaking the rocky material and thus begins the process of formation of soil.

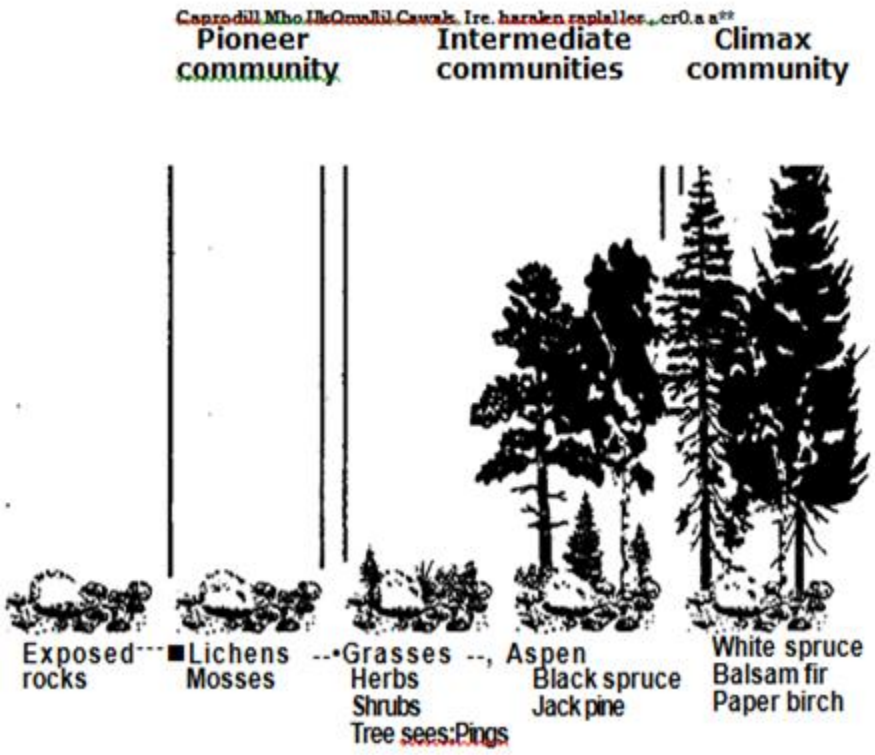
2. foliose lichen stage: Foliose lichen retain more water and accumulate more soil particles, helping in the development of a fine layer of soil on the rock surfa

3. moss stage : Accumulation of soil and humus leads to the growth of mosses such as Polytrichum and Grimmia. Their rhizoids penetrate soil on the rocks. The bodies of mosses are rich in organic and inorganic compounds. Due to ephemeral life cycle of these mosses when they die they add these compounds to the soil, increasing the fertility of the soil.

4 herbs stage : Death and decay of mosses and subsequent enrichment of soil along with holding of moisture helps in germination of seeds of hardy grasses like Eleusin, Aristicla, Poa, etc. Further decomposition of these annual grasses promotes the growth of perennial grasses like *Cymbopogon, Heteropogon* etc.

5. shrub stage –Consequent upon soil formation moisture content increases. Further weathering or rocks and death of herbs make the habitat more suitable for the growth of shrubs like *Rhus, Caparis and Zizyphus etc*

6. forest stage (climax stage). The succession culminates in a climax community, the forest. Many intermediate tree stages develop prior to establishment of a climax community. The forest type depends upon climatic conditions. Vegetation finally becomes mesophytic.



Stages in the succession of a Forest

Topic-5

ECOSYSTEM

An ecosystem includes all of the living things (plants, animals and organisms) in a given area, interacting with each other, and also with their non-living environments (weather, earth, sun, soil, climate, atmosphere). Ecosystems are the foundations of the Biosphere and they determine the health of the entire earth system.

Structure and Function of an Ecosystem:

Each ecosystem has two main components:

(1) Abiotic- The non living component

(2) Biotic- The living component

(1) Abiotic Components:

The non living factors or the physical environment prevailing in an ecosystem form the abiotic components. They have a strong influence on the structure, distribution, behaviour and inter-relationship of organisms.

Abiotic components are mainly of two types:

(a) Climatic Factors: Which include rain, temperature, light, wind, humidity etc.

(b) Edaphic Factors: Which include soil, pH, topography minerals etc.?

The functions of important factors in abiotic components are given below:

Soils are much more complex than simple sediments. They contain a mixture of weathered rock fragments, highly altered soil mineral particles, organic mat-ter, and living organisms. Soils provide nutrients, water, a home, and a struc-tural growing medium for organisms. The vegetation found growing on top of a soil is closely linked to this component of an ecosystem through nutrient cycling.

The atmosphere provides organisms found within ecosystems with carbon di-oxide for photosynthesis and oxygen for respiration. The processes of evapora-tion, transpiration and precipitation cycle water between the atmosphere and the Earth's surface.

Solar radiation is used in ecosystems to heat the atmosphere and to evapo-rate and transpire water into the atmosphere. Sunlight is also necessary for photosynthesis. Photosynthesis provides the energy for plant growth and me-tabolism, and the organic food for other forms of life.

Most living tissue is composed of a very high percentage of water, up to and even exceeding 90%. The protoplasm of a very few cells can survive if their water content drops below 10%, and most are killed if it is less than 30-50%.

Water is the medium by which mineral nutrients enter and are trans-located in plants. It is also necessary for the maintenance of leaf turgidity and is required for photosynthetic chemical reactions. Plants and animals receive their water from the Earth's surface and soil. The original source of this water is precipita-tion from the atmosphere.

(2) Biotic Components:

The living organisms including plants, animals and micro-organisms (Bacteria and Fungi) that are present in an ecosystem form the biotic components.

On the basis of their role in the ecosystem the biotic components can be classi-fied into three main groups:

(A) Producers

(B) Consumers

(C) Decomposers or Reducers.

(A) Producers:

The green plants have chlorophyll with the help of which they trap solar energy and change it into chemical energy of carbohydrates using simple inorganic compounds namely water and carbon dioxide. This process is known as photo-synthesis. As the green plants manufacture their own food they are known as Autotrophs (i.e. auto = self, trophos = feeder)

The chemical energy stored by the producers is utilised partly by the producers for their own growth and survival and the remaining is stored in the plant parts for their future use.

(B) Consumers:

The animals lack chlorophyll and are unable to synthesise their own food. There-fore, they depend on the producers for their food. They are known as heterotrophs (i.e. heteros = other, trophos = feeder).

The consumers are of four types, namely:

(a) Primary Consumers or First Order Consumers or Herbivores: These are the animals which feed on plants or the producers. They are called her-bivores. Examples are rabbit, deer, goat, cattle etc.

(b) Secondary Consumers or Second Order Consumers or Primary Carnivores:

The animals which feed on the herbivores are called the pri-mary carnivores. Examples are cats, foxes, snakes etc.

(c) Tertiary Consumers or Third Order Consumers:

These are the large carnivores which feed on the secondary consumers. Example are Wolves.

(d) Quaternary Consumers or Fourth Order Consumers or Omnivores:

These are the largest carnivores which feed on the tertiary consumers and are not eaten up by any other animal. Examples are lions and tigers.

(C) Decomposers or Reducers:

Bacteria and fungi belong to this category. They breakdown the dead organic materials of producers (plants) and consumers (animals) for their food and re-lease to the environment the simple inorganic and organic substances produced as by-products of their metabolisms.

These simple substances are reused by the producers resulting in a cyclic ex-change of materials between the biotic community and the abiotic environment of the ecosystem. The decomposers are known as Saprotrophs (i.e., sapros = rotten, trophos = feeder)

Types of Freshwater Ecosystems

Freshwater ecosystems fall under the umbrella of aquatic biomes. As the name suggests, these ecosystems exclude oceans and saltwater lakes, swamps and marshes.

Some of the most common types of freshwater ecosystems are:

Lakes, Ponds, Streams, Freshwater wetlands

Freshwater ecosystems are the rarest type of ecosystem on Earth, only amounting to 0.8 percent of the Earth's surface and 0.009 percent of the water on Earth (the rest being saltwater).

Not all freshwater ecosystems are going to have the exact same biotic factors, as the organisms within those ecosystems will depend on many of the abiotic factors within the ecosystem that are determined mostly by climate and geographical location.

Biotic Factors in Freshwater Biomes:

Algae are the main autotrophs of fresh water biomes that perform photosynthesis. They're also sometimes called phytoplankton. Green algae, red algae and diatoms are all common types of photosynthetic algae that are found in freshwater ecosystems.

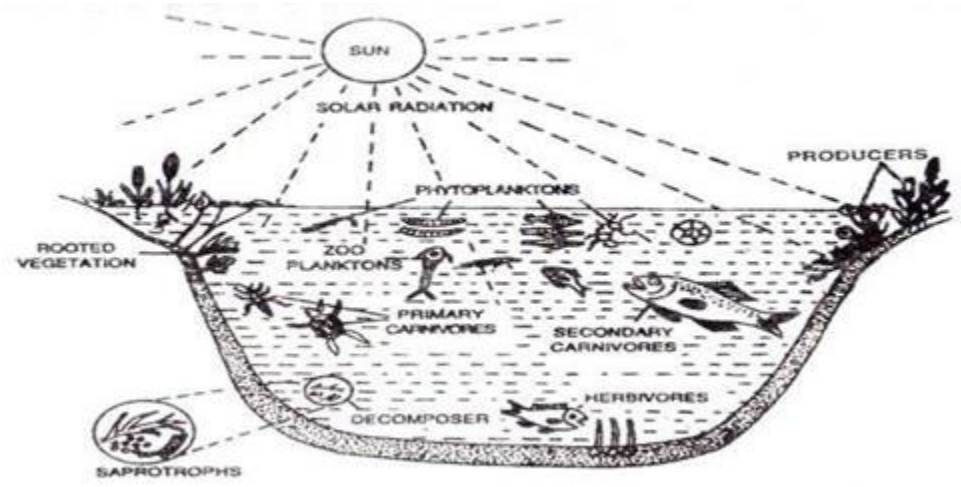
Invertebrates

Invertebrates are often the next trophic level up on the food chain after algae and other autotrophs.

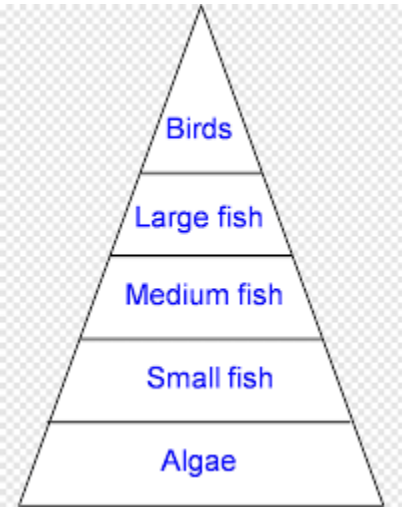
In freshwater ecosystems, many invertebrates are primary consumers, which means they eat algae and other producers for food. They may also eat other invertebrates and small organisms in the water as well.

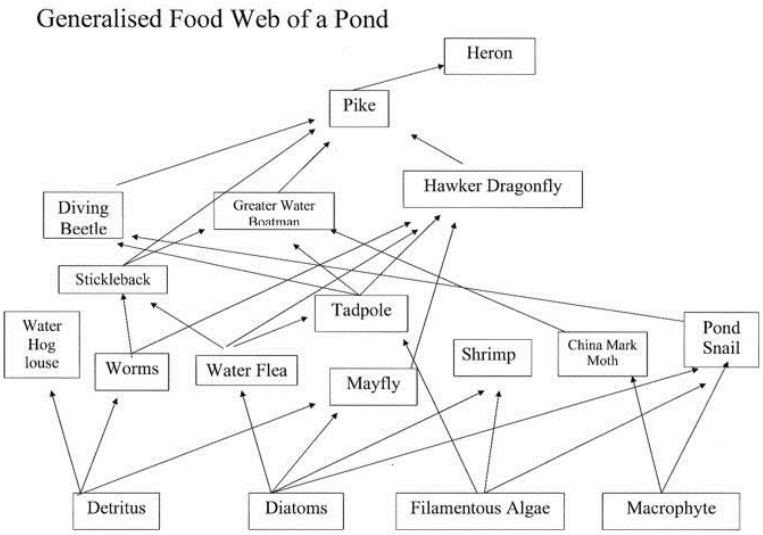
Common invertebrates in freshwater ecosystems include arthropods, worms, molluscs, other crustaceans, insects and more. Specific examples include: Earthworms ,Dragonflies, Water mites, Leeches, Water fleas, Crayfish, Crabs, Fish

Some other species living in Fresh water biomes are Frogs and toads, Aquatic birds, Terrestrial birds that feed on fish/organisms in the freshwater Alligators and crocodiles,Water snakes, Turtles

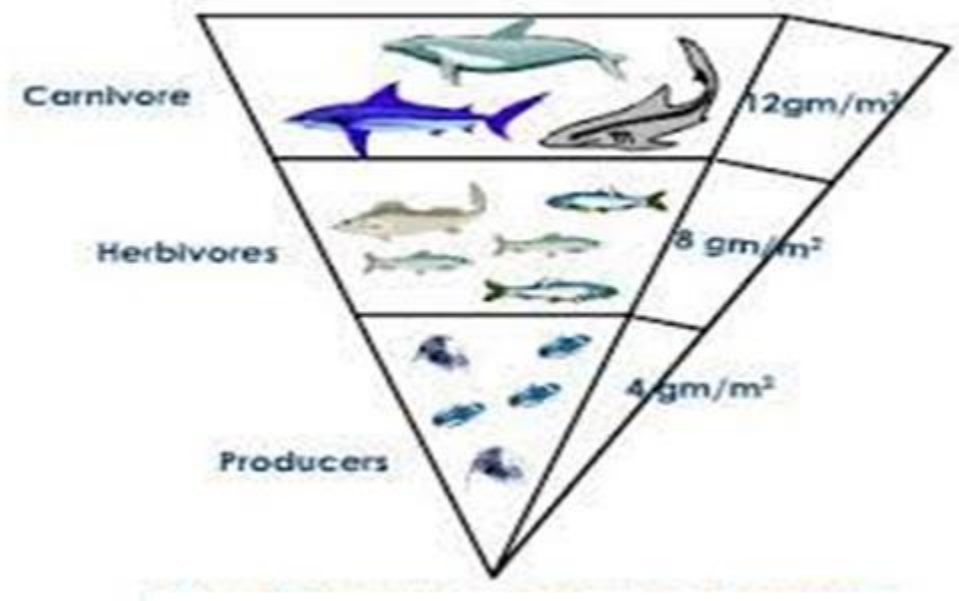


Various trophic level of a Pond Ecosystem

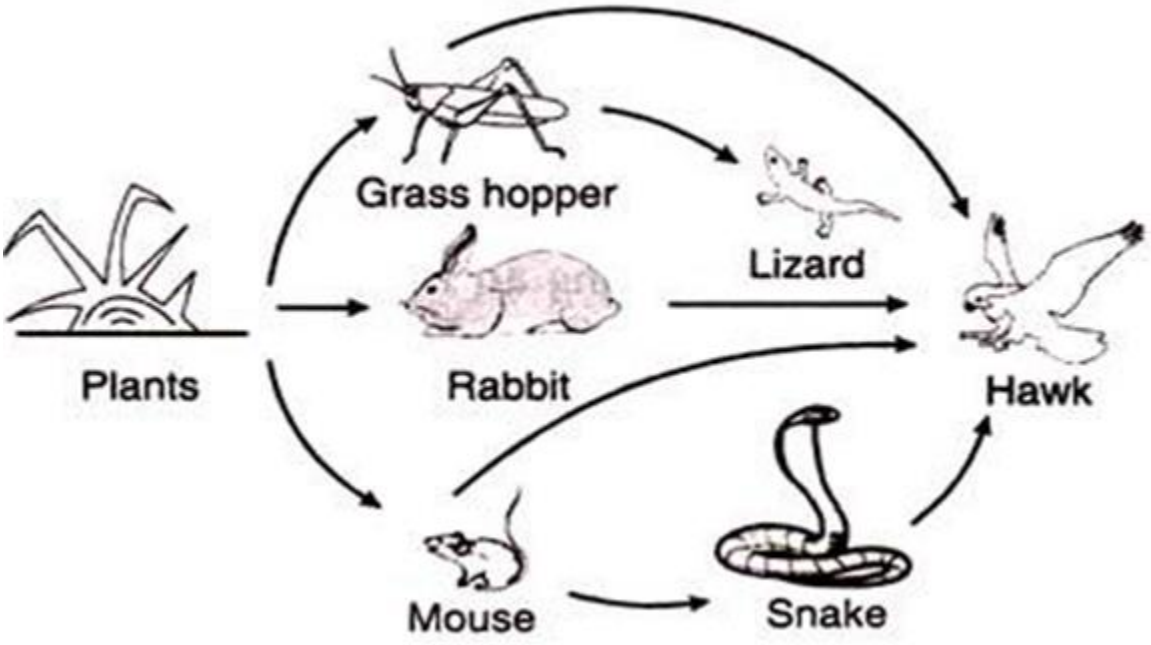




Erect Pyramid



An inverted pyramid



Grass land ecosystem

Forest Ecosystem:

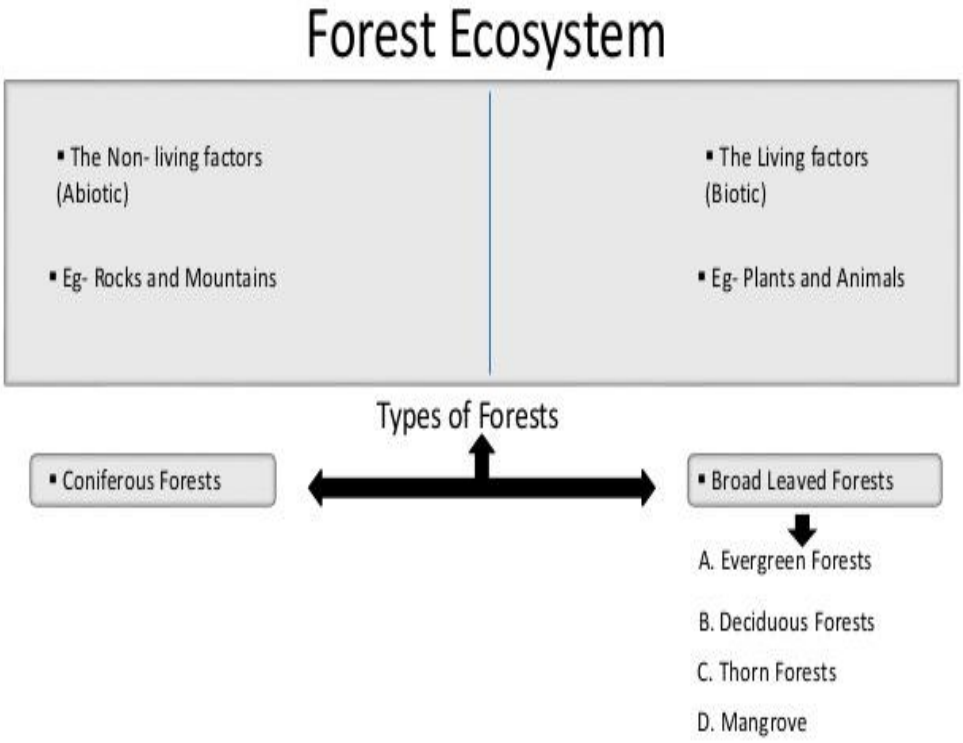
This also consists of:

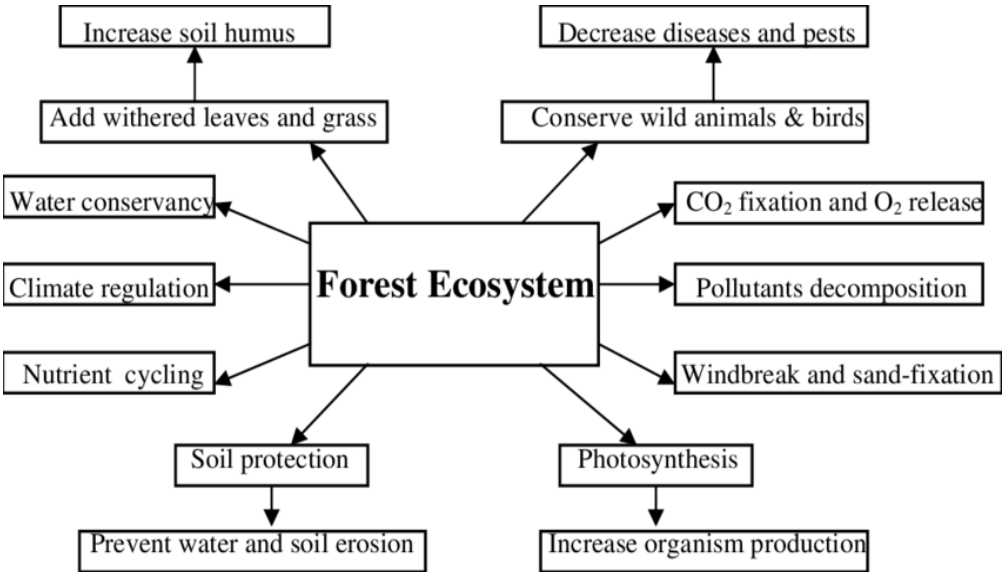
The Producers; The trees, shrubs and moss are all producers. They turn water and sunlight into the energy they need to live and grow, through a process called photosynthesis.

The Primary consumers: The primary consumers are the large herbivores like deer as well as insects, rabbits and rodents. These creatures eat mostly plants, seeds, berries and grasses.

The Secondary consumers: Secondary consumers are the carnivorous animals that eat only herbivores.

Decomposers: Examples of decomposers include bacteria, fungi, some insects, and snails, which means they are not always microscopic. Fungi, such as the Winter Fungus, eat dead tree trunks. Decomposers can break down dead things, but they can also feast on decaying flesh while it's still on a living organism.


Forest Ecosystem
▪ The Non- living factors (Abiotic)
▪ Eg- Rocks and Mountains
▪ The Living factors (Biotic)
▪ Eg- Plants and Animals
Types of Forests
▪ Coniferous Forests
▪ Broad Leaved Forests
A. Evergreen Forests
B. Deciduous Forests
C. Thorn Forests
D. Mangrove


Increase soil humus
Decrease diseases and pests
Add withered leaves and grass
Conserve wild animals & birds
Water conservancy
CO_2 fixation and O_2 release
Climate regulation
Forest Ecosystem
Pollutants decomposition
Nutrient cycling
Windbreak and sand-fixation
Soil protection
Photosynthesis
Prevent water and soil erosion
Increase organism production

Topic-6

The Food web

The concept of a food web, previously known as a food cycle, is typically credited to Charles Elton, who first introduced it in his book Animal Ecology, published in 1927. He is considered one of the founders of modern ecology and his book is a seminal work.

In a food web, organisms are arranged according to their trophic level. The trophic level for an organism refers to how it fits within the overall food web and is based on how an organism feeds. Broadly speaking, there are two main designations: autotrophs and heterotrophs. Autotrophs make their own food while heterotrophs do not. Within this broad designation, there are five main trophic levels: primary producers, primary consumers, secondary consumers, tertiary consumers, and apex predators. A food web shows us how these different trophic levels within various food chains interconnect with one another as well as the flow of energy through the trophic levels within an ecosystem.

Trophic Levels in a Food Web

Primary producers make their own food via photosynthesis. Photosynthesis uses the sun's energy to make food by converting its light energy into chemical energy. Primary producer examples are plants and algae. These organisms are also known as autotrophs.

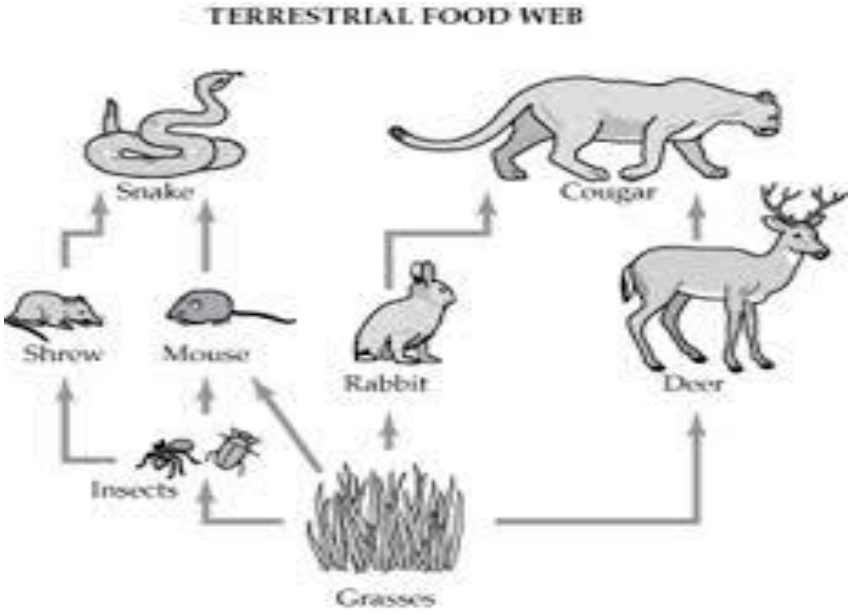
Primary consumers are those animals that eat the primary producers. They are called primary as they are the first organisms to eat the primary producers who make their own food. These animals are also known as herbivores. Examples of animals in this designation are rabbits, beavers, elephants, and moose.

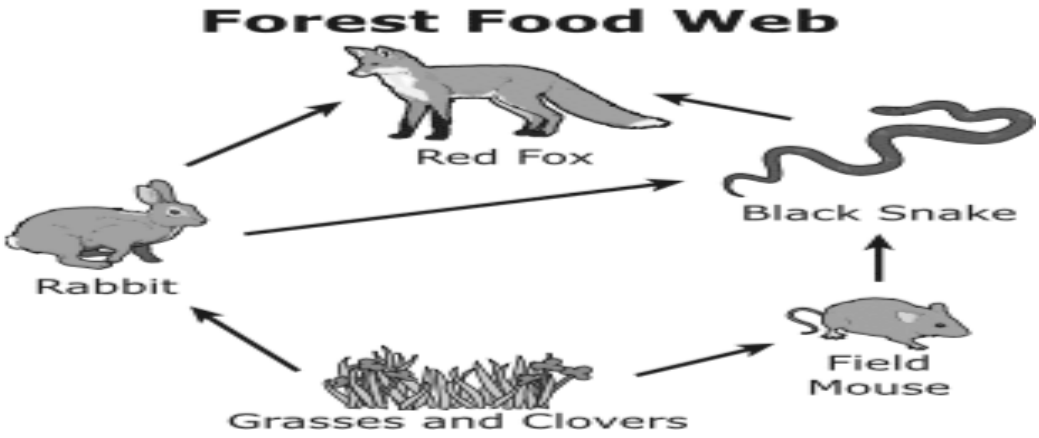
Secondary consumers consist of organisms that eat primary consumers. Since they eat the animals that eat the plants, these animals are carnivorous or omnivorous. Carnivores eat animals while omnivores consume both other animals as well as plants. Bears are an example of a secondary consumer.

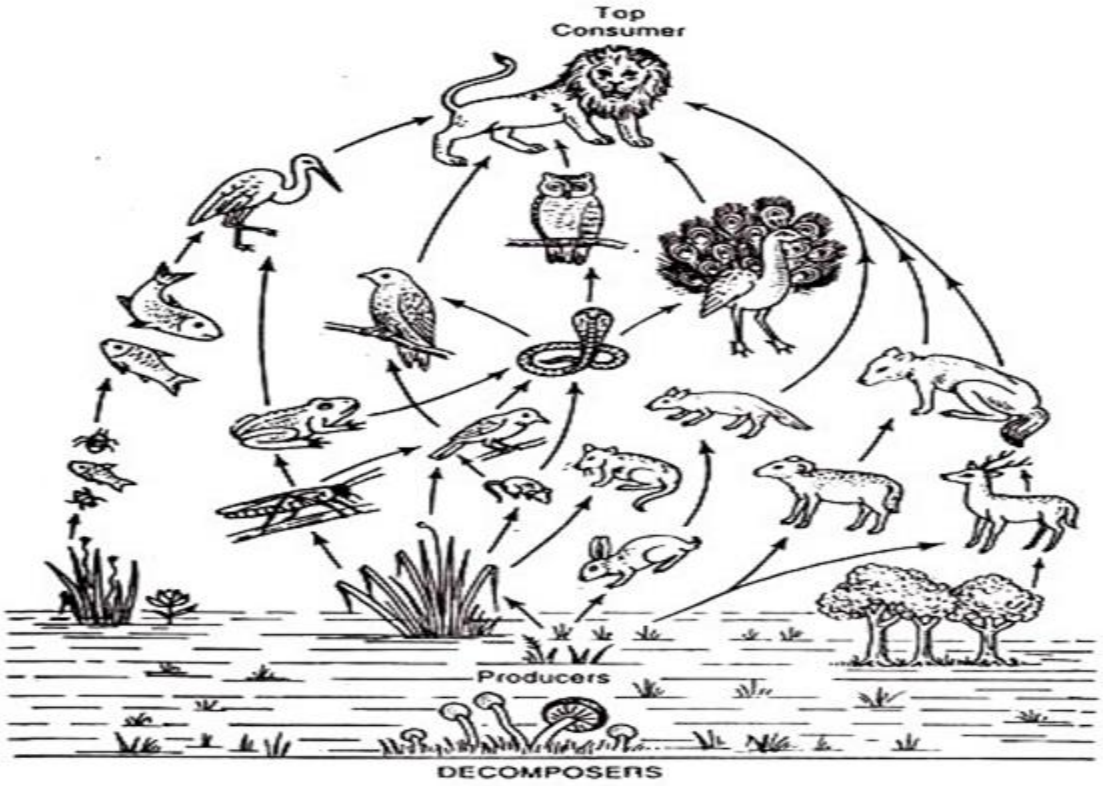
Similar to secondary consumers, tertiary consumers can be carnivorous or omnivorous. The difference being that secondary consumers eat other carnivores. An example is an eagle.

Lastly, the final level is composed of apex predators. Apex predators are at the top because they do not have natural predators. Lions are an example.

Additionally, organisms known as decomposers consume dead plants and animals and break them down. Fungi are examples of decomposers. Other organisms known as detritivores consume dead organic material. An example of a detrivore is a vulture.







A complex Food web

Topic-7

ECOLOGICAL ADAPTATION

Hydrophytic plant - a plant that grows partly or wholly in water whether rooted in the mud, as lotus, or floating without anchorage, as the water hyacinth. Hydrophytes are plants that live in environments that are aquatic or involve living in areas with an abundance of water. Areas where Hydrophytes live can be in ponds, rivers and streams, lakes, bays, and various other aquatic environments. Hydrophytes can either be fully submerged in water, or partly submerged

Hydrophyte survival characteristics:

Thin cuticle.

Stomata open most of time (as water is abundant).

Plants in water have less structure (water pressure supports them).

Large flat leaves on surface plants for flotation.

Air sacs for flotation.

Hydrophytes

Hydrophytes are the plants which grow in habitats where water is abundant. They are further divided into the following six groups.

Free floating: These plants float freely and independently on water surface; e.g., *Eichhornia, Lemna, Pistia* etc.

Floating and possessing roots: These plants float on the surface of water. These plants attach themselves to the bottom with the help of their roots; e.g., *Nymphaea, Trapa* etc.

Submerged: These plants occur below the water surface, but they do not attach themselves to the bottom; e.g., *Ceratophyllum, Najas* etc.

Submerged and possessing roots : These plants occur below the water surface and also remain attached to the bottom of water reservoir; e.g., *Hydrilla, Vallisneria* etc.

Ambhibious and possessing roots: These plants grow in waterlogged soils. Examples are, *Polygonum, Marsilea* etc.

Emergent and possessing roots: These plants grow in shallow waters and remain attached to the bottom. A part of the plant is below the water surface and a part above it. Examples are, *Cyperus, Typha* etc.

Morphology of Hydrophytes

Hydrophytes have some special adaptations. Following are some of the external features.

Roots:

In hydrophytes roots do not play an important role in water absorption.

Roots are either completely absent (e.g., *Ceratophyllum*) or poorly developed (e.g., *Hydrilla*).

Root pockets are present instead of root caps (e.g., *Eichornia, Lemna, Pistia* etc.).Some plants develop floating roots in addition to normal adventitious roots (e.g., *Jussiaea repens*)

Stems:

The stem of hydrophytes shows the following adaptations.In most of the hydrophytes the stem is long, slender, spongy and flexible; e.g., *Hydrilla, Potamogeton* etc.The stem may float horizontally on water surface (e.g., *Azolla*) or may be thick, short and stoloniferous; e.g., *Eichhornia*. It may be attached to the bottom of the pond by a rhizome (e.g., *Nymphaea*).

Petiole

The petioles have special modifications to suit the aquatic environment. Following are some of the modifications.Long, slender and delicate petioles are present in hydrophytes with their leaves floating on water surface (e.g., *Nymphaea*). In some plants petiole is swollen to form a bulb like structure to help the plants to float on water (e.g., *Eichhornia*).

Leaves

The leaves of hydrophytes show the following characteristics:

In submerged hydrophytes the leaves are thin, long and in the shape of a ribbon, (e.g., *Vallisneria*) or finely dissected (e.g., *Ceratophyllum*).Floating leaves are large, entire and flat (e.g., *Nymphaea*). These leaves have a coat of wax. The leaves may also have hairs (e.g., *Salvinia*).

The leaves of emergent and amphibious hydrophytes are heterophyllous, i.e., the leaves below the water are long, narrow and dissected while those outside the water are entire and broad. This is also termed as dimorphism of leaves. Heterophylly is shown in plants such as *Ranunculus, Limnophila heterophylla, Sagittaria, Sagitifolia* etc.

Anatomy of hydrophytes

Following anatomical characters are common to all hydrophytes.

All hydrophytes show presence of large air chambers. The tissue that forms air chambers is termed as aerenchyma. Mechanical tissue, i.e., sclerenchyma is either poorly developed or absent. Vascular tissue, particularly xylem is poorly developed. Cuticle is absent. Stomata are absent in submerged hydrophytes.

Roots

Epiblema is not cuticularised. Cortex is mostly parenchymatous. Aerenchyma may also be present. Xylem is poorly developed in comparison to phloem. Amphibious hydrophytes show xerophytic characters in addition to hydrophytic characters. The roots of these plants have well developed mechanical and vascular tissues, besides aerenchyma.

Stem

Cuticle is absent in epidermis. Cortex is large and parenchymatous. It is largely made of aerenchyma. Xylem is poorly developed in comparison to phloem. The vascular tissues are so reduced that these form a single vascular bundle.

Leaves

The leaf epidermis does not have cuticle. However, in floating leaves wax or hairs cover the upper epidermis. Stomata are present only in the upper epidermis. Stomata are absent in the in the submerged leaves. Large air chambers and spongy parenchyma are present in the leaves. Palisade parenchyma is generally absent.

Xerophytes (Adaptations to dry environment)

The plants which are growing in xeric (dry) environment (habitat) are called Xerophytes. Deserts are the best examples for xeric environment, where plant face inadequate water and excessive transpiration .xerophytes are classified into the following three categories-Ephemerals [the plants complete their life cycle within a short period. they also called “drought escapers” or “drought evaders”], Succulents [these plants have succulent, fleshy organs, to store to store high amount of water accumulated during rainy seasons. these xerophytes suffer dryness only in external environment],true xerophytes[these plants which are able to live under extreme dry conditions and high temperature].the xerophytes show the following adaptations.

Morphological adaptations

1. Stem shows stunted growth

2. Certain plants have under ground stem to tide over dry season.

3. Plants like acacia, zizyphus etc .have very hard ,woody stem with thick bark.

4. In many plants the leaves are reduced to scaly or spiny e.g.*Ruscus*, *Asparagus* etc.

5. Many plants have very small and narrow leaf blade to reduce the transpiration area.

6. Some plants have shining leaf surface to reflect light. E.g.*Nerium odorum*.

7. In certain plant leaves are very thick and leathery to reduce transpiration. E.g.*Calotropis procera*

8. Many plants have waxy coating on the upper surface of leaves.

9. Folded type leaves are seen in some of the grasses to protect the

10. In non-succulent plants root system is several times larger than the aerial portion.

Anatomical adaptations

1. Presence of thick cuticle on the upper surface of leaves.

2. The epidermal cells are thick walled.

3. Multiple epidermal layers are seen on both upper and lower surface of leaves.

4. Stomata are reduced in numbers and are sunken type.

5. The stomata pits are filled with number of hairs.

6. Thick walled sclerenchyma cells are seen in the hypodermis. E.g. pinus needle

7. Few spongy parenchyma cells with small inter cellular spaces.

8. Presence of many layered palisade parenchyma

9. The cells are relatively smaller in size and vacuoles are small.

10. Well developed vascular tissues are present

Xerophyte survival characteristics:

Thick cuticle.

Stomatal closure.

Reduction in # of stomata.

Stomata hidden in crypts or depressions in leaf surface (less exposure to wind and sun).

Reduction in size of transpiration surface (lower leaf only).

Increased water storage.

i. Epidermis and Thick Cuticle:

Heavy cuticularization and extreme cutinization of the epidermis and even of sub-epidermal cells are common in xerophytes. The thickness of the cuticle shows different gradations. In certain cases the thickness of cuticle is only slightly greater than normal, like that of plants of semi-xerophytic habitats. In extreme xerophytes the cuticle may be as thick as, thicker than, the diameter of the epidermal cell.

In addition to the presence of thick cuticle, the walls of epiderml cells become cutinized and sometimes also those of underlying cell. Along with well-evolved cutinized layers the epidermal and sub-epidermal cells also become lignified. In some cases the covering of wax is formed on the epidermis (viz., Calotropis). The epidermal cells are usually radially elongated. In the leaves of Nerium and Ficus, the epidermis becomes multilayered.

In many xerophytes in addition to a cutinized epidermis, single to multi-layered hypodermis is also present. In most plants, the hypodermis of leaves is morphologically mesophyll and can be in the form of a sheet of fibrous tissue or a layer of sclereids. The hypodermis of the stems seems to be a part of the cortex. The hypodermis of stems and leaves can be cutinized to lignified. In many plants, the mucilage, gums and tanning are commonly found in hypodermis.

Hairs:

In several xerophytic plants, especially those of alpine regions exposed to strong winds, a covering of matted epidermal hairs on the underside of the leaves prevent water loss. Hairs can also be abundant over the entire aerial part of the plant. The thick matting of hairs also prevents rapid evaporation through stomata. The xerophytes that contain abundant hairs, on their leaves and stems, are commonly called trichophyllous.

ii. Structure of Stomata:

The stomata are very minute opening produced in the epidermal layer in green aerial parts of the plants. This way, the reduction of transpiration is of great importance in xerophytes. The xerophytes can contain less stomata, either by reduction of leaf surface or of stomatal number per unit area. To reduce excessive transpiration usually the stomata that remain sunken in pits are formed. Such stomata are commonly called sunken stomata (e.g., *Hakea, Agave,* etc.). In certain cases the stomata are found in groups and they remain confined to depressions found on leaf surface (e.g. *Nerium, Banksia*, etc.). Generally the depressions attack of wind gusts.

iii. Sclerenchyma:

The xerophytes commonly have a large proportion of sclerenchyma in their leaf structure than is observed normally in mesophytes. The sclerenchyma is either found in groups or in continuous sheets.

iv. Rolling of Leaves:

The leaves of several xerophytic grasses roll tightly under dry conditions. In these grasses, the stomata are confined to the ventral surface of the leaf, so that when the leaf edges roll inward, the stomata are effectively shut away from the outside air. As the stomata are situated on the inner surface of the leaf, the air enclosed by the rolled leaf soon becomes saturated with water arid the outward water diffusion stops.

v. Reduced Leaf Surface:

In many xerophytes, reduction of the leaf surface partly checks water loss because the total exposed surface of the plant body is relatively small as compared with that of normal mesophytes (viz., *Casuarina, Asparagus,* etc.). In such xerophytes the leaves are either scale-like or very small in size. Generally they are not found in the mature plant, or they persist as small scales or bracts.

In some plants the photosynthesis takes place in the stem where assimilatory tissues are well-developed. The reduction of leaf surface is usually accompanied by well-evolved sclerenchyma, water storage tissue and sunken stomata. Xerophytes, with reduced leaves, are called micro-phyllous.

vi. Water Storage Tissue:

Many fleshy xerophytes contain water storage tissue and mucilaginous substance in them. In leaves such tissues are situated beneath the upper or the lower epidermis or upon both sides of the leaf and sometimes in the center too. The xerophytes, that possess fleshy leaves or stems, are called malacophyllous.

vii. Abundant Palisade Parenchyma:

In the stems of several xerophytes, the palisade tissue is present (viz., *Capparis decidua*). In the xerophytic leaves the palisade is abundant and completely arranged.

viii. Latex Tubes:

In many xerophytic stems and leaves the laticiferous canals are present (viz., *Calotropis, Euphorbia, Asclepias,* etc.). Because of vicosity latex the transpiration is reduced to some extent.

Topic-8

POLLUTION

Pollution is the introduction of contaminants into the natural environment that cause adverse change. Pollution can take the form of chemical substances or energy, such as noise, heat or light. Pollutants, the components of pollution, can be either foreign substances/energies or naturally occurring contaminants. Air pollution is defined as all destructive effects of any sources which contribute to the pollution of the atmosphere and/or deterioration of the ecosystem. Air pollution is caused by both human interventions and/or natural phenomena. It is made up of many kinds of pollutants including materials in solid, liquid, and gas phases. PSI is a guideline for reporting air quality which was first introduced by Thom and Ott in 1974. Hence, it would provide a method of comparing the relative contribution of each pollutant to total risk. The calculation of PSI is based on the concentration of five major air pollutants including particulate matters (PMs), sulfur dioxide (SO2), nitrogen dioxide (NO2), carbon monoxide (CO), and ozone (O3) in the air. According to Johnson et al., "air quality index (AQI) is defined as a measure of the condition of air relative to the requirements of one or more biotic species or to any human need."[22] AQI is divided into ranges, in which they are numbered, and each range is marked with color codes. It provides a number from healthy standard level of zero to a very hazardous level of above 300 to indicate the level of health risk associated with air quality There are 7 types of Pollution:

1. Air Pollution.

2. Water Pollution.

3. Soil Pollution.

4. Light Pollution.

5. Noise Pollution.

6. Radioactive Pollution.

7. Environmental Pollution.

1. Air Pollution: Types of Pollutant of Air

Particle pollutants

Particle pollutants are major parts of air pollutants. In a simple definition, they are a mixture of particles found in the air. Particle pollution which is more known as PM is linked with most of pulmonary and cardiac-associated morbidity and mortality.

Long-term exposure to current ambient PM concentrations may lead to a marked reduction in life expectancy. The increase of cardiopulmonary and lung cancer mortality are the main reasons for the reduction in life expectancy. Reduced lung functions in children and adults leading to asthmatic bronchitis and chronic obstructive pulmonary disease (COPD) are also serious diseases which induce lower quality of life and reduced life expectancy. Strong evidence on the effect of long-term exposure to PM on cardiovascular and cardiopulmonary mortality come from cohort studies

Ground-level ozone

O3 with the chemical formula of O3 is a colorless gas which is the major constituent of the atmosphere. It is found both at the ground level and in the upper regions of the atmosphere which is called troposphere. Ground-level ozone (GLO) is produced as a result of chemical reaction between oxides of nitrogen and VOCs emitted from natural sources and/or due to human activities. GLO is believed to have a plausible association with increased risk of respiratory diseases, particularly asthma.O3 induces a variety of toxic effects in humans and experimental animals at concentrations that occur in many urban areas

C**arbon monoxide**

CO is a colorless and odorless gas, which is produced by fossil fuel, particularly when combustion is not appropriate, as in burning coal and wood. The affinity of CO to hemoglobin (as an oxygen carrier in the body) is about 250 times greater than that of oxygen. Depending on CO concentration and length of exposure, mild to severe poisoning may occur. Symptoms of CO poisoning may include headache, dizziness, weakness, nausea, vomiting, and finally loss of consciousness. The symptoms are very similar to those of other illnesses, such as food poisoning or viral infections.

Sulfur dioxide

SO2 is a colorless, highly reactive gas, which is considered as an important air pollutant. It is mostly emitted from fossil fuel consumption, natural volcanic activities, and industrial processes. SO2 is very harmful for plant life, animal, and human health. People with lung disease, children, older people, and those who are more exposed to SO2 are at higher risk of the skin and lung diseases.Residents of industrialized regions encountered with SO2 even at lower concentrations (<1 ppm) in the polluted ambient air might experience a high level of bronchitis.

Nitrogen oxide

Nitrogen oxides are important ambient air pollutants which may increase the risk of respiratory infections. They are mainly emitted from motor engines and thus are traffic-related air pollutants. They are deep lung irritants that can induce pulmonary edema if been inhaled at high levels.

They are generally less toxic than O3, but NO2 can pose clear toxicological problems. Exposures at 2.0–5.0 ppm have been shown to affect T-lymphocytes, particularly CD8+ cells and natural killer cells that play an important role in host defenses against virusesCoughing and wheezing are the most common complication of nitrogen oxides toxicity, but the eyes, nose or throat irritations, headache, dyspnea, chest pain, diaphoresis, fever, bronchospasm, and pulmonary edema may also occur.

Lead

Pb or plumb is a toxic heavy metal that is widely used in different industries. Pb pollution may result from both indoor and outdoor sources. It is emitted from motor engines, particularly with those using petrol containing Pb tetraethyl. Smelters and battery plants, as well as irrigation water wells and wastewaters, are other emission sources of the Pb into the environment. Fetuses and children are highly susceptible to even low doses of Pb. Pb accumulates in the body in blood, bone, and soft tissue. Because it is not readily excreted, Pb can also affect the kidneys, liver, nervous system, and the other organs.. Pb is a powerful neurotoxicant, especially for infants and children as the high-risk groups. Mental retardation, learning disabilities, impairment of memory, hyperactivity, and antisocial behaviors are of adverse effects of Pb in childhood. Therefore, it is very important to reduce the Pb level of ambient air.Abdominal pain, anemia, aggression, constipation, headaches, irritability, loss of concentration and memory, reduced sensations, and sleep disorders are the most common symptoms of Pb poisoning. Exposure to Pb is manifested with numerous problems, such as high blood pressure, infertility, digestive and renal dysfunctions, and muscle and joint pain.

Other air pollutants

Other major air pollutants that are classified as carcinogen and mutagen compounds and are thought to be responsible for incidence and progression of cancer in human include VOCs such as benzene, toluene, ethylbenzene, and xylene, PAHs such as acenaphthene, acenaphthylene, anthracene, and benzopyrene, and other organic pollutants such as dioxins, which are unwanted chemical pollutants that almost totally produced by industrial processes and human activity.

Various agents of Air pollution

a) The burning of fossil fuels. Sulfur dioxide emitted from the combustion of fossil fuels like coal, petroleum and other factory combustibles are one the major cause of air pollution. ...

b) Agricultural activities. ...

c) Exhaust from factories and industries. ...

d) Mining operations. ...

e) Indoor air pollution.

Causes of Air Pollution

-Particulate Matter. Air pollution is characterised by the presence of particulate matter in the air of the atmosphere.

-Poisonous Gas. ...

-Emission from Vehicles. ...

-Combustion of Fossil Fuels. ...

-Pollution From Air Conditioners. ...

-Dust & Dirt. ...

-Household Pollution. ...

-Pollution from Natural Events.

Method to reduce Air Pollution

1. Understand Where Air Pollution comes From- To identify the pollution causing agent.

2. Reduce Use of Automobiles :to minimize the use of Automobiles.

3. Plant More Plants : To plant more trees

4. Go Solar – More use of Solar power

5. Get the Lead Out- Lead free fuel should be used.

WATER POLLUTION

Causes of water pollution

Water is uniquely vulnerable to pollution. Known as a "universal solvent," water is able to dissolve more substances than any other liquid on earth. It's also why water is so easily polluted. Toxic substances from farms, towns, and factories readily dissolve into and mix with it, causing water pollution**.**

Various source of water pollution are:

a) Industrial waste.

b)Sewage and wastewater.

c)Mining activities.

d)Marine dumping.

e)Accidental oil leakage.

f)The burning of fossil fuels.

g) Chemical fertilizers and pesticides.

f)Leakage from sewer lines.

Effect of water pollution on human health

Infectious diseases can be spread through contaminated water. Some of these water-borne diseases are Typhoid, Cholera, Paratyphoid Fever, Dysentery, Jaundice, Amoebiasis and Malaria. Chemicals in the water also have negative effects on our health.It can result into following disease:

Respiratory diseases.

Cardiovascular damage.

Fatigue, headaches and anxiety.

Irritation of the eyes, nose and throat.

Damage to reproductive organs.

Harm to the liver, spleen and blood.

Nervous system damage.

Besides above mentioned disease Human health is affected by the direct damage of plants and animal nutrition. Water pollutants are killing sea weeds, mollusks, marine birds, fishes, crustaceans and other sea organisms that serve as food for human. Insecticides like DDT concentration is increasing along the food chain.

How can we stop water pollution?

There is no easy way to solve water pollution; if there were, it wouldn't be so much of a problem. Broadly speaking, there are three different things that can help to tackle the problem—education, laws, and economics—and they work together as a team.

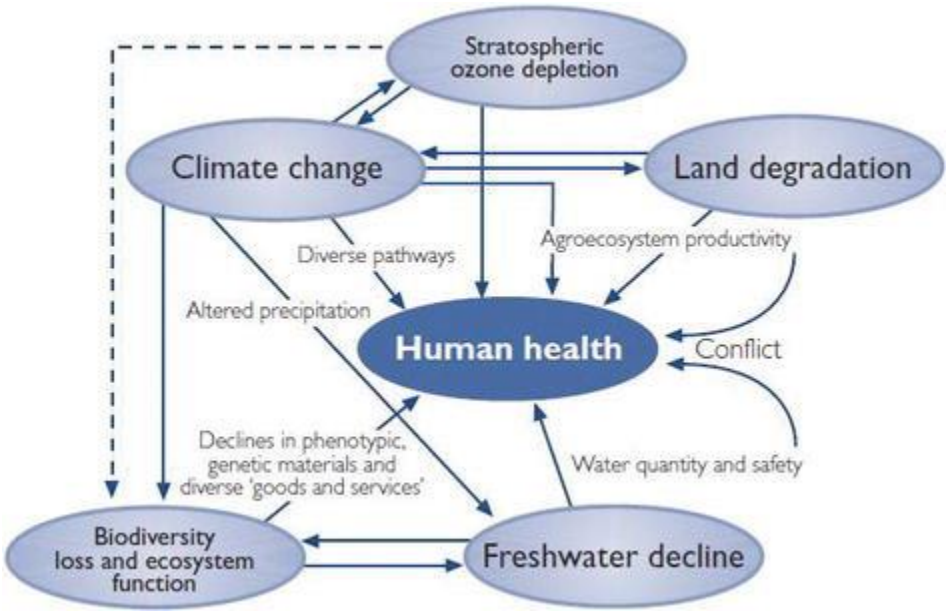
Education- This can be done by creating awareness. NGO can be assigned this job

Laws

One of the biggest problems with water pollution is its transboundary nature. Many rivers cross countries, while seas span whole continents. Pollution discharged by factories in one country with poor environmental standards can cause problems in neighboring nations, even when they have tougher laws and higher standards. Environmental laws can make it tougher for people to pollute, but to be really effective they have to operate across national and international borders. This is why we have international laws governing the oceans, such as the 1982 UN Convention on the Law of the Sea (signed by over 120 nations), the 1972 London (Dumping) Convention, the 1978 MARPOL International Convention for the Prevention of Pollution from Ships, and the 1998 OSPAR Convention for the Protection of the Marine Environment of the North East Atlantic. The European Union has water-protection laws (known as directives) that apply to all of its member states. They include the 1976 Bathing Water Directive (updated 2006), which seeks to ensure the quality of the waters that people use for recreation. Most countries also have their own water pollution laws. In the United States, for example, there is the 1972 Clean Water Act and the 1974 Safe Drinking Water Act.

Economics

Most environmental experts agree that the best way to tackle pollution is through something called the polluter pays principle. This means that whoever causes pollution should have to pay to clean it up, one way or another.



Effect of water Pollution on the environment