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B.Sc. BOTANY
THIRD YEAR
PAPER - VIII : PLANT ECOLOGY AND PHYTO GEOGRAPHY

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B.Sc. BOTANY

THIRD YEAR

PAPER - VIII : PLANT ECOLOGY AND PHYTO GEOGRAPHY

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UNIT II	ECOSYSTEM COMPONENTS OF ECOSYSTEM
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B.Sc. BOTANY

THIRD YEAR

PAPER-VIII : PLANT ECOLOGY AND PHYTO GEOGRAPHY

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Definition, Basic concept, The environment climatic, edaphic and biotic factors.

UNIT – II

Ecosystem – Definition, Components of ecosystem – Abiotic and Biotic Components – Pond Ecosystem, Forest Ecosystem, Ecological niches, Food chain, Food Web, ecological pyramids (Pyramid of number, pyramid of biomass and pyramid of energy).

UNIT – III

Vegetation – Plant succession : Definition, Hydroxere and xeroxere, Plant adaptation – Hydrophytes, Xerophytes Mesophytes, Halophytes and Epiphytes.

UNIT – IV

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BLOCK INTRODUCTION

We are in the block of course - Plant Ecology and phytogeography. In this block we will discuss about Ecology, Enviromental studies, Ecosystem, Ecological pyramids, Plant adaptation pollution, types of pollution, phytogeography, pytogeographical regions and vegetations.

Ecology deals with the various principles the govern the relationship between the organisms and environment.

In the first unit we are going to discuss about the Ecology, Basic concepts of Ecology and Environmental factors.

In the second unit of this block you are going to explore about Ecosystem, components of Ecosystems and Ecological pyramids.

In the third unit we are going to Learn about plant succession and plant adaptation.

In the fourth unit we get clear idea about the pollution types of pollution, causes of pollution and control methods.

In the fifth unit you will acquire the knowledge on the area of phytogeography phytogeographical regions and vegetations.

UNIT – I BASIC CONCEPT OF ECOLOGY

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UNIT – I

1.0 INTRODUCTION

Plant eclogy deals with the study of plants in relation to there environment. Plants are forces to occupy diverge environmental conditions due to struggle for existence. Ecology is a natural science and it is a branch of biology deals with relation ship between living organisms and their environment.

The term environment was introduced in ecology by Tacob Van Verkvl (1884-1944) to denote to the various aspects of the world surrounding with reference to organisms two Greek words. Oikos (meaning house (or) dwelling place) and logos (Means study of) to dens to interaction among the environment and living organisms. The tern ecology was coined by Reiter (1885) Ecology like a biology has been sub divided into plant ecology and animal ecology. According it is important to implement the environment studies in order to bring about awareness among the student and peoples. Basically environment broadly classified in to aut ecology (Interaction between individuals) and synecology similar inter action at communities into various area such as production ecology, population ecology I marine ecology, and human ecology. The environment play and important role in determining the destiny of plant species.

1.1 Definition :

Ecology is the study at the reciprocal relationship between living organism and there environment according to ODUM The study of the structure and function of nature. At present the science of ecology is dealt under the name Environmental Biology.

Environmental science is the application of knowledge from many disciplines for the study and management of the environment. It involves and under standing of scientific principles. Economical influence a and political action.

Environmental studies deals with every issue that affects a living organism. It is essentially a multi disciplinary approach that bring about an appreciation of our natural world and human impact on its integrity. It is an applied science, as it seeks practical answers to the increasing important question of how to make human civilization . sustainable on the earths finite resources. It component inside biology, geology chemistry, physics, engineering , sociology health anthropology, economics, statistics.

Ecology can also be defined as, the study of the action, reaction, and co-action between living organisms and their environment"

1.2 IMPORTANCE:

Environment is not a single subject; it is an integration of several subjects that include both science and social studies. To understand all the different aspects of our environment we need to understand biology, chemistry, physics, geography, resource management, economics and population issues. Thus, the scope of environmental studies is extremely wide and covers some aspects of nearly every major discipline.

The five major elements of earth, Air, water, atmosphere ,fire, land constitute the earth. Any change. Reference about the aspects of ecology were found in our ancient writing like Vedas and puranas. Philisophers like charaka in his "charaka samhita" mentioned the importance of vayu (air), Jala (water), Desha (topography) and kaala in regulating plants life.

In one of these element is bound the equilibriums of the others elements. The environment is subject to constant change as happen in the element constituting the earth. Any change in the environment brings impacts on all living organisms including man.

Human activity are the basic cause for all kinds of pollution every part of the world. The following are among the importance decisions of the 1972 world conference at Stockholm.

1. Immediate action should be taken to reduce (or) minimize pollution to water and air.
2. Wild animals and energy resources have to be protected the number of government and NGO take action to protect nature.
1. Convention on Interjectional trade in endangered spp (CITES)
2. Convention of Biological Diversity
3. World literates convention so on

1.3 SCOPE OF ENVIRONMENT :

1. To create awareness among learners about the natural resources, disturbances caused to environment. Causes for such pollution and measures to minimize its impact.
2. To take the citizens environmentally literate. By acquiring environmental awareness they can make proper decisions to protect the environmental.
3. To provide necessary attitude for the conservation of environment.
4. To understand the effect of using the environment is multiple wages.

5. To become capable of evaluating alternative solutions to environmental issues.
6. To develop ecofriendly technology to tackle them for the benefit of all.
7. Present day problems of varied nature in human life are directly and indirectly very much reacted to ecology, as this solution needs an ecological knowledge.
8. These days ecology has been contributing very much to socio-economic, political and other similar policies of the world.
9. Ecology indeed plays environmental role in human welfare.
10. Ecology plays an important role in agricultural grassland forestry, biological survey. Pest control fishery biology and conservation of soil wild life forest.

1.4 Basic Concept of Ecology :

1. Environment is dynamic in nature. It is a complex of many interrelated factors. It modifies the life of the organisms.
2. All living organisms and their environment are mutually relative affecting each other in various ways. Animal population flora and vegetation are interdependent through the environment and are mutually reactive.
3. The environment study Explain
    1. Ecology
    2. Ecosystem
    3. Biome
    4. Community
    5. Population
    6. Niche
    7. Guild
    8. Homeostasis
    9. Laws of Thermodynamics
    10. Habitated
    11. Habit

a. Ecology :

The reciprocal relationship between the living organism and their environmental

b. Ecosystem :

A Group of organism there physical environmental interactive as an ecological unit is called ecosystem.

Biome :

1. Terrestrial habitat occurs throughout the world me climate is not uniform throughout . so the nature of distribution of plants and animals varies from area to area and the terrestrial habitat in divided into numbers of sub-units called biomes (or) major communities Ex. Himalaya biome Desert biome.
2. The earth has different combinations of environmental conditions that support the amazing range of organisms around us which results in "Bio diversity". However these can be classified into a few broad group.
3. Community :

   A group of organisms (Taxa, genera, spp) belonging to number of different spp that occur in a given area at a given time further these organism interact each other in such an association.
4. Population :

   An the individuals of a singles species with in a definite area and at a given time is called population.
5. Niche

   Niche is refer to us profession of an organism. The collegial role or function of species in a community is called riche.

   Function (or) Profession of organism is called niche.
6. Guild

   A group of species with comparable roles and niche dimension with a community are called guilds.

10. Hemostasis :

    A maintenance of the relatively constant internal environment (or)state by a organism in a variable external environmental by way at intrinsic regulatory mechanism is called homeostasis.

Habitat

Address of an organisms (E.P. ODUM). The locality (or) site and particular type at local environment occupies in a organisms is called habited.

Habit

The external appearance aspect or growth for often an organisms is called habit.

The dynamic environment and organisms make ways for the development of different kinds of organisms through a process known as succession. The process continues fill the development of a community which is now more less stage and is now able to keep it self adjusted in equilibrium is called a climax the chemical components of the ecosystem move in defined cycles biogeochemical cycle.

Synecology

Under natural conditions however organisms plants, animals, microbes live as a natural group affecting each others like in several ways. They more complex situation exist where the units of study instead of single organisms are groups of organisms known as a community such as approach where units of study are groups of organisms is called Synecology. Gynecology may deal with 1.community ecology 2. Population ecology 3. Biome ecology 4. Ecosystem ecology.

Autecology

This is also known as ecology of individuals where we study the relation of individual species at investment

1.4 The Environment

The environment is the aggregate of all those things and set of conditions which directly or indirectly influence not only the life of organisms but also the communities at a particular place.

Thus environment is a complex of so many things light temperature soil water soon. which surrounds an organisms. Any external force substance or condition which surrounds and affects the life of an organisms in any way becomes a factor its environment factor ecological factor or simply calls as factor of its environment. The factor living (Biotic) nonliving (A Biotic). The natural place where organisms or communities of organisms live is called habitate. A factor can be defined as the external force ,substance or condition that affects organisms in any way and at any rate.

1.6 Ecological factors

Ecological factors include the

1. Climatic factor
2. Edaphic factor
3. Topographic factor
4. Biotic factors these conditions of a site which influence the vegetation of region.

1.6.1 Climatic factors

Climate is defined as the average whether conditions prevailing in any locality, it depends on various meterological and whether conditions such as temperature solar radiation (sunlight) , moisture, air pressure, and evaporation rates.

The climatic factors are mainly confirmed to aerial environment. Hence they are called atmospheric factors. They important climatic factors are the following.

1.Temprature

2.Light

3.Wind

4.Humidety/precipitapion/ rain fall

5. Forest

6.Snow

7.Fire

Climate :

The climate is favorable to the establishment of a species then a number of climatic factors may influence population growth . changes in temperature years that are warmer or colder then . Normal may permit a species to thrive and increase or they may . cause a decrease and permit its survival only in the most favorable site. Climate one of the important natural factors controlling the plant life. the study of climate is called climatology.

In greek climate means inclination or angle which the suns rays strike the earth. But now the word climate includes all the atmospheric and meteorological influence. Climate is defined by the interaction and intensity of many sub factors climate and atmospheric factors tend to have their most severe effects upon those introduced populations of plants and animals which man attempts to grow or produce in areas that have climate more extreme then the optimal climate for the species concerned.

Certain factors at weather and climate may have catastrophic effects on all populations in an area hurricanes, torandoes, unusually severe floods or droughts, but usually there are less significant than the normal changes.

(i)Temperature;-

Temperature means the heat energy available from solar radiation . it has been estimated that the amount of solar radiation available with in our atmosphere is to 2 cal per sq/cm perminit, of this 50%of which reaches the

earth and the remaining portion is absorbed , reflected or scettered within the atmosphere.

1. Temperature directly aspect the physiological processes of plants and consequently their growth and size.
2. Temperature determines which species' can survive in partway region. The different species of plant show a wide variation as regards their tolerance to temperature range and fluctuation generally temperature (32^0c) is most favorable for tropical place

Mesotherm;

High summer temperature and low winder temperature.

Ex . aquatic plants

Megatherm:

Living at high temperature

Ex: desert plant

Microtherm:

Moderate warmth in summer, low temperature in winter

Ex: plant at high altitudes

Eury thermal:

Organism which can tolerate wide variation in temperature.

Stenothermal:

Organism living at nearly constant temperature can not tolerate variations.

Poikilothermal:

Temperatures varies with the surroundings (ectothermal = clod blooded)

Homoisothermal : (Endothermal / warm blooded)

Temperature Constant due to Internal regulation, excessive subcutaneous fact (blubber) protects whales sea and polar bear from low temperature.

Hibernation : (winter sleep, Aestivation summer sleep).

Periodic activity and winter summer temperature stimulates the growth of seadlings the optimum temperature are seed germination ranges between 20^0c to 27^0c

1. Temperature affects all the metabolic activity of plants.
2. Rate of temperature determine rate of photosynthesis and respiration

3. High temperature increase the rate of cuticular transpiration even if the stomata are closed.
4. Control the plant distribution high temperature during day time increase the photosynthesis rate and during night reduces the rate of respiration. Temperature in combination with humidity and other factor helps in the spread of disease in plants.

(ii) Light

The sun light enters the earths crust, it undergoes many changes. A portion of sun light is reflected back to the atmosphere by the water vapour and water droplet of clouds. In the sun light rays of several wavelength are present. it controls photosynthesis tissue differentiation, growth, pigmentation, plant movement, reproduction in plants and animals depending upon the period of activity period of activity animals are diurnal active during day, nocturnal active and disk

Effect of light

1. Light is essential for photosynthesis in green plant and photosynthetic microorganisms
2. It affect directly the plant life both physically and physiologically.
3. The affect upon transpiration by determination of opening and closing of stomata.
4. It help synthesis of growth hormones, flowering and light induces phototropic movement of plant parts

The solar radiations which penetrates earth's atmosphere consist visible light and small portion of ultraviolet and infrared radiations.

The visible light range between 400/750μm. visible sun light is passed through a prism it is dispersed into a series of wavelengths exbisting seven different colours violet, indigo, blue, green, yellow, orange, red, (VIBGYOR)

Flowering and growth plants based on light

1. Long day plant

Plants which bloom when the light duration is more than 12 hours per day, as for ex. Radish potato

2. Day neutral plants

Which so little response to length of day light as for ex. Tomato plant.

3.Short day plants

Plants which bloom when the light duration is less then 12 hours per day ex: Topacco , Cerealls, Dahelia.

Light affects the movements in some plants . the stems roots and leaves show different response to light the effect of sun light on the plant movement is called heliotoropic effect seeds when moist or very sensitive to light. The quantity of light needed for the stimulation of embryo varies in different seeds. Germination of seeds is retarted in light.

Wind :

It determines cloud formation pollination dispersed in many organisms. Wind restricts light animals, nest formation and height in plants. It is a important ecological factors of the atmosphere, as it affects plant life mainly on flat plains, along seacoasts, and at high altitude in mountains. Wind is directly involved in transpiration in causing several types of mechanical damage, and in dissemination of pollen, seeds and fruits. It enhance soil erosion, transpiration and develop flag trees. The velocity of wind is affected by such factors as geographic situation, topography and vegetation masses , and position with respect to seashores. The air generally moves from the poles towards equator. Wind has number of physical anatomical and physiological effect on plant.

1. Mechnically wind causes erosion of soil and abrasion of vegetation trough removed of particles and physiologically, it decrease the growth of plants by way of reducing the moisture content of air and the turgidity of plant. Moist air promotes the growth of mesophytes
2. Wind increase the .water loss, it is help the dispersal of pollen grains, fruits , seeds and spores of the plants.
3. Dry and hot winds, young parts of plants may become shriveled and killed in a few hours and the surface of soil may become dry.
4. In open situation, sea shores and high mountain tops ,where the strong winds below all the year round in one direction , the trunks and branches are twisted chiefly in the direction of prevailing wind ,In India and many other countries of the world, unchecked winds have caused total disappearance of vegetation at certain places and rendered big area deserted . Rajasthan desert in India is spreading east ward due to unchecked wind erosion.

Plant growing under the influence of drying winds generally suffer from dehydration and consquent loss of turgidity in some trees boles, as a result of wind deformation, there develops a dense, reddish type of xylem called the compression wood. In some plants such as grasses wheat, maize, oat, sugarcane, where violent winds causes the flattening of there herbaceous plants against the growth. It is called ludging.

Nitrogen-78.08%	Co-0.0318%
Oxygen-20.9486%	Neon-0-001832%
Argon-0.9340%	Helium-0.00052%
Hydrogen-0.00006%	Methane-0.0002%
Ozone-0.000004%	

HUMIDITY AND PRECIPITATION

Epiphytes can be found in humid areas. Arid areas do not have them transpiration in inversely proportional to atmospheric humidity low atmospheric humidity produces aridity and xerophytism. Periodicity and amount of precipitation. determine type of vegetation Evergreen, Deciduous, Savannah, Desert, Grassland. So on.

Water is present in the atmosphere in the atmosphere in the form of vapour. This is called humidity of the air. The amount of water vapory present in the atmosphere of a particular place depends many factors. In the atmosphere, water is found in the form of vapour. The quantity of water retained in the atmosphere depends on the temperature and wind .vapour increases in the atmosphere if the temperature rises and pressure decreased. At saturation points if the temperature is lowered the water holding capacity of atmosphere is reduced which causes the condensation of water vapour in the form of raindrop . dew frost, sleet, snow this is precipitation.

Atmospheric moisture in the form of invisible vapour is known as humidity. Humidity is greatly influenced by intensity of solar radiation, temperature altitude, wind , exposure, and water status of soil high temperature cause the lower relative humidity. Low temperature cause high relative humidity.

Snow which may lie on the ground to form a valuable protective blanket and also a reserve of water, it up to limit the growing season by its late melting. The form and structure of the plants on the basis of water requirements the plants grouped into following types.

i) xerophytes:

Plants adapted to grow in dry lands where water content is low.

(ii) Hydrophytes:

Plant adapted to aquatic environment

(iii) Mesophytes:

Plants living in the habitat that usually shows neither an excess nor a deficiency of water.

PRECIPIATION

The water available to plants and animals from soil comes a result of rainfall. There occurs an interchange of water between the earths surface and the atmosphere , forming the water or hydrologic cycle. The two important events which are involved in this cycle are precipitation and evapo-transpiration. The annual rainfall determines the type of vegetation in any region etc., tropical region has heavy rainfall through out the year main vegetation are evergreen forest. The amount of annual rainfall greatly influence the vegetation as well as animal populations of a particular region on high mountains the regions are correlated with the distribution of rain fall and there are distinguished three regions.

i) Lower region with scanty rainfall,

ii) Middle region or the cloudy region with lot of rain.

iii) Upper dry region, above the clouds covered with snow and ice.

In India due to differences in the amount of annual rainfall and its distribution in different seasons, of the year, we find that vegetation types in different parts of the country are much different from each other. Similarly with, changes in vegetation we also find different types of geographical regions.

SNOW

Frozen water vapor, that falls on the ground from the sky in the form of solf white flakes is called snow. It is most common at high altitudes where the temperature is low generally snow falls on an area which is found at 2000m above the sea level but on the Himalaya it occurs even at 1200m above the sea level.

Snow influence the growth and development of some plant and their distribution. Sliding of snow causes erosion of top layer of soil and uprooting of plants. Snow covers the plant surface and hence it prevents further dropping in temperature of the plants. Thus it protects seedlings and vegetation from the damaging effect of severe colds. Snow glaciers melt and release water in the rivers and stream, so water flows in the river through out the year. Snow gets deposited on the branches of trees and on young trees.

FIRE FACTOR

Fire is important ecological factor in forest area. It causes some deleterious effects on forest vegetation. There are three kinds of fire namely, ground fires, surface fire, and crown fires. Forest fire are common in some areas with woody vegetation. Generally controlled fires . has many advantages over uncontrolled fires on vegetation. Fire destroys plants, animals and microbes while burning. So it is said to be a limiting factor for removing competition of plants in the affected area of forest. Thus it creates an ecological balance in the burnt area. Controlled fire increases the bacterial activity in the soil. It reduces the rate of natural uncontrolled fires in a forest area. It reduce the density of under growth in forest area.

1.6.2 Edaphic Factors

The edaphic factors explain the structure and chemical composition of soil along with its physical and chemical properties. The characterstics of soil, which influence the ecological characters of the soil and vegetation, are called edaphic factor. Hence edaphic factors are soil factors which are characterstics to a particular type of soil, soil is an abiotic factors, and forms a suitable substratum for plants and animals edaphic factors are those which are dependent on the soil as such on soil constitution, soil water, soil air, soil organism, and so on soil is defined as the unconsolidated fated superficial layer of earth's crust lying below any aerial vegetation and on composed dead organic remains and extending down to the limits to which it affects the plants growing about its surface.

IMPORTANCE OF SOIL :

Plants depends upon soil for anchorage, water and mineral nutrient supply even in aquatic habit, the soil act as a reservoir for mineral nutrients these nutrients dissolve in water and become available to the water plants. Soil affect the germination growth flowering development of roots and other organs.

COMPOSITION OF SOIL :

Soil serves as a neutral medium for the growth of plants. The soil system is not only chemical and geological but also biological and physical. The fertile soil consists of major components they are

1. Mineral Matter
2. Humus (or) Organic Matter
3. Soil Water
4. Soil Air
5. Biological System

The soil is composed of about half solids and half spore space. The soil space consist of mineral material and organic matter which 45% and 5% respectively of the total soil volume.

A. MINERAL MATERAILS :

The soil consist of various minerals or nutrients, when are inorganic by nature. These nutrients are very essential for normal growth and development.

a) Macro nutrients – C, H, O, P, N, K, Mg, G, S, Ca

b) Micro nutrients – Cu,Fe, Mo, Mn, Bo, C1

Both macro elements and trace elements are required in large quantities and these are obtained from various sources. Through photosynthesis element like C, H, O build UP higher molecules like carbohydrates.

B. Soil Water :

Soil water is a dissolved solution of organic and inorganic compounds. Soil solution is the source of mineral nutrients for the plants. This includes all the dissolved liquids. Soilds and gases within it water held in the soil is found in the following forms.

1. Gravitation
2. Capillary water
3. Hygroscopic water
4. Water vapor
5. Combined water

Gravitation Water :

This type of soil water that moves downwards through a moist soil in response to gravity. It is thus removed from the soil by gravity alone. Free water move downwards through the pore space between soil particles and accumulated in the pore space in the form of ground water.

Combined Water :

Water of chemical compound is called combined water. This is the form of water present as hydrated oxides of aluminum, iron, silicon, etc in the soil.

Hygroscopic Water :

Soil particles retain some water. So tenaciously that the plants cannot absorb it. It is called hygroscopic water. The water is held tightly around the particles as a result of cohesive and adhesive forces and it cannot be easily removed by the plants.

Capillary Water :

Due to the surface tension, water moves from one place to another when the gravitational ground water is drained what remain is capillary water.

The total amount of water present in the soil is called holard. The amount of water that can be absorbed by plants roots is called chresard. The amount of water that cannot be absorbed by plants roots is called echard.

Soil Air :

When respiration of roots and microorganisms, Co_2 released, in well aerated soils Co_2 is freely exchanged with are above the soil. Soil air differ from atmospheric air in having more of moisture and less of O_2. The soil air consist of four main gases. (Table – 1)

TABLE 1

	Soil Air	**Atmospheric Air**
1. O_2	20%	21%
2. N_2	78.6%	78.03%
3. Co_2	0.5%	0.03%
4. Ar	0.9%	0.94%

Organic Matter :

The organic matter includes dead and decayed of plants and animals. The decayed organic matter otherwise called humus. Humus black in colours and it occupies nearly 10% of the total soil.

Soil Structure or soil Profile :

The vertical section of the earth's crust shows different layers or horizons. Each of the horizons vary in thickness texture, structure, colours etc., But generally four horizons present in soil.

1. Organic O horizons
2. Mineral A horizons
3. Mineral B horizons
4. Mineral C horizons

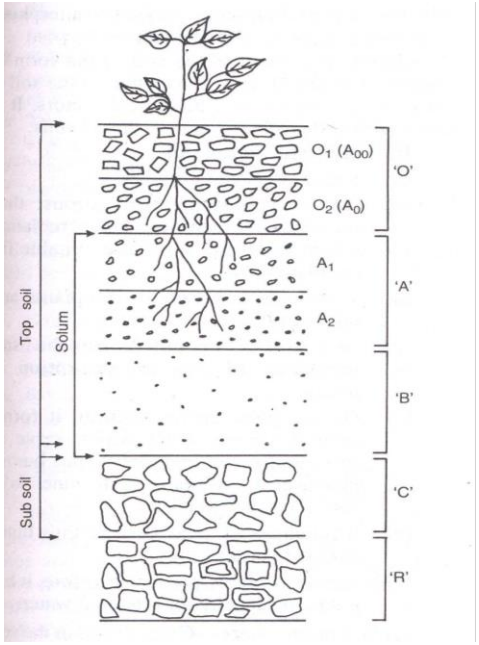

Fig : 1 Hypothetical diagram of the soil profile showing different horizons

Mineral A and B horizons form soil. The R horizons at the bottom is the consolidated bedrock further subdivided.

Profile of soil : (Fig : 1)

Organic horizon is the surface layer above the mineral layers and composed of fresh or partially decomposed organic matter. Life is more abundant in this region. Carbon is also present O horizons sub divided into 0_1, 0_2.

0_1 is the upper most layer. It consists of dead leaves, branches, flowers, fruits and seed remains of animals. Below the 0_1 region is the O_2 layer present. Decomposition process start in this region microbes like bacteria, fungi actinomycetes are found in this region. Mineral horizons are three type – A, B, C.

A-horizons. The A-horizons sub divided into A_1, A_2, A_3.

A_1 is the region where the organic matter is very much. This dark or brown coloured, amorphous organic matter mites mineral matter.

A_2 is the region where the mineral particles are larger in size and number with small amounts of organic matter. Due to heavy rainfall this mixture gradually into a light colour.

B horizons :

It is also known as sub soil. It consist of clay, iron, aluminum and humus B horizons sub divided into B_1, B_2.

C - horizons :

It lies between the B and R region. It comprises of weathered materials known as regoliths, which are light coloured.

R – horizons :

It is the consolidated bedrock.

Morphology of soil :

Soil has various texture structure colour.

Colour of soil :

The colour of soil based on the parental rock. The soil forming process is known as litho chromic this colour is genetic colours. The colour is sometime responsible for the function of a soil. Colour also helps in identification of the various soil types.

TABLE – II

Soil Type		Composition
Sandy soils	-	Chiefly sand
Loam soils	-	Sand, Silt and clay in equal
Clayey soils	-	Chiefly clay
Sandy Loam soils	-	Sand prominent
Silt Loam soils	-	Silt Prominent
Clayey Loam soil	-	Clay Prominent

The nature of soil and their corresponding vegetation are given below.

TABLE - III

Sandy Soil	Psamo Phytes
Rock Soil	Litho Phytes
Humus Soil	Oxylo Phytes
Cold Soil	Psychrophytes
Desert Soil	Cremophytes

Soils of rock crevices	Chasmophytes

Texture of Soil : (Table – II & III)

The texture of a soil is determine by the formation of different sized soil particles. The gravel consists of coarse particles larger than 2.0 mm sand and ranges from 0.02 to 2.0 mm in diameter silt consists of particles from 0.0002 to 0.02 mm in diameter. The clay particles are ranged below 0.002 mm in diameter and are colloidal in nature.

Physical properties of soil :

The average density of soil is 2.65 gms / ml. it may differ from place to place due to the process of weathering. Micro pore spaces are also called capillary pore spaces. They hold lost of water and restrict the free movement of water and air. Macro pore spaces are non – capillary. The hold little water and allow free movement of water air.

Heat absorption varies between the difference soil. Black soil absorb more heat than white soils.

Chemical properties of soil :

Soil consists of different – chemical compounds namely organic matter and inorganic elements. Soil has major organic matter is humus. It contains proteins, amino acids, purines, pyrimidines, hexose, sugars, aromatic compound fats, alcohol, waxes, oils, tannions etc., and major compound of inorganic compound in the soil are Ca, Mg, k, Al, Si, Fe and Na and some minor constituents of inorganic compounds are B – Mn, Cu, Zn, Mo, Co, I. the soil pH are neutral some are acidic and some are basic so. The pH value of soil normally ranges between 2.2 and 9.6.

1.6.4. Biotic Factors

All the living organisms inter related among some activities. In all ecosystems plants. Animals micro organisms are living together that inter relation may influence the vegetation directly or indirectly. Such factor are known as Biotic factors. Any activity of the living organism which may cause marked effects upon vegetation in any way is referred to as biotic effect. The biotic effect may be both direct and indirect. It may be beneficial . for the plants in some respects but determinal in other respects.

The various influences of living organisms which affects the vegetation and the environmental conditions directly and indirectly are called biotic factors. The relationship among may plants, animals, bacteria, fungi algae, viruses, nematode and micro organisms.

The various interaction between living organisms have been explained below there head lines.

I. Interaction between the plants and animals and man.

II. Interaction between the plants growing in a community.

III. Interaction between the plant and microorganisms so in

I. Interaction between the plants and animals and man :

These can be classified following heads.

1. Role of animals in the pollination.
2. Role of animals in the dispersal of seed and fruit.
3. Insects and carnivorus plant.
4. Effect of human activities on vegetation.
5. Effect of grazing and browsing by animals.
6. Myremcophily.
7. Miscellaneous effects.

1. Role of animals in the dispersal of seeds and fruits.

Many animals like a monkeys, birds and some other act as agent for dispersal of seeds and fruits they play a significant role in migration of plants. The seeds of many plants are very hard. Fruits of some plants have special adaptations such as spine hairs, hooks, glandular hair etc., for their dispersal these structure help the fruits to cling on animals or birds. The seed dropped some where when the animals clean their body. They animals participate in the dispersal of seeds and fruits Eg. Aegle, Opuntia, Andropogon , Plumbago, Texanthium.

2. Role of animal in the pollination :

In majority of plants pollination takes place through the agency of insects.. birds and many other animals cross, pollination in carried out by insects, birds, animals, the plants have attractive flowers honey sweet scent and edible pollengrins to attract the animals for pollination. The flowers which are called entomophilious flowers. Eg. Ficus, Calotropis, "R-F Davbenmire says that extreme specialization is as dangerous in connection with pollination as with other function in the biological word for not only must the range of two symbionts coincide but also the extinction of the one heralds the doom of the other". Some cross pollination family, Rosaceae, Euphorbiaceous, Asteraceae, Rutaceae.

3. Effects of browsing and grazing by animals :

The eating of grases herbaceous plants by domestic as well as wild animals is called grazing. Eg eating of grasses by cows, buffaloes, goats etc., on

the other hand browsing is the eating of foliage of large shrubs and trees by animals Eg. Eating of foliage by giraffes camels, elephants, grazing and browsing educing cause damages to vegetation but the controlled grazing in help for to improve the quality of desired plants in forest. Heavy uncontrolled grazing and browsing have the following harmful effects.

- The seedlings of desired species have been eaten by grazing animals.
- The seedling of desired plants have been destroyed by the feed of grazing and browsing animals.
- Grazing and browsing reduce the photosynthetic organs of plant.
- Grazing reduces the density of ground flora so that the soil becomes susceptible to erosion.
- It affects the aeration of the soil adversely as a result the soil becomes compact and hard.

4. Insects and Carnivorous Plants :

Insectivorous plants like Prosera, Dionaea, Bladder wort etc, grow in places where there is deficiency of nitrogen compounds various parts of their body is modified into pitches these plants have some specialized organs and mechanisms for trapping and assimilating the preys. In utricularia also bladders are present the bladders catch and digest small aquatic animals.

5. Effect and human activity on vegetation :

Man affects vegetation in the following ways A. By cutting felling and replanting the forest tress B. By cultivation.

B. By cultivation.

Besides the old methods of cultivation man has adopted a number of advanced methods for cultivation of plants. Cutting, budding, grafting and other methods used by man are proved beneficial for certain plants. Now breeding technology is advanced.

C. By Fire :

Fire caused by mans activity are responsible for complete destruction of vegetation et certain places resulting in temporary or permanent alterrations in the characters of vegetation D. Man also clears the vegetation for making houses rods etc.,

6. Myremecophily :

An association which ants are living on plants by getting food and shelter from them is celled myremecophily. Some times ants take their abode or shelter on some trees such as mango, litchi, Acacia and so on. these ants acts a body guards of the plants against any disturbing agent.

7. Miscellaneous Effects :

The animals also affect the plant life in many other ways. Some animals as for eg bark eater, rodents, may kill a large number of trees. juice sucking, insects, wood peckers but eating birds, sparrow, squirrel and other animals caves great harm to the vegetation elephants detach the branches of the trees and some time uproot the gigantic trees. Fishes, docks, and other aquatic animals depend upon aquatic plants for food and shelter.

2. Interaction between plant growing in a community :

Various plants in a community react with one another in several way for.

(i) Water (l) essential soil minerals and organic compounds.

Interactions among plants growing in a community are as follows :

1. Action of lianas
2. Epiphytic relationship
3. Parasitic relationship

i) The Action of lianas:

lianas are woody climbers which stand erect with the help of supporting plants found near to them. They twine round the trunk of the supporting trees, and keep their crown at the level of canopy or over the canopy to get enough light. Even though, lianas are autotrophic in their nutrition, their growth is highly harmful to forest trees.

Example :

Bauhinia Wahl, Michelia, Combretam Aecandrum, Naravelia, Tinospora etc., are some common lianas found in forest areas.

ii). Epiphytic Relationship :

Epiphytes are commonly seen on trees and shrubs. Unlike parasitic plants, they derive nutrients from rain water or from the atmospheric moisture and synthesis their food with the help of sunlight. Some times they derive nutrients from the bark of the supporting plants also. Epiphytes have two types of roots – aerial roots and clinging roots. The aerial roots possess water storage tissue called velamen so that they preserve enough water for future use. The aerial roots are other wise called velaman roots. The clinging roots on the other hand, finely fix the epiphyte on the supporting plant. epiphytes are more common in wet tropical forests, and they are fewer in dry and cold areas.

Example :

Orchidaceae, Asclepiadaceae, Bromeliaceae etc., Dischidia, Tillandsia are most common examples.

iii). Effects of Parasitic Plants :

some plants are heterotrophic and are dependent on other plants for their food requirements. They are called parasites. These are of the following two types.

i. Ectoparasites (external); and

ii. Endoparasites (internal)

The endoparasites are more destructive than the ectoparasites. Because the parasites take their food from host plants, they check the growth and ultimately cause the death of their hosts.

Cuscuta, Loranthus, Rafflesia, and sandal wood (Santalum album) are important parasitic angionsperms which may grow either on roots or on stems and sometime even on the leaves of the higher plants. The parasites may be either obligate or facultative.

Cuscuta is an obligate stem parasite on acacia, Zizyphus and a number of other angiospermic plants.

3. Interrelationship Between plants and micro organisms

Micro organisms such as bacteria fungi, Virus, algae, worms etc., house some marked influence on plants life. Some of then increase the fertility of the soil while some other directly favour the growth of the plants and there by encourage the plant growth.

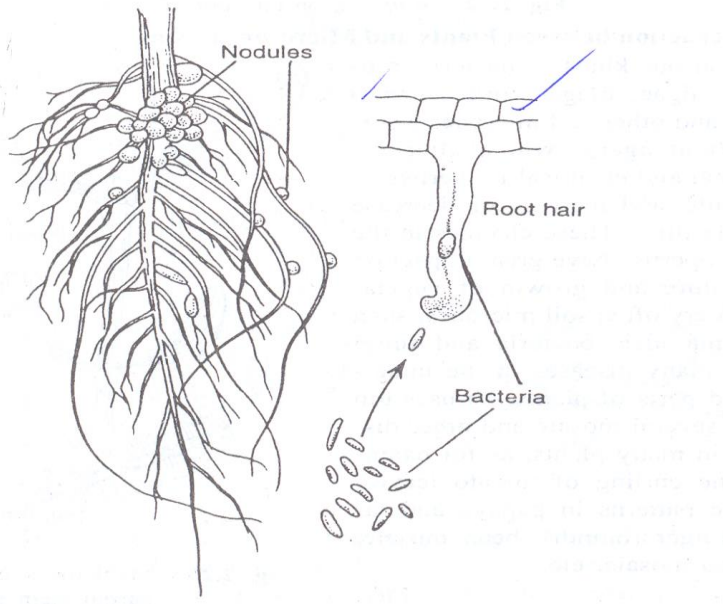

Fig : 1.1 A Nodulated root, soil bacteria and infected root hair

Symbiosis :

Some soil microses live in close association with plants both benefiting from each other. In this association both organisms are inter dependent and they do not harm each other. This mutual relationship between two organisms is known as symbiosis and the interdependent organisms are called symbionts.

Symbiotic Nitrogen Fixation : (Fig : 1.1)

Several species of bacteria are known to have symbiotic association with the roots of leguminous plants. They are called symbiotic Nitrogen fixation. They nodulated roots of legumes nitrifying bacteria (Rhizobium). These bacteria fix atmospheric nitrogen into nitrogenous. Compound and benefit the legumes by supplying nitrogenous, compounds in usable form. Nostoc, Anabaena living symbioticcally in the coralloid roots of cycas also fix atmospheric nitrogen.

Lichens also show symbiosis. There are symbiotic plants in which algae and fungi live symbiotically. Mostly the algal component belongs to Myxophyceae and fungal component of Ascomycetes and Basidiomycetes form. The association of some fungi and the roots of some higher plants is called mycorrhizal association. Fungal lives on the surface of roots of higher plants. It is called ectotrophic mycorrhiza. Fungal penetrates the deeper tissues of the roots and rhizomes.

Self Assesment Questions: I

1. The term Ecology was coined by_____
2. The atmosphere contain_____% of Nitrogen
3. The Study of sandy soil is Called as_____

Self Assesment Questions: II

1. Mesotherm Means _____
2. Soil air _____%
3. Fungi and Algae living together is called_____

Unit Questions :

1. Write explanation of Temperature.
2. Brief notes on Edaphic Factors.
3. Definition of synecology and Autecology

Answer of self Assesment Questions : I

1. Reiter (1885)
2. 78.08%
3. Psamophytes.

Answer of self Assesment Questions : II

1. Low temperate Plant
2. 25 to 30%
3. Mycorriza

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UNIT II

ECOSYSTEM, COMPONENTS OF ECOSYSTEM

UNIT STRUCTURE

ECOSYSTEM

UNIT – II

2.0 Introduction :

The term "Ecosystem" was first coined by A.G. Tansley (1935). The living organisms and non living environment are inseparably inter-related and also interact with each other. The system resulting from the integration of all the living (Biotic) and non living (Abiotic) factors of the environment. The term "Biocoenosis" was coined by kari mobius and is a synonym for the ecosystem. It is a segment of nature consisting of a community of living beings and A biotic environment both interacting and exchanging materials between them. The ecological system or ecosystem comprises specific units of organisms occupying a given area thereby producing trophic structure, biotic diversity and material cycles.

2.1 Definition of Ecosystem :

The word derived from "Eco" - Meaning environment and "System" implying interacting and interdependent complex. The Ecosystem can be defined as any unit, comprising all the organisms (ie., Communities) in a given area interacting with the physical environment resulting in the flow of energy , biotic diversity as well as mineral cycle.

According to E.P odum (1963) organisms and physical Features of the habitat from an ecological complex (or) ecosystem. Thus ecosystem is the basic functional unit of ecology embracing biotic communities and abiotic environment both influencing each other. Every ecosystem encompasses interacting organisms that transform and transmit energy and chemicals. These energy and chemical flow processes support ecosystem organization and are responsible for the functional indentities of ecosystem. The ultimate source of energy for all ecosystem is the sun.

2.2 Structure and Function of Ecosystem :

The structure of an ecosystem is basically a description of the organisms and physical features of environment including the amount and distribution of nutrients in a particular habitat. It also provides information regarding the range of climatic condition prevailing in the area. Form the structure point of view , all ecosystem consist of two basic components. The quantity and distribution of the non living materials e.g. nutrients, water, gases…, The range or gradients of condition of existence e.g. Temperature light function dynamics based on rate at materials or nutrients cycling and Biological control, including both regulation of organism by environment.

Ecosystem and organisms are open thermodynamics systems without equilibrium that exchange energy and matter with the environment continuously to decrease internal but increase external entropy.

2.3 Components of Ecosystem :

All the ecosystems, terrestrial or aquatic from a purely functional point of view have the following two basic components.

2.3.1 Biotic Components

2.3.2. A Biotic Components

Biotic Components :

These are represent trophic (nutritional)structure of any ecosystem where organisms are distinguish on the basis of their nutritional relationships. It include the living organisms of the Components. E.g. plants, animals, bacteria, viruses etc.,

It includes the following :

1. Producers
2. Consumers
3. Decomposers

A Biotic Components :

The term abiotic means nonliving. Thus there components refer to nonliving elements or factors present in the ecosystem. Ecological relationships are manifested in physico – Chemical environment. The biotic factors of the ecosystem depends on the a biotic factors for their survival. It include the following component.

i. In organic substance :

It include inorganic substance like C, N,P, H_2O, H, S, etc.. which are involved in the mineral cycle.

ii. Organic Compounds :

It includes carbohydrates, fats, Proteins which link the biotic and abiotic components. They are formed by decomposition of dead – plants and animals.

iii. Climatic regime :

Solar radiation temperature, and other physical factors making the climate to the given region. Light energy forms the main non living component for the growth of photosynthetic organism.

Biotic component :

i. Autotrophic Component

ii. Heterotrophic Component

Autotrophic Component : or (Producers)

The autotrophic component fixes the radiant energy of sun and manufactures food from simple inorganic substances. It includes only green plants and photosynthetic bacteria members of autotrophic components are also known as producers since they produce organic matter like, H_20, CO_2, and sunlight energy.

Heterotrophic Components : or (Consumers)

The generalized equation at photosynthesis $6CO_2 + 12\ H_2O$ 2800kj energy $C_6\ H_{12}\ O_6 + O_2 + 6H_2O$ chl

The heterotrophic component takes food from autotrophic rearranges it and finally decomposes the complex organic materials into simple inorganic forms. The organisms which fall under his category is also known as consumers since they consumers the organic matter produced by the producers. The consumers are of two types. These are fungi most of bacteria and animals. They have lack of chlorophyll.

1. Macro Consumers : (or) Phagotrophs

In this category are included heterotrophic organisms mainly animals which eat or ingest other organisms or particular organic matter. In a food chain, the consumers include primary consumers or herbivores eating plants and secondary consumer or carnivores and omnivores eating animals tissues. There can be further tertiary consumers depending on the food chain. These denotes orderly placed animals – such as herbivores (Primary consumers) pattern of food chain.

Micro Consumers :

Microscopic bacteria and actinomycetes fungi are included in this category. These are known as decomposers as they are capable of decomposing the dead organic matter. Which decompose the complex compounds of dead protoplasm and absorb some of the decomposed products. During this, they release inorganic nutrients, which are taken by producers the materials are then attacked by trans formers another type of bacterium that change the inorganic compounds into forms plants. So that these substance can be reutilized by the primary producers. Organisms which are not capable of under going photosynthetic process are called consumers. Consumers are organisms which eat other organisms. The consumers are further divided into three category.

A. Primary Consumers :

A herbivores is a primary consumers that derives its nutrition directly from plants. Elton referred the herbivores as Key industry animals. Ex : Garsshopper, Rabbit, Goat.

B. Secondary Consumers :

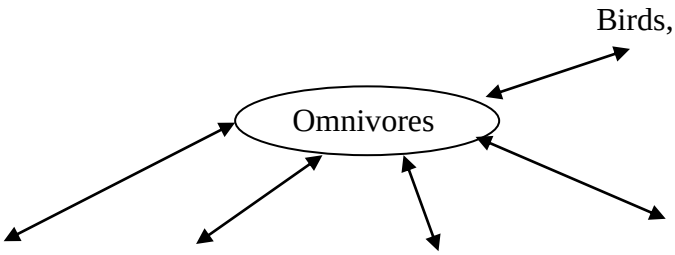
They kill and eat the herbivores. They are also called carnivores. As these carnivores directly depend on herbivores they specially called primary carnivores . Ex : Fox, Wart, Snake.

C. Tertiary Consumers :

Tertiary consumers are carnivores that feed on other carnivores Ex. Lion, Tiger.

D. Omnivores :

Some consumers kill and eat producers and consumers. They are often called omnivores. (or) Multilevel consumers. Ex. Birds, Human beings.



Producers – Herbivores – Carnivores - Top Carnivores

Primary Consumer Secondary Consumer Tertiary Consumer

Ex. Cattle Ex. Snake, Fox Ex. Lion, Tiger

A. Scavengers :

A special type of consumption is that of scavengers, who feed upon dead and decaying plants and animals matter, Vultures, sea gulls and even eagles consume extensively on animals that have died of other causes.

Decomposers :

If the world only had producers and consumers. It would not work very well because the flow of matter would be in oxy one direction, that is, from lower to higher order compounds. Something needs to return these compounds to more elements forms so that they can be recycled and used over again in the food chain. This process requires a group of organisms known as decomposers.

Bacteria and fungi play this role an important role in decomposition on mechanism Bacteria generally act on animal tissue and fungi on plant tissue. Plant and animal materials is degraded enzymatically and released as basic

elements into the environment, where the elements are again available to the producers for reuse.

Some organic matter, such as sugars, lipids and proteins are decomposed rapidly where as others such as, cellulose , lignin, hair bones are decomposed slowly. Aerobic respiration is essentially an oxidative process as represent below.

$C_6H_{12}O_6 + 6O_2$ ----------$6Co_2 + 6H_20$ + Energy.

2.4 Ecological Niches

The term 'niche' whose dictionary meaning is a place, employment or activity for which a person is best fitted should never be confused with habit. The term niche was for the first time used by Grinnel (1917) to explain micro – habitats. According of him 'niche' is the ultimate distributional unit, within which each species is held by its structural and instinctive limitations no two species in the same general territory can occupy for long identically the same ecological niche. The concept of ecological niche is of much significance in ecology in terms of differences between species at same physical place or at different places or the same species at more than one location. Species concept is thus considered mainly on the basis of functional rather than its taxonomic features, E.P. odum defined the term niche function or profession of organism is called niche.

The grasses living is temperate regions of Australia are largely different from those of a similar climatic region of north America. But they do the same function as primary producers in the ecosystem. These three aspects of ecological niche are generally designated as

1. The spatial or habitat niche.
2. The trophic niche
3. The multidimensional or hyper volume niche.

1. Spatial or habitat niche :

It concerns with the physical space occupied by as organisms good example of spatial niche is provided by the three species of fungi colonizing the decaying culms of a fodder grass, setaria glauca. These all fungi live in the same general habitat, the decaying internodes, and they all belong to the same trophic level. ie decomposers, but each of two three species is more frequent and extensive, with higher intensity of fritting on the upper internodes of the grass. This upper and lower internodes of the grass, due to difference in their morpho anatomical characteristic appear to have two distinct microhabitats. Thus one should find the species very easily on the upper internodes.

2. Trophic niche :

It is concerned with the trophic position of an organism. There are several interesting example that explain the concept of trophic niche and one of such cases is the occurrence of various species of birds in Galapagos islands in south America. The various birds belong to 3 Genera viz. Geospiza (ground finches) camarhynchus (tree finches) and certhidia warbler finches). These all live in same general habitat but differ in terms of their trophic positions. And the two quatic bugs, Notonecta and Corixa live in the same habitat inpond. But occupy different trophic niches.

2.5 Food chains :

Simple and linear relationship between the producer and consumer of different trophic level is called food chain. In this case the food energy moves from green plant to the top carnivores in one linear direction. In each transfer energy is lost.

E.g. Grass gives food to grasshopper which are eaten by frog and frogs are eaten by snake.

Grass ⟶ Grasshopper ⟶ frogs ⟶ snake.

It is of 3 types :

1. Predator Chain :

Start from producers (green Plant) through herbivores and to the carnivores e.g

Green Plant ⟶ Rabbit ⟶ Jackal ⟶ Tiger

1. Parasitic Chain :

Parasitic chain starting from larger animals and goes to smaller animals. e.g

E.g :

Human being ⟶ Helminthes ⟶ Bacteria ⟶ Crop plant ⟶ Hyper parasite

1. Saprophytic Chain :

Start from organic materials and goes from micro – organisms E.g.

Dead organic matter ⟶ Decomposers ⟶ $Co_2 + H_20$

(Bacteria Fungi)

Notonecta is an active predator, whereas corixa feeds largely on decaying vegetation.

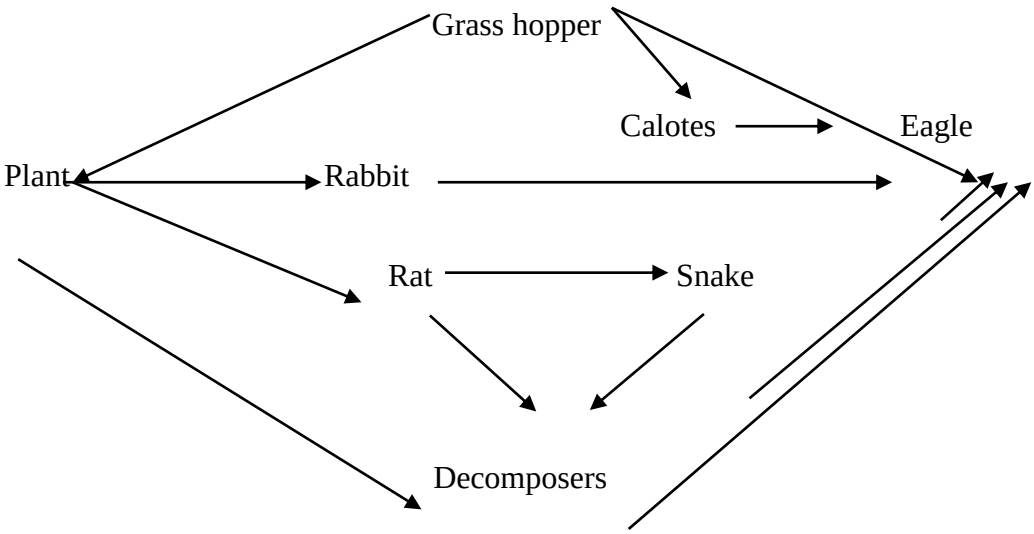
1.0 Multifactor or Hyper volume niche :

This concept where is considered as on abstract n-dimensional inhabitated hyper volume was developed by G.E. Hutchinson (1965).

In 1957 a G.E. Hutchinson1957 suggested that the niche could be visualized as a multidimensional space or hyper volume within which the environment permits an individual or species to survive indefinitely. Hunchinsons niche, which we can designate as the multidimensional or hyper volume niche, is an able to measurement and mathematical manipulation . "the climatic niche" of a species of bird and fruit fly cloud be expanded as a series of coordinates to include other environmental dimension. Hutchinson has also made a distinction between the fundamental niche – " the maximum abstractly in habited hypervolume when the species is not constrained by competition with others – and realized niche – a smaller hyper volume occupied under biotic constraints.

A grass land Ecosystem is taken as an example in this ecosystem the food chain start from grasses and goes through the grasshopper, calottes, snake, and the eagle or hawk in an orderly sequence.

Food chain in grass land ecosystem



2.6 Food Web :

Individual food chains interconnect to form a food web. In any ecosystem no organisms is fully dependent on only one source. The linear arrangement of food chains interconnected with each other through different types of organisms at the different trophic levels. In this case feeding relationship between producers and consumers of different level is called food web. Food web maintains the stability of the ecosystem. The greater the

number of alternative pathways the more stable is the community of living things.

In a grassland ecosystem, grass is eaten by grasshopper rabbit and mouse. Grasshopper is eaten by hawk or lizard, which is eaten by hawk. Rabbit is eaters by hawk mouse is eaten by snake which may be eaten by hawk. Besides these hawk also eats grass hopper and mouse. Thus there are five linear food chins which are inter connected to form a food web.

1. Grass → Grass hopper → Hawk
2. Grass → Grass hopper → Lizard → Hawk
3. Grass → Rabbit → Hawk
4. Grass → Mouse → Hawk
5. Grass → Mouse → Snake → Hawk

The nature of food web also differ, from one grassland to another one. It also differ from season to season.

2.7 Ecological pyramids :

The trophic structure and function at successive trophic level form the ecological pyramids. The interrelation between numbers, biomass and energy contents of consumers of the first order, second order and upto the top carnivores in any ecosystem is represented in diagramatic ways. They are called as ecological pyramids. The idea of ecological pyramids was advanced by C.E.Elton (1927). At each step in the food chain a considerable portion of the potential energy is lost as head. As a result organisms in each trophic level pass on lesser energy to the next trophic level than they actually receive. There are three possible kinds of pyraminds given below.

Trophic Level :

The food chain in any ecosystem can not be more than five stage Elton (1947). All the organisms with similar feeding habitats in food chain have been grouped together as trophic level. the graphic representation of trophic level is,

Producer Herbivores Carnivores Top carnivores De composer

T1 T2 T3 T4 T5

The number of organism at T_1 is always higher than that of T_2, T_3, T_4 level at least.

1. Pyramid of number
2. Pyramid of biomass
3. Pyramid of energy

2.7.1 Pyramid of Number :

It deals relationship between the no.of primary production and consumers at different trophic level. The base of pyramid is represented by producers which are the most abundant and in the successive level of consumers, the number of organisms goes on decreasing rapidly until there are a few carnivores. The pyramid of numbers an ecosystem indicates that the producers are ingested in large numbers by smaller numbers of primary consumer. (Fig : 2.0)

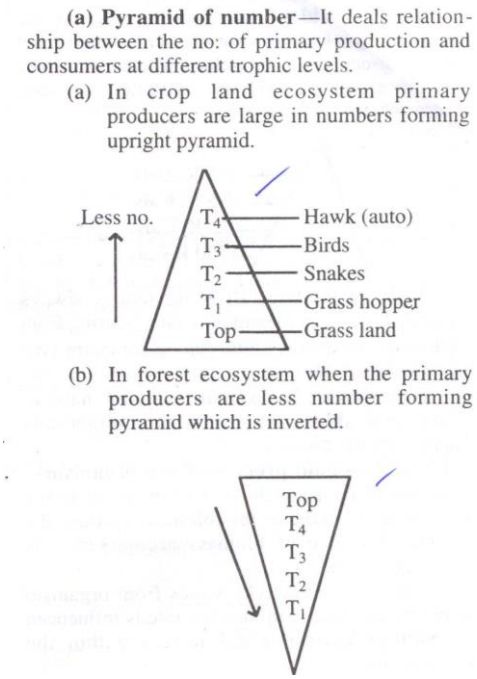


Fig : 2.0 Pyramid of Number

Grassland Ecosystem :

In the grassland ecosystem the wide base of the pyramid represents the large number of primary producers. The primary consumers like the rabbit and the grasshopper from the second large number. The top carnivore like the tiger is present in the least number and occupy the peak of the pyramid so in this way the number are represented in a diagramatic way and an upright pyramid is formed.

6. Forest Ecosystem :

In forest ecosystem when the primary producers are less forming pyramid which is inverted.

2.7.2 Pyramids of Biomass :

Biomass is the total dry weight of organisms in an area. A pyramid of biomass in takes to account size or weight. Biomass is the amount of living organisms and living matter present in a particular ecosystem. Pyramid of biomass indicates the decrease of biomass in each trophic level from base to apex. e.x total biomass of producers consumed by herbivores is more than the total biomass of the herbivores. Like wise the total biomass of secondary consumers will be lesser than that of herbivores and so. On since some energy and material are lost in each successive link the mass supported at each level is limited by the rate at which the energy is being stored below.

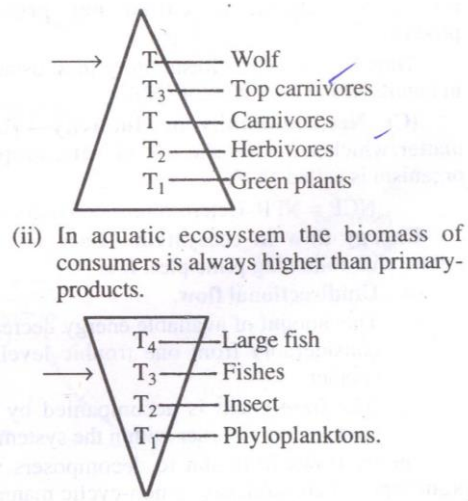


Fig : 2.1 Pyramid of biomass

Pyramid of biomass of terrestrial ecosystem (Fig : 2.1)

In terrestrial ecosystem, the biomass of all the primary producers is always maximum and top carnivores have minimum. The bottom pyramids green plants occupied. The pyramid is upright.

Pyramid of biomass of aquatic ecosystem :

In aquatic ecosystem the biomass of consumers is always higher than primary product the aquatic ecosystem shoos inverted.

2.7.3. Pyramid of Energy :

It represent the productivity of the system at each trophic level values of energy accumulation at each level per square meter per year are obtained for any ecosystem. If the trophic level is represented by a bar whose length is directly proportional to the number of kilocalories available from, food for

growth and development, the bars representing the different trophic levels, stacked in order form a steep sided energy pyramid.

In an ecosystem the primary producers trap the sunlight energy and convert into chemical energy through the unique process of photosynthesis. The energy traped in the food materials flow in the food chain from producers to the herbivores and then to carnivores and finally to top carnivores. Here energy flow is always unidirectional and at successive trophic levels is decrease. Therefore the pyramid of energy is always vertical (upright). Comparison of standing crop and energy flow pyramids for silver springs florida.(Fig : 2.2)

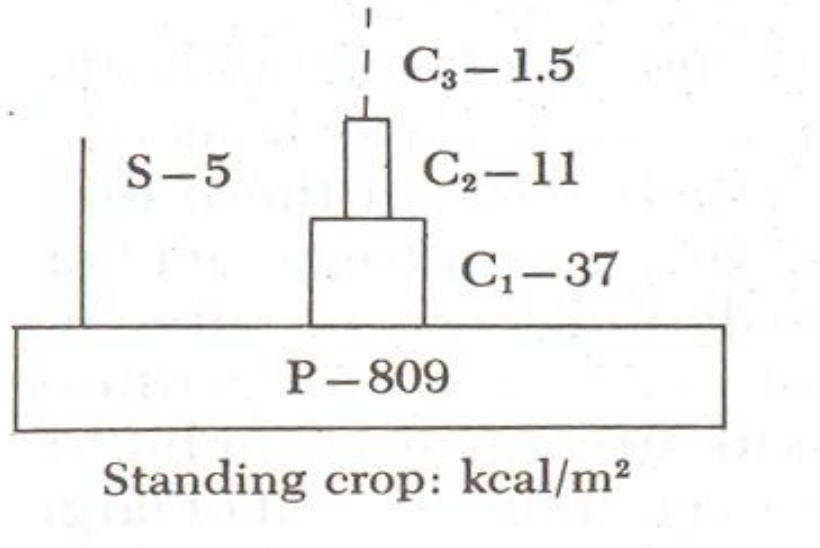


Fig : 2.2 Pyramid of Energy

P	-	Producers
C1	-	Primary Consumers
C2	-	Secondary Consumers
C3	-	Tertiary Consumers (Top Carnivores)
S	-	Saprotrophs (bacteria and fungi)

2.8 Pond Ecosystem

It is small aquatic ecosystem where water is stagnant characterized by relatively quiet water and abundant vegetation with thousands of micro organisms large plants and animals. Pond ecosystem are fresh water ecosystem in which other ecosystem there are of four types. (Fig : 2.3)

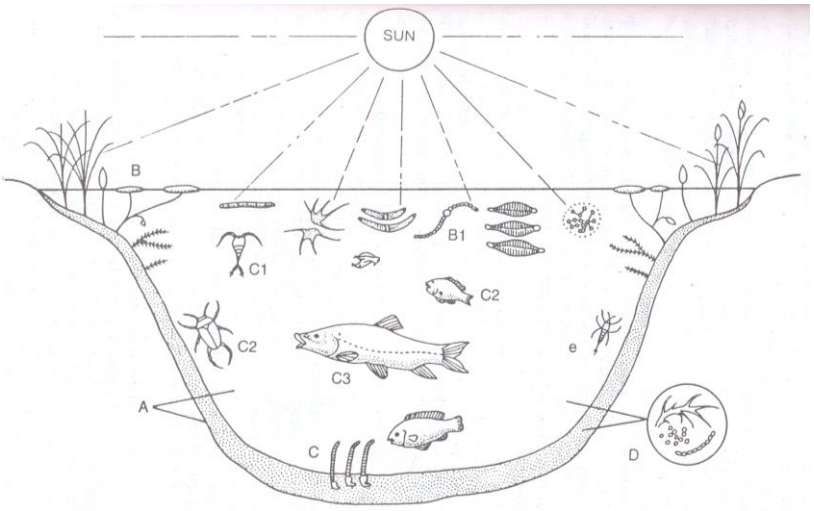


Fig : 2.3 A Pond Ecosystem

i . Flood Plain Ponds :

These are ponds, which are found in stream flood plains. These are quite productive habitats due to accumulation of organic matter in them.

ii. Temporary Ponds :

These ponds remain dry for most part of the year but support unique community. Organisms in such ponds must be able to survive in a dormant stage during dry periods.

iii. Artificial ponds :

These ponds are the result of damming stream or basin by man. They are artificially managed habitats.

iv. Beaver Ponds :

Ponds constructed by beavers (amphibious rodents) are called beaver ponds. The beaver often does not constrict pond but live in holes in the bank of streams and thus becomes essentially the stream animals. Such habitat are of two general types.

1.0 Standing water or Lentic such as pond, lake, bog swamp.

2.0 Running water or Lotic such as, river stream, spring.

The component of pond ecosystem.

a. Abiotic Component :

the chief substance, of A biotic component are heat light. P^H value organic and inorganic compounds namely Carbon dioxide, Oxygen, Calcium, Nitrogen, Phosphates, Amino acids so on. A little portion of these compound

present in solution. Major portion of compound reserve bottom of the pond as sediments and also with in the body of organisms.

b. Biotic Component :

It includes following;

1. Producers
2. Consumers
3. Decomposers

1. Producers :

The main producers in pond ecosystem are algae. Es Diatoms, Oedogonium, Chlorella, Nostoc, Spirogyra, Chara and other hydrophytic plants such as Hydrilla, Lemna, Nymphaea, Pistia, Eichhornia. These are free floating or suspended or routed at the bottom. There producers convert the sunlight energy into chemical energy through photosynthesis. The chemical energy stored in the form of food utilized by all the organisms O_2 evolved during photosynthesis.

$6Co_2 + 6H_20$ ----------$C_6H_{12}\ O_6 + 6O_2$

2. Consumers :

The consumers in pond are distinguished a primary consumer, e.g. fish, zooplantons, secondary consumers, insect , fish, frog, snake and tertiary consumer large fish, water bird, etc., It is also called as phagotrophs.

3. Decomposers :

The fungi and bacteria are main decomposer of ecosystem other than, actinomycetes, some microbes. The dead organic substances looked up in the dead bodies or converted into simple organic compounds and element are utilized again by aquatic plants for their nutrition. Fungi and bacteria play role in the return of the mineral element again to the pont. It is also called saprotrophs.

2.9 Forest Ecosystem

Introduction :

In this ecosystem example for terrestrial ecosystem forest occupies roughly 49% of the total land. In India the forest occupies roughly about one - tenth of the total land area. Forest ecosystem having a dominance of trees that are interspersed with a large number of species of herb, shrubs, climbers, lichens, algal, and wild animals and bird, forest receive high rain fall and usually occurs as a stable climax community on the basis of geographical distribution and the type of plant living there forest are grouped in to different types 1. Tropical forest 2. Temperate forest 3. Alpine forest 4. Scrub forest

5. Subtropical forest 6. Deciduous forest 7. Coniferous forest and 8. Mangroves component of forest ecosystem.

1. Abiotic Factors :

The abiotic factors include soil moisture, air, sunlight, atmospheric humidity, rain fall and other physical factors. The organic and inorganic matter in the land and atmosphere are called abiotic components. These are based on the available age nutrients, dead organic matter and available sunlight static layer of vegetation formed. The soil is covered with thick layer of humus. The annual temperature 21 - 27^0C the annual rain fall 2000 to 3300 mm.

2. Biotic factors :

It includes following component.

a. Producers :

In a forest trees are the primary producers. The angiosperm and gymnosperm trees grow in different height. The vegetation is luxuriant.

Top Canop :

Tall trees liker Polyalthia, Calophyllum, Pinus Cerdus, Rhododendron.

Other Storeys :

Short trees like Cordia, Emblica, Murraya Calotropis.

Climbers :

Jasminum, Artabotrys, Tylophora.

Ground flora :

Selaginella, Ixora, Chara, Eichhornia

b. Consumers :

The macro organisms in different forest are well adapted for the conditions prevailing there. Foliage arthopods such as, ants flies, beetles, leaf hopper bugs, spiders, moles fruit fly, mongooses are also present and the to carnivores like Lion, Tiger, Leopard.

D. De composers :

The decomposers of the forest ecosystem are bacteria and fungi. These organisms obtain energy to carry on their life function by breaking down the organic compounds of dead organic matter and organic waste. In doing so the prevent the accumulation of organic matter and also release the essential minerals mostly found in soil for reuse. Decomposers are mostly found in soil and heterotrophic bacteria are found enormously. Eg. Fungi – Polyporus, Aspergillus, Fusariun, Trichoderma, Bacteria – Pseudomonas, Bacillus, Clostridium and Actinomycetes like species streptomycies etc.,

Self Assesment Questions - I

1. A group of interconnected food chains is called as
2. In which of the following pyramids the shape is always upright?

   A. Pyramid of biomass B. Pyramid of Energy

   C. Pyramid of Number C. None of the Pore Pared
3. The first pyramid diagrams were prepared by_____

Self Assesment Questions: II

1. Give an example of number of pyramid_____
2. Describe forest and pond Ecosystem_____
3. Example of secondary consumers _____

Unit Questions :

1. Discuss about the Ecological niches
2. Brief account on food chain and food web
3. Explain the types of pyramids
4. Definition of Ecosystem

Answer of self Assesment Question : I

1.Food web

2. B. Pyramid of Energy

3. Elton

Answer of self Assesment Question : II

1. Lake ecosystem

3. Cow, Fox, Snakes

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UNIT – III

PLANT SUCCESSION AND ADAPTATION

Introduction

Definition

Basic Concepts of Succession

Patterns of Succession

Hydrosere

Xerosere

Plant Adaptation

Introduction of Plant Adaptation

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Xerophytic Adaptation

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Mesophytic Adaptation

Halophytes

Halophytic Adaptation

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References

Self Assesment Questions: I

Self Assesment Questions: II

Answer of self Assesment Questions : I

Answer of self Assesment Questions : II

Unit Questions :

References

UNIT – III

PLANT SUCCESSION

3.0 Introduction :

A Community or biocenose is an aggregate of organisms which form a distnict ecological unit. Such a unit May be defined in terms of floras, fauna, or both community units may be very small like the community of invertebrates and fungi in a decaying log. A different community occurs in each different habitat and environmental unit of larger size, and in fact the composition and character of the community is an excellent indicator of the type of environment that is present. Since plants and animals, bacteria and fingi all occurs together in the same habitat and have many, they can scarcely be considered independely of each other communities are not stable, but dynamic, changing more or less regularly over time and space. They are never found permanently in complete balance with their component species or with the physical environment. Environment always keep on changing over a period of time due to

i. Variation in climatic and physiographic factors and.

ii. The activating of the species of the communities themselves.

3.1 Definition :

Clements (1916) defined the succession as the natural process by which the same locality becomes successively colonized by different groups or communities of plants.

E.P.Odem (1971) defined it as An orderly process of community change in a unit area.

An orderly sequence of different communities over a period of time in some particular are.

Sere :

It is the sequence of developmental stages from pioneer to climax communities, e.g. litho sere or (rock), psamosere (on sand), hydrosere (in water), and xerosere plants grow on dry conditions.

3.2 Basic types of succession :

1. Primary Succession
2. Secondary Succession
3. Autogenic Succession
4. Allogenic Succession
5. Autotrophic Succession
6. Heterotrophic Succession

1. Primary Succession :

Primary Succession occurs on base life less substrate, such as rocks or in open water, where organisms gradually move in to an area and change its nature. On bare area mineral – poor soils, lichens grow first, forming small pockets of soil.

ii. Secondary Succession :

If a wooded area is cleared and left alone, plants will slowly reclaim the area. Eventually, traces of the clearing will disappear and the area will again be woods. This kind of succession, which occurs in area where an existing community has been disturbed, is called secondary succession. Humans are often responsible for initiating secondary succession.

iii. Autogenic Succession :

The succession taking place due to the influence of existing plant community it self, is known as autogenic succession.

iv. Allogenic succession :

In some cases, however, the replacement of the existing community is caused largely by any other external condition and not by the existing vegetation it self.

On the basis of successive changes in nutritional and every contents, successions are some times classified as.

v .Autotrophic succession:

Photosynthetic organisms form dominant communities during the early stages of succession, and in organic substance are rich in this area. This kind of succession is called autotrophic succession.

vi. Heterotrophic Succession :

Heterotrophic communities such as bacteria, fungi, actinomycetes, Protozoa and animals form dominant communities . Organic substances are rich in this area.

3.3 Patterns Of Succession

Depending upon the types of habitant and varying amount of moisture, the succession are designated as below

3.3.1. Hydro Sere

3.3.2. Xero Sere

3.3.1 Hydrosere

Plant succession occurring in the aquatic environment or starts on a wet area it is called hydro sere. It may be originating in a pond, starts with colonization of some phytoplankton's which ferns the pioneer community and

finally terminates into a forest climax community. The various stages of hydro sere can be enumerated as below.

1. Phytoplankton Stage :

Micro organisms like bacteria, blue green algae, diatoms first appear. In due course the number of these organisms increases. They constitute the pioneer community. The soils are very much reduced with a P^H value of not more than 5.00 death and decay of phytoplanktons, organic matter is added to the water.

2. Rooted Submerged Stage :

Most of the micro organisms perish away leaving humus along with the humus the dust particles and sand combine together forming clay due to the formation of clay at the substratum. Water depth at this stage is about 10 feet. As a result a soft mud is formed at the bottom of the pond. Hydrilla, Potamogeton and Najas form dense growth at bottom enriched with organic matter.

3. Rooted floating Stage :

The water depth at this stage is much reduced to 2 to 5 feet. In the shallower regions appear plants with tuberous rhizomatous and creeping stems and leaves floating on the surface of water. Humus rich bottom begins to rise making water shallower rooted floating hydrophytes like Nymphaea, Nelumbo, Pistia, Azolla, Wolffia, Lemna etc.,

4. Reed Swamp Stage :

The depth of water is very low 1to2 feet. In shallower water, amphibian plants are grow. They add more silt and humus at the bottom so that shoves built up. The plants of community are rooted but most parts of their shoots (assimilatory organs) remain exposed to air. Amphibious plants include scirpus, Typha, Sagittaria, Alisma, Phragmites etc.,

5. Sedge – Meadow Stage :

Due to the deficiency of water plants like, carex, cyperus and juncos start growing. There plants increase in number. They form a mat like vegetation towards the centre of the pond with the help of their much branched rhizomatous systems. There is rapid rate of loss of water due to their high rate of transpiration. As a result the soil gets dried up and nutrients like ammonia, sulphites and so on some common vegetation are Eleocarpus cymbopogan, Cyprus, Eriophorum, Juncus, Themeda, Cicuta, Gallium etc.,

6. Woodland Stage :

Due to high rate of transpiration by the plants and due to further lowering of water table, the soil becomes on favourable for the growth of the

grass like plants. Subsequently the terrestrial plants invade this area, some of them are shrubs. And other are woody plants ex. Populus, Aluns, Terminalia, Cephalanthus, Salix, Cornus, Acacia, Casia etc.,

7. Climax Stage :

New trees, shrubs and herbs appear which are in perfect harmony with the climate of the area. It is also called forest stage. This is the climax community of hydro sere succession. The wood land community is rapidly invaded by several trees. Thus is hydrosere, stage first is the pioneer community and stage seven in the climax pioneer community and stage 2 to 6 as seral communities or stages. Bacteria, fungi and other microorganism are more frequently found in the climax vegetation. The common plants are Acer, Ulmus, Querous Taxus, Fraxinus etc. (Fig : 3.1)

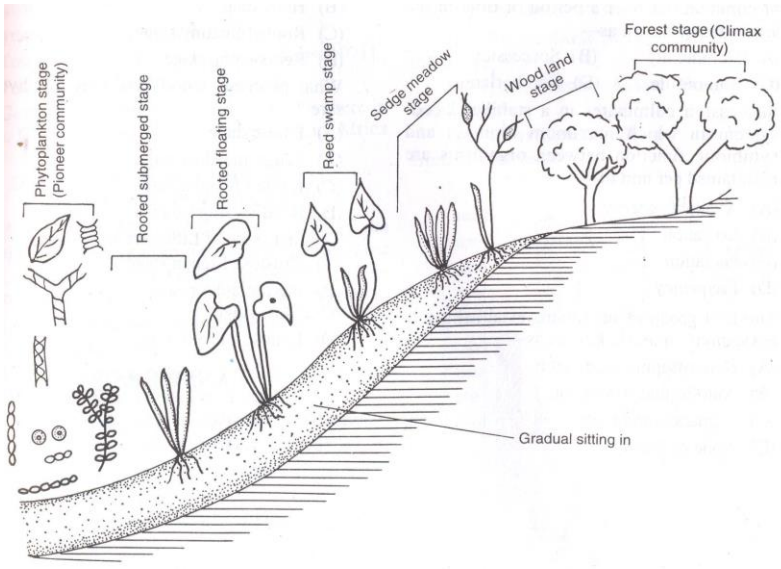

Fig : 3.1 Different plant communities appearing at different stages of hydrosere in a pond

3.3.2 Xerosere

Xeric succession commonly occurs on bare rock surfaces resulting from glaciations from erosion by wind and water. The original substratum is deficient in water and lacks any organic matter, having only minerals in disintegrated un weathered state. The pioneer plants, to colonies this rocky substratum are crustose lichens. After a series of developmental stages a climax community develops on the substratum. The lichens secrete carbonic acid in excess. The carbonic acid react with the rocky materials and loosen the rock particles. Xerosere include various stages.

1. Lichens Stage
2. Moss Stage
3. Annual Stage
4. Shrub Stage
5. Climax Stage

i. Lichens Stages :

bare rock is invaded first by crustose lichens e.g. graphics, Rhizocarpon. The reproduce by means of soredia. There soredia fall on the rocky substratum and grow into a thallus. The plant body very soft and sponge like. The corrode the rock at places causing foliose lichens e.g. parmelia, Dermatocarpon. Their body consist of a branched leaf like thallus with a foot.

The death and decay of the lichens, more organic matter is added to the substratum. Thus the substratum becomes suitable for the growth of mosses. The weathering of rocks and its mixing with humus results into the development of a fine thin soil layer on rock surface and thus there is a change in the habitat.

2. Moss Stage

Mosses capable of tolerating drought invade the human rich holes created by foliose lichens. The formation of thin soil layer on the rock surface favours the growth of xerophytic mosses like Grimmia, Polytrichum etc., the erect leafy shoots of mosses shade out the fruticose lichens and replace them gradually. As a result of the death and decay of the mosses, still more amount of organic matter is added to the soil finally they create move humus and shade to eliminate lichens.

3. Annual Grass Stage :

At first small herbaceous annual plants make their appearance. The roots of there herbs grow deeper into the crevices of rocks there by making the rock wither away. Annual grasses with runners and rhizome are slowly replaced by perennial grasses with runners and rhizomes e.g. Heteropogon, Cymbopogon, several, small animals begin to reside. Herbivorous animals visit the site.

4. Shrub Stage

Xerophytes plants like Rhus, phyocarpus begin to grow and later they die. Shrubs begin to grow in area occupled by perennial grasses. They increases soil and humus contents besides moisture e.g. Rubus, Rhus, Capparis, Zizyphus. This intern increases the soil fertility.

5. Climax Stage

At first small trees make their appearance. There are drought resistant plants. The rocks under goes withering and the amount of soil increase. Initially hardy, light demanding small trees invade the area. They make the habitat shadier and move moist. Ultimately, trees, shrubs and herbs representing the climax community begin to grow in the area. Xerophytic trees also form climax forest, if the climate of the area, is dry. Trees such as Acacia, Prosopis, Balanites, etc., may occur in the forests. This forests vegetation is more or less stable for several years with out much changes in its structure.

3.4 PLANT ADATATION

3.5 Introduction :

Organisms try to adapt to the prevailing environmental conditions. thus adaptation may be defined as process by which the organism to cope with its environmental conditions in an attempt to cope with their environment organisms may have undergo changes in their morphology, and physiology thus showing structural and physiological and biochemical adaptation. Extreme desert is with out any vegetation and rainfall.

3.6 Hydrophytes

Plant which grow in wet places or in water either partly or wholly submerged are called hydrophytes or aquatic plants. Examples are utricularia, Vallisneria, Hydrilla, Chara, Eichhornia, Wolfia lemna, etc. The plants readily fall into three categories viz, 1). Submerged Plant, 2). Floating Plants, 3). Amphibious Plants.

1. Submerged is a hydrophytes has following type.

a. Suspended. Eg. Utricularia, Hydrilla, ceratophyllum Najas.

b. Rooted E.g. Vallisnaria, Elodea, Isoetes, Potamogeton.

The absorbing and conducting tissue are therefore reduced to minimum. The root are poorly or absent or not at all branches. In some of cases root are absent eg. wolffia, ceratophyllym. Salvinia, and utricularia. Some hydrophytes to grow and do not branch. Eg. Azolla, Lemna and often have root pockets that fit over the end of root. Plant which grow below the water surface and are not in contact with atmosphere are called submerged hydrophytes. Submerged hydrophytes has following types

(Fig : 3.2)

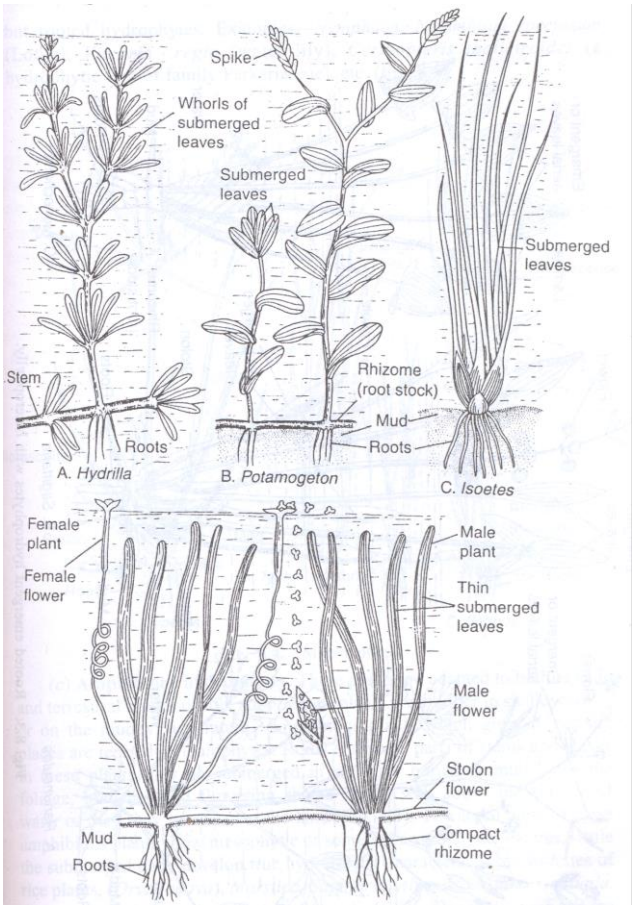

Fig : 3.2 Rooted submerged hydrophytes

D. Floating Hydrophytes :

Plant that float on the surface or slightly below the surface of water are called floating hydrophytes. The plants are in contact with both water and air. They may or may not by rooted in the soil. This is following two types.

i. Free floating hydrophytes

ii. Floating but rooted hydrophytes.

i. Free floating hydrophytes :

These plant float freely on the surface of water but are not rooted in the mud. Eg wolffia arhiza, wolffia microscopica, (a root less minutest duck weed) Tapa bispinosa, Lymnathemym, Eichharnia.

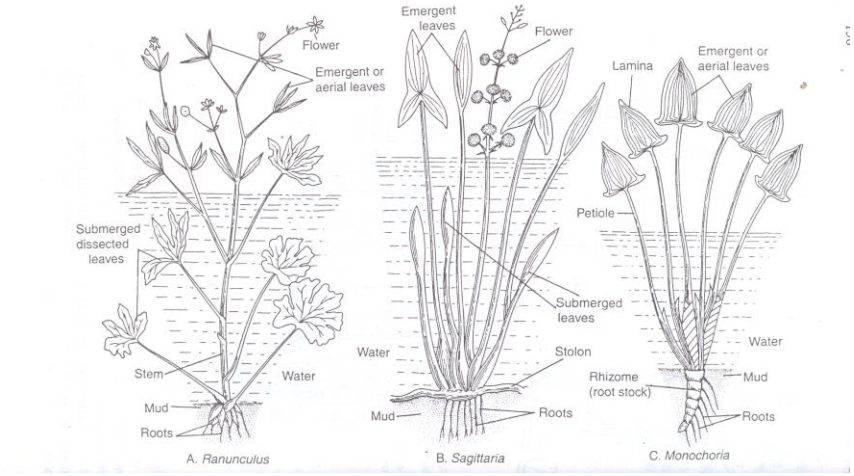

Fig : 3.3 Rooted Hydrophytes (Emergent)

ii. Floated but rooted hydrophytes. (Fig : 3.3)

Submerged plants are rooted in muddy substrate of ponds, rivers, and lakes but their leaves and flowering shoots float on or above the surface of water.

Eg. Nymphaea, Nelumbium, Victoria Regia, Ceratopteris

Amphibious hydrophytes :

This plant are adapted to both aquatic and terrestrials modes of life. Amphibious plant grow either in water or on the muddy substratum. Amphibious plants which grow in marshy places are termed as “halophytes” the aerial parts of these amphibious plant shows mesophytes or some times xerophytes feature, while submerged parts develop true hydrophytic characters.

Eg. Oryza sativa, Marsilea, Sagittaria , Alisma, Jussiaea, Neptunia, Commelina, Polygonum, Ranunculus.

Factors affecting the plant in the Aquatic Environments. :

- Temperature of water
- Osmotic Concentration
- Toxicity of water

The osmotic concentration and toxicity and development upon the amount and nature of chemical substances that are dissolved in water. The physiology of aquatic plants is greatly affected by the changed of osmotic concentration of water. The aquatic plants are subjected to less extremes of temperature because water is had conductor of heat.

Hydrophyte Adaptation :

Important features of these plants are described in the following heads.

3.6.1 Hydrophytic Adaptation

a). Morphological :

i. Roots : Root system in hydrophytes are poorly developed which may or may not be branched in submerged hydrophytes. The xylem being less in demand is poorly developed and reduced its place being often taken by a central cavity surrounded by phloem which remain unaffected as in Hydrilla, potamogeton and ullisnaria when present in xylem elements are thin walled. In submerged leaves, the stomata, are all together lacking and when present, function less indicating the ancestry of the plant. The rooting floating plants do not possess true root caps but very often they develop root pockets or root sheaths which protect their tips injuries.

In wolffia and salvinia the roots are entirely absent. In Hydrilla the root are poorly developed. In emergent forms like Typha and Ranunculus are well developed. Root cap are absent. In plant like Eichhornia the root caps are Replaced by roots pockets. Roots hairs are usually absent sometimes they are poorly developed.

ii. Stem :

In aquatic plants it is very delicate and green or yellow in colour. In some cases if may be modified in to Rhizome or runner etc., the stem is long slender and floatable in submerged plants like Hydrilla and potamogetum in free floating form like Azolla, it may be slender, floating horizontally on water surface or may be thick stoloniferous and spongy as in Eichhornia. Reproduction by vegetation propagation by runners stolen stem and root tubers offsets are very common.

iii**. Leaves :**

They are ribbon like submerged form like vallisnaria. The leaves are finally dissected in ceratophyllum. The floating leaves are generally long circular light or dark green in colour. Thin and very smooth. The floating leaves are large flat and entire as in nelumbo and Nymphea. The upper surface are coated with wax. The petiole are long flexible often covered with mucilage. The petiole of Eichhornia and typha become swollen and spongy. Heterophylly means occurrence of different type of leaves is met with in plant life Limnophylla, heterophylla, Ranunculus, Sagittaria, etc., The occurrence of heterophylly is associated probably with the following characteristics physiological behviours of these aquatic palnts.

i. Quantitative reductions in transpiration.

ii. The broard leaves on the upper surface overshadow the submerged dissected leaves of the same plant

iii. Plant show very little response to drought because the necessity of excess water during drought period.

iv. Variation in the life forms and habitat.

v. Broadleaves found on the surface of water transpire actually and regulate the hydro static pressure.

Anatomical Modification

The anatomical modification in hydrophytes aim mainly at.

1. Reduction in protecting structure.
2. Increase in aeration
3. Reduction of supporting or mechanical tissue.
4. Reduction of vascular

Reduction in Protecting structure of cuticle.

Cuticle is totally absent in submerged parts of plants. It may be present in the form of very fine film on the surface of parts which are exposed to atmosphere. Epidermal cell contain chloroplast thus they can be functionally photosynthetic tissue. Especially where the leaves and stem are very thin eg. Hydrilla. Hypodermis in hydrophytes is poorly developed. Vascular tissue are poorly develop and they are not well differentiated. The xylem has few vessels and trachieds are common.

Increase in the aeration :

a. Stomata are totally absent, in submerged parts of the plant. in some exceptional cases vestigial and functionless stomata have been noticed. In these cases exchange of gases take place directly through cell walls.

b. Air chamber

Aerenchyma is very much developed in leaves and stems. Air chamber are filled with respiratory and other gases and moisture. Co_2 present in the air chamber is used up in the photosynthesis and also that already present in their air chamber is used up on respiration .

3. Reduction of supporting or mechanical tissue

Mechanical tissue are absent or poorly developed in the floating and submerged parts of the plants because buoyant nature of water saves them from physical injuries.

The thick walled sclerenchymatous tissue is totally absent in submerged and floating hydrophytes. They may, however develop in the cortex of amphibious plants. particularly in the aerial or terrestrial parts.

These thin walled cells when turgid, provide mechanical support to the plants.

a. The reduction of absorbing tissue
b. In water Lilly and some other plants special type of star shaped lignified cells called asterosclereids develop which give mechanical support to the plant.

4. Reduction of Vascular tissue.

Conducting tissue is very poorly developed as the absorption of water and nutrient take place through the enteire surface of submerged parts. There is little need of vascular tissue in these plants. In the vascular tissue in these plant xylem shows greatest reduction. In some cases it consist of only a few tracheids while in some xylem elements are not at all developed. Phloem tissue is also poorly defined in most of the aquatic plants but in some cases it may develop fairly well.

Physiological Adaptation in Hydrophytes

The aquatic plants exhibit a low compensation point and low osmotic concentration of cell sap. Osmotic concentration of cell sap is equal or slightly higher than that of water. Nutrient are absorbed by the submerged plant through the general plant surface.

3.7 Xerophytes

Plant which grow in dry habitats or xeric condition are called xerophytes. Places where available water is not present in adequates quantity are termed xeric habitats. Xeric habitats may be of following type.

4. Physically dry habitats, (where water retaining capacity of soil is very low and the climate is dry eg. Desert, rock, surface waste, land etc.,)
5. Habitats physiologically dry (Places where water is present in excess amount but it is not such as can be absorbed by the plant easily. Such habitats maybe either too salty or too acidic too not, or too cold)
6. Habitats dry physically as well as physiologically eg slopes of mountains.

The xerophytes are region which are characterized by short or long periods of drought. Xeric may be the result of soil drought or atmospheric drought or in more severs cases due a combination of these factors soil drought result in adequate water absorption by the plant and atmosphere drought leads to excessive transpiration. Deserts are classified into hot deserts, cold deserts,

and physiological deserts. Hot desert have high summer temperature dry hot atmosphere, low rainfall and scanty water in the soil as in Rajasthan. Cold desert have severe winters when the soil is frozen and covered with snow so that water absorption is difficult.

Xerophytes will be found in all habitats where the soil is poor in water and atmosphere condition are such as promote rapid water loss. Thus plant growing on rock or cliffs or rooted in gravel in an otherwise mesic climate are xerophytes. When growing under favourable condition the plant develop special structure and physiological characteristics which aim mainly at the following objectives

1 To absorb as much water as they can get from the surroundings.

2 To retain water in their organs for very long time

3 To reduce the transpiration to minimum and

4 To check high consumption of water

Xerophytes are categorized into several groups according to their drought resistant power. These groups are as follows

i. Drought Escaping Plants :

Xerophytes are short lived during critical dry periods they survive in the forms of seeds and fruits which have hard and resistant seeds coats and pericarps respectively. At the advent of favourable condition the seed germinate into new small sized plants which complete their life cycle within a few week time. Eg astrogalus (papilionates) some inconspieouous compositate) eg Artemesia and member of families zygophyllace , boraginaceae, some grasses etc.,

ii.Drought Enduring Plants:

There are small sized plants which have capacity to endures or tolerates drought.

iii. Drought Resistant Plant:

Xerophytes grow on a variety of habitats some grow on rocky soils (Lithophytes) some in deserts some on the sand and gravels (Psammophytes) and some may grow on the waste land (Eremophytes) some plants of xeric habitate have water storing fishy organ.

Apart from this,

(a) Succulent xerophytes

(b) Non- Succulent also called true xerophytes

are all so be present.

Succulent xerophytes are those plant in which some organs become swollen and fleshy due to active accumulation of water in them.

3.7.1 Xerophytic Adaption:

Plant growing in the dry habitants develop certain structural devices in them. These structural modification in xerophytes plants may be of two types.

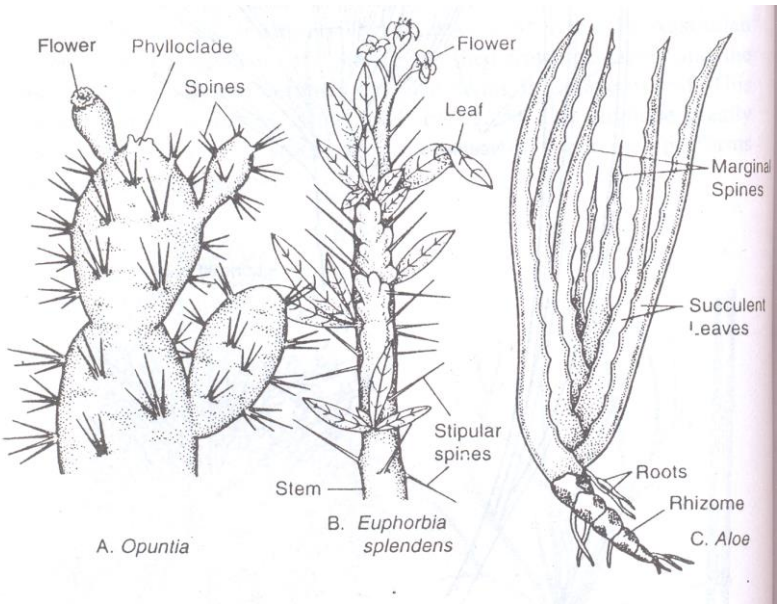

Fig : 3.4 Succulent xerophytes

i. xeromorphic characters : xerophyte characters that are genetically fixed and inherited are reffered to as xeromorphic. They will appear in the xerophytes irrespective of conditions whether they are growing in deserts or humid regions. (Fig : 3.4)

ii. Xeroplastic characters: These features are induced by drought and are always associated withdry condition. They are never inherited. These characters may disappears from plants if all the favourable condition are made available to them. Important xerophtic features are summarized under the following heads.

   i. Morphological adaptation

   ii. Anatomical adaptation

   iii. Physiological adaptation

1.External Morphology Of Xerophytes :

A.) Root : Xerophyte have well developed root system which may be profused branched. It is extensive and more elaborate than shoot system. Many desert plants superficial root system where the supply of water is restricted to surface layer of the earth. The root are perennial xerophyte grow very deep in the earth and reach the layers where water is available in plenty. Root hair are

densely developed near the growing tips of the rootless. Many desert shrubs have thin leaves and show a high rate transpiration when water is available. Their root system are extensive penetrate deep into the soil and are densly clothed with root hairs.

B) STEM:

Some of the important characteristics of xerophytic stems are listed below.

ii. Stem of some xerophyte become very hard and woody it may be either aerial or subterranean

iii. They are thick coating of wax and silica in equisetum. Some may be covered with dense hairs as in calotropis.

iv. In some xerophytes stem may be modified into thorns. Eg. Duranta, ulex,etc

v. In stem succulents main stem itself becomes bulbous and fleshy and it seems as if leaves in this plants are arising directly from the top of the roots. Eg kleinia articulata.

vi. Stem in some extreme xerophytes are modified into leaf like flattened green and fleshy structure which are termed as phylloclades. May cacti and cocolaba are familiar examples for this. In ruscus plant the branches developing in the axils of scaly leaves become metamorphosed into leaf like structures the phylloclodes or cladophylls. In asparagus plant also a number of axillary branches become modified into small needle like green structure which root exactly like leaves. They are called cladodes. A number of species of euphorvia also develop succulence and become green. In the plants leaves are greatly reduced so the main function of leaves.

LEAVES

In some xerophytes the leaves if present are greatly cadueous i.e. they fall early in the season, but in the majority of the plant leaves are generally reduced to scales as in casuarinas, ruscus asparagus

Some evergreen xerophytes have needle shape leaves. In this succulent leaves become reduced to stem. The leaves are vertically erect and epidermis show special feature. In some plant both leaf and stem also succulent.

Eg. Bryophyllum. In leaf succulent the swell remarkable and become very fleshly owing to storage of excess amount of water and latex in them.

In majority of xerophytes leaves are generally much reduced and are provided with thick cuticle and dense coating of wax or silica, sometimes they

may be reduced to spines as for examples in ulex, opuntia, euphorbia, splendense, Capparis and acacia.

Generally the leaves of xerophytic species possess reduced leaf blade or pinnae and have very dense network of veins. In Australian species of acacia the pinnae are shed from the rachis and the green petioles swells and becomes flattened taking the shape of leaf. This modified petiole is termed as phyllodes.

TRICHOPHYLLY

In some xerophytes especially those growing well exposed to stroing wind the under surface of the leaves are covered with thick hairs which protect the stomatal guard cells and also check the transpiration. Those xerophyte which have hairy covering on the leaves and stem are known as trichophllous plants. eg. zizphus, Nerium, Calotropis etc.,

ROLLING OF LEAVES

Leaves in some extreme xerophytes grasses have capacity for rolling or folding. In this cases stomata are scattered only on the upper or ventral surface and as the leaves roll upwardly. Stomato are effectively shut away from the outside atmosphere. The tissue and round cells are large grooves and on the side of the ridge are chloroenchymatous The rest of the leaf tissue is mostly mechnical. During the period of water scarecty the hing cells lose water more rapidly than the other cells which are strongly cuticularised. As a result the two sides of the grooves are drawn together and the leaf rolls up thus protecting the stomata. During the process the mechanical tissue effectively prevent the collapse of the leaf .The lower epidermal becomes the outer surfaces.

FLOWERING FRUIT AND SEEDS

Flower usually develop in the favourable condition. Fruits and seed are protected by very hard shells or coatings.

ANATOMICAL MODIFICATION IN THE XEROPHYTES

Heavy cutinisation lignified and wax deposition on the surface of epidermis and even in the hypodermis are very common in xerophytes. Shiny smooth surface of cuticle reflects the rays of light and not allow them to go deep rays of light and not allow them to go deep into the plant tissues.

EPIDERMIS

Cells are small and compact. It is single layered but multiple epidermis is not uncommonly in nerium leaf epidermis are is two, three layered. In stem radially elongated. Wax, tannin, resin, cellulose, etc, deposited on the surface of epidermis from screen against high intensity of light. Certain grasses with rolling leaves have specialized epidermis. In these some of the epidermal cell that are found in the depression become more enlarged than the found in the

ridges this enlarged cells are thin walled and are called bulliform cells or motor cells or hing cells. These are found on the upper surface of leaves by becoming abacid during dryperiods. In most condition these cells region their normal turgidity which causes unrolling of loaf margin. Bulliforms are common occurrence in the leaf epidermis of sugarcane bamboo, typha and a number of other grasses.

HAIRS

Hair are epidermal in origin. They may be simple or compound unit or multicellular compound hairs are branched at the node. These hair protect the stomata and prevent excessive waterloss. The furrow and pits in these plants are common site of stomato. Hair found in the depression protect stomata from the direct of strong wind.

STOMATA :

In xerophytes, reduction of transpirtation is of utmost importance . it is possible only if the stomatal number per unit area is reduced or if the stomatoa are elaborately modified in their structure. In xerophytes the number of stomata per unit area of leaf in a greater than mesophytes. They are generally sunken stomata. In some cases they may be found in the furrow or pits. Subsidiary cell of sunken stomata may be of such shapes and arrangement that they form the outer chamber that is connected by narrow opening of the stomata. Such type of specified stomata are very common in conifers Cycas, Equisetum etc walls of the guardcells and subsidiary cells are heavily cutinized and lignified in many xeric plants. These devices have little value in directly reducing transpiration when stomata are open when plants are wilting and stomata closed than only lignified or cuticularized walls of guard cells have protecting properties and under such circumstances only cuticular transpiration is possible which is of little significance. Indorisventral leaves stomata are generally found on the lower surface but in rolling leaves they are scattered mostly on the upper surface. In the colled leaves stomata are protected from the direct contact of outside wind.

HYPODERMIS

In xerophytes just below the epidermis one or several layers thick walled compactly grouped cells may develop that form the hypodermis. The cell may be much like those of epidermis and may either be derived from epidermis or form cortex or from the mesophyll. The hypodermal cells may sometimes be filled with tannin and mucilage

GROUND TISSUE

In the stem, a great part of body is formed by sclerenchyma. In those case where the leaves are either greatly reduced or they fall in the early session, the photo synthesis activity is taken up by outer chlorenchymatous cortex. The chlorenchymatous tissue is connected with outside atmosphere through stomato. The gaseous exchange takes place in regular manner in the green part of stem.

In succulent stems and leaves ground tissue area is filled with the walled parenchymatous tissue stores excess quantity of water mucilage latex etc. this makes the stems swollen and freshly

In the leaves mesophyll is very compact and the inter cellular space are greatly reduced . palisade tissue develop in several layer. There are some xerophytes in which mesophyll is surrounded by thick hypodermal sheath of sclerenchyma from all the sides except from below this sheath forms a diaphragm against intense light. Such xerophytes in which selerenchyma is extensively developed are called sclerophyllous plants.

CONDUCTING TISSUES :

Xylem and phloem develop very well in the xerophytic body.

PHYSIOLOGICAL ADAPTATION

It was long assumed that the structural adaptation in the body of xerophyte were useful in reducing the transpiration but now a number of experiments releated with physiology of these plant reveal some factor which are contorary to the early assumptions.

Succulents are well known to contain polysaccharides, pentosans and a large number of acids by virtue of which they are able to resist drought. The structural modification in these xerophytes are directly governed by their physiology. How does the succulent developed metabolic reaction which induced developments of succulence is the conversion of polysaccharides into pentosans.

In xerophytes the chemical compounds of cell sap are actually converted into well forming compound that are finally incorporated into the cell walls. Conversion of polysaccharides into anhydrous forms such as cellulose, formation of suberine etc are some example

Some enzymes such as cataylses peroxidases are more active in xerophytes than in mesophytes. In xerophytes amylase enzyme hydrolysis the starch very actively

The capacity of xerophytes to survive in long periods of drought lies not only in the structural features but also in the resistances of the hardened protoplasm to heat and desiccation

REGULATION OF TRANSPIRATION

Presence of the cuticle polished surface compact cells and sunken stomata protected by stomatal hairs regulate the transpiration

HIGH OSMOTIC PRESSURE OF CELL SAP

The xerophyte have very high osmotic pressure which increases the turgidity. The turgidity of cell sap exerts tension force on the cell wall. In this way wilting of cell is prevented. High osmotic pressure of cell sap also affected the absorption of water.

3.8 MESOPHYTES

Definition :

Mesophytes are plants which grow in moist habitat and need well – aerated soils. They avoid soil with standing water and saline soils. In some respects they stand in between the hydrophytes and xerophytes.

These plant can grow in water lack lands or dry places. Broad – leaved trees growing in wet depressions along lakes and rivers, are mesophytes. Therefore, they grow in regions where moisture and temperature are optimum. They cannot tolerate high concentration of salts in the soil.

Mesophytes show the following important feature.

3.8.1 Mesophytic Adaptation

Morphological features :

1. Root system is well developed. Roots are generally fairly branched, with root and root hairs.
2. Leaves are usually large, broad, thin and varied in shapes. They usually lack hairs and wax coating.
3. Stems are generally aerial, Solid and freely branched.
4. The Plant show luxuriant growth and they are found in several storeys.
5. Thick bark covering on the stem
6. Better protection of winter buds.

Anatomical Features :

1. Epidermis is well developed, without any hairs or waxy coating and cells with out chloroplasts.
2. Stomata are present both surface of leaves on lower and upper surfaces of leaf.

3. Mesophyll in leaves is differentiated into palisade and spongy parenchyma with many intercellular spaces. Conducting strands and mechanical tissues are well developed.
4. Vascular tissues are fairly developed and well differentiated.
5. Mechanical tissues are fairly developed.

Classification of mesophytes.

1. Grasses and herbs communities.
2. Woody plants communities.

1. Grasses and herbs communities :

These include annual or perennial grasses herbs. The grasslands occur in area of approximately 25 to75 cm rainfall per annum. These type of community occurs in Canada, Australia, Africa, India. These plants are small sized soft shrubs and the under-shrubs are totally absent. Mosses may be intermingled but lichens do not appear. The vegetation usually includes grasses dicot herbs and some mosses.

2. Woody plants communities

This type of community includes trees, woody plants, shrubs, these forests are found in the area where rainfall is high enough about (75-150cm per year) and evenly distributed and the temperature is moderate. The important features of these plants.

a. Formation of underground stem
b. Thick bark covering on the stem
c. Better protection of winter buds.

Climate of such forest is characterized by.

i. High humidity
ii. Daily rains
iii. High temperature
iv. Not distinct dry season.
v. Soil very rich in humus. Black in colour and porous.

3.9 HALOPHYTES

Halophyte are plants which occur on saline soil or in saltish water. They are known as salt plants or halophytes. These plants can be commonly see along the sea shores where mesophytes and fresh water plants can not thrive. Though these plants live in areas where the soil is saturated with water. They cannot use such water because of high concentration of salts in the soils. Thus halophytes are living in habitats which are physically wet but physiologically dry. Such a condition is called physiological drought plants.

In a cell to maintain turgidity the concentration of osmotically active substance with in the cell sap must exceed that of the soil solution. The non halophytic plants show reduced growth when the osmotic pressure of the soil solution rises above 2 atm. The osmotic pressure of halophytes are usually 40 atms or more. As a result their tissue fluids are impregnated with salt and they taste salty. Saline habitats are not restricted to sea coasts only but they may also be found in many dry places for away from the sea coasts.

CLASSIFICATION OF HALOPHYTES

They are many classification done by different workers. According to chapman (1942) halophytes have been classified in to the following categories

i) Miohalophytes : Plants growing in the habitats of low salinity (below 0.5 % Na cl)

ii) Euhalophytes : Plants highly saline habitats. They have been further sub-divided in to the following groups.

a) Mesohalophytes : Plants of habitats with salinity renge of 0.5 % to 1 %

b) Mesoeuhalophyte: Plants of habitats with salinity range of 5% and higher

c) Eneuhalophytes : Plants of habitats with salinity range of 1% and up

According to TOSPA (1939) Classified halophytes in the following four groups on the basis of their response to salinity.

1 **OBLIGATORY HALOPHYTES:** Plants requiring salinity through out their life.

2 **PREFERENTIAL HALOPHYTES:** Plants show optimum growth in saline habitats, despite their appearance in non- saline habitats.

3 **SUPPORTING HALOPHYTES** : Non aggressive plants which are capable of growing in slaine habitats.

4 **ACCIDENTAL HALOPHYTES :** Plants which grow in marsh saline habitats only accidentally.

Steiner (1935) classified salt marsh plants in to the following three type.

3.9.1 Halophytic Adaptation

a) **SUCCULENT HALOPHYTES :** Plants which can tolerate high concentration of chloride in their cell sap due to increased succulence (as for example salicornia herbacea)

b) **NON SUCCULENT HALOPHYTES :** Plants resisting salt by desalimization of their tissues and secreting excess salts through salt glands (eg. Spartina alterniflora)

c) **ACCUMULATING TYPE :** Plants with out any special mechanism of salt removal. Salt concentration in such plants goes on increasing until the death of plants. (eg., Juncus gerardii, suaeda fructicosa)

Costal angiospermous halophytes have been divided in to the following groups.

i) Submerged marine halophytes – hydrohalophytes,

ii) Low coast plants- hygrohalophytes

   a) Swamp halophytes , the mangrove,and

   b) Marsh halophytes,

iii) High coast plants- aerohalophytes.

IMPORTANT CHARACTER OF HALOPHYTES

As the water in the habitat is not such as can easily be absorbed by the plants, the halophytes develop in them almost all important xerophytic devices for water economy.

1.HABITAT :

A great majority of halophytes in trophical and sub trophical regions are shrubs, but a few of them are herbaceous, for example Acanthus ilicifolius. In temperature zones, halophytic vegetation is purely herbaceous.

2.EXTERNAL MORPHOLOGY:

Halophytes develop many shallow normal roots. In halophytes in addition to normal roots are, many stilt or prop roots develop from the aerial branches of stem for efficient anchorage in muddy or loose sandy soil. These roots grow down wardly and enter the deep and tough strata of the soil.

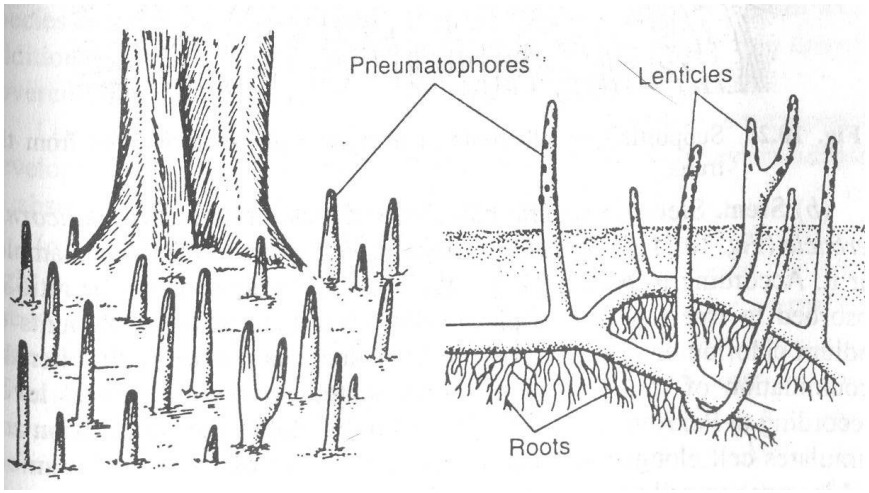

Fig : 3.5 Pneumatophores of mangrove plant

The soil in costal region is poorly aerated and contains very little percentage of oxygen because of water logging. Under such conditions the roots of halophytes do not get sufficient aeration. In order to compensate this lack of soil aeration, the hydrohalophytes develop special type of negatively geotrophic roots called pneumatophores or breathing roots. The pneumatophores usually develop from the underground roots and project in the air well above the surface of mud and water. They appear as peg like structures. The tips of these respiratory roots may be pointed. They possess numorous centicles or pneumathodes on their surface and prominent aerenchyma enclosing large air cavities internally. The arenchyma helps in the conduction of air down to the subterranean or submerged roots. In some plants eg., Bruguiera, the horizontal roots grow above the surface of mud and then again bend downwardly and enter deep in to the mud. In this way, they form knee like structures. The aerial surface bears a number of pores which facilitate the exchange of gases. Pneumatophores do not develop in some species of rhizophora. In those cases, the upper aerial parts of deffcending stilt root probably take up the respiratory activity. (Fig : 3.5)

STEM :

Stem in several halophytes develop succulence, salicornia herbacia and suaeda martitima may be quoted as familier examples for it.

According to Arnold (1955) the succulence depends on the ratio of absorbed free loans in the plant cell rather than absolute amounts of sodium chloride or sulphate present . succulence is induced only after the accumulation of free ions in an organ increase above the critical level.

LEAVES :

In most of the halophytes the leaves are entire, thick, succulent and usually small in size. They are often glassy in appearance. Few species are aphyllous. The leaves of submerged marine halophytes are thin and have very poorly developed vascular system. They are capable of absorbing water and nutrients directly from the medium.

Fruits, Seeds, And Their Dispersal :

The fruits and seeds are generally light in weight. Fruit walls have a number of air chambers and the fruits, seeds and seedlings which can float on the water surface for pretty long time are dispersed to distant places by water current.

A littoral species of spinifex (S.quarrosus) a number of gramineae commonly growing in the sandy saline sea shores in Andhra, shows peculiar type of fruit dispersal. In this plant, female inflorescence is spherical in shape and consist of many spike let. A number of stift bractiolar bristles of the inflorescence help in the dancing and some rsaulting of the inflorescence.

Viviparous Germination:

Many halophytes of sea coasts or other saline areas bordering the seas, in the deltas and estuaries, has developed peculiar type of germination known as vivipary. vivipareus is defined as the germination of seeds before the fruits break off from the plant. The embryo grows and develops in the seed with in the fruit when it still attached to the plant. In Rhiziphora mucronata the fruits is lathery and indehiscent, soon after the completion of its growth, is pierced at its summit by the green hypocotyls as the embryo does not require any period of rest, continuing its development with out interruption . The hypocotyl is club shaped at attains a length of 50 -75 cm. (some times even a metre) before its falls down, leaving behind the fused cotyledons which serve as absorbing organs of the developing seedling. Since the lower end of the hypocotyl is thicker, the embryo seedling falls vertically downwards with root tip in to the soft saline mud. Then with in a few hours develops lateral roots to fix the seedling firmly. Sometimes, if the water level becomes high, the embryo floats with hypocotyls (radicle) vertically downwards and waits for a good chance of cacthing a suitable crack in the soft mud as the water , level falls.

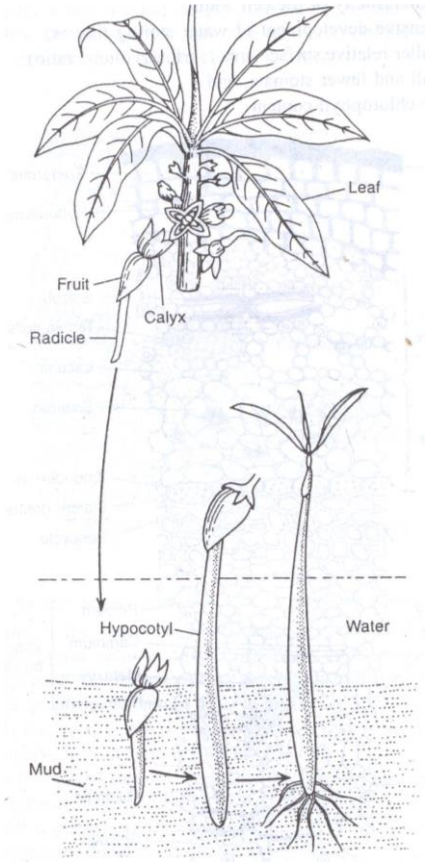

Fig : 3.6 Vivipary in Rhizophora

Vivipary is also exhibited by other plants like Aegiaeras Malus, Aegialitis rotundfolia, Ceriops sp, and Bruguiera sp. An incipient type of vivipary is also seen in Avicennia sp. (Fig : 3.6)

Anatomical Features Of Halophytes

The appearance and structures which characterize certain groups of plants sum up to a great extent their ecological and physiological means of adaptation.

Halophytes show the following important anatomical features.

ROOT

1 Cork is several layered in thickness.

2 Cortex is assembled out of star shaped cells connected with each other by lateral arms the cells are more lignified

3 Pith cells are thick celled and walled with pited presence of lignin deposition and containing tannin and oil.

Silt Root And Pneumatophores

1. The silt root of mangrove plants show normal features with periderm on the surface
2. Aerenchymatous cortex containing sclereids
3. Normal endodermis secretory pericycle, radially arranged xylem and phloem and extensively developed pith
4. Cork cambium is not seen in regions just below the lenticels
5. The cortex is spongy and consist of extensively developed aerenchyma enclosing large air chambers
6. Pneumatophores show variations in their internal structures
7. Vascular bundles conjoint, collateral, vascular bundles with endarcn xylem at maturity
8. The negatively geotropic breathing roots show features of stem and not of roots
9. Pith is made of large aernchyma cells with large intercellular spaces

STEM

1. Cuticle is very thick even in young stem
2. Hypodermis several layered of heavily thick walled cells
3. Primary cortex possesses a number of lacunae, cells of which thicked filled with tannin and oils.
4. Some cells possess calcium oxalate crystals
5. Inner cortex possess a number of branched thick walled cells sclereides that provides mechanical strength.
6. Pericycle is made 3-4 layers of sclerencnymatous cells
7. Vascular system is well developed and is clealrly distinguished into xylem and phloem

3.10 EPIPHYTES (EPI=above, phyton= plant)

Epiphytes are plant growing on other plants. They use other plants only as their support and not for water in food supply. They contain chlorophyll in the leaves. These plants absorb sufficient moisture form the atmosphere and mineral nutrients from the decaying bark of the supporting plants upon which they are situated. They grow either on the trunk or leaves. Epiphytes are very common in tropical rain forest. Epiphytes vegetation is very rich in moist and cold regions but poor in dry and cold area, in tropical rain forests, epiphytic species found at the tops of trees and xerophytes in nature but those occurring at lower leaves are hygrophilous. (Fig : 3.7)

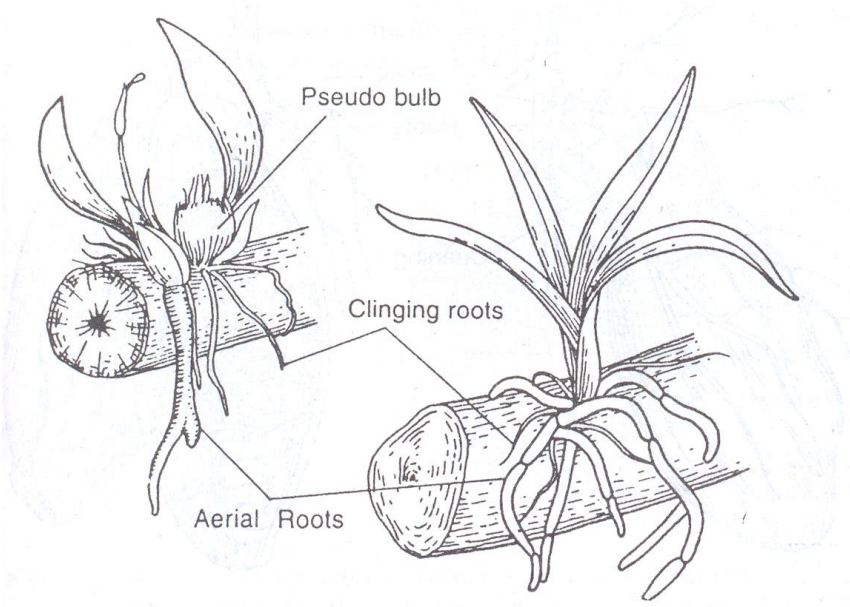

Fig : 3.7 Epiphytes (Vanda)

Types of epiphytes :

1. Hemi epiphytes:

These plants grow on the supporting plants in the beginning like true epiphytes but later on they establish connection with the soil by their roots. Ex. Epiphytic fig tree, some root climbing aroids. Scindapasus officinales etc.

Some plant grow initially in the soil, but later below the stem die and terminal portion remain live independently like hemi epiphytes. Such plants are called pseudo epiphytes.

2. proto epiphytes :

These plant grow on partially form sureace of the supporting plants and partially from the atmosphere ex. Peperomia,, Dischidia .

3. Nest epiphytes :

These plants have appropriate devices to collect large quantity of water and humus for their own use. Orchids are familiar examples of this group.

4. Tank epiphytes:

Nidularium, Tillandsia, like plants develop fibrous anchoring roots which do not take part in the water absorption. Leaves, that are variously modified absorb water and manufacture food.

3.10.1 Epiphytic Adaptation

Anatomical adaptations:

Root system:

The epiphytic plants, the root system is well developed. In cases, the roots may be of the following types.

1.Clinging root:

This is achieve by the developed of clasping roots. These roots fix the plant firmly into the bark of the trees they absorb nutrients from the humus and dust that are accumulated on the surface of bark.

2. Normal roots:

In normal roots absorb, water, mineral, and organic materials form the decay, dead tree or bark of supporting plants .

3. Aerial roots:

Aerial roots are spongy in nature so that they absorb atmospheric moisture form humid air they have water problem also, since they are not connected with soil. The only source of water is the atmospheric precipitation in the form of rain, dew or moisture , contained in the humid air these roots can photosynthesize in light because of the presence of green colour in them. In some epiphytes, the roots collects on the surface good amount of dust that holds water with will finally be absorbed by roots.

Many epiphytes orchids develop long thick white shiny roots which hang dowse into the air. These roots have a multi layered sporty tissues are called velamen tissue. The velamen tissue develops on the outside of the roots epidermis.

ii) Leaves:

The leaves are thick and succulent and store water e.g, vanilla. The cuticle is thick and the stomata are sunken. In some cases the leaves are reduced or absent . eg. polyrhiza. The reduction of leaf number some orchids develop only a single leaf in a growing season. Leaves is some may be fleshy

and leathery, the pitches and adventitious roots are present in to the inside sunder ban plants.

Stem :

The epiphytes plant has well developed or not be extensively developed some epiphytes stems succulent. And become pseudo bulbous or tuberous.

The fruits and seeds :

The fruits and seeds are usually distributed by wind, insect and birds. When the seeds reach the suitable substratum they, germinate over there to produce a new epiphytes.

ANATOMICAL ADAPTATIONS :

Anatomy of epiphytes show following features :-

1. cuticle is thick and stomata is sunken. Therefore water loss is much reduced.
2. cells have thick lignified walls.
3. thin wall cells or passage cells, walls of which are permiable of water. The velamen absorbs and retains moisture till that is absorbed by passage cells of exodermis.
4. Inner of the velaman tissue a peculiar layer is present and is known as exodermis. It has two types of cells, 1. thick walled cells and 2. thin walled passage cell.
5. In succulent epiphytes, thin walled paranchymatous tissue that stores water, develop extensively.
6. Vascular tissues are well developed.

Self Assesment Questions : I

1. Psamosere means of
   a) Plant grow on rock b) Plant grow in water
   c) Plant grow on Desert d) Plant grow on sand
2. Give two example of Epiphytes_____
3. Halophytes Love in
   a) On plants b) Saline soil
   c) Dry land d) All of the above

Self Assesment Questions : I

1. Plant succession means_____
2. Give example of submerged plant_____
3. Wood land stage_____

Unit Questions :

1. Define the plant Succession
2. write notes on xerosere
3. Describe the Halophytes
4. Anatomical Adaptation of hydrophytes.
5. Explain the buoyancy

Answer of self Assesment Question : I

1. Plant grow on sand
2. Vanilla Velaman
3. Saline soil

Answer of self Assesment Question : II

1. Gradual community formation
2. Ranunculus, Valisnaria
3. Development of Shrubs

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UNIT – IV

POLLUTION, TYPES OF POLLUTION AND CONTROL METHODS.

UNIT - IV

POLLUTION

4. 0 Introduction :

Environmental pollution is a serious problem of the industrialized societies because people have converted the life supporting system of the entire living world into their own resources, and have vastly disturbed the natural ecological balance serious degradation and depletion have been caused through over use, misuse and mismanagement of resources to meet the humans needs and satisfy the increasing demands.

India today is one of the first ten industrialized countries of the world. Today we have good industrial infrastructure in industries like metal, chemical fertilizers, petroleum food and pesticides, detergents plastics, solvent fuels, paints, dyes etc. These are the basic reason to cause the pollution

4.1 Definition :

Odum , 197 defined as that pollution is undesirable changes in the physical chemical or biological characteristics of our air, land and water that may or will waste or deteriotate our raw material resources.

The word pollutionem (mean make dirty) is the act of polluting the environment. Environmental pollution is defined as the unfavourable alternation of our surrounding wholly as a by product of mans activities through direct indirect efforts to changes in the physical chemical and biological characteristics of land water air or water that harmfully effect human life or any desirable living thing. Human population explosion, rapid industrialization, deforestation, unplanned urbanization, scientific and technological advancement etc.

Pollution refers to undesirable change in the physical, chemical, on biological characteristics of the air , water and land which may or with harmfully affect human life, the lives of the desirable specis, our industrial processes, living condition and cultural asserts, or which may or will waste or deteriorate our raw material resources

The pollution can be divided into

i. Natural

ii. Manmade

The agent causing pollution are termed pollutants . A pollutant may thus include any chemical or geochemical substance biotic component or its product or physical factor that is released intentionally by man in to the environment in such a concentration that may have adverse harmfull unpleasant effects.

Pollutants may also defined as any solid liquid or gaseous substance present in such concentration as may be injurious to environment.

The lakes and river are polluted by wastes from chemical and other factories and the air by gases of automobile exhausts , industries, thermal power plants etc.

4.2 Causes of Pollution :

The major causes of pollution are industrialisation, urbanisation, and motorization. We have already referred to the pollution which result from the expansion of industry both in the developed and developing nation. In the developing counteries especially, a large number of industries have been set near up inside near the large cities. The smoke from the factory chimneys pollutes the air that man breaths. The effluents from the industry flow down the drains and sewage and, by the time they reach the rivers and finally the sea, may contaminate the soil ground water from which supply of drinking water is obtained.

A Consequence of industrialisation in recent times in developing countenies like India is the large scale migration of rural population to the industrial centers in large cities, leading to their over population. Today the automobile, with poisonous exhaust, is a conspicuous part of the environment not only in large cities but also in small towns and rural areas.

4.3 Classification of Pollution :

i. Primary Pollutant :

Pollutant persisting in the environment in the form it is produced eg. Carbon monoxide.

ii. Secondary Pollutant :

Pollutant formed from a primary one through change or reaction. Nitrogen Oxides and hydro carbons react photo chemically to produce peroxyacyl nitrate and ozone. The secondary pollutant may be more toxic them primary ones . the phenomenon is called synergism.

iii. Qualitative Pollutant :

It causes harm due to its nature. It is often produced due to human activity e.g. insecticides .

iv. Quantitative Pollutant :

It is a component which becomes pollutant only when its concentration reaches beyond a threshold value eg. Co_2, Co.

v. Degradable Pollutant :

The pollutant degrades after some time either automatically (eg. Heat) or through the agency of microorganism (biodegradable) e.g. sewage.

vi. Non degradable Pollutant :

The pollutant not get degraded to broken down in to harmless materials e.g. D.D.T, plastics, phonelic compounds, polythene – ware etc.,

vii. Atmospheric Pollution :

It is the addition of particulate matter gases and other ingredients in to air which con produce can adverse effect on human beings animals, vegetation, human assets and resources.

4.4 Type of Pollution

4.4.1 Water Pollution

Water is the important constituent of life support system. Water is most important natural system. It is the degradation of quality of matter due to addition of substances. (inorganic, biological, radiological) or factors(e.g. heat)

We depend on water for irrigation, industry, domestic needs, most of our water bodies like ponds, lakes, streams, rivers, sea oceans, have become polluted due to sewage, domestic waste, industrial effluent, infectious agents and other man-made problem. Which contain substance varying from simple nutrients to highly toxin chemicals. (heavy metals; etc)

The water pollution defined as the addition of any substance to water to changing of water's physical and chemical characteristics in any way normally water is never pure in chemical sense. It contain impurities of various dissolved as wer as suspended. These include dissolved gases (H_2S, Co_2, NH_3 N_2), dissolved minerals (Ca, Mg, Na, Salts), suspended matter (Clay, Silt, Sand) even microbes. These are natural impurities derived from atmosphere; catchments areas and the soil.

They are in very low amounts and normally do not polluted water and it is potable. Polluted water, however, are turbid, unpleasant bad smelling, unfit for drinking, but, and washing other purpose. They are harmful and are vehicles of many diseases as cholera, dysentry, typhoid etc.,

Source of water pollution :

i. Sewage and other waste
ii. Industrial effluent
iii. Agriculture discharge

iv. Industrial waste from chemical industries.

Sewage :

It is waste water having food residue, animal and human excreta, detergents, discharges from commercial and industrial establishments. Raw sewage contain a number of pathogens. Coli forms and enterococi. It stimulate the activity of several decomposer organisms collectively called sewage fungus. The property of becoming decomposed through microbial activity is known as putrcescibility. Degree of impurely of water due to organic mater is measured in terms of B.O.D. Biochemical oxygen demand. is the oxygen in milligrams required for five days in one liter of water at 20^0C for B.O.D. is the microorganisms to metabolise organic waste. Low pollution below 1500mg/l medium pollution 1500-4000 mg / l and high organic pollution above 400 mg /

l.Water has a brown colouration and an unpleasant odour due to formation of secondary. Pollutants like CH_4, NH_3, H_2S scum and sludge (H_2 S & metallic ions). There may be algal blooms and entrophication. The latter is due to phosphates present in detergent.

Industrial effluent :

A wide verities of both, inorganic and organic pollutants are present in effluents from breweries tanneries, dying textiles, paper and pulp mill, so all industries mining operations. The pollution includes oils, toxins, acids salts, dyes, cyanides, D.D.T. etc.,

The effects of water pollution

i. Mercury :

It is changed to water soluble dimethyl mercury which undergoes biomagnification. Eating poisoned animals causes deformity known as mina mata disease which is characterized by diarrhoea, Lemolysis, impairment of various senses, meningitis and deart.

ii. Copper :

Hypertensions, uremia, occasional fever and coma.

iii. Lead : (also conmen from automobile exhausts)

Anaemia, Vomating, Convulsion, loss of appetite, damage to liver kidneys and brain.

Zinc :

Vomiting, Cramps, renal damage. Cobalt Diarroboea, hypo tension, bone defects and paralysis.

Cherimoya :

Gastro – intestinal ulcers, nephritis nervous system disorders.

Cadmium :

Anemia, hyperresion, testicular atrophy, damage to liver and kidneys, diarrhea and skeletal deformities. Called itai - itai (ouch – ouch, first reported in 1947 in Toyota city of Japan).

Agriculture Discharge :

The agriculture discharge mainly contain fertilizers, insecticides, herbicides, plant nutrients, silage etc. It is added to water bodies due to drainage and irrigation. Several toxic metals such as Fe, Pb,As,Mn,Hg,Cr,Cd, Se etc, are also added through sewage and industrial discharge. The plant nutrients such as nitrogen and phosphorus are also added to water such as pollutant. The enrichment of water by nutrients is called eutrophication. This stimulates growth of aquatic plants including water blooms. Due to eutrophication oxygen level of water decrease and Co_2 level increase. It causes death of fish and other animals, due to clean water body turns in to a stinking drain

Pesticides :

Pesticides are the chemical used for killing the plant and animal pests. It is spread over crops also pass in to water bodies due to surface run-off. In excess they cause immediate and mass scale death of aquatic animals. This is general term that include bactericides, fungicides, nematicides, insecticides and also herbicides and weedicides. There is wide range of chemical used as pesticides and herbicides. But the most harmful use those which either do not degrade or degrade very slowly in nature. The most important groups of compounds which both toxic and persistant are chlorinated hydrocarbons including organs chlorine pesticides such as dichloro diphenyl tricholoro ehhane DDT. Dieldrin , (benzene hexochloride). BHC, polychlorinated biphenyls (PCB_S) and benzene products . This disprersed in environment through air and water. They become concentrated in successive transfer from plants to herbivores to carnivores.

In discriminate use of biocides could make them an integral part of our biological, geological and chemical cycles of the earty. Measurable amounts of DDT residues may be found in air, soil, water and at several thousand of kms from the point where it had original entered the ecosystem .

This the reason why our food grains as wheat and rice and vegetables and fruits today contain varying amounts of pesticides residue which have become their integral part.

Thermal pollution :

Hot effulent and hot water (e.g. thermal plants atomic reactors) bring about rise in water temperature warm water contain less oxygen has lower rate of putrescibility result in increased organic loading replacement of green algal by blue green ones. Many animals fail to reproduce eg trout, salmon.

Oil :

Oil spills and refinery discharges cause oil pollution. It reduces oxygenation, inhibits plankton growth and kills animals. Petroleum extracted from the area of continental shelf is transported from the country to another through sea after unloading the tankers are washed in sea. This causes oil Slicks or spills in the sea especially near the ports and shrne lines.

Fluorides :

Fluorine is also regularly present in water and soil besides air. In nature it is found as fluoride. The plant crop grown in high fluoride soils in agricultural, non industrial areas had a fluoride content as high as 300 ppm. High fluoride content water caused dental fluorisis, fluoride is not levels more than 0.5 ppm over a period of 5-10 years results in floursis terminating in crippling on paralysis.

Control of water pollution

Various legislative measures should be employed to control water pollution.

1. Strict check should be maintained on the quality of drinking water.
2. Improved methods for handling and disposal of sewage garbage and
3. Right soil should be introduced.
4. To control the epidemics and other disease.
5. Proper methods of sterilization of water drawn from shallow wells, should be developed.

Recycling the wastes :

The effluents from industries should be neutralized and properly treated before being discharged into streams. Suspended matter should be removed by settling or filtration and specific poisons should be removed by chemical method.

NEERI (National Environmental Engineering Research Institute) has devised a very cheap and unconventional process of sewage treatment in specially constructed large swallow ponds. These ponds are known as oxidation

or stabilization ponds. Domestic or industrial wastes with organic nutrients are stored in these pits in dilute condition for few days. In the presence of sunlight and organic nutrients, the medium flourishes with green algae and colonies of bacteria. The bacteria digest the organic waste and water is purified. This water is rich in nitrogen, phosphorus and potassium and can be used as irrigation water.

Removal of pollutants :

Various pollutants (radio active , chemical, biological) present in water can be removed by appropriate method such as absorption, electrodialysis, ionex-change, reverse – osmosis etc. Reverse- osmosis is based on the removal of salts and other substances by forcing the water through a semipermeable membrane under pressure exceeding osmotic pressure. Due to this flow occurs in reverse direction for this we use a power membrane that attracts the solvent and repulses the solute. Reverse – osmosis commenly used to desalinate the brakish water and can also be used for purifying water from sewage.

Council of scientific and Industrial Research new delhi could devise the following technique for successful removal of different pollutions from water.

Ammonia :

This could be removed from waste water of industry by ion exchange technique. There is developed a weak acidic cation exchange which removes NH in form of ammonium sulphate. This can be used for fertilizers.

Mercury :

This could be removed from chlor- alkali effulent plants by using mercury – selective in exchange resin.

Phenolics :

These could be removed from waste waters of pulp and paper mills, carbonization plants, petroleum refineries, tanneries and resin plants by use of polymeric absorbents.

The waste from printing and sari dying industries could be decolourised by an electrolyte decomposition technique.

Sodium Salts

These could be removed by reverse osmosis method. Sodium sulphate from a rayon mill effulent could be easily removed. The water for resuse could also be recovered by this method. From chees whey, we may recover 80% of protein and 80% of lactose by this method.

4.4.2 Air Pollution

Introduction :

It is the addition of particulate matter, gases and other ingredients into air which can produce an adverse effect on human beings, animals, vegetation, human assests and resources. Air forms nearly 80% of man's daily intake by weight pollution it is not a new problem. Primitive man too introduced foreign substances in to the air by way of burning and other activities. The adverse effects of air pollution are well known our existence in a pollution free urban atmosphere is still far beyond our reach at the present time. Indias main problem of atmospheric pollution is due to the fact that 80 % of industries in this country are concentrated in 10 or 12 big cities forming isolated pockets. Industrial chimneys, power houses, burning of fuels, autoexhausts, etc. emit such a pollutants in to the atmosphere as suspended matters like smoke, dust and sprays, So_2, Co,nitrogen oxides, fluorides, silicon, tetra fluoride and foul odours.

In Bombay where the industries are concentrated pollution rate is 3 to 6 times higher than that in other areas of city. Recently leakage of MIC (Methyl isocyanate) gas form the carbide plant is Bhopal caused a great havoc in which thousands of human lives and animals were lost and big populations were rendered disabled besides great damage to vegetation in the affected area. The effects of most commen air pollutants on respiratory disease.

Major source of atmospheric pollution are

i. combustion of fossil fuels in homes, factories, thermal plants, automobiles, aircrafts, railways etc.
ii. mining processing
iii. chemical industries
iv. processing industries
v. forest fires, agricultural burning
vi. coal, fuel oil, natural gas and wood fuel combustion.

Particulate matters:-

It consist of soot, flyash, dust of various types, fur , hair , spores, pollen grains etc. solid and liquid aerosols suspended in the atmosphere are referred to as particulate matters. Particulate matter matter is differentiated in to settleable (larger than 10 km) and suspended less than 10 km SPM (suspended particulate matter) is maximum in Calcutta. Tokyo is the most polluted city of the world. It is differentiated in to aerosol less than 1 km dust more than 1 km and mist liquid morethan 1 km. particles of 2 -4 km size are mostly deposited in the respiratory tract.

Soot : In complete burning of carbohydrate smoke, flyash (fine particulate matter passed out along with gases during burning of coal) and dust deteriorate the quality of articles log stomata, cover leaf surface, produce allergic reactions, especially bronchial asthma, particulate matter from processing industries (e.g. cotton dust, iron mill dust, mine dust, flour mill dust, gem grinding) causes byssinosis, emphysaema, siderosis and other pulmonary problems.

Dust and smoke produce smog :

i) Carbon monoxide and carbon dioxides

It produce due to in complete combustion and naturally by plants as well as animals. 70 % emission are form automobiles. Carbon monoxide is a colour less odourless gas. It is a non irritant but is highly toxic and impairs respiration. Carbon monoxide combines with haemoglobin produce carboxyhaemoglobin or COHb at 50 ppm, Co covers 7.5 % of haemoblobin in to carboxy haemoblobin , with 8 hours. It impairs oxygen transport resulting in giddiness, headache, decreased vision, cardiovascular malfunction and asphyxia.

Carbon dioxides is a green house gas the concentration of which is constantly rising (0.033 from o.029 and expected to be doubled by 2020). In excess itcauses headache and nausea, with increased in excess un absorbed Co_2 could have a catastrophic warming effect on the atmosphere, melting of polar ice, change in the ecosystem of seas and even floods on an undreamed scale.

H_2S

It is a product of putrefaction, treatment of sulpher containing over, refineries, chemical plants and bituminous fuels. It causes mottled chlorosis and defoliation in plants, de colourises paints, produces eye irritation, throat irritation and naurea.

Hydrocarbons :

They are produced naturally (eg. Marsh gas) as well as due to incomplete combustion. Many hydro carbons are known to be present in the atmosphere as pollutants. Natural sources of hydro carbons are largely biological. World wide methane production mainly form anaerobic decay of organic matter probably amounts to one billion metric tons annually. Some plants produce volatile tarpenes. In urban areas, ethylene is known to inhibit the plant growth. Hydrocarbons are carcinogenic, cause irritation of eyes and mucous membrane and bronchial construction. There is increased mucus

secretion and tearing of alveoli. They give rise to secondary pollutants with nitrogen oxides. Methane (Marsh gas) has the potential to destroy ozone.

Sulphur Dioxides :

It is produced during combustion of fossil fuels and smelting of sulphur containing ores. Sulphur dioxides produces smog. This is most important air pollutant which is colourless, non flammable gas with pungent irritating odour. About one third of So_2 present in the atmosphere is believed to be produced by man's activity. So_2 present in atmosphere comes largely from coal and petroleum combustion. Biologically produced H_2S when oxidized produced So_2.

It causes membrane damage destruction of chlorophyll (change to phaeophytin), necrosis and water soaked appearance. Lichens are most sensitive to So_2 pollution. Mosses and garden pea are also destroyed. So_2 corrodes metals, equipment, damages buildings, marble, paper and textiles. It produces eye irritation damages respiratory tract. So_2 along with nitrogen oxides produces acid rain that destroys vegetation and degrades various articles (like So_2). They would convert. Ca Co_3 (marble) in to calcium sulphate and calcium nitrate.

Nitrogen oxides :

They are formed electro photo – chemically in air, burning of fossil fuels and denitrifying bacteria. Maximum No_2 pollution is recorded from Baroda. It is estimated that biological production of No and No_2 amounts to about I billion metric annually while man's combustion processes produce 48 million metric tons No_2 annually. Nitrogen oxides causes necrosis, defoliation, dieback and death of plants. Like So_2, they corrode metals and deteriorate paints as well as various article. The oxides produce injury to liver kidney lung oedema dilation of arteries.

Fluorides :

They are given out during refining of minerals (e.g. alumunium) as also from ground water. In minute amounts, fluorides are beneficial helping prevention of tooth-decay in man. How ever, higher leves become toxic. It is also comes atmosphere from industrial process of phosphate fertilizers, ceramics, aluminum, fluorinated. Hydrocarbons. The pollutant is in gaseous or particulate state.

In particulate form it is deposited hear the vicinity of emission where as in gaseous form becomes dispersed over large areas. Fluorides causes fluorosis. In plants there is chlorosis and necrosis of leaf tips and leaf margin,

followed by abscission. In human, there is mottling of teeth, weak bones, boat shaped posture, knocking knees, gastro intestinal problem.

Chloro fluoro carbons / chloro fluoro methane / Feron / Aerosol :

They are chemical used as refrigerants, propellants and solid plastic foams. The chemicals are released as aerosols by jets flying at high altitudes. Along with nitrogen oxides chlorofluoro carbons react with ozone of ozonosphere and deplets the same. This can increase the amount of ultra violet radiations reaching the earth. The supersonic air crafts flying at stratosphere heights cause major disturbance in O_3 levels. The threat to O_3 is mainly from CFC_5. which are known to deplete 0_3 by 14% at the current emission rate. The nitrogen fertilizers release nitrogen oxide during denitrification. Depletion of O_3 would lead to serious temperature changes on the earth and consequent damage to life support system.

Photo Chemical Product :

There is much interlinking of No_2 hydrocarbons and O_3 in the atmosphere. These individually are recognized air pollutants. How ever, at the same time in presence of light as a result of photo chemical reactions these may react with each other and / or may undergo transformation to produce even more toxic secondary pollutants in the air. There are also same other pollutants. The principal photo chemical product are ole fine oldhyde, ozone, PAN and photo chemical smog.

Ole Fimes :

Are produced directly from exhaust and in the atmosphere from ethylene. They wither the sepals of orchid flowers, retard the opening of carnation flowers and may cause droping of their petals.

Among the photo chemical products the aromatics the most potent pollutants. These are benzpyrene, peroxyacetyl nitrate (PAN) and peroxy benzoil nitrate (PBzN). Benzpyrene is carcinogenic, PAN is a potent eye irritating but less lethal, PAN is produced due to reaction between Nox and hydrocarbons under effect of UV radiations of sunlight, when O3 is also formed. Photo chemical smog is highly oxdising polluded atmosphere comprising largely of O3, No_x, H_2 O_2 organic peroxides, and PAN.

Some sulphates and nitrates can also be formed in photo chemical smog due to oxidation of sulpher containing components ($S0_2$, H_2S) and Nox (N_2o5, No_2). HNO_3 and nitrates are important toxicants of smog. They cause damage to plants human health hazards and corrosion problems. Photo chemical smog adversely affects plant, human health and materials. The

oxidants enter as part of inhaled air and after, impair or interfere with respiratory process and other process.

Other Air Pollutants :

A number of other minor emission such as vapour resulted from Cosmetics, the smoke from tobacco products, aeroallergens (spores and pollen grains) which Cause allergy in some persons are also regarded as air pollution. Mercury (burning of Coal, Smelting), methyl isocyanate (Pesticide, manufacture), phosgene (pesticide manufacture, dyeindustry), ammonia (fertilizers and lacquer industries) and lead (automobile exhausts) are added to atmosphere though they may not reside in them. Bhopal gas tragedy was due to release of phosgene and methyl isocynate (MIC).

Automobile Exhausts :

Automobiles burn petroleum inefficiently causing 80% of air pollution and 75% of noise pollution urban areas. They release hydro carbons (13.7%), carbon monoxides (77.2%) , Nitrogen. Oxides. (7.7%), sulpher oxides, ammonia, aldenydes and lead (99% of total lead poisoning). Lead is present in petroleum in the form of $Pb(CH_3)$ 4 tetra methyl lead and Pb $(C_2 H_5)4$ tetra ethyl lead as antiknock agent.

Smog :

Smog is opaque or dark fog having condensed water vapours, dust, smoke and gas (So_2, H_2S, No_2 etc) It causes silvering / glazing and necrosis in plants, allergies and asthma bronchitis in humans. Many of the products of incomplete combustion of petrol and diesel under go photo chemical reaction with oxides of nitrogen to form photochemical smog. Growth of lichen trees is inhibited by air pollution. Hence lichen can serve as pollution indicators. Clean air is indicated by abundance growth of lichen.

Acid rain

It is rainfall and other forms of precipitation with a P^H of less than 5. The most acidic rain has occurred over west Virginia. It is caused by large scale emission of acidic gases into atmosphere from thermal power plants, industries and automobiles. The common ones are sulpher dioxide, nitrogen oxides and hydrogen chloride.

Sulphur oxide and nitrogen oxides are changed in the atmosphere in to sulphuric acid and nitri acid by combining with oxygen and water.

Acid rain damages plants by direct effect on foliage and growing points chlorosis, necrosis, defoliation dieback. It causes leaching of essential mineral of soil. Acid rain corrodes metals, marble, painted surfaces, slate, stone etc. the phenomenon is called stone leprosy.

Ozone Depletion

Ozone layer or shield is present in the stratosphere. It protects the earth from short wave ultraviolet rays (below 300 nm) by changing the same into infra- red rays. Thinning of ozone shield has also been reported elsewhere (eg 8% between 30–50 N) Depletion of ozone layers allows harmful Uv – radiations to reach earth . It is the major cause of skin cancer, cataract, dimming of eye sight, decrease in immune system and increased susceptibility to herpes.

Thinning of ozone shield is being caused by a number of pollutants like chlorofluoro carbons (14% of total depletion) nitrogen oxide (3.5% depletion) sulpher dioxides , halon, carbon tetra chloride , being fired into space. Other are persistant in the troposphere and gradually pass into stratosphere.

Maximum ozone depleting potential or ODP is of chlorofluoro carbon due to release of chlorine by it. A single chlorine atom converts 1 lakh molecules of ozone in to oxygen. Consequently chlorofluoro carbons (CFCs) are being replaced by hydrofluoro carbons (Hcl FCs). Carbon tetrachloride halogen and methyl chloroform also deplete ozone by a similar method. Nitri oxide (NO) and other gases released by jets directly react with ozone to form oxygen.

Control measure of air pollution :

- Two stroke engines fitted in two wheelers (waste fuel 20-30 %) be change to either four – stroke engines or fitted with catalytic converters specially designed for them.
- Leaded petrol replaced with unleaded one and diesel with low sulphur diesel.
- Tune ups (for high air fuel ratio) and catalytil converters (for oxidising co – Co_2 and reducing No – No_2) be fitted in automobiles.
- Periodic checkup of pollution control for all vehicles.

Fly ash :

About 38 % fly ash produced by coal based thermal plants. It should be removed through wet method and used in building material.

Industrial pollution control measure

i. **Tall chimneys :** they disperse smoke more thoroughly
ii. **Gravity settings chambers particles :** larger than 50 km settle down.
iii. **Wet scrubers :** a fine spray of water or alkaline fluid is used to remove soluble gases and particles.

iv. Electrostatic precipitation **(ESPs)** They are electrically charged plates or electrodes which remove most of the particles present in chimney exhausts.

Control through vegetation

A broad strip of vegetation along road and around industrial areas reduces particulate pollution. Vegetation can also metabolise toxic gases like co (eg. Ficus, coleus, daucos, phaseolus) and nitrogen oxides (eg. Vitis, Ayrus, Aobinia, Ahamnus). Industries should be zoned and population establishment should be kept well out of the danger zones around industries.

4.4. 3. SOIL POLLUTION

Introduction :

Soil provides habit for plants animals including human being. Like other environment factors such as water and air, soil is also very much polluted. It is alternation in soil caused by removal or addition of substance . and factor which decreases its productivity, quality of plants and ground water. Negative soil pollution is reduction in soil productivity due to erosion and over use. Positive soil pollution is reduction is soil productivity due to addition of undesirable substances (Eg. pesticides, fertilizers industrial wastes, air pollutants washed down by rain, faulty sanitation). Landscape third pollution is converting fertile land in to barren one by dumping wastes, (e.g. ash, sludge, garbage, rubbish, industrial wastes, broken cans bottles etc.,)

The following pollutants causes the soil pollution

Pesticides :

They in chide insecticides, fungicides algaecides, rodenticides and weedicides. Pesticides are generally broad spectrum and function as biocides. The increase in the usage of pesticides, particularly in secticides, has mounted considerably in recent year. The careless use of pesticides by farmers are contaminating food stuffs and posing a health hazard insecticides and pesticides pollution has been greatly aggravated unnecessary aerial spraying of the entire landscape modern pesticides are primarily of the organic type, they are either chlorinated hydrocarbons or D.D.T. chlorinated hydro carbons when washed away with rain water destroys larval stages. Of valuable aquatic food organism and also depress the photo synthetic activity of phytoplankton. These have the direct effect on the hormonal balance in man.

Organo chlorides/ chlorinated hydrocarbons :

The important ones are DDT (dichlorodiphenyl trichloroethane), BHC (benzene hexa chloride) aldrin, dieldrin and endrin. They are persistent, fat saoluble and show biomagnifications whence they. Prove harmful to higher

tropic level organism. Hence their use is restricted. Organo pesticides. it is degradable, but toxic to workers. and in organic pesticides contain arsenic and suppler persistent. Hence their use is highly restricted.

Fertilizers :

Fertilizers are good to boost the food production But the inorganic nitrogen fertilizers threaten to disrupt the natural nitrogen fixing bacteria . which take nitrogen from the air and convert them into useful soil materials. But usage of inorganic nitrogen kills these bacteria and the quality of soil deteriorates and ultimately the crop yield declines. The un used fertilizers very often drains out into rivers and lakes where it join with nitrates imposed on water by sewage effluent. This leads to over growths of green plants resulting in organic pollution. The lakes get checked and die. The excessive use of fertilizers causes soil deterioration through decrease of natural micro flora. Salt entering crop plants in excess may prove harmful for example nitrate rich leaves, fruits and water produce nitrate in alimentary canal that enter bloods, combines with hemoglobin forming met- haemoglobin and reducing oxygen transport. It may prove futal in infants organic farming involves use of bio fertilizers, manures , pesticides of organic origin, biological control and resistant verities.

Industrial effluents/wastes:-

They contain number of toxic substances including cyanides, chromates, acids, alkalis and metals like mercury, copper, zinc, lead, codmium etc.

Mine Dust :

It destroys vegetation and produces many deformities in animal and human beings.

Soil Salination :

It is increase in salt concentration of soil making the soil halomorphic salination is often accompanied by white incrustation over the surface. It makes the soil barren. Only halophytes can grow over it. Soil salination is caused by the following factors.

i. parent rock
ii. ii) poor drainage and elevated water table.
iii. salt rich ground/ canal water.
iv. Excessive fertilizers.
v. salt blown rocks/ sea.
vi. plants that absorb ions.

In India, 6million hectare soil is saline. They can be reclaimed by addition of gytosum related chemicals, trenches and proper drainage, growing salt tolerant plants and blue green algae.

Recycling wastes:-

Sludge from sewage treatment plants be burnt along with coal. Organic wastes be composted or employed in biogas plants. Paper, plastics and metals are now recycled. Agricultural wastes are used in manufacture of paper, hard board, animal feed etc.

Soil Erosion :

Removal of natural plant cover by deforestation, over grazing, improper tilling and over cropping make a soil prove to erosion by wind and water. soil erosion denudes additional 40,000 ha of land annually in India.

Desertification :

It is the conversion of fertile land into barren sandy tract. Desertification is due to

Over grazing

a) Drying of rivers/ irrigation canals/ dry weather
b) Clean tilling, firre and felling of trees.
c) Nearness to sandy beach, sand storms and shifting sand dunes.

Control of Soil pollution

The soil pollution caused through different agencies can be reduced by various methods. The soil pollution due to sewage can be reduced by giving microbial or chemical treatment during chemical treatment methane gas is evolved which is used in generating power. The sludge recovered after the separation of water is dried and used as manure. The soil pollution caused due to cattle fecal matter in our country is used to produce bio-gas or gobar gas. The gobar gas is mainly of methane and Co_2 used for cooking and illumination. The Solid waste is collected and suitably recycled. Some of the waste is recycled into biogas. The sewer gas is also a mixture of methane and Co_2 the former is separated and used for heating purpose. Proper efforts should also be made to reduce the toxicity level of soil. It is necessary to utilize more land for agriculture, pastures and foreste.

The soil pollution due to pesticides can be reduced by using biodegradable chemicals. Instead of DDT methoxychlor be used which is biodegradable. Intact, Chlorinated pesticides should not be used. Instead of synthetic insecticides, a few plants can be used as insecticides such as Azadiracta indica, Bambusa arundinacea, Cannabis Sativa, Nicotiana tobaccum, Ocimum basilicum, Ricinus communis etc,

4.4.4 NOISE POLLUTION

It is a physical form of pollution that affects the receiver directly. In addition to the disturbances caused by air pollution, a new kind of disturbance has come in to prominence . This is Noise pollution unwanted sound. It has been regarded as urban pollution.

It has become serious in urban areas due to over population different kinds of sounds produced by mankinds. Noise pollution due to release of unwanted sound generally with the value of 80 db and above. Frequency of sound is measured in Hz (Hertz) while unit of sound in dB(decibel)

Range of human hearing is 20 Hz to 2000 Hz . Infrasonic vibrations (below 20 Hz) are used in imaging , clearing, drilling cutting welding and sealing.

The aero planes, trains, cars, radio and television sets have in common. They all produces noise , the most dangerous pollutant of mans environment . Noise has become a permanent part of our lives these days because of the development of machinery, industry and technology. Noise harms to the body and mind. The word noise (Latin nausea) is usually defined as unwanted or unpleasant sound that causes discomfort .

Formerly noise was limited only to the industry. This too was not much as there were only few industries. These days there has been rapid industrial growth. Moreover there has been population explosion due to which there is heavy traffic, urban crowd and electric equipment . all these have added to the noise nuisance in environment.

Source of noise pollution :

The main contribution to noise are factories and industries, transportation (air, rail, road) and community and religious activities. The chief man made source in urban areas are automobiles, factories, industries, trains, airplanes. Increased of automobiles booming of jet planes and crowded street in urban are one of the main source of this pollution.

Noise makers are horns, sirens, lawn mover, musical instrument, tv, radio, telephone, dogs, loudspeakers, washing machine, food mixers, pressure cookers etc. ever since the industrial revolution there has been doubling every 10 years environmental noise.

Effects of noise pollution

1. Auditory Effects

These includes auditory and deafness. Auditory fatigue appears in the 90 dB and may be associated with side effects as whisling and buzzing in ears.

Deafness can be caused due to continuous noise exposure. Temporary deafness occurs at 4000-6000 hz. Permanent loss of hearing occurs at 100 dB.

Non auditory effects :

1. interference with speech communication

A noise of 50-60 dB commonly interfers with speech, sound of warning (signal) may be misunderstood.

2. Annyance :

Balanced persons express great annoyance at even low levels of noise as crowd, highway radio etc. the effects are ill temper, brickering etc

3. Loss in working efficiency :

there develop a tiredness and those doing mental work may put to deterioration in their efficiency or even complete loss of ability to work.

Physiological disorders :

There develop a number of physiological disorders due to imbalance in functioning of the body. These are neurosis, anxiety, insomnia, hypertension, hepatic diseases, behavioural and emotional stress, etc. Noise also causes visual disturbance and reduces depth and quality of sleep thus affecting over all mental and physical health continuous noise cause an increase in cholesterol level resulting in the construction of blood vessels making you prone to heart attacks and strokes.

- Damage to ear drum and impairment of hearing a ten year exposure to 80 dB impairs hearing by 15 dB .
- Interference in conversation and hearing.
- Emotional disturbance development of anxiety and stress (first affect).
- damage to eye sight colour perception high vision etc.

Control of noise Pollution :

- This can be done by designing and fabricating silencing devices in air craft engines automobiles industrial machines and home appliances and by segregating the noisy machine.

- These can be achieved by covering the rooms walls with sound absorbers as acoustic tiles and construction of enclosures around industrial machinery.
- In some of the busiest aeroderms the time for taking off jet planes were regulated so as not to disturb the sleep of citizens in the near by areas.
- Industrial must be established from the residential areas.
- Usage of horns must be banned in many areas of cities where school and hospitals are located. Usage of loud speakers must be strictly controlled as not to disturb the neigbhours.
- Public must be made aware and educated about noise nuisance through adequate news, media, lectures and other programmes.

Self Assesment Question – I

1. Water Pollution Caused by_____
2. Sewage wate can be purified for recycling with the action of

   1. Aquatic Plants 2. Penicillium

   3. Micro-Organism 4. Fishes
3. Photochemical smog is related to the pollution of

Self Assesment Question – II

1. Expantion of ISW _____
2. BOD Stands for_____
3. Acid rain caused by _____

Unit Questions ;

1. Define Pollution
2. What are the different types of Pollution give example for it
3. Briefly explain the Air pollution and its control measures

Answer for Self Assessment questions : I

1. Industrial Effluent
2. Micro-organism
3. Air Pollution
4. Biological oxygen demand

Answer for Self Assessment Questions II

1. Industrial solid waste
2. Biological Oxygen Demand
3. So_2 & N_2o_2

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UNIT – V

PHYTOGEOGRAPHY

Introduction

- Approaches to Phytogeography
- Principles of Phytogeography
- The Phytogeographical regions of India

Vegetations of India

Vegetations type in Tamil Nadu

Self Assesment Questions: I

Self Assesment Questions: II

Answer of self Assesment Questions : I

Answer of self Assesment Questions : II

Unit Questions :

References

UNIT – V

PHYTOGEOGRAPHY

5.0 Introduction

Phytogeography is the science dealing with the origin distribution and environmental interrelationship of plants. All plants, animals and microbes are living together in the biosphere of the earth. Some organisms are extinct now. The study of origin and distribution of organisms that present in the past and present is called biogeography. Biogeography is divided in to two groups, namely plant geography or phytogegraphy and animal geography or zoogeography plant geography is the study of the geographical distribution of plants and of various factors involved in their distribution, Alexander von humbold (1806) is the father of plant geography.

According to campell (1926) the main theme of plant geography is to discover the similarities in the plants and floras of the present and past found in widely separated parts of the earth, according to croizat (1952), phytogeography is the study of migration and evolution of plants in time and space.

5.1 Approaches of Phytogeography :

There are two major approaches to the study of phytogeography 1. Descriptive, 2. Interpretive phytogeography, Descriptive other wise known a static phytogeography and Interpretive geography other wise known dynamic phytogeography descriptive type. This deals with actual description of floristic or vegetational groups found in different parts of the biosphere. Interpretive type deals with the dynamic of migration and evolution of plants and Floras. It explain the respons for varied distribution of plant species in different parts of the biosphere.

5.2 Principles of Plant Geography :

The distribution and composition of various plant existing in the world differ from area to area and season to season. Solt was very difficult to explain the distribution of plants after the collection of data about plants found at different region of the world. The principles of plants geography grouped into four major categories.

- Principles relating to plant responses.
- Principles relating to environment.
- Principles relating to perpetuation and evolution of floras.
- Principles relating to the migration.

I. Principles relating to plant Responses.

Range of distribution of plants is limited by their tolerance each plant species has a range of climative and edaphic conditions. There fore tolerance of a large taxon is the sun of tolerance of its constituent species.

Tolerance have a genetic basis. The response of plant to environment is governed by their genetic make many of the group through breeding and genetic changes have be made to grown in wider environmental conditions. Different on to gentic phases have different tolerance. Different development stage of plant show different degree of tolerance, as for example seeds and nature plants are more tolerance to temperature and moisture various than their seedlings.

II. Principles relating to environment :

These principles are concerned with environmental factors in relation to the distribution of plants. These principles state that the distribution of plants is determined mainly by the distribution of climatic condition in the area.

Parallelism Between climate and vegetation.

Generally plant grow well and spread rapidly when climate of the area is suitable for their growth. Climate factor allows a suitable type of vegetation to reach climate stage. The major type of vegetation tropical rain forest have tropical climate, Cold temperature forest have tropical climate warm temperature broad level forest have warm temper at climate.

Oscillation of Climatic Conditions :

Climatic conditions have shown great oscillation and vegetation during the geological parts. This oscillation caused fluctuation in the temperature especially at higher latitudes.

The distribution of plants is primary controlled by climatic conditions. Biotic factors also play important role in distribution and establishment of plant species.

The sea surrounding the land mass acts as migration barrier to check the speading of plant from one land mass to others edaphic. Conditions such as composition, texture depth, moisture and aeration of soil, determines types of vegetation in an area.

III. Principles relating to Migration of floras:

Great migration have taken place, the fossils and palaeogeographical evidence revels that large scale migrations of plants and animals have taken place during Mesozoic era and tertiary periods.

Migration resulted from transport and establishment :

In the process of migration plants are dispersed to new habitat through their propagules. Such as spores, seeds, bulbils etc., and there they are Established if environmental conditions are favorable.

IV. Principles relating to perpetuation and evolution of floras :

Perpetuation depends first upon Migration and secondly upon the ability of species to transmit the favorable variation to the progenies. Evolution of floras and climaxes depends upon migration evolution of species and environmental selections.

5.3 Phytogeographicl Regions In India

Nature of vegetation plant distribution and abundance determined by the climate as India sub-continent is characterized with a variety of climate type, flora of the country is also correspondingly of different types in different parts, climate geology and biotic factors are the environments factors. Phyto geographically Indian Botanical regions divided into following parts.

1. Western Himalayas.
2. Eastern Himalayas (Eastern)
3. Indus Plain
4. Gangetic Plain
5. Central India
6. Deccan
7. Western Coats of Malabar
8. Assam
9. Andaman and Nicobar Island.

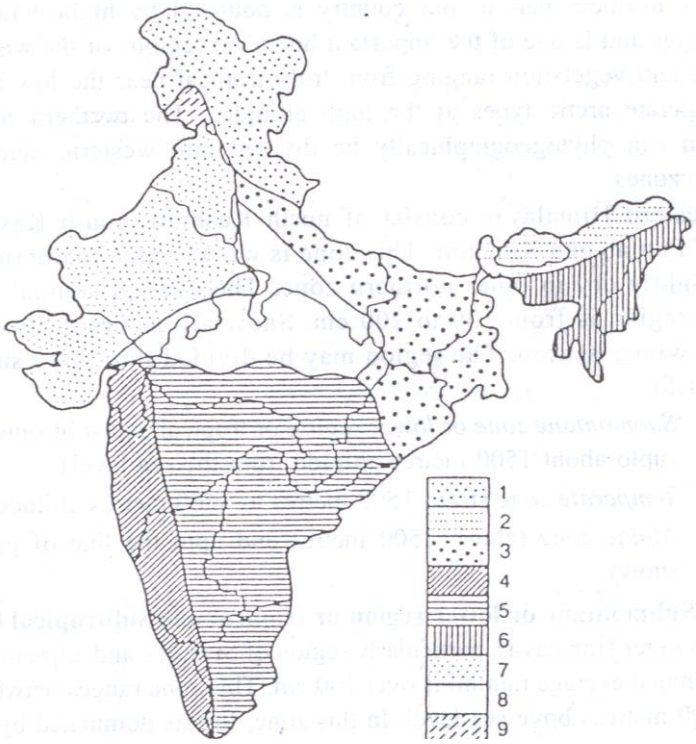

Fig : 5.0 Vegetation of India

1. Western Himalayas

It extends from central region of kumaon to north west region of Kashmir. Here annual rainfall of 40-80 inches. There is a good deal of climatic variation as the altitude increases. This zone is wet in outer southern ranges and slightly dry in inner northern zone. Snowfall occurs in this region during winter season. the western himalaya has three climatic belts. (Fig : 5.0)

i. Sub montane zone or basal region.

ii. Temperate zone

iii. Alpine zone.

i. Sub montane zone or basal region.

This region forms the foot of Himalayas. The annual rainfall is 1000mm. from about 1000 to 5000 ft. Above sea level in regions of swanlike and adjacent area. This zone ranges between 300 meters and 1500 meters. This forest is dominated by timber trees of shorea robusta. Trees like. Artocarpus, cedreca ,toona, salmalia, Buteasp, zizypus , carissa, Acacia, Euphorbias.

ii)Temperate zone:

It commonly ranges at the attitudes form 1500 to 3500 meters about the sea level it receives less rain fall and the temperature is low. The annual rain

fall may be 40 inches many coniferous species of pines, cedru , Quercus and Rhododendron, Taxus, Abies pindrow.

iii) Alpine zone:

It is the limit of tree growth at about 12,000 ft. The vegetation consist of evergreen conifers and some low and broad leaved trees. In lower alpine region, shrubby forests are common which may be junipers, Rhododendron, Astragalus, Primula potentilla, Aster exc.

Eastern Himalaya :

The eastern Himalayas extends from the region of sikkim to upper assam. In this vegetational zones. It is similar to the western Himalayas. The eastern Himalayas has more tropical elements, greater variety of oaks and Rhododendrons and less of conifers than the western Himalayas.

The environmental factors as heavy monsoon rainfall less snowfall and high temperature and humidity. On the basis of the altitude, Eastern Himalayas is divided into three zones.

i. Sub Montane Zone
ii. Temperate Zone
iii. Alpine Zone

i. Sub Montane Zone :

It extends from the plain foot of the hill up to 6,000 ft, altitude. The vegetation is of mixed forest of evergreen type. The important plants are Terminalla, Bauhinia, Albizzia, Salmalia, Artocarpus, bamboo, michelia champak etc.

ii. Temperate Zone :

This region extends from plants to an altitude of 5000 ft to 11,000 feet. The lower region has several species of oaks, such as Quercus, michelia, cedrela and Eugenia and Abies junifers etc.,

iii. Alpine Zone :

The dominant plants are shrubs and meadows. It is above 12,000ft. where vegetation is devoid of tree. Shrubby growth of junifers and Rhododendron is found in grassy areas. This type of vegetation occur in China, Japan, Burma, Malaya.

3. Indus Plains :

Indus plain has annual rain fall less than 70cm. the climate is characterized by very hot and dry summer and cold winter. Much of the lands has become desert due to excessive dryness, vegetation is mainly bushy and

thorns. Acacia arabica, capparis, Prosopis, Zizypus, Tecomella, Salvadora, Calotropis, Elausine etc.,

4. The Gangetic Plain :

The climate factors Such as temperature and rain fall together are responsible for type of vegetation. The rain fall in this zone is from 50cm to 150cm. it is a fertile region which includes eastern Punjab to sunderbans in Bengal, Bihar, U.P, part of Orissa, some of common plants are capparis apylla, Acacia nelotica, Madhuca indica Cordia, Sterwlaria urens, Mangifera indica, Terminalia, Ficus bengalensis etc.,

5. Central India :

It covers M.P. Part of Orissa, Gujarat, and Vindhya. The areas are hilly. The annual rainfall may be 100-170cm. forest develops into thorny mixed deciduous and Sal types. The common plants are Bauhinia, Mango Phyllanthus, Terminala tomentosa, Acacia, Zizypus Focus glomerata etc.,

6. Deccan :

It includes southern peninsular india including satpura and southern part of godawari river. The annual rainfall 100cm and it cover Andra Pradesh, Tamil Nadu, Karnataka. The vegetation is represented by santalum album, magnolia, michelia, prunes, capparis, phyllanthus,

7. Western Coats of Malabar :

In the region includes the western coats of India and Extends from Gujarat in the north of cape comer in south. The rain fall is heavy. The vegetation is four types. i) Tropical Forest, ii) Mixed deciduous forest, iii) Temperate ever green, iv)Mangrove forest. The tropical region has very luxuriant and multistoreyed vegetation. The common plants are Berberis, Rhododendron, Tectona grandis, Ranunculas, Gardenia and Eurya japonica etc.,

8. Assam :

The temperature and wetness are very high. The annual rain fall 1000cm or more. Tropical evergreen forests are abundant in this region. This vegetation and covers valley of Brahmaputra, Naga hills and Manipur, some common plants are magnolis, Rhododendron, Alnus nepalensis, calamus, ficus elastica, stercularia allta etc.,

9. Andaman and Nicobar Island:

In this region of the Bay of Bengal from this region. Tropical wet evergreen forests and tropical moist deciduous forest are common in this region. It has a wide range of spreading coastal vegetation like margroves seeth forests and in the interior evergreen forests of tall trees. Climate is humid in the

coastal region. The common plants are calophyllum, Mimusops, Rhizophora, terminator, and Dipterocarpus etc.,

5.4 Vegetation of India :

Vegetation is the total plant cover of a region or area or place. Geographically, India is a tropical country but whole of the Gangentic plain lies outside the tropics. The vegetation of India has been broadly divided into forest vegetation and grasslands. In forests several kinds of trees, herbs, shrubs, climbers and some grasses form a luxuriant growth. On the other hand, grassland vegetation has luxuriant growth of several grasses. Therefore, the vegetation of the country that we see around us are much interfered. The most important factors used in the classification of vegetation are rainfall, temperature, biotic influence, and life forms Besides climatic factors, soils upon which vegetation is found greatly determine the nature of vegetation. Depending upon the climate, the vegetation of India maybe divided into

i. Tropical
ii. Sub Tropical montane forest
iii. Temperate montane forest
iv. Alpine

There was about 33% forest area in India. But now the forests cover only 24% of the total area. Man has been destroying the natural forests for getting his household materials, and houses, raw materials, medicines and for getting land for agriculture.

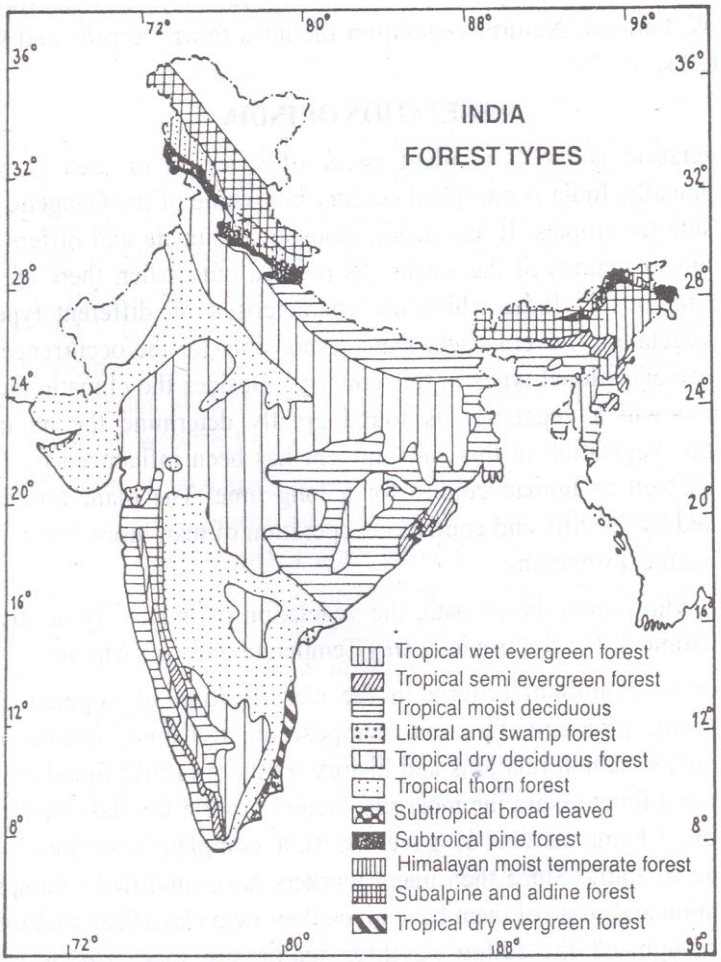

Fig : 5.1 India Forest Types

1. Tropical Forests. (Fig : 5.1)

Common in the warmer plains, ranging from very dense, multistoried of diverse trees, shrubs and lianas in area of high rainfall to dry, scrub jungles of thorny bushes in isolated patched in dry areas. The great majority of the forests found in India are of this type. Tropical forests are of two types.

A. Tropical Moist Forest :

Tropical Moist forest again divided into four types on the basis of wetness.

a. Tropical Moist evergreen forests.

b. Tropical Moist semi-evergreen forests.

c. Tropical Moist deciduous forests.

d. Littoral and swamp forests.

a. Tropical moist evergreen forests :

The annual rainfall is over 250cm as in Tamilnadu, Kerala, Karnataka, Andaman, Western Ghats, Assam, Orissa, West Bengal the forest vegetation in dense and luxuriant. The dominant members are such trees are mangifera, Michelia, Artocarpus, Eugenia, Dipterocarpus, Shorea, Ixora.

b. Tropical Moist – Semi evergreen forests :

These forests are found along the western coasts, eastern orissa and upper Assam where annual rainfall is 200cm. the dominant tree grow up to 40m. deciduous trees are intermingled with evergreen species Epiphytes and climbers are common. There are some semi evergreen plants. Terminalia, Daemia, Pterocarpus, Amoora, Elaeocarpus, Albizzia, Crotalaria and some orchids.

c. Tropical Moist deciduous forests :

This type forest cover an extensive area of the country receiving sufficiently high rainfall 100 to 200cm. many plants of such forests show leaf fall in hot summer climbers also present. ex. Bauhinia, Caesalpinia. The dominant trees grow up to 40m height, and they remain leafless at least for 1-2months, example Terminalia, Paniculata, T. bellerica Dalbergia latifolia, Tectona grandis, Adina cordifolia, Bombax, Indigo fera etc. These forests seen in Maharastra, Gujarat, Tamilnadu, Kerala, Karnataka, Andaman, Orissa, West Bengal.

d. Littoral and Swamp forests :

These forests are seen all along the sandy beaches of coastal areas, river deltas, swampy margins of islands, estuaries and dry banks of rivers. Littoral and swamp forests include Beach forest, Tidal forest, Fresh water swamp forests.

Beach forests are found all along the sea beaches and river Deltas. The soil is sandy having large amount of lime and salts but poor in nitrogen and other mineral nutrients the common plants callophyllum littorals, pandanus, Thespesia, Cocos, spinifex littoreas, and number of twiners and climbers. Tidal or mangrove froest grow near the estuaries or the deltas of rivers, swampy margins of island and along sea coasts. Tidal forests has four type with overlapping constituent species.

Tree Mangrove forests	- Avicenna alba, Rhizophorsa
Low Mangrove forests	- Aegialitis rotundifolia
Salt water forests	- Xylocarpus molluccenis
Brackish water forest	- Sonneratia Caselaris

Amoora cuculata, Nipa, Phoenix.

Tropical dry forests :

The plants remain deciduous for major part of the dry season. Species are not gregarious. The dry forests are divided into Northern and southern dry deciduous forests. These are classified into the following types.

i. Tropical dry evergreen forests.

ii. Tropical dry deciduous forests.

iii. Tropical dry thorn forests

a. Tropical dry evergreen forests :

These forests have dense ground vegetation during rainy season and it has abundant shrubs. The top canopy is broken at several places and remain open. The rainfall is in plenty but dry season is comparatively longer these forests seen in Tamilnadu, Haryana, Himachala Pradesh, u.p. Punjab and common species are maba, calotrops, acacia, catchu, Nyctanthes. Zizyphus oenoplia, aegle marelose.

B. Tropical dry deciduous forests :

Most of trees remain leafless for several week in dry season the annual rainfall is low. plants are growing in patches here and there so the vegetation is not continuous. The trees show stunted grown and grow upto 8 to 10 meters height these forest common in Andhra Pradesh, rajasthan, M.P, Harayana, Karnataka, Punjab, Tamilnadu, …. And the common species are Terminalia, zizypus, Dalbergia, Acacia, Hardwickia, Dillenia, Dendrocalmus, Terminalia, Bauhinia, Aegle, Phyllanthus.

Tropical thorn forests:-

These forests occur in the area where annual rainfall is between 20 to 70 cm. dry season is hot and very long. The vegetation is of open type consisting of small trees 8 to 10 m height and thorny and spiny shrubs of stuned growth. These forest commonly occur in part of Gujarat.most of Rajasthan, south Punjab, Tamilnadu, Bihar, Madhya Pradesh. The species of Zizypus, Justicia, Crotalaria, Chrysopogan, Opuntia, Euphorbia antiquarum.

III Sub tropical montane forest:

These type of forest seen on hills of south India, as Nilgiri, Pachmarhi between an altitude of 3000 to 5600 feet. These forest has low rainfall but where temperature differences between winter and summer are less marked. Winter generally goes without rain the composition subtropical forests are almost intermediate between tropical forest and temperature forests subtropical montane forest divided into following types

a. Wet hill broad leaved forests
b. Dry evergreen forests
c. Pine forests.

i. Wet hill broad leaved forests:

The annual rainfall 150-1140 cm . the number of rainy days varies from 54 to 162. they are seen in Karnataka, coorg, parts of Assam, panchmarhi and parts of madhiya Pradesh. The survival plants are Rhudodendron, Dalbergia, Mangifera, Aegle marmelos, smilax, cassia, Randia, Eugenia, Alnus, Lantana.

ii. Dry evergreen forests :

The annual rainfall may 100 to 110cm.they occupy foothill areas of himalaya. The summer is so hot and dry, but winter is cool. They occur in Punjab, Haryana, Jammu and Kashmir. The common Plants are Acacia modesta, Olea, Dedonaea.

iii. Sub tropical pine forest :

The annual rainfall varies from 100 to 300 cm. in these forests pinus forms climax vegetation so that they are called pine forest. They found mostly in western and central Himalayas and in Assam hill and U.P, Nepal, Jammu, West Bengal the dominant species are pinus, Berberis, Magnolia, Niburnum, Andropogan, Quercus, Carissa, Aauhinia, Aalix…

Temperate montane forests

These forest chiefly fond on mountains of Himalayas and Nilgiri. They occur above 5,300 feet altitude. The humidity and temperature are 10 generally rainfall 130-600 cm per year. In Himalayas, oaks and conifers are abundant.

i. Montane wet temperate forest
ii. Himalaya moist temperate forest
iii. Himalaya dry temperate forest

1.Montane wet temperate forests :

The trees produces dense canopy and grow upto 20 m height. The leaves of the trees appear in different colours. The annual rain fall usually 130-600cm. They found Himalayas extending from Nepal to assam at the altitude from 1800-3000 m. As well as the same parts of Nilgris. The forest in south are evergreen and are called shoals. The important plants are Salmelia, Dioscoria, Pterocarpus, Hopea, Rhamnus, Rhododendron.

II) Himalaya moist temperate forest :

These forests develop in the area of lesser rainfall. The trees are high, some times upto 45 m tall. The community found Arunachala Pradesh, u.p.

Himachala Pradesh. The annual rainfall 110 to 250 cm. common plants are Berberis, Quercus, Rhododendron, Pyrus acer etc.,

III) Himalaya dry temperate forests :

Very low rainfall occurs during rainy season also. Snow is main source of water for maintaining the moisture content in the forest soil. These forests dominated by Rhododentron, oks and conifers from a narrow belt at the altitude from 3000 to 4000m the common species, cannabis, fraxinus, fragaria etc.,

IV) Alpine forest:

This type of vegetation is distribution extensively through and the Himalayas about 3000 metres. The tree height becomes lesser with increasing altitude being replaced finally by sparse growth of small plant like sedum, primulla, saxifra, open xerophytic formation spread in u.p, Himachala Pradesh, Punjab, and Kashmir, Artemisia, kochia, eurotia , juniperus common at lower level Alpine forests consists of dwarf trees with or without conifers and at higher level scrubs and only scattered xerophytic shrubs are left to merge with alpine meadows common plant in alpine forests are Pinus, Betularia, Quercus Pyrus Rhododendron and lichens. The annual rainfall between 8 to 65cm.

Mangrove Forests

Mangroves are a special halophytic vegetation. It includes trees and shrubs. This forests grow near the estuaries or the deltas of river, swampy margins of island and along sea coasts about 30 sp of mangrove were reported so far they are widely present in India Malaysia, Africa, pacific islands and madagacar. The presence of proof roots with well developed knees for support and pneumatophores and viviparous germination of seed. Mangrooves forests are highly developed in India Andaman and Nicobar islands. The mangrove plants grow on the soil higher concentration of soluble salts like sodium chloride, sodium carbonate, magnesium chloride and magnesium sulphate, mangrove forest classified into four types.

i. Tree mangrove forests
ii. Low mangrove forests
iii. Salt water forests
iv. Brackish water forests

1. Tree mangrove forest:

The forest floor is flooded with salt water daily plants may grow 10-15 m and form closed evergreen forest. Its western and eastern area have fresh waters. The flora of sunderban forests consists of avicennia, phoenix, aegiaitis, kandelia candel, xylocarpus, savannans are present along the eastern sunderbans.

Low mangrove forests :

Forest is dense but the trees with leathery leaves attain maximum height of 3-6 m. these are found along the edge of water waves forest grow on soft tidal mud flooded by salt water. The common plants are Avicennia, Excoecaria, Agallocha, Ceriops decandra, Acanthus Elicifolia. The low mangrove forest commonly occurs in Krishna, Ganges, Aodhvari, Mahanadi, Bramaputra.

Salt water mangrove forests :

Silt and salt deposition on soil is low. The height of the plants is upto 20m but girth is less the forests are abundant the ground is flooded with tidal water. Pneumatophores are common . the plants Excoecaria, Xylocarpus, Avicennia officinalis, Nipa, Sonneratia are common species.

Brackisn water mangrove forests :

These forests are seen all along the sandy beaches of coastal areas, river deltas, swampy margins of islands , estuaries and dry banks of rivers. The water is salt where rainy season fresh water height of tree 30m . Forest are Avicennia, Sonneratria caseolaris, Acida, Amoora cuculata, palms, Nipa, Pandanus.

5. 5 Vegetation of Tamil Nadu

Vegetation of Tamil Nadu has Number of different hill stationssuch as Anamalai, Alagar Hills, Palani Hills, Nilgiri Hills, Tirunalveli Hills, so on . it has tropical areas. Tamilnadu the south most state of India, between 8.4^0 and 13.4^0 north from the equator. Topographic conditions of there will ranges determine the climate and vegetation of Tamilnadu.

Forest vegetation in Tamil Nadu

Tamil Nadu forest type into eight types on the basis of climate – they are.

1. Thorn tropical forest.
2. Dry evergreen Tropical forest
3. Wet tropical deciduous forest
4. Wet evergreen tropical forest
5. Wet semi-evergreen tropical forest
6. Dry deciduous tropical forest
7. Montane wet temperate forest
8. Broad – Leaved Hill Subtropical forest

1**. Thorn tropical forest**

There type of vegetation occurs in Ramad, Dharmapuri, Dindigal, Salem, Maduri, Rameshwaran, There forest are called carnatic umbrella thorn forests. The annual rainfall is less 45 to 93 cm. the vegetation has Acacia, Chloroxylon. Terminalia, Albizzia amara etc.,

2. Dry evergreen tropical froest

These type of vegetation occurs in carnatic coast in Tamil Nadu. The annual rain fall are low from 85 to 125cm. the vegetation consists of Acacia leucopholea, Albizzia amara, candhian, calotropis feronia etc.,

3. Wet tropical deciduous forests.

There forests are distributed in the areas where annual rainfall usually low, ranging between 120 to 310cm. these type of forests found in part of coimbatore and some part of Tirunelveli district. The common plants Dillenia pentagyna, zizypus, Diospyres. Bauhinia, Terminalia, Emblica etc.,

4. Wet evergreen tropical forests

The annual rain fall is 200 to 300 cm, it present western parts of kanyakumari district and the western ghats possess tropical wet evergreen forests. The common plants are Mangifera, Eugenia, Calophyllum, Mesua, Baboos, palms etc., epiphytes, climbers, ferns and orchids also present.

5. Wet semi evergreen tropical forests

There type of vegetation occurs in Tirunelveli district, the annual rainfall ranges from 200 to 300 cm the vegetation consist at Arotocarpus heterophylla, Euphorbia, Myristica, Salmelia, Dioscoria, Hope and epiphytes, ferns orchids are common.

6. Dry deciduous tropical forests

There forests are distribution in the areas where annual rainfall is low ranges between 70 to 100 cm. the dry season is long and most of the trees remain leafless during that season. Pure and mixed teak forest are seen in the areas. Dalbergia, Terminalia, Emblica, Madhuca, Diosphyros, chloroxylon are common plants and associates of teak in the there forests.

7. Montane wet temperate forests

There forests are occur in above 1500m elevations in Nilgiris, Anamalai, Palani, Tirunalveli hills the annual rainfall ranges from 130 to 600 cms. The forests are dense with closed canopy and the trees may be 15 to 20 m hight. The common plant are Hardevickia, salmelia, Elaeocarpus, Rhododendron michelia nilagirica, Hopea, Dioscoria etc.,

8. Broad – Leaved Hill tropical forests

These forests are seen in Nilgiris, Anamalai, Kodaikanal and palani hills. They occur on the hills at above 1000m elevation. The annual rainfall 150 to 650 cm. the vegetation are Randia, Terminalia, Eugenia, Ficus, Alnus Calamus, Calophyllum, Murraya etc.,

Self Assesment Questions - I

1. India has _____% of forest an total area
2. Give an example of Tropical dry Deciduous forest_____
3. Mangrove Forest occurs in India

Self Assesment Questions - II

1. Annual Rainfall range in tropical forest_____

2. Example of Tropical dry evergreen forest_____

Unit Questions :

1. Explain the various phytogeographical regions In India?
2. Give an account of vegetation types in Tamil Nadu.
3. Describe the Indus Plain genetic plants and central India

Answer of self Assesment Questions : I

1. 24%
2. Pteorocarpus, Diophyrous
3. Bengal, Kerala

Answer of self Assesment Questions : I

1. 250cm
2. Zizypus, Randia

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