Unit II

Syllabus

Ecosystem- Introduction to Ecology and Ecological Succession, Ecosystem, Food Chain, Ecological Pyramids, Types of Ecosystems, Forest Ecosystems, Aquatic Ecosystems, Grassland Ecosystem, and Desert Ecosystem.

Biodiversity and its Conservation- Biodiversity, Values or Benefits of Biodiversity, Biogeographic Zones of India. Threats to Biodiversity, Human –Wildlife Conflicts, Conservation of Biodiversity.

ECOSYSTEMS

An ecosystem is defined as a dynamic entity composed of biological community and its associated abiotic environment. Often the dynamic interactions that occur within an ecosystem are numerous and complex. Ecosystems are also undergoing alterations to their biotic and abiotic components.

In recent years, the impact of humans has caused a number of dramatic changes to a variety of ecosystems found on the Earth. Humans use and modify natural ecosystems through agriculture, forestry, recreation, urbanization, and industry. The most obvious impact of humans on ecosystems is the loss of biodiversity. The number of extinctions caused by human domination of ecosystems has been steadily increasing since the start of the Industrial Revolution. The frequency of species extinctions is corelated to the size of human population on the Earth, which is directly related to resource consumption, land-use change, and environmental degradation.

Ecosystem is the basic functional unit in ecology, since it deludes both biotic and abiotic environment, influencing each other for maintenance of life. A.G. Tansley (1935) first proposed the term ecosystem and defined it as, "the system resulting from the interaction of all the living and non-living factors of the environment".

The term ecosystem is most preferred, where eco = environment, and system = an interacting and interdependent complex.

Barrett (1978) explained the "term ecosystem for its structural and functional aspects". He proposed a new term ecosystem to define "a basic unit of study encompassing biological, physical, social, economic and cultural influences on the total system'. The organisms of any community besides interacting among themselves always have functional relationship with the environment. This structural and functional system of communities and environment is called ecological system or ecosystem.

An organism is always in the state of perfect balance with the environment. The environment literally means the surrounding. The environment refers to the things and conditions around the organisms which directly or indirectly influence the life and development of the organisms and their populations. Organisms and

environment are two non-separable factors. Organisms interact with each other and also with the physical conditions that are present in their habitat.

Structure 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 particular to a habitat. It also provides information regarding the range of climatic conditions prevailing in that area. From the structural point of view, all ecosystems consist of the following basic components.

- Abiotic components (a = without, biotic = Life)
- Biotic components (Life)

Abiotic Components:

They are the non-living components in the environment. Abiotic component of ecosystem includes basic inorganic elements and compounds, such as soil, water, Oxygen, Calcium, Carbonates, Phosphates and variety of organic compounds. It also includes such physical factors and ingredients as moisture, wind currents and solar radiation. Radiant energy of sun is the only significant energy source for any ecosystem.

Biotic Components:

The biotic components include all living organisms present in the environment system. From nutrient point of view, the biotic components can be grouped into two basic components.

- Autotrophic Components.
- Heterotrophic components

The autotrophic components include all green plants which from radiant energy of sun manufacture food from inorganic substances.

The Heterotrophic components include non-green plants and all animals which take food from autotrophs. So, biotic components of an ecosystem can be described under the following three heads.

1. Producers (Autotrophic components)
2. Consumers

3. Decomposers or reducers and transformers.

Producers (Autotrophic elements):

The producers are the autotrophic elements chiefly "Green Plants." They use radiant energy of sun in photosynthetic process whereby carbon di-oxide is assimilated and the light energy is converted into chemical energy. The chemical energy is actually locked up in the photosynthesis. This is used in respiration by all green living organisms and oxygen is evolved as by product in the photosynthesis processes. This is used in respiration by all living things. Algae and other hydrophytes of a pond, grass of the field, trees of the forest are examples of producers.

Consumers: (Heterotrophic elements)

Those living members of ecosystem which consume the food synthesized by producers are called consumers under this category are included all kinds of animals that are found in an ecosystem.

There are different classes of consumers

1. Primary Consumers
2. Secondary Consumers
3. Tertiary Consumers
4. Parasites Scavengers and saprophytes.

1. Primary Consumers: These are purely 'Herbivores' animals that are depended for their food on producers or green plants. Ex: Insects, Rodents, Rabbit, Deer, Cow, Buffalo, Goat are of common herbivorous animals in terrestrial ecosystem.

2 Secondary Consumers: These are also called as "Omnivores" they are the animals that are adapted to consume herbivorous as well as plants and flesh-eating animals. Ex. Sorrow, Crow, Fox, Wolves, Dogs, Cats, Frog etc.

3. Tertiary Consumers: They are the highly carnivorous, which prey other carnivores, Omnivores and herbivores. E.g. Lions, Tigers, Hawk, vulture, snake etc.

4. Besides different classes of consumers, the Parasites Scavengers and

Saprophytes are also included in the consumers. The parasitic plants and animals utilize the living tissues of different plants and animals. The scavengers and saprophytes utilize dead remains and plant as their food.

5. Decomposers or transformers

Decomposers and transformers are the living components of the ecosystem and they are Fungi and Bacteria. Decomposers attack dead remains of producers and consumers and degrade the complex organic substances into simpler compound. The simple organic compounds are then attacked by another kind of bacteria that are the transformers which change these organic components into the inorganic forms suitable for reuse by producers or green plants. Decomposers and transformers play very important role in maintaining the dynamic nature of ecosystem.

Function of an Ecosystem

An ecosystem is a discrete structural, functional and life sustaining environmental system. The environmental system consists of biotic and abiotic components in a habitat. Biotic component of the ecosystem includes the living organism, plants, animals and microbes, whereas the abiotic component deludes inorganic matter and energy. Thus, in an ecosystem we have the following functional components.

1. Inorganic constituents (Air, water and mineral salts (Nitrogen, Phosphorous))
2. Organisms (Plants, animals and microbes)
3. Energy input which enters from outside (the sun)

Above three components interact and form an environment system. Inorganic constituents are synthesized into organic structures by green plants (Primary producers) through photosynthesis and solar energy for renewals (Herbivores) which, in turn become source of energy for the flesh-eating animals (Carnivores). These are known as secondary producers. Animals of all types grow and add organic matter to their body weight and their source of energy is complex organic compounds taken as food.

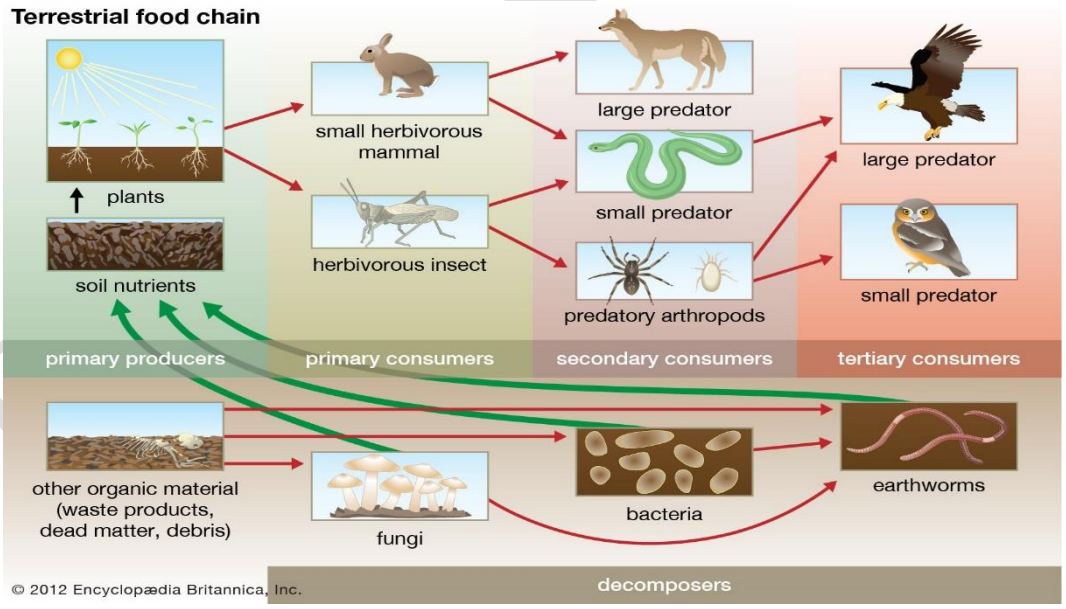
All the living organisms whether plants or animals in an ecosystem have definite life span after which they die. The dead organic remains of plants and animals

provide food for microbes such as bacteria, fungi and many other animals the saprophytes. During the process of decomposition of organic molecules, the energy which kept the inorganic components bound together in the form of organic molecules gets liberated and deposited into the environment as heat energy.

Food Chain

In the ecosystem, green plants alone are able to trap solar energy and convert it into energy. The chemical energy is locked up in the various organic compounds, such as carbohydrates, lipids and proteins, present in the green plants. Since virtually all other living organisms depend upon green plants for their energy, the efficiency of plants in any given area in capturing solar sets the upper limit to long-term energy flow and biological activity in the community.

The food manufactured by the green plants is utilized by themselves and also by herbivores. Animals feed repeatedly. Herbivores fall prey to some carnivorous animals. In this way one form of life supports the other form. Thus, food from one trophic level reaches to the other trophic levels and a chain is established known as food chain.



Food chains are of three types

- Grazing food chain
- Parasitic food chain
- Detritus or saprophytic food chain

Grazing food chain: It is also called as predator food chain. It starts with green plants, going to grazing herbivores (primary consumers), to primary carnivores (Secondary consumers) and then to secondary carnivores (tertiary consumers) and so on. In this food chain the killing and hunting nature is therefore this food chain is called as predator food chain.

Parasitic Food Chain: This also starts with green plants (large organisms) base. However, food energy passes into smaller organisms called parasites that live at the expense of the larger organism (host).

The Detritus Food Chain: It is also called as saprophytic food chain. The dead organic remains including tabolic waste and excreta derived from grazing food chain 01 generally termed as "Detritus." The energy contained in Detritus is not lost in ecosystem as a whole, rather it serves as source of energy for a group of organisms called as detritivores that are separate from the grazing food chain. The food chain so formed is called detritus food chain.

Food Web

Many food chains exist in an ecosystem, but as a matter of fact these food chains are not independent. In ecosystem one organism does not depend wholly on another. The resources are shared specially at the beginning of the chain. However, a feeding relationship is never that simple. In most natural ecosystems the food chains are complicated by the presence of omnivores. These are animals that eat both plant and animal material. Bears, rats, many birds and men are omnivorous, it is very difficult to place them in a simple food chain, as there are many inter connections at different point in the food chain. Such interactions form a food web. Food maintains the stability of the ecosystem.

Ecological Pyramid

In ecosystem, energy and organic compounds are passed from one trophic level to the next. Unknown is the efficiency of the transfer. In a highly efficient transfer almost all of the energy would be transferred namely 80% or more. In a low efficiency transfer very, little energy would be transferred like less than 20%. In a typical food chain, not all animals or plants are eaten by the next trophic level. In

addition, there are portions or materials (such as beaks, shells, bones, etc.) that are also not eaten. That is why the transfer of matter and energy from one trophic level to the next is not an efficient one.

One way to calculate the energy transfer is by measuring or sizing the energy at one trophic level and then at the next. Calories are a unit of measure used for energy. The energy transfer from one trophic level to the next is about 10%. For example, if there are 10,000 calories at one level, only 1,000 are transferred to the next. This 10% energy and material transfer rule can be depleted with an ecological pyramid.

This pyramid helps one visualize the fact that in an ecological system there need to be many producing organisms at the bottom of the pyramid to be able to sustain just a couple of organisms at the top.

Charles Elton (1927), a pioneer British Ecologist, developed the concept of ecological pyramids. According to him there is some sort of relationship between the number, biomass and energy content of the primary producers, consumers of the first and second orders and so on to top carnivores. In the ecosystem such relationship is represented graphically by means of pyramids, called ecological pyramid and the successive levels (the tiers) making the top. These are of three types:

- Pyramid of numbers. It shows the number of organisms at each trophic level (number/m2).
- Pyramid of biomass. It shows the total dry weight or any other suitable measure of the total amount of living matter (g/ m2).
- Pyramid of energy. It shows the amount of energy flow and or productivity at successive trophic levels (calories/ m2/year).

Pyramid of Numbers

It indicates the numerical relationship between different trophic levels of a food chain. The more abundant species from the base of pyramid and the less abundant species remain near the top. It is the relationship between the number of producers, consumers of primary, secondary and tertiary orders constituted. The form of the pyramid of numbers depends and varies according to different communities and depends on whether producers are small (phytoplankton, grass) or large (oak trees).

Pyramids of Biomass

Biomass may be defined as the total dry weight of dry matter present in the ecosystem at any one time. By using the weight of the organisms at different trophic level a pyramid of biomass results. This pyramid indicates the total bulk of organisms and gives a rough picture of the overall effect of food chain relationship for the ecological groups as a whole. In this type of pyramid, the relationship between different trophic levels is presented in terms of weight of organisms (biomass).

Pyramid of energy

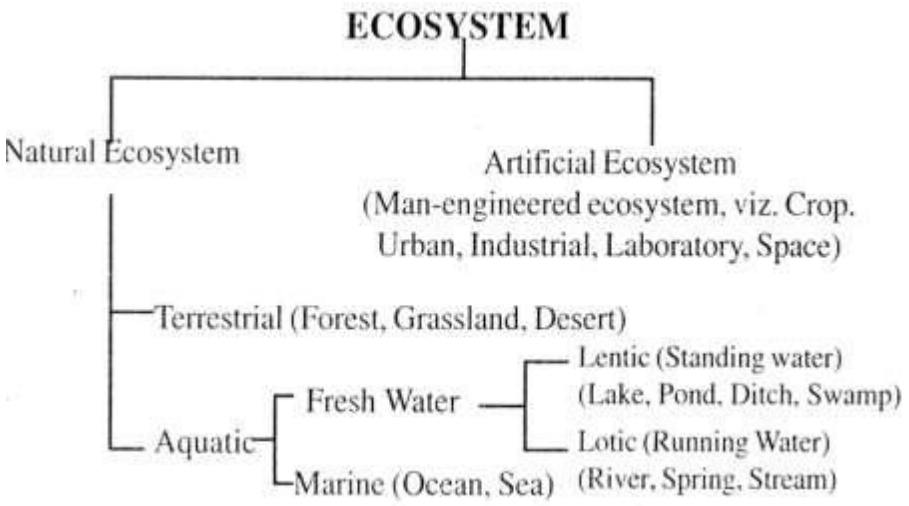
This pyramid indicates the amount of energy flow at each trophic level in the ecosystem as well as the role played by different organisms in the transfer of energy. Energy pyramids are always slopping. Energy production of the primary consumers (Herbivores) is greater than that of the secondary consumers (Primary Carnivores), which form next link in the energy chain. The energy remaining at the tertiary consumer level (Secondary carnivores) is very little in amount.

The trapped radiation energy flows in the food chain from the producers to the top carnivores, decreasing at successive trophic levels

Types Of Ecosystems

Life on Earth continued to evolve around 420 million years ago. During the Silurian Period, ancient plants and arthropods began to occupy the land, over the millions of years that followed. These land colonizers developed and adapted to their new habitat.

In the biosphere various ecosystems like pond, lake, river, stream spring estuary, the sea, forest, grassland, desert, coral reef and cropland are operating as self-sufficient interacting terms. These ecosystems have more or less similar fundamental plan of their gross structure and function



Terrestrial Ecosystems

Terrestrial habitats are naturally quite different from the aquatic habitats. Most aquatic organisms die relatively soon after being exposed to air. Water diffuses and evaporates so quickly from their bodies that cellular metabolism is disrupted and then destroyed. The conservation of water is, therefore, a major problem for land organisms. Terrestrial animals and plants have special devices to conserve water. On land great variation for availability of water, occurs ranging from marshes at one extreme to waterless desert at the other. This determines the habitability of particular land masses.

The ecosystems of the terrestrial environments are most variable. Factors having significant effect on life are as follows:

Soil: The major life supporting element of the terrestrial environment is soil, composed of mineral matter interspersed with varying quantities of organic substances, air and water. Soil generally consists of three layers. At the surface is the top soil, which contains particular mineral matter as well as appreciable quantities of organic substances. The top soil is of key importance to most terrestrial habitats.

Water: The body of all organisms is composed of about 60-70 percent of water. That is why water is a major limiting factor for terrestrial life.

Temperature: Temperature varies greatly on land, not only from place to place but also with the season. The surface temperatures in some desert may fall far below 0°C in the winter and rise above 50°C in the summer. No organism, in its active state, can withstand the entire range of environmental difference encountered on land. Each species has evolved adaptations for life in a specific ecosystem.

Oxygen and Carbon Dioxide: Oxygen and carbon dioxide are the only required substances in all terrestrial ecosystems that are nearly constant in amounts. They are constant for the same reason that the sea is constant. They are part of a continuous and ever moving mass. In air, oxygen is about 20% and carbon dioxide 0.4% by volume.

Light: Light is the most important factor for producers or autotrophs for their photosynthetic activities. Consumers depend upon producers. Light intensity on the earth's surface varies greatly. The variations in the intensity, quantity and quality of light are caused by the angle of incidence, degree of latitude, climatic and various biological factors.

Biotic Components

Biotic components include producers, consumers and decomposers as stated in the following lines:

Producers: Photosynthetic organisms are the producers in the terrestrial environment. This category includes Monera and Protista kingdoms but their contribution to specialized ecosystems is very small and limited. Flowering plants are the main and dominant producers. These producers provide the initial source of food in food chain and secondly provide habitats for other organisms. They are the prime agents in soil formation and in modifying the non-living environment.

Consumers: In terrestrial ecosystems, the primary consumers are numerous and belong to almost all phyla of invertebrates and venerates. The number of species of primary consumers is greater than the number of species of producers upon which they feed. The activity and growth of the population of consumers are directly related to the vegetation, the number and kinds of other consumers.

Decomposers: In terrestrial ecosystems too, bacteria and fungi are the main decomposers. They break down the organic compounds of dead organisms and their wastes. Thus, the accumulation of such dead organic matters is checked up. The activity of the decomposers depends upon temperature and moisture.

Arctic Ecosystem

The polar regions, together with snowcapped peaks constitute arctic zones, similar in many ways, though not identical. Except in a more or less irregular form the arctic one is without life.

Tundra Ecosystem

Tundra is a Siberian term that means a treeless marshy plain. The alpine zone, above the tree line on mountains corresponds to the tundra. The land is fiat or gently rolling and reticulated by ponds, small lakes, and bogs. On certain mountains the alpine zone is subjected to winds in excess of 160 kilometers per hour and temperature down to - 21 °C. Light energy and ultraviolet radiations are intense at this altitude. The tundra has a very fragile ecological balance because the growing season is so short and there are few animal and plant species. The productivity of the tundra ecosystem is low. Very little energy is left for consumers after the plants have met their own energy requirements. Of all the ecosystems, the tundra is probably the most inhospitable, least productive and least utilized by man.

Tundra means an infertile land or a hostile territory. Tundra biomes occur in the polar regions in northern Canada, Greenland, other island of Arctic oceans, and northern Europe (northern hemisphere).

Grassland Ecosystem

Soils associated with grasslands are typically moist soils which are deep, dark, and rich but arid soils may occur in drier regions. Most of the grasslands have been extensively disturbed and are now major crop growing regions of wheat, corn and other grains. These lands are dominated by grasses, rather than large shrubs or trees. Temperate grasslands, savanna grasslands are some of the examples of grassland ecosystems.

1. Tropical Grasslands or Savannas

Savanna is grassland with scattered individual trees. It covers about half the surface of Africa and large areas of Austral South America, and India. Climate is the most important factor in creating a savanna. Savannas are always found in warm and hot climates where the annual rainfall is from about 50 to 127 cm (20-50 inches) per year. It is crucial that the rainfall is concentrated in six or eight months of the year, followed by a long period of drought when fires can occur. If the rain were well distributed throughout the year many such areas would have become tropical forest.

2. Temperate Grassland

It is the grasses dominant land where trees and large shrubs are absent. Temperatures vary more from summer to winter, and the amount of rainfall is less in temperate grassland or savannas. Such lands are found in Such Africa, the puszta of Hungary, the pampas of Argentina and Uruguay, the of the former Soviet Union, and the plains and prairies of central North America. Temperate grasslands have hot summers and cold winters. Rainfall is moderate.

Desert Ecosystem

The vegetation of deserts around the world are quite variable. Desert cover about one fifth of the Earth's surface and occur where rainfall is less than 50 cm /year. Most deserts, such as the Sahara of North Africa and the deserts of the southwestern U. S., Mexico, and Australia, occur at low latitudes. Another kind of desert, namely cold deserts, occurs in the basin and range area of Utah and Nevada and in parts of Western Asia. Most deserts have a considerable amount of specialized vegetation, vertebrate and invertebrate animals. Soils in deserts often have abundant nutrients because they need only water to become very productive and have little or no organic matter. Disturbances are common in the deserts in the form of occasional fires or cold weather, and sudden, infrequent, but intense rains that cause flooding.

There are relatively few large mammals in deserts because most of them are not capable of storing sufficient water and withstand the heat in. The dominant animals of warm deserts are non-mammalian vertebrates, such as reptiles. Mammals are usually small, like the Kangaroo mice of North American deserts.

Aquatic Ecosystem

The seas are characterized by constancy and lands by variability- The seas have always existed and been connected. if contrast, land masses have been considerably shifted, both vertically and horizontally. At one time or another nearly every bit of land had been covered by sea. Even areas where we now find great mountain ranges were once under water. For example, the deposits comprising the Himalaya mountains were once, many millions of years ago, the floor of an eastward continuation of the Mediterranean.

Water maintains link between the five biomes and makes up the largest part of the biosphere, covering nearly 75% of the Earth's surface. Aquatic regions house numerous species of plants and animals, both large and small. In fact, this is where life began billions of years ago when amino acids first started to come together. Without water, most life forms would be unable to sustain themselves and the earth would be a barren, desert like place. Although water temperatures vary widely, aquatic areas tend to be more humid and the air temperature on the cooler side. The aquatic biome is classified into two basic regions, freshwater (ponds and rivers) and marine (oceans and estuaries).

Aquatic ecosystems are usually, divided into: (I) Freshwater, (ii) Marine water, and (iii) Estuarine water.

Freshwater Ecosystem

Freshwater biomes have suffered mainly from pollution. Runoff containing fertilizer and other wastes and industrial dumping enter into rivers, ponds, and lakes and tend to promote abnormally rapid algae growth. When these algae die, dead organic matter accumulates in the water. This makes the water-unusable and it kills many of the organisms living in the habitat. Strict laws have helped to slow down this thoughtless pollution. Freshwater has low salt concentration (less than 1 per cent) therefore, the plants and animals living in freshwater adjust themselves with low salt content and unable to survive in areas of high salt concentration (Ocean). Following are the freshwater regions.

Ponds and Lakes

These regions range in size from just a few square meters to thousands of square kilometers, scattered throughout the earth. Many ponds are seasonal, lasting just a couple of months (such as sessile pools) while lakes may exist for hundreds of

years or more. Ponds and lakes may have limited species diversity since they are often isolated from one another and from other water sources like rivers and oceans.

Streams and Rivers

These are flowing water bodies, which move in one direction. They are found everywhere and they get their start head waters, which may be springs, snowmelt or even lakes, and then travel all the way to their mouths, usually another water channel or the ocean. The characteristics of a river or stream change during the journey from the source to the mouth. The temperature is cooler at the source than it is at the mouth. The water is also clearer, has higher oxygen levels, and freshwater fish such as trout and heterotrophs can be found there. In the middle part of the stream or river, the width increases, this causes diversity in the species. Various aquatic green plants and algae are found. Towards the mouth of the river or stream, the water becomes muddy from all the sediments that it has picked up upstream, decreasing the amount of light that can penetrate through the water.

Marine Ecosystem

Marine regions cover about three fourths of the Earth's surfaces and include oceans, coral reefs, and estuaries. Marine algae supply much of the world's oxygen supply and take in a huge amount of atmospheric carbon dioxide. The evaporation of the seawater provides rainwater for the land.

The Ocean Ecosystem

The oceans, which cover 70 percent of the earth's surface, constitute one of the greatest reservoirs of living things and of the essential nutrients needed by both land and marine organisms. The average depths of the oceans are roughly 3000-4000 meters. Since the organisms are found throughout the depths of the oceans, the actual space available for marine life is about 300 times as great as the space available for terrestrial life. As in other ecosystems, the life in the ocean also depends upon light. With light the ocean becomes a factory for life. The energy of tight is stored in carbon compounds, which are used for the substances and energy of all organisms. The life in the ocean is affected by important physical factors like currents, tides, depth, temperature, light penetration, salinity and pressure etc.

The Estuarine Ecosystem

The word 'estuary' refers to the mouth of a river or coastal bay where the salinity is greatly affected by tidal action and within it, sea water is mixed with fresh water from land drainage. The examples of estuarine ecosystems are: river mouths, coastal bays, tidal marshes any bodies of water behind barrier breaches. Most estuaries, particularly those in temperate and arctic regions undergo marked variations in temperature, salinity and other physical properties in the course of a year, and to survive, estuarine organisms must have a wide range of tolerance to these changes.

Estuaries are areas where freshwater streams or rivers merge with the ocean. This mixing of waters with such different salt concentrations creates a very interesting and unique ecosystem. Microflora like algae, and macroflora, such as seaweeds, marsh grasses, and mangrove trees (only in the torpics), can be found here. Estuaries support a diverse fauna (worms, oysters, crabs, and waterfowl).

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BIODIVERSITY AND ITS CONSERVATION

Biodiversity:

It is the term given to the variety of life on earth and the natural patterns it forms. The bio-diversity we see today is the fruit of billions of years of evolution, shaped by natural processes and, increasingly, by the influence of humans. It forms the web of life of which we are an integral part and upon which we so fully depend.

This diversity is often understood in terms of the wide variety of plants, animals and microorganism. So far, about 1.75 million species have been identified, mostly small creatures such as insects. Scientists estimate that there are actually about 13 million species, though estimates range from 3 to 100 million. Biodiversity is the combination of life forms and their interactions with each other and with the rest of the environment that has made earth a uniquely habitable place for humans. Bio-diversity provides a large number of goods and services that sustain our lives. Bio-diversity can be understood at 3 levels.

Genetic bio-diversity: It is a well-known fact about rice that they are available in different varieties, e.g., Basmati, which has larger grain size, other variety of rice, which has smaller grain size etc. This special internal distinction among rice varieties is due to genetic diversity. It is the diversity of the genes. These genes are basic units of hereditary information. These contain the instruction for the development of a generation to another. These variations need not be always visible like color or size. They can be sensed through other organs also such as taste or flavor. Sometimes they can be invisible also for e.g., resistance to diseases, resistance to natural disasters (like cockroaches who have with-stood the effects of disasters since ages).

Species Bio-diversity: Species is a form of unit used to classify the millions of life forms on earth. Species diversity refers to the variety of species within a region. Each species is distinct from every other species for e.g., Lions and Tigers are distinct species, horses and donkeys are distinct. At the same time, members of an individual species will be very similar, that they can produce fertile off spring.

Generally, the total number of species within a particular area is referred to as species diversity. It is the most commonly used level for describing the bio-

diversity of countries.

Ecosystem Diversity: It refers to difference among groups of organisms in different physical settings. It is the place where an organism or a population naturally occurs. There can be two phenomena as far as ecosystem diversity is concerned a) the variety of species within different ecosystem, b) Variety of ecosystems found within a biogeographical or political boundary.

Bio-diversity doesn't confine only to wild animals and plants, but speaks also about the considerable varieties among domesticated plants and animals. This is known as domesticated bio-diversity. Similarly there also exists the microorganism diversity. Microorganisms or microbes include bacteria, virus, protozoa, yeast, and fungi etc. These were indeed part of the earth's atmosphere since 3.8 billion years.

Bio-geographical Classification of India:

The identification and conservation of the world's natural heritage depends on an understanding of the ecosystems and Biodiversity and Its Conservation habitat of the plant and animal species within it. Classification of natural world heritage sites by habitat or bio-geographic province helps us better appreciate the wide range of ecosystems already protected.

India has ten bio-geographic regions including the Trans Himalayan, The Himalayan, The Indian Desert, The Semi-Arid Zone (s), The Western Ghat, The Deccan Peninsula, the Gangetic Plain, North East India, the Islands and Coasts. India has two major realms called the palearctic and the Indo Malayan and three bio-mass, namely The Tropical Humid Forests, The Tropical Dry/Deciduous Forests and The Warm Desert/Semi Deserts.

Values of Biodiversity

It is not strange thing to notice the extinction of some species and evolution of new ones, which are very natural process of evolution. This is because the rates of extinction and evolution usually get balanced. But now the rate of evolution has failed to cope up with the alarmingly fast rate of extinction. Biodiversity loss is a cause for a genuine concern because its survival is of utmost importance not only for human society but also for the total health of our planet. Hence its values are to be sensed by all.

Bio-Diversity at Different Levels Global Level

It is estimated that there exist 5-30 million species of living forms on our earth and of these, only 1.5 million have been identified. It includes 3,00,000 green plants, fungi, 8,00,000 species of insects. 40,000 species of vertebrates and 3,60,000 species of microorganisms. Recently it has been estimated that the number of insects alone may be as high as 10 million, but many believe it to be around 5 million.

The tropical forests are regarded as the richest in biodiversity. According to the opinion of the scientist more than half of the species on the earth live in moist tropical forests which is only 7% of the total land surface. Insects (80%) and primates (90%) make up most of the species.

The species diversity in tropics is high as:

- In tropics, as the conditions for evolution were optimum and for extinction fewer.
- In tropics, species diversity was conserved over geological time. Due to low rates of extinction prevailing there; and
- Biological diversity is the result of interaction between climate, organisms, topography, parent soil materials, time and heredity.

Country Level

India is located in South Asia, is bounded by Himalayas in the north, the Bay of Bengal in the east, the Arabian Sea in the west, and Indian Ocean in the South. The wide variety in physical features and climatic situation has resulted in a diversity of ecological habitats. The Indian region having a vast geographical area is quite rich in bio-diversity with a sizable percentage of endemic flora and fauna. These vary from the humid tropical Western Ghat to the hot desert of Rajasthan, from the cold desert of Ladakh and the icy mountains of Himalayas to the warm casts of peninsular India.

In India, about 1,15,000 species of plants and animals have identified and described. For example, the following crops been in the country and spread throughout the world: rice, sugarcane, jute, mango, citrus, banana, several species of millets, several cucurbits, some ornamental orchids, several medicinal and aromatics. In flora, the country has been recognized as one of the world's top

12 mega diversity nations. This region is also secondary center of diversity for maize, red pepper, soyabean, potatoes and rubber plant.

In flora, the country can boast of 45,000 species, which accounts for 15 per cent of the known world plants. Of the 15,000 species of flowering plants, 35 percent are endemic and located in 26 endemic centers. Among the monocotyledons, out of 588 genera occurring in the country, 22 are strictly endemic.

Information regarding other flora and fauna are patchy. Hundreds of new species may be present in the country-awaiting discovery. The Western Ghat in Peninsular India, which extend in the southern states, are a treasure house of species diversity and has about 5000 species. It is estimated that almost one third of the animal varieties found in India have taken refuge in Western Ghat of Kerala alone.

Hot Spots Of Biodiversity

Bio-diversity is not distributed uniformly across the globe. Some habitats, particularly tropical forests among terrestrial systems possess a greater number or density of species than others. A number of methods by which such areas could be determined have been suggested.

The most widely accepted approach of suggesting target areas for conservation action is to identify areas with the greatest number of endemic or restricted range species. An endemic species is one restricted to some given area, which might be a mountain top, a river, a country or continent.

India has two of the 25 identified 'hot spots'. These are Eastern Himalaya and Western Ghat.

Eastern Himalayas

The Eastern Himalaya forms a distinct floral region and comprises Nepal, Bhutan, neighboring states of East and Northeast India, and a contiguous sector Yunnan province in south Western China. In the whole of Eastern Himalaya, there are an estimated 9,000 plant species, with 3,500 (i.e., 39%) of them being endemic.

At least 55 flowering plants endemic to this area are recognized as rare, for example, the pitcher plant (Nepenthes Khasiana)

The area has long been recognized as a rich center of primitive flowering plants and the area is recognized as 'Cradle of Speciation'.

The area is also rich in wild relatives of plants of economic significance, e.g. rice, banana, citrus, ginger, chili, jute and sugarcane. The region is regarded as the

center of origin and diversification of five palms of commercial importance namely, coconut, areca nut, palmyra palm, sugar palm and wild date palm.

Tea is reported to be in cultivation in this region for the last 4000 years. Many wild and allied species of tea, the leaves of which are used as substitute of tea, are found growing in the Northeast in their natural habitats.

The 'taxol' plant Taxus wallichiana is sparsely distributed in the region and has come under red data category due to its over exploitation for extraction of a drug effectively used against cancer.

As regards faunal diversity, 63% of the land mammals in India are known from this area. During the last four decades, two new mammals have been discovered from the region: Golden Langur from Assam, Bhutan region and Namadapha flying squirrel from Arunachal Pradesh indicating in the species richness of the region.

Western Ghat

The Western Ghat region is considered as one of the most important biogeographic zones of India, as it is one of their richest centers of endemism. Due to varied topography, and micro climatic regimes, some areas within the region are considered to be active zone of speciation.

The extent of endemism is high in amphibians and reptiles. There occurs 117 species of amphibians in the region, of which 89 species (i.e. 76%) are endemic. Of the 165 species of reptiles found in Western Ghat, 88 species are endemic.

Many of the endemic and other species are listed as threatened. Nearly 235 species of endemic flowering plants are considered endangered. Rare fauna of the region includes' Lion Tailed Macaque, Nilgiri Langur, Nilgiri Tahr, Flying Squirrel, and Malabar Gray Hornbill.

Human-Wildlife Conflict

Human-wildlife conflict (HWC) occurs when animals pose a direct and recurring threat to the livelihood or safety of people, leading to the persecution/torture/harassment of that species.

Human-wildlife conflict is, when encounters between humans and wildlife lead to negative results, such as loss of property, livelihoods, and even life. Although this is not a new scenario — people and wildlife have coexisted for millennia — it is

one that is becoming much more frequent, serious and widespread, and a global concern for conservation and development alike.

HWC also often severely impacts the livelihoods, security and wellbeing of the people. Defensive and retaliatory killing may eventually drive these species to extinction. From baboons in Namibia attacking young cattle, to greater one-horned rhinos in Nepal destroying crops, to orangutans in oil palm plantations, to European bears and wolves killing livestock – the problem is universal, affects rich and poor, and is bad news for all concerned.

As human populations and demand for space continue to grow, people and wildlife are increasingly interacting and competing for resources, which can lead to increased human-wildlife conflict. The impacts are often huge.

The cause of human wildlife conflict was human settlement, agricultural expansion, illegal grass collection, over grazing by livestock and deforestation in national park. As a result, local communities disliked wildlife inhabiting in and around their surroundings. This has a great negative impact in conservation of the wildlife.

- With 88 human deaths, Maharashtra witnessed the worst-ever human-animal conflict in 2020 indicating significant consequences for the economy, human health, safety and welfare, and ecosystem.
- Most human deaths were in leopard and tiger attacks.
- These deaths include 32 in attacks by leopards and 38 in attacks by tigers.
- Most of the tiger attack cases were from Chandrapur district.

<u>Conservation Efforts in Hot Spots</u>

A number of programs are currently being implemented for conservation and sustainable utilization of Bio-diversity in the two 'not spots'. These include survey and inventorization, in-situ conservation, through protected area network, and ex-situ conservation. In addition, the Ministry also supports Bio-diversity elated research in the two hot spots. A brief account of these efforts is given below.

Eastern Himalaya

The Botanical Survey of India through its Sikkim Himalayan Circle in Gangtok and Arunachal Field Station in Itanagar, is engaged in botanical exploration, inventorisation and documentation of the plant diversity of Eastern Himalaya. About 6000 species of flowering plants have been inventorised so far from the

region and two publications namely 'Flora of Sikkim Vol. I Monocotyledons' and 'Flora of Arunachal Pradesh Vol. I Dicotyledons', have been brought out.

The faunal survey of Eastern Himalaya has been carried out by the Zoological Survey of India through its Arunachal Pradesh Regional Station in Itanagar. Status Faunas of Sikkim, Meghalaya, Tripura and Mizoram and Fauna of Namdapha Biosphere Reserve have been published by ZSI.

The Ministry for strengthening their infrastructure facilities undertakes ex-situ conservation of endemic plant species and has supported five botanic gardens in this region.

Threats Of Bio-Diversity

With the Current rate of development, population growth and migration communities are increasingly unable to meet their sustained needs. Growing demand for fuel wood, pollution due to industrialization, market for rare animal species and medicinal plants have all threatened the biological diversity and thereby hampered a sustainable human development. Further, the race for development and cultivation of improved varieties in larger area has threatened Bio-diversity to a considerable extent.

In biosphere, where the evolution is in operation, extinction of unfits and rarity of fewer fits in natural selection is an evolutionary necessity. Therefore, it is not an abnormal process in the life of a species. Whenever all the niches of an ecosystem are occupied, extinction occurs as a part of origin of new species Thus, it is a must for the survival of the fittest.

However, the present-day drastic changes in the environment and habitat due to population explosion and unmanaged developmental activities are so unnatural that the species are not getting full liberty of time and space for their survival and adaptive radiation. Therefore, resulting in loss of biodiversity, this is a global crisis. Biological extinction has been a natural phenomenon in geological history and man’s intervention has speeded up extinction rates all the more. Between 1600 and 1950 the rate of extinction went up to one species every 10 years. Currently it is perhaps one species every year.

The destruction of the world's tropical forests, which are disappearing at an alarming rate, is one of today's most urgent global environmental issues.

Causes For the Loss of Biodiversity - Proximate Causes

The important proximate causes for the loss of biodiversity are as follows,

Destruction of habitat: The natural habitat may be destroyed by man for his settlement, grazing grounds, agriculture, mining, industries, highway construction, drainage, dam building, etc. As consequence of this the species must adapt to the changes, move elsewhere or may succumb to predation, starvation or disease and eventually die. In our country, several rare butterfly species are facing extinction with the uncannily swift habitat destruction of the Western Ghat. Of the 370 butterfly species available in the Ghat, up to 70 are at the brink of extinction.

Wildlife Hunting: From time immemorial, man has hunted for food. Commercially, wild animals are hunted for their product such as hides and skin, tusk, antlers, fur, meat, pharmaceuticals, perfumes, cosmetics and decoration purposes. For example, in Africa, in recent years 95% of the black rhino populations have exterminated by poachers for their horn. Today, rhino horn fetches more than $15,000 in the pharmaceutical market. Over one third Africa's elephants have been wiped out for some 3,000 tonnes of ivory. In the international market the cost of ivory is about $150 per kg, whereas in the Indian Market it varies between Rs. 2,000 to 2,500 per kg. Africa produces about 700 tons of raw ivory every year. The major buyers are Japan, Hong Kong, followed by US, Germany and the UK. The U.S. alone imports about $30 million worth of ivory annually.

In our country, rhino is hunted for its horns, tiger for bones and skin, musk deer for musk (have medicinal values), elephant for ivory. Gharial and crocodile for their skin, and jackal for thriven fur trade in Kashmir. One kg of tiger bones fetches $90 in India and $3000 in the international market.

Hunting for sport is also for loss of animal biodiversity.

Over exploitation: This is one of the main. Commercial exploitation of biodiversity has been as true in the case of Indian wild mango trees which were turned into plywood as of the whales, that were hunted for tallow, in the oceans.

Several plants of medicinal value and horticultural plants like orchids and rhododendrons come under the over exploited category. Faunal losses have been mainly because of over exploitation.

Collection for zoo and research: Animals and plants are collected throughout the world for zoos and biological laboratories for study and research in science and medicine. For example, primates such as monkeys and chimpanzees are sacrificed for research as they have anatomical, genetic and physiological similarities to human beings.

Introduction of exotic species: Native species are subjected to competition for food and space due to introduction of exotic species. For examples, introduction of goats and rabbits in the Pacific and Indian regions has resulted in destruction of habitats of several plants, birds and reptiles.

Control of pests and predators: Predator and pest control measures, generally kill predators that are a component of balanced ecosystem and may also indiscriminately poison non target species.

Pollution: Pollution alters the natural habitat. Water pollution especially injurious to the biotic components of estuary and coastal ecosystem. Toxic waste entering the water bodies disturbs the food chain, and also the aquatic ecosystems.
Insecticides, pesticides, Sulphur and nitrogen oxides, acid rain, etc. and global warming too, affect adversely the plant and animal species.

Deforestation: One of the main causes for the loss of biodiversity is population explosion and resultant deforestation. Deforestation mainly results from population settlement, shifting cultivation, development projects, demand for fuel wood, demand of wood for industry and other commercial purposes.

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