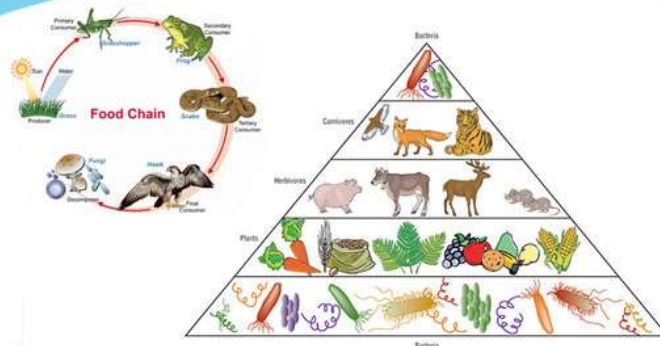


Subject: Environmental Sciences

Production of Coursework

- Content for Post-Graduate Courses



Paper No: 01 Ecosystem Structures & Functions

Module: 1 Ecosystems: Concept, Structure and Functions – Part 1



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**Environmental
Sciences**

Ecosystem Structures & Functions

Module 1: Ecosystems: Concept, Structure and Functions – Part 1

Description of Module	
Subject Name	Environmental Sciences
Paper Name	Ecosystem Structure & Function
Module Name/Title	1. Ecosystems: Concept, Structure and Functions – Part 1
Module Id	EVS/ESF-I/1
Pre-requisites	
Objectives	• To learn about earth system and its components. • To understand the science of ecology and its types. • To learn about the ecosystem concept and its structure. • To understand different types of ecosystems. • To know about ecosystem boundary, ecotone and edge effect.
Keywords	Earth systems, Atmosphere, geosphere, hydrosphere, ecology, autecology, synecology, ecosystem, abiotic component, biotic components, natural ecosystems, artificial ecosystem, ecotone, edge effect.

Module 1: Ecosystems: Concept, Structure and Functions – Part 1

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- 1.1 The Earth System and its components
- 1.2 Ecology and Ecosystems
- 1.3 Concept of Ecosystem
- 1.4 Ecosystem Structure
- 1.5 Types of Ecosystem
- 1.6 Ecosystem Boundary

1.1 The Earth System and its components

The earth's life support system consists of four main components – the geosphere, the atmosphere, the hydrosphere, and the biosphere (Fig 1.1). These components are overlapping and interrelated with each other. A change in one is likely to result in change in one or more others. These components are briefly described in the following way:

1. The Geosphere:

This part of earth system consists of rocks, minerals, and sediments. It includes thin outer crust, a thick molten mantle composed mostly of rocks, and intensely hot core. Its upper portion contains soil layers where organisms live, grow and reproduce and thus provides an important ecological habitat and basis of many forms of life. Various processes taking place on the surface of geosphere include erosion, weathering and transport as well as tectonic forces and volcanic activity, which result in the formation of landforms such as mountains, hills, etc.

2. The Atmosphere:

The atmosphere is the gaseous layer surrounding the earth's surface and held to its surface by gravity. Its inner layer, the troposphere, consists mostly of nitrogen (78% of the total volume), oxygen (21%), and others (1%). The others include carbon dioxide, methane and water vapours mainly, all of these are called as greenhouse gases which absorb and release energy to warm the lower atmosphere. This layer extends only about 17 km above sea level at the tropics and about 7 kms above the poles. The next layer, stratosphere, extends from 17 to 50 km above the earth surface. Its lower portion consists

of ozone layer which traps 95% of the ultraviolet radiations coming from sun, prevents them from reaching the earth surface and allows life to exist on the earth surface. The outer layers of atmosphere are called as thermosphere and exosphere. The atmosphere also absorbs water from the earth's surface via the process of evaporation; it then acts to redistribute heat and moisture across the earth's surface, thus giving rise to different weather conditions.

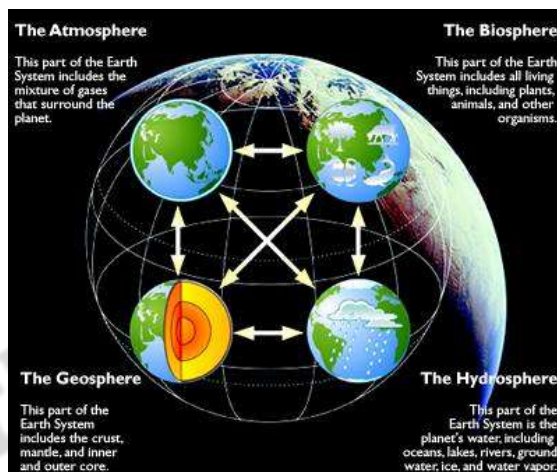


Fig 1.1: The Earth System – its four primary components are geosphere, atmosphere hydrosphere and biosphere, the Sun is the major source of energy.

Source: <https://sites.google.com/site/brianzhuapesportfolio/earth-systems>

3. The Hydrosphere:

This part includes all the gaseous, liquid, and solid water of the earth system. The hydrosphere includes - earth's oceans and seas, polar ice, glaciers, icebergs, lakes, rivers and streams, atmospheric moisture and ice crystals, areas of permafrost, moisture found in the soil (soil water) and within rocks (groundwater). It includes both saltwater and freshwater systems. The oceans, which cover about 71% of the globe, contain about 97% of the earth's water. The glaciers and icebergs lock 2% of the total water on earth and remaining 1% is found as surface waters and ground waters. Water is essential for the existence and maintenance of life on earth. The earth's temperature is highly influenced by the hydrosphere. In some classifications, the glaciers, icebergs, and ice-caps are also called as the cryosphere.

4. The Biosphere:

This part includes all zones of earth where life is present. It includes all the plants, animals, and microorganisms present on earth. Much of the biosphere is contained within a shallow surface layer encompassing the lower part of the atmosphere, the surface of the geosphere and approximately the upper 100 metres of the oceans. All living organisms of biosphere are intimately related to the other three spheres – as most living organisms require gases from the atmosphere, water from the hydrosphere and nutrients and minerals from the geosphere.

Human beings as part of the biosphere, interact with the entire earth system, its components and subcomponents which follow the fundamental principles of physics, chemistry, biology, and geology. These principles function in terms of processes and cycles, such as climate processes, biogeochemical cycles and hydrologic cycle. The ability for utilizing and altering all aspects of the earth system including natural resources directly or indirectly place human beings in seemingly inevitable competition with all other organisms. The consequences of this competition are revealed in the form of global warming, disturbances in biogeochemical cycles such as perturbation of the nitrogen cycle, regional changes in quality and quantity of fresh water, etc.

The main components of the earth system are interconnected by two factors –

a) ***the one-way flow of energy*** from the sun, through the living organisms in their feeding interactions, into the environment, and eventually to outer space as heat. As the solar energy interacts with carbon dioxide and other gases in the troposphere, it warms the earth surface and lower atmosphere by the process of greenhouse effect. The later makes the earth's temperature sustainable for living organisms which would otherwise be too cold to support the life on earth.

b) ***the cycling of the nutrients*** through parts of biosphere. The nutrients that cycle through the major biogeochemical cycles are carbon, oxygen, hydrogen, nitrogen, phosphorous and sulphur – all of which are essential for life. These biogeochemical cycles operate at global scale and involve all of the main components of earth system, thus materials are transferred continually between the geosphere, atmosphere, hydrosphere and biosphere.

1.2 Ecology and Ecosystems

The interactions in nature are studied in a branch of science termed as ‘**Ecology**’. Have you ever pondered that why the forest area is covered by huge lush green trees and besides these, what more is present in a forest? Why there is a difference in forest types along the physical gradients? Why the plants and animals in a pond differ from an ocean? How the availability of water and temperature could mark a difference in vegetation of a desert and a tundra region? How the animals affect water and nutrient availability in the soil? How does fire affect the amount of food available in grasslands? All these questions find answers in the study of ecology and ecosystems.

The term ‘**Ecology**’ was first coined by the German biologist Ernst Haeckel in 1869. Haeckel defined ecology as ‘**the study of natural environment including the relations of organisms to one another and to their surroundings.**’ It is derived from two Greek words - "*oikos*" meaning home and "*logos*" meaning study. Thus literally, ecology is the study of life at home with main emphasis on pattern of relations between organisms and their surrounding environment. Clements (1916) considered ecology to be the “**science of communities.**” Odum (1963) has defined ecology as the “**study of the structure and function of nature.**” It was broadly defined by Andrewartha (1961) as “**Ecology is the scientific study of interactions that determine the distribution and abundance of organisms.**” Modern ecologist Smith (1977) has defined it as “**a multidisciplinary science which deals with organism and its place to live and focuses on ecosystem.**” In simple words, it deals with the intricate web of relationships between living organisms and their non-living surroundings. The surroundings consist of other living organisms and non-living environment such as water, air, soil, etc. Ecologists mainly focus on the distribution, life processes and adaptations among the organisms, which further are associated with the analysis of flow of energy and nutrients.

Ecology can also be considered in terms of concept of levels of organization. The entire biological spectrum can at the best be divided into ten levels of organization including atom, cell, organ and organ system. The ecologists study interactions within and among six of these levels – organisms, populations, communities, ecosystems, biomes and the biosphere (Fig 1.2).

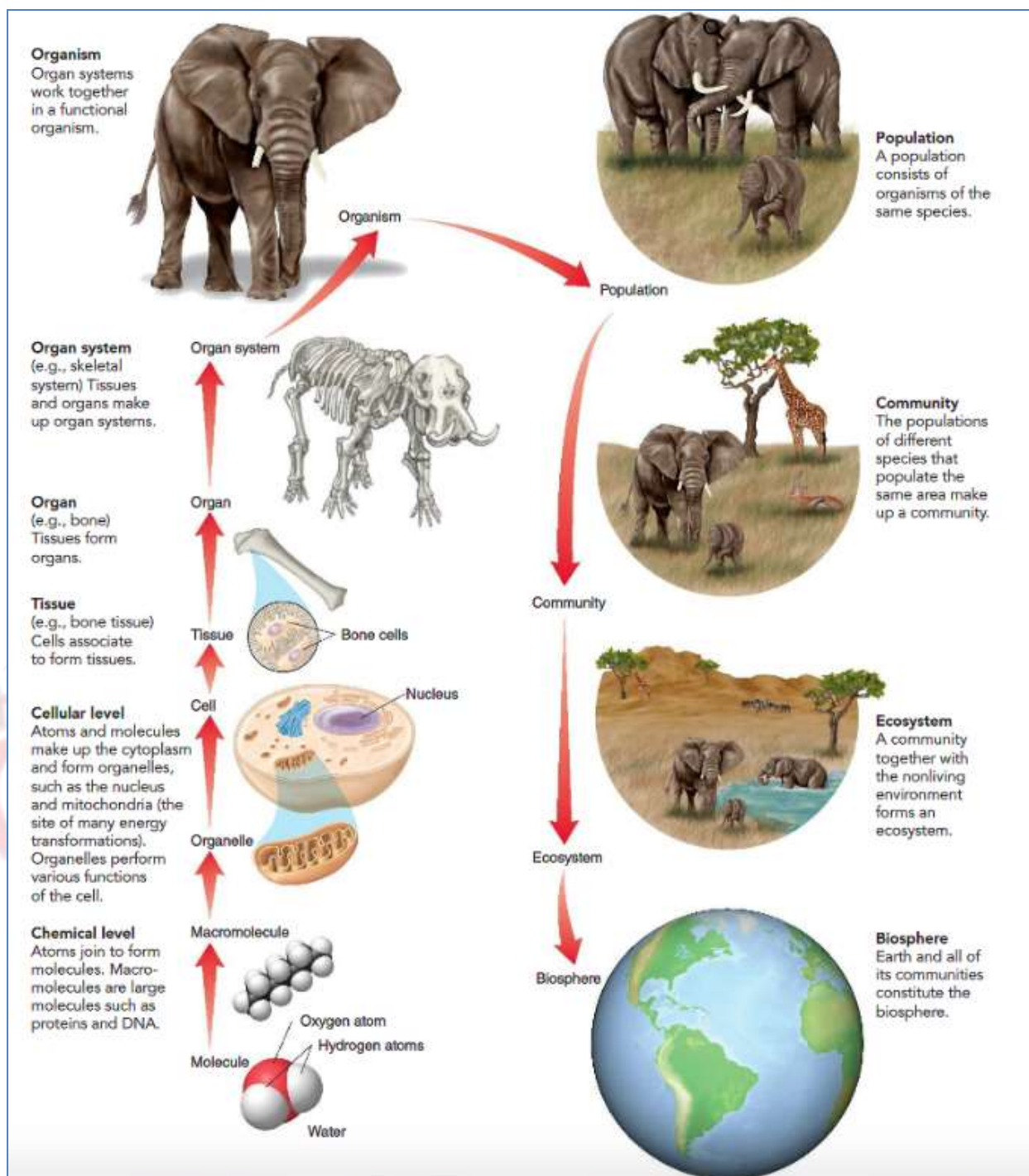


Fig. 1.2: Levels of Biological Organization

Source: <http://erinmayer238.weebly.com/old-page-5th-life-science-biomes.html>

Ecology is divided into two branches depending upon whether an individual organism or a group of organisms is considered in the study:

1. Autecology:

The study of an individual species in relation to its environment is known as autecology. It includes the study of its geographical distribution, taxonomic position, morphological characters, life cycle and behaviour with reference to ecological factors that might influence these activities. For example, the study of a particular fish, i.e. where it lives, what it eats, how many eggs it lays, etc.

2. Synecology:

The study of group of organisms in relation to their environment is called as synecology. Here the unit of study is the group of species. For example, the study of aquatic flora and fauna in a particular river, i.e., the kinds of fishes and other animals living in it, types of plants found, the interrelationship between the plants and animals and with the physical factors of water, etc.

1.3 Concept of Ecosystem

In nature, the living organisms (plants, animals and microorganisms) and nonliving environment (e.g. water, air, soil, etc.) are inseparably interrelated and interact with each other. No living organism can exist by itself, or without an environment. Every organism uses energy, nutrients and water from its surrounding environment in various life activities.

1. The plants obtain the **energy** directly from the sun, and, in case of animals and microorganisms, energy is taken from other organisms through feeding on plants, predation, parasitism and/or decomposition.
2. The terrestrial plants obtain **water** mainly from soil, while animals get it from free standing water in the environment or from their food.
3. The plants obtain most of their **nutrients** from the soil or water, while animals get nutrients from plants or other organisms. Microorganisms are the most versatile, obtaining nutrients from soil, water, food, or other organisms.

As a result, the organisms interact with one another and with their environment in a number of ways. These fundamental interactions among organisms and their non-living/physico-chemical environment constitute an interrelating and interdependent ever-changing system known as an **ecological system** or **ecosystem**. The ecosystem has been considered as the basic functional unit of ecology and ecology as study of ecosystems.

The togetherness of organisms and environment has been expressed in history by different ecologists. However, the formal terminologies began to appear in different parts of the world in late 1800s. Karl Mobius, a German scientist, in 1877 gave the term 'biocoenosis' to a community of organisms in oyster reef; in 1887, S. A. Forbes, an American scientist, described lake as 'microcosm' and Russian ecologist, Sukachev in 1944, expanded it to 'geobiocenosis'.

Although the roots of ecosystem concept can be traced in 19th century, it is largely a twentieth century construct. A. J. Lotka came up with the idea of ecosystem and wrote in his book (entitled Elements of Physical Biology (1925): *"the organic and inorganic worlds function in a single system to such an extent that it is impossible to understand either part without understanding the whole."*

However, the term 'Ecosystem' was first coined in 1935 by the British ecologist Sir Arthur G. Tansley as part of a debate over the nature of biological communities: *"Our natural human prejudices force us to consider the organisms as the most important parts of these systems, but certainly the inorganic "factors" are also parts - could be no systems without them, and there is a constant interchange of the most various kinds within each system, not only between the organisms but between the organic and the inorganic. These ecosystems, as we may call them, are of the most various kinds and sizes."* Tansley described the most fundamental nature of ecosystems – *as a system in which biotic and abiotic components of environment are interrelated*. The main focus is on the organisms in the definition and the nature of the "constant interchange of the most various kinds" is not made clear.

The great ecologist, E. P. Odum (1971) defined ecosystem as *"Any unit that includes all of the organisms (i.e. the "community") in a given area interacting with the physical environment so that a flow of energy leads to clearly defined trophic structure, biotic diversity, and material cycles (i.e. exchange of materials between living and nonliving parts) within the system is an ecological system or*

ecosystem” Thus, Odum describes explicitly that ecosystem is a geographical unit and energy flow plays a central role in defining structural and functional features of the ecosystem.

Allen and Hoekstra (1992) stated ecosystem as *“The functional ecosystem is the conception where biota are explicitly linked to the abiotic world of their surroundings. Systems boundaries include the physical environment. Size is not the critical characteristic, rather the cycles and pathways of energy and matter in aggregate form the entire ecosystem.”* They defined it as “functional ecosystem” and emphasized on the functional features such as nutrient cycling or trophic dynamics as much as what it contains or its size.

Though there may be differences in the definitions given by different authors, all have three common characteristics – biotic component, abiotic environment and interactions between these two. The biotic component of ecosystem generally consists of communities of organisms, and abiotic component includes the physico-chemical environment surrounding them. Interactions may be numerous including food webs, trophic dynamics, nutrients cycling, flow of energy, etc. It has held a central position in modern ecology and environmental sciences. Modern ecology is now defined as **“the study of structure and functions of ecosystems.”** Now a day, most of the environmental management strategies include recognition of ecosystems as a way of ordering our perception of nature.

Ecosystems differ greatly in their composition - in the number and kind of species, the type and relative proportions of non-living constituents, and in the degree of variations in time and space. A forest, a grassland, a pond, a coral reef, a part of any field and a laboratory culture can be some examples of ecosystem. The size of ecosystems varies tremendously. An ecosystem could be an entire rain forest, covering a large geographical area, or it could be a single tree inhabiting a large no. of birds and/or microorganisms in its leaf litter. It could be a termite’s gut, a lake or the biosphere as a whole with an entire intertwined environment of earth. The number of ecosystems on earth is countless and each ecosystem is distinct. All ecosystems have the following common characteristics as given by Smith (1966):

1. The ecosystem is the major structural and functional unit of ecology.

2. The structure of an ecosystem is related to its species diversity; the more complex ecosystems have high species diversity.
3. The function of ecosystem is related to energy flow and material cycling through and within the system.
4. The relative amount of energy needed to maintain an ecosystem depends on its structure. The more complex the structure, the lesser the energy it needs to maintain itself.
5. Ecosystems mature by passing from less complex to more complex stages. Early stages of such succession have an excess of potential energy and a relatively high energy flow per unit biomass. Later (mature) stages have less energy accumulation and its flow through more diverse components.
6. Both the environment and energy fixation in any given ecosystem are limited and cannot be exceeded without causing serious undesirable effects.
7. Alterations in the environment represent selective pressures upon the population to which it must adjust. Organisms which are unable to adjust to the changed environment disappear ultimately.

All ecosystems have a feeding hierarchy which starts with an energy source (e.g. the sun) and then followed by producers, consumers and decomposers. These components are dependent on one another. One of the important features is presence of grazing or detritus food chain and webs which become the lifeline of ecosystems. In grazing food chain and webs, green plants (i.e. producers) synthesize food from non-living nutrients with the help of the sunlight in the process of photosynthesis. Animals (i.e. consumers) consume plants and other animals to get the nutrients. When plants and animals die and decay or when animals excrete waste, bacteria and fungi (i.e. decomposers) feed on the dead or waste materials and release the nutrients back into water and/or soil for reuse by the producers. In a detritus food chain or web, the energy comes from dead organic matter (i.e. detritus) instead of green producers. One example of a detritus food web is the ecosystem of a deciduous forest floor.

Ecosystems are sustained by the presence of biodiversity. Each organism in an ecosystem has a purpose (i.e. niche), as a result, the loss of one species can alter both the size and stability of

ecosystems. In a whole, the ecosystems are open systems – depicting that things are entering and leaving the system, even though the general appearance and basic functions may remain constant for long periods of time.

1.4 Ecosystem Structure

The ecosystem is largely divided into two components - **Abiotic** and **Biotic** components. Ecosystem structure is created due to interaction between abiotic and biotic components, varying over space and time.

1. Abiotic Components

The abiotic components of an ecosystem refer to the physical environment or the non-living factors. The organisms cannot live or survive without their abiotic components. They mainly include i) **inorganic substances** required by organisms such as carbon dioxide, water, nitrogen, calcium, phosphorus, etc. that are involved in material cycles. The amount of these inorganic substances present at any given time in ecosystem is called as standing state or standing quality of ecosystem. ii) **organic compounds** like proteins, carbohydrates, amino acids, lipids, humic substances and others are synthesized by the biotic counterpart of an ecosystem. They make biochemical structure of ecosystem. iii) **climatic factors** including mainly rain, light, temperature, humidity, wind and air and iv) **edaphic and other factors** such as minerals, soil, topography, pH, etc. greatly determine the functions, distribution, structure, behavior and inter-relationship of organisms in a habitat.

2. Biotic Components

The biotic components of the ecosystems are the living organisms including plants, animals and microorganisms. Based on their nutritional requirement, i.e. how they get their food, they are categorized into three groups – i) **Producers** are mainly the green plants with chlorophyll which gives them the ability to use solar energy to manufacture their own food using simple inorganic abiotic substances, through the process of photosynthesis. They are also called as **photoautotrophs** (photo-light, auto-self, troph-nutrition). This group is mainly constituted by green plants, herbs, shrubs, trees, phytoplanktons, algae, mosses, etc. There are some chemosynthetic bacteria (sulphur bacteria) deep

beneath in the ocean which can synthesize their food in absence of sunlight, thus known as **chemoautotrophs** (chemo-chemical, auto-self, troph-nutrition). ii) **Consumers** lack chlorophyll, so they depend on producers for food. They are also known as **heterotrophs**. They mainly include herbivorous (feed on plants), carnivorous (feed on other animals), omnivorous (feed on both plants and animals) and detritivores organisms (feed on dead parts, waste, remains, etc. of plants and animals,). iii) **Decomposers** (saprotrophs) are the microorganisms, bacteria and fungi, which break down complex dead organic matter into simple inorganic forms, absorb some of the decomposition products, and release inorganic nutrients that are reused by the producers. All ecosystems have their own set of producers, consumers and decomposers which are specific to that ecosystem. The nutritional relationship among different biotic components of an ecosystem is shown in Fig 1.3.

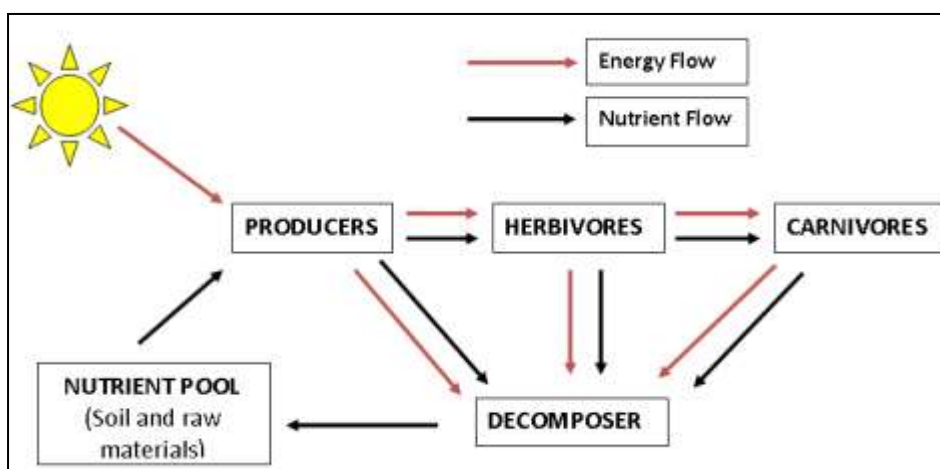


Fig 1.3: Nutritional relationship among different biotic components of an ecosystem

1.5 Types of Ecosystem

Based on the kind of habitat, there are essentially two types of ecosystems: Aquatic and Terrestrial Ecosystem (Fig 1.4). Any other sub-ecosystem falls under one of these two types.

1. Terrestrial Ecosystem

The ecosystems on land are called as terrestrial ecosystems. They are broadly classed into:

a) Forest Ecosystem:

They are the ecosystems with an abundance of flora, or plants in relatively small space. A wide diversity of fauna can also be seen. A small change in this ecosystem could affect the whole balance and effectively bring down the whole ecosystem. They are further divided into:

- **Tropical rainforest:** These contain more diverse biodiversity than ecosystems in any other region on earth. They receive a mean rainfall of 80 cm for every 400 inches annually. In these, warm, moisture-laden environments, dense evergreen vegetation comprising tall trees at different heights are present, with fauna species inhabiting the forest floor all the way up to canopy.
- **Tropical deciduous forest:** In these ecosystems, shrubs and dense bushes are found along with a broad selection of trees. The trees are mainly which shed their leaves during dry season. The type of forest is found in quite a few parts of the world while a large variety of fauna and flora are found there.
- **Temperate evergreen forest:** Those have a few numbers of trees as mosses and ferns make up for them. Trees have developed needle shaped leaves in order to minimize transpiration.
- **Temperate deciduous forest:** The forest is located in the moist temperate places that have sufficient rainfall. Summers and winters are clearly defined and the trees shed the leaves during the winter.
- **Taiga:** found just before the arctic regions, the taiga is defined by evergreen conifers. As the temperature is below zero for almost half a year, the remainder of the months, it buzzes with migratory birds and insects.

b) Desert Ecosystems:

Desert ecosystems are located in regions that receive low precipitation, generally less than 25 cm per year. They occupy about 17 percent of land on earth. Some deserts contain sand dunes, while others feature mostly rock. Due to the extremely high temperature, low water availability and intense sunlight, vegetation is scarce or poorly developed, and any animal species, such as insects, reptiles and birds, must be highly adapted to the dry conditions. The vegetation is mainly shrubs, bushes, few

grasses and rare trees. The stems and leaves of the plants are modified in order to conserve water as much as possible, for example, succulents such as the spiny leaved cacti.

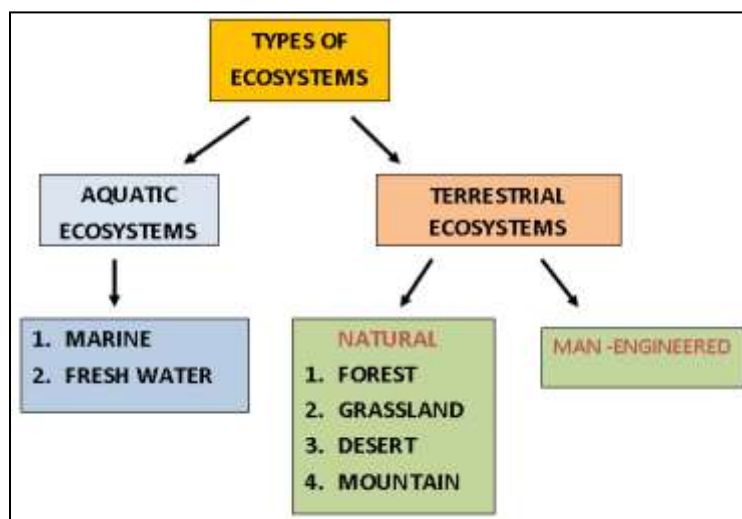


Fig 1.4. Basic types of ecosystems

c) Grassland Ecosystems:

Grassland Ecosystems are typically found in both tropical and temperate regions of the world. They share the common climatic characteristic of semi-aridity. The area mainly comprises grasses with a little number of trees and shrubs. A lot of grazing animals, insectivores and herbivores inhabit the grasslands. The two main types of grasslands ecosystems are

Savanna: The tropical grasslands are dry seasonally and have few individual trees. They support a large number of predators and grazers.

Prairies: It is temperate grassland, completely devoid of large shrubs and trees. Prairies could be categorized as mixed grass, tall grass and short grass prairies.

d) Mountain Ecosystem:

Mountain land provides a scattered and diverse array of habitats where a large number of animals and plants are found. At the higher altitudes, under harsh environment, only the treeless alpine vegetation

can survive. The animals have thick fur coats for prevention from cold and hibernation in the winter months. Lower slopes are commonly covered with coniferous forests.

2. Aquatic Ecosystems:

Aquatic ecosystem is the ecosystem found in a body of water. It encompasses aquatic flora, fauna and water properties, as well. There are two main types of aquatic ecosystem – Marine and Freshwater Ecosystem.

a) Marine Ecosystem

Marine ecosystems are the biggest ecosystems, which cover around 71% of earth's surface and contain 97% of our planet's water. Water in marine ecosystems contains high amounts of dissolved minerals and salts. Various marine ecosystems include oceanic (a relatively shallow part of oceans which lies on the continental shelf), profundal (deep or bottom water), benthic bottom substrates, inter-tidal (the place between low and high tides), estuaries, coral reefs, salt marshes, hydrothermal vents where chemosynthetic bacteria make up the food base. Many kinds of organisms live in marine ecosystems: the brown algae, corals, cephalopods, echinoderms, dinoflagellates, sharks, etc.

b) Freshwater Ecosystem

Contrary to the Marine ecosystems, the freshwater ecosystem covers only 0.8% of Earth's surface and contains 0.009% of the total water. Three basic kinds of freshwater ecosystems exist. i) **Lentic** - slow-moving or still water like pools, lakes or ponds ii) **Lotic** - fast-moving water such as streams and rivers iii) **Wetlands** - places in which the soil is inundated or saturated for some lengthy period of time.

Natural and Artificial Ecosystems

All above ecosystems are **Natural ecosystems** as these operate themselves under natural conditions without any major interference by man.

Some ecosystems are maintained artificially by human beings where, by addition of energy and planned manipulations, natural balance is disturbed regularly. For example, croplands like maize,

wheat, rice-fields etc. where man tries to control the biotic community as well as the physico-chemical environment. These are called as **Artificial or Man-engineered ecosystems**.

1.6 Ecosystem Boundary

The ecosystems appear distinct from each other with time and space, but functionally they are linked with each other. No ecosystem can exist alone. They are always in contact with the adjacent ecosystems. There exist no functional boundaries between them. Adjacent ecosystems interact with each other in order to make their structure and function. For example, various insects may be aquatic for certain parts of their life cycle and later on they become herbivorous of the vegetation on land. The adjacent aquatic and land ecosystem may have common organisms like birds. There is an exchange of inorganic nutrients between them. For example, sea birds bring the element phosphorus from sea to land (in the form of guano). The same element phosphorus as found in Himalayan region may be brought to land by the rivers.

The boundaries of ecosystem do overlap and this overlapping area is known as the transition zone. The transition zone is also known as the ecotone. It can be wide or narrow. The tropical rain forest and savannah along with the grasslands are also included under it. These areas have the plants and animals of both the ecosystems. (See box 1.1)

Summary

1. The earth's life support system consists of four main components – the geosphere, the atmosphere, the hydrosphere, and the biosphere. These components are overlapping and interrelated with each other. A change in one is likely to result in change in one or more others.
2. Ecology is defined as the study of natural environment including the relations of organisms to one another and to their surroundings. It is derived from two Greek words – *oikos* meaning home and *logos* meaning study. Thus literally, ecology is the study of life at home with main emphasis on pattern of relations between organisms and their surrounding environment.
3. The fundamental interactions among organisms and their non-living/physico-chemical environment constitute an interrelating and interdependent ever-changing system known as an

ecological system or ecosystem. The ecosystem has been considered as the basic functional unit of ecology and ecology as study of ecosystems.

4. The ecosystem is largely divided into two components - Abiotic and Biotic components. The abiotic components of an ecosystem refer to the physical environment or the non-living factors. The biotic components of the ecosystems are the living organisms including plants, animals and microorganisms.
5. Two important processes flow of energy and material cycling keep the ecosystem functional.
6. Based on the kind of habitat, there are essentially two types of ecosystems: Aquatic and Terrestrial Ecosystem. The aquatic ecosystem includes marine and freshwater ecosystems. While, terrestrial ecosystems are the forests, grassland, deserts, mountain and man-made ecosystems.
7. The ecosystems appear distinct from each other with time and space, but functionally they are linked with each other. No ecosystem can exist alone. They are always in contact with the adjacent ecosystems. There exist no functional boundaries between them. Adjacent ecosystems interact with each other in order to make their structure and function.
8. The boundaries of ecosystem do overlap and this overlapping area is known as the transition zone. The transition zone is also known as the ecotone.
9. The mixed ecosystem characteristics result in greater density and biodiversity along the ecotones. This phenomenon is called the edge effect. The new species living along edges are unique and are called edge species.

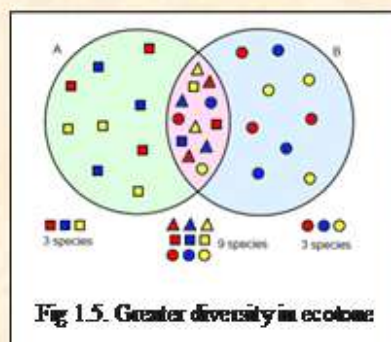
Box 1.1: Ecotone and Edge Effect

When an ecosystem changes abruptly from one to another, that transition zone is called as **ecotone**. The transition from one ecosystem to the other can be a very gradual or a very sharp one. This zone can go through long stretches along two ecosystems and is a place where characteristics of both ecosystems can be seen. Therefore, it makes a completely different habitat. For example, transition from a forest to a grassland ecosystem forms an ecotone. A slow change in the tree composition occurs as the conditions of temperature and rainfall varies. Quite suddenly, the forest will give way to the open spaces of grassland. Another example is that of a floodplain - a shift from terrestrial to aquatic ecosystem. The stretch of the bank where these two ecosystems meet forms one of the most important ecotones in nature.

Ecotones are not only a physical transition from one ecosystem to another, they also represent a transition in the living conditions. Along the ecotone, organisms from both communities face increasing environmental stresses. For example, a deer (terrestrial animal) cannot live comfortable in an area that consists of wet marshlands (the ecotone between terrestrial and aquatic ecosystems). Similarly, the same deer will find it difficult to survive along the ecotone of a forest and a grassland because of lack of open spaces. It cannot keep a lookout for predators as effectively as it can in open grasslands.

Since the ecosystem characteristics are so unique in ecotones, we also find a completely new array of species along this zone. Taking the river-land example again, we will find many amphibians and reptiles living along this ecotone. These animals will not be found in the interior zones of either ecosystem.

The mixed ecosystem characteristics result in greater density and biodiversity along the ecotones. This phenomenon is called the **edge effect**. For example, a large number of bird species are found along the land-water ecotones. Similarly, the sea-river ecotones (deltas or estuaries) have wide varieties of fish species. The new species living along edges are unique and are called **edge species**. For example, amphibians in floodplain ecotones. *There are some seasonal edge species that occur for only a short period of time. For example, sea turtles that come into beaches to lay eggs, and get back to their sea habitat when their young ones are ready.*



Ecotones and edges are unique because of the conditions they host. Their ability to support so many different organisms makes them highly sensitive areas for biodiversity. These zones represent harsh living conditions. Therefore, even small changes in their characteristics can be potentially disastrous for the organisms living there.

Humans have affected ecotones and edges massively to modify them for their benefit. These edges also represent advantageous conditions for humans. Along the river-land ecotone, the land is extremely fertile. It also has a ready water source in close proximity. These conditions are excellent for the development of agricultural land.

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