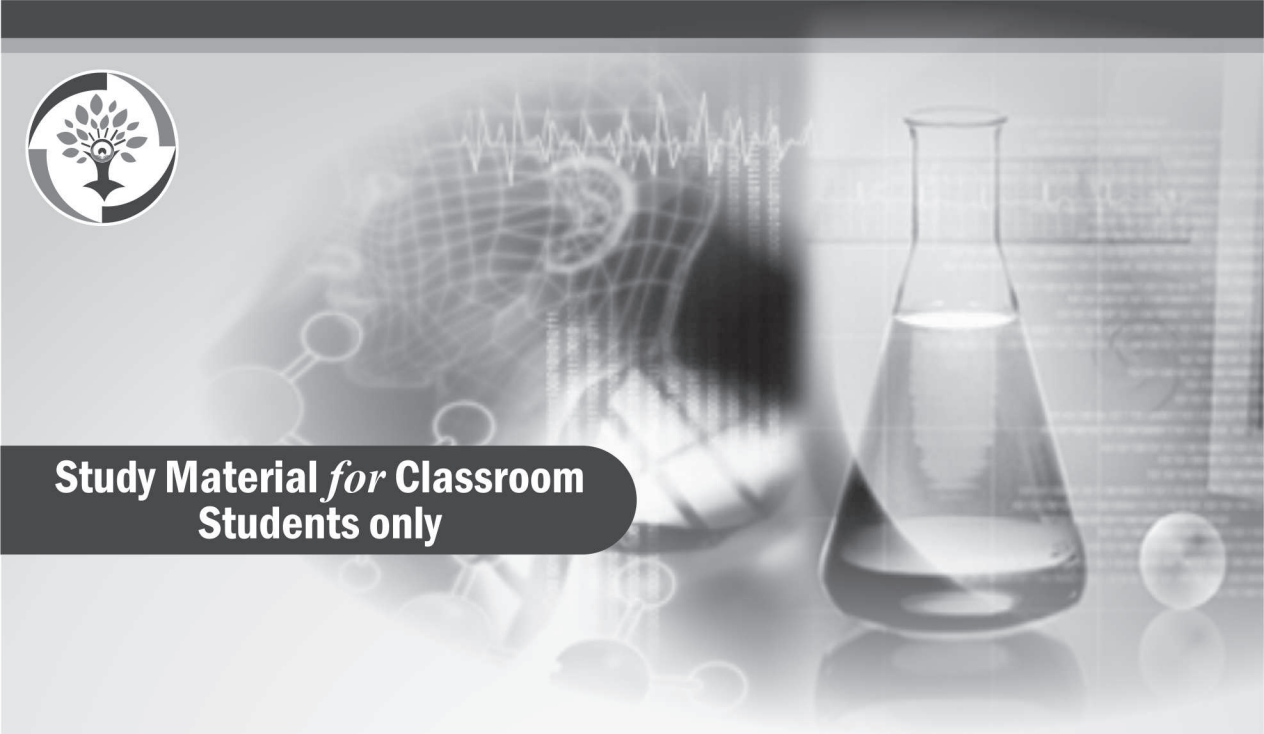


Study Material *for* Classroom Students only

GENERAL STUDIES

GENERAL SCIENCE

ECOLOGY & ECOSYSTEM

Head Office: 53/5, Old Rajinder Nagar Market, Delhi-60
Branch Office: 105-106, Top Floor, Mukherjee Tower, Mukherjee Nagar, Delhi-110009
9999329111, 011-45596505
Website: www.vvrias.com
Email: vvrias@gmail.com

VVR
IAS EXAM PREPARATION

ECOLOGY AND ECOSYSTEM

Ecology may be defined as the scientific study of the relationship of living organisms with each other and with their environment.'

The term **ecology** was first coined in 1869 by the German biologist **Ernst Haeckel**. It has been derived from two Greek words, '**oikos**', meaning home or estate and '**logos**' meaning study. The emphasis is on relationships between organisms and the components of the environment namely abiotic (non-living) and biotic (living).

Environment: *Everything that surrounds and affects an organism during its lifetime is collectively known as its environment which comprises both living and non living components*.

LEVELS OF ECOLOGICAL ORGANIZATION

Ecology not only deals with the study of the relationship of individual organisms with their environment, but also with the study of populations, communities, ecosystems, biomes, and biosphere as a whole

INDIVIDUAL, SPECIES, ORGANISM

An individual is any living thing or organism. Individuals do not breed with individuals from other groups. Animals, unlike plants, tend to be very definite with this term because some plants can cross-breed with other fertile plants.

POPULATION

A group of individuals of a given species that live in a specific geographic area at a given time. (example is Gill and his family and friends and other fishes of Gill's species) Note that populations include individuals of the same species, but may have different genetic makeup such as hair/eye/skin colour and size between themselves and other populations.

COMMUNITY

This includes all the *populations in a specific area at a given time*. A community includes populations of organisms of different species. A great community usually includes biodiversity.

ECOSYSTEM

Ecosystems include more than a community of living organisms **(biotic)** interacting with the environment **(abiotic)**. At this level they depend on other abiotic factors such as rocks, water, air and temperature.

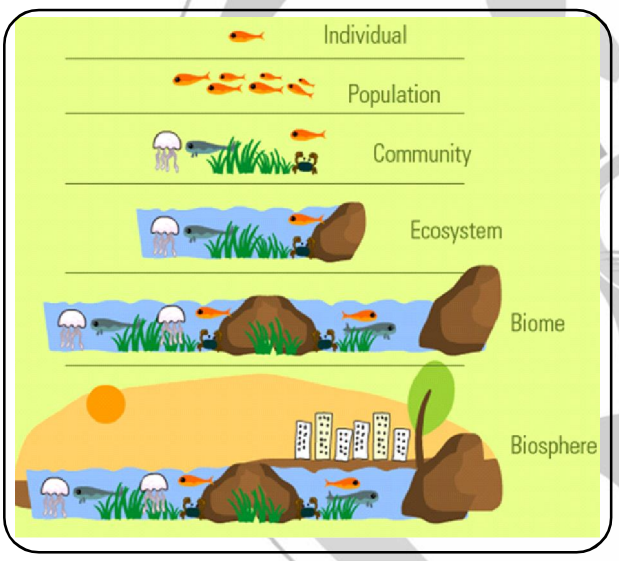
BIOME

A biome, in simple terms, is a *set of ecosystems sharing similar characteristics with their abiotic factors adapted to their environments.*

Eg:- Desert Biomes (Hot and Dry deserts Aridty Semi aid desert etc) Grass land Biomes (Savna grass lands stage lands)

BIOSPHERE

When we consider all the different biomes, each blending into the other, will all humans living in many different geographic areas, we form a huge community of humans, animals and plants, in their defined habitats. A biosphere is the sum of all the ecosystems established on Earth.



ORGANISM

ORGANISM AND ITS ENVIRONMENT

Ecology at the organismic level is essentially physiological ecology which tries to understand how different organisms are adapted to their environments in terms of not only survival but also reproduction. You may have learnt in earlier classes how the rotation of our planet around the Sun and the tilt of its axis cause annual variations in the intensity and duration of temperature, resulting in distinct seasons. These variations together with annual variation in precipitation account for the formation of major biomes such as desert, rain forest and tundra.

Regional and local variations within each biome lead to the formation of a wide variety of habitats. On planet Earth, life exists not just in a few favourable habitats but even in extreme and harsh habitats Even our intestine is a unique habitat for hundreds of species of microbes.

HABITAT

Habitat is the *physical environment in which an organism lives*. Each organism has particular requirements for its survival and lives where the environment provides for those needs. The environmental requirement of an elephant would be a forest. A habitat may support many different species having similar requirements. For example, a single ocean habitat may support a whale, a sea-horse, seal, phytoplankton and many other kinds of organisms. **Eg:-** Forest, ocean, river etc. are examples of habitat.

Earth has four major habitats-(1) **Terrestrial** (2) **Freshwater** (3) **Estuarine** (Where rivers meet the ocean) and (4) **Ocean**.

NICHE

In nature, many species occupy the same habitat but they perform different functions. *The functional characteristics of a species in its habitat* is referred to as "**niche**" in that common habitat. Habitat of a species is like its 'address' whereas niche can be thought of as its "profession" (i.e. activities and responses specific to the species). The term niche means the sum of all the activities and relationships of a species by which it uses the resources in its habitat for its survival and reproduction. A niche is unique for a species while many species share the habitat. No two species in a habitat can have the same niche. This is because if two species occupy the same niche they will compete with one another until one is displaced.

Eg:-

1. For example, a large number of different species

of insects may be pests of the same plant but they can co-exist as they feed on different parts of the same plant.

2. Another example is the vegetation of the forest. The forest can support a large number of plant species as they occupy different niches: the tall trees, the short trees, shrubs, bushes and grasses are all part of the forest but because of varying heights they differ in their requirements for sunlight and nutrients and so can survive together

ADAPTATION

Adaptation is any attribute of the organism (morphological, physiological, behavioural) that enables the organism to survive and reproduce in its habitat. Many adaptations have evolved over a long evolutionary time and are genetically fixed.

Examples:

1. In the absence of an external source of water, the kangaroo rat in North American deserts is capable of meeting all its water requirements through its internal fat oxidation (in which water is a by product). It also has the ability to concentrate its urine so that minimal volume of water is used to remove excretory products.
2. Many desert plants have a thick cuticle on their leaf surfaces and have their stomata arranged in deep pits to minimise water loss through transpiration.
3. In the polar seas aquatic mammals like seals have a thick layer of fat (blubber) below their skin that acts as an insulator and reduces loss of body heat.

*Mammals from colder climates generally have shorter ears and limbs to minimise heat loss. (This is called the **Allen's Rule.**)*

SPECIES

A species is defined as; "a group of similar populations of organisms whose members are capable of interbreeding, and to produce fertile offspring.

- Only members of the same species can interbreed to produce fertile offspring.
- Every species has its own set of genetic characteristics that makes the species unique and different from other species.
- Every species has a scientific name, understood by people of all over the world. Humans belong to species of *Homo sapiens*.

EVOLUTION

It is the change in the heritable traits of bilogical in the populations over successive generations

Evolutionary process give sure to diversity at every level of biological organismation including the levels of spaces, individual organisms and molecules.

Variations are the changes in the heratable traits and come from **mutation**,

(members of the same species show 'variation' and are not exactly identical. Variations are heritable).

In a sexually reproducing population, meiosis and fertilization produce new combination of genes every generation, which is termed **recombination.**

Mutation are the changes in the DNA sequence of a cells are resultant of an error in replication. They give rise to new genes in the population.

*A valid theory of evolution was propounded by **Charles Darwin** and **Alfred Wallace** in 1859. This theory has been extended in the light of progress in genetics and is known as **Neo-Darwinism**.*

*An evolutionary force which Darwin termed **natural selection**, selects among variations i.e. genes that help the organism to adopt to its environment. Such genes are reproduced more in a population due to natural selection.*

*Those offspring which are suited to their immediate environment have a better chance of surviving, reaching reproductive age and passing on the suitable **adaptations** to their progeny.*

*Evolution thus results in **adaptation** and **diversity of the species**.*

POPULATION

'Population' is defined as a *group of freely interbreeding individuals of the same species present in a specific area at a given time.*

A population has traits of its own which are different from those of the individuals forming the population. An individual is born and dies but a population continues. It may change in size depending on birth and death rates of the population.

The characteristics of any population depends on:

(i) density of the population, (ii) natality (birth rate), (iii) mortality (death rate), (iv) dispersal, (v) biotic potential (vi) age distribution (vii) dispersion and (viii) growth form.

POPULATION INTERACTIONS

Interspecific interactions arise from the interaction of populations of two different species. They could be beneficial, detrimental or neutral (neither harm nor benefit) to one of the species or both. Assigning a '+' sign for beneficial interaction, '-' sign for detrimental and 0 for neutral interaction, let us look at all the possible outcomes of interspecific interactions

Population Interactions

Species A	Species B	Name of Interaction
+	+	Mutualism
–	–	Competition
+	–	Predation
+	–	Parasitism
+	0	Commensalism
–	0	Amensalism

Both the species benefit in **mutualism** and both lose in **competition** in their interactions with each other. In both **parasitism** and **predation** only one species benefits (parasite and predator, respectively) and the interaction is detrimental to the other species (host and prey, respectively). The interaction where one species is benefitted and the other is neither benefitted nor harmed is called **commensalism**. In **amensalism** on the other hand one species is harmed whereas the other is unaffected.

COMMUNITIES

In ecology the term community, or more appropriately 'biotic community, refers to the populations of different kinds of organisms living together and sharing the same habitat.

COMMUNITY CHARACTERISTICS

Species diversity

An important attribute of a community is its species diversity.

The different kinds of organisms present in a community represent its **species diversity**. The species composition or diversity differs from one community to another. Even in the same community, there may be seasonal variation in species composition.

Species diversity also influences the stability of the community. A stable community is one which is able to return to its original condition after being disturbed in some way. Communities with high species diversity have been found to be comparatively more stable.

The diversity is calculated both by the **number of species (richness)** and the **relative abundance of each species (evenness)**. Relative abundance is measure of relative proportion of different species occurring in a community. The greater the number of species and more even their distribution the greater is the species diversity.

ECOSYSTEM

In nature several communities of organisms live together and interact with each other as well as with their physical environment as an ecological unit. We call it an **ecosystem.**

The term '**ecosystem**' was coined by **A.G. Tansley** in 1935. *An ecosystem is a functional unit of nature encompassing complex interaction between its biotic (living) and abiotic (non-living) components*.

COMPONENTS OF AN ECOSYSTEM

Components of ecosystem: They are broadly grouped into:-

(a) Abiotic and (b) Biotic components

(a) Abiotic components (Nonliving): The abiotic component can be grouped into following three categories:-

(i) Physical factors: Sun light, temperature, rainfall, humidity and pressure. They sustain and limit the growth of organisms in an ecosystem.

(ii) Inorganic substances: Carbon dioxide, nitrogen, oxygen, phosphorus, sulphur, water, rock, soil and other minerals.

(iii) Organic compounds: Carbohydrates, proteins, lipids and humic substances. They are the building blocks of living systems and therefore, make a link between the biotic and abiotic components.

(b) Biotic components (Living)

(i) Producers: The green plants produce food for the entire ecosystem through the process of photosynthesis. They are called autotrophs, as they absorb water and nutrients from the soil, carbon dioxide from the air, and capture solar energy to form nutritional organic substances..

(ii) Consumers: They are called heterotrophs and they *consume food synthesized by the autotrophs*. Based on food preferences they can be grouped into three broad categories.

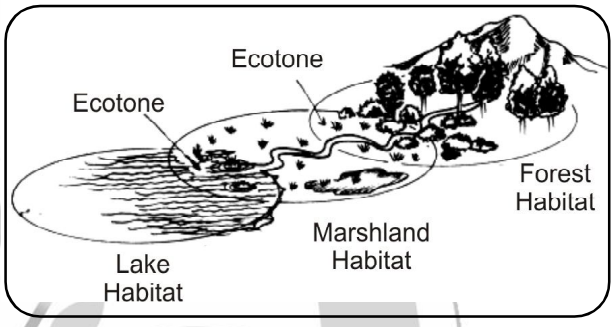
Herbivores (e.g. cow, deer and rabbit etc.) feed directly on plants.

Carnivores are animals which eat other animals (eg. lion, cat, dog etc.) and

Omnivores organisms feeding upon both plants and animals e.g. human, pigs and sparrow.

(iii) Decomposers: Also called **saprotrophs.** These are mostly bacteria and fungi that *feed on the dead it docomposing organic matter of plants and animals by* secreting enzymes outside their body on the decaying matter. They play a very important role in recycling of nutrients. They are also called **detrivores or detritus feeders**.

ECOTONE



Ecotone is a *zone of junction between two or more diverse ecosystems* e.g. the mangrove forests. They represent an ecotone between marine and terrestrial ecosystem.Some more examples of ecotone are – grassland, estuary and river bank

Characteristics of ecotone:

(1) It may be very narrow or quite wide.

(2) It has the conditions intermediate to the adjacent ecosystems. Hence ecotone is a zone of tension.

(3) It is linear as shows progressive increase in species composition of one in coming community and a simultaneous decrease in species of the other out going adjoining community.

(4) A well developed ecotones contain some organisms which are entirely different from that of the adjoining communities.

(5) Sometimes the number of species and the population density of some of the species is much greater in this zone than either community. This is called **edge effect.** The

organisms which occur primarily or most abundantly in this zone are known as **edge species.** In the terrestrial ecosystems edge effect is especially applicable to birds. For **Eg.** the density of song birds is greater in the mixed habitat of the ecotone between the forest and the desert.

ECOSYSTEM FUNCTION

Ecosystem function is the biological, geochemical and physical processes and components that occur within an ecosystem. Functions of the ecosystem relate to the structural components of an ecosystem, how they interact with each other, within ecosystem and across ecosystem. Ecosystem functions are sometimes called **ecological processes**.

- The functional aspects of an ecosystem helps to keep the components of the ecosystem running together.
- Few important aspects of ecosystem are dependent on the biodiversity and maintenance of stability in the ecosystem.
- The numerical strength and biomass of organisms affect the functioning of the ecosystem.
- The biotic community in an ecosystem usually contain a few species represented by a large number of individuals or by a large biomass and a comparatively large number of species occurring in small numbers.
- Under the conditions of stress the number of indigenous species is usually reduced, only a few species may survive and the frequency of the occurrence of stress may be very high.
- Under extreme conditions of stress like in the arctic and the antarctic regions, the total number of species in an ecosystem is reduced.
- An ecosystem is considered to be stable if its structure and function remain more or less the same from year to year.
- A system with high species diversity and low dominance is less productive but stable.
- A system with a low species diversity and high dominance is more productive but unstable.

Ecosystems are complex dynamic system. Function of ecosystem can be classified as

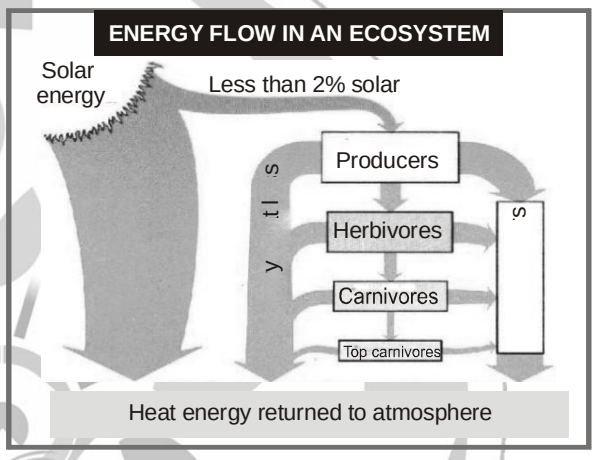
(i) Energy flow through food chain

(ii) Nutrient cycling (biogeochemical cycles)

(iii) Ecological succession or ecosystem development

(iv) Homeostasis (or cybernetic) or feedback control mechanisms.

ENERGY FLOW

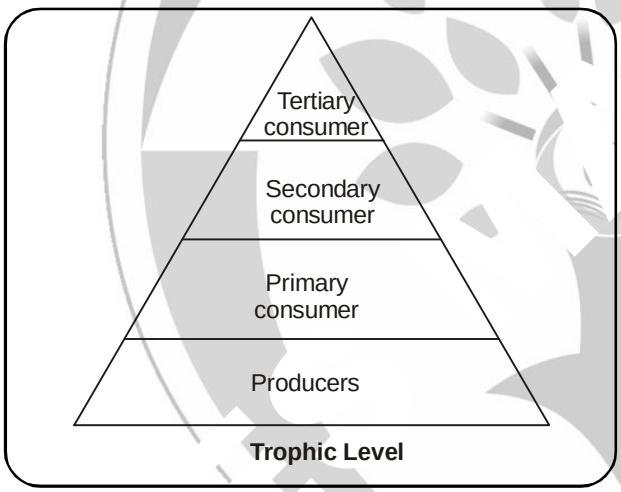


- Energy cannot be reused indefinitely though matter circulates.
- Energy from the sun or the solar energy is converted by the photosynthetic producers into chemical energy in the form of carbohydrates in plants.
- Primary consumers like the herbivores consume the plant carbohydrates and so the chemical energy is transferred to them.
- Herbivores are consumed by carnivores, so the energy is further transferred into the next trophic level.
- In these animals the chemical energy is used as mechanical energy and heat. The chemical energy in the food molecules is stored as ATP molecules. This stored energy is used by the body cells for synthesis of new chemical compounds and for mechanical work.
- Energy used at each trophic level, only 10% of it is transferred to the next trophic level.

- At the last trophic level, that is with the decomposer no energy is left for recycling.
- Hence, energy flow from sun to the producers to consumers is in a single direction only.

TROPHIC LEVEL

Trophic level of an organism is the *position of that organism in a food chain*. A food chain represent the organism that prey on others organisms which in turn are preyed upon by organisms of higher trophic level. Biodiversity in an ecosystem can be organized into trophic pyramids. In a trophic pyramid the vertical dimension represents feeding relations, which are consumed from the base of the food chain up to the top predators and the horizontal dimension represents the abundance at each level. Species of an ecosystem community are categorized as autotrophs, heterotrophs and detritivores.



Trophic Level

- Autotrophs are organisms that produce their own food by the process of photosynthesis.
- Heterotrophs are consumers which feed on the the producers for nourishment.
- Detritivores or decomposers are organisms that feed on the dead matter and convert the matter in the basic organic compounds.

FOOD CHAIN

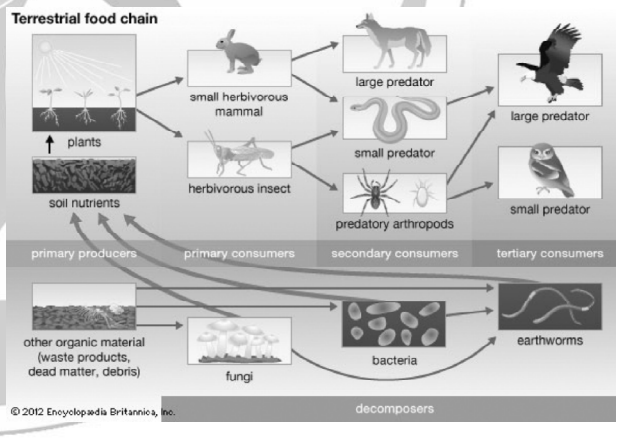
Transfer of food energy from green plants (producers) through a series of organisms with repeated eating and being eaten is called a food chain. e.g.

Grasses → Grasshopper → Frog → Snake → Hawk/Eagle

Each step in the food chain is called **trophic level**.

During this process of transfer of energy some energy is lost into the system as heat energy and is not available to the next trophic level.

(1) **Autotrophs:** They are the producers of food for all other organisms of the ecosystem. They are largely green plants and convert inorganic material in the presence of solar energy by the process of photosynthesis into the chemical energy (food). The total rate at which the radiant energy is stored by the process of photosynthesis in the green plants is called **Gross Primary Production** (GPP). This is also known as total photosynthesis or total assimilation. From the gross primary productivity a part is utilized by the plants for its own metabolism. The remaining amount is stored by the plant as **Net Primary Production** (NPP) which is available to consumers.



P = Producer, H = Herbivore, C = Carnivore, C1 = First level carnivore, C2 = Top Carnivore

Some examples of food chain

(2) **Herbivores:** The animals which eat the plants directly are called primary consumers or herbivores e.g. insects, birds, rodents and ruminants.

(3) **Carnivores:** They are secondary consumers if they feed on herbivores and tertiary consumers if they use carnivores as their food. e.g. frog, dog, cat and tiger.

(4) **Omnivores:** Animals that eat both plant and animals e.g. pig, bear and man

(5) **Decomposers:** They take care of the dead remains of organisms at each trophic level and help in recycling of the nutrients e.g. bacteria and fungi.

There are two types of food chains:

(i) **Grazing food chains:** which starts from the green plants that make food for herbivores and herbivores in turn for the carnivores.

(ii) **Detritus food chains:** start from the dead organic matter to the detrivore organisms which in turn make food for protozoan to carnivores etc.

In an ecosystem the two chains are interconnected and make y-shaped food chain. These two types of food chains are:-

(i) Producers → Herbivores → Carnivores

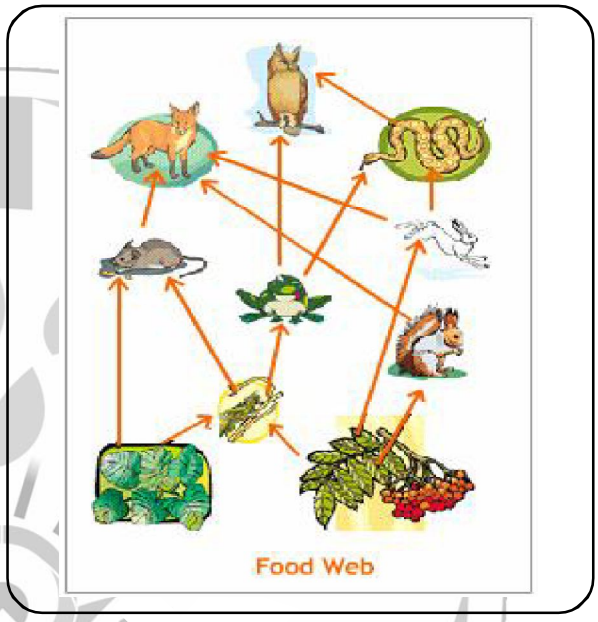
(ii) Producers → Detritus Feeders → Carnivores.

FOOD WEB

A food web is a *graphical depiction of feeding connections among species of an ecological community.* Food web consists of food chains of a particular ecosystem. The food web is a illustration of various methods of feeding that links the ecosystem. The food web also *defines the energy flow through species of a community as a result of their feeding relationships*. All the food chains are interconnected and overlapping within an ecosystem and they make up a food web.

In natural environment or an ecosystem, the relationships between the food chains are inter-connected. These relationships are very complex, as one organism may be a part of multiple food chains. Hence, a web like structure is formed in place of a linear food chain. The web like structure if formed with the interlinked food chain and such matrix that is interconnected is known as a food web.

Food webs are an indispensible part of an ecosystem; these food webs allows an organism to obtain food from more than one type of organism of the lower trophic level. Every living being is responsible and is a part of multiple food chains in the given ecosystem. It is also referred to as a **consumer-resource system.**



A animal ecologist pioneer **Charles Elton** (1927) introduced the food web concept which he referred to as food cycle. Charles Elton described the concept of food web as : The carnivore animals prey upon the herbivores. These herbivores get the energy from sun-light. The later carnivores may also be preyed upon by other carnivores. Until a reach where an animal has no enemies it forms a terminus on this food cycle. There are chains of animals that are linked together by food, and all are dependent on plants in the long run. This is referred to as a food chain and all the food chains in a community is known as the food cycle.

ECOLOGICAL PYRAMIDS

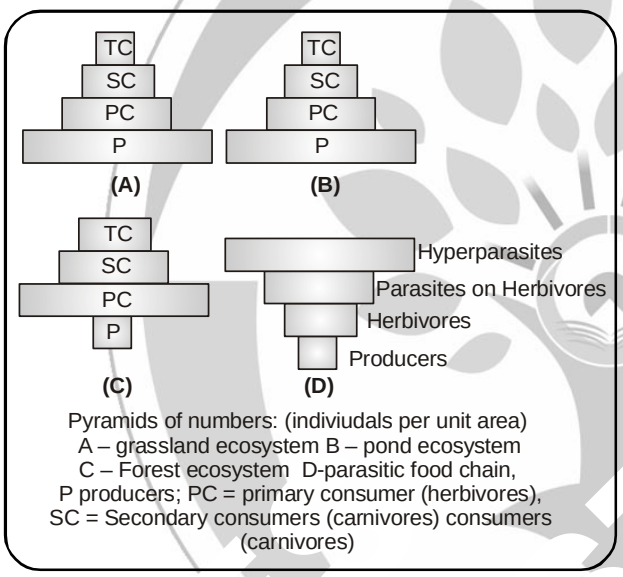
Some of the important types of Ecological Pyramids of an Ecosystem are

1. Pyramids of numbers
2 Pyramids of biomass
3. Pyramid of energy.

The trophic structure and function of successive trophic levels, i.e. producer's herbivores carnivores, may be shown graphically by means of ecological pyramids where the first or producer level constitutes the base of the pyramid and the successive levels, the tiers making the apex. Ecological pyramids were developed by Charles Elton (1927) and are, therefore, also called Eltonian pyramids. Ecological pyramids are of three general types.

PYRAMIDS OF NUMBERS

They show the relationship between producers, herbivores and carnivores at successive trophic levels in terms of their number. In a grass land ecosystem the pyramid becomes upright.



Pyramids of numbers: (indiviudals per unit area)
A – grassland ecosystem B – pond ecosystem
C – Forest ecosystem D-parasitic food chain,
P producers; PC = primary consumer (herbivores),
SC = Secondary consumers (carnivores) consumers (carnivores)

Similarly in a pond ecosystem the pyramid is upright. In a temperate forest ecosystem (summer) and aquatic ecosystem however, the pyramid of numbers is somewhat different in shape. The producers, which are mainly large-sized trees, are lesser in number and form the base of the pyramid.

(1) The herbivores insects and predatory insects are more in number than the produces.

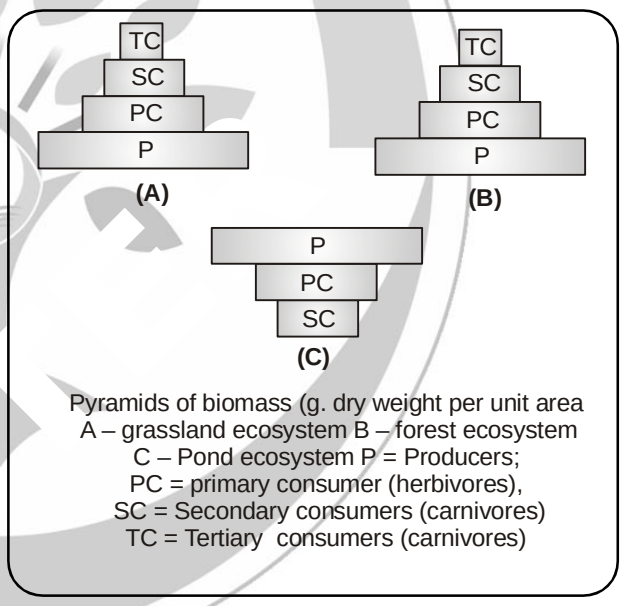
(2) In Aquatic eocystem the zoos plntation qwhich are primary consumers are nose in no than producers

Then there is a gradual decrease in the number of successive carnivores, thus making the pyramid again upright. However, in a parasitic food chain, the pyramids are always inverted.

The pyramids of numbers do not give a true picture of the food chain as they are not very functional. They generally vary with different communities with different types of food chains in the same 'environment.

PYRAMIDS OF BIOMASS:

The biomass of the members of the food chain present at any one time forms the pyramid of the biomass. They are comparatively more fundamental, as they, instead of geometric factor, show the quantitative relationship of the standing crops. In grassland and forests, there is generally a gradual decrease in, biomass of organisms at successive levels from the producers to the top carnivores. Thus pyramids are upright. However, in a pond the pyramid of biomass is inverted in shape.



Pyramids of biomass (g. dry weight per unit area
A – grassland ecosystem B – forest ecosystem
C – Pond ecosystem P = Producers;
PC = primary consumer (herbivores),
SC = Secondary consumers (carnivores)
TC = Tertiary consumers (carnivores)

PYRAMID OF ENERGY

It is a graphic representation of amount of energy trapped per unit time and area in different trophic levels of food chain with producers forming the base and top carnivores the tip. The energy content is expressed as Kcal/m^2/yr. Of the three types of ecological pyramids, the energy pyramids give the best picture of overall nature of the ecosystem.

The pyramids of energy indicates not only the amount of energy flow at each level, but more

important the actual role the various organisms play in the transfer of energy. In shape it is always upright, as in most of the cases there is always a gradual decrease in the energy content at successive trophic levels from the producers to various consumers.

BIOGEOCHEMICAL CYCLES

Biogeochemical cycles are natural pathways of circulation of essential elements of life. These elements of the living matter may flow from the nonliving abiotic to the living biotic components of the biopshere and then back to abiotic component. For the survival of the major ecosystem like lakes or forest, it is essential that all chemical elements make up the living cells must be recycled.

Biogeochemical cycles involve biological, geological and chemical factors and there is circulation of chemical nutrients like oxygen, carbon, nitrogen, phosphorus, calcium and water, etc throughout he physical and biological world. These cycles are known as biogeochemical cycles. As effect of these elements being recycled, in some cycles the elements get accumulated for a long period of time and form reservoirs like ocean or lake.

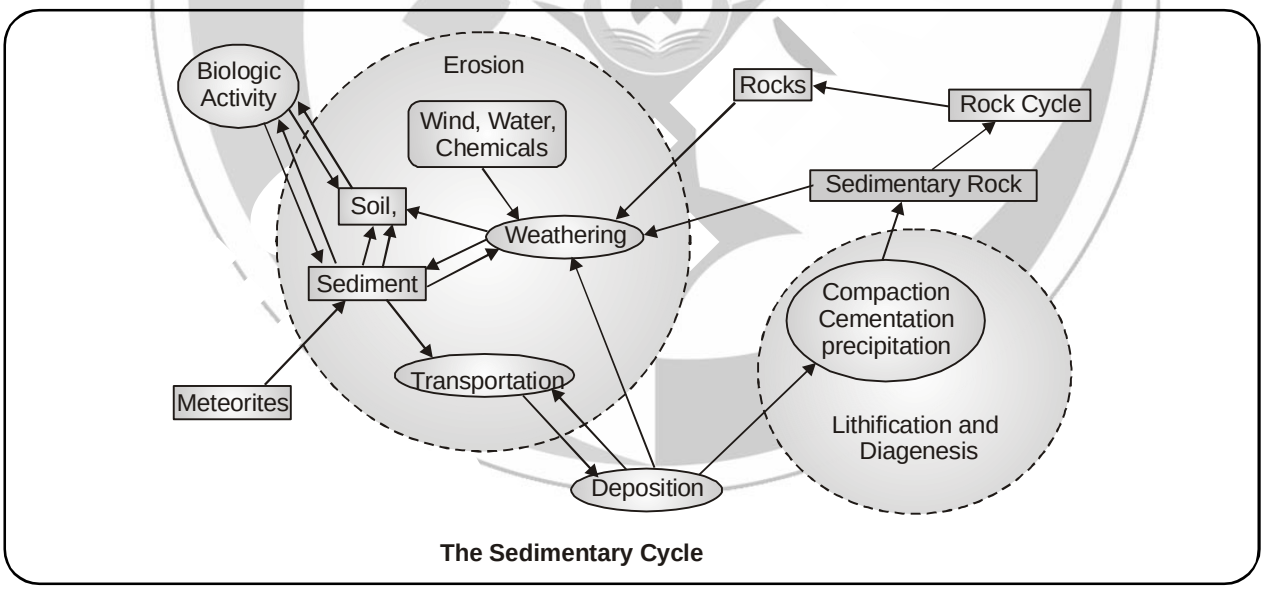
There are two types of cycle namely gaseous and sedimentary based on the nature of reservoir.

GASEOUS CYCLE

Biogeochemical cycles are classed as in which the reservoirs are the air or the oceans via evaporation. Gaseous cycle includes that of nitrogen, oxygen, carbon and water.

Gaseous cycle move rapidly and adjust more readily to the changes in the biosphere because of the large atmospheric reservoir. For example, accumulations of carbon dioxide are scattered by winds or are absorbed by plants. Any unusual or frequent disturbances affect the capacity for self-adjustment.

SEDIMENTARY CYCLE



The Sedimentary Cycle

Sedimentary cycle varies from one element to the other, each cycle consists of a solution and a rock or sediment phase. Weathering of rocks releases minerals in the form of salts which dissolve in water and can pass through a series of organisms and can reach deep sea where they settle out of circulation indefinitely. Other salts settle as deposits of sediment and rock in shallow seas.

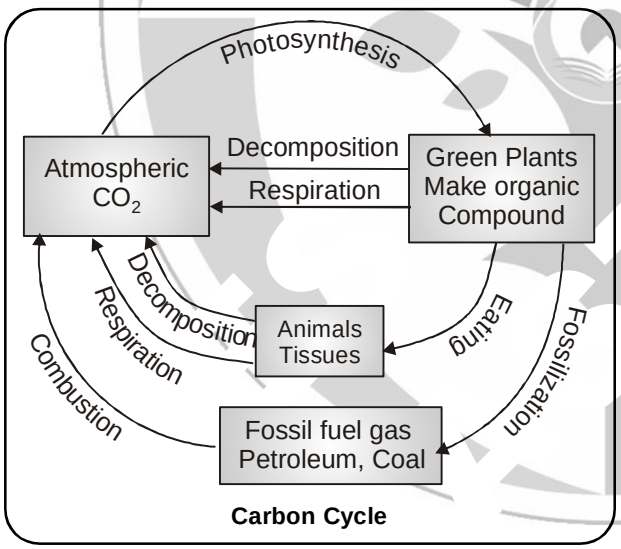
CARBON CYCLE

The source of all carbon is carbon dioxide present in the atmosphere. It is highly soluble in water; therefore, oceans also contain large quantities of dissolved carbon dioxide.

The global carbon cycle consists of following steps-

PHOTOSYNTHESIS

Green plants in the presence of sunlight utilize CO_2 in the process of photosynthesis and convert the inorganic carbon into organic matter (food) and release oxygen. A part of the food made through photosynthesis is used by plants for their own metabolism and the rest is stored as their biomass which is available to various herbivores, heterotrophs, including human beings and microorganisms as food. Forests acts as reservoirs of CO_2 as carbon fixed by the trees remain stored in them for long due to their long life cycles. A very large amount of CO_2 is released through forest fires.



Carbon Cycle

RESPIRATION

Respiration is carried out by all living organisms. It is a metabolic process where food is oxidized to liberate energy, CO_2 and water. The energy released from respiration is used for carrying out life processes by living organism (plants, animals, decomposers etc.).

DECOMPOSITION

All the food assimilated by animals or synthesized by plant is not metabolized by them completely. A major part is retained by them as their own biomass which becomes available to decomposers on their death. The dead organic matter is decomposed by microorganisms and CO2 is released into the atmosphere by decomposers.

COMBUSTION

Burning of biomass releases carbon dioxide into the atmosphere.

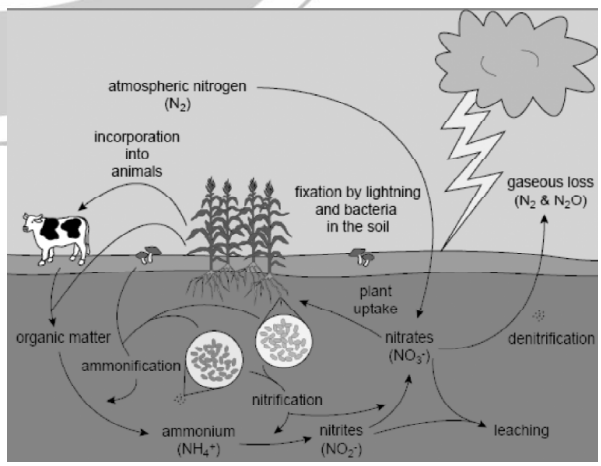
IMPACT OF HUMAN ACTIVITIES

The global carbon cycle has been increasingly disturbed by human activities particularly since the beginning of industrial era. Large scale deforestation and ever growing consumption of fossil fuels by growing numbers of industries, power plants and automobiles are primarily responsible for increasing emission of carbon dioxide.

Carbon dioxide has been continuously increasing in the atmosphere due to human activities such as industrialization, urbanization and increasing use and number of automobiles. This is leading to increase concentration of CO2 in the atmosphere, which is a major cause of global warming.

NITROGEN CYCLE

Nitrogen is an essential component of protein and required by all living organisms including human beings.



Our atmosphere contains nearly 79% of nitrogen but it can not be used directly by the majority of living organisms. Broadly like corbondioxide, nitrogen also cycles from gaseous phase to solid phase then back to gaseous phase through the activity of a wide variety of organisms. Cycling of nitrogen is vitally important for all living organisms. There are five main processes which essential for nitrogen cycle are elaborated below.

(a) Nitrogen fixation: This process involves conversion of gaseous nitrogen into Ammonia, a form in which it can be used by plants. Atmospheric nitrogen can be fixed by the following three methods:-

1. **Atmospheric fixation**: Lightening, combustion and volcanic activity help in the fixation of nitrogen.
2. **Industrial fixation**: At high temperature (400oC) and high pressure (200 atm.), molecular nitrogen is broken into atomic nitrogen which then combines with hydrogen to form ammonia.
3. **Bacterial fixation**: There are two types of bacteria-
   - **(i) Symbiotic bacteria** e.g. Rhizobium in the root nodules of leguminous plants.
   - **(ii) Freeliving or symbiotic** e.g. 1. *Nostoc* 2. ***Azobacter*** 3. **Cyanobacteria** can combine atmospheric or dissolved nitrogen with hydrogen to form ammonia.

(b) **Nitrification:** It is a process by which ammonia is converted into nitrates or nitrites by ***Nitrosomonas*** and ***Nitrococcus*** **bacteria** respectively. Another soil bacteria *Nitrobacter* can covert nitrate into nitrite.

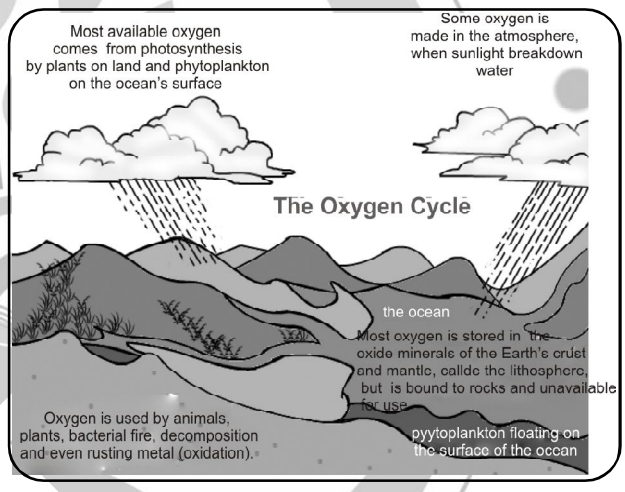
(c) **Assimilation:** In this process nitrogen fixed by plants is converted into organic molecules such as proteins, DNA, RNA etc. These molecules make the plant and animal tissue.

(d) **Ammonification** : Living organisms produce nitrogenous waste products such as urea and uric acid. These waste products as well as dead remains of organisms are converted back into inorganic ammonia by the bacteria This process is called ammonification. Ammonifying bacteria help in this process.

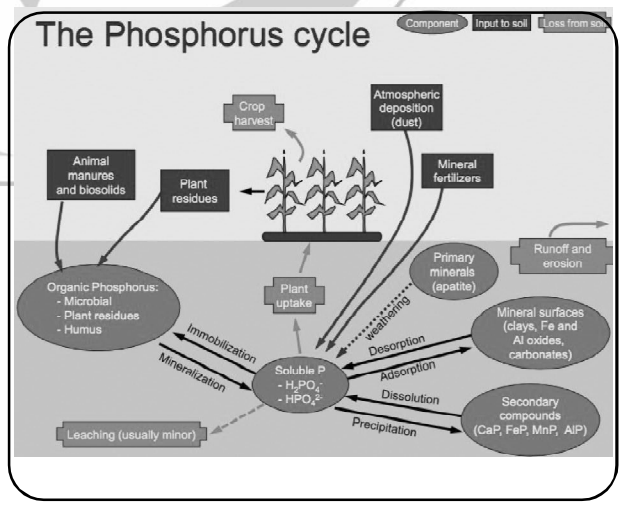
(e) **Denitrification:** Conversion of nitrates back into gaseous nitrogen is called denitrification. **Denitrifying bacteria** live deep in soil near the water table as they like to live in oxygen free medium. **Denitrification** is reverse of nitrogen fixation.

OXYGEN CYCLE

The oxygen cycle describes the movement of oxygen within the atmosphere, biosphere and the lithosphere. Failures of occurence of oxygen cycle in the hydrosphere may result in hypoxic zones. Photosynthesis is the main factor for the oxygen cycle and is also responsible for the Earth's atmosphere and life on earth.

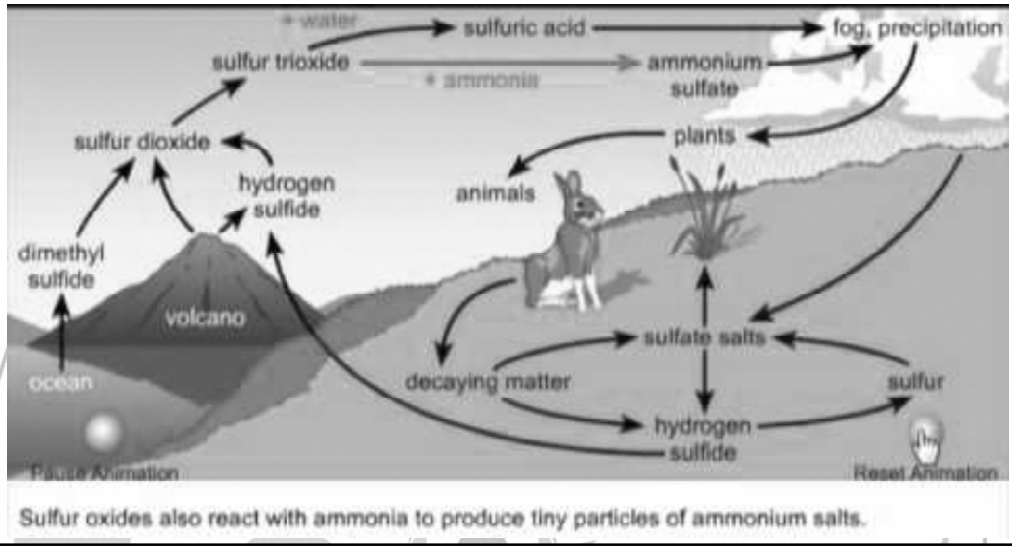


PHOSPHORUS CYCLE



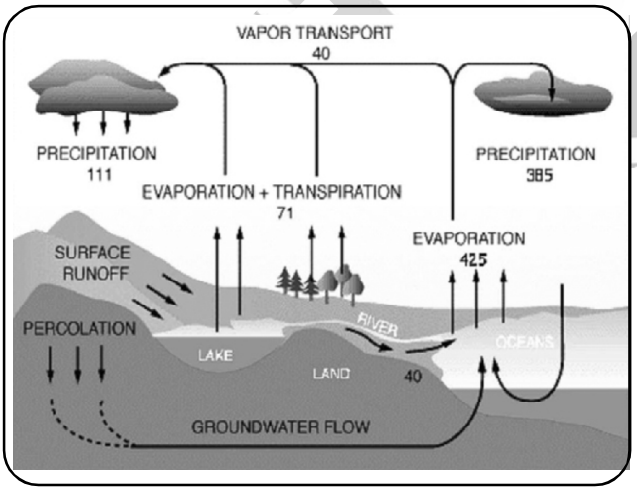
The phosphorus cycle is the movement of phosphorus through the lithosphere, hydrosphere and biosphere. In this cycle, the atmosphere does not play a significant role as phosphorus and phosphorus based compounds are usually solids at the typical range of temperatures of Earth. Phosphorus has gradually become less available to plants as it is slowly lost in runoff. Phosphorus is essential for plant growth and microbial biomass. Microorganisms of the soil act as sink and source of phosphorus available in the biogeochemical cycle.

SULPHUR CYCLE



The sulphur cycle is the group of processes through which sulphur moves to and from the mineral, waterways and the living systems. It is an important biogeochemical cycle as sulphur is an essential element and is constituent of many proteins and cofactors.

WATER CYCLE



The water cycle describes the continuous movement of water on, above, and below the surface of the Earth. Water moves from one reservoir to another by physical processes of evaporation, condensation, precipitation, infiltration, runoff and substrate flow. Through these processes water undergoes different phases like liquid, solid and gas.

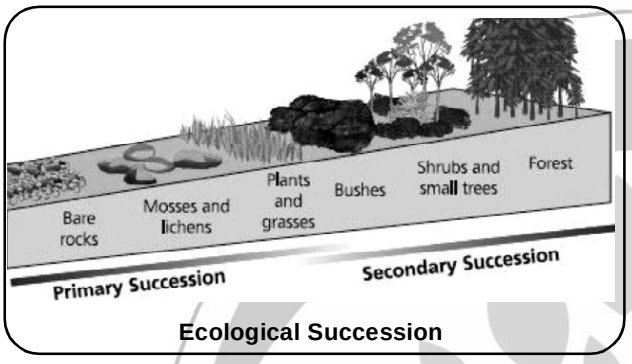
ECOLOGICAL SUCCESSION

It is a graduall process of change and replacement of the types of species in a community

Ecological succession is a fundamental concept in ecology and it refers to orderly, predictable changes in the community. This succession can be initiated by the formation of new habitat which was unoccupied or from disturbance of an existing community.

Each species in the ecosystem has set of environmental conditions under which these species grow and reproduce. As long as these conditions

remain constant, the species that are adapted to these conditions flourish in the environment. Succession is caused by a change in the ecosystem and its impact on the species and their own environment. The first environment may be optimal for the first species and it the altered conditions can be optimal for other species of organism. Under the altered conditions the first species may fail to flourish and the second species may flourish.



Ecological Succession

Ecological succession may also happen when the conditions of the changes drastically and suddenly. Conditions of environment like the forest fires, wind storms and anthropogenic activities can alter the environmental conditions drastically. This may result in destruction of species and also alteration of the dynamics of the ecological community and may also trigger a struggle for dominance among the present species in the altered environment.

Types of Ecological Successiion

There are two different types of succession

- Primary succession and
- Secondary succession.

Primary ecological succession occurs in the lifeless areas like in the regions which are incapable of sustaining life as result of lava flows, sand dunes newly formed; left over rocks from the retreating glacier. It is the beginning of a new habitat in a uninfluenced area without any pre-existing communities.

Secondary ecological succession occurs in areas where a community has been removed from a previously existing area. This succession may be triggered by smaller-scale disturbances and they do not eliminate all the life and nutrients from the pre-existing environment. Secondary succession occurs after the disruption of a pre-existing community.

Stages of Ecological Sucession

There are three fundamental stages involved in the order of ecological succession. They are as follows:

- Primary Succession
- Secondary Succession and
- Climax Community.

The order of ecological succession can be altered depending upon the location of the region and its climatic conditions. Although there are stages in which succession occurs.

The order is as follows:

1. Pioneer species,
2. Grasses,
3. Shrubs,
4. Trees,
5. Eventually a climax community stage is reached where the succession process is stabilized until the land is forced to turn into a barren land once again.

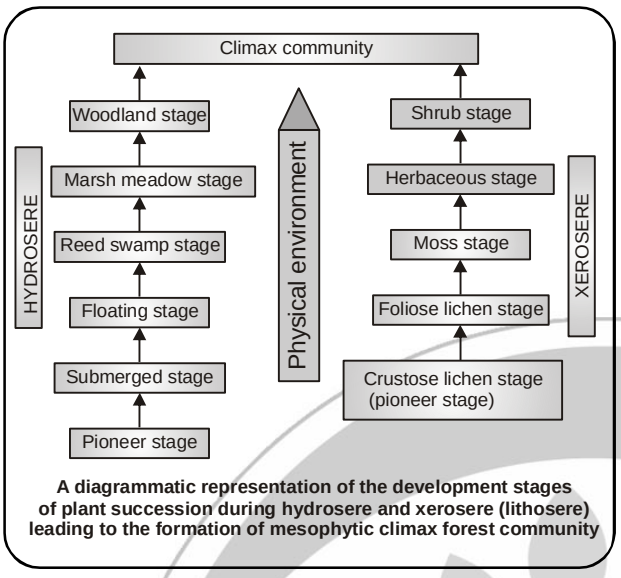
Primary succession happens simultaneously with the growth of the pioneer species. During the primary succession, a barren land is transformed from a lifeless environment into a environment which supports life.

Secondary succession is the process where one community is changed into another. It occurs in the place where life is already present.

Climax community is where succession leads to a single stage which is stead and terminal known as the climax stage.

Climax Community

Climax concept is a classical theory concerned with ecology; it states that succession stops at a stage where the biotic and the physical environment have arrived at an equilibrium stage or a steady state. This succession will persist indefinitely, facing the major disturbance and this end point of succession is known as climax.



A diagrammatic representation of the development stages of plant succession during hydrosere and xerosere (lithosere) leading to the formation of mesophytic climax forest community

Some of the features or the characteristics of the climax community are:

- The vegetation of this region is tolerant to the environmental conditions.
- The species diversity is large and the food chains of these species are complex and with spatial structure.
- It is a balanced ecosystem.
- In the climax ecosystem there is a balance between the primary production, total respiration and also the energy being used from sunlight and also the energy being released by the process of decomposition.
- There is also a equilibrium between the nutri taken in from the soil and the return of nutrients to the soil by litter fall.
- The individual organisms in the climax ecosystem are replaced by other organisms of the same kind. Thus maintaining species equilibrium.
- The life and growth here indicates the climatic types of an area.

HOMEOSTASIS

Ecosystems are capable of maintaining their state of equilibrium. They can regulate their own species structure and functional processes. This capacity of ecosystem of self regulation is known as **Homeostasis**.

In ecology the term applies to the tendency for a biological systems to resist changes.

Note that in a homeostatic system, negative feed back mechanism is responsible for maintaining stability in a ecosystem.

However, homeostatic capacity of ecosystems is not unlimited as well as not everything in an ecosystem is always well regulated.

Humans are the greatest source of disturbance to ecosystems.

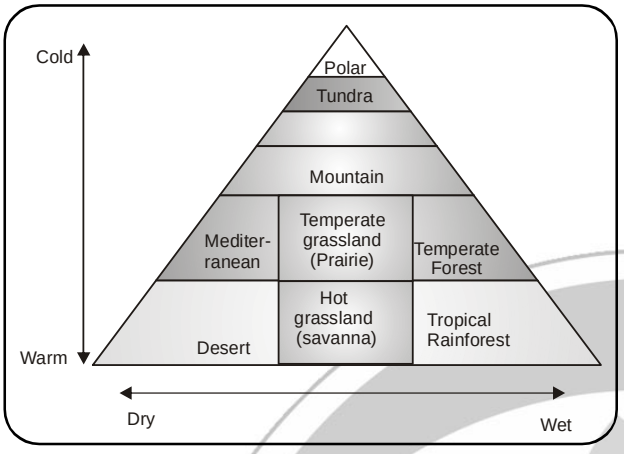
BIOME

The terrestrial pat of the biosphere is divisible into enormous regions called biomes which are **characterized by specific climate, vegetation, animal life and general soil type.** No two biomes are like. Cimate determines the boundaies of a biome and abundance of plants and animals found in each one of them.

Six Major Biomes

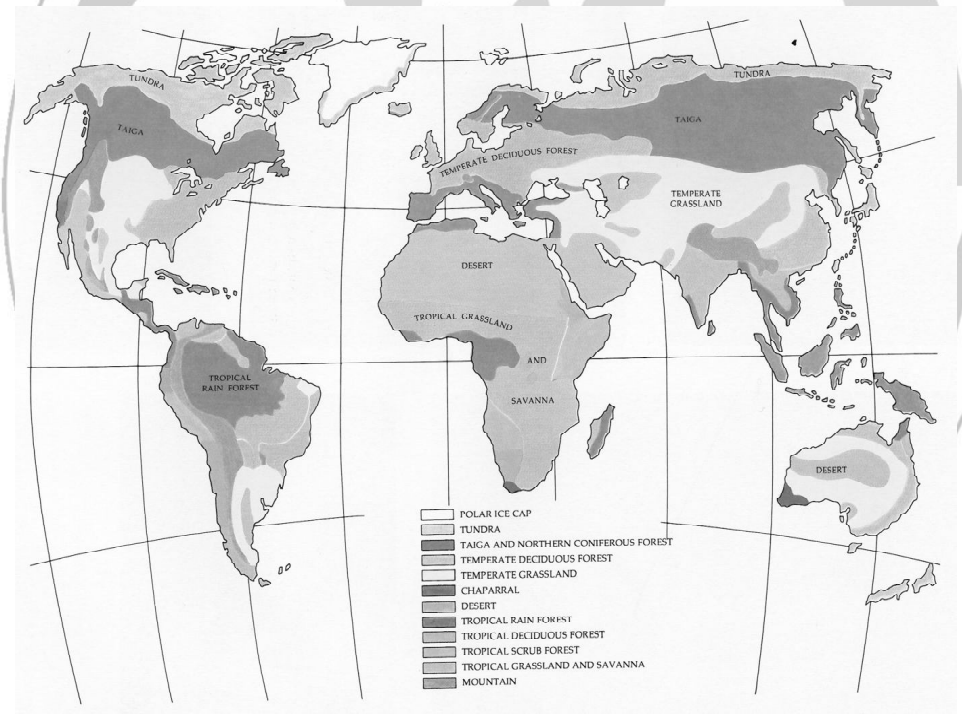
- **Tropical Rain Forests**
- **Grasssland**
  - – Tropical/Subtropical Grassland
  - – Temperature Grassland
- **Desert**
- **Temperature**
  - – Temperature Decidous Forest
  - – Temperature Rain Forest
- **Taiga**
- **Tundra**

MAJOR TERRESTRIAL BIOMES



(a) Arctic Region at the north and south poles

- Located above 60º North and South latitudes
- Arid
- Bitterly cold temperatures
- Day length varies tremendously, with 24 hour daylight or night at the respective solstices.
- Low animal diversity
- Most photosynthetic organisms are marine, and most sun energy is captured in the water.
- Some typical vertebrates you might find here: penguins (Antarctic only; no penguins in the North), seals, walruses, whales of various species, polar bear.



(b) Tundra

- Located just south of the polar regions in the northern hemisphere.
- Arid (as are the polar regions)
- Characterized by **permafrost** i.e., a **permanently frozen layer of soil,** which may not be deeper in summer than in winter, but still prevents the growth of large trees with deep root systems.
- Most plants are scrubby and small
- Lichens (fungus/algae symbiosis) are a major photosynthetic food source

- High winds and cold temperatures prevail
- Very short days in winter, very long days in summer
- Typical animal found are reindeer/caribou, Snowy Owls, Grizzly Bear, Brown Bear, Wolf, Arctic Fox, Ptarmigan (a partridge-like bird), migratory birds, lemmings (small rodents), voles (another rodent).

(c) Coniferous (Boreal) Forest (also known as "Taiga")

- Found south of the arctic and tundra regions, primarily in the northern hemisphere
- Northern boreal forest receives tremendous snowfall in winter; the conical shape of pines may help them shed snow and avoid damage to their branches from the weight of snow.
- Highly endangered, these ecosystems are being rapidly logged out, especially in North America.
- Also found along the the Andes of South America
- Major plant forms are evergreen, coniferous trees such as pines, firs, spruce, etc. (Cone-bearing trees). Under the trees grow shrubs, mosses, ferns, etc.
- Relatively high levels of rainfall, but short days in the winter.
- Typical animals are deer, wolf, bear, foxes, many migratory birds, squirrels, rabbits, etc. Higher species diversity than tundra.

(d) Temperate Deciduous Forest

- Found south of the coniferous forest in areas of relatively high rainfall and relatively high elevation, but with longer day length than in coniferous regions
- Major plant forms are deciduous (i.e., trees that seasonally drop their leaves) flowering trees and shrubs.
- Typical temperate deciduous forest areas are found in the northeastern U.S. and most of Europe.
- Typical animals are deer, wolf, bear, foxes, many migratory birds, squirrels, rabbits, etc. Somewhat higher species diversity than coniferous forest. Some species hibernate through the winter, when food is scarce in the snowy landscape.

(e) Prairie (Temperate Grassland)

- Characterized by distinct seasonal changes, moderate rainfall, extremely rich, organic soil.
- **Major plant forms** are annual grasses and flowering plants; some areas with more standing water become marshes characterized by small trees such as willows, cottonwoods, etc.
- Very fertile land, but with harsh seasonal variations: hot summers, cold winters
- The **"veld" of South Africa,** the **"puszta" of Hungary,** the **"pampas" of Argentina,** the **'steppes' of Central Asia and Russia,** and the **plains of the central U.S.** are all examples of this highly productive biome.
- Most of these grasslands have been converted to farmland for human use, but some native grasslands have been preserved.
- Typical animals are American Bison (sometimes erroneously called "buffalo"), prairie dog, jackrabbit, fox, coyote, deer, many migratory birds (especially predatory birds such as hawks and falcons), etc. Many animals undergo winter hibernation.

(f) Savanna (Tropical/Subtropical Grassland)

- Characterized by distinct seasonal changes, highly seasonal rainfall (very harsh dry season), extremely rich, organic soil.
- Major plant forms are annual grasses and flowering plants; Trees are generally very drought tolerant and have high canopies due to herbivory by large animals such as elephants and giraffes.
- Fire is a major abiotic component of this biome, and most plant species are evolved to withstand periodic fires
- Very fertile land, but with harsh seasonal variations- very wet season followed by extremely harsh dry season (during which most animals migrate away)
- Lush grass and shrubbery growth in the rainy season provides ample food for large animals,

but they must migrate to greener pastures during drought.

- Typical animals are grazing hoofed mammals (gazelles, antelopes, etc.), lions, leopards, cheetahs, elephants, giraffes, true buffalo (Water Buffalo, Cape Buffalo), rhino, hippopotamus, etc.

(g) Chaparral (Mediterranean Scrub Forest)

- Found in arid regions with Mediterranean climate (e.g., southern California, Spain, European and African areas bordering the Mediterranean Sea; southern tip of Africa, southwestern tip of Australia)
- Winters are rainy and mild; summer days are long, hot, and very dry
- Characterized by periodic, seasonal fires
- Major plant forms are Dense, spiny, evergreen shrubs (some of these produce seeds that will germinate and grow only after they've been through a fire.)
- Typical animals are coyote, mule deer, various rodents, many lizards, snakes, migratory birds, etc.

(h) Tropical Rainforest

- Found worldwide (at least in times past) around the equator
- Extremely high levels of rainfall
- Poor nutrient content in soils due to high levels of rainfall
- Tremendous plant diversity; large trees have shallow root systems evolved to be able to quickly absorb nutrients as soon as they become available (due to decay of dead things), before the rains wash them away.
- Very dense plant growth and very high level of productivity
- In mature rainforest, the forest floor is relatively clear of plants, since the upper canopy of trees blocks most sunlight. Only when there's a large treefall does a new growth of shrubby "pioneer species" germinate from the soil and provide cover for the forest to re-grow.
- Typical animals include more than 50% of all the earth's terrestrial animal species monkeys, toucans, parrots, reptiles of all types, amphibians, and representatives of just about any major animal group.

(i) Desert

- Extremely arid, very hot in the daytime; in some regions, extremely cold at night
- High nutrient levels in the soil due to very little rainfall
- Sparse plant life due to very low humidity and available water
- Plantlife is **xerophytic** - evolved to have special adaptations to store and avoid losing water.
- Typical plants are cactus, Yucca, xeriphytic shrubs of various species, spectacular explosion of flowering annuals comes with spring rains
- Typical animals are drought-tolerant mammals such as desert foxes, burros, jackrabbits, high diversity of snakes and lizards, tortoises, Roadrunner and some other desert-adapted birds (plenty of hawks and eagles)
- **Desertification-** It is the destruction of biological potential of land which can ultimately lead to desert like conditions.

ECOSYSTEMS OF INDIA

India is a vast country and possess many types of natural ecosystems.

(A) Terrestrial

1. Forests
   - (i) Tropical rain forests
   - (ii) Tropical deciduous forests
   - (iii) Temperate broad leaf forests
   - (iv) Temperate needle – leaf or coniferous forests
   - (v) Alpine and tundra forests
2. Grasslands
3. Deserts
   - (i) Thar deserts
   - (ii) Rann of Kutch
4. Mountains — The Himalayas
5. Ghats

(B) Aquatic

1. Fresh water ecosystem
2. Marine ecosystem

TERRESTRIAL ECOSYSTEM IN INDIA

1. Forests

Forests in India can be classified in different ways, according to their position, atmosphere, weather condition etc. Some of the common characteristics of various types of natural vegetation in India includes:

- tropical rain forests,
- tropical deciduous forests,
- temperate broad leaf forests.
- temperate needle leaf or coniferous forests
- alpine and tundra forests, etc.

Apart from these, there are also some other types of forests are found in India like **tidal forests, Himalayan vegetation, rain forests of southern India, desert region,** etc.

(i) Tropical rain forests

- The tropical rain forests are playing an important role in natural vegetation in India.
- These types of forests include the tropical evergreen forests and tropical semi-evergreen forests and they are mostly found in places where there is plenty of rainfall and sunshine throughout the year.
- Growth of the trees is usually at its best where rainfall is in surplus of **200 cm**, with a short dry season.
- Such types of forests are found within rainy slopes of the **Western Ghats, plains of West Bengal and Orissa and north-eastern India.** Trees grow very briskly in these forests and attain heights of about 60 m and above. The number of species in these forests is too vast and too assorted to utilise each one of them commercially. **Ebony**, **mahogany** and **rosewood** are the main trees of these forests.

(ii) Tropical deciduous forests

- Tropical deciduous forests are also known as deciduous (whether it is moist or dry) forests because they cast leaves for about six to eight weeks in summer.
- They are also called the **monsoon forests** with all their grandeur and beauty. This is so because they form a natural cover approximately all over India, especially within regions having **200 and 75 cm** of annual rainfall. Most of the tropical deciduous forests are found in the state of **Kerala** in India. Apart from Kerala, these forests can be found in the **eastern slopes of Western Ghats** and also in the **north eastern parts of the peninsular plateau** and in **the valleys of the Himalayas.** These forests can be divided into **moist and dry deciduous forests.** The moist deciduous forests are most commonly found on the eastern slopes of the Western Ghats. They are also found in the region of Chhotanagpur plateau, covering east Madhya Pradesh, south Bihar, and west Orissa, Shiwaliks in the northern India. Important trees of these forests are **teak, sal, and sandalwood.**

(iii) Temperate broad leaf forests

It mainly occur between **1500-2400 m altitudes** in **western Himalayas.** Several species of **Oak** (Quercus) are found in these forests. Oak species are ever green in the Himalayan region. These species show peak leaf fall during summer but never become leafless. Height of the trees may be 25-30 m. Trees canopy is dense, herbaceaus layer is least developed and grasses are generally lacking. The Oak forests are often rich in epiphytic flora.

(iv) Temperate needle leaf or coniferous forests

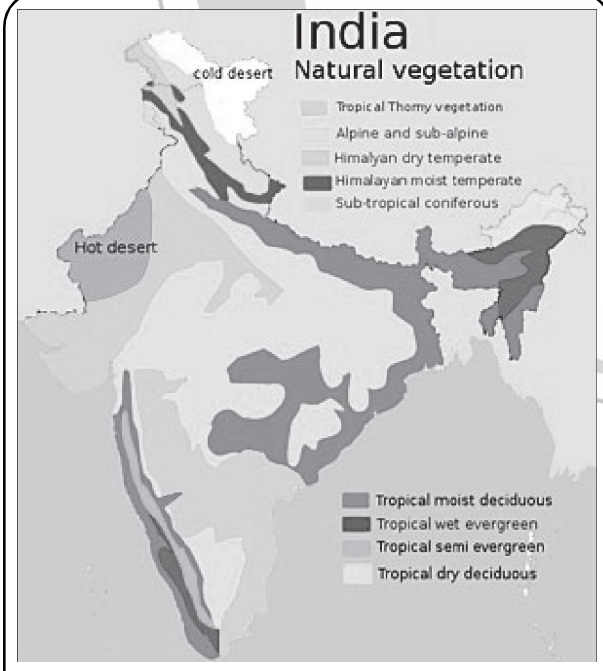
This type of forests are found in the Himalaya over **1700 to 3000 m altitude.** These forests contain economically valuable gymnospermous trees like **pine** (Pinus wallichiana) **deodar** (Cedrus deodara), **Cypress** (Cypressus torulosa), **Spruce** (Picea simthiana) and siver fir (Abies pindrow). Coniferous forests are taller 30-35 m and possess evergreen

canopy of long needle like leaves. Canopy of these trees always remains green. In many species, it is cone-shaped.

(v) Alpine and Tundra forests

The alpine and tundra forests is another kind of natural vegetation in India. Vegetation growing at altitudes above **3600 m** is usually known as **alpine vegetation** and it can be noticed that with the increment of the altitude, the plants show stunted growth. The trees like **silver fir, pine, juniper** and **birch** belong to this category. The alpine grasslands are mainly found at higher altitudes in this region. The people belonging to the tribal groups like **Gujjar** and **Bakarwal** make extensive use of this region. The vegetations like lichen and mosses are also found in high altitudinal regions.

*The **tidal forests** provide another variety of natural vegetation in India. They can be found along the coasts and rivers and they are enshrouded by mangrove trees that can live in both fresh and salt water. **Sundari** is a renowned mangrove tree, mainly found in the tidal forests and it is after this tree that the name Sundarban has been entitled to the forested parts of the Ganga-Brahmaputra delta.*



Natural Vegetation

(2) Grasslands

Grasslands are one of the intermediate stage in ecological succession and cover a part of the land on all the altitudes and latitudes at which climatic and soil conditions do not allow the growth of trees. In India, grasslands are found as village grazing grounds (Gauchar) and extensive low pastures of dry regions of western part of the country an also in Alpine Himalayas. Perennial grasses are the dominant plant community. In some regions grasslands also support a variety of other herbaceous plants like sedges, legumes and members of the sunflower family.

Grasslands support a large number of herbivores from minute insects to very large mammals. Rats, mice, rodents, deer, elephant, dog, buffalo, tiger, lion, ferrets are some common mammals of grasslands. In the north east India, one horned rhinoceros is amongst the threatened animal of grassland is this region. A large number of avian fauna makes the grassland colourful.

(3) Deserts

The Thar desert in Rajasthan is an extension of the Sahara deserts through Arabian and Persian deserts. They extend from **Punjab, Haryana, Rajasthan to Gujarat state.**

Indian deserts are divided into four main types:

- hills,
- plains with hills,
- marshes and
- plains with sand dunes.

The distinct Rann of Kutchch–Bhuj in Gujarat forms a separate zone with in Thar deserts due to its different climatic conditions. It represents vast saline flats. The region of sand dunes is most spectacular and covers an area of 100,000 sq. km nearly. It extends into Pakistan.

Since heat and light intensity are very high and sand dunes are shifting, these deserts can not support vegetation. There are only some thorn forests and dry open grasslands. **Indira Gandhi canal** which carries water through Punjab and Haryana enters into Rajasthan supports some vegetation. The main crops of desert are bajra, millet, wheat, barley,

maize, jowar, guwar. Medicinal plants found here are mehndi, hak, isabgole and gugal. Indian deserts support many threatened species of birds and mammals, such as Asiatic lion, wild ass, bats, scaly ant eater, desert fox, Indian gazzel, four horned antelope , white browed Bushchat, Great Indian Bustard, Cranes and Sandgrouse. Gulf of Kuchch is distinguished by the presence of living corals, pearl oyster, sea turtles and a large number of migratory birds like kingfisher, cranes ibis and herons.

(4) Mountains – The Himalayas

Distribution: The Himalaya is a great range of mountains that spreads over a westnorthwest to east-southeast over a distance of about 2500 km covering Afganistan, Pakistan, India, Nepal, Bhutan and China. In India, it extends from the Indus trench below **Nangaparbat in the west to Yarlungtsangpo-Brahmputra George below Namchebarwa peak in east.**

The Himalayas lying within India occupy nearly 5,31,250 sq. km area

They cover about 16.6% of India's total geographical area and are spread partially or completely over 12 states namely: Jammu and Kashmir, Himachal Pradesh, Uttaranchal, Sikkim, West Bengal, Arunachal Pradesh, Assam, Nagaland, Manipur, Tripura, Mizoram and Meghalaya.

Himalayas are geographically divided into:

(i) the **Eastern Himalayas** or the **Assam Himalayas:** Out of the above the Eastern Himalaya has a greater diversity of ecosystems like, forests, grasslands, marshes, swamps, lakes streams and rivers Eastern Himalayas consists of nearly 8000 species of the flowering plants. It has many primitive as well as many endemic plant species. Eastern Himalayas is known as centre of origin of cultivated plants . Many cereals, fruits and vegetables are cultivated here. E.g. Orchids, *Aster, Accasia, Albizzia, Delbergia* species (timber) and many legumes etc.

(ii) the **Central Himalayas** or the **Nepal Himalayas**

(iii) the **Western Himalayas:** On the western Himalayas cold deserts of Ladakh support drought and cold resistant varieties of plants and animals e.g. Yak.

(iv) the **North-West Himalayas** or the **Punjab Himalayas**

Eastern Himalayas are one of the of the world and has large no animals because of its varied ecological conditions e.g. Pangolins elephants macaque languor civet.

(5) Ghats

Western and eastern ghats are also important ecosystems of India **Western ghats** also known as **Sahyadri** extend from Tapti river in north to Kanyakumari in south covering nearly 1,40,000 sq km parallel to the west coast of peninsular India.

They pass through the states of Gujarat, Maharashtra, Goa, Karnatka, Tamilnadu and Kerala. These ghats are one of the richest biological resources and form distinct ecological and biogeographical region of India. Western ghats are one of 25 hot spots of the world.

Hot spots are the regions which show maximum biodiversity, richness of species *and endemic forms.* These ecosystems are the threatened due to human interference. June- September are rainy months. The rainfall may vary from **100 to 500 cm**. Soil is mainly red or black in most of the regions and rich in nutrients. 3500 species of flowering plants have been recorded from western ghats of which nearly1500 are endemic species. Nearly 209 species of fresh water fishes occur in these ghats of which 120 are endemic. Similarly out of 219 species of amphibians found here 106 are endemic.

Eastern ghats extend in north south-west strike in Indian peninnsula covering an area of about 75000 sq. km They are spread through the states of **Orissa, Andhra Pradesh and Tamilnadu**. The eastern ghats do not form a continuous range because the great rivers Mahanadi,Godavari and Krishna cut across them. They are an assemblage of discontinuous ranges of hills, plateaus and basins. The climate of these ghats may be semiarid to semihumid with a rainfall ranging from **60 to 160 cm**. The vegetation ranges from evergreen trees to that of dry savannas. The eastern ghats are affected by the human activity. Conservation of biodiversity here is a big issue today. Special measures are

taken to protect this floristic zone. United Nations Conference on Environment held in Rio de Janerio in 1992 discussed the issue of conservation of this region.

AQUATIC ECOSYSTEM IN INDIA

Freshwater ecosystem

Freshwater are terrestrial aquatic ecosystems. Lakes, flood ponds, reservoirs and rivers are its important components. The total freshwater area of India is about 7.6 million hectare.

- **Lakes** are naturally formed deep water bodies e.g. Sultanpur lake, Batkal lake (Haryana).
- **Flood points** are the places that undergo periodic flooding as a river channel overflows with flood water i.e. natural areas constituting shallow and seasonal water bodies. Bank of large rivers have flood points.
- **Reservoir** is man made areas holding water irrigation and human use. e.g, reservoirs formed by dams used for irrigation.
- **Rivers** are the flowing water bodies as you have studied in this lesson. For example river Yamuna, Ganga and Tapti, Krishna, Kawari, Narmada etc.

MARINE ECOSYSTEM

India has a long coastline of about 8000 km stretching along nine states and two island chains. At the coast a number of rivers form estuaries at their confluence with the sea. There are three gulfs - one on the east coast that is gulf of Mannar and two on the west coast i.e. gulf of Kutchch and gulf of Khambhat.

The continental shelf (extension of land into the sea) is 200 m in depth but variable in width along the coast. The Indian ocean is the smallest of the five great oceans.

The tides are very important in determining the marine life. Nearly 14 species of sea grasses and 120 species of sea weeds are found along the coast. Representatives of almost all the invertebrate and vertebrate groups are found in the marine ecosystem. Corals are the most abundant and play a very important role. 199 Species of corals are known from Indian Ocean. They make coral reefs which are home to a large number of other sedentary species like many molluscs, crustaceans and coelenterates. The biodiversity in a coral reef is comparable to that of a tropical rain forest. Sea shore provides feeding and breeding ground to a number of birds also. Sea crows, whales and dolphins are the mammals that have secondarily invaded the sea.

Marine fisheries constitute a highly productive sector in India It is a source of food and employment to the coastal population.

BIOSPHERE

Biosphere is the sum of all ecosystems. Biosphere is the largest scale of ecological organization.

- Biosphere includes the spheres, lithosphere, hydrosphere and the atmosphere.
- It includes all living organisms and also the dead organic matter which is produced by the living organisms.
- Biosphere interacts between and the exchange of matter and energy with other spheres.

Biosphere from an ecological point of view comprises the total biodiversity on earth and performs all forms of ecological functions like photosynthesis, respiration, nitrogen fixation, denitrifi cationand decomposition.

Objective Questions

1. Which of the following is the major problem caused by Indira Gandhi Canal in the Thar Desert ecology of India?

(a) Reduced production of indigenous crops

(b) Fall in the fertility of soil

(c) Spread of water borne disease

(d) Water logging and salination

2. Which of the following is not an adverse effect of a dam on the ecology of the concerned area?

(a) large tracts of forested area are submerged.

(b) Vast agricultural land in the upstream area is destroyed.

(c) There is provision for irrigation and water power production.

(d) Ecological balance in catchment area is disturbed.

3. What is/are the significance of Desert Locust?

(a) It is a pulse crop grown in deserts.

(b) It is a pest species endemic to India.

(c) It damages agricultural crops very seriously.

(d) Both (b) and (c)

4. Which of the following regions does not have laterite soil?

1. Western Coastal Plain
2. Himalayan foothills
3. Rajasthan
4. Odisha

(a) 1 only (b) 2 only

(c) 1 and 2 only (d) 3 and 4 only

5. What is meant by Water damage?

(a) Degradation of water bodies by sewage

(b) Intrusion of water bodies by sewage

(c) Growth of lichens over moist surfaces

(d) Both (b) and (c)

6. Government of India encourages the cultivation of 'sea buckthorn'. What is the importance of this plant? (UPSC-2012)

1. It helps in controlling soil erosion and in preventing desertification.
2. It is a rich source of biodiesel.
3. It has nutritional value and is well-adapted to live in cold areas of high altitudes.
4. Its timber is of great commercial value.

Which of the statements given above is/are correct?

(a) 1 only (b) 2, 3 & 4 only

(c) 1 & 3 only (d) 1, 2, 3 & 4

7. Consider the following kinds of organisms (UPSC-2012)

1. Bacteria
2. Fungi
3. Flowering plants

So e species of which of the above kinds of organisms are employed as biopesticides?

(a) 1 only (b) 2 and 3 only

(c) 1 and 3 only (d) 1. 2 and 3

8. Which of the following is/are unique characteristic/characteristics of equatorial forests? (UPSC-2013)

1. Presence of tall, closely set trees with crowns forming a continuous canopy
2. Coexistence of a large number of species
3. Presence of numerous varieties of epiphytes

Select the correct answer using the code given below :

(a) 1 only (b) 2 and 3 only

(c) 1 and 3 only (d) 1, 2 and 3

9. Contour bunding is a method of soil conservation used in (UPSC-2013)

(a) desert margins, liable to strong wind action

(b) low flat plains, close to stream courses, liable to flooding

(c) scrublands, liable to spread of weed growth

(d) None of the above

10. In India, the problem of soil erosion is associated with which of the following. (UPSC-2014)

1. Terrace cultivation
2. Deforestation
3. Tropical climate

Select the correct answer using the code given below :

(a) 1 and 2 only (b) 2 only

(c) 1 and 3 only (d) 1, 2 and 3

11. Lichens, which are capable of initiating ecological succession even on a bare rock, are actually a symbiotic association of (UPSC-2014)

(a) algae and bacteria

(b) algae and fungi

(c) bacteria and fungi

(d) fungi and mosses

12. If you travel through the Himalayas, you are Likely to see which of the following plants naturally growing there? (UPSC-2014)

1. Oak
2. Rhododendron
3. Sandalwood

Select the correct answer using the code given below :

(a) 1 and 2 only (b) 3 only

(c) 1 and 3 only (d) 1, 2 and 3

13. Consider the following (UPSC-2014)

1. Bats
2. Bears
3. Rodents

The phenomenon of hibernation can be observed in which of the above kinds of animals?

(a) 1 and 2 only

(b) 2 only

(c) 1, 2 and 3

(d) Hibernation cannot be observed in any of the above

14. Sustainable development is a case of inter-generational sensibility in respect of use of (UPPSC-2012)

(a) Natural resource

(b) Material Resource

(c) Industrial resource

(d) Social resource

15. The world Environmental Day is celebrated on (UPPSC-2012)

(a) December 1 (b) June 5

(c) November 14 (d) August 15

16. The main constituent of biogas is : (UTTARAKHAND PSC-2012)

(a) Hydrogen (b) Methane

(c) Butane (d) Acetylene

17. Soil erosion can be prevented by (SSC-CGL-2014)

(a) Increasing bird population

(b) Afforestration

(c) Removal of vegetation

(d) Overgazing

18. The largest amount of fresh water on our planet is in (UPPSC-2015)

(a) Rivers

(b) Lakes and streams

(c) Continental and mountain glaciers

(d) Underground water

19. Which of the following are decomposers?

(a) Rat and snake

(b) Tiger and lion

(c) Bacteria and fungi

(d) Fungi and insects

20. Change in sequence of communities living in an ecosystem with change of environment on specific period of time is as known as :

(a) Ecological sequence

(b) Ecological succession
(c) Ecological change
(d) Ecological aggression

21. Which one of the following terms describes not only the physical space occupied by an organism, but also its functional role in the community of organisms? (UPSC-2013)
1. Ecotone
2. Ecological niche
3. Habitat
4. Home range
(a) (b)
(c) (d)

22. Among the biotic components of the ecosystem, the producer system is (UPPSC-2013)
(a) Cow (b) Peacock
(c) Tiger (d) Green Plants

23. Which of the following is the most stable ecosystem? (UPPSC-2013)
(a) Desert (b) Mountain
(c) Ocean (d) Forest

24. Which one of the following is the correct sequence of a food chain?
(a) Diatoms → Crustaceans → Herring
(b) Crustaceans → Diatoms → Herring
(c) Diatoms → Herring → Crustaceans
(d) Crustaceans → Herring → Diatoms

25. Bio-indicators of pollution are:
(a) Lichens
(b) Mosses
(c) Mycorrhizal association
(d) Toadstools

26. Which is correct
(a) Both Azotobacter and Rhizobium fix atmospheric nitrogen in root nodules of plants
(b) Cyanobacteria, Anabaena and Nostoc are mobilizers of phosphates and plant nutrition in soil
(c) At present it is not possible to grow maize without chemical fertilizers.
(d) Excessive use of chemical fertilizers may lead to eutrofication of nearby water bodies.

ANSWERS

1. (d)	**6.** (c)	**11.** (b)	**16.** (b)	**21.** (b)	**26.** (d)
2. (c)	**7.** (d)	**12.** (a)	**17.** (b)	**22.** (d)	
3. (c)	**8.** (d)	**13.** (c)	**18.** (c)	**23.** (c)	
4. (b)	**9.** (d)	**14.** (a)	**19.** (c)	**24.** (a)	
5. (d)	**10.** (b)	**15.** (b)	**20.** (b)	**25.** (a)	

HINTS

3. (c) It is a most dangerous pest affecting the 1/10th of the population of Africa and other countries and not endemic to India.

5. (d) Water damage describes a large number of possible losses caused by water intruding where it will enable attack of a material or system by destructive processes.

6. (c) Sea buckthorn is the native plant of Himalayan region and its berries have nutritional and medicinal value and also this has good potentiality for soil and moisture conservation, checks the soil erosion and also helpful in the land reclamation and rehabilitation.

7. (d) Several bacteria and fungal organisms have the capacity to act as biopesticides and flowering plants like neem, karanj and custard apple are also good sources of biopesticides.

8. (d) In equatorial tropical forest because of its luxuriant growth of trees canopy is formed as a continuous layer due to the interlocking of adjacent crowns of the trees blocking the sunlight. The epiphytes are common in these forests.

9. (d) Contour Bunding is associated with terracing, which checks the flow of water and soil on a hill slope in order to reduce soil erosion.

10. (b) The major cause of soil erosion is deforestation, which will increase the runoff and the Terrace Cultivation on the contrary helps in reducing the soil erosion. The Tropical Climates alone cannot create soil erosion.

11. (b) The lichens are the symbiotic association of chlorophyll containing algae and the fungus.

The Fungus provides shelter, water and minerals to the algae and, in return, the algae provides food which it prepares by photosynthesis due to the presence of chlorophyll.

12. (a) Sandal wood grows commonly in tropical dry regions of Karnataka

13. (c) Hibernation is also known as winter sleep and is exhibited by Bat, Hedgehog, Bear, frog, Rodents etc.

15. (b) It is to create awareness against global environmental problems like pollution and climate change etc., and also to protect nature and the planet Earth.

17. (b) In the above mentioned activities all are deteriorating the soil erosion except Afforestation, which means the development of forests by tree planting, which prevents soil erosion.

21. (b) The niche is the unique functional role or place in an ecosystem played by a species.

22. (d) Green plants containing chlorophyll are known as producers because they produce their own food from CO_2, water, sunlight, nutrients through the process of photosynthesis.

23. (c) Oceans comprise stable ecosystem because they are self-sustaining ecosystem.