BIOTIC FACTORS & TROPHIC LEVELS

- The term 'biotic factors" refers to all living organisms in an ecosystem.
- Depending on how the living organisms in an ecosystem obtain, store and utilize release energy, they are categorized into three main trophic levels,

(a) producers (b) consumers and (c) decomposers or detritivores.

Producers*:*

Life cannot exist without energy. The ultimate source of energy for the functioning of an ecosystem is teh sun. They can starch by the process of photosynthesis utilizing radiant energy, $C0_2$ water and minerals. The producers occupy the first trophic level in a food chain.

Certain bacteria such as sulphur bacteira obtain energy by breaking down chemical substances. These are described as chemoautotrophs. The producers occupy the first trophic level in an ecosystem are described as chemoautotrophs. The producers occupy the first trophic level in an ecosystem.

The plants and their products containing stored energy form the source of energy for the animals, which directly feed on them, (herbivores), the producers occupy the *first tropic level* in an ecosystem.

Consumers:

Animals feed on autotrophs or their products either directly or indirectly. They occupy different trophic levels and accordingly ihey are divided into three types.

Primary consumers*:*

Feed on producers directly. These are also called herbivores. The primary consumers constitute the second trophic level in an ecosystem.

Ex: Protozoans, crustaceans, molluscs etc.

On land the primary consumers include animals such as cows, deer, rabbits, grasshoppers, snails etc. In the aquatic environment the herbivores include some protists, crustaceans, molluscs etc. The microscopic free-floating zooplankton constitutes the primary consumers. The primary consumers from the second trophic level in an ecosystem.

Secondary consumers*:*

- Feed on the primary consumers. They constitute the third trophic level. *Ex.:* Frogs, dogs, foxes etc.Wolves of the terrestrial eco-system and fishes of the aquatic ecosystem.
- Approximately 50 % of light energy that falls on the plants is absorbed. Of this *1%* is converted into chemical energy.

Tertiary consumers*:*

Feed on secondary consumers and also on primary consumers, these are also called as 'Climax consumers'. Ex: Hawks, vultures, lions, tigers etc.

Decomposers:

- When organisms die their bodies and the waste materials passed from the bodies of living organisms form a source of energy and nutrients for other organisms.
- Decomposers are also called microconsumers, saprotrophs or osmotrophs etc. Eg: Fungi and bacteria.
- Producers and consumers can not survive without decomposers, because decomposers play an important role in an ecosystem by breaking down complex molecules of dead organisms into simple molecules. These are converted into nutrients which are available for the producers to prepare food material.
- An Ecosystem has two functional aspects (a) Biogeochemical cycles and (b) Energy flow.
- Recycling of the inorganic nutrients is brought about by the decomposers (Bacteria and fungi) which breakdown the compiex molecules of deed organisms and waste materials. The nutrients are utilized by producers to store energy. These activities form the "Biogeochemical cycles".

Decomposion of organic matter includes 3 stages

i. Particulate detritus formation by saprophytes
ii. Conversion of detritus into humus by saprophytes and detrivores
iii. Slower mineralization of humus

Characaters of a biotic community

- The kinds of organisms present in biotic community are called - Species composition.
- A few species which are dominant in terms of number and biomass are referred to as - Dominant species
- The species which greatly influence biotic community relative to their abundance in biomass or number are said to be - Keystone species
- Species like Mycorhizal sps absorb nutients from soil and organic residue and are called Link species.
- Insects, as they are useful in pollination referred to as- Critical link species. The transition zone between two biotic communities is called - Ecotone
- Dominant species are - Pine trees in taiga and grass in grass lands
- Keystone species are - Fig trees in tropical forests (as they produce large number of fruits)
- Ecosystem is seriously, influenced by - Removal of either keystone species (or) dominant species Example of ecotone is the zone between forest and grass land.
- The increase in the number of organisms and diversity of organisms in ecotone is called Edge effect.
- The species in ecotone are called - Edge specie;

Interactions

- Lemna gibba dominates Spirodela polyrhiza and is called Competetive exclusion.
- When in a same medium Competitive exclusion is observed between aquatic aroids called duckweed or Spirodela and Lemna (Acquatic aroids) Lemma gibba excludes -Spiro dela polyrhiza
- Chemical inhibition of one species by another is called Allelopathy
- Different species interacting with one another and live together intimately and is called – Symbiosis
- Association between two organisms which and metabolically dependent on each other and both are benefited is called – Mutualism
- Association in which one gets benefitted and the other one is unaffected is called - Commensalism
- Association in which one is living at the expense o the other is called - Parasitism
- In commensalism one is harmed and other is Uneffectuated
- Interaction in which one organism is killing the other for the food is called – Predation
- predation helps for the transfer of energy in a food chain. Population size of the prey is limited by- predation.
- Important adaptations in animals to avoid predator are - camouflage, venomous nature, spiniscence mimicry, warning coloration etc.
- Two species resembling each other to escape from predators is called - Mimicry
- The type of protection in defenceless organism is to mimic.
- Mimicking other organism with defence is called - Batesian mimicry.
- The process in which the mimics share the same defence mechanism as model is -Mullerian mimicry

ECOLOGICAL SUCESSION

- The process of occurance of gradual, orderly and predictable changes in the composition of communities towards a climax type is called Ecological succession
- The succession which begins on an area which is not in habited by any biotic community to establish a climax community is - Primary Succession
- The succession that begins in an area from which a community was removed to establish a climax community is called Secondary Succession
- An inorgamic environment which get: predominated by autotrophs is called -Autotrophic Succession
- Polluted areas with more decomposed matter get: dominated by heterotrophs is called Heterotrophic Succession
- The first community that is established either in primary or secondary succession is called Pioneer Community
- Climax community is established after the Stabilization of environment
- Climax community can not be replaced
- The ecological succession that starts on barren Rocks or in places where there is extreme deficiency of water is said to be -Xerosere

- The ecological succession that starts in the habitat which is rich in water is called Hydrosere
- The ecological succession in the habitat which i: moderate in water is called - Mesosere
- In ecological succession finally - Climax stage, woodland stage is established

FOOD CHAINS

- The transfer of food - energy from plants to animals and then to other animals by successive stages of feeding is called a **food chain.**
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- The cyclic interdependence of one trophic level over the others forms a food chain.
- A food chain is also defined as "the sequence of organisms that are related to each other for their source of food."
- In an ecosystem energy is transfered through a series of organisms, each feeding on the preceding organisms and providing raw materials and energy for the next organisms.
- Each stage of the food chain is known as **trophic level.**
- The first trophic level is occupied by the autotrophic organisms, so they are called **producers.**
- The organisms of the second trophic level are called **primary consumers or herbivores.** 20% - 30% of net primary production is consumed by the herbivores.
- The organisms of the third trophic level are called **secondary consumers or primary carnivores.**
- The organisms of the fourth trophic level are called **tertiary consumers or secondary carnivores.**
- The final carnivore of a food chain is not eaten by other animals, so it is known as **climax carnivore.**
- The grazing food chains are linear and are usually with 4 to 5 trophic leves in the chain.
- The grazing food chain starts from a green plant base, goes to grazing herbivores and onto carnivores, (predator food chain and parasitic food chain)
- In predator food chain one animal captures and devours (eats) another animal.
- An animal that eats another animal is called a **predator.**
- The animal consumed by the predator is called **prey.**
- A predator that consumes members of its species is known as **cannibalistic.**
- An animal that eats dead animal is referred to as **scavenger.**
- The plants and animals of a grazing food chain are infected by parasites. The parasites derive their energy from their hosts. Thus a parasitic food chain is formed within a grazing food chain.
- The detritus food chain starts from dead organic matter and ends in inorganic compounds.
- The organic waste materials and the dead bodies of producers, consumers of a grazing food chain form detritus.
- The organisms which feed exclusively on the dead bodies of animals and plants and organic waste mterials are known as detrivores (algae, fungi, bacteria, insects worms, nematodes, centipedes).
- Detritus ecosystem develops on organic debris, living producers may be absent, sunlight is not directly essential.
- The cross-linking of many food chains in an ecosystem is called **food web.**
- Stability of the ecosystem is maintained by Food web.
- A direct linking between prey and predator without any branching is called **Iota link**
- A branching link in which a predator feeding on more than one type of organisms is **Lamda link**
- A branching link in which one prey organism is predated by more than one predator is **Gamma Link**
- The number, biomass and energy of organisms gradually decrease from producer level to the consumer level. This can be represented in the form of a pyramid called **ecological pyramid**

- Ecological pyramid is the graphic representation of the number, biomass and energy of the successive trophic levels of an ecosystem.
- The concepts of ecological pyramid was first described by **Charles Elton.** Ecological pyramids represent the trophic structure (feeding relationships) and trophic function (efficiency of energy transfer through biotic components) of an ecosystem.
- Pyramid of numbers depicts the number of individual organisms at different trophic levels of food chain.
- The total weight of living matter per unit area present in the ecosystem is called **biomass.**
- Pyramid of biomass depicts the amount of biomass at different trophic levels of food chain.
- Pyramid of energy depicts the amount of energy at different trophic levels of food chain.
- Ecological pyramids are always upright, ie. the apex is pointed upwards.

- In some ecosystems the number and biomass of producers are less and those of consumers are more. So the apex is directed dowards. This type of pyramid is called **inverted pyramid.**
- Inverted pyramid of numbers is found in parasitic food chain. Inverted pyramid of biomass is occur in pond and lake ecosystems.
- The pyramid of energy is always upright (never inverted).

Functional aspects of an ecosystem

- Main processes that are related to the field **o** ecosystem ecology are **energy transformation & biogeochemical cycling**
- Energy that enters the ecosystem is- **Light energy**
- Light energy is converted to chemical/potentia energy by the process - **Photosynthesis**
- Potential energy is converted to- **Kinetic energy**
- Biological systems get closed if there is no continuous entry of - **Solar energy**
- Regarding the energy flow, the earth is considered as an **Open system**
- Regarding the flow of elements in an ecosystem the earth is considered as **Closed system**
- Cycling of elements occurs endlessly in an ecosystem between **-Biotic & abiotic factors**
- The elements whose non-supply tend to limit biological activity are called **nutrients**

Biogeochemical Cycles:

- The pathway by which a chemical element **o|** molecule moves through both biotic and abiotic components of an ecosystem is called **-Biogeochemical cycles**
- All biogeochemical cycles are closed systems. The place where chemicals are held for long period: of time at one place in biogeochemical cycle is called -Reservoir
- The place where chemicals are held for short periods are called **Exchange pools**
- Reservoirs & Exchange pools are generally Abiotic & Biotic factors respectively
- The period of time a chemical is held in one place is called its Residence time is called its **-Residence time.**
- Reservoir of gaseous cycles like Nitrogen, Carbon etc is **–Atmosphere**
- Reservoir of sedimentary cycles like sulphur, phosphorus etc are **-Sedimentary rocks Nitrogen cycle**
- The very important element of proteins, DNA & RNA, Nucleic acids is - **Nitrogen**
- Nitrogen is fixed in the form of **Nitrates**
- Nitrogen is fixed in soil by **Azatobacter** Nitrogen is fixed in the roots of legumes by Rhizobium
- In water cyanobacteria act as **Nitrogen fixing bacteria**
- Nitrogen is changed into ammonia by ammonifying bacteria Nitrosomonas (Nitrite bacteria) present in the soil converts Aminonia **into nitrite** Nitrobactor (Nitrate bacteria) converts **Nitrites to nitrates** Pseudomonas & Clostridium (denitrifying bacteria) convert **Nitrates into nitrogen**

Phosphorus Cycle

- Atmosphere does not play a role in the movement of phosphorus, because they are present as solids **On the earth**
- Phosphate normally occurs in nature as part of a **Phosphate ion**
- Most of the phosphates are found in **–Ocean**
- **Sediments or in rocks** Phosphates are carried back to the oceans by weathering of rocks and from soil as runoff Phosphorus occurs in nature as **Orthophosphate (P04)3**
- Geological process which brings ocean sediment on to land are - **Geological up heavals**

Energy Flow

- The study of the laws of energy and its transformation is called- **Energetics**
- The standard international unit of energy is the **joule**
- Energy flow in an ecosystem is **-Unidirectional**
- The weight or quantity of organisms in an area at a given moment is called**-Standing crop**
- The total amount of organic material produced **by** living organisms of a particular area within a set period of time is called - **Productivity**
- The rate at which biomass is produced by organisms which convert inorganic substrates into complex organic substrates is called **-Primary productivity**
- Organisms like bacteria convert chemical energy to biomass by —Chemosynthesis
- The total primary productivity is known as **-Gross Primary productivity (GPP)**

- Energy stoted in plant tissues is considered as Net Primary productivity
- Net primary production = Gross primary production- energy utilised for respiration**-NPP = GPP - R**
- The rate at which consumers of an ecosystem convert the chemical energy of their ingested food material into their own body substance (biomass) is called **-Secondary productivity**
- The percentage of production of one trophic leve that is ingested by the next higher trophic level is called **Exploitation efficiency**
- The percentage of energy ingested that is actuall) absorbed across the wall of gut is called **Assimilation efficiency**
- Assimilation efficiency of herbivores is less than that of carnivores due to the presence of relatively **indigestible cellulose** in their food material

Exploitation efficiency

food ingested / total food available for ingestion X 100

Assimilation efficiency

food digested / total food ingested x 100

- The total plant material ingested by herbivore - the materials lost as faces is called - **Gross secondary production (GSP)**
- Energy stored in the tissues of consumers is - **Ne secondary production (NSP)**
- Percentage of energy lost in the transformation of absorbed solar energy to chemical energy by producers is as high as 99%
- The efficiency of transfer of energy from one trophic level to the higher trophic level is -10%
- The rule that states that only 10% of net energy ii transferred to next higher trohic level in an ecosystem is referred to as -10% **rule (Lindermann's trophic efficiency rule)**
- Percentage of net primary production that i^ converted to net secondary production in herbivore: is called - **Trophic efficiency of herbivores.**