ECO SYSTEM

I. Introduction:

1. **Ecosystem:** The interaction between biological community with non-living(physical) environment is called ecosystem. (or) Structural and functional unit of nature is called ecosystem.
2. Types of ecosystems- Natural ecosystem and Man-made ecosystem.
3. Natural ecosystems are terrestrial (e.g., forest, grassland, desert) and aquatic (pond, lake, river)
4. Man made ecosystem are crop land and aquarium.
5. **Stratification**- vertical distribution of different species occupying different levels is called (stratification).

II. Ecosystem- Structure and Function

1. Structure of ecosystem is related to species diversity.
2. Interaction of biotic and abiotic components results in a physical structure.
3. The functional components of ecosystem are productivity, decomposition, energy flow and nutrient cycling.

Productivity

1. The amount of biomass or organic matter produced or obtained or stored at a particular tropic level per unit area in a unit time is called (Productivity) (or) The rate of biomass production is called productivity.
2. It is expressed in terms of gm^{-2} yr^{-1} or (kcal m^{-2}) yr–1 to compare the productivity of different ecosystems.

Primary Productivity

1. The amount of organic matter or biomass produced per unit area over a time period by plants during photosynthesis is called primary productivity.
2. **Gross Primary Productivity (GPP):** The rate of production of organic matter during photosynthesis by plants is called GPP.
3. **Net Primary productivity (NPP):** The gross primary productivity minus respiratory loss is called NPP.GPP-R = NPP
4. **Secondary productivity:** The rate of formation of new organic matter by consumers is called Secondary productivity.
5. The annual net primary productivity of the whole biosphere is approximately 170 billion tons dry wight) of organic matter.

Decomposition

1. The process of breaking complex organic matter into inorganic substance like carbon dioxide, water and nutrients called decomposition. (or) It is a complex process of enzymatic reaction and involves the stepwise degradation of detritus is called Decomposition.

   Detritus: The dead organic matter formed by excreta of animals and dead remnants of plants such as leaves, bark, flowers. It acts as a raw material for decomposition.

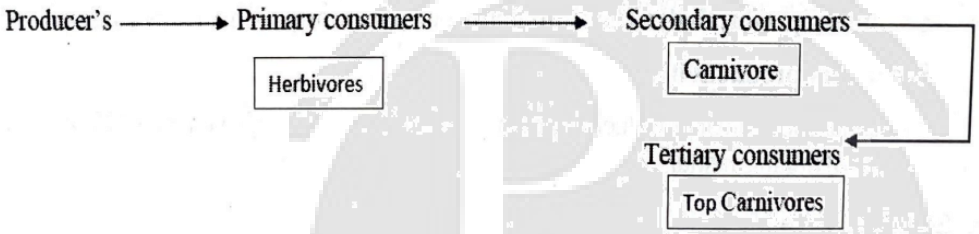
   Detritivores: Organisms which break down detritus into smaller particles are called detrivores. e.g. Bacteria, fungi, invertebrates like Earthworm.

   1. **Fragmentation:** The process of making fragments from detritus by bacteria, fungiand invertebrates like earthworm is called Fragmentation.
   2. **Leaching:** The process by which simple and H_2 O soluble compounds like simple sugars and inorganic nutrients move downwards along with percolating gravitational water. These inorganic nutrients are precipitated to form non available salts to plants is called Leaching.

3. **Catabolism:** The destructive process in which detritus breakdown into simple organic and inorganic substances by the effect of extracellular enzymes released by decomposers in their surroundings is called Catabolism. e.g., Pseudomonas decomposes proteins into ammonia and simple N_2 O compounds.
4. **Humification:** The process by which simplified detritus is changed into dark coloured amorphous substance called humus, which act as a reservoir of nutrients.
5. **Mineralization:** The process of further degradation of humus by some microbes and releasing inorganic nutrients such as Ca^{++}, Mg^{++}, K^{++} etc. is called mineralization.

III. Energy Flow

1. The only source of energy for all ecosystems on Earth (Sun).
2. Plants capture only 2-10 percent of the PAR (Photosynthetically Active Radiation) and this small amount of energy sustains the entire living world.
3. Producers of our ecosystem are autotrophic organisms (plants, photosynthetic bacteria and chemosynthetic bacteria). They fix sun's radiant energy to make food from simple inorganic materials for herbivores. Energy from one level to next level passes in the following way.



4. **Producers:** Green plants in the ecosystem terminology are called producers. They manufacture food from natural resources like CO_2, Water, and Light with the help of chlorophyll by the process of photosynthesis.
5. **Consumers:** Animals depend on plants directly or indirectly for their food needs called consumers. e.g. Goats, Cattle etc.
6. **Herbivores:** Animals which feed on producers are called herbivores also referred as primary consumers. e.g. Zooplanktons, Grasshopper, Cow
7. **Secondary consumers:** Animals that feed on the primary carnivores for food are called secondary carnivores. e.g. Birds, fishes etc.
8. **Tertiary consumers or Top carnivores:** Animals that feed on secondary consumers for food are called tertiary consumers. e.g: man, Lion etc.,
9. **Food Chain**: The process of transfer of energy from producers to consumers.
10. **Types of Food chain:** GFC (Grazing Food Chain) and DFC (Detritus Food Chain).
11. **Grazing Food Chain:** A simple grazing food chain (GFC) is depicted below

Grass ..... >	Goat..... >	Man.....>
(Producer)	(Primary Consumer)	(Secondary Consumer)

12. **Detritus Food Chain:** Food Chain that begins with dead organic matter is detritus food chain.
    Here decomposers like fungi, bacteria, derive their nutrients from degrading dead organic matter.
13. **Saprotrophs (Sapro = decompose)**: Microbes that decompose i.e. degrading complex organic food into simple nutrients for their nutrition to survive are called decomposers. They are also called natural scavengers.
14. **Food web:** A network of food chain which become interconnected at various trophic levels so as to form a number of feeding connections amongst different organisms of biotic community is called food web.
15. Trophic level: It is a specific place in the food chain where organisms occupied for the source of nutrition or food is called Trophic level.
    1. In any ecosystem producers represent the first trophic level.
    2. Herbivores represent second trophic level.
    3. Primary carnivores represent the third trophic level.
    4. Top carnivores represent last trophic level or fourth trophic level.

16. **Standing crop:** It is a mass of living material at a particular time in each trophic level is called standing crop. It is measured as the mass of living organisms (biomass).

IV Ecological Pyramids:

Idea of ecological pyramids was developed by Charles Elton, so also called Eltonian Pyramids. The graphical representation of each trophic level in food chain is called (ecological pyramid)

Types of Ecological pyramids

1. Pyramid of number:

1. The graphical representation showing the arrangement of number of individuals of different trophic levels in a food chain in an ecosystem is called Pyramid of number.
2. Food chain in grass land or pond ecosystem, pyramid of number is upright or straight.
3. Food chain in tree and forest ecosystem, pyramid of number is spindle shaped.
4. In parasitic food chain, the pyramid of number is inverted.

2. Pyramid of biomass:

1. The graphical representation of biomass present per unit area in different trophiclevels are called (Pyramid of biomass).
2. Pyramid of biomass is straight or upright in terrestrial habitat.
3. In aquatic habitats pyramid of biomass is inverted or spindle shaped.

3. Pyramid of energy:

1. The graphical representation of amount of energy trapped per unit time and area in different tropic levels of food chain is called Pyramid of energy.
2. Pyramid of energy is always upright or straight.

V. Ecological succession:

Succession: The occurrence of relatively definite, gradual and predictable sequence of communities over a long period of time in the same area resulting in establishment of stable or climax community, known as ecological succession or biotic succession.

Sere: The entire sequence of communities that successively change in a given area is called sere.

Types of Ecological succession.

1. Primary succession: The succession that starts where no living organisms are there in an area on bare rock,newly cooled lava, or newly created pond is called Primary succession.
2. Secondary succession : The succession which starts from previously unit up substrata with already existing living matter is called Secondary succession

Climax community: The final community that is more or less stable for a long period of time which can be maintained in equilibrium with climate of the area is called climax community.

Succession in plants:

1. Hydrarch or Hydro sere succession : It is an ecological succession that begins in the newly formed pond or lake i.e. in what areas and successional series progress from hydric to the mesic condition is called (Hydrarchsuccession.)
2. Xerosere or Xerarch succession: Succession that takes place in dry areas, progress from xeric to mesic conditions is called Xerarch succession
3. Pioneer species: The first species that invade in a baren area are called pioneer species. e.g. Lichens.

Small Phyto – plankton stage:

1. It is the pioneer community of hydroseed and is formed by the germination of encysted spores in 1. the newly formed water body.
2. Death and decomposition of planktons produce organic matter which mixes with the silt and form a soft mud at the bottom of pond which favours the growth of next stage.

Rooted-submerged plants:

1. It is formed of rooted submerged hydrophytes like Hydrilla, Potamogeton, Vallisnaria.
2. Due to death and decay of these plants, and sand and silt deposited around the plants, the bottom level of the pond rises slowly.
3. The older plants buried parts of other plants form humus which favours the growth of next stage.

Rooted-floating angiosperms:

1. It is formed of rooted hydrophytes like Nymphaea, Limnantheum, Trapa etc. Some free-floating species like Azola, Pistia, Eichornea, Lemna, Wolffia, Salvinia etc are also found.
2. The death and decomposition of these plants further increase the level of the substratum, so the pond becomes shallower. Finally, the floating species disappear.

Reed-swamp stage:

1. It is also called amphibious stage as most parts of the rooted plants remain exposed to air.
2. It includes the plant species like Segittaria, Typha etc
3. The organic matter added by these plants further raises the substratum, so the pond becomes unsuitable for the growth these amphibious plants.

Sedge - meadow stage:

1. It is mainly formed of plant species like Carex, Juncus,Cyperus, herbs like Caltha, Polygonum etc.
2. They form a mat like vegetation toward the centre of pond with the help of their much branched rhizomatous systems.
3. This develops the mesic conditions in the area marshy vegetation disappears gradually.

Woodland stage:

1. In this stage, first peripheral part of the area is invaded by some shrubby plants which can tolerate bright sunlight as well as water logged condition. e.g. Cornus, Cephalanthus.
2. These further lower the water table by their transpiration and build up more soil.
3. Mineralization and soil favours the arrival of plants of next stage.

Forest stage:

1. It is the climax community. (or) Climax community of hydrosere is (Forest stage)
2. It depends upon the climatic condition

   e.g. Tropical deciduous or monsoon forests in regions of moderate rainfall, tropical rain forests in areas with heavy rainfall and tropical climate; and mixed forests of Alnus, Acer and Quercus in the temperate regions.

VI Nutrient Cycling

1. **Nutrient cycle:** The exchange of materials between living and non-living components of biosphere is called biogeochemical cycle or nutrient cycle. (Or)
2. The cyclic pathways through chemical elements move from environment to organisms and back to the environment is called Nutrient cycle.
3. **Standing state:** The amount of nutrients such as carbon, nitrogen, phosphorous, calcium etc present in the soil at any given time, is referred to as the standing state.

   Sedimentary cycles: Phosphorous and sulphur cycles. Here the reservoir of the elements is in sediments of the earth is called sedimentary cycle.

   Carbon cycle:

   1. Carbon constitutes 49% of dry weight of organisms, 71% carbon is found dissolved in oceans. Fossil fuel represents a reservoir of carbon.
   2. Carbon cycling occurs through atmosphere, oceans and through living and dead organisms. *4×10^13 " " kg of carbon is fixed in the biosphere through photosynthesis annually.
   3. Carbon dioxide is released into atmosphere by respiration of producers and consumers. It is also released by decomposition of organic wastes and dead bodies by decomposition by the action of bacteria and fungi of decay.

4. Volcanic eruptions and hot springs also release CO_2 into the atmosphere.
5. Weathering of carbonate containing rocks by action of acids and excreted by microorganisms and plant roots or treatment of carbonate minerals also add to CO_2 in atmosphere.
6. Carbon returns to the plant biomass by photosynthesis. Through food chain carbon passes to various levels of food chain as a source of food energy, but by respiration, it is returned to atmosphere.

VII Phosphorus Cycle

1. Phosphorus is one of the nutrients of major importance to biological systems and is the constituent of energy rich compounds e.g., ADP, ATP, GTP, and NADP.
2. It is also found in plasma membrane, shells, bones and teeth.
3. Phosphorus is an example for _____ (sedimentary cycle)
4. Inorganic phosphate is added to soil as a result of weathering of phosphate rocks by the action of dilute nitric acid formed during nitrification and is released by leaching, erosion, and mining for agricultural uses.
5. Plants get phosphorus from soil especially as phosphate ions and is then transferred to consumers and decomposers as organic phosphate through the food chain.
6. After death and decay of organism's phosphorus is recycled dur to recycled due to action of decomposers especially by phosphate solubilising bacteria.

VIII Ecosystem Services

1. A wide range of economic, environmental and aesthetic benefits provided to the human beings by the ecological processes of an ecosystem are collectively called as ecosystem services.

   Examples:

   1. The forests provide food in the form of roots, tubers, leaves and fruits especially for the tribal.
   2. Forests ecosystems purify air and water, migrate drought and floods, cycle nutrients, generate fertile soils, provide wild life habitat, maintain biodiversity, pollinate crops, provide storage site for carbon and also provide aesthetic, cultural and spiritual values.
   3. Price tag on ecosystem services: Robert Constanza and his colleagues supporting services. It is proposed an average price tag of US $ 33 trillion a year on these fundamental ecosystem services.