Chapter -14
Ecosystem.

- Ecosystem is a functional unit of nature, where living organisms interact among themselves and also with the surrounding physical environment.
- Ecosystem is divided into two categories. terrestrial & aquatic
- terrestrial - Forest, grassland and desert ecosystem
- Aquatic - pond, lake, Wetland, river, estuary.

Ecosystem ~~and~~ Structure and function:

Vertical distribution of different species occupying different levels is called stratification. example - trees occupy top vertical strata or layer of the forest, shrubs the second and herbs and grasses occupy the bottom layers.

e.g: To understand ethos of water ecosystem lets take small pond example.

Abiotic Component is the water. autrophs are phytoplankton, some algae and floating plants. Consumers are Zooplankton. decomposers are bacteria, fungi and flagellets.

phytoplankton ← Zooplankton ← decomposers.

productivity.

- primary production is defined as the amount of biomass or organic matter produced per unit area over a time period by photosynthesis.
- expressed in terms of weight (gm^{-2}) or energy ($kcal\ m^{-2}$)
- The rate of biomass production is called productivity.
  productivity expressed $gm^{-2}yr^{-1}$ or $(kcal\ m^{-2})y^{-1}$
- Gross primary productivity (GPP) of an ecosystem is the rate of production of organic matter during photosynthesis. Considerable GPP is utilised by plants in respiration.

- Net primary productivity - Gross primary productivity minus respiration losses (R)

$$GPP - R = NPP$$

- Npp - available biomass for the consumption to heterotrophs.
- Secondary productivity - rate of formation of new organic matter by consumer.
- annual Npp of whole biosphere - 170 billion tons (dry weight) of organic matter.

Decomposition:

- Decomposition - decomposers break down complex organic matter into inorganic substances like CO_2, water and nutrients and the process is called decomposition.
- detritus - raw material of decomposition. e.g: leaves, bark, flower, dead remains of animal including fecal matter.
- Fragmentation - Detritivores (e.g: earthworm) breakdown detritus into smaller particles.
- leaching - Water soluble inorganic nutrients go down into the soil horizon and get precipitated as unavailable salts.
- Catabolism - Bacterial and fungal enzymes degrade detritus into simple inorganic substances.
- Humification - accumulation of dark coloured amorphous substance called humus that is highly resistant to microbial action and undergoes decomposition at an extremely slow rate., it is reservoir of nutrients.
- Mineralisation - Humus is further degraded by microbes and release of inorganic nutrients occure by the process called as mineralisation.
- decomposition is oxygen requiring process. if detritus is rich in lignin and cellulose, decomposition rate is lower.

and quicker if detritus is rich in nitrogen and water soluble substance like sugar. Warm and moist environment favours decomposition whereas low temperature and anaerobiosis inhibit decomposition.

Energy flow:

Green plants in the Ecosystem are called producers. All animals depend on plants (directly or indirectly) for their food needs Hence they are called consumers or Heterotrophs. primary consumers will be herbivores. consumers that feed on herbivores are Carnivores (primary carnivores). Those animals that depends on primary Carnivores are Secondary carnivores. Grazing food chain:

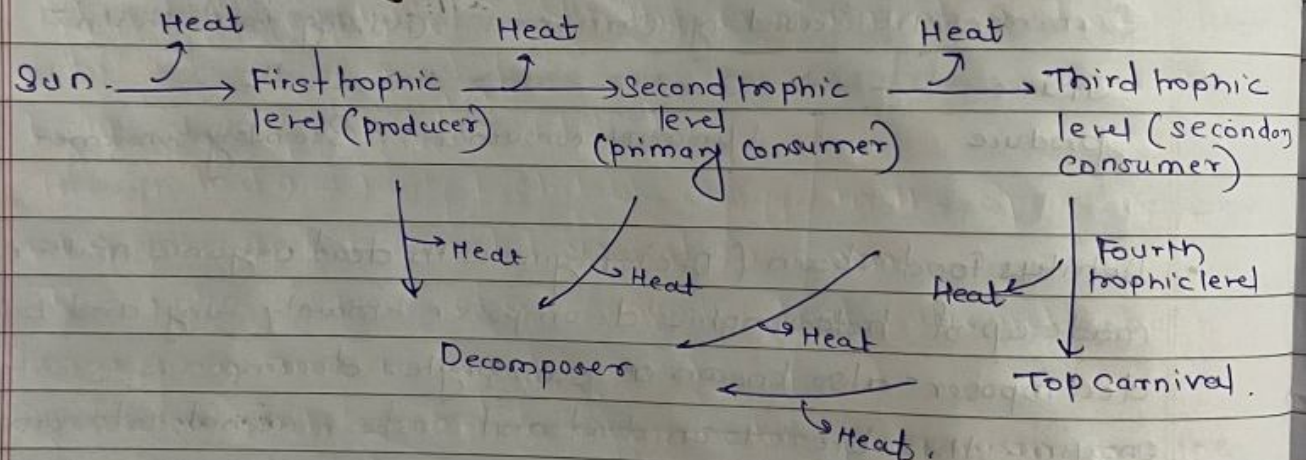
Grass ----> Goat ----> Man ---->
produce primary consumer Secondary consumer.

- Detritus food chain (DFC) begins with dead organic matter. made up of heterotrophic decomposer - mainly fungi and bacteria. decomposer also known as saprophyte. decomposers secrete digestive enzyme that breakdown dead and waste material into simple one.
- Detritus food chain may be connected with grazing food chain at some level.
- Natural interconnection of food chain is called food web.
- Based on source of nutrition or food, organisms occupy a specific place in the food chain called trophic level.
- Amount of energy decreases at succesive trophic level.
- Each trophic level has a certain mass of living material at a perticular time called as the standing crop.
- The biomass of a species is expressed in terms of fresh or dry weight.

Diagrammatic representation of trophic levels in Ecosystem.

Trophic level			
IV	Tertiary consumer	Top Carnivore	Man, lion.
III	Secondary consumer	Carnivore	Birds, fishes, Wolf
II	primary consumer	Herbivore	Zooplankton, grasshopper, cow
I	producer	plant	phytoplankton, grass, tree

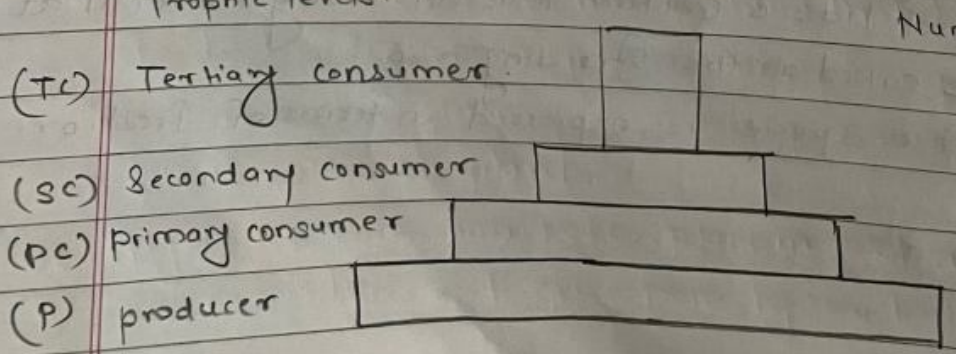
Energy flow through different trophic level.



Ecological pyramids:

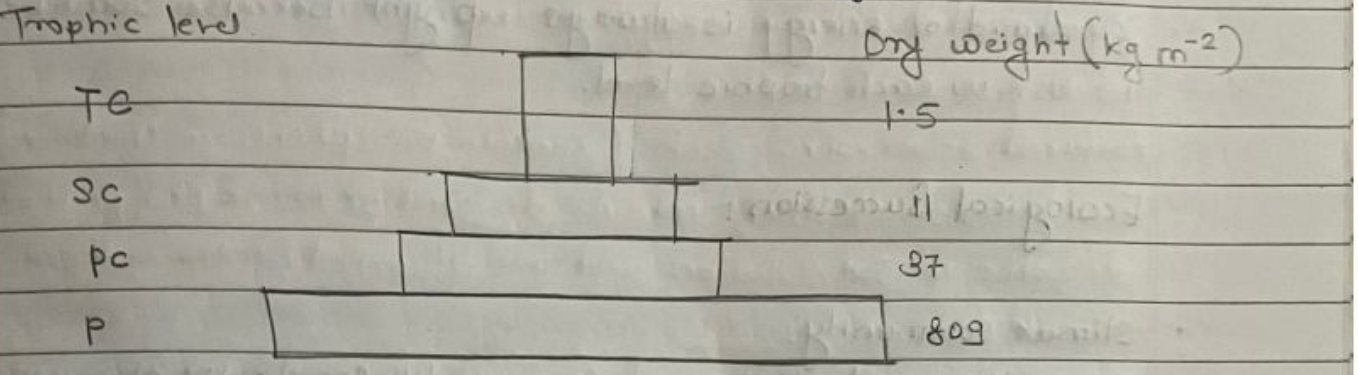
Expression of food or energy relationship between organism at different trophic level. expressed in terms of number, biomass or energy.

1) pyramid of number.

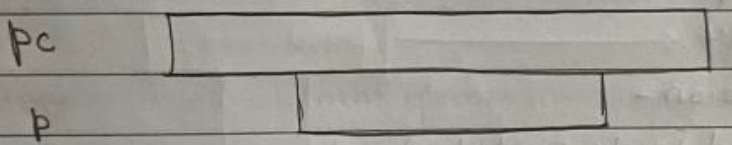


2) pyramid of biomass.

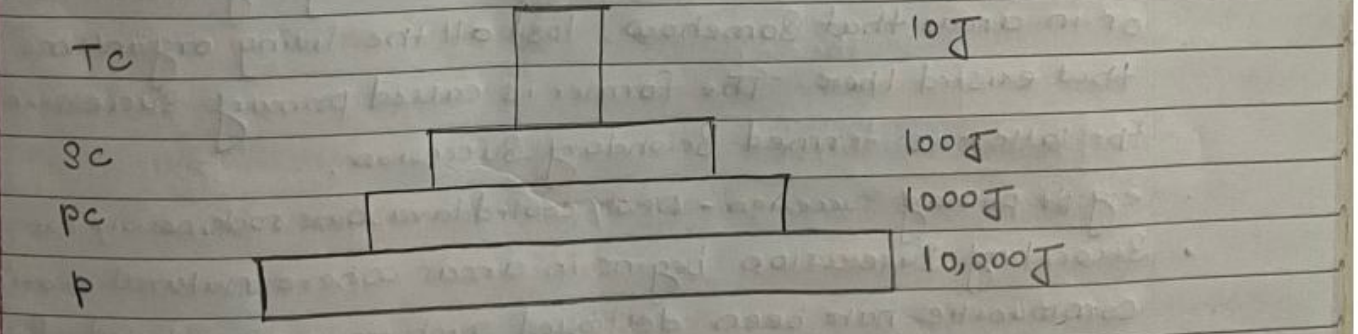
Shows sharp decrease in biomass at higher trophic levels.



2a) Inverted pyramid of biomass (Aquatic System) small standing crops of phytoplankton supports large standing crops zooplankton.



3) Pyramid of energy. observe that primary producers convert only 1% of energy in the sunlight available to them into NPP.



- Here Trophic level represents functional level, not a species as such. Species may occupy more than one trophic level in the same ecosystem at the same time. eg: Sparrow is primary consumer of fruit, seed, & secondary consumer of insects, worms.
- In most ecosystem all the pyramids are upright eg: pyramid of number, energy.

- The pyramid of biomass in sea is generally inverted, because biomass of fishes far exceeds that of phytoplankton.
- pyramid of energy is always upright because some energy is lost in each trophic level.

Ecological Succession:

- Climax Community:
  composition and structure of community constantly changes in response to changing environmental conditions. This change is orderly and sequential, parallel with the change in physical environment. This changes leads finally to a community that is in near equillibrium with the environment and called climax community.
- Ecological Succession -
  The gradual and fairly predictable change in the species composition of a given area is called Ecological Succession.
- The entire sequence of a communities that successively changes in a given area are called sera(s).
- Succession starts in an area where no living organisms are there. or in areas that somehow, lost all the living organisms that existed there. The former is called primary succession & the latter is termed secondary succesion.
- e.g. of primary succesion - newly cooled lava, bare rock, newly created pond
- Secondary succession begins in areas where natural biotic communities have been destroyed such as in abandoned farm lands, burned or cut forest, land that have been flooded it is faster than primary succession.

Succession of plants:

- Hydrarch succession takes place in wet areas and the successional series progress from hydric to the mesic conditions.

- Xerarch succession takes place in dry areas and the series progress from xeric to mesic conditions.
- Species that invade a bare area are called pioneer species.
- In primary succesion on rock- lichen secrete acid and dissolve rock & help in soil formation. later small plants like Bryophytes take hold in the small amount of soil. Succeded by higer plants lastly stable climax community formed.
- In water pioneer are phytoplankton which are replaced with time by rooted submerged plants.

Nutrient cycle -

- The amount of nutrients such as carbon, nitrogen, phosphorus, calcium present in the soil at any given time is referred to as the standing state.
- The movement of nutrient element through the various components of an ecosystem is called nutrient cycling (biogeochemical cycle).
- It is of two types a) gaseous b) sedimentary.
- reservoir of gaseous nutrient cycle - Nitrogen, carbon dioxide.
- reservoir of sedimentary cycle - Sulpher, phosphorus cycle.

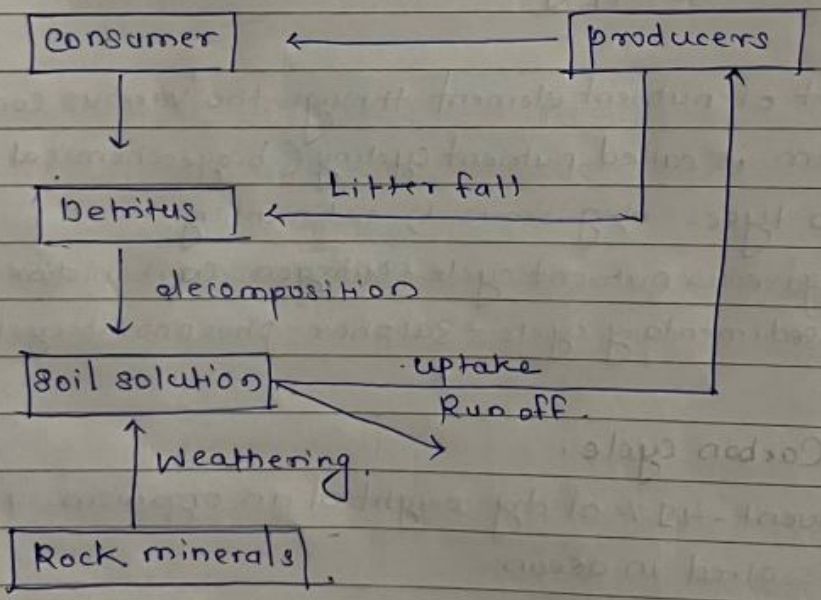
Ecosystem - Carbon cycle.

- Carbon constituent - 49 % of dry weight of an organism. 71% Carbon is found dissolved in ocean.
- 4×10^{13} kg of carbon is fixed anually in the biosphere through photosynthesis
- through respiratory activity of producer and consumer considerable amount of carbon returned to atmosphere.
- decomposers also process dead and waste material & contribute to CO_2 pool. Burning of wood, forest fire and combustion of organic matter, fossil fuels, volcanic activity additionaly releases CO_2
- Rapid deforestation, and massive burning of fossil fuel for energy & transport have significantly increased CO_2 release in atmosphere.

Ecosystem - phosphorus cycle -

- phosphorus - major constituent of biological membrane, nucleic acid and cellular energy transfer system. it is a constituent of shell, bones, teeth.
- natural reservoir - rock (contain phosphorus in the form of phosph
- When rocks weather minute amount of these phosphate dissolve in soil solution and are absorbed by the roots of the plants.
- Herbivore and other animals obtain this element from plants.
- The waste product and dead animals are decomposed by phosphate solubalising bacteria releasing phosphorous into atmosphere

phosphorous cycle:



Ecosystem services:

- The product of ecosystem processes are named as ecosystem services. e.g: Healthy forest ecosystems purify air and water, mitigate droughts and floods, cycle nutrients, generate fertile soil, provide wildlife habitat, maintain biodiversity, pollinate crops, provide storage site for carbon.
- out of total cost of various ecosystem services, the

Soil formation accounts for about 50%, and contribution of other services like recreation and nutrient cycling are less than 10 per cent each. The cost of climate regulation and habitat for wildlife are about 6 per cent each.