Ecosystem

Terrestrial and the aquatic.

- Forest, grassland and desert are some examples of terrestrial ecosystems; pond, lake, wetland, river and estuary are some examples of aquatic ecosystems.
- Crop fields and an aquarium may also be considered as man-made ecosystems.
- Vertical distribution of different species occupying different levels is called stratification. For example, trees occupy top vertical strata or layer of forest, shrubs the second and herbs and grasses occupy the bottom layers

The components of the ecosystem are seen to function as a unit when yo nsider he following aspects:

(i) Productivity;

(ii) Decomposition;

(iii) Energy flow; and

(iv) Nutrient cycling.

- The abiotic component is the wate with all the dissolved inorganic and organic substances and the rich soil osit at he bottom of the pond.
- The solar input, the ycl of temperature day-length and other climatic conditions regulate the rate of fun on of the tire pond.
- The autotrophic co pone s include the phytoplankton, some algae and the floating, subm ged and mar inal plants found at the edges.
- The consumer are repres nted by the zooplankton, the free swimming and bottom dwelling forms
- T e decomposers th fungi, bacteria and flagellates especially abundant in the bot m o the pond.
- This sy m perf ms all the functions of any ecosystem and of the biosphere as a w ole, i.e conversion of inorganic into organic material with the help of the radi t energy of the sun by the autotrophs; consumption of the autotrophs by heterot phs; decomposition and mineralisation of the dead matter to release them back for
  reuse by th autotrophs, these event are repeated over and over again.
- There is unidirectional movement of energy towards the higher trophic levels and its dissipation and loss as heat to the environment.
- Primary production is defined as the amount of biomass or organic matter produced per unit area over a time period by plants during photosynthesis.
- The rate of biomass production is called productivity.

- It can be divided into gross primary productivity (GPP) and net primary productivity (NPP).
- Gross primary productivity of an ecosystem is the rate of production of organic matter during photosynthesis.
- A considerable amount of GPP is utilised by plants in respiration.
- Gross primary productivity minus respiration losses (R), is the net primary productivity (NPP).
- Net primary productivity is the available biomass for the consumption to heterotrophs (herbiviores and decomposers).
- Secondary productivity is defined as the rate of formation of new o ganic matter by consumers.
- Primary productivity depends on the plant species inhabiting a pa icu ar are
- It also depends on a variety of environmental factors, avail lity of utrien s and photosynthetic capacity of plants.
- The annual net primary productivity of the whole bi p re is app ximately 170 billion tons (dry weight) of organic matter.
- Of this, despite occupying about 70 per cent of th urface, th productivity of the oceans are only 55 billion tons.
- Rest of course, is on land. decomposers b eak do n com lex organic matter into inorganic substances like carbon dioxid water an nutrients and the process is called decomposition.
- Dead plant remains such as leav s bark, fl ers nd dead remains of animals, including fecal matter, constitute d ritus, which is the raw material for decomposition.
- The important steps the proce of de omposition are fragmentation, leaching, catabolism, humificatio and miner lisation.
- Detritivores (e.g e rthwo m) break down detritus into smaller particles. This process is calle fragmentati
- By the proces of leachin water soluble inorganic nutrients go down into the soil horizon and get recipitat d as unavailable salts.
- B cterial and fung ymes degrade detritus into simpler inorganic substances. Thi pro ss is called as catabolism.
- Humif ion and mineralisation occur during decomposition in the soil.
- H mifica on leads to accumulation of a dark coloured amorphous substance call d humu that is highly resistant to microbial action and undergoes decomp sition at an extremely slow rate.
- Being coll idal in nature it serves as a reservoir of nutrients.
- The humu is further degraded by some microbes and release of inorganic nutrients occur by the process known as mineralisation.
- Decomposition is largely an oxygen-requiring process.
- The rate of decomposition is controlled by chemical composition of detritus and climatic factors.

- In a particular climatic condition, decomposition rate is slower if detritus is rich in lignin and chitin, and quicker, if detritus is rich in nitrogen and water-soluble substances like sugars.
- Temperature and soil moisture are the most important climatic factors that regulate decomposition through their effects on the activities of soil microbes.
- Warm and moist environment favour decomposition whereas low temperature and anaerobiosis inhibit decomposition resulting in build up of organic materials.
- The detritus food chain (DFC) begins with dead organic matter.
- It is made up of decomposers which are heterotrophic organisms, mainly fungi and bacteria.
- They meet their energy and nutrient requirements by degrading d ad or anic matter or detritus.
- These are also known as Saprotrophs (sapro:to decompose)
- Decomposers secrete digestive enzymes that breakdown dead and waste materials into simple, inorganic materials, which are subseque y bsorbed y them. In an aquatic ecosystem, GFC is the major conduit for energy flow.
- As against this, in a terrestrial ecosystem, a much lar r fraction of energy flows through the detritus food chain than thro gh the RAZING FOOD CHAIN.
- Detritus food chain may be connected w th the gra ng food chain at some levels: some of the organisms of DFC are ey the GFC animals, and in a natural ecosystem, some animals like cockroaches, ow , etc., are omnivores.
- These natural interconnection of fo d chains make it a food web.
- The consumers that feed o se her vores are carnivores, or more correctly primary carnivores (ough seco dary c nsumers).
- Those animals that dep d on the p mary carnivores for food are labeled secondary carnivor s
- Organisms occ py a place in he natural surroundings or in a community according to t ir feeding relationship with other organisms.
- Based on he so rce of th ir nutrition or food, organisms occupy a specific place i the fo d chain t t i known as their trophic level.
  Pro ucer belong to the first trophic level, herbivores (primary consumer) to the second d carni ores (secondary consumer) to the third the amount of energy d reases t successive trophic levels.
- Wh any o ganism dies it is converted to detritus or dead biomass that serves as an ener y source for decomposers.
- Organism at each trophic level depend on those at the lower trophic level for their energy demands.
- Each trophic level has a certain mass of living material at a particular time called as the standing crop.
- The standing crop is measured as the mass of living organisms (biomass) or the number in a unit area.
- The biomass of a species is expressed in terms of fresh or dry weight.

- Measurement of biomass in terms of dry weight is more accurate.
- Pyramid of energy is always upright, can never be inverted, because when energy flows from a particular trophic level to the next trophic level, some energy is always lost as heat at each step.
- Each bar in the energy pyramid indicates the amount of energy present at each trophic level in a given time or annually per unit area.
- An important characteristic of all communities is that composition and structure constantly change in response to the changing environmental conditions.
- This change is orderly and sequential, parallel with the changes in the physical environment.
- These changes lead finally to a community that is in near equilibr um wi h th environment and that is called a climax community.
- The gradual and fairly predictable change in the species c ositio of a gi en area is called ecological succession.
- During succession some species colonise an area an r populat ns become more numerous, whereas populations of other spec es decl e and even disappear.
- The entire sequence of communities that successi ly change n a given area are called sere(s).
- The individual transitional communities re term d sera stages or seral communities.
- In the successive seral stages there a c ange in th diversity of species of organisms, increase in the numb r of speci and organisms as well as an increase in the total biomass.
- Succession is hence a proc hat sta s where no living organisms are there – these could be areas whe e no li ng org nisms ever existed, say bare rock; or in areas that somehow, lo all the livi g organisms that existed there.
- The former is called prim y succession, while the latter is termed secondary succession.
- Examples of a eas where rimary succession occurs are newly cooled lava, bare rock, new y cre ed pond r reservoir.
- T e esta ishment f ew biotic community is generally slow.
  Bef e a iotic community of diverse organisms can become established, there must b oil.
- D pendin mostly on the climate, it takes natural processes several hundred to seve l thou and years to produce fertile soil on bare rock.
- Second y succession begins in areas where natural biotic communities have been destroyed uch as in abandoned farm lands, burned or cut forests, lands that have been flood d.
- Since some soil or sediment is present, succession is faster than primary succession.
- Based on the nature of the habitat – whether it is water (or very wet areas) or it is on very dry areas – succession of plants is called hydrach or xerarch, respectively.

- Hydrarch succession takes place in wetter areas and the successional series progress from hydric to the mesic conditions.
- As against this, xerarch successiontakes place in dry areas and the series progress from xeric to mesic conditions. Hence, both hydrarch and xerach successions lead to medium water conditions (mesic) – neither too dry (xeric) nor too wet (hydric).
- The species that invade a bare area are called pioneer species.
- In primary succession on rocks these are usually lichens which are able to secrete acids to dissolve rock, helping in weathering and soil formation.
- These later pave way to some very small plants like bryophytes, which are able to take hold in the small amount of soil.
- They are, with time, succeeded by bigger plants, and after several more ages, ultimately a stable climax forest community is formed.
- The climax community remains stable as long as the envir ent r ains unchanged.
- With time the xerophytic habitat gets converted into sophytic ne. succession, particularly primary succession, is a very slow pro ess, tak ng maybe thousands of years for the climax to be reached.
- Another important fact is to understand that all succe sion whether taking place in water or on land, proceeds to a similar cl max co muni y – the mesic.
- The movement of nutrient elements thr ugh the va ous components of an ecosystem is called nutrient cyclin
- Another name of nutrient cyclin i biogeo emi al cycles (bio: living organism, geo: rocks, air, water).
- Nutrient cycles are of two yp s: (a) g seous and (b) sedimentary.

Phosphorus Cycle

- Phosphorus is major co stituent of biological membranes, nucleic acids and cellular energy ansfer sy tems.
- Many an mals als e large quantities of this element to make shells, bones and tee
- The n u al res ir of phosphorus is rock, which contains phosphorus in the f m of p osphates.
- Wh rocks are weathered, minute amounts of these phosphates dissolve in soil solutio and are absorbed by the roots of the plants.
- Herbivor and other animals obtain this element from plants.
- The waste roducts and the dead organisms are decomposed by phosphate-solubilizing bacteria releasing phosphorus.
- Unlike carbon cycle, there is no respiratory release of phosphorus into atmosphere.
- The other two major and important differences between carbon and phosphorus cycle are firstly, atmospheric inputs of phosphorus through rainfall are much

smaller than carbon inputs, and, secondly, gaseous exchanges of phosphorus between organism and environment are negligible.

- Healthy ecosystems are the base for a wide range of economic, environmental and aesthetic goods and services. The products of ecosystem processes are named as ecosystem services, for example, healthy forest ecosystems purify air and water, mitigate droughts and floods, cycle nutrients, generate fertile soils, provide wildlife habitat,
  maintain biodiversity, pollinate crops, provide storage site for carbon and also provide aesthetic, cultural and spiritual values.