

Chapter - 14

Ecosystem

Ecosystem : It is the basic functional unit of biosphere in which living organisms interact among themselves and with their surrounding physical environment.

Stratification : Vertical distribution of different species occupying different levels in an ecosystem. Trees occupy top vertical strata, shrubs the second layer and herbs the third layer and herbs/grasses occupy the bottom layers.

Primary Production : Amount of biomass or organic matter produced per unit area over a time period by plants during photosynthesis.

Gross Primary Productivity : Rate of production of organic matter during photosynthesis.

Net Primary Productivity : $NPP = GPP - R$ (Gross primary productivity minus the respiration losses).

Secondary Productivity : Rate of formation of new organic matter by consumers.

Detritus : Dead leaves, twigs, animal remains etc. constitute detritus.

Detrivore : Organisms who break down detritus into smaller particles, e.g., earthworm.

Ecological succession : The successive and orderly replacement of one community by the other community in an area, over a period of time.

Climax community : The stable and final biotic community that develops at the end of ecological succession and is in perfect harmony with its physical environment.

Detritus : Dead leaves, twigs, animal remains etc. constitute detritus.

Detrivore : Organisms who break down detritus into smaller particles, e.g., earthworm.

Process of Decomposition : The decomposers break down complex organic matter into inorganic substances like carbon dioxide, water and nutrients.



This process is called decomposition. Steps of decomposition are : (i)

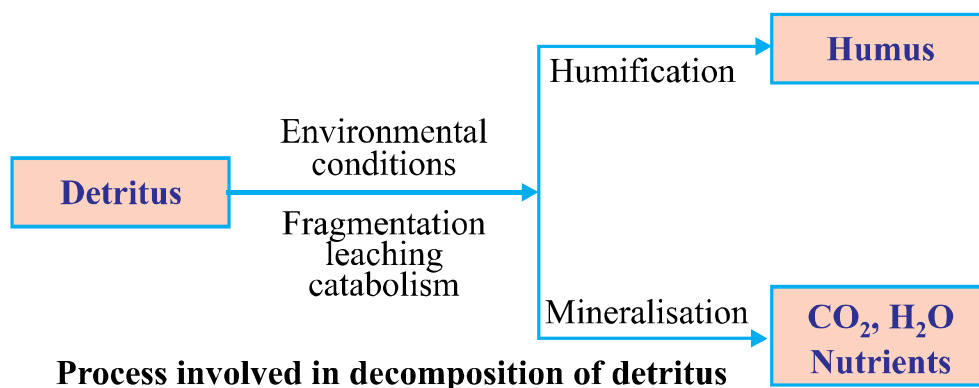
Fragmentation : Break down of detritus into smaller particles by detritivores (earthworm).

(ii) **Leaching** : Water soluble inorganic nutrients go down into the soil horizon and get precipitated as unavailable salts.

(iii) **Catabolism** : Bacterial and fungal enzymes degrade detritus in simple inorganic substances.

(iv) **Humification** : Accumulation of a dark coloured amorphous substance called humus which is highly resistant to microbial action and rich in nutrients.

(v) **Mineralisation** : The humus is further degraded by some microbes and release of inorganic nutrients occur.



Process involved in decomposition of detritus

Factors affecting decomposition :

Decomposition is controlled by :

(a) **Chemical composition of detritus** : The decomposition will slower if detritus is rich in lignin and chitin and will faster if detritus is rich in nitrogen and water soluble substance (sugar).

(b) **Climatic factors** : In warm and moist environment, the process of decomposition increases whereas low temperature and anaerobiosis inhibit the decomposition.

Energy Flow : Energy flow is the key function in the ecosystem. The plants (producers) capture only 2-10 percent of the photosynthetically active radiation (PAR). Unidirection flow of energy is taken place from the sun to producers and then to consumers. About 10% energy flows from one trophic level to another.

Grazing Food Chain (GFC) : It begins with producers.

Grass → deer → Lion
(Producer) (Primary Consumer) (Secondary consumer)

Detritus Food Chain : (DFC) It begins with dead organic matter. It is made up of decomposers (Fungi, Bacteria). They meet their energy and nutrient requirements by degrading detritus. Decomposers are also known as saprotrophs.

Food Web : A number of food chains interconnected with each other forming a web-like pattern.

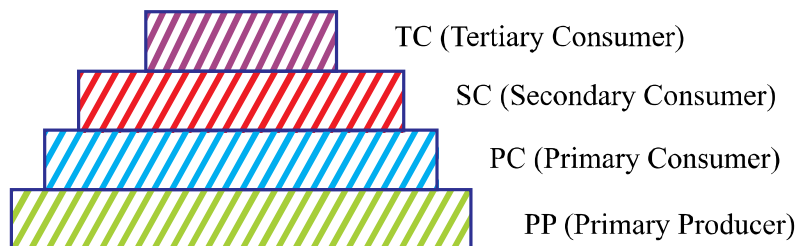
Ten Percent Law of Energy Transfer : Proposed by Lindeman. At each step of food chain, when energy is transferred from one trophic level to the next trophic level, only 10 percent of energy is passed on to the next trophic level.

Standing State : Amount of all the inorganic substances present in an ecosystem per unit area at a given time.

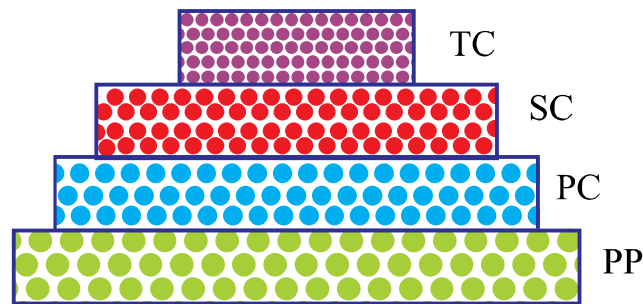
Standing Crop : Amount of living material present in different trophic levels at a given time. It is measured as the mass of living organisms or the number in a unit area.

Ecological Pyramids : The sequential graphic representation of an ecological parameter (energy/number/biomass) depicting different trophic levels in a food chain.

(i) Pyramid of Numbers : (Grassland Ecosystem)

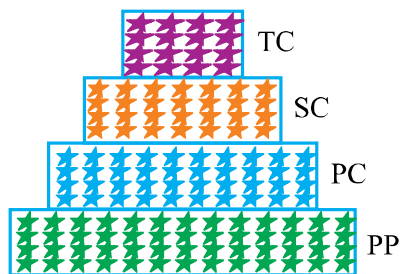


(ii) Pyramid of Energy : (Always upright in all Ecosystems)

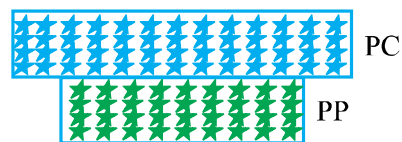


(In Terrestrial Ecosystem)

(iii) Pyramid of Biomass



(In Terrestrial Ecosystem)

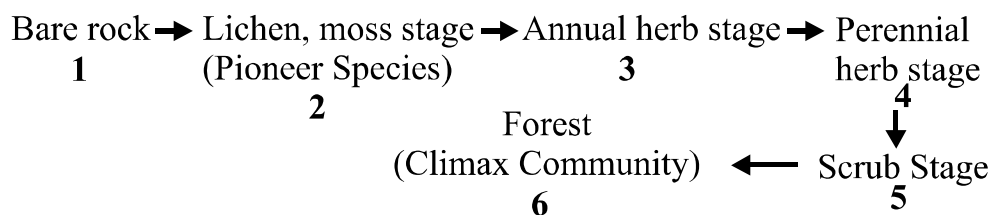


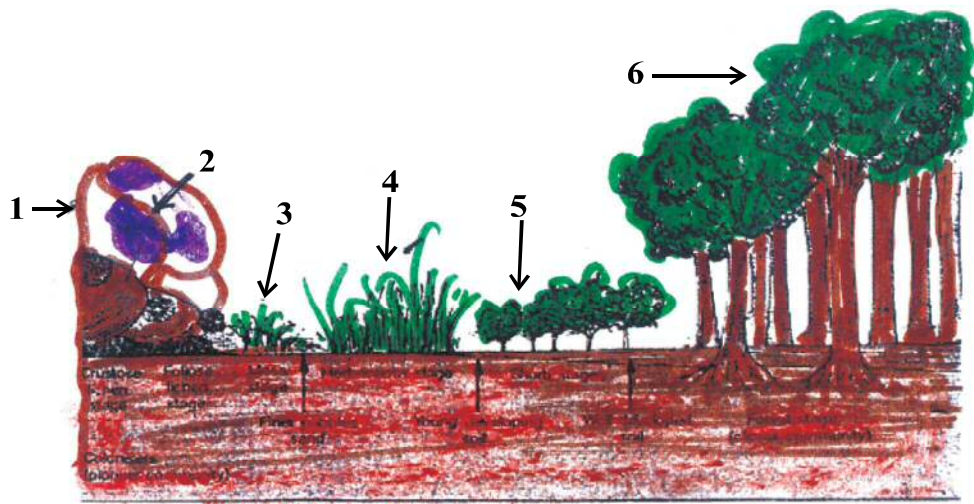
(In Aquatic Ecosystem)

Ecological Succession : The gradual and fairly predictable change in the species composition of a given area is called **ecological succession**. The species that invade a bare area is called pioneer species.

The entire sequence of communities that successively change in a given area is called sere. The stable and final biotic community that develops at the end of ecological succession and is in perfect harmony with its physical environment is called climax.

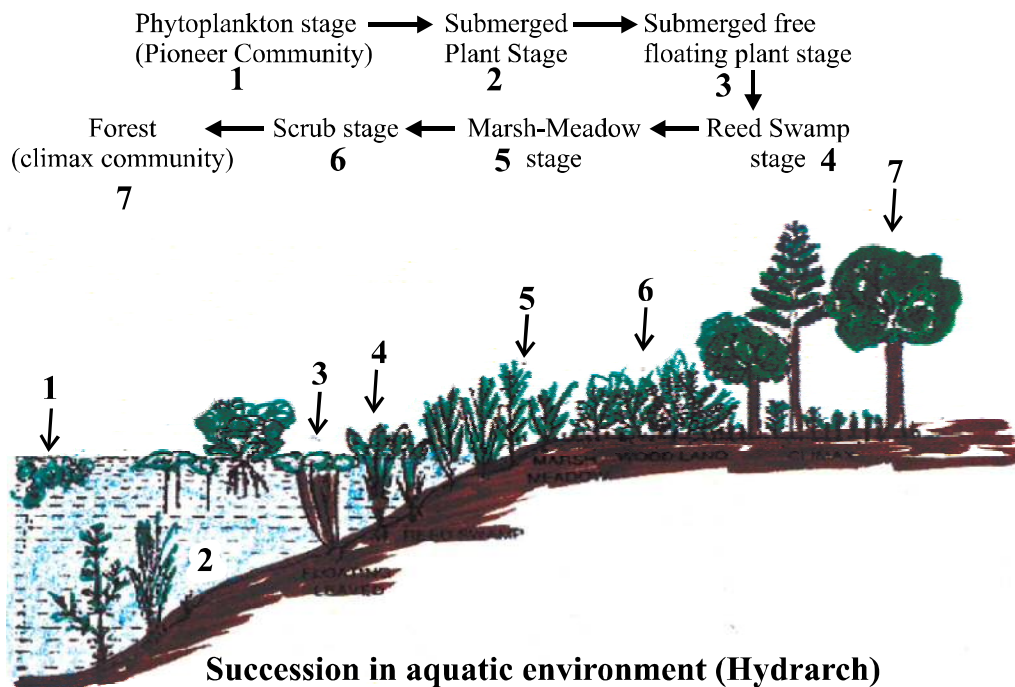
Xerarch :





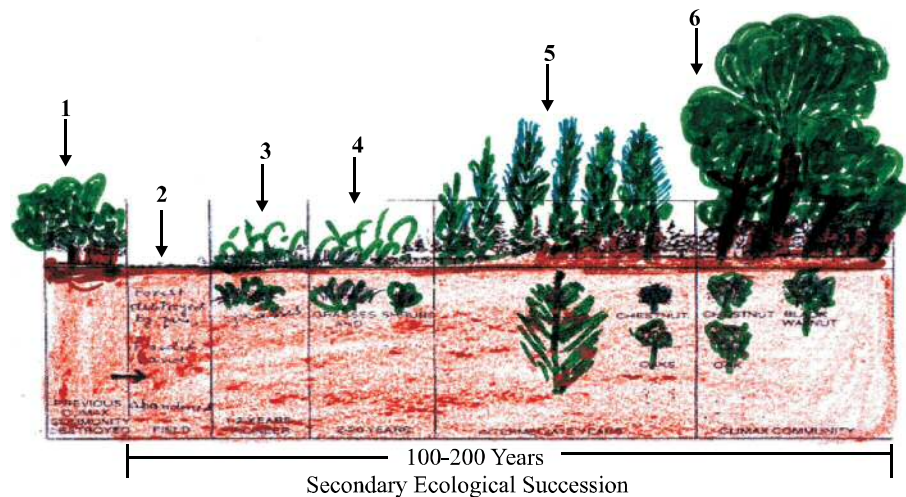
Succession on a bare rock (Xerarch)

Hydrarch :



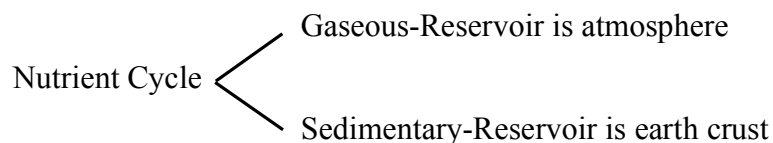
Succession in aquatic environment (Hydrarch)

Secondary Succession : The secondary succession begins in the area where natural biotic communities have been destroyed (burned or cut forests, land that have been devastated by flood).



1. Previous climax community
2. Forest destroyed by fire/flooded land/abandoned field
3. Grasses/Pioneer Community
4. Grasses and shrubs
5. Intermediate Communities
6. Climax Communities

Nutrient Cycling : Movement of nutrient elements through the various components of an ecosystem also called Biogeochemical cycles.



Carbon cycle : Occurs through atmosphere, ocean, and through living and dead organisms. Considerable amount of carbon returns to atmosphere as CO_2 through respiratory activities. Decomposers also contribute to Carbon di-oxide pool. Burning of wood, forest fire and combustion of organic matter, fossil fuels, volcanic activity also release CO_2 , in atmosphere.

Phosphorus cycle : (Sedimentary cycle) Rocks contain phosphorous in the form of phosphates.

Comparison between carbon cycle and phosphorus cycle :

S. No.	Carbon cycle	Phosphorus cycle
1.	Atmospheric inputs is more in amount	Atmospheric inputs is less in amount
2.	Degree of exchange of carbon between organisms and environment is high	Degree of exchange of phosphorus between organisms and environment is negligible

Questions

VSA

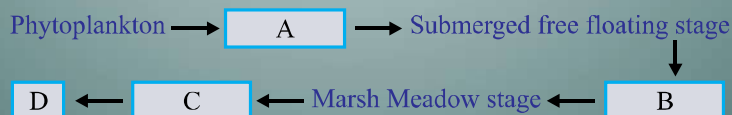
(1 Mark)

1. If we count the number of insects on a tree and number of small birds depending on those insects and also the number of larger birds eating the smaller, what kind of pyramid of number would we get ?
2. Differentiate between Sere and Seral communities.
3. Who are generally the pioneer species in a Xerarch succession and in a Hydrarch succession ?

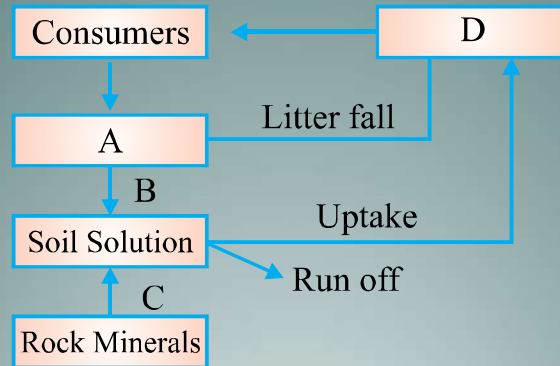
SA-I

(2 Marks)

4. What is the shape of pyramid of biomass in sea ? Why ?
5. Give an example of an ecological pyramid which is always upright. Justify your answer.
6. Differentiate between primary succession and secondary succession. Which one occurs faster ?
7. Gaseous nutrient cycle and sedimentary nutrient cycles have their reservoir. Name them. Why is a reservoir necessary ?
8. Fill up the missing links depicted as A, B, C and D in the given model of primary succession.



9. In the model of phosphorus cycle given below, what does A, B, C and D refer to ?



10. Differentiate between Hydrarch and a Xerarch succession.

11. What is the effect on decomposition rate if :

- (a) Detritus is rich in lignin and chitin
- (b) Detritus is rich in nitrogen and sugars

SA-II

(3 Marks)

12. Name any four ecosystem services. Who gave the price tags on nature's life support services ? Which is the most important ecosystem service provider ?

13. In the pyramid of biomass drawn below, name the two crops (i) one which is supported (ii) one which supports in which ecosystem is such a pyramid found.



LA

(5 Marks)

14. Detrivores like earthworm are involved in the process of decomposition of dead plants and animals. Describe the different steps involved in the process of decomposition.

Answers

VSA

(1 Mark)

1. Inverted Pyramid of Number.
2. **Sere** : Entire sequence of communities that successively change in a given area.
Seral community : Individual transitional community.
3. Pioneer species in Hydrarch succession are usually the small phytoplanktons and that in Xerarch succession are usually lichens.

SA-I

(2 Marks)

4. Inverted, because biomass of fishes far exceeds that of phytoplankton.
5. Pyramid of energy is always upright and can never be inverted, because when energy flows from a trophic level to the next trophic level some energy is always lost as heat at each step.
6. **Primary Succession** : A process that starts where no living organisms are there. This is slow.
Secondary succession : A process that starts in areas which have lost all the living organisms that existed there. Is faster.
7. **Reservoir for Gaseous nutrient cycle** : Atmosphere; for sedimentary nutrient cycle : Earth's crust. Reservoir is needed to meet with the deficit which occurs due to imbalance in the rate of influx and efflux.
8. A = Submerged plant stage
B = Reed Swamp Stage
C = Scrub stage
D = Forest stage
9. A = Detritus
B = Decomposition
C = Weathering
D = Producers.
10. **Hydrarch Succession** : Starts in water proceeds from hydric (aquatic) to mesic (neither dry nor wet) situations.
Xerarch succession : Starts on barren rock proceeds from Xeric dry to mesic conditions.

11. (a) Decomposition rate is slower.
(b) Decomposition rate is faster.

SA-II

(3 Marks)

12. (i) Forest (ecosystem) purify water and air
(ii) Mitigate Droughts and floods
(iii) Nutrient cycling
(iv) Generate fertile soil
(v) Provide habitat for wildlife
(vi) Pollinate flowers
(vii) Maintain Biodiversity
(viii) Provide aesthetic, cultural and spiritual values

- Robert Constanza and his colleagues gave price tags to ecosystem services.
- Most important ecosystem services provider : Soil formation.

13. (i) Supported trophic level is founded by zooplanktons
(ii) Supporting trophic level is formed by phytoplanktons ecosystem.
It is found in aquatic ecosystem.

LA

(5 Marks)

14. The dead remains of plants and animals called detritus undergo decomposition and are converted into simpler substances. The steps of this process are fragmentation, leaching, catabolism, humification, mineralisation.

Steps involved : Refer to content in chapter.

