Ecological Succession

Q. 1. What do you understand by ecological succession ? Describe various patterns of succession

(Delhi 1992)

What is the difference between primary and secondary ecological succession ? Explain it with the help of suitable examples.

With suitable examples give an account of ecological succession.

(Delhi 1992)

Write an essay on 'Biotic Succession' in nature.

Ecological succession may be defined as on orderly sequence of different ommunities over period of time in some particular area. Development of ommunity in an ecosystem begins with pioneer stages which are replaced by a ries of more mature communities until a relatively stable community is formed nich is in equilibrium with local conditions. The progressive development in an ological succession can be enumerated as follows :

1. There is usually progressive development of the soil with increasing depth, increasing organic content and increasing differentiation of layers towards mature soil of the final community.
2. The height, massiveness, and differentiation into strata of the plant community increases.
3. The rate of formation of organic matter per unit area in the community increases with increasing development of the soil and of community structure.
4. As density of above ground plants increases, the microclimate within the community is increasingly determined by characteristics of community itself.
5. Species-diversity increases from the simple communities of early succession to the richer communities of late succession.
6. Populations of pioneer stages rise and fall and replace one another with the time gradient due to interspecific and intraspecific competition for space provide a continuing course of succession through the modification of environmental factors such as soil, moisture and humus. The rate of this replacement shows through the course of succession as smaller and

short-lived **pioneers** (species) are replaced by larger and longer-lived ones.

7. Consequently, the relative stability of the communities increases and the final community which is usually stable is called **climax community.** It is dominated by longer-lived plants which maintain their populations in equilibrium with community composition.

Fig. 1. Hypothetical representation of the process of ecological succession

Kinds of Ecological Succession

Ecological succession may be of the following two types :

1. Primary succession : When succession begins on an area which has not been previously occupied by a community (e.g., a new exposed rock area, sand dunes, new islands, deltas, shore or a recent lava flow), it is known as **primary succession.** The first group of organisms (plants or animals) which becomes estabilished in such an area is termed the **pioneer community.**

2. Secondary succession : When community development is proceeding in an area from which a community was removed and where nutrients and conditions for existence are already favourable, e.g., cut over forest, abandoned cropland and ploughed field, it is termed **secondary succession.** Secondary succession is more rapid because some organisms are already present. Moreover, previously occupied territory is more receptive to community development than the sterile areas.

Patterns of Succession

Depending upon the types of habitat and varying amount of moisture, the successions are variously designated. The chief patterns are **hydrosere** or **hydrarch** (in water), **xerasere** or **xerarch** (in dry conditions) and **mesrarch** or **mesosere** (an intermediate type with adequate moisture).

1. Xerosere

One of the best examples of a xerosere is the succession which starts on bare rock, wind blown sand, rocky slopes or any such place where there is extreme deficiency of water. The various stages in xerosere can be enumerated as follows :

1. Lichen stage : Due to great exposure to sun and extreme deficiency of water, the first pioneers on the bare rock area are a few simple organisms. The most successful of such organisms are crustose lichens. These are able to withstand extreme desiccation due to excessive dryness. During rainy season they absorb large quantities of water and flourish rapidly. Migration to distant rocks takes place either by spores or soredia by wind. The common species of crustose

lichens are *Rhizocarpon*, *Rinsodina*, etc. These begin the long, slow process of rock disintegration. Rock particles and dead organic matter of lichens accumulate to provide conditions possible for the growth of higher forms of lichens.

As soon as little soil is formed by the activity of crustose lichens, higher forms of lichens such as foliose lichens appear. These include *Dermatocarpon*, *Parmelia*, *Umbilicana* etc. These have large leafy thalli which overlap the crustose lichens and cause their gradual death and decay. In this way more and more humus accumulates and gradually a thin layer of soil is formed which consists of rock particles, remains of lichens, dust particles and moisture.

Associated with the lichens a few mites make their appearance. Along with them a few spiders also make their appearance in cracks and crevices of the rock.

2. Moss stage : With the accumulation of dust and humus in small quantities, the environment is altered enough to allow the establishment of secondary communities in a rather definite sequence. Scattered patches of mosses such as *Tortula*, *Grimmia byrum* and *Barfula* etc., begin, to invade the environment that had so far been dominated by lichens. Later on, mosses like *Funaria*, *Sphagnum* and *Polytrichum* make their appearance.

Fig. 2. Stages of primary succession on a bare rock. Hatched area indicates increasing depth of soil.

Among the animals, mites become more varied, some small spiders and spring tails as well as tradigardes become associated with this secondary community.

3. Herbaceous stage : As the mites of mosses become more extensive soil accumulates, much of the soil is blown in from surrounding areas windy periods. More mineral material is added to the soil as acid leaches out the overlying vegetation and increases the depth of the mineral soil layer. annual weeds develop which are, later on, followed by biennial and perennial grasses. *Andropogon*, commonly known as broom sedge becom dominant grass in many areas.

With the influx of grasses, the fauna (animals) also becomes Nematodes and larval insects, collembola, ants and mites appear in the grad altered environment.

4. Shrub stage : Further modification of the environment provides condi for the germination and growth of shrubs and perennial wood plants such *Acacia, Prosopis, Capparis, Zizyphus*, etc.

With the approach of shrubs, the animals also become vivid and numer and join hands with the vegetation in altering the environment.

5. Climax forest : With the establishment of shrubs, more and more soi formed and environment becomes increasingly humid. This favours the growth woody trees. In the beginning, trees show stunted growth and are sparesely pla Finally, a climax forest community is established. The climax community is last aggregation in the successional series. It the climax conditions do change no catastrophic event alters the area, the community maintains indefinitely.

2. Hydrosere

Hydrosere or hydrarch is succession state in water. A freshly built pond can taken as a most suitable example of hydrarch succession. The various stages hydrosere can be enumerated as follows :

1. Submerged stage : In initial stages water is poor in nutrients and devoid life. The pioneers in an aquatic habitat are planktons. The phytoplanktons gro floating or suspended in water and multiply. With the death of phytoplanktons an zooplanktons, the substratum is enriched with organic matter. As water become rich in organic and mineral substances, certain rooted submerged hydrophyte make their appearance. Prominent among them are *Ceratophyllum, Potamogeton Vallisneria* and *Utricularia*, etc. By the death and decay of these plants there further enrichment of the medium. With the increase in nutrients, the level of the pond is raised and it becomes shallow.

2. Floating stage : When the water level in the pond remains only 6 to 8 deep floating plants begin to appear. These plants include *Nymphaea, Nelumbium Trapa* and *Monocharia*, etc. These have their roots rooted in the mud and their leaves freely floating at the surface. Later on, free floating plants like *Lemna Azolla* and *Wolffia* grow profusely to cover the water surface.

3. Reed-swamp stage : As the water body becomes shallow by silting and removal of water by transpiration, the environment becomes less suitable for the free floating and submerged plants. Now reed-swampy plants like *Typha, Rumex* and *Sagittaria* invade the area. The red-swamp plants built up the shores by retaining the sediment and accumulation of plant remains. Beavers, muskrats and other animals carry materials into the pond, deciduous vegetation blows in from the shore, and silt is carried in from the surrounding land. Rafts of vegetation

from the pond margin drift offshore, strand, and take root, establishing islets that grow in size until they meet and also join the shore.

4. Marsh-meadow stage : As the free water is changed to swampy land, the water plants give way to swampy plants such as sedges and rushes. As succession continues, marshy meadow becomes too dry for swampy plants and these are subsequently replaced by herbs and shrubs.

Fig. 3. Gradual succession of a pond into a forest.

5. Woodland stage : As succession continues, the soil is further built up, so that it becomes drier and is also changed chemically. In time certain smaller species of trees invade the area, taking the place of the shrubs, and eventually full-sized forest trees will dominate the scene. At the same time when the vegetation is undergoing these profound changes in the hydrarch succession, the animal life of the community is correspondingly altered. Fish, beavers and muskrats are gradually excluded and land vertebrates make their appearance.

6. Mesosere : It is an intermediate type, with moisture present in adequate amounts. The successional series is much shorter because moisture conditions are more ideal, and the initial water problems that must be resolved in a xerarch or hydrarch type of succession are non-existent. In actuality, the conditions towards which hydrarch and xerarch communities are gradually progressing are those that prevail in the mesrarch series, thus giving the later type of sequential pattern a head start.