PLANT SUCCESSION

Plant succession can be defined as the process of gradual replacement of one plant community by another plant community which is of stable type. It occurs over a period of time. The first plant community which develops in a bare area is known as **pioneer community** and the last invading community is called the **climax community**. The plant communities that develop during the succession are called the **seral communities**.

BASIC TYPES OF SUCCESSION

1. Primary succession:

The formation of ecosystem from bare rock, sand or clear glacial pool where previous life do not exist is called primary succession. In this case, the ecosystem is formed from the start. So it is a long process. It often requires thousands of years.

2. Secondary succession:

The formation of a new ecosystem after the disturbance of an existing ecosystem is called secondary succession. 'Die disturbance may be in the form of, forced fire or an abandoned farm field. The previous community leaves some mark in the form of improved soil and seeds. Therefore, secondary succession occurs more rapidly than primary succession.

On the basis of factors responsible for environment changes successions are sometimes classified as,

1. Autogenic succession:

The succession in which organisms themselves bring change in the environment during succession is called autogenic succession. The organisms cause change in the soil. These changes include accumulation of organic matter in form of humus or litter alteration of soil nutrients and change in pH of soil. The structure of the plants themselves can also change the community. For example, larger species like trees produce shade on to the developing forest floor. It destroys the light-requiring species. Shade-tolerant species-establish in the area.

2. Allogenic succession:

The succession in which external environmental factors cause change in the environment during succession is called allogenic succession. Soil erosion, leaching or the deposition of silt can changes the soil. Similarly, clays can alter the nutrient content and water relationships in the ecosystems. Animals also play an important role in allogenic changes. They act as pollinators, seed dispersers and herbivores. They can also increase nutrient content of the soil in certain areas.

DIFFERENT TYPES OF HABITATS IN WHICH SUCCESSION TAKES PLACE

- **Hydrosere**: succession occurs where water is plenty, e.g. pond.
- **Derosere**: succession occurs on a dry soil or rock.
- **Xerosere**: succession occurs on dry habitat like dry desert or bare rock
- **Psammosre**: succession which occurs on sand dunes.
- **Halosere**: succession which occurs on saline soil
- **Lithosere**: Succession on newly exposed rock surface
- **Oxylosere**: Succession on acidic soil

HYDROSERE OR HYDRARCH

It is succession occurring in the **aquatic environment**. Such a type of succession does not necessarily lead the aquatic communities toward the development of land communities.

If the body of water is large and very deep or very strong wave action and other powerful physical forces are at work, the succession results in a stable aquatic community in which any considerable further change is hardly recognizable.

Succession is recognizable only if the colonization of plant communities takes place in artificial small and shallow ponds, lakes, etc. where wave action speeds up the process by allowing the erosion of soil towards edge regions. In this way, the filling process also speeds up quickly and consequently the body of water disappears within few years time.

Fig. 7.1 illustrates the different types of vegetation at different depths in a pond; floating plants in the central region; rooted hydrophytes in shallow region, amphibious plants in the marginal mud and trees developing in dry habitat.

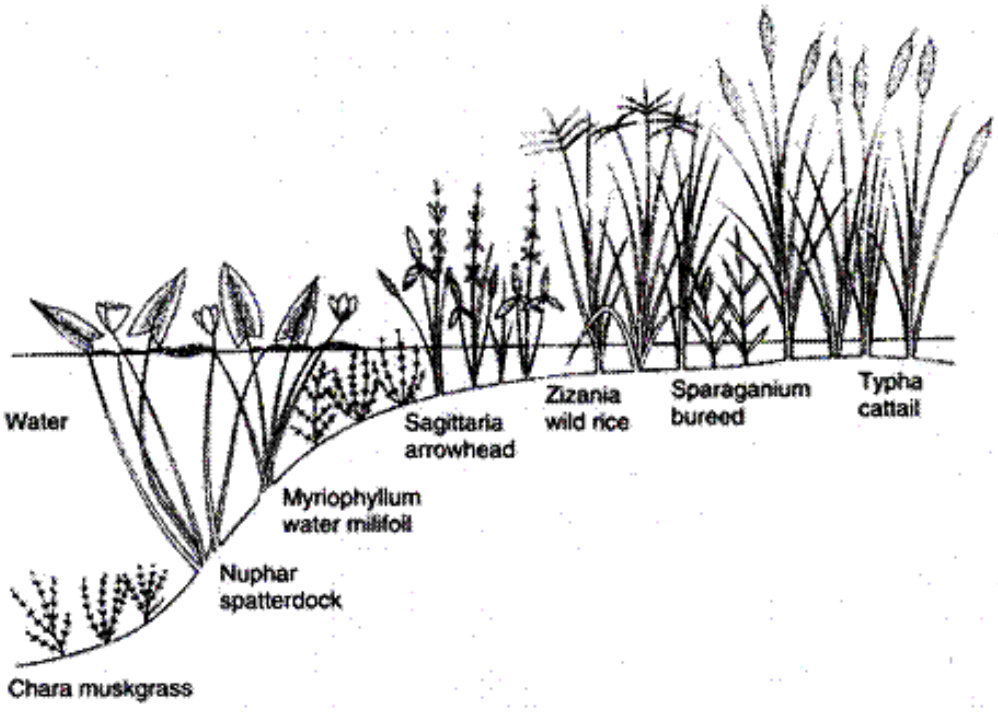


Fig. 7.1. Zonation of aquatic vegetation (hydrophytes) along a pond and along river banks. Note the changes in vegetation with water depth.

In a new and virgin pond hydrosere starts with the colonisation of **phytoplankton** and finally terminates into a **forest** (the climax community).
The process of aquatic succession completes in the following stages (Fig. 7.2):

1. Phytoplankton stage:

In the initial stage of succession algal spores are brought in the body of water. The simple forms of life like bacteria, algae and many other aquatic plants (phytoplankton) and animals (zooplankton) floating in water are the pioneer colonizers. All these organisms add large amount of organic matter and nutrients due to their various life activities and after their death, they settle at the bottom of pond to form a layer of muck.

2. Submerged stage:

The phytoplankton stage is followed by submerged plant stage. When a loose layer of mud is formed on the bottom of the pond, some rooted submerged hydrophytes begin to appear on the new substratum. The submerged aquatic vegetation develops in the regions of ponds or lakes where water depth is about 10 feet or more. The pioneers are *Elodia, Potamogeton, Myriophyllum, Ranunculus, Utricularia, Ceratophyllum, Vallisnena, Chara,* etc.

These plants form tangled mass and have marked effects upon the habitat. When these plants die their remains are deposited at the bottom of the ponds or lakes. The eroded soil particles and other transported materials are also deposited at the bottom. This gradually raises the bottom of the ponds and lakes up. As this process of stratification progresses the body of water becomes more and more shallow, consequently the habitat becomes less suited for the submerged vegetation but more favourable for other plants.

3. Floating stage:

When the depth of water reaches about 4 to 8 feet, the submerged vegetation starts disappearing from its original place and then the floating plants make their appearance gradually in that area. In the beginning the submerged and floating plants grow intermingled but in the course of time the submerged plants are replaced completely. The most tolerant species in the area are able to

reproduce and perpetuate. Their broad leaves floating on the water surface check the penetration of light to deeper layer of water.

This may be one of the main causes responsible for the death of submerged plants. Due to continuous interaction between plant communities and aquatic environment, the habitat becomes changed chemically as well as physically. More water and air borne soil and dead remains of plants are deposited at the bottom. Thus, the substratum rises up in vertical direction. Important floating plants that replace the submerged vegetation are *Nelumbmm, Trapa, Pistia, Nymphaea*, and *Limnanthemum* etc.

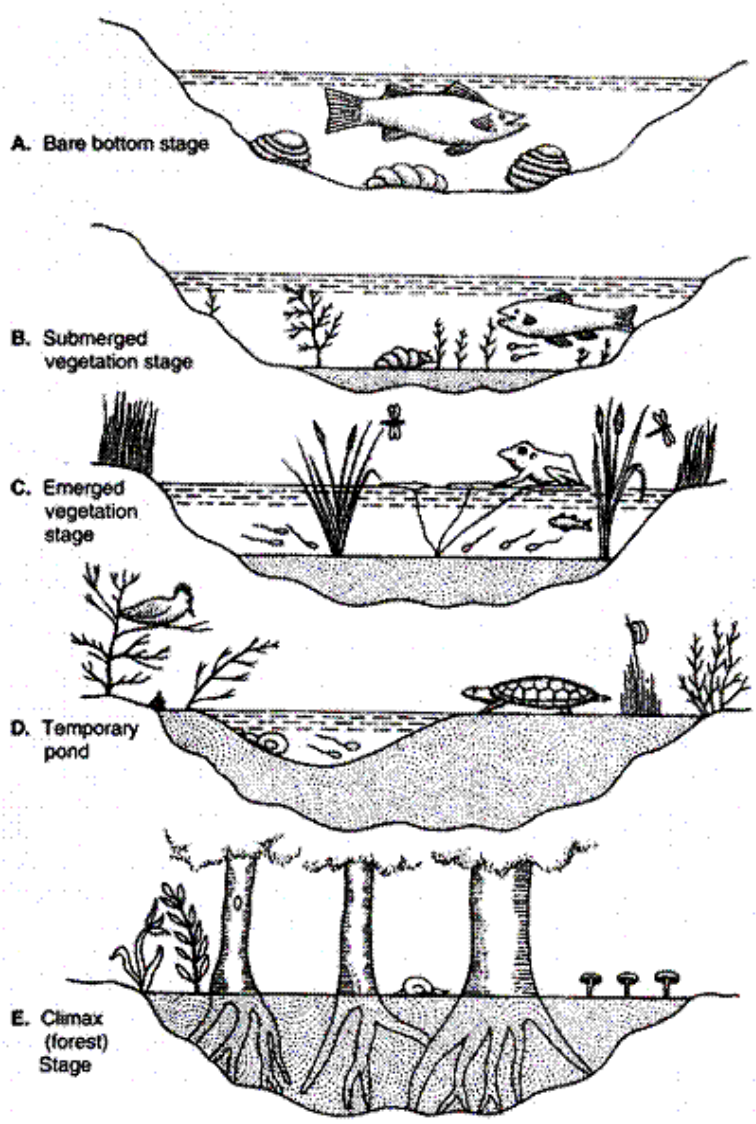


Fig. 7.2. Community succession in an open pond.

4. Reed-swamp stages:

When the ponds and lakes become too shallow (water depth one to three feet) and the habitat is changed so much that it becomes less suited to the floating plants some other plants which are well adapted to new environment will then come in .Under these conditions, the floating plants start disappearing gradually and their places are occupied by amphibious plants which can live successfully in aquatic as well as aerial environment Important examples are *Bothrioclova, Typha, Phragmites* (Reed), etc.

The foliage leaves of such plants are exposed much above the surface of water and roots are generally found either in mud or submerged in water. The foliage leaves form a cover over submerged and floating plants and thus they cut off light from the plants underneath them. Under such conditions neither submerged nor floating plants can survive. Further deposition of soil and plant debris at the bottom reduces the depth of water and makes the habitat less suitable for the pre-existing plants.

When the bottom reaches very close to the water surface many secondary species, such as those of *Polygonum, Sagittaria*, etc. make their appearance. Later, they also bring about such reactions by which the habitat becomes less suitable for most of the existing species, and consequently new successional step follows.

5. Sedge Marsh or Meadow stage:

The filling process finally results in a marshy soil which may be too dry for the plants of pre-existing community. Now the plants well adapted to new habitat begin to appear in the pre-existing community in mixed state. Important plants that are well suited to marshy habitat are the members of cyperaceae and poaceae. The species of sedge (*Carex*) and rushes (*Juncus*), species of *Themeda, Iris, Dichanthium, Eriophorum, Cymbopogon, Campanula, Mentha, Caltha, Gallium, Teucrium, Cicuta*, etc. are the first invaders of marshy area.

As these plants grow most luxuriantly in the marshes, they modify the habitats in several ways. They absorb and transpire a large quantity of water and also catch and accumulate plant debris

and wind and water borne soil particles. Consequently a dry habitat results which may be totally unfit for the growth of normal hydrophytes. Gradually the mesophytes start appearing and after some time the sedge vegetation is totally replaced by them.

6. Woodland stage:

In the beginning some shrubs and later medium sized trees form open vegetation or woodland. These plants produce more shade and absorb and transpire large quantity of water. Thus, they render the habitat drier. Shade loving herbs may also grow under the trees and shrubs. The prominent plants of woodland community are species of *Buteazon, Acacia, Cassia, Terminalia, Salix, Cephalanthus,* etc.

7. Climax forest:

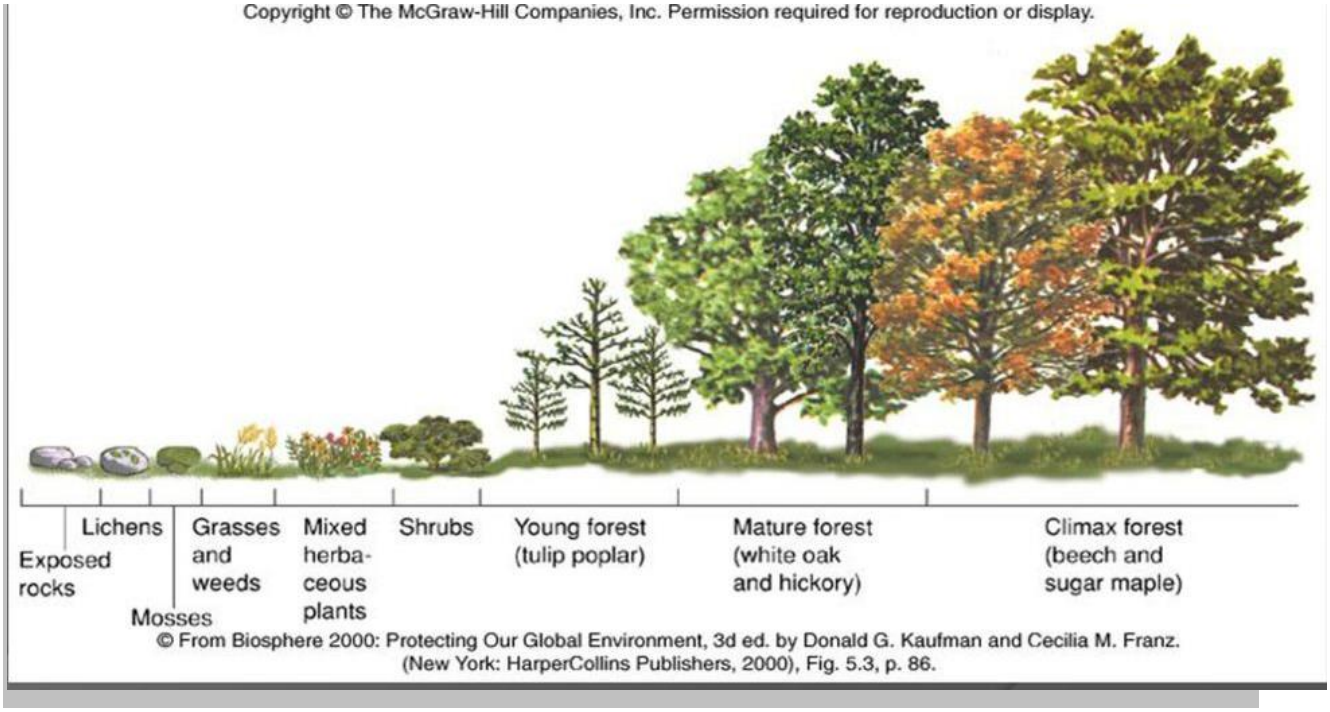
After a very long time the hydrosere may lead to the development of climax vegetation. As the level of soil is raised much above the water level by progressive accumulation of humus and soil particles, the habitat becomes more dry and certainly well aerated. In such a habitat, well adapted self-maintaining and self-reproducing, nearly stable and uniform plant community consisting mostly of woody trees develops in the form of mesophytic forest.

In the climax forest, all types of plants are met with. Herbs, shrubs, mosses and shade loving plants represent their own communities. Trees are dominant and they have control over the entire vegetation. Bacteria, fungi, and other micro-organisms are more frequently found in the climax vegetation. They react upon the habitat and make the soil rich in the organic materials. At the climax stage, a complete harmony develops between plant community and habitat.

It is now clear that whole sere is a continuously but gradually changing complex in which the changes are forced by biotic, topographic or climatic factors. It is very slow process that cannot be observed in nature. It may require thousands of years to reach the climax stage. One can however, observe the sequence of hydrosere as he moves in the lake or pond from the deepest region towards the shallower margin.

XEROSERE OR XERARCH

This is a type of succession originating on bare rock surfaces. The original substratum is deficient in water and lacks any organic matter, having only minerals in disintegrated unweathered state. The pioneers to colonise this primitive substratum are crustose type of lichens, and through a series of successive seral stages the succession finally terminates into a forest which constitutes the climax community.



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, Rinodina, Lecanora* etc. The lichen secretes carbonic acid

causing 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, Umbilicaria* 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 *Barbula* 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.

Among the animals, mites become more varied; some small spiders and springtails as well as tardigrades become associated with this secondary community.

3. Herbaceous stage:

As the mats of mosses become more extensive, more soil accumulates; much of the soil is blown in from surrounding area during windy periods. More mineral material is added to the soil as acid leaches out from the overlying vegetation and increases the depth of the mineral soil layer. Many annual weeds develop which are, later on, followed by biennial and finally perennial grasses. *Andropogon* commonly known as broom sedge becomes; dominant grass in many areas. With the influx of grasses, the fauna (animals) also becomes varied. Nematodes and larval insects, collembola, ants and mites appear in the gradually altered environment.

4. Shrub stage:

Further modification of the environment provides conditions for the germination and growth of shrubs and perennial wood plants such as *Acacia, Prosopis, Capparis, Zizyphus* etc.

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

5. Climax forest:

With the establishment of shrubs, more and more soil is formed and environment becomes increasingly humid. This favours the growth of woody trees. In the beginning, trees show stunted growth and are sparsely placed. Finally a climax forest community is established. The climax community is the last aggregation in the successional series. If the climax condition does change and no catastrophic event alters the area, the community maintains indefinitely.

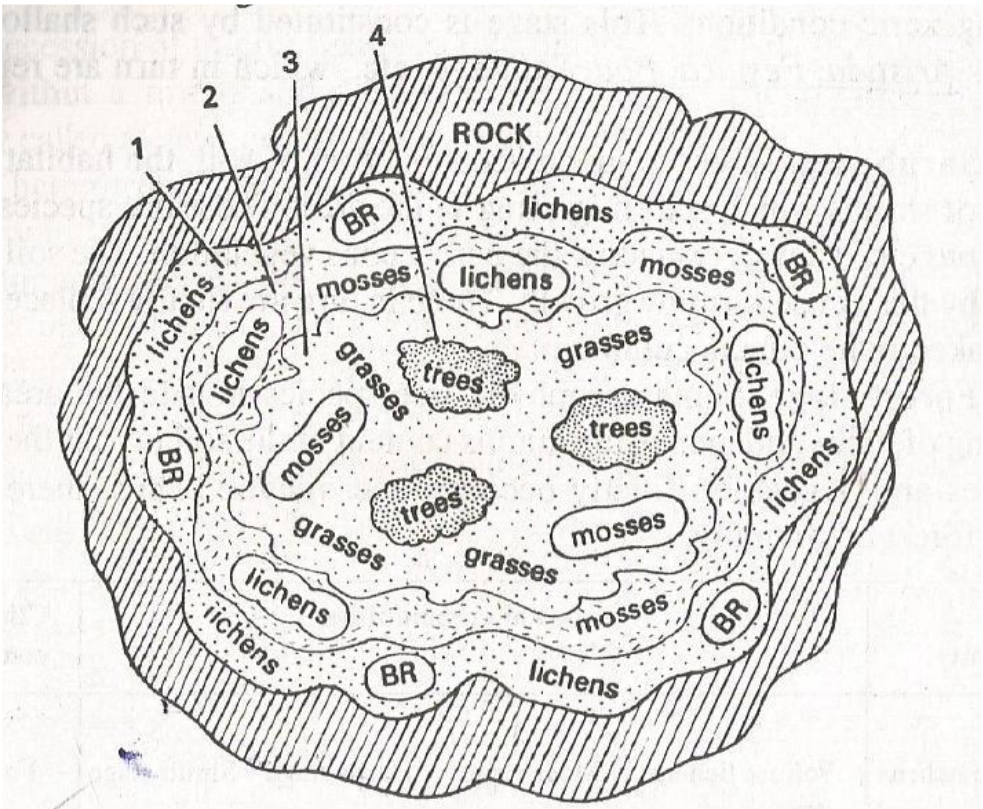


Fig. 4. Diagrammatic representation of different plant communities of a lithosere appearing on a rock. Note the vegetational zonation showing the poineer community of lichens around the outer edge and more advanced stages of trees located in the centre. The various zones from outside towards the centre of rock are (1) lichens (pioneers), (2) ring of mosses, (3) grasses (broad zone), and (4) trees (seedlings) scattered. BR- bare rock.