

3. Ecological Succession

Krishna Kumar Verma

Assistant Professor,
Department of Microbiology,
D. L. S. P. G. College,
Bilaspur (C.G.).

Akhilesh Tiwari

Assistant Professor,
Department of Biotechnology,
Pandit Shambhunath Shukla University,
Shahdol (M.P.).

Abstract:

An ecosystem develops and stabilizes through the process of ecological succession. It is a process of change in the species structure of an ecological community over time from a pioneer community that sets first in a barren land to the climax. There are two types of ecological succession i.e. primary succession and secondary succession. The ecological succession occurs in the five stages viz nudation, invasion, competition and coaction, reaction, and stabilization. It helps to recognize the seral stage of a biotic community in an area. Ecological succession is completed in five stages initial cause, ecesis cause, and stabilizing cause. Its knowledge helps us to maintain a specific biotic seral stage by interfering with the process of ecological succession and Dams are also protected by preventing ecological succession. It gives us information about the method to be used during forestation.

3.1 Definition:

Ecological succession of biotic succession is a unidirectional progressive process of change in community towards the establishment of a stable climax community on an ecological time scale. It can be simply defined as the process of the development and stabilization of an ecosystem. ("ecological succession | Definition & Facts", 2022)

3.1.1 What is Ecological Succession?

The biotic community is a dynamic community. By interaction with the biotic and abiotic community, there is a change constantly occurring in an ecosystem. These changes finally lead to a community near equilibrium with the environment and are called a climax community. A climax community is a last and stable community in an area after ecological succession while the first community inhabits an area known as a pioneer community. The intermediate community between the pioneer and climax community is called the seral community and the entire series of communities is known as sere ("ecological succession |

Definition & Facts", 2022). The reason behind the ecological succession is the dynamic change in response to the changing environmental condition so the community composition and physical structure are never stable. Ecological succession slows as the community reaches a steady equilibrium with the environment (Verma and Agarwal, n.d., 2014).

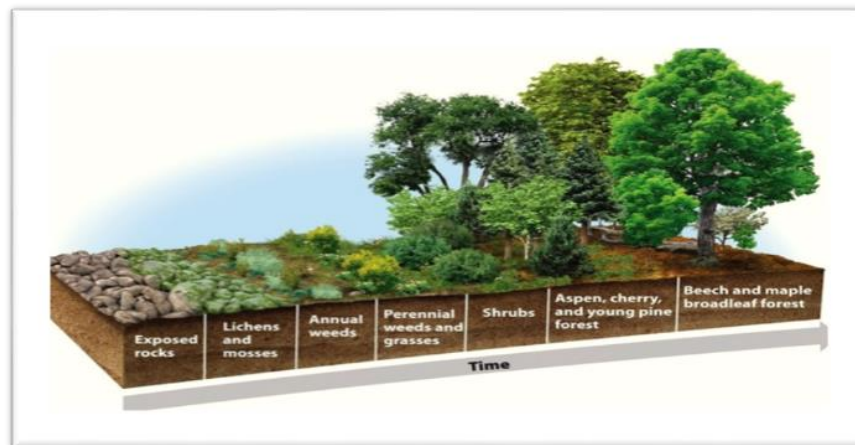


Figure 15.1: Ecological Succession

3.1.2 Characteristics of ecological succession (Shugart and Hett, 1973)

- An orderly change in community towards a stable state
- It includes changes in species structure and also an increase in species diversity.
- Increasing the organic and biomass
- Gradual increase in complexity of life forms
- It proceeds to a mesic climax community
- It is a systematic process.
- The succession takes place due to changes in the physical environment and population of the species.
- The changes that occur are directional and take place as a function of time.
- Succession works in a stabilized ecosystem.
- The population of decomposer components becomes significant.
- The changes are calculable.
- The simple food chains will be replaced by complex food chains.

3.1.3 Control of Ecological Succession:

Succession involves many complex processes and it is controlled by the following causes; (<https://www.embibe.com/exams/ecological-succession/>)

- Initiating causes – Production of bare areas
- Continuing causes – Cause successive waves of population
- Stabilizing causes – Stabilize the community

3.2 Type of Ecological Succession

- A. **Primary succession** – It begins in a bleak landscape with no flora and no living organisms. The newly exposed seafloor, igneous rocks, dunes, cooled lava sediments, newly submerged places, etc. Here succession is slower because there is no soil and the conditions are too hostile to sustain life. Depending on the substratum and environment, developing a biotic community can take anything from a few hundred to a thousand years (McIntosh, 1985; Connell and Slatyer, 1977)
- B. **Secondary succession** – It begins in places where all of the living organisms that ever existed have vanished. Because there is some soil or sediment present, succession is faster. Forest fires, flooded lands, landslides, earthquakes, drought, overgrazed areas, storms, and other natural disasters, can destroy the previous community. Following such destruction, the natural succession process will begin again under new environmental conditions. A grassland takes 50–100 years to mature, while a forest takes 100–200 years (McIntosh, 1985; Connell and Slatyer, 1977).

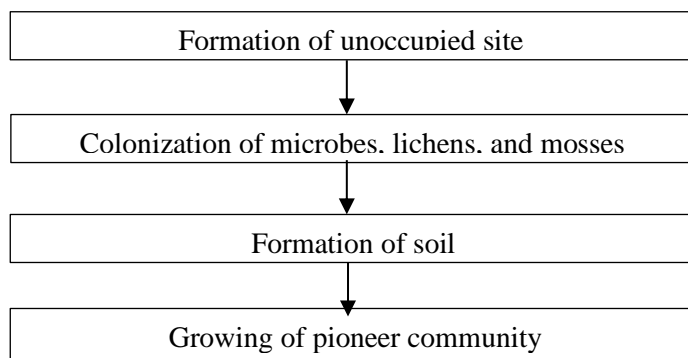


Figure 15.2: Steps Involved in Primary Succession

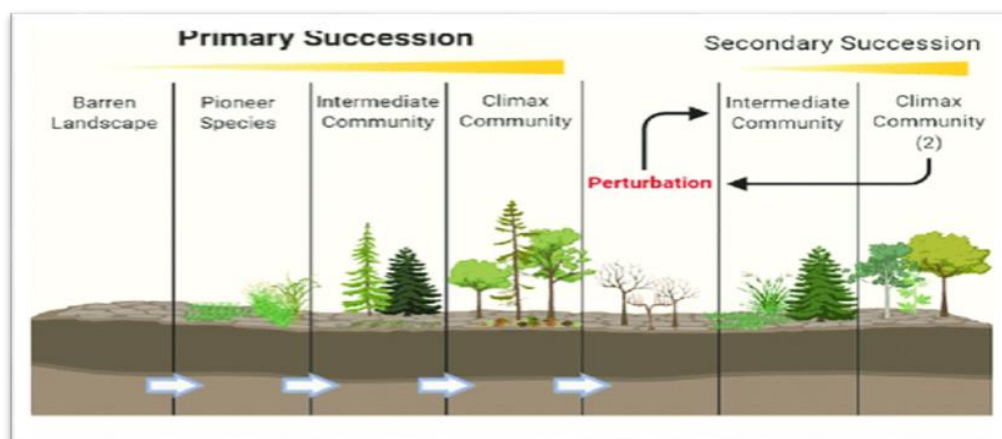


Figure 15.3: Primary and Secondary Succession

Based on successive changes in nutritional and energy content succession is sometimes classified as; (<https://www.embibe.com/exams/ecological-succession/>; Verma and Agarwal, n.d., 2014).

- a. **Autotrophic succession** –starts in an inorganic environment where the energy flow is maintained indefinitely. It is characterized by the dominance of autotrophic organisms.
- b. **Heterotrophic succession** –starts in an organic environment where the energy flow is maintained indefinitely. It is characterized by the dominance of heterotrophic organisms.

Table 3.1: Some other types of succession are given above

Autogenic succession	Allogenic succession	Progressive succession	Retrogressive succession
Self-driven	Not self-driven	Self-driven	Self-driven
Resulting from the interaction between organisms and their environment	Resulting from the interaction between organisms and their environment	Take place from simple to complex and several kinds of forms	Take place from complex to simple and contains less biomass over time
Changes brought by the organisms themselves	changes brought in the habitat by external organisms themselves	Change from grassland community to the forest community	Change from forest community to grassland community

Cyclic Succession: It's a pattern in which the ecosystem's structure changes on a cyclic basis inside an established community.

3.2.1 Types of Successional Communities

(<https://www.embibe.com/exams/ecological-succession/>; Verma and Agarwal, n.d., 2014)

(A) **Pioneer community** is the one that **sets first in a barren area**. Lichens on rocks, phytoplankton, and zooplankton in ponds are examples of pioneer communities. They survive in the worst conditions.

(B) **Climax community is the last** in biotic succession, a climax community is a generally stable community that is in close equilibrium with the surrounding environment. Forests are an example of a climax community.

(C) **Transitional or seral communities** are the ones that **follow the pioneer community**. Bryophytes, herbs, and shrubs in exposure, as well as submerged, floating, and other pond plants, are examples of **seral communities**. They make the greatest contribution to the formation of a stable community. Sere refers to the entire sequence of communities that occur in biotic succession.

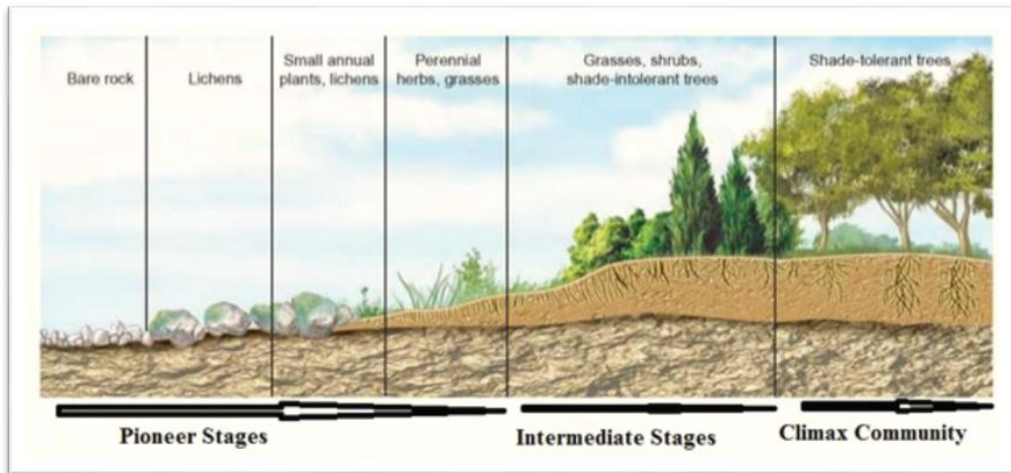


Figure 3.6: Types of Successional Communities

3.2.2 Types of seral community

("Ecological Succession: Definition, Types & Examples", 2022)

- a. **Xerosere or Xerarch succession** – When succession occurs in dry environments such as a rock (lithosere), sand (psammosere), and saline conditions (halo sere).
- b. **Hydrosere or Hydrarchsuccession** – When succession starts in the **aquatic habitat** where water is plenty and progresses from hydric to mesic conditions.

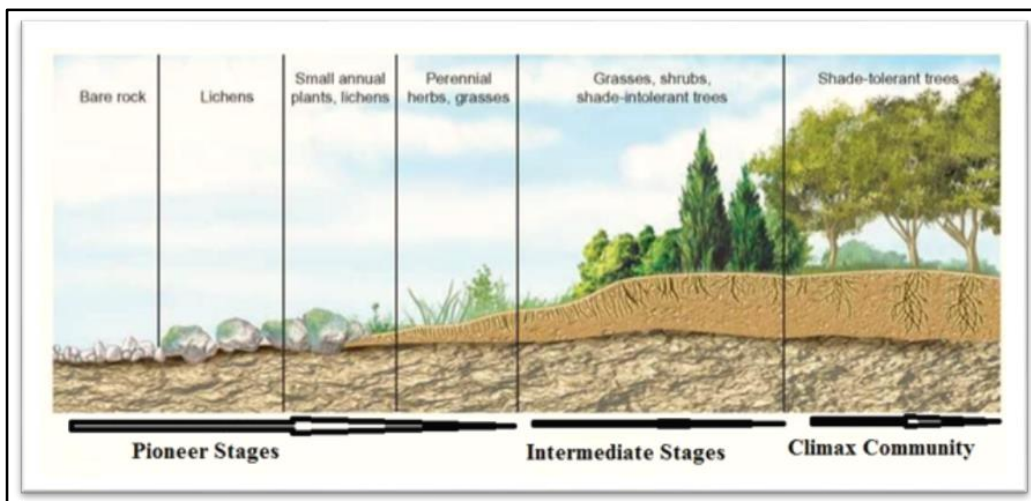


Figure 3.7: Xerarch Succession

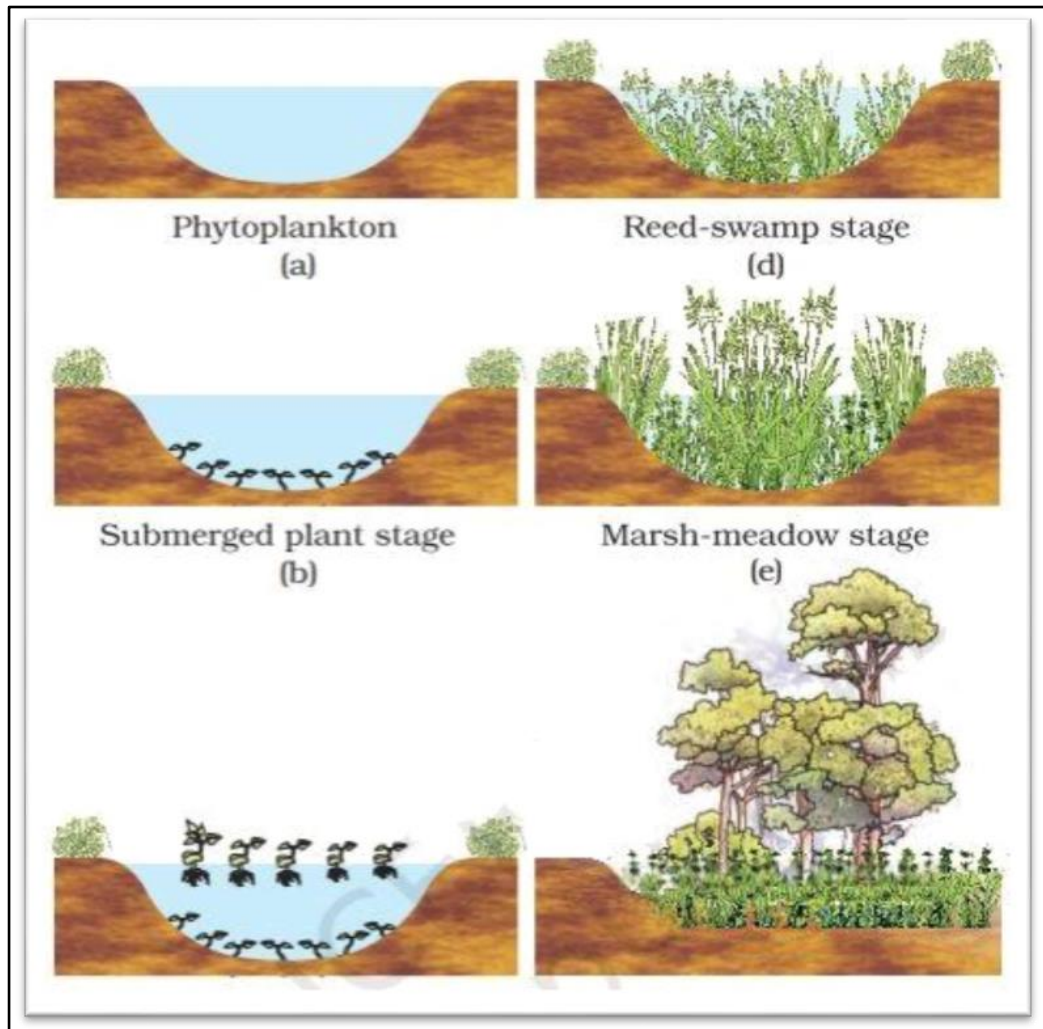


Figure 3.8: Hydrarch Succession

3.2.3 Types of Climax Community (Whitmore, 1982)

- a. **Climatic climax** – Determined by the general climate of the region.
- b. **Edaphic climax** - Determined by topography and local microclimate of the region.
- c. **Sub climax** – The stage in succession just preceding the climatic climax.
- d. **Disclimax** – When a stable community (not the climatic or an edaphic) is maintained by a man with his domestic animals.
- e. **Pre-climax and post-climax** – in pre-climax life forms are lower than those in the expected climatic climax but in post-climax life forms higher than those in the expected climatic climax.

Mechanism of Ecological Succession (Whitmore, 1982; Pickett *et al.*, 1987)

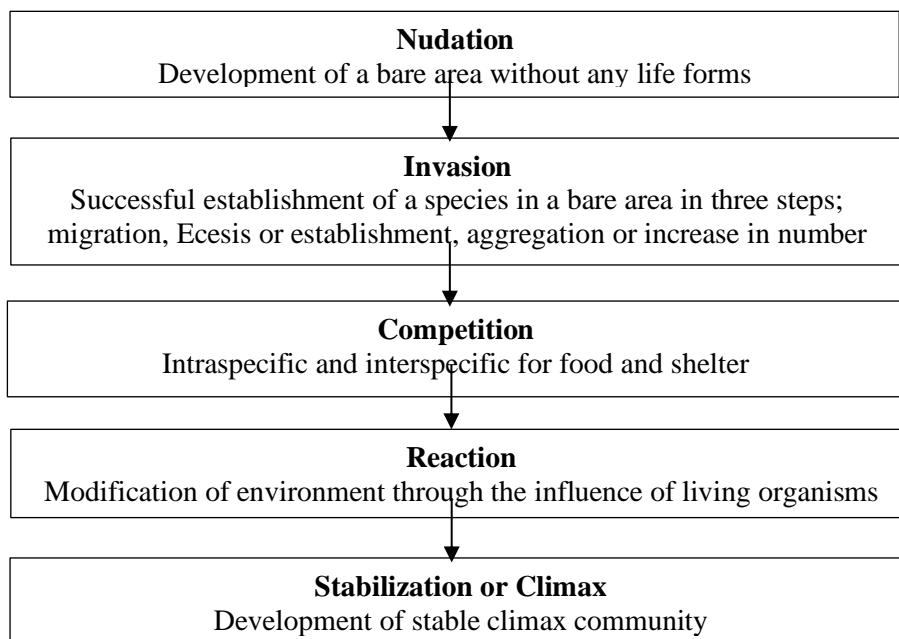


Figure 3.9: Mechanism of Ecological Succession

The examples of ecological succession are as follows:

(A) Surtsey, a volcanic island off the coast of Iceland, is a popular tourist destination. This island was formed in 1963 as a result of the volcano's eruptions. The earth was largely rocky after the eruption. On the rock, fungi and mold began to develop. These began to break down the rock, resulting in the formation of soil.

The little grasses will then begin to take root and thrive. Following that, smaller shrubs emerge. As larger plants grew, little burrowing animals moved in to disturb the soil. Trees begin to take root and grow where there was only rock after a few years (Huston and Smith, 1987).

(B) Secondary succession can be seen in tropical forests, which were destroyed for timber and agricultural purposes. The reestablishment of these communities occurred at varied rates, and it took several years for a village to be entirely restored (Huston and Smith, 1987).

3.3 Significance of Ecological Succession:

- Its knowledge helps in maintaining a specific biotic seral stage by interfering with the process of ecological succession.
- Dams are protected by preventing siltation and ecological succession.
- It gives information about the techniques to be used during reforestation and afforestation.

The knowledge of biotic succession is used to prevent the growth of superiors in an area and control the growth of one or more species.

3.4 References:

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