Ecological Succession

Ecological Succession Definition: It is a series of predictable changes of growth that occur in a community over time in order to reach stability (climax community).

Types of Succession

After a disaster, succession helps an ecosystem recover. Ecologists recognize two main types of ecological succession:

1. Primary succession
2. Secondary succession

Primary Succession: series of changes that occur in an area where no ecosystem previously existed. It is very slow process due to lack of soil. The plants which colonize first in a barren area is called **pioneer species** or **primary community** or **primary colonies**. Generally, Primary succession takes a very long time for the occurrence in any region.

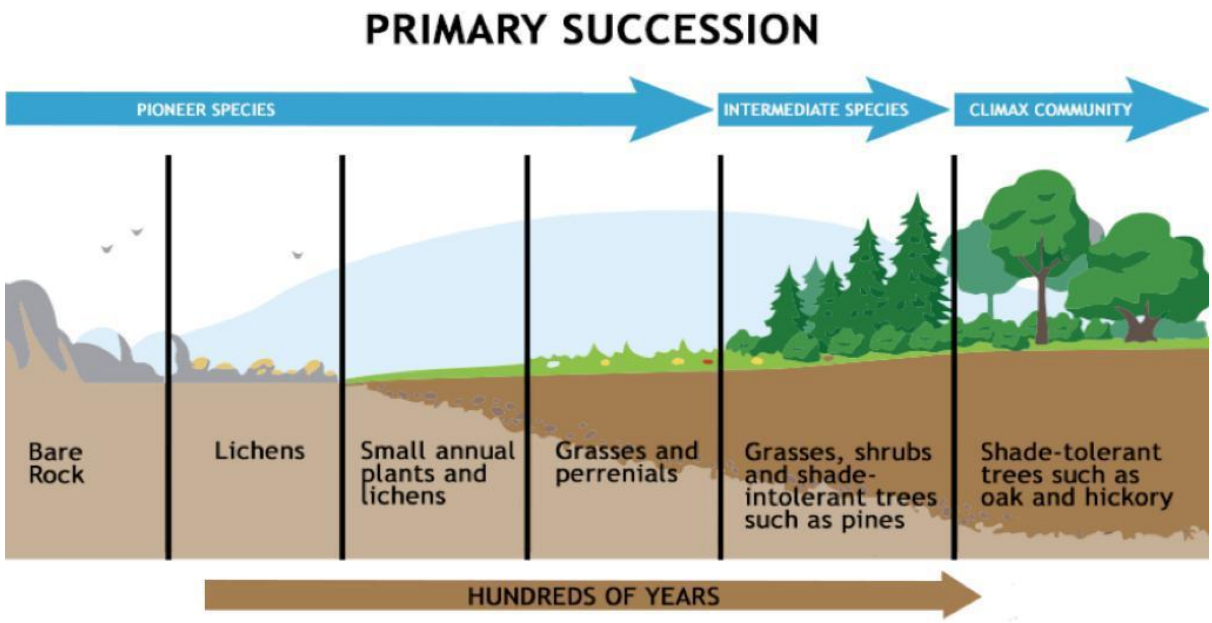
Example: Microbes, Lichen, Mosses.

How Does Ecological Succession Occur?

The formation of new land (cooling of lava, breakdown of rock by lichens, melting of glacier to expose land)

Example1: An area might be a new island formed by the volcano eruption.
Example 2: An area of rock uncovered by a melting sheet of ice.

The first species to populate the area are called **Pioneer Species**. Lichens and mosses – carried by the wind or water. After the lichens create cracks in the rocks, mosses begin to grow in the cracks. The moss further breaks down the rock helping to form soil. Pioneer species create soil in primary succession. Soil is a thin layer that covers the land. Soil goes down into the ground a short way. Soil is more than rock particles. It includes all the living things and the materials they make or change. After years and years, the soil layer increases in thickness and harbors many nutrients and beneficial bacteria that are required to support advanced plant life. Herbs and shrubs follow the lichens and mosses. Then pine trees and aspens are next. The Climax community are the birches and spruces.



Stages of Succession:

Colonization: of bare rock, tiny seedless plants like mosses, and lichens, "pioneer species"

Early: plants typically small with short lifecycles (annuals), rapid seed dispersal, "environmental stabilizers"

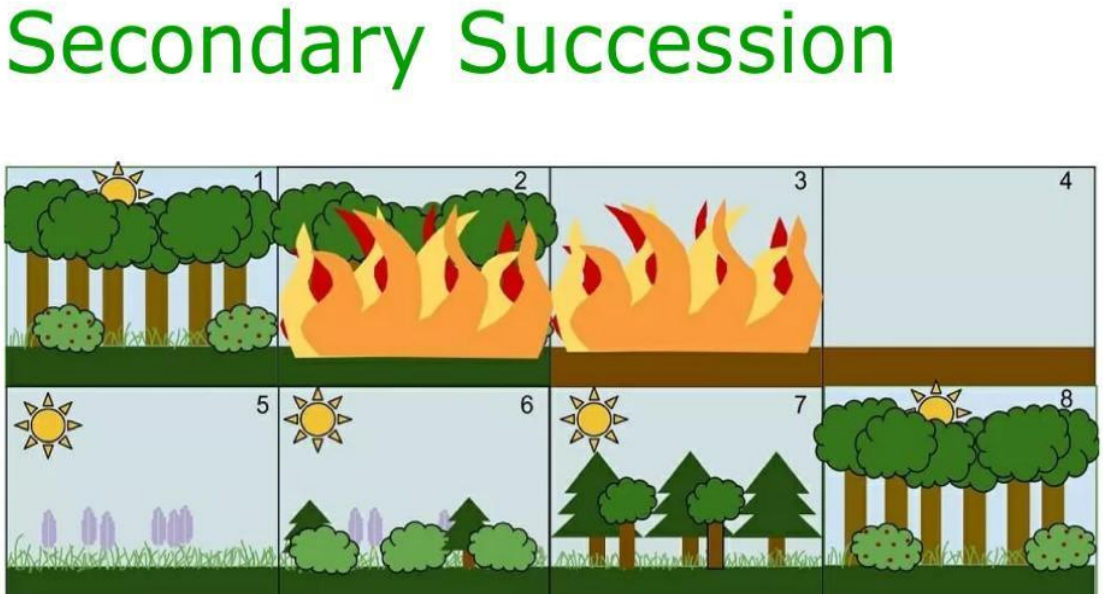
Middle: plants typically longer lived, slower seed dispersal (herbs, shrubs, perennials)

Late: plant species are those associated with older, more mature ecosystem-largest vegetation (trees)

"**Climax Community**" mature forest in this case (but varies by biome)

Secondary Succession: the series of changes that occur after a disturbance in an existing ecosystem. Secondary succession restores the ecosystem to a state in which equilibrium can be maintained and occurs more rapidly than primary succession. **Pioneer species** comes in first species of plant to arrive after a disturbance. Generally are plants that grow quickly and produce many seeds (weeds). e.g., in a plowed field or a clear-cut forest Pioneer Community. The pioneer community is made up of grasses. Insects, small mammals and reptiles make their home here. If the soil has been disturbed, weeds are the first plants to grow. They secure the soil. Shrubs and bushes begin to grow. Other mammals, such as rabbits and birds, join the developing community. A climax community of trees can support a wide variety of larger mammals such as foxes and badgers.

Climax Community this is the last stage of succession. These are plants that can reproduce successfully beneath their own shade and can maintain the community indefinitely if conditions don't change.



What is the main difference between primary and secondary succession?

Primary Succession	Secondary Succession
Succession takes place on barren area	Occurs in an area which has been denuded recently
Serial stages are many	Serial stages are few
Rate of succession is very slow	Rate of succession is fast
Soil is absent at the time of beginning of primary succession	Soil is present in the area where secondary succession begins
Pioneer species come from outside environment	Pioneer species develop from existing environment
Begins as a result of a volcano or glacier	Begins after a fire, flood
Primary Succession takes long time for completion, 1000 years or more	Secondary Succession takes less time for completion, 50-200 years or more
e.g. forest that grow in barren land, cooled lava	e.g. Trees growing in on a burnt or cut forests, Abandoned farm

Characteristics of ecological succession

1. It is a systematic process which causes changes in specific structure of plant community.

2. It is resultant of changes of abiotic and biotic factors.

3. It transforms unstable community into a stable community.

4. Gradual progression in species diversity, total biomass, niche specialization, and humus content of soil takes place.

5. It progresses from simple food chain to complex food web.

6. It modifies the lower and simple life form to the higher life forms.

7. It creates inter-dependence of plants and animals.

Characteristics of Climax Community:

1. A divers, stable community.

2. Usually the final community in succession.

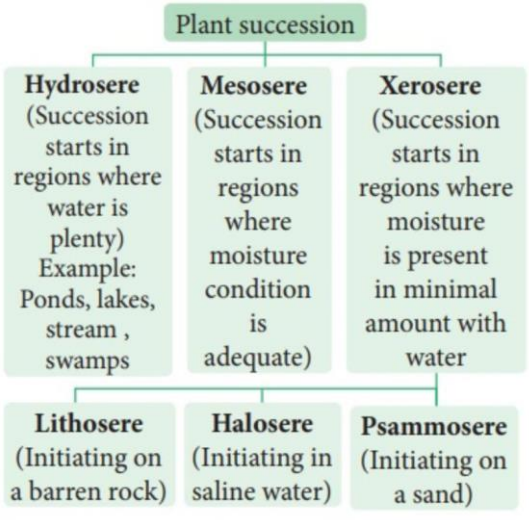
3. The vegetation is tolerant of environmental conditions.

5. It has a wide diversity of species and very complex food chains.

6. Individuals in the climax stage are replaced by others of the same kind.

7. It is an index of climate of the area.

Classification of succession



Hydrosere

The succession in a freshwater ecosystem is also referred to as hydrosere. Succession in a pond, begins with colonization of the pioneers like phytoplankton and finally ends with the formation of climax community like forest stage. It includes the following stages.

1. Phytoplankton stage - It is the first stage of succession consisting of the pioneer community like blue green algae, green algae, diatoms, bacteria, etc., The colonization of these organisms enrich the amount of organic matter and nutrients of pond due to their life activities and death. This favors the development of the next serial stages.

2. Submerged plant stage - As the result of death and decomposition of planktons, silt brought from land by rain water, lead to a loose mud formation at the bottom of the pond. Hence, the rooted submerged hydrophytes begin to appear on the new substratum. Example: *Chara, Utricularia, Vallisneria* and *Hydrilla* etc. The death and decay of these plants will build up the substratum of pond to become shallow. Therefore, this habitat now replaces another group of plants which are of floating type.

3. Submerged free floating stage - During this stage, the depth of the pond will become almost 2-5 feet. Hence, the rooted hydrophytic plants and with floating large leaves start colonising the pond. Example: Rooted floating plants like *Nelumbo, Nymphaea* and *Trapa*. Some free floating species like *Azolla, Lemna, Wolffia* and *Pistia* are also present in this stage. By death and decomposition of these plants, further the pond becomes more shallow. Due to this reason, floating plant species is gradually replaced by another species which makes new seral stage.

4. Reed-swamp stage - It is also called an amphibious stage. During this stage, rooted floating plants are replaced by plants which can live successfully in aquatic as well as aerial environment. Example: *Typha, Phragmites, Sagittaria* and *Scirpus* etc. At the end of this stage, water level is very much reduced, making it unsuitable for the continuous growth of amphibious plants.

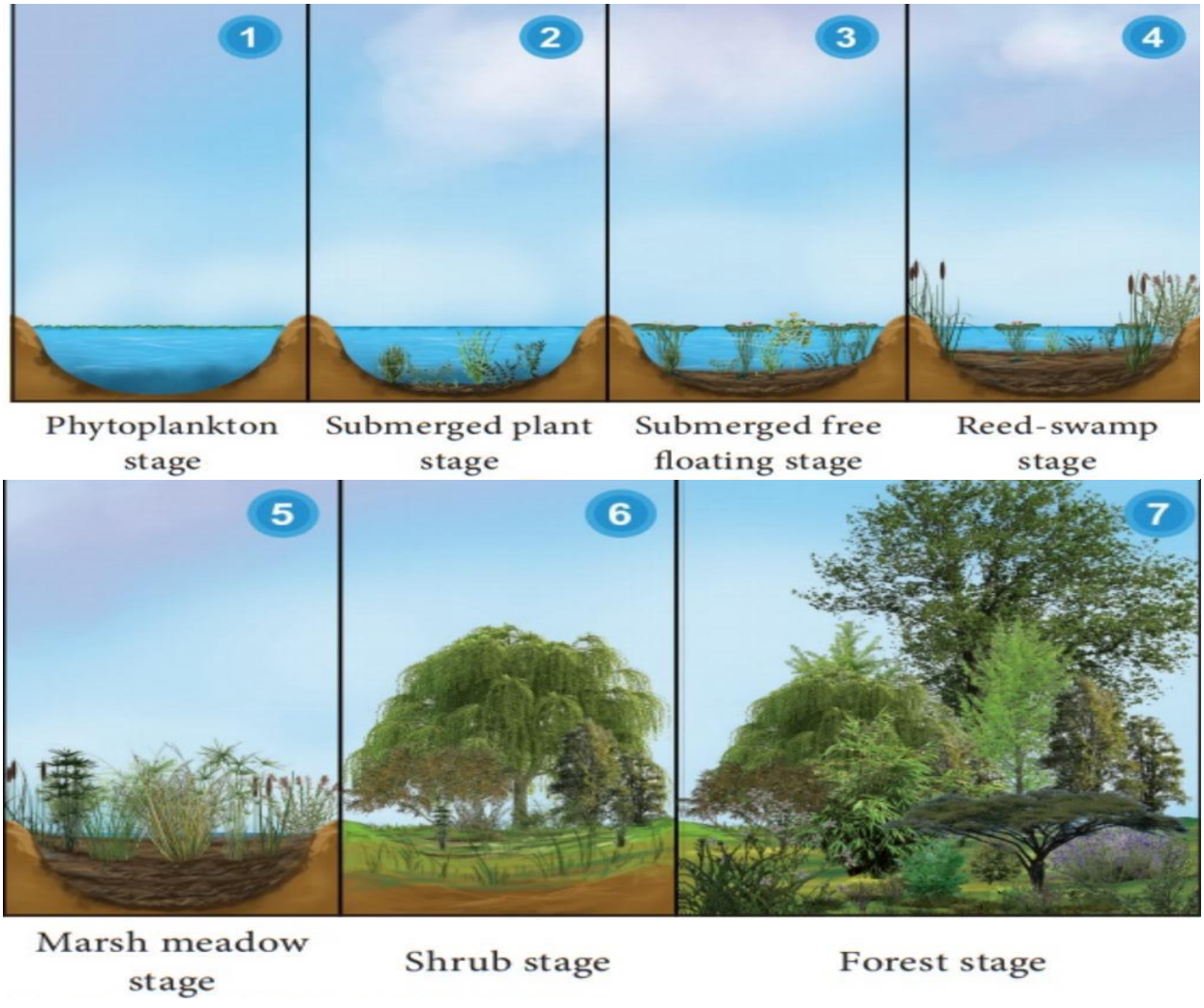
5. Marsh meadow stage - When the pond becomes swallowed due to decreasing water level, species of Cyperaceae and Poaceae such as *Carex, Juncus, Cyperus* and *Eleocharis* colonise the area. They form a mat-like vegetation with

the help of their much branched root system. This leads to an absorption and loss of large quantity of water. At the end of this stage, the soil becomes dry and the marshy vegetation disappears gradually and leads to shurb stage.

6. Shrub stage - As the disappearance of marshy vegetation continues, soil becomes dry. Hence, these areas are now invaded by terrestrial plants like shrubs (*Salix* and *Cornus*) and trees (*Populus* and *Alnus*).

These plants absorb large quantity of water and make the habitat dry. Further, the accumulation of humus with a rich flora of microorganisms produce minerals in the soil, ultimately favouring the arrival of new tree species in the area.

7. Forest stage - It is the climax community of hydrosere. A variety of trees invade the area and develop any one of the diverse type of vegetation. Example:Temperate mixed forest (*Ulmus,Acer* and *Quercus*), Tropical rain forest (*Artocarpus* and *Cinnamomum*) and Tropical deciduous forest (*Bamboo* and *Tectona*).



How do species replace one another in ecological succession?

Ecologists have identified three factors that affect how and what rate succession occurs:

1. Facilitation

Facilitation occurs when one set of species makes an area suitable for species with different niche requirements and is especially important in the soil - building stages of primary succession For example , as lichens and mosses gradually build up soil on a rock in primary succession , herbs and grasses can colonize the site . Similarly , plants such as legumes add nitrogen to the soil , making it more suitable for other plants found at later stages of succession

2. inhibition

in which early species hinder the establishment and growth of other species . Inhibition often occurs when plants release toxic chemicals that reduce competition from other plants (interference competition) . Succession then can proceed only when a fire , bulldozer , or other disturbance removes most of inhibiting species .

3. tolerance

late successional plants are largely unaffected by plants at earlier stages of succession.

Characteristic	**Immature ecological succession**	**Mature ecological succession**
Plant size	small	large
Species diversity	low	high
Trophic structure	Mostly producers , few decomposers	Mixture of producers, consumers , and decomposers
Ecological niches	Few , mostly generalized	Many , mostly specialized .
Community organization(number of interconnecting links)	low	high
Ecosystem Function		
Biomass	low	high
Net primary productivity	high	low
Food chains and webs	low	Complex , dominated by decomposers
Efficiency of nutrient recycling	low	high
Efficiency of energy use	low	high