PUC Ist year - Semester – II

Unit VI Ecology and Environment

Module No. 35. Ecological Succession

An ecological succession includes a series of orderly, progressive and predictable changes that a biotic community undergoes in its development towards a stable or climax condition.

According to Smith (1966),

"Ecological *succession is an orderly and progressive replacement of one community by another until a comparatively stable community occupies the area".*

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 (i.e., area devoid of organisms, it is called Primary succession.

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. For example, succession in a forest area where vegetation has been devastated by fire or by flood.

On the basis of successive changes in nutritional and energy contents, successions are classified into autotrophic succession and

heterotrophic succession. The autotrophic succession is characterised by early and continued dominance of autotrophic organisms like green plants. It begins in a predominantly inorganic environment and the energy flow is maintained indefinitely. The heterotrophic succession is characterised by an early dominance of heterotrophs i.e., fungi, bacteria, and animals. This begins in a predominantly organic environment and there is a progressive decline in the energy content.

Trends in Succession:

An ecological succession proceed along the following lines

1. A continuous change in the kinds of plants and animals towards a state of stability.
2. The diversity of species tends to increase with succession.
3. An increase in the organic matter and biomass supported by available energy flow in autotrophic succession.
4. Decrease in net community production or animal yield.
5. In an area, the plant and animal communities undergo succession side by side. It is so because vegetational changes in turn affect the food and shelter for various types of animals.
6. Biotic succession is according to specific laws and towards particular direction so future seral communities can be predicted.

Causes of succession:

There are three types of causes for succession.

1. **Initial or initiating causes:** These may be climatic factors (such as erosion and deposits, wind, Drought, Snow, Fire etc) or may be biotic factors (Such as various activities of organisms). These causes produce the bare area or destroy the existing populations in an area.
2. **Continuing causes:** These are the process as migration, aggregation, competition, reaction etc. which cause successive waves of populations.
3. **Stabilising Causes:** These cause the stabilization of the community. Climate of the area is the chief cause of stabilization.

General Process of succession:-

The general process of succession takes place by the following steps:

1. **Nudation:** It involves the development of a bare area without any form of life. The cause of nudation may be topographic (eg. Soil erosion, land slide, volcanic eruption etc) or climatic (eg. Glaciers, hails, storms, fire etc) or biotic (eg. Epidemic, human activities etc.). Man is also responsible for destruction of forests, grasslands for industry, agriculture, housing etc. which destroy the population.

Invasion:- This is the successful establishment of a species, in a bare area. It involves three steps.

1. **Migration:** With the help of wind, water the seeds, spores of the species migrated to the bare area. These migrants are called as pioneers.

2. **Establishment (Ecesis):** The process by which the migrants establish themselves in the new place is known as Ecesis. The migrant tries to adjust with the conditions prevailing there. In plants after migration seeds germinate, seedlings grow and adults start to reproduce. Only a few of them are capable of doing this under primitive harsh conditions and thus most of them disappear. By this process the individuals of species become established in this new area.

3. **Aggregation:** After establishment, as a result of reproduction the individuals of one or more species increase in number and this process is called aggregation.

Competition and Coaction:

Once the species number increases by reproduction in a limited place, there develops competition (inter specific and intra specific), for space, food and reproduction. Individuals of a species affect each other's life in various ways and this is called coaction. The species, if unable to compete with other species, if present, would be discarded.

Reaction:-

This is the most important stage in succession. The mechanism of the modification of the environment through the influence of living organisms is called reaction. As a result of reactions, changes takes place in soil, water, light condition, temperature etc of the environment. The changed environment becomes unsuitable for the growth and spread of existing organisms, so it is

sooner or later replaced by another community. By their death and decay, the pioneers increase organic matter, moisture and nitrogen content of the soil. This enriched soil now becomes suitable for the growth of the next group of invaders. These are called as seral communities and constitute one seral stage in succession. The different seral stages of succession together constitute a sere. These invaders tolerate the physical conditions, compete successfully with the species and also defend themselves against new invaders. But, by their activities, these serals again modify the environment, this changed environment becomes unsuitable for the growth, and a new group of plants and animals invade the environment and the process is repeated.

Climax Community (stabilization):

In this way, the development of communities progresses and the number of new arrivals at each stage goes on decreasing. Finally there occurs a stage in the process when the final terminal community becomes more or less stabilised for a longer period of time and it can maintain itself in equilibrium with the climate of the area. This final community is not replaced and is known as climax community and the final stage is called climax stage.

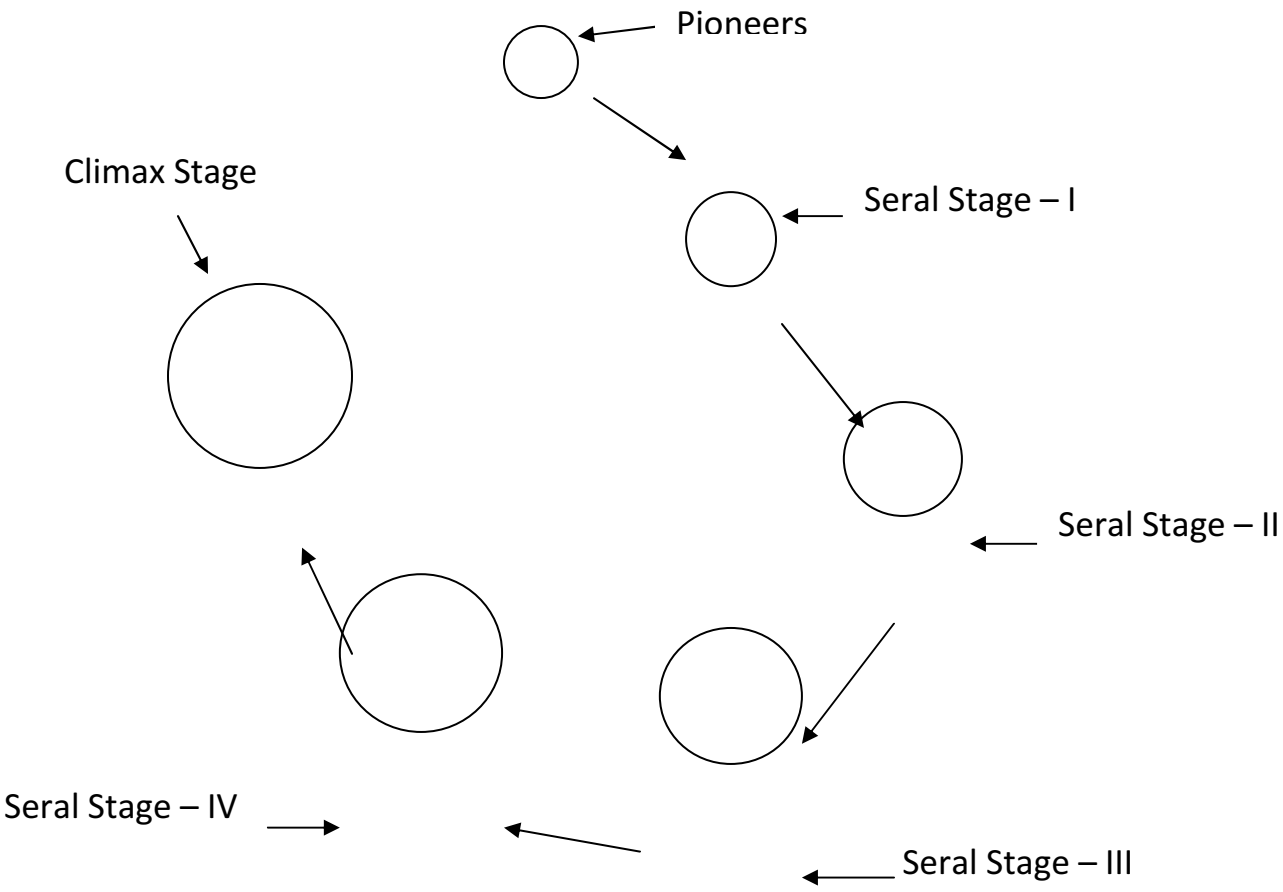

Fig:- A Diagramatic representation of ecological succession

Example: Succession which begin in watery habitats like ponds, lakes etc are called Hydrarch and different stages of development of hydrarch constitute hydroseres.

Stages of Hydrosere:

1) **Pioneer Stage:** It is the first step in succession. It is formed by the germination of encysted spores in the newly formed water body and these spores reaches the water body through wind or animals. This stage mainly

includes diatoms, Phytoflagelletes, Cyano bacterial and green algal cells and animals like Paramecium, Amoeba, Vorticella etc. and zooplanktons. Death and decomposition of planktons produce organic matter which mixes with silt and form a soft mud at the bottom of pond which favours the growth of next seral stage.

2) **Rooted - Submerged Stage:** This stage includes Hydrilla, Utricularia, Pond weeds, vallisneria, myriophyllum, Elodea, Chara etc.,. These are all rooted plants. The plants are entirely submerged. Due to death and decay of the plants, sand and silt deposited around the plants forming the humus. As a result the water becomes shallow and the habitat becomes unsuitable for submerged plants, which inturn are replaced by floating plants.

3) **Rooted – floating Stage:**

When the water level in the pond remains only 6 to 8 feet deep, floating plants begin to appear. This stage includes rooted plants with floating leaves such as hydrophytes like *Nymphaea, Limnanthemum, Aponogeton, Trapa, manochoria, pistia, Azolla* etc. The organic matter formed by the death and decomposition of these plants increases the level of the substratum. Finally the floating species disappear.

4) **Reed – Swamp Stage:** This stage occurs where the water is 1 – 4 feet deep. This stage includes species like *Sagittaria, Phregmites, Typha, Scirpus etc.* These have well developed rhizomes and form a dense vegetation. The

organic matter added by the death of these plants further raises the substratum so the pond becomes unsuitable for the growth of these plants.

5) **Marsh – Meadow Stage:** This stage includes hydrophytes or water loving plants. This stage is formed by species like *Juncus, Cyperus, Carex, Eleocharis, Diochanthium, Caltha, Polygonum,* etc. which form a mat – like vegetation towards the centre of the pond. These species disappears gradually and these are subsequently replaced by herbs and shrubs.

6) **Woodland Stage:** In this stage, first the peripheral part of the area is invaded by some shrubby plants which can tolerate bright sunlight as well as waterlogged soil around their roots eg:- *Cornus, Celphalanthus* thus etc., Next to invade are trees capable of tolerating bright sunlight eg:- *Poplus, Almus etc.* These further lower the water table by their transpiration and build up more soil. These plants by their reactions make the soil unsuitable for themselves and more suitable for shade enduring herbs which grow among the trees and shrubs.

7) **Forest Stage or Climax Stage:** It is climax community and this stage represents the final stage of hydrarch. It includes mixed forest of *Alder, Willow, Cotton – wood, Ulmus, Fraxinus, Quercus* etc. After a few generations a pure forest of oaks and hickries may develop.

Short Answer Questions

1. What is pioneer community
2. What is heterotrophic succession
3. What is Climax community
4. Explain the process of Nudation
5. Explain the trends in succession
6. What are the causes of succession

Long Answer Questions

1. Explain the process of Ecological succession.
2. Explain the different stages found in Hydrarch.

Multiple Choice Questions

1. The nature of Climax Community will depend upon
   A) **Climate**
   B) Water
   C) Soil fertility
   D) All

2. Series of changes on previously barren area is
   A) Sere
   B) Climax Community

C) **Primary Succession**

D) Secondary Succession

3. A community that starts the process of succession in a habitat is called

A) Pioneer Community

B) Seral Community

C) Climax Community

D) Ecotonel Community

4. The ultimate seral community appears in an area as a result of

A) Ecesis

B) Nudation

C) Invasion

D) Reaction

5. The direction of succession is

A) Predictable

B) Unpredictable

C) Haphazard

D) Always Changing

6. The invasion of a community in succession involves

A) Ecesis, aggregation and competition

B) Migration, aggregation and competition

C) Aggregation, competition and coactions

D) Migration, ecesis and aggregation

7. The climatic factor responsible for the initiation of succession is
   A) Erosion
   B) Wind
   C) Fire
   D) All of these

8. Mark the climatic cause for the initiation of Succession
   A) Micro organisms
   B) Fire
   C) Epidemic
   D) Land slide

9. The pioneer in a hydro sere
   A) Diatoms
   B) Najas
   C) Zanichellia
   D) Lemna

10. In a hydrosere, the submerged stage is followed by
    A) Phytoplanktons
    B) Reed – Swamps
    C) Sedges
    D) Floating plants

11. Primary Succession occurs in

A) Previously unoccupied area

B) Previously occupied area

C) Both of the above

D) None of the above

12. In a hydrosere the plants like *Carex, Cyperus, and Juncus* appear just after a community comprising:

A) *Lemna, Wolffia, Spirodela*

B) *Nuphar, Nelumbo, Victoria*

C) *Scirpus, Typha, Sagittaria*

D) *Najas, Eeratophyllum, Eloder*

13. Some of the stages in the hydrarch are labelled as

A) Marsh Meadow stage

B) Reed Swamp stage

C) Rooted Submerged stage

D) Pioneer stage

E) Rooted Floating stage

Identify the choice that represents the correct sequence of these stages

A) D, C, E, B and A

B) C, E, A, B, and D

C) B, D, C, A and E

D) D, E, C, B, and A