C9T,unit-7;Plant communities, 4th sem hons , Santosh Murmu.

- Concept of Ecological Amplitude
- Habitat and niche
- Characters: analytical and synthetic
- Ecotone and edge effect
- Dynamics:Succession-processes,types;
- Climax concepts

Ecological amplitude

- Ecological amplitude is the range of habitats, often dependent on and defined by elevation, within which a certain species has the ability to survive. In the Klamath Mountains there are two species of pines that define the highest elevations–growing at or near the summits of peaks from ~7500’ to 9000’ (The Klamath Mountains get no higher). Foxtail pine (Pinus balfouriana) and whitebark pine (Pinus albicaulis) inhabit our sky islands where they are the crowning jewels of this coniferous wonderland.

Habitat and niche

- **Habitat:**
- This is a specific place or locality where an organism lives. It is a physical entity that comprises of the sum total of the abiotic factors to which a species or a group of species is exposed. Habitat usually refers to a relatively large area, such as a pond, a forest, an estuary or an ocean.
- **Ecological Niche:** Niche refers to the **unique functional role and position of a species in its habitat or ecosystem**.
- The functional characteristics of a species in its habitat is referred to as “niche” in that common habitat.
- In nature, many species occupy the same habitat, but they perform different functions:
- Niche plays an important role in the **conservation of organisms**. If we have to conserve species in its native habitat, we should have knowledge about the **niche requirements of the species**.

Characteristics of Plant Communities | Ecology

- **Analytic Characters:**
- They are directly observed or measured in sample plots. They include kinds and number of species, distribution of individuals, number of individuals, height of plants, etc.
- **Synthetic Characters:**
- They are derived from the measurements of analytic characters and utilise data obtained in the analysis of a number of stands.
- **Analytical characters are of two types:**
- **(i) Qualitative (ii) Quantitative:**

- **Qualitative characters** :They are based on non-quantitative observations, e.g., species composition and stratification of vegetation. They are expressed only in qualitative way.

- **Quantitative characters :**They are expressed in quantitative terms. They are measured. The major quantitative characters include frequency, diversity, cover, biomass, leaf size, abundance, dominance, etc . **They are as follows:**
- **Frequency:**
- This is based on percentage of sample plots in which a species is present, indicating its dispersion in space.

This frequency of each species is calculated as follows:

- Frequency percentage = number of sampling units in which that species occurred / number of sampling units studied X 100
- **Diversity:**
- This is denoted by number of individuals per unit area, indicating the relative abundance of a species.
- **Cover and Basal Area:**
- This is percentage land area occupied by a species, indicating the influence zone of a species. Although sometimes used in general sense for the area occupied by a plant, (which may be the herbage cover or the cover of basal area), it is generally used for above ground parts.

Basal area refers one of the chief characteristics to determine dominance

- It is measured either at 2.5 cm above ground or actually on the ground level.
- **Biomass:**This expresses quantity of living materials per unit area, indicating the growth of a species. Thus, biomass is the standing crop expressed in terms of weight (i.e., organism mass) of the living matter present
- **Leaf Area:**The percentages of species having different leaf sizes, indicating the adaptation of the vegetation to the prevailing environment
- **Density:**Density represents the numerical strength of a species in the community. The number of individuals of that species in any unit area is its density. This gives an idea of degree of competition.

It is calculated as follows:

- Density = Number of individuals of the species in all the sampling unit/Total number of sampling units studied.
- **Abundance:**This is the number of individuals of any species per sampling unit of occurrence.
- **It is calculated as follows:**
- Abundance =Total number of individuals of the species in all the sampling units/Number of sampling units studied
- **Synthetic Characters:**These are determined after computing the data on the quantitative and quantitative characters of the community. These are determined in terms of presence and Constance, fidelity ,dominance etc.

Synthetic characters are as follows:

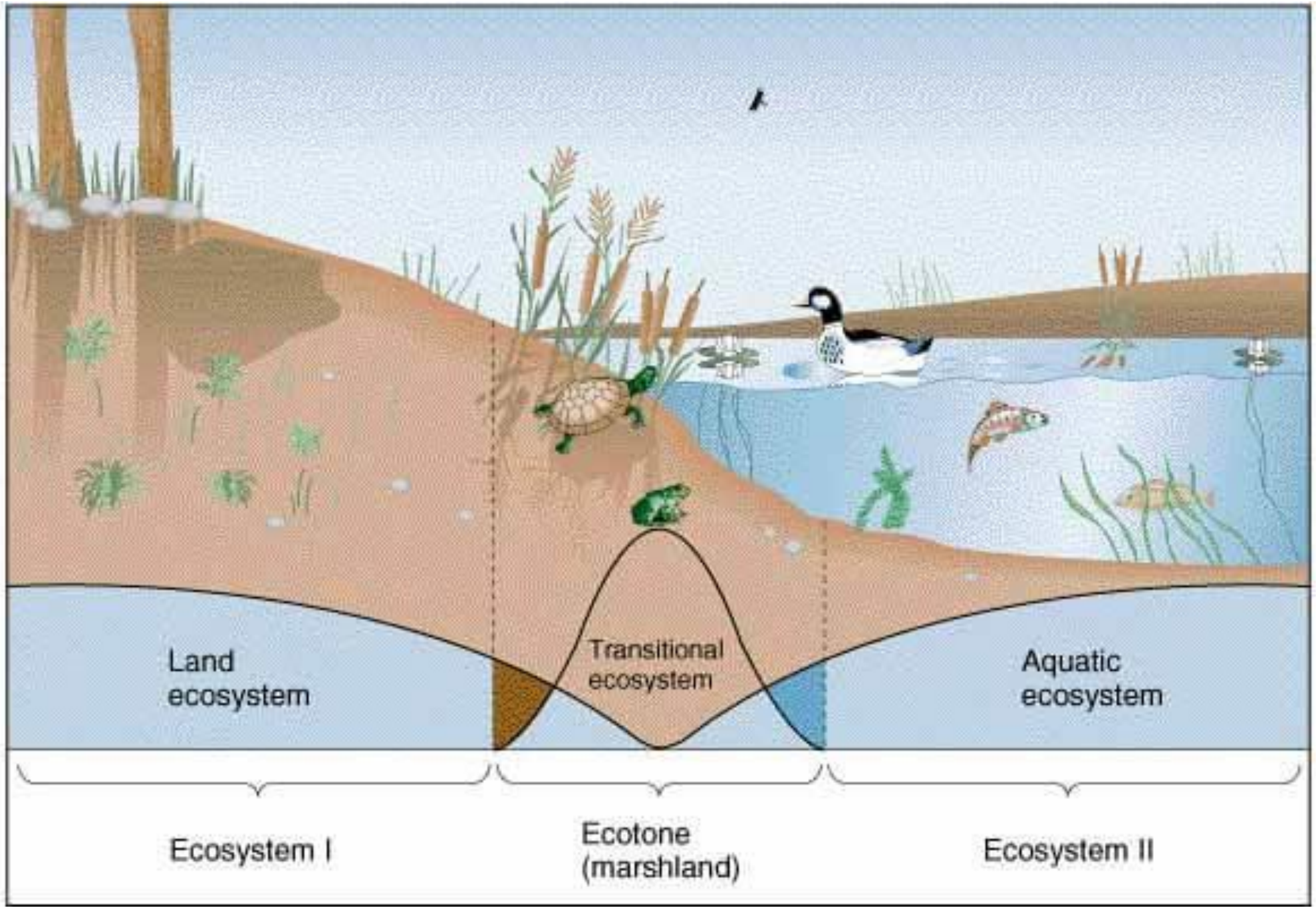
- **Presence and Constance:**
- It expresses the extent of occurrence of the individuals of a particular species in the community.
- **Fidelity:**
- This is the degree with which a species is restricted in distribution to one kind of community. Such species are sometimes known as indicators.
- **Dominance:**
- Here, the dominance is expressed in synthetic form. On the basis of density, frequency and dominance (cover) values; there has been proposed idea of Importance Value Index (IVI). IVI of a species in the community give the idea of its relative importance. For IVI, values of Relative density.

Relative frequency and Relative dominance (cover basis) are obtained as follows:

- Relative density = Density of the species x 100/Total density of all the species
- Relative Frequency = Frequency of the species x 100/Total frequency of all the species
- Relative dominance (cover) = Dominance (cover) of the species x 100/Total dominance (cover) of all the species
- Now for IVI, three values are added. IVI values of different species are then arranged in decreasing order.

Ecotone

- An ecotone is a **zone of junction or a transition area** between two biomes (diverse ecosystems).
- Ecotone is the zone where two communities meet and integrate.
- For e.g. the **mangrove forests** represent an ecotone between marine and terrestrial ecosystem.
- Other examples are **grassland** (between forest and desert), **estuary** (between fresh water and salt water) and **riverbank or marshland** (between dry and wet).


Land
ecosystem
Transitional
ecosystem
Aquatic
ecosystem
Ecosystem I
Ecotone
(marshland)
Ecosystem II

Characteristics of Ecotone

- It may be narrow (between grassland and forest) or wide (between forest and desert).
- It has **conditions intermediate** to the adjacent ecosystems. Hence it is a **zone of tension**.
- Usually, the number and the population density of the species of an outgoing community decreases as we move away from the community or ecosystem.
- A well-developed ecotone contains some organisms which are entirely different from that of the adjoining communities.

Edge Effect – Edge Species

- Edge effect refers to the **changes in population or community** structures that **occur at the boundary of two habitats (ecotone)**.
- Sometimes the number of species and the population density of some of the species in the ecotone is much greater than either community. This is called **edge effect**.
- The organisms which occur primarily or most abundantly in this zone are known as **edge species**.
- In the terrestrial ecosystems edge effect is especially applicable to **birds**.
- For example, the **density of birds is greater in the ecotone** between the forest and the desert.

Ecological Succession

- ***Definition***: Ecological succession is the gradual and sequential replacement of one community by the other in an area over a period of time. According to E.P. Odum (1971), the ecological succession is an orderly process of community change in a unit area. It is the process of change in species composition in an ecosystem over time. In simpler terms, it is the process of Ecosystem Development in nature.
- **Causes of succession:**A number of causes induce together the process of succession.

Some important causes may be outlined as below:

- **(i) Climatic Causes:**The climatic causes include temperature, rainfall, light intensity, gaseous composition, wind etc.
- **(ii) Biotic Causes:**In a community, there is competition amongst different members for their existence. In such a process, some of the members are not found suitable and thus are gradually replaced by new ones.
- **(iii) Ecesis Causes:**The soil condition is also changing by the process of invasion, migration, competition and reaction of the Population.
- **(iv) Stabilising Causes**:Succession is taking place in order to attain the climax stage.

Types of succession:

- **(1) Primary sucession:**
- This type of succession being in a sterile area or barren land or in an inorganic environment. When a bare or nude area is colonized by organisms for the first time and subsequently the communities are changed in a successive form, the process in known as primary succession.
- **(2) Secondary succession:**
- The community development on area previously occupied by another well developed living community amidst the interruption due to adverse conditions like natural calamities, biotic intervention etc. is designated as secondary succession. The natural calamities include forest fire, disease, flood, grazing etc.

(3) Autotrophic succession:
When the population of autotrophs (plants) dominate the population of heterotrophs, the succession caused is known as autotrophic succession.
(4) Heterotrophic succession:
It is characterised by early dominance of heterotrophs like bacteria, fungi and some animals in an organic environment. Since the environment is dominated by heterotrophs the succession is called heterotrophic succession.

(5) Autogenic succession:
Due to the continuous interaction of community with environment, there happens a modification of the later. Such a modification of environment causes the replacement of an old community by a new one, which is known as autogenic succession.

(6) Allogeneic succession:

When the replacement of a community is caused by any other external condition and not by the existing organisms, the course of succession is known as allogeneic succession.

- (7) Habitat Succession:
- Successions are also named differently basing upon the type of habitat from which the phasic replacement starts.
- (a) Hydrosere:
- The succession starting from aquatic habitat is known as “Hydrach” and the series of changes occurring in the vegetation of hydrarch are called ‘Hydrosere’.
- (b) Mesarch:
- The succession starting from a habitat where adequate moisture condition are present.
- (c) Halosere:
- The succession occurring at saline water or soil is known as holosere.
- (d) Xerosere:
- Succession taking place in xeric havitat like sand or rocks where moisute is present at minimal amount is known as xerosere. Xeroseres can further be subdivided into:
- (i) Psammosere:
- Where the succession starts on sandy habitat.
- (ii) Lithosere:
- Where the succession starts on the surface of rocks.
- (e) Oxylosere:
- The succession starting on acidic soils in known as oxylosere.

Stages of ecological succession

- The process of succession is completed through a series of sequential steps as given below:
- ***(1). Nudation***
  (2). Invasion
  (3). Competition and Co-action
  (4). Reaction
  (5). Stabilization (climax)
- ***(1). Nudation*** Ø *Definition*: Nudation is the development of a bare area (an area without any life form). It is the first step in ecological succession.

- ***(2). Invasion:***
- Ø *Definition:* Invasion is the successful establishment of a species in the bare area.
- Ø It is the second step in ecological succession.
- Ø A new species reaches the newly created bare area and they try to establish there.

(3). Competition and Co-action

- Ø Aggregation results in the increase of the number of species within a limited space.
- Ø This results in competition between individuals for food and space.
- Ø The competition may be intra-specific (individuals within a species) or inter-specific (individuals between species).
- Ø Individuals of a species affect each other's life in various ways and this is called co-action.
- Ø Competition and co-action results the survival of fit individuals and the elimination of unfit individuals from the ecosystem.
- Ø A species with wide reproductive capacity and ecological amplitude only will survive.

Ecological Competitions

- ***(4). Reaction***
- Ø Reaction is the most important stage in the ecological succession.
- Ø It is the modification of the environment through the influence of living organism present on it.
- Ø Reaction cause change in soil, water, light and temperature of the area.
- Ø Due to these modifications, the present community becomes unsuitable for the existing environmental conditions.
- Ø Such communities will be quickly replaced by another community.
- Ø The whole sequence of communities that replaces one another in the given area is called sere (sera).
- Ø The various communities contributing sere are called seral communities or seral stages.

(5). Stabilization.climax concept

- Ø It is the last stage in ecological succession.
- Ø The final or terminal community becomes more or less stabilized for longer period of time.
- Ø This community can maintain its equilibrium with the climate of the area.
- Ø This final community is called the Climax Community (climax stage).
- Ø The climax community is not immediately replaced by other communities.
- Ø Climax community is determined by the climate of the region.
- Ø Example of climax community: Forest, Grassland, Coral Reef

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