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NAAC ACCREDITED 'A' GRADE

Topic: **Community Characteristics and Diversity**

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Community: Characteristics and Diversity

An aggregation of populations of different species living together (in inter dependence) in a specific area, having a specific set of environmental conditions constitute a **biotic community** e.g., the various plants and animals in a pond constitute one biotic community whereas the plants and animals in a particular grassland constitute another biotic community. Broadly speaking, there are two types of communities.

(a) Major Community: It is a large community which is self-regulating, self-sustaining and independent unit comprising of a number of minor commu-nities in it. Examples of major communities are: a pond, a lake, a forest, a desert, a meadow and grassland. Each of these major communities in-cludes several minor communities.

(b) Minor Community: It is a smaller community which is not a self-sustain-ing unit. It is dependent on other communities for its existence. The major community exemplified by a forest has many minor communities namely the plant community (the plant population of the forest), the animal community (the animal population of the forest) and the microbial com-munity (bacteria and fungi population).

Characteristics of a Community

The features within communities are highly variable, and there are a number of characteristics that can be used as descriptors to distinguish them.

- **Species Diversity:** The community consists of different groups of plants and animals of different species that may belong to different growth forms or life forms and are essentially prevailing in uniform environmental surroundings. Diverse communities are healthy and stable communities.

- **Coexistence:** Species occurring in a particular habitat coexist in mutual adjustment by interacting with each other in different ways. Different types of interactions are:
  - **i. Exploitation-** one species lives at the expense of the other.
  - ii. **Mutualism-** two or more co-existing populations benefit from the relationship and none of them suffer.

iii. **Competition-** two or more populations compete for same resource of a habitat.

iv. **Neutralism-** two populations may be quite independent and do not affect the other.

- **Interdependency:** Communities are not just a random mixture of plants, animals and microbes; each of the organisms within a community has a fundamental dependence on at least one other, although most organisms will engage in multiple interactions.There are three main forms of interdependence.

  Nutritional interdependence describes the transfer of energy and nutrients through feeding. Certain organisms may be more reliant on the presence of others to fulfill their nutritional requirements, for example insects that can feed only from one species of plant.

  Reproductive independence can take several forms. A common example is that of pollination, which is present within most communities. Whilst for the pollinator the interaction provides a food source of nectar, for the plant, the interaction is essential to its reproductive success. Certain species may only be able to reproduce on a particular plant or substrate and are therefore dependent on the presence of this within the community.

  Protective interdependence is the third main interaction. Most organisms require a level of shelter, and may rely on other organisms within the community for this. For example, insects living on a tree are dependent on the leaves and branches to shelter them from predation by birds.

- **Species Dominance:** There is usually one or two species at each trophic level, which exert a more dominant influence over the function and structure of the community than others. This may be due to their physical size, population numbers, or activities that have an impact upon other organisms or the environment. These so called **'ecological dominants'**, can have a major effect on the nature of the community. Plants usually dominate land communities, and so the name of the community is often based on the ecologically dominant vegetation, for example Douglas-fir Woodland or Rocky Mountain Maple Forest. The ecological dominants may be responsible for modifying the abiotic conditions of a habitat, although rare species might be equally as important for the correct functioning of the community. For instance, in a forest, a dominant tree species may control amount of light available to other plants, the temperature in the lower canopy, and the

nutrients that are available to other organisms, whilst their reproduction may depend on pollination by a rare insect.

- **Stratification:** The ecological communities are arranged in different layer or **strata forms**, a phenomenon called stratification. For example in **a natural forest community**, as per the height of the plants the community is arranged into number of strata or layers such as herbaceous layer consisting of herbaceous plants followed by shrubs, smaller trees and tall trees. This fractionation in the community is caused by the gradations in the external environmental factors like water levels, temperature and light. Different strata or layer of forest community receives different degree of light intensity providing vertical stratification to the community structure.

  Various growth form have different mode of arrangement classifying community into (a) **Horizontal Zonation and (b) Vertical stratification**, i.e. Populations assembled to form communities and these populations are dispersed into definite vertical or horizontal strata.

  a. **Horizontal Zonation**: The spatial arrangement of community species exhibit patterns and based on these patterns the community is divided into sub-communities which are ecologically related. If the distribution pattern is horizontal it's called zonation layering in community. For example in **lakes or deep ponds** majorly three zones are recognised i.e. littoral, limnetic (Photic or openwater) and profondal zone (Aphotic or Deep-water).

  b. **Vertical Zonation:**Vertical change in the pattern of community structure is called vertical stratification where each zone has different vertical storey, or complex stratification.

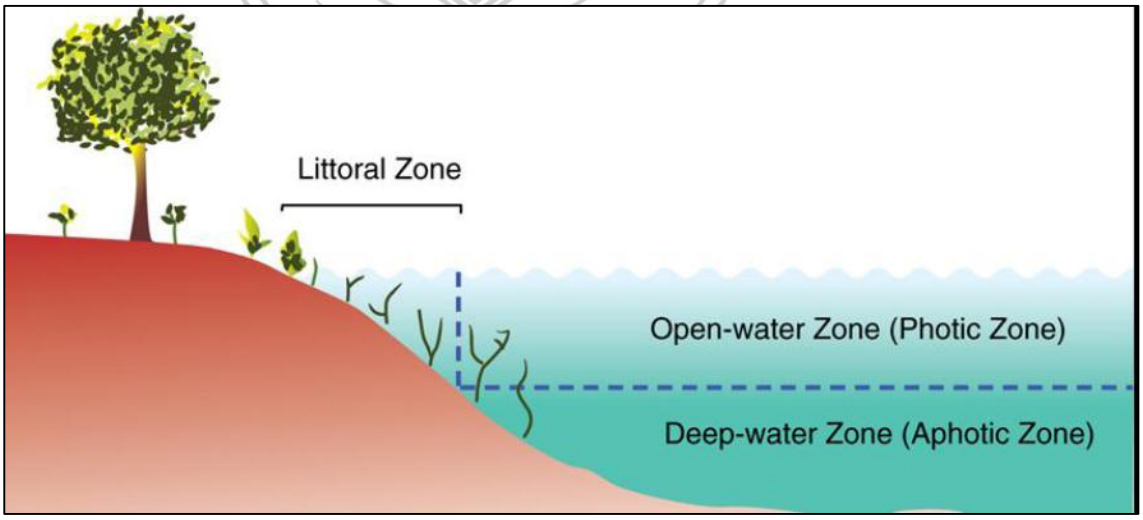


Figure: 1.Horizontal Stratification of a Lake

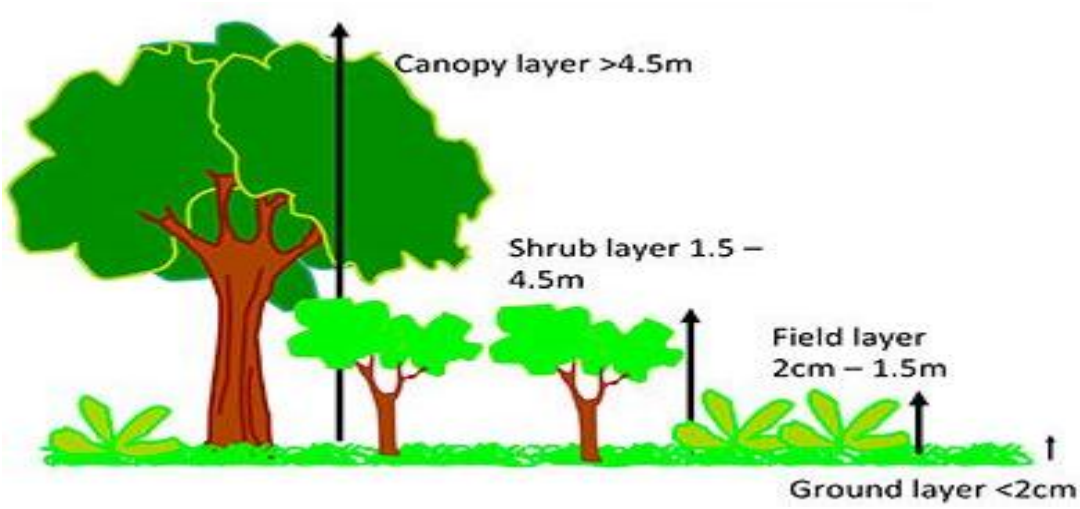


Figure: 2. Vertical Stratification of a Forest Commumity

In **grassland communities** distinct floor with different yet characteristics growth forms are exhibited: **Subterranean-beneath the soil-** the lowest vertical sub-division including roots of plants, debris and living organisms like soil bacterium, protozoas or fungi etc. **Herbaceous substratum**: Above the soil with roots of growth forms, the herbaceous substratum includes upper parts of growth forms.

The **forest community** stratification is much more complex with five vertical layering including:

- The subterranean layer
- The forest floor
- The herbaceous vegetation
- The shrub layer
- The canopy layer

- **Succession:** Communities may also be characterized by their *successional stage*. Ecological succession is the progressive and predictable replacement of one type of community by another, over time. *Primary succession* is the initial colonization of a bare landscape which has not previously been occupied, often following a significant ecological disturbance such as a volcanic eruption. *Secondary succession* occurs where a community has existed previously but has been removed from a landscape, for example, an area of deforestation or an abandoned cropland. In this case the nutrients within the soil are already present, and conditions for growth are favorable and so secondary succession happens much more rapidly than primary succession.

- **Periodicity:** The dominant species of the community are studied in various seasons of the year to determine various life processes such as reproduction, growth and respiration. Periodicity is defined as the expression and reoccurrence of various life processes annually at regular intervals in nature.

- **Community Productivity**: Community productivity is defined as the net storage of energy and production of biomass per unit time by the community.

- **Biotic Stability:** Biotic stability is the ability of a community to regain its equilibrium followed by disturbances causing population fluctuations. The stability of the community is directly dependent on the diversity of the community.

Community Diversity

Ecological or Community diversity has three different levels:

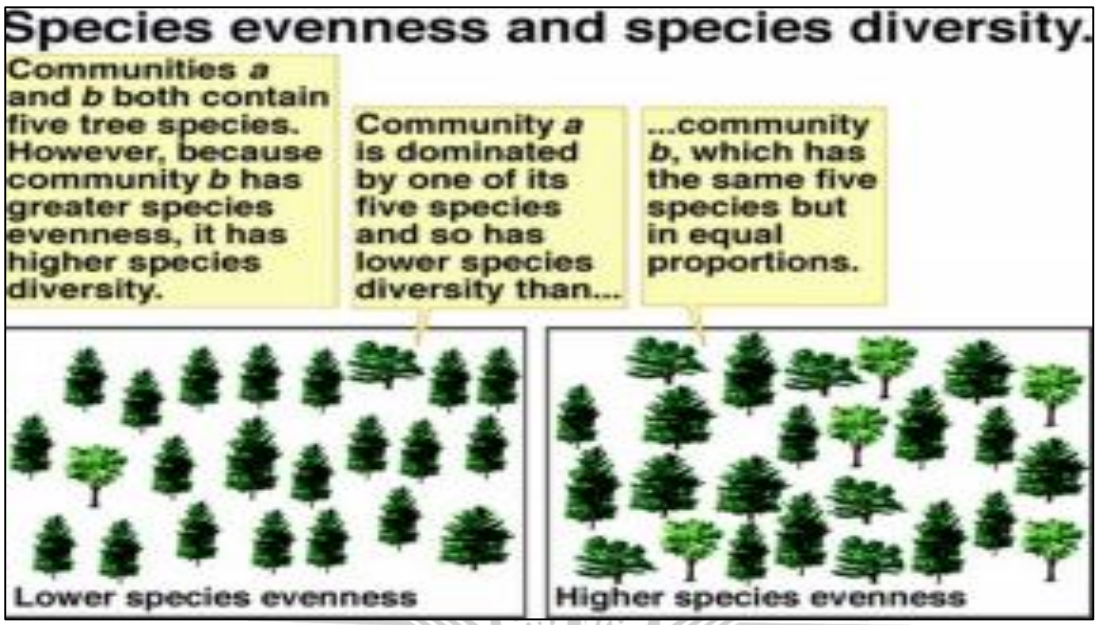
a. Alpha Diversity (within-habitat diversity) Alpha diversity (α-diversity) is expressed in terms species richness or number of species in an ecosystem. It defines the biological diversity within an ecosystem, community or simply in a particular habitat. The alpha diversity can be measured by counting the distinct group of organisms such as different species, genera, and families or number of taxonomic entities (number of taxa) within the ecosystem.

b. Beta Diversity (between habitat diversity along environment gradient) Beta diversity (β-diversity) is defined as the quantitative measurement of diversity of communities along environmental gradients. The species diversity that experience changing environment between ecosystems is compared to measure the beta diversity. It is given as the rate of change in species composition among communities or across different ecological habitat.

c. Gamma diversity (γ-diversity) is defined as the species richness or total number of species over a large region (ecological, units). Gamma diversity also called as large-scale landscape diversity, within a region is given by the quantitative measurement of overall diversity for different ecosystems. It is often expressed as the species richness of component communities.

Species richness - number of species present in the community (without regard for their abundance).

Species evenness - relative abundance of the species that are present. Species diversity - Considers both the number of species (richness) in the community and their relative abundance (evenness or equability).



Suggested Readings

- Sharma PD, Ecology and Environment, 12th Revised Edition (2014-2015), Rastogi Publications,Meerut- New Delhi.
- Shukla RS, Chandel PS, A Textbook of Plant Ecology,12th Revisedand Enlarged Edition (2014), S. Chand Publication, New Delhi.
- Krishnamurthy KV, An Advanced Textbook on Biodiversity: Principles and Practice (2007), Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi.