CHAPTER 4

BIODIVERSITY AND CONSERVATION

Introduction

BIODIVERSITY AND CONSERVATION

It hard to believe that there are more than 20,000 species of ants , 3,00,000 species of beetles, 28,000 species of fishes and nearly 20,000 species of orchids.

1. BIODIVERSITY

Biodiversity is the term popularised by the sociobiologist Edward Wilson to describe the combined diversity at all the levels of biological organisation.

The most important of them are-

A. Genetic diversity : A single species might show high diversity at the genetic level over its distributional range. The genetic variation shown by the medicinal plant Rauwolfia vomitoria growing in different Himalayan ranges might be in terms of the potency and concentration of the active chemical (reserpine) that the plant produces. India has more than 50,000 genetically different strains of rice, and 1,000 varieties of mango.

B. Species diversity: The diversity at the species level. For example, the Western Ghats have a greater amphibian species diversity than the Eastern Ghats.

C. Ecological diversity: At the ecosystem level, India , for instance, with its deserts, rain forests, mangroves, coral reefs, wetlands, estuaries, and alpine meadows has a greater ecosystem diversity than a Scandinavian country like Norway.

2. HOW MANY SPECIES ARE THERE ON EARTH AND HOW MANY IN INDIA

A. According to the IUCN (2004), the total number of plant and animal species described so far is slightly more than 1.5 million, but a more conservative and scientifically sound estimate made by Robert May places the global species diversity at about 7 million.

B. More than 70 per cent of all the species recorded are animals, while plants (including algae, fungi, bryophytes, gymnosperms and angiosperms) comprise no more than 22 per cent of the total. Among animals, insects are the most species-rich taxonomic group, making up more than 70 per cent of the total. That means, out of every 10 animals on this planet, 7 are insects. The number of fungi species in the world is more than the combined total of the species of fishes, amphibians, reptiles and mammals.

C. Although India has only 2.4 per cent of the world's land area, its share of the global species diversity is an impressive 8.1 per cent. That is what makes India one of the 12 mega diversity countries of the world. Nearly 45,000 species of plants and twice as many of animals have been recorded from India.

How many Hving species are actually there waiting to be discovered and named? If we accept May's global estimates. only 22 per cent of the total species have been recorded so far.

3. SPECIES-AREA RELATIONSHIPS

German naturalist and geographer Alexander von Humboldt observed that within a region species richness increased with increasing explored area, but only up to a limit.

$$\log S = \log C + Z \text{ Jog } A$$

where

S= Species Richness A= Area

Z = slope of the line (regression coefficient)

C = Y-intercept

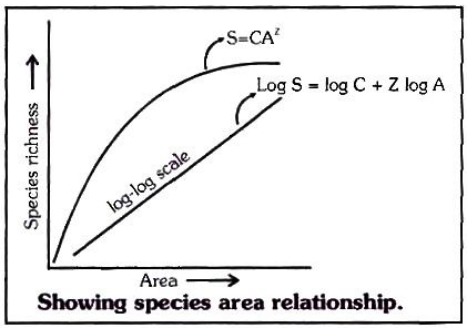


Fig. 4.1

Ecologists have discovered for a small region (Britane, California, Newyork) the value of Z lies in the range of 0.1 to 0.2, regardless of the taxonomic group.

For very large areas like the entire continents ~ the value of Z lies in the range of 0.6 to 1.2.

In the tropical forests of different continents for frugivorous (fruit-eating) birds and mammals value of Z found to be 1.15.

The steeper slopes in this context means more species richness.

A. Loss of Biodiversity

i. The biological wealth of our planet has been declining rapidly and the accusing finger is clearly pointing to human activities. The colonisation of tropical Pacific Islands by humans is said to have led to the extinction of more than 2,000 species of native birds.

ii. The (UCN Red List (2004) documents the extinction of 784 species (including 338 vertebrates, 359 invertebrates and 87 plants) in the last 500 years.

iii. Some examples of recent extinctions include the Dodo (Mauritius), Quagga (Africa), Thylacine (Australia), Steuer's Sea Cow (Russia) and three subspecies (Bali, Javan, Caspian) of tiger.

iv. The last twenty years alone have witnessed the disappearance of 27 species. Careful analysis of records shows that extinctions across taxa are not random; some groups like amphibians appear to be more vulnerable to extinction . This is the fact that more than 15,500 species world-wide are facing the threat of extinction.

v. Presently, 12 per cent of all bird species, 23 per cent of all mammal species, 32 per cent of all amphibian species and 31per cent of all gymnosperm species in the world face the threat of extinction.

vi. In general, loss of biodiversity in a region may lead to (a) decline in plant production, (b) lowered resistance to environmental perturbations such as drought and (c) increased variability in certain ecosystem processes such as plant productivity, water use, and pest and disease cycles.

B. Why Should we Conserve Biodiversity

There are many reasons to conserve biodiversity we can group then into three categories.

i. **Narrowly utilitarian :-** It is concerned with direct economic benefits from nature food, firewood, fibre, construction material, industrial products and products of medicinal importance.

More than 25 percent of the drugs currently sold in the market world wide are derived from plants

ii. **Broadly Utilitarian :-** It is concentred with indirect benefits from nature, like, photosynthesis, pollination. This argument says that biodiversity plays a major role in many ecosystem services that nature provides Amazon forest is estimated to produce 20% of the total oxygen in the earth's atmosphere pollination is another Service, ecosystem provide through insects.

iii. **Ethical :-** It is our moral duty to care for the well being of biodiversity and pass on our biological legacy in good order to future generations.

Importance of Species Diversity to the Ecosystem

Tilman found that plots with more species showed less year-to-year variation in total biomass and

CHAPTER 5

DEMOGRAPHY (POPULATIONS)

INTRODUCTION

DEMOGRAPHY (POPULATIONS)

Scientific study of human population is called demogrpahy.

Population is defined as the total number of individual of a species present in a particular area at a given time.

The population have specific character different from the character of individual.

1. Character of population :

A. Population density (Population size)

It is measured as total number of individual present in unit area or unit volume.

The size of a population for any species is not a static parameter. It keeps changing in time depending on various factor including food availability, predation pressure and reduced weather.

For human population density is officially counted in first four month of Ist year of each decade is called census.

(i) For human population density is calculated as number of person living in per square km area.

(ii) The tiger census in our national park and tiger reserves is often based on pug marks and fecal pellets.

B. Birth rate / Biotic potential / Fertility / Natality :

Birth rate is defined as total number of birth in a population with respect to total number of individual of the population in a year.

Birth rate is represented as per capita birth rate

$$\text{Per capita birth rate (b)} = \frac{\text{Total birth}}{\text{Initial population}}$$

Eg. If in a pond there are 20 lotus plant last year and through reproduction 8 new plant are added, then the birth rate during the year is calculated as :

$$\text{Solution : } b = \frac{\text{Total birth}}{\text{Initial population}}$$

$$= \frac{8}{20}$$

b = 0.4 offspring per lotus per year.

- Birth rate varies from region to region
- Developed country have lower birth rate.
- Developing or poor country have higher birth rate than developed country
- Higher fertility in developing world is partially explained by large number of hand needed to perform work.
- Population evolve different strategy to maximise their reproductive fitness . Some organism breed only once in their life time like Pacific salmon fish, Bamboo etc. and some produces small sized offspring like Oyester, Pelagic fishes etc. maximise their fitness by producing large number of offspring. Some organism breed many times in their life and produces a small number of large sized offspring (Birds, Mammals).

C. Death rate / Mortality :

- Death rate is defined as total number of death in a population with respect to total number of individual of the population in a year.
- Death rate is represented as per capita death rate

$$d = \frac{\text{Total number of death}}{\text{Initial population}}$$

Eg.: If 4 individuals in a laboratory population of 40 fruit fly died during week. The death rate is calculated

$$\textbf{Sol.} \qquad d = \frac{\text{Total number of death}}{\text{Initial population}}$$

$$= \frac{4}{40}$$

d = d = 0 .1 individual per fruitfly per week

D. Growth rate:

Intrinsic growth rate (r) = b - d

$$\text{Growth rate} = \frac{\Delta N}{\Delta t}$$

$$\text{Percent growth rate} = \frac{\left(\frac{\Delta N}{\Delta t}\right)}{N_0} \times 100$$

Note : Natality, Mortality, Immigration and Emigration are the basic process responsible for fluctuation in population size under normal conditions, Natality and Mortality are the most important factors influencing population

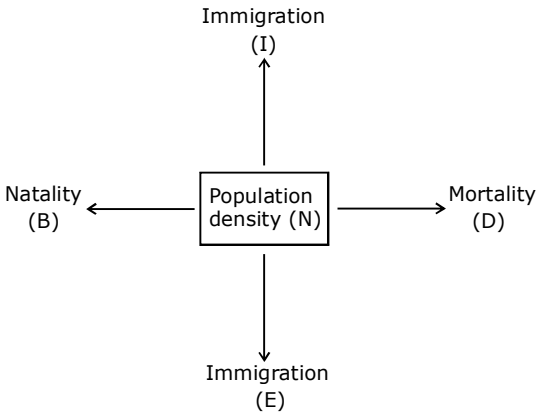


Fig.5.1

size than other two factor i.e., Immigration and Emigration.

$N_{[+]} = N_t + [(B + I) - (0 + E)]$

E. Age and Sex Structures:

The age structure of a given population refers to the proportion of individuals of different age. This is important aspect because many functional aspect of individuals are related to age. (Like Reproduction)

Age structure of a population can be depicted in the form of a pyramid diagram.

Diagram is particularly important in understanding future growth.

Population has 3 age groups.

(i) Pre-Reproductive individuals

(ii) Reproductive individuals

(iii) Post-Reproductive individuals

2. Representation of age pyramids for human population

- A higher number of pre-reproductive individuals, moderate number of reproductive individuals and fewer post reproductive individuals will form young population it shows rapid growth.
- Fewer number of pre reproductive individuals as compared to reproductive ones will make population aged. It shows negative growth.
- An equal number of pre reproductive and post reproductive individuals will constitute a mature population or stable population.
- Developed countries have a steeper pyramid which represent nearly a stable population.

A. Population Growth Models / Curve

There are two type of growth curve

a. Exponential growth (Geometric growth curve or J-Shaped Curve) :

Any species growing exponentially under unlimited resource conditions can reach enormous population densities in a short time. If in a population of size "N", the birth rates are represented as b and death rates as d, then the increase in N during a unit time period t $\left(\frac{dN}{dt}\right)$ will be.

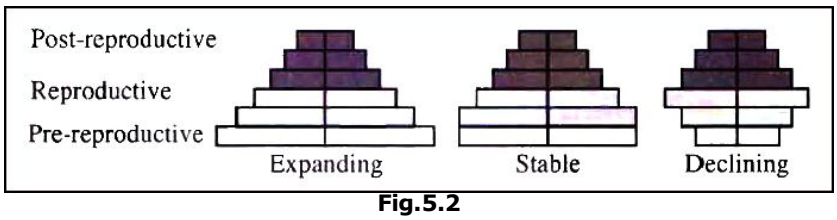


Fig.5.2

CHAPTER 2

ECOSYSTEM

INTRODUCTION

- **A.G.Tansley –** The term "ecosystem" first of all coined by A.G. Tansley.

  According to Tansley – Ecosystem is symbol of structure and function of nature.
- **E.P. Odum –** Father of ecosystem ecology.

  According to E.P. Odum – Ecosystem is the smallest structural and functional unit of nature or environment.
- **Karl Mobius –** Used term biocoenosis for ecosystem

  Definition – Total living factor (biotic) and total non living factor (abiotic) of the environment present in a particular area is called ecosystem.

Note :

- The boundaries of ecosystem are indistinct and have a overlapping character over each other.
- Ecosystem is the smallest structural and functional unit of nature or environment. It is a self regulatory and self sustaining unit.

- Ecosystem may be large or small. Single drop of water may be an ecosystem.
- Ecosystem may be temporary or permanent.

1. TYPE OF ECOSYSTEM

A. Natural Ecosystem –

a. Terrestrial Ecosystem –

e.g. forest, grassland, tree, desert ecosystem

b. Aquatic ecosystem – Aquatic ecosystem is again of two type :

(i) Lentic ecosystem → stagnant fresh water, lake, pond, swamp.

(ii) Lotic – Running fresh water ecosystem
e.g. - river.

B. Artificial Ecosystem

Man made e.g. cropland, Gardens etc.

On the basis of size types of ecosystem

(i) Mega ecosystem – Ocean/Sea

(ii) Macroecosystem – Forest

(iii) Microecosystem – Pond

(iv) Nanoecosystem – Drop of water

2. COMPONENTS OF ECOSYSTEM

Every ecosystem is composed of two components -

BIOTIC COMPONENT

It involve all livings (plant, animal and microbes) of ecosystem. Biotic component are mainly of two type.

1. Producers –

All the autotrophs of ecosystem are called producers. They prepare their own food. The green plants are the main producers. In the process of photosynthesis, producers absorb solar energy and convert it into chemical energy so producers are also called **transducers** or **converters.**

Energy enters into the ecosystem through the producers. The **solar energy** is the only ultimate source of energy in ecosystem. This energy is available for the remaining living organisms.

- **In aquatic ecosystem :** Floating plants called **phytoplankton** are the major autotrophs.

2. Consumer –

All the heterotrophs of the ecosystem are known as consumers. They directly (herbivores) or indirectly (Carnivores) depend on the producers for food.

Types of consumer

(i) **Macroconsumers** (ii) **Microconsumers**

(i) Macro consumers (Phagotrophs or holozoic) – They digest their food inside the body of organism i.e. first ingestion then digestion.

Macro consumers are of following type

(a) Primary consumer – Such living organisms which obtain food directly from producers or plants are known as primary consumers.
e.g. herbivores of ecosystem, cow, grazing cattle, Rabbit.

- These are also known as secondary producers

(b) Secondary consumers or primary carnivores – Animals which feed upon primary consumers and obtain food. Those carnivores which kill and eat the herbivores.
e.g. Dog, cat, snake

(c) Top Consumers – Those animals which kill other animals and eat them, but they are not killed & eaten by other animal in the nature.
e.g. Lion, man, hawk, peacock

(ii) Micro Consumers/Decomposers or Saprotrophs /osmotrophs –
Those living organisms which decompose the dead body of producers and consumers are known as decomposers or reducers or transformers or osmotrophs.

Note :

- The main decomposers in ecosystem are bacteria and fungi.
- Decomposers play a significant role in **mineral cycle.** Decomposers are responsible for converting complex organic material of dead animals or plants into simpler organic matter through the process of decomposition and release mineral substances into the soil where these are reused by the producers, So that soil is considered as the best resource of minerals.
- In Bacteria and fungi, process of decomposition completely takes place outside the body. They release enzymes from their body on dead remains and decompose it into simpler organic substances and then absorb it so these are called as **osmotrophs (absorptive).**

SPECIAL POINT OF BIOTIC FACTOR

- **Nutrient Immobilisation-** In the process of decomposition, some nutrients get tied up with the biomass of microbes and become temporarily unavailable to other organisms. Such incorporation of nutrient in living microbes (bacteria & fungi) is called **nutrient immobilisation.**
- In aquatic system **whale** is secondary consumer. It is an example of **filter feeder** because it feeds on plankton.
- **Plant parasites** are known as primary consumers while animals parasites (E.coli bacteria, Entamoeba histolitica, liver fluke, tapeworm) are known as secondary consumers.
- **All the insectivorous** plants play the double role i.e. producer as well as secondary consumer because they synthesise their own food through photosynthesis and they eat insects simultaneously.
- **Man and peacock** are omnivores.
- Organisms which use **milk** or curd are known as secondary consumer.

Note :

Inorganic materials (CO_2 ,H_2O, Light), autotrophs (**Producers**) and **decomposers** are essential in ecosystem but, **macro consumers** are non essential.

Functional aspects of ecosystem :
(i) Energy flow (ii) Nutrient cycling
(iii) Productivity (iv) Decomposition

Energy flow – The storage, expenditure, transformation of energy is based on two basic law of thermodynamics –

- First law of thermodynamics :- Energy is neither created nor destroyed but only transformed from one state to another state.
- Second law of thermodynamics (the law of entropy) - The transfer of food energy from one to another organism leads to loss of energy as heat due to metabolic activity. Further. ecosystems

CHAPTER 3

ENVIRONMENTAL ISSUES

INTRODUCTION

"Any undesirable change in physical, chemical or biological characteristic of air, water and land which is harmful to the man directly or indirectly through his animals, plants, industrial units or raw materials is called **pollution**".

Pollutants :- "Any material or act on the part of man, or nature which leads to pollution is called pollutants."

1. USUALLY POLLUTANTS ARE DIVIDED INTO FOLLOWING CATEGORIES

A. Nondegradable Pollutants– Many of such pollutants are usually not degraded or degraded partially in environment. Such as aluminium pecks, Mercury compounds, Iron, Compounds of phenols, Glass, D.D.T. benzene, BHC pesticides, etc.

They are collected in the environment and cause pollution. These pollutants are harmful even in low concentration and harm increases with their increasing concentration. No treatment is found in the nature for their recycling. There are two methods by which we can stop the pollution caused by pollutants

(i) Such type of substances should be banned by law,

(ii) Use their alternative substances.

B. Biodegradable Pollutants– If much of domestic sewage papers, woods, garbage, live stock wastes, etc. are easily degraded completely by microorganisms, it becomes useful. But if these materials enter the environment in such large quantities, that they can not be degraded completely then addition of these materials causes pollution in environment.

a. **Primary pollutants –** These persist in the form in which they are added to the environment

e.g. DDT, CO etc.

b. **Secondary pollutants –** These are formed by chemical reaction amongst primary pollutants

e.g. Photochemical smog, London smog, PAN, O_3

Synergism – Formation of secondary pollutants is known as synergism. secondary pollutants are more toxic than primary pollutants.

(i) **Quantitative pollutants :-** These are the substances which occur in nature but become pollutant when their concentration reaches beyond a threshold value in the environment

e.g. CO_2, Nitrogen Oxide.

(ii) **Qualitative pollutants –** These are the substances which do not occur in the environment but are passed in through human activity

e.g. fungicides, herbicides, D.D.T., etc.

C. Other Type of Pollution

a. **Natural pollution –** Caused by natural sources like, CH_4 from paddy fields and cattle, marsh, forest fire.

b. **Anthropogenic pollution –** Caused by human activities.

(i) **Negative pollution –** Loss of soil productivity. e.g., Overgrazing, Soil erosion.

Removal or absence of desirable substances at right place which results in loss of soil productivity.

(ii) **Positive pollution –** Presence or addition of undesirable substances at wrong place which results in reduction of soil fertility e.g. more use of bio fertilizer, Land filling by wastes.

D. Main Sources of Pollution :

(i) **Point source pollution** – Where the effluent discharge occur at a specific site.
e.g. factory outlet and Municipal sewage

(ii) **Line source pollution** – It is passed along a narrow belt, Roads
e.g. Rods, Railway tracks

(iii) **Diffuse source pollution** – It is over a large area
e.g. sprayed fertilizer or pesticides through run off

(iv) **Area source pollution** – Industrial estate & mining area.

E. Different Kinds of Pollution

AIR POLLUTION

The air pollution is caused due to addition of unwanted substances or gases. The atmospheric pollution is mainly caused by the activities of man and concentrated to the inhabited and the industrial complexes in cities.

There are two main categories of air pollutants

(i) Gases **(ii) Particulates**

Gases :

The gaseous materials include various gases and vapours of volatile substances or the compound with a boiling point below 200^0C.

F. Major Air Pollutants and Their Effects

a. Carbon monoxide (CO) –

Source – It is the main air pollutant released from smoke of automobile.

Effect – Carbon monoxide is highly toxic gas, it combines with haemoglobin of the blood and blocks the transportation of oxygen. Thus, it impairs respiration and it cuases death due to asphyxiation when inhaled in large amount.

b. Un burn Hydrocarbons – (3,4 Benzopyrine, CH_4, Benzene)

Source – These are mainly released from automobiles and burning of fossil fuel (petrol, diesel). Methane (CH_4) is the most abundant hydrocarbon in atmosphere and its main source is marshy area and paddy field.

Effect – Hydrocarbons causes lungs cancer.

Note :

Poly nuclear aromatic hydrocarbons – It is an important hydrocarbons and it also causes lungs cancer i.e. this is carcinogenic.

c. Ethylene –

Source – It main sources are .....

Effect – Falling of leaves without particular reason, falling of flowering bud before time.

d. Nitrogen oxide – (NO, NO_2)

Source – Burning (combustion) of fossil fuel in automobiles.

Effect – These nitrogen oxide form photochemical smog in atmosphere and release ozone. Nitrogen oxide also responsible for acid rain. Entry of these nitrogen oxide causes respiratory trouble such as emphysema, bronchitis, swelling of lungs and lungs cancer etc.

e. Sulphur oxide – (SO_2, SO_3)

Source – These are most harmful gaseous pollutants, main source of sulphur oxides are coal burning, smelters, oil refineries.

Effect – Lichen and mosses do not grow in SO_2 polluted areas. Lichen and mosses are indicator of SO_2 pollution.Oxides of sulphur produce acid rain and smog in atmosphere Taj Mahal also get effected.

f. Smoke – (SO_2, SO_3, NO_2, NO, CO, CO_2)

G. Secondary Pollutants

A. Smog (Smoke + Fog) –

This word was given by Desvoeux. Smog/Smoke is measured by Ringlmann method.

Smog is two types

(a) Los Angeles Smog or Photo Chemical smog –

It was first observed in Los Angeles. In this process smoke, fog, nitrogenoxide, hydrocarbons, oxygen, UV light and high temperature are essential. These components react with each other and form reddish brown smog (PAN + O_3 + Nitrogen oxides) or brown haze/brown air. Los angles smog is light induced smog.

CHAPTER 1

ORGANISM AND ENVIRONMENT

INTRODUCTION

(i) The term ecology was coined and described by – **E.Haeckel**

(ii) Father of ecology – **Reiter**

(iii) Father of Indian Ecology – **Prof. Ram Deo Misra**

(iv) First of all term ecology was employed for study of plant by – **Warming**

The study of interaction or inter-relationship of organisms with their environment is called ecology.

Organism ⇌ Environment

Organism and environment are always interdependent, inter related or mutually reactive.

1. BRANCHES OF ECOLOGY

It is based on organism level

(a) **Autecology** – Study of the relation of a species with its environment is known as autecology

(b) **Synecology** – Study of the relation of the group of different species with their environment

ECOLOGICAL HIERARCHY

Organism → Population (species) → community → Ecosystem → Biome → Biosphere

——————————————————→

size → Increase

complexity → Increase

2. ORGANISM

An organism is the smallest unit of ecological hierarchy and basic unit of ecological study.

- It may be small, large, unicellular or multicellular.
- Fixed life span and organized life cycle (birth to death)

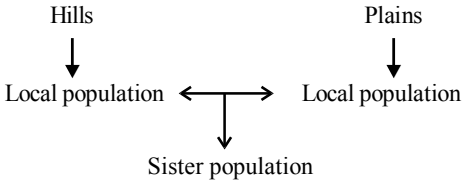
3. POPULATION

A group of Individuals (members) of same species living at one place (specific geographical area) constitute a population.

- **Local Population or demes (Sub groups of population) –** Population of organism inhabiting a particular area.

  eg. Homosapiens inhabiting hills, plains

- **Sister population –** Different population of same kind of organisms which are found in different places are known as sister population.



- **Meta population –** A set of local population which are interconnected by dispersing individuals.

4. SPECIES

Definition - Species is a basic unit of classification, defined as the group of living organisms similar in structure,function and behaviour and produced by similar parents, have common gene pool, can inter breed under natural conditions and reproductively isolated from other group of organism.

SOME TERMS RELATED TO SPECIES :

- **Endemic Species or Endemism :**

  A species which is found only in a particular area is known as endemic species.

  e.g. Meta sequoia is found only in valley of China, Kangaroo in Australia

◆ **Key-stone Species :**

The species which have great influence on the community's characteristics relative to their low abundance or biomass are called key-stone species. The activities of key-stone species determine the structure of the community.

e.g. Lion in forest, Kangaroo rat in desert

◆ **Critical Link Species :**

The species which establishes an essential link with other species to help the latter in some vital activity is called link species.

e.g. Mycorrhizal fungi, many insect species which works as pollinators of flowers.

5. COMMUNITY

Groups of organisms of different species that live in common area, which are interrelated and interdependent. It is a natural aggregation of plants and animals in the same environment.

Biotic Community = Animal community + Plant community + Microbial community

Characteristics of a community –

A. Species Diversity

There are different types of population (species) found in community, this is called species diversity. It depends on size of the area, type of area, type of soil , altitude, climate.

B. Dominance

The highest number of organism of a species present in community, is called as the dominant species. Whole community is known by the name of that particular dominant species.

e.g. Prosopis community at Aravali hills, Pinus community at Himalaya

C. Stratification

The different growth form (trees, shrubs, under shrubs, herbs) determines the structure of a plant community. Stratification is based on mode of arrangement of various growth forms.

◆ **Stratification in lake–**

In deep lake, zonation or stratification may be according to the need of **light**. There are three types of zones differentiated in a deep lake.

(i) **Littoral Zone –** This zone is found at bank of lake where very shallow water or marshy land is present. Rooted vegetation is found in this zone.

(ii) **Limnetic zone –** This is the zone of lake water, where light reaches in sufficient amount to entire surface area. It means this is not too deep. In this region different types of floating plants (phytoplanktons), suspended and submerged plants are present.

(iii) **Profundal zone –** It is very deep area of the lake where light does not reach up to the bottom. Only heterotrophs are present in this zone.

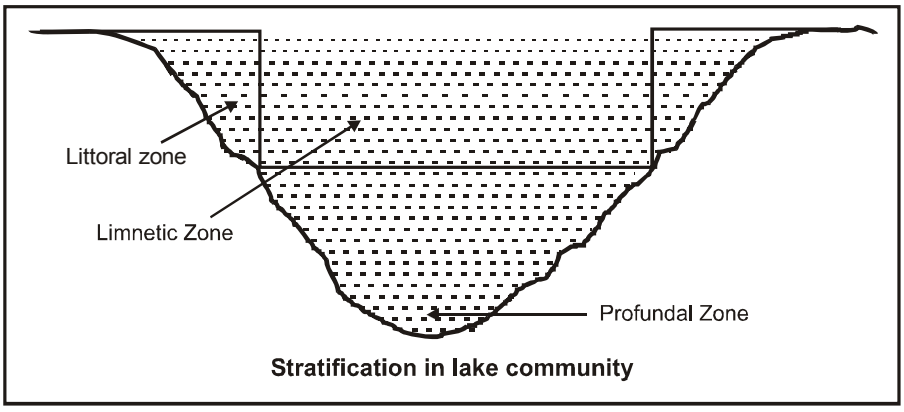


Fig. 1.1

◆ **Stratification in forest –**

The clear stratification (vertical arrangement) in various growth forms of plants according to the need of light in any dense forest.

Surface dewellers → Herbs → Under shrubs → Shrubs → Trees