Unit-III
Paper II

Page No.
Date

Community Ecology

- No plant or animal lives as isolated individual. plants and animals generally prefer to live in groups or colonies.
- Different plants and animals living in a habitat constitute a biotic community.
- When there is only assemblage of plants in a habitat is considered, it is called plant community. समुदाय
- In any biological organization plants and animals are very closely related and interdependent. plant and animals share the same set of environmental conditions.

- Thus the study of the relationships of plants and animals making up natural community is termed as community ecology or synecology.

- The basic unit of vegetation is called plant community.
- Each community consists of a set of many different species which persist year after year.
- In a community, each plant species is represented by many individuals.
- A group of individuals of the same species is commonly known as population.
- Thus a population is a part of community and populations of different species may be intermingled in a community.

Page No.
Date

- Oosting defines community as, "an aggregation of living organisms having mutual relationship among themselves and to the environment.
- According to Benton and Werner (1974) "a biological community consists of all the organisms living together in an interrelated fashion in a given environment."

Page No.
Date

Characteristics of community

Following are some of the characteristics of community

(1) species diversity :-

- The biotic community is a natural assemblage of a large number of plant and animal species in an area.
- various species of plants and animals live in a community and exhibit species richness or species diversity.
- Because in any particular habitat there is no considerable variation in environmental conditions, the plants growing together in a community show unique uniformity in their behaviour.
- Each species of community has got definite range of tolerence towards the physical and biological conditions of the habitat.
- The range of environment a species can tolerate is called its ecological amplitude.
- The nature of community of a particular habitat is determined by the species contents, ecological amplitudes of the species and physical and biotic influences in the community.

(2) Coexistence :-

- species occuring in their particular habitat do not live in complete isolation as pure cultures, but they coexist in mutual adjustment. सहजीवन

Page No.
Date

- The coexisting populations are inter-related and they show some sorts of interaction.
- The relationships bet^n coexisting species may be obligatory in one direction or in both. (अनिवार्य)

For ex: The trees in a forest community can live just as good as without shrubs and herbs which grow under them. This relationship is obligatory in one direction only.

- The nature of interaction bet^n two coexisting species may fall into one of the following types.

(i) Exploitation :- In this, one species lives at the expense of another.

(ii) Mutualism :- In this, two or more coexisting populations benefit from the relationship but no one suffers.

(iii) Competition :- In this, two populations may compete for same resources of the habitat.

(iv) Neutralism :- In this, two populations may be quite independent and neither population affects the other.

(3) Interdependency :-

- All the members of a community have ability to live under the conditions of habitat and they are interdependent upon one another. It is called dependency.

Page No.
Date

Thallophytes, mosses, ferns and many shade loving herbs that are found on the forest floor are dependent on the forest trees because trees provide shallow and moist conditions. If the trees of forest are removed, the ground vegetation may disappear.
similarly the fungi and saprophytes found in the forest depend upon the roots of plants and on the humus and some fungi form mycorrhizal associations with the plant roots.

(4) Species Dominance:-

Not all the species of a community are found in abundance. Only a few species are found in abundance, either in number or in biomass (weight) while the majority are rare. The common species which are more abundant and contain more biomass are considered to be dominants.
Dominant individuals affect the associated individuals.
For ex:- In the forest tallest trees influence the under-storey plants and ground vegetation not only by decreasing the intensity of light reaching the forest floor and increasing the moisture content of air but also by changing the soil structure and its chemical composition.

Page No.
Date

(5) Stratification :-

- In a plant community, the plants, which have relationship among themselves, may be trees, shrubs, herbs, mosses, lichens and thallophytes.
- These plants form distinct strata or layers or storeys on vertical as well as in horizontal planes. This is known as stratification.
- The individuals of different layers represent different "Life forms".
- Each layer of community may include individuals of different morphological classes. For ex. the layer of forest may be formed by tallest trees and lianes (woody climbers).
- In order to overcome this objection, plants belonging to different morphological classes are put in sinusiae (singular - sinusia), as for example, trees are put in sinusia of trees, epiphytes are put in sinusia of epiphytes, and so on.

- In forest vegetation five vertical subdivisions of life forms may be present.
  (1) subterranean zone
  (2) Forest floor.
  (3) Ground vegetation nearly extending upto a metre
  (4) understorey tree and shrub layer extending to the height of 1-5 m and
  (5) Tree layer or top storey extending to 5-15 m or sometimes 40-50 metres in rain forest.

Page No.
Date

Life - Forests

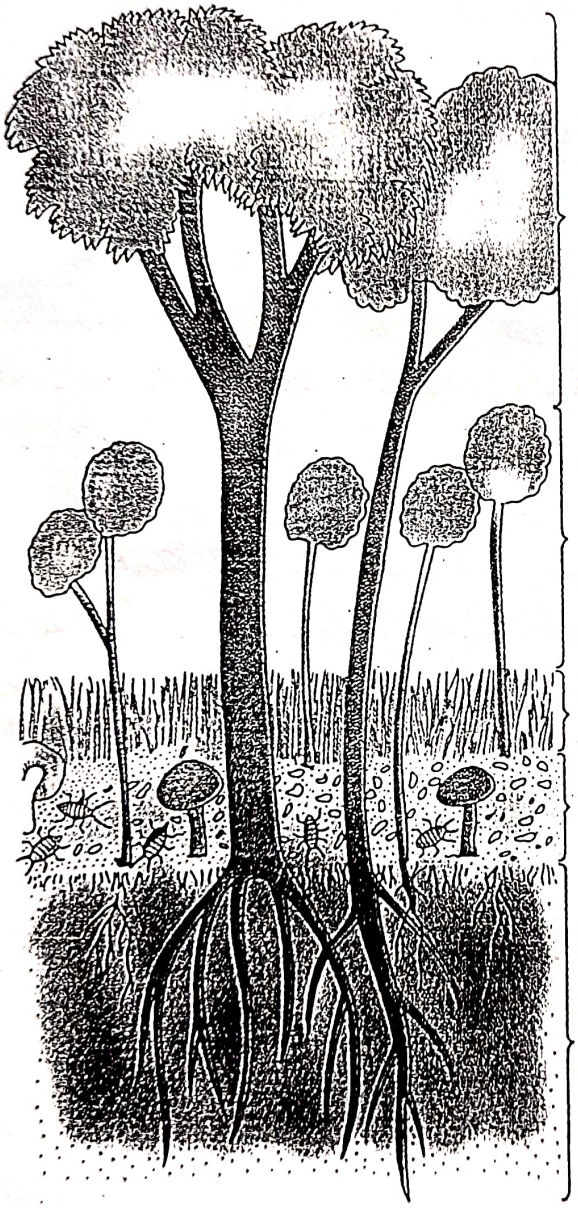

Fig. 7.4. Vertical stratification in a complex forest community.

Figure

Page No.
Date

* Life-forms (Growth form)

A Life form is the sum of the adaptation of the plant to the community.
- Ecologist generally use christen Raunkiaer's classification (1934) of plant life forms.
- Raunkiaer classified plants into following five broad life form categories.
- His classification is based on the position of perennating buds on plants and the degree of their protection during adverse conditions.

(1) Phanerophytes :-
- The growing buds of these plants are naked or covered with scale (i.e. they are not well protected) and situated in upright shoots much above the ground surface.
- Phanerophytes include trees, shrubs and climbers.
- Phanerophytes are found mostly in tropical regions.

(2) Chamaephytes :-
- In chamaephytes the buds are situated close to the ground surface and these buds get protection from fallen leaves and snow cover.
- They commonly occur in high altitudes and latitudes, e.g. Trifolium repens which is found in North America.

germinating season to another, especially under unfavourable conditions such as drought or winter.

Bud :- An undeveloped, vegetative or [illegible] shoot covered with ~~scales~~ protective scales.

Page No.

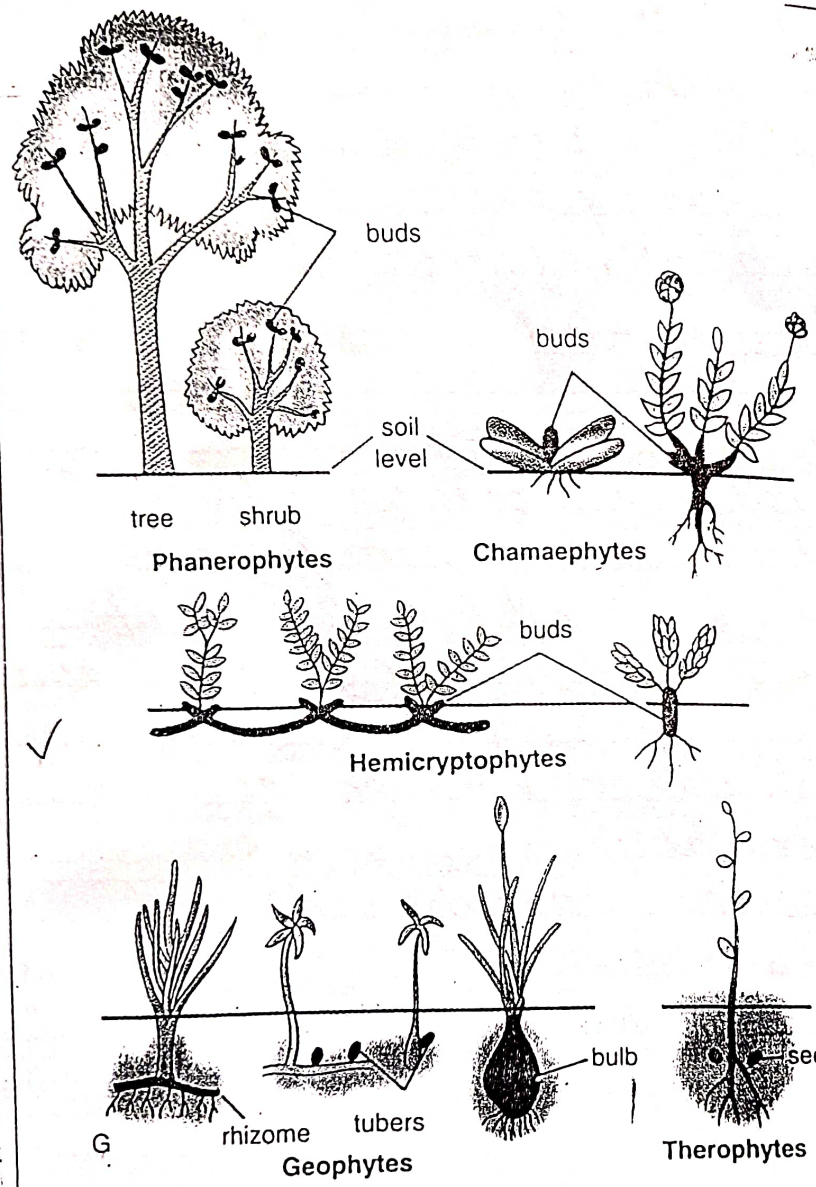

Fig. 7.7. Diagrammatic representation of Raunkiaer's life-forms. The barred regions survive during adverse periods of the growing season. Note the successive increasing degree of protection of renewal or perennial buds, organs or seeds from phanerophytes to therophytes.

of
ate zone.
ice,
ng
al parts
ach year,
erbs
a
~~100~~
urried
here
ds of
zing and
(buds
marsh
and
ergound
their
on, and
ast
rm of
ry, bot

Bud :- An undeveloped, vegetative or floral shoot covered with ~~scales~~ protective scales.

Page No.
Date

(3) Hemicryptophytes :-
- These are mostly found in cold temperate zone.
- Their buds are hidden under soil surface, protected in soil itself.
- In the warm season the growth of aerial parts is marked. Their shoots generally die each year, e.g. most of the biennial and perennial herbs including grasses.

(4) Cryptophytes or geophytes :-
- In these plants, the buds are usually buried in the soil or in bulbs and rhizomes where food is stored to withstand long periods of adverse climatic conditions (i.e. freezing and drying).
- Cryptophytes include the hydrophytes (buds remaining under water), helophytes (marsh plants with rhizomes under the soil) and geophytes (terrestrial plants with underground rhizomes or tubers).

(5) Therophytes :-
- These are seasonal plants, completing their life cycle in a single favourable season, and remain dormant throughout the rest unfavourable period of year in the form of seeds.
- Therophytes are commonly found in dry, hot or cold environments (i.e. deserts).

Page No.
Date

* Density

(Population Density).

Density indicates numerical strength of a species in an area or.

The numerical strength of a species in relation to a definite unit space is called its density. The total number of individuals of each species in the sample area is assessed in a subjective manner by using the following terms,

(i) Dominant (ii) Abundant (iii) Frequent (iv) Occasional and (v) Rare.

Quantitatively density of a species is obtained by counting the number of individuals of the species in the sample areas and then dividing them by the total area sampled.

$$\text{Density} = \frac{\text{number of individuals of a species}}{\text{total area sampled}}$$

Density of species in a field is determined by the method given in following table →

In some cases, e.g. grass and vegetatively propagated plants, the term individual creates difficulty. In such cases, each aerial tiller or shoot arising out from the soil is generally regarded as one individual.

Page No.
Date

The proportion of density of a species to that of stand as a whole is referred to as relative density.
The following formula is used for calculating relative density of a species:

$$\text{Relative density of a species} = \frac{\text{Total no. of individuals of a species}}{\text{Total no. of individuals of all species}} \times 100$$

Names of species	*Number of individuals in differsnt quadrats each of 1 square metre size*										*Total No. of individuals*	*Density*
	1	2	3	4	5	6	7	8	9	10		
1. *Evolvulus alsinoides*	5	4	7	×	1	3	9	2	8	5	44	$\frac{44}{10} = 4{\cdot}4$ plants/m²
2. *Indigofera sp.*	×	7	6	9	2	4	×	1	5	×	34	$\frac{34}{10} = 3{\cdot}4$ plants/m²
3. *Peristrophe sp.*	3	1	4	×	×	×	1	2	×	7	18	$\frac{18}{10} = 1{\cdot}8$ plants/m²
4.												
5.												
6.												

Page No.
Date

* Frequency.

- To the community, the individuals of all the species are not evenly distributed. Individuals of some species are widely spaced while those of some other species are found in clumps or mats.
- The number of plots in which a species occurs, divided by the total number of plots sampled, represents the frequency of that species.

For ex., if one or more individuals of a species is found in each of 30 of a total of 50 samples, its frequency is 60%.

- Frequency of a species relative to other species in a community is called relative frequency.

$$\text{Frequency} = \frac{\text{number of plots in which species occurs}}{\text{total number of plots sampled.}} \times 100$$

$$\text{Relative frequency} = \frac{\text{Frequency of a species}}{\text{total frequencies of all species.}} \times 100.$$

Page No.
Date

ex:
suppose, species 'A' occured in 4 plots or quadrats out of total 10 quadrats studied, the frequency of species A will be,

$$\frac{4}{10} \times 100 = 40\%$$

Page No.
Date

* Ecological succession

- A plant community is a dynamic system.
- The population and the habitat constantly act and react upon each other leading to changes in the environment.
- This changed environment renders itself unsuitable for the growth and stabilization of the existing plants.
- This leads to the migration and establishment of other papulations, which are better suited for the modified habitat.
- This unstable community - environment system by means of constant interaction and modification of the environment seeks to develop into more advance communities.
- This process continues until a relatively stable community is finally emerges.
- This successive colonisation of the same area by different plant communities in the course of development of vegetation is called plant succession or development of ecosystem.
- succession on a baren area which has never before borne a vegetative cover is known as primary succession. and on an area which once bore vegetation but was denuded later, is known as secondary succession.
- The different intermediate stages are called 'seral communities' or seral stages.
- A complete range of plant succession is called a sere.

Page No.
Date

Causes of succession :-

(1) physiographic processes, producing mostly primary bare areas,
   (a) Erosion, by water, wind etc
   (b) Depaction, by water, wind, gravity
   (c) Emergence, of barren land surfaces.

(2) Climatic phenomena, producing mostly secondary bare areas,
   (a) Wind, eliminating the previous vegetation.
   (b) Drought, drying and killing the weaker species.
   (c) Snow, killing the previous vegetation.
   (d) Lightening, causing fires in forests.

(3) Biotic agents, producing secondary bare areas,
   (a) Man, destroying natural vegetation.
   (b) Animals, overgrazing, etc.
   (c) Bacteria, fungi, insects, eliminating species by disease or by eating.

Processes in succession

(1) Nudation :- An area may become nude by any of the several causes mentioned earlier.
(2) Migration :- A nude area is exposed to invasion by a number of plants from the surrounding areas. The structures like seeds, spores, runners etc. migrate from nearby places to the nude area.

Page No.
Date

(3) Ecesis :- The process by which the migrants establish themselves in the new place is known as ecesis.

(4) Aggregation and competition :-
Increase of population number results in aggregation of individuals in an area leads to interspecific and intraspecific competition.

(5) Reaction :- The interaction and reactions among plant species and bet^n habitat and a population provide a continuing cause of succession.

(6) Stabilization :- The whole process of succession results in stabilization of the vegetation which is now in complete harmony with the environmental complex of the place.

* Kinds of succession

The succession of plants can be broadly classified into two kinds on the basis of the nature of the habitat.

(1) Hydrach :- When the succession takes place in a wetter area, i.e. the successional series progresses from hydric to mesic conditions. It can be of two kinds,

(a) Hydrosere :- When the succession starts in ponds, pools, lakes and marshes.

(b) Halosere :- When it starts in saline water.

(2) Xerach :- When the succession takes place in drier area, i.e. the successional series progresses from xeric to mesic conditions, the sere is called xerosere.

Page No.
Date

* Hydrosere

- When the succession starts in ponds, pools, lakes and marshes, it is called hydrosere.
- Hydrosere can be studied both in standing or running water but it would be better observed in the case of standing water, e.g. in ponds, pools or lakes, where various stages form distinct zones around a single body of water.
- There are about 7 stages in this sere.
- In a new pond hydrosere the colonization of phytoplankton starts and finally terminates in a forest. The process completes in 7 stages.

① **Phytoplankton stage:-**

- It is the initial stage of succession in which algal spores are brought in the body of water.
- The simple forms of life like bacteria, algae and many other aquatic plants (phytoplanktons) and animals (zooplankton) floating in water are the colonizers.
- Due to life activities and death of all these organisms, large amount of organic matter is added in the water and settle at the bottom of pond to form a layer of muck.

Page No.
Date

(2) Submerged stage :-

- The phytoplankton stage is followed ~~by~~ & by submerged plant stage.
- When a loose layer of mud is formed on the bottom of the pond, some rooted submerged hydrophytes begin to appear on the new substratum.
- The submerged aquatic vegetation develops in the regions of ponds or lakes where water depth is about 10 feet or more.
- The plants are Elodia, Potamogeton, Ranunculus, Utricularia, Vallisneria, Chara, etc.
- These plants form tangled mass and have marked effects on the habitat.
- When these plants die, their remains are deposited at the bottom of ponds or lakes.
- The eroded soil particles and other transported materials are also deposited at the bottom.
- This gradually raises the bottom of the ponds and lakes up. As this process of stratification progresses, the body of water becomes more and more shallow resulting the habitat becomes less suited for the submerged vegetation but more favourable for other plants.

(3) Floating stage :-

When the depth of water reaches about 4-8 feet, the submerged vegetation starts disappearing from its original place

Page No.
Date

and then the floating plants make their appearance gradually in that area.
- In the begining the submerged and floating plant grow intermingled but in the course of time the submerged plants are replaced completely.
- The most tolerent species of floating plants in the area are able to reproduce.
- Their broad leaves floating on the water surface check the penetration of light to deeper layer of water.
- This may be one of the main causes responsible for the death of submerged plants.
- Due to continuous interaction between plant communities and aquatic environment, the habitat becomes changed chemically as well as physically.
- More dead remains of plants are deposited at the bottom and thus, the substratum rises in vertical direction.
- Important floating plants ~~are~~ that replace the submerged vegetation are Trapa, Pistia, Nymphaea, Nelumbium, etc.

(4) Reed-swamp stage (Amphibious stage):-

- When the ponds and lakes become too shallow (water depth 1-3 feet) and the habitat is changed so much that it becomes less suited to the floating plants, some other plants which are well-adapted to new environment will then come in.

Page No.
Date

Under these conditions, the floating plants start disappearing gradually and their places are occupied by amphibious plants which can live successfully in aquatic as well as aerial environment.

Important examples are Typha, phragmites, (Reed), Bothriodova, etc.

The foliage leaves of these plants cover the surface of water and roots are generally found either in mud or submerged in water.

- The foliage leaves form a cover over submerged and floating plants and thus they cut off light from the plants below of them.
- Under such conditions neither submerged nor floating plants can survive.
- Further deposition of soil and plant debris at the bottom reduces the depth of water and makes the habitat less suitable for the pre-existing plants.
- Under such conditions many secondary species, such as polygonum, sagittaria have appear.

Later, they also bring about such reactions by which the habitat becomes less suitable for most of the existing species, and consequently new successional step follows.

(5) ~~Reed~~ Sedge Marsh or Meadow stage:-

- The filling process finally results in a marshy soil which may be too dry for the plants of preexisting community.

Page No.
Date

- Now the plants well adapted to this new habitat begin to appear in the pre-existing community in mixed state.
- Important plants that are well suited to marshy habitat are the members of cyperaceae and graminae. The species are Themeda, Iris, Dichanthium, Eriophorum, Mentha, Gallium, Caltha, etc. All these are the first invaders of marshy area.
- As these plant grow most luxuriantly in the marshes, they modify the habitats in several ways.
- They absorb and transpire a large quantity of water and also catch and accumulate plant debris.
- Consequently a dry habitat results which may be totally unfit for the growth of normal hydrophytes.
- Gradually the mesophytes start appearing and after some time the sedge vegetation is totally replaced by them.

⑥ Woodland stage :-

- In the begining some shrubs and later medium sized trees form open vegetation or woodland.
- These plants transpire very large quantity of water. Thus they make the habitat more dry.
- Shade loving herbs may also grow under the trees and shrubs.
- The prominent species of woodland community are Buteaton, Acacia, cassia, Terminalia, Salix etc.

Page No.
Date

(7) Climax Forest :-

- After a very long time the hydrosere may lead to the development of climax vegetation.
- As the level of soil is raised much above the water level by progressive accumulation of humus and soil particles, the habitat becomes more dry.
- In such habitat, well adapted self-maintaining and self-reproducing, nearly stable and uniform plant community consisting mostly of woody trees develops in the form of mesophytic forest.
- In the climax forest, all types of plants are present. Herbs, shrubs, mosses and shade loving plants represent their own communities.
- Trees are dominant and they have control over the entire vegetation.
- Bacteria, fungi and other microorganisms are more frequently found in the climax vegetation.
- They react upon the habitat and make the soil rich in the organic materials.
- At climax stage, a complete harmony develops between plant community and habitat.

- It is now clear that whole sere is a ~~community~~ continuously but gradually changing complex in which the changes are forced by biotic and climatic factors.

Page No.
Date

It is very slow process that can't be observed in nature. It may require thousands of years to reach the climax stage.

* Analysis of plant communities (quadrant method)

- Intro:-

The structure of sociological order in any plant community can not be studied by observing each and every individual of plant species growing in a habitat. It is rather impossible. Therefore, rough estimate of species content of a habitat is made by observing the plant species at different places or sample areas in the habitat.

several methods have been used by ecologist which are as follows,

1. Quadrat method
2. Transect method
3. Loop method and
4. pointless or point method

→

Page No.
Date

* Quadrat method of sampling the vegetation

- The quadrat is a square sample plot or unit for a detailed analysis of vegetation.
- It is actually the sample-plot method proposed by Clements (1898).
- It may be a single sample plot or may be divided into several subplots.
- In vegetational analysis, quadrats of any size, shape, number and arrangement may be used.
- In the study of forest community quadrats of 1/5 acre are established to include maximum number of trees, while for studying shrubs and grass covers usually the quadrats of smaller sizes are used.
- For grassland community, the quadrats of one square metre size or 50 cm x 50 cm size or even 20 cm x 20 cm size is used.
- The shape of quadrat is usually a square but rectangular, or even circular ones also used.

Kinds of quadrats

Quadrats are named according to the use. These are of the following types,

(1) List quadrats :-
When the organisms encountered in the sample plot are listed by their names, the quadrat is called list quadrat.

Page No.
Date

- It includes all the species botanically identified.
- A series of list quadrat gives floristic analysis of the community.
- This is used for studying the frequency of different species.

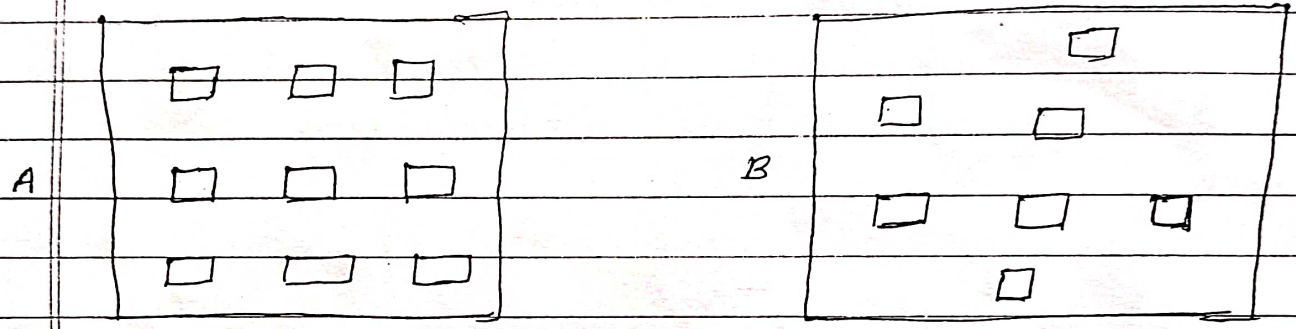

Fig:- Arrangement of quadrats in the study area.
A - systematically distributed quadrats,
B - Randomized quadrats.

(2) Count quadrat or List-count quadrat:-

- When the species name and the number of individuals of each species found in the sample are recorded, the sample plot is called count or list-count quadrat.
- This type of plot is usually used in forest survey work.

(3) Cover quadrat:-

When the actual or relative coverage is recorded usually as percentage of ground area covered or shaded by vegetation, the sample area is known as cover quadrat.

→

Page No.
Date

④ Chart quadrat :-

Quadrats that are mapped to show the location of individuals of species are called chart quadrats.
Individual plants are recorded on miniature quadrat on a graph paper with the help of an instrument called plantograph.

⑤ Clip quadrat :-

For studying the amount of yield of the vegetable matter, the vegetation is clipped from the quadrat at ground level and at various heights.
The clipped matter is then determined in terms of fresh or dry weight. This sampling technique is called clip quadrat.

sometimes quadrats of different sizes are laid down at different heights for the study of different life forms present in a community.
The quadrat is the smallest at the ground level and largest at the top.
such superimposed quadrats are termed as nested quadrats.

Shape and size of Quadrats

The quadrats are usually square-shaped but they can also be rectangular.
The proper size of the quadrat to be used in a given community is determined by

Page No.
Date

constructing a species-area curve. This is done by sampling vegetation in nested sample areas and listing the species in the smallest plot.

- The size of the quadrat is increased and newly encountered species are listed separately.
- The plot area is increased in this manner and every time the number of new species encountered is listed.
- The richness in species of a community influences the form of the curve, called a species-area curve.
- Usually 1 square metre quadrats are used for herbaceous vegetation.

10-20 square metres for communities containing plants 3-4 m high, and 100 square metres quadrats for forest community.