Course: B.SC.Botany
Semester: IV
Paper Code: BOT CC-409
Paper Name: Plant Ecology & Phytogeography
Topic: Community
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STUDY OF PLANT COMMUNITY STRUCTURE

The special field of synecology which is concerned with the structure and classification of plant community is known as **Phytosociology.**

Two sets of characters are studied in a community at the same time :

1. **ANALYTICAL CHARACTERS** According to Hanson (1950) and Braun Blanquet (1932) analytical characters are those features of the community which can be observed or measured directly in each stand. They include kinds and number of species, distribution of individuals, species vigor, form, number of individuals, height of plants, area volume, growth rate and periodicity, etc. There are two different aspects of vegetational analysis - quantitative characters which can be measured and qualitative characters which are described and not measured.
2. **SYNTHETIC CHARACTERS** Those aspects of community which are based on analytical characters and utilize data obtained in the analysis of a number of stands.

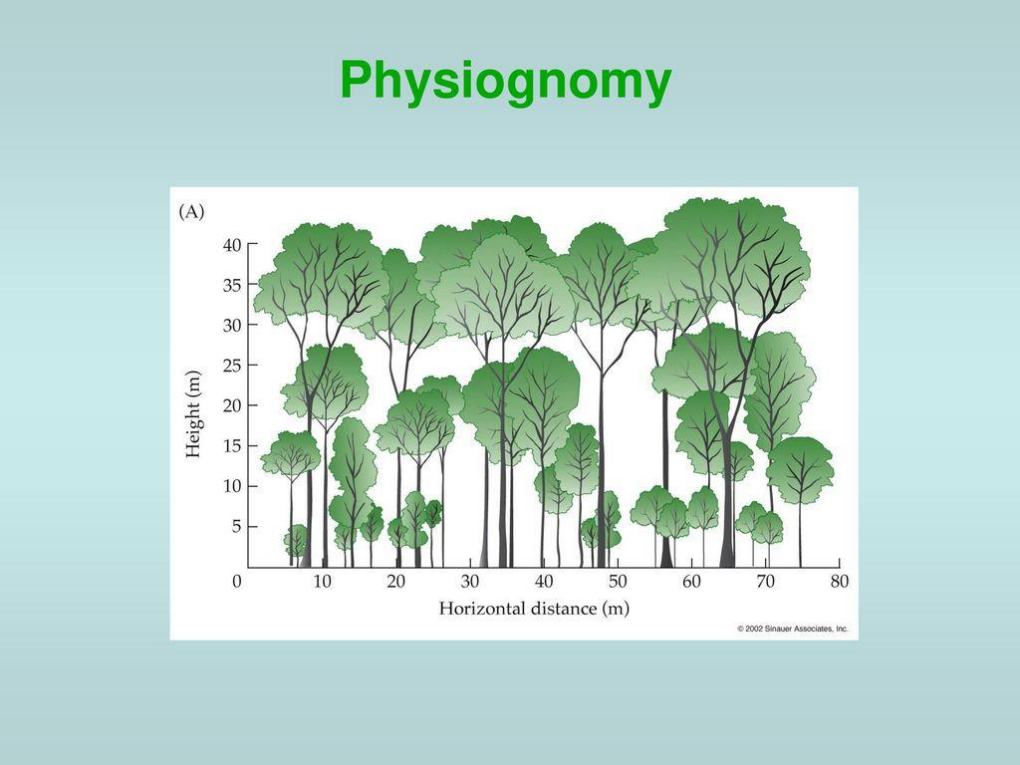
ANALYTICAL CHARACTERS

A. Qualitative structure of plant community

The qualitative structure and composition of plant community can be described on the basis of visual observation without any special sampling and measurement. In the qualitative characters species content in terms of floristic enumeration, stratification, sociability, inter specific association, life forms and biological spectrum, etc are studied in the field.

1. Physiognomy

This is the general appearance of vegetation as determined by the growth form of dominant species, such a characteristic appearance of a community can be expressed by single term. For example, on the basis of appearance of a community having trees and some shrubs, it can be concluded as a forest having trees as dominant. Physiognomy is a combination of the external appearance of vegetation, its vertical structure and the growth form of dominant species. It is an emergent trait of the community.



2. Life Form

(Raunkiaer 1934) Recognized in 5 groups on the basis of adaptations for surviving the unfavorable season like winter and cold

A. **Phanaerophytes** **T**heir buds are naked or covered with scale and are situated high upon the plants. These life form includes climbers generally common in tropical climate.

B. Chamaephytes In these plants the buds are situated close to the ground surface which gets protection from fallen leaves and snow cover. Commonly occur in high altituds and latitudes.

C. Hemicryptophytes These are mostly found in cold temperate zone. Their buds are hidden under soil surface protected by the soil itself. Their shoots generally die each year so it includes most of the biennial and perennial herbs.

D. Cryptophytes In these plants the buds are completely hidden in the soil as bulbs and rhizomes. It includes the hydrophytes, halophytes and geophytes (terrestrial plants with underground rhizomes or tubers)

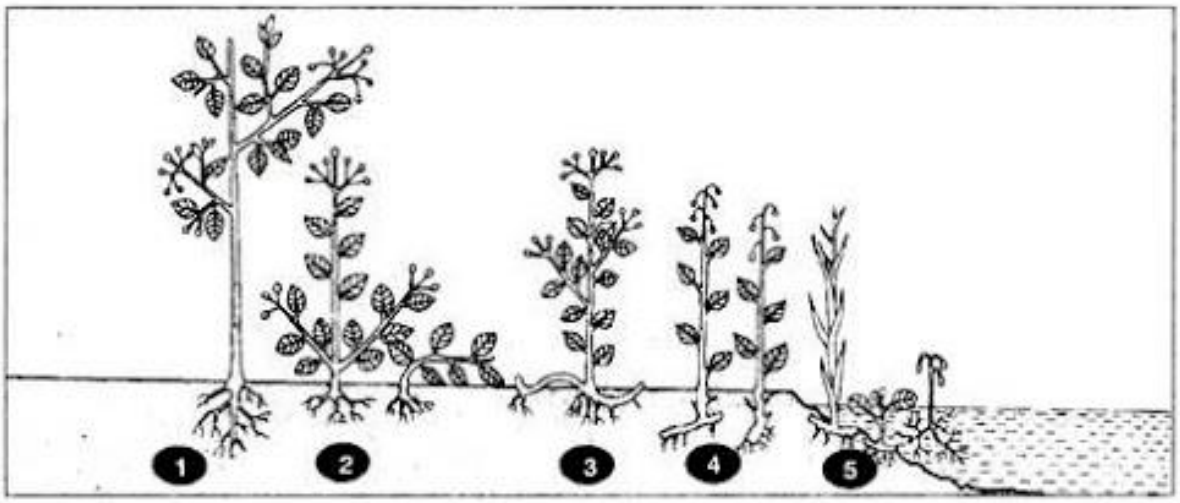


Fig. 3.1: Diagram showing five different life-form classes:
(1) Phanerophytes, (2) Charnaephytes, (3) Hemicryptophytes, (4) Cryptophytes, (5) Therophytes

3 Phenology

(First used by Shelford in 1929) It is the scientific study of seasonal change that is the periodic phenomenon of organisms in relation to their climate. Different species have different periods of seed germination, vegetative growth, flowering and fruiting, leaf fall, seed and fruit dispersal, etc. Such data for individual dominant species are recorded. A study of the date and time of such events is phenology.

4 Stratification

The number of strata or layers in a community can be determined by general observation of the vegetation. If one periodically observes the flora of the whole year, changes in the appearance of vegetation may be apparent with the change in the season. This

is known as **aspection.** On the basis of general observation a number of latrs have been distinguished as

L1 -- ground stratum like mosses, thallophyts, lichens, etc.
L2 – herbaceous or ground flora
L3 -- middle later or shrubby layer
L4 – top layer or canopy layer of trees

5 **Sociability** In a plant community, the individual of species are not evenly distributed. Individuals of some species grow widely spaced while those of some species are found in clumps or mats. The space relationship of plants is referred to as sociability. Individuals of some species when growing in clumps are either very weak or they tend to disappear due to hard competition and as such they does not form big populations. Braun Blaquet (1953) has recognized five sociability classes which accomodates different type of species:

Class 1 Shoots grow singly
Class 2 Scattered groups or tufts of plants
Class 3 Small scattered patches or cushions
Class 4 Large patches or broken mats and
Class 5 Very large mats of nearly pure population covering

High degree of sociability is seen in those plants which produce large number of seeds with high germination percentage. Show good survival of seedlings and mature plants and have many adaptive features.

6 **Interspecific association** When the plants belonging to two or more different species grow near one another they form a community. This type of association is known as interspecific association. This is possible if

- The species can live in similar environment
- The species having similar geographical distribution
- The species belong to different life form which reduce the competition
- The plants of one species are related to another species may be obligatory or mutualistic.

B. Quantitative structure of plant community

Coexistence and competition both are affected directly by the number of individuals in the community. Therefore it is essential to know quantitative structure of community. To characterize the community as a whole certain numerical constants called

parameters are used. The total count of individuals of each species, mean value of individuals of a species per plot are some parameters.

1. Density

Numerical strength of a species in relation to a definite unit space is called it's density. The crude density refers to the number of individuals of a particular species per unit area.

Density of a species per unit area= Total number of individuals of a species in all th sample plots/ Total no. of sample plots studied. Density of species in a field is determined by the method givn in following table:

Names of species	Number of individuals in different 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	$\frac{44}{10} = 4.4$ plants/m^2
2. *Indigofera sp.*	×	7	6	9	2	4	×	1	5	×	34	$\frac{34}{10} = 3.4$ plants/m^2
3. *Peristrophe sp.*	3	1	4	×	×	×	1	2	×	7	18	$\frac{18}{10} = 1.8$ plants/m^2
4.												
5.												
6.												

The proportion of density of a species to that of stand as a whole is referred as a relative density.

Relative density of a species= Total no. of individuals of a species/ Total no. of individuals of all species X 100

2. **Frequency :** In 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 distribution pattern of individuals of different species indicate their reproductive capacity as well as the environment. Frequency refers to the degree of dispersion in terms of percentage occurrence. It is determined with the help of following formula:

Frequency= Total no. of quadrats in which the species occur/ Total no. of quadrats studied X 100

species	Number of sample plots										Frequency Percentage
	1	2	3	4	5	6	7	8	9	10	
1. *Evolvulus alsinoides*	×	×	–	–	×	×	–	–	×	×	$\frac{6}{10} \times 100 = 60\%$
2. *Peristsophe bicalyculata*	–	–	×	×	×	×	–	×	–	–	$\frac{5}{10} \times 100 = 50\%$
3. *Cynodon sp.*	×	×	×	×	×	×	×	×	×	–	$\frac{9}{10} \times 100 = 90\%$
4. *Euphorbia sp.*	×	–	–	–	–	×	×	×	–	×	$\frac{5}{10} \times 100 = 50\%$
5. *Boerhaavia sp.*	–	–	–	–	–	–	–	×	–	×	$\frac{2}{10} \times 100 = 20\%$
6.											

If the individuals of a species are evenly distributed over the area they may occur in all the sample plots and thus the frequency will be 100%. Poorly dispersed species will occur in a few quadrats and their frequency will be low. Raunkiaer recognized five frequency classes

These are

Class A -- 1 to 20% frequency
Class B -- 21 to 40% frequency
Class C -- 41 to 60% frequency
Class D -- 61 to 80% frequency
Class E -- 81 to 100% frequency

Relative frequency is determined by the following formula:

Relative frequency of a species = Frequency of the species in stand / sum of the frequencies for all species in stand X 100

3. Abundance:

The estimated number of individuals of a species per unit area is referred to as abundance. To determine abundance the sampling is done by quadrats or other methods at random at many places and the number of individuals of a species is added for all the quadrat studies.

The abundance is determined by following formula:

Abundance of a species = Total number of individuals of the species in all quadrats/ Total number of quadrats in which the species occurred

The abundance is usually expressed by assigning the species to one of the following abundance clsses:

Classes	Stalks per square metre quadrat
Rare	1 to 4
Occasional	5 to 14
Frequent	15 to 29
Abundant	30 to 90
Very abundant	100 +

4. Cover

The cover implies the area covered or occupied by the leaves, stem and flowers, As viewed from the top. The coverage is studied at the canopy level and the basal region. In forest where several strata are well marked, each layer of vegetation is considered separately for measuring the coverage. Basal cover is best expressed as the basal area, the ground actually covered by the crowns or by stems penetrating the soil. In forest the basal area is the cross section area of a tree measured at 4-5 feet above the ground. It is estimated by point method of sampling. In grassland the coverage of ground surface by stems and leaves.

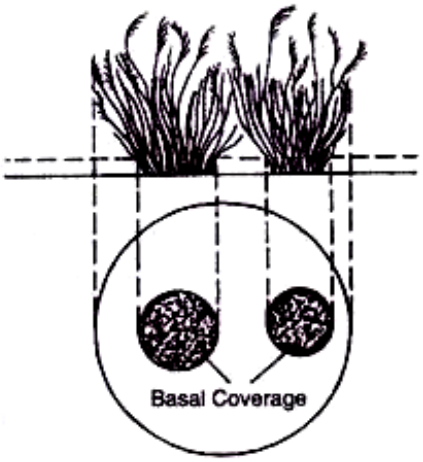


Fig. 6.11. Herbage cover of two clumps of grasses. Basal coverage of each clump one inch above the ground level is shown by shaded smaller circles and total coverage by large circle.

Total basal area =Basal area per tree X number of trees (basal area for tree)
The average cross section area of one stem X the density (no. of individuals per unit area)
Relative dominance (R.D.) is the proportion of the basal area of the sum of the basal coverage of all the species in the area.
Relative dominance = Total basal area of the species in all the quadrats/ Total basal area of all the species in all the quadrats X 100

5. Total estimate

It is probably the best method for obtaining a complete general picture of a plant community. Total estimate = abundance + coverage

Scale as suggested by Braun- Blanquet is as follows:

a. Individuals of a species very few --- coverage very poor
b. Individuals numerous – coverage 5% of the total area
c. Individuals few or many – coverage 25 to 50% of the total area
d. Individuals few or many – coverage 50 to 75% of the total area
e. Plant species over 75 to 100% of the total area

C. **SYNTHETIC CHARACTERS**

These are determined after computing the data on the quantitative and qualitative characters of the community. For comparing the vegetation of different areas, community comparison needs the calculation of their synthetic characters. Synthetic characters are determined in terms of the following parameters.

1. Presence and constance:

It expresses the extent of occurrence of the individuals of a particular species in the community, i.e. how uniformly a species occurs in a number of stands of the same type of community. The species on the basis of its percentage, frequency may belong to any of following five presence classes that were first proposed by Braun- Blanquet

i. Rare -- present in 1 to 20% of the sampling units
ii. Seldom -- present in 21 to 40% of the sampling units
iii .Often present – present in 41 to 60% of the sampling units
iv. Mostly present – present in 61 to 80% of the sampling units
v. Constantly present—present in 81 to 100% of the sampling units

2. Fidelity

The term fidelity refers to the faithfulness of a species to its community. Some species are confined to one particular community and they are called indicator species. Some can flourish in several communities. According to Hanson it is a measure of ecological amplitude. Pandeya (1960) observed that characteristic species with high fidelity value has low ecological amplitude. Ecological amplitude of a species is the capacity of growing and reproducing within a certain range of environmental condition. Braun- Blaquet recognized the following classes of species on the basis of fidelity.

Fidelity Classes	Characters
Class—1	**Strange species** or **accidentals** which are either intruders from other community or relics from other successional stages.
Class—2	**Indifferent species** or companions which have no preference or affinities for any community.
Class—3	**Preferential species** which may be found in several communities but have affinity for only one community.
Class—4	**Selective species** which may occur rarely in other communities but have strong affinity to one particular community.
Class—5	**Exclusive species** which occur exclusively or almost exclusively in one community.

Species of 3rd,4th and 5th fidelity classes are called characteristic or key species of the community.

3. Importance Value Index (IVI)

This index is used to determine the overall importance of each species in the community structure. In calculating this index the percentage values of the relative frequency, relative density and relative dominance are summed up together and this value is designed as IV or importance value index of the species. It [provides the idea of the sociological structure of a species in its totality in the community, but does not indicate its position separately with regard to other aspects.

For IV calculation (RD + RF + RDo)

Relative Density = Density of the species/ Total density of all the species X 100

Relative Frequency = Frequency of the species/ Total frequency of all the species X 100

Relative Dominance = Dominance of the species/ Total dominance of all the species x 100

4. Other synthetic characters

Besides these other synthetic characters include interspecific association, association index, index of similarity, dominance index, diversity index, etc.

Several methods have been used by ecologists for studying a community which are as follows:

1. QUADRAT METHOD

The quadrat is a square sample plot or unit for a detailed analysis of vegetation. It may be a single sample plot or divided into several subplots. In vegetational analysis, quadrat of any size, shape, number and arrangements may be used. In the study of a forest community quadrat of one fifth acre are established to include maximum number of trees while for studying shrubs and grass covers usually quadrats of smaller size

are used (one square meter size or 50 cm X 50 cm or 20 cm X 20 cm size). In some cases rectangular plots give best results where the ratio of breadth and length is 1:2 or 1:4 or 1:8

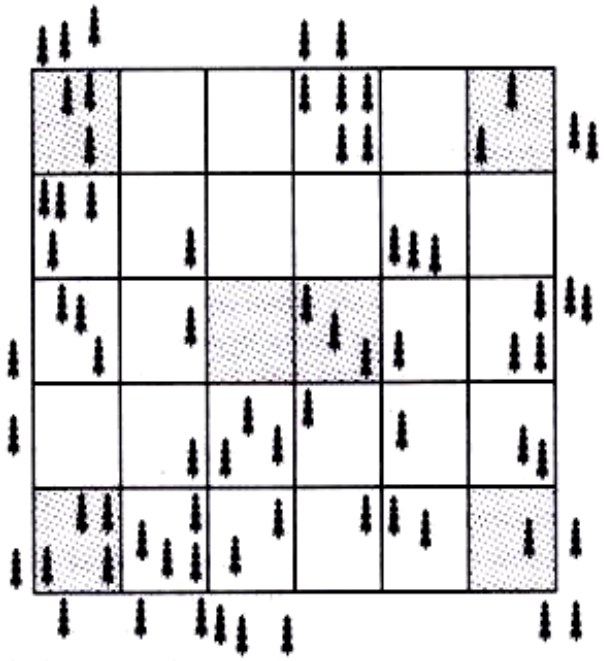


Fig. 6.4. Quadrat sampling method for population estimation. 8.

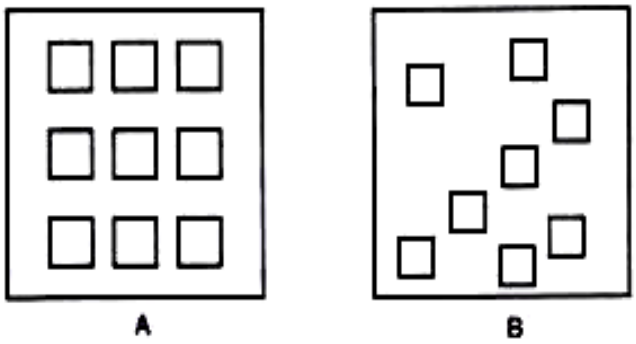


Fig. 6.5. A and B—Arrangement of quadrats in the study area
A—Systematically distributed quadrats. B—Randomized quadrats.

There are **following types of quadrats**

a. **List quadrat**

When the organisms encountered in the sample plot are listed by their names. A series of list of quadrats gives floristic analysis of the community.

b. **Count quadrats or list-count quadrat**

When the species name and the number of individuals of each species found in t he sample area are recorded the sample plot is called count or list- count quadrat.

c. 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 called cover quadrat.

d. Chart quadrat

Quadrats that are mapped to scales to show the location of individuals of species are called chart quadrat. Individual plants are recorded on miniature quadrqt on a graph paper with the help of an instrument called **Pantograph**. On the map of the area under study a series of horizontal and vertical grid lines are laid and then these lines are numbered.

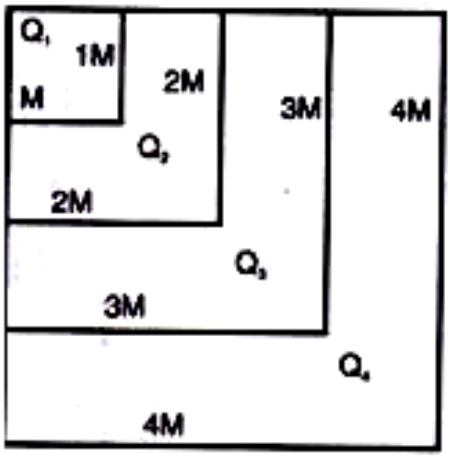


Fig. 6.6. Nested quadrats.

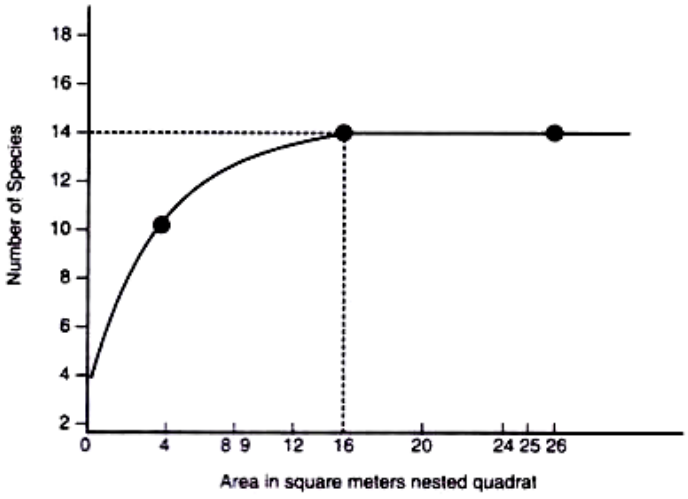


Fig. 6.7. Species-area curve.

Such a curve is obtained because as the size of sample plot is increased the number of species increases.

2. TRANSECT METHOD

A cross section of an area used as a sample for recording, mapping or studying vegetation is called transect method. It may be a strip, belt or a line across the area of study. The species occurring along these stripes or lines are recorded. Transect are either belt or line as shown below :

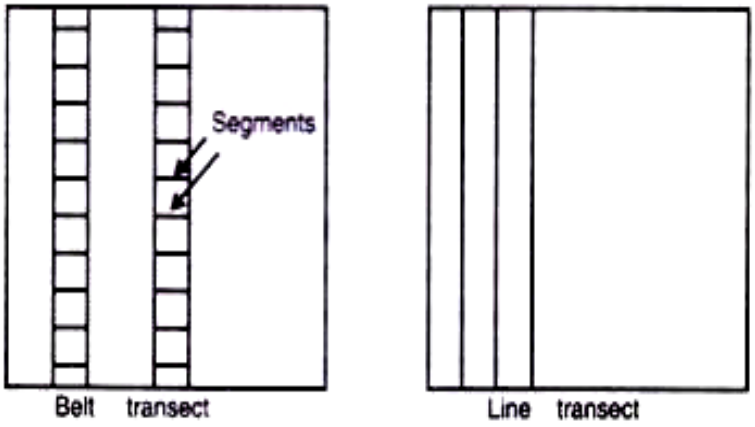


Fig. 6.8. Transects

3. LOOP METHOD

This is a simple, accurate and quick method for sampling of only grassland and low herbaceous communities. It is used for determining community composition, species frequency and range condition. In this method equally spaced 100 small circles or loops located along a stretched line are used as observation points.

4. POINTLESS OR POINT METHOD

In this method of sampling observations are taken on the point in the study area where a nail or set of nails touch the ground on grid lines or at random places.

In point frame method a frame like scale is used which is supported by a pair of legs. The frame bears 10 equidistant holes having 60 cm long pointers or pins. It is placed one after another at several observation points. The plant species that are hit by the pointers or nails are recorded.

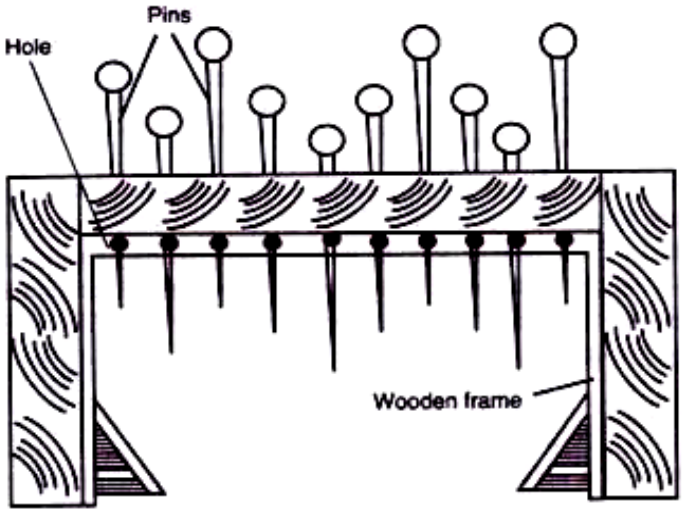


Fig. 6.9. Point frame apparatus.

In **point centre or quarter method** four measurements are taken at each observation points. Quarter method uses an easy instrument which consists of a brass needle or a nail fitted with rubber cork and compass on the top.

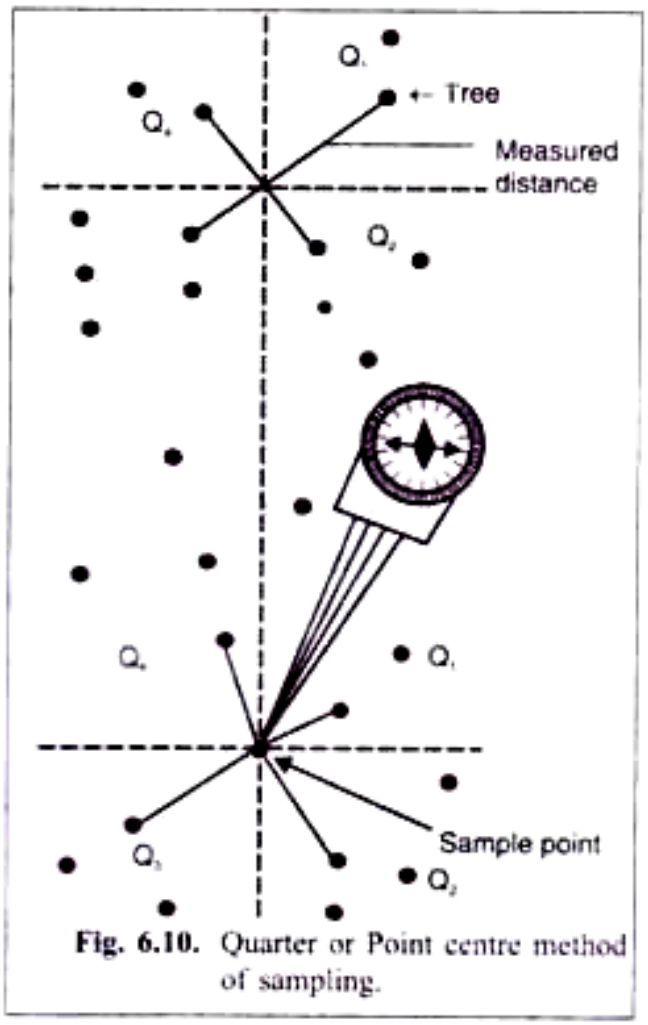


Fig. 6.10. Quarter or Point centre method of sampling.

At each observation point needle is fixed, the working area is divided into four quarters and then plant species nearest to the central point is spotted and recorded. The distance from the central point iand also the basal diameter of the plant is measured (Tally of 50 is to be recorded).

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