CHAPTER 3

Landscape Surveying

Topics Covered : Landscape Study ; Transect Surveying ; Quadrat Method ; Constructing a Sketch ; Photo and Video Recording ; Different Strategies.

3.1 Landscape Study

A landscape is part of the Earth's surface that can be viewed at one time from one place. It consists of the geographic features that mark or are characteristic of, a particular area. The term 'Landscape' comes from the Dutch word *'landschap'*. The name was used to paintings of the countryside. Geographers have borrowed the word 'Landscape' from artists. Geography uses this concept since Humboldt, which pointed out its spatiality and its physical and cultural characteristics. A natural landscape is made up of a collection of landforms, such as mountains, hills, plains, and plateaus. Lakes, streams, soils (such as sand or clay), and natural vegetation are other elements of natural landscapes. Landscape survey is a research tool for understanding the landscape, through a range of allied non-invasive analytical techniques, which can be applied at different scales and resolutions. The purpose of landscape survey is to locate both natural and man-made topographic features on a parcel of land.

3.2 Transect Surveying

3.2.1 Concept and Definition

A transect is a line following a route along which a survey or observations are made. It is an important geographic tool for studying changes in human and/or physical characteristics from one place to another along a line. That's why it is sometimes known as the line transect method of data collection. Line transects are used when a researcher wishes to illustrate a particular gradient or linear pattern along which communities of landscape features particularly plants and, or animals change with space. An urban transect, usually following a street or several streets, may identify changes in land use patterns like the nature of buildings /houses, shops, schools, churches, community centres, and parks, etc. A rural transect, on the other hand, might follow a road, or stream, and identifies all kinds of features or land use patterns like crops in adjoining fields, farm buildings, vegetation cover, or any man-made features. In this case, however, both the line transect and the belt transect concept are introduced.

Line transects identify features along the actual line selected while the belt transect follows the features on either side of the selected line. Depending on the kinds of features being observed, transects can be a single straight line, straight line segments, or curved lines.

3.2.2 Type of Transect

Depending upon the object of study, two types of transect can be drawn : (a) Line Transect or Line Intercept, and (b) Belt Transect.

➡ Line Transect

1 Concept : In this type of transect the landscape is surveyed only along a line (with-out any width). A line is laid over the earth's surface with a metric steel tape or steel chain or long rope and kept fixed with the help of pegs or hooks. The surveyor will start recording the data or scene from one end and will gradually move to the other end.

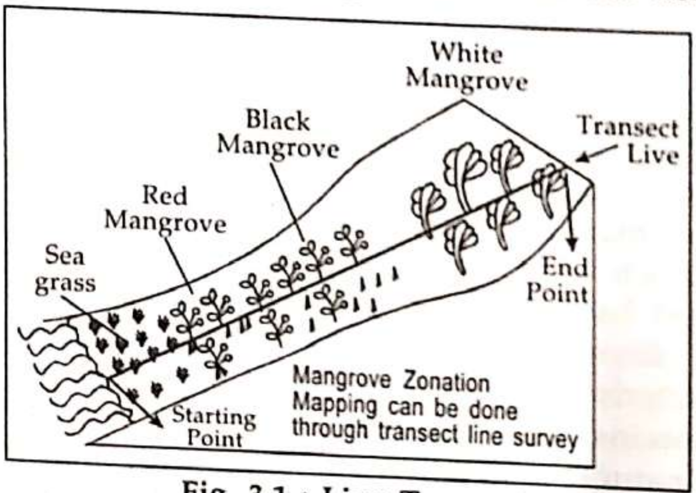


Fig. 3.1 : Line Transect

2 Methods : (a) Planning : Select the transect route carefully and identify the starting and ending points of the study. Transect route should be made carefully to ensure that the line will pass through a variety of zones, As a result, transect will provide meaningful information and documents after surveying.

(b) Mapping : Once the route has been selected, it should be drawn carefully on an appropriate map of the area collected earlier. Then, the researcher will follow the route or selected line and note point to point data on the field copy of the map. This will make the first draft of the desirable transect (Fig. 3.1). It's a good idea to write a brief description of features that you see along the path for future reference as well as further surveying.

(c) Presentation : After field, mapping researcher should be encouraged to prepare the final output of the transect route. First, the researcher will copy or trace the field route to prepare a new map. Second, they should use appropriate symbols/shades/ colour to show the features and changes along the route. Third, brief notes about features can be written on either side of the transect route. Fourth, transect presentation will have a title, legend, and a rough scale.

(d) Analysing : The completed transect route can be used to analyse the changes (concerning any earlier map) and the possible relationships between physical and cultural features. If another student selects the same route or segment of a route for the survey, the two transects can be analysed in terms of the similarities and differences, and the varying perceptions arisen from the same area of study.

➡ Belt Transect

1 Concept : Belt transects are basically used in the biogeographical or ecological study to estimate the distribution of living organisms (mainly plant communities) in a specific area, such as the seashore or a meadow. The belt transect method is similar to the line transect method but gives information on abundance as well as presence, or absence of species. The width of the belt is to be determined according to the objective of the study. If any researcher wants to make a biological resource mapping of a sea beach, he or she can select a belt transect having a minimum width of 1m and a maximum of 10m. In close herbaceous vegetation zone, it is usually 10 cm, but it varies from 1 to 10m in woodland. A belt is generally studied by dividing it into some equal-sized segments. The length of each segment is generally equal to the width of each transect. These segments are sometimes called quadrats (Fig. 3.2).

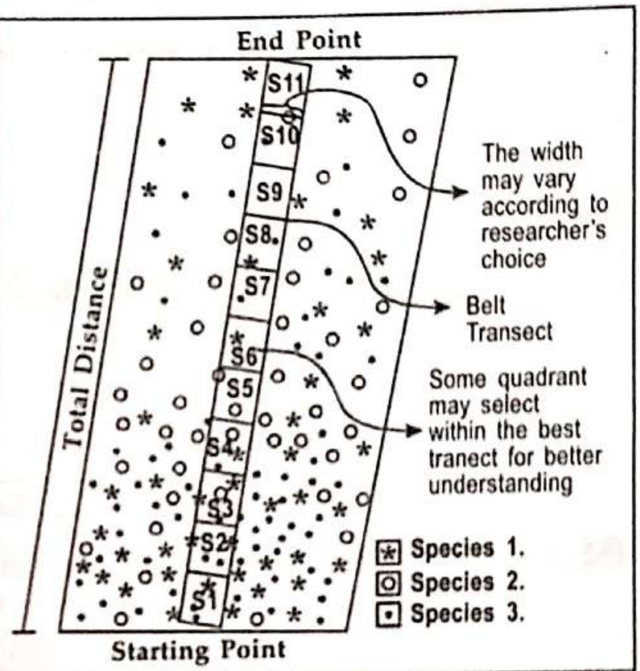


Fig. 3.2 : Belt Transect

2 Method : (a) First, the researcher has to think about where he/she will apply the belt transect method. Because belt transect study require smore time than line transects.

(b) Second, the researcher has to select an appropriate zone for the construction of a belt transect keeping in mind all the pros and cons.

(c) Third, the researcher will divide the transect into number of segments depending on the objectives of the study as well as several considerations like the slope of the surface, density of species, density of bioturbation activity, etc.

(d) Forth, the researcher will observe and record all the features or species with on the area marked along with a short description.

(e) Finally, the survey sheet covering all observable features/species will prepare. For proper identification of the objects, different symbols or colour will be used.

3.2.3 Examples : A morpho-biological study of a beach using transect

■ **Example 1** : The following sketch (Fig. 3.3) shows the morphological and biological signatures of a beach in a tropical region. How would you study all the signatures through a transect and relate it with the hydrological character ?

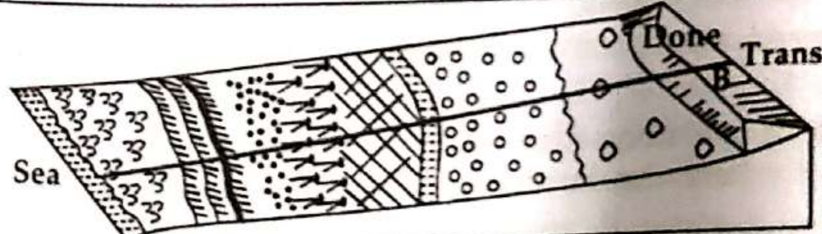


Fig. 3.3 : Beach Transect Survey

Solution

1 Methodology : To understand the beach morphological signature and its relation with the hydraulic action as well as the biological activity of the beach in relation with the tidal condition, the field survey through a transect is very useful. First, a transect-AB is drawn from east to west (suppose). Student can start his survey from a starting point (A) of Low Tide Line (LTL) to theending point (B) of High Tide Line (HTL). Along his/her journey different features (macro or micro) are to be recorded in the field book along with a schematic representation. The schematic representation (Fig. 3.4) should be hand drawn based on an estimated scale.

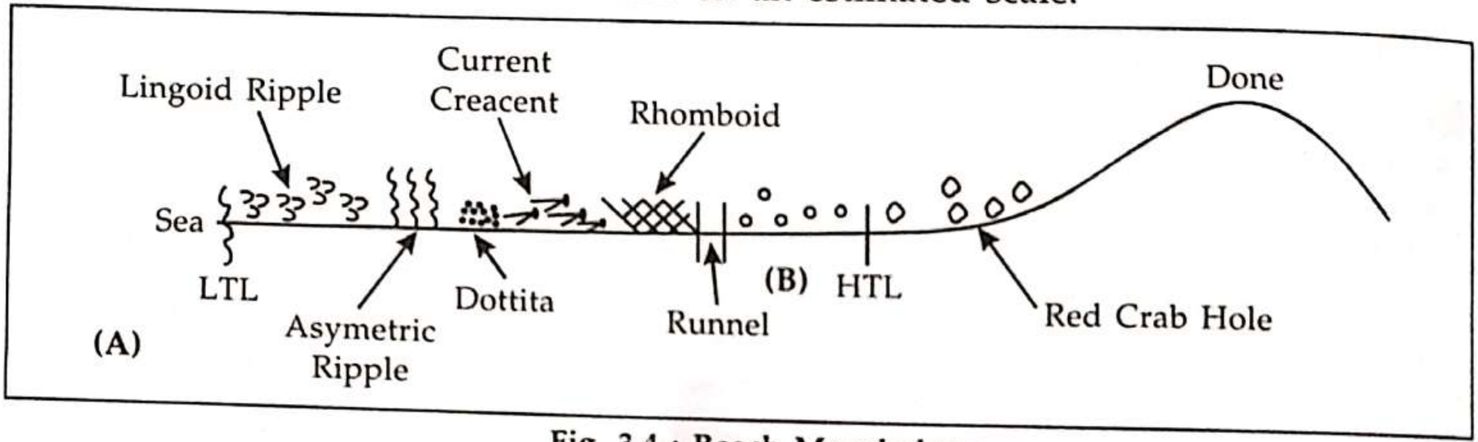


Fig. 3.4 : Beach Morphology

2 Result : After schematic representation of the transect, some phenomena of the beach will appear. (a) Moving from A to B you will find : (a) lingoid ripple (that can be developed where there is an effect of current as well as the presence of mud), (b) asymmetric ripple, (c) dottila, (d) rhomboid ripple, and (e) current crescent (that develops between the HTL and LTL). Dottila is the most artistic creature of the sea beach that always makes some "rangoli" type features through their grazing remnants. These are found basically near the LTL due to organic richness. The red crab holes, on the other hand, are found near the HTL. However, after every high tide, crabs spread all over the beach and eat food from the organic detritus and make some biogenic signature called grazing mark.

3.2.4 Evaluation of Transect Method

- **Merits :** (a) It is more economical due to the lesser requirement of survey instruments.

(b) Through a liner transect, any surveyor can easily understand the rate and frequency of changes at any time.

(c) A larger area can be covered in a very short period.

(d) If any researcher registered any permanent transect through GPS, he/she can temporally study that zone.

(e) This method can be used in any accessible and manageable place. This method is most suitable for a hilly tract where the landscape changes rapidly with time.

- **Demerits :** (a) Distances are not always properly measured due to the high density of vegetation or undulation of the landscape.

(b) The linear movement of the observer may disturb by several land barriers.
(c) It is also a labour-intensive work.
(d) This method surveys a small section of a natural area.

3.3 Quadrat Method

3.3.1 Concept and Definition

When a researcher wants to know what the change is in a biological signature in a sea beach, or an ecologist wants to know how many organisms there are in a particular habitat, it would not be feasible to measure or count them all simply by a transect method. Instead, they would be forced to count a smaller representative part of the population, called a sample. A sampling of morphological signature, plants, or signature of slowly moving animals (such as worms) can be done using a sampling square called a quadrat (Fig. 3.5). A quadrat is a sample plot of a specific size used for the study of population or a community. A quadrat is typically a square frame constructed of plastic or PVC pipe, metal rod, or wood that is placed directly on top of any physical landscape. Quadrats are also commonly called "plots." Quadrat sampling is a classic tool for the study of ecology, especially biodiversity.

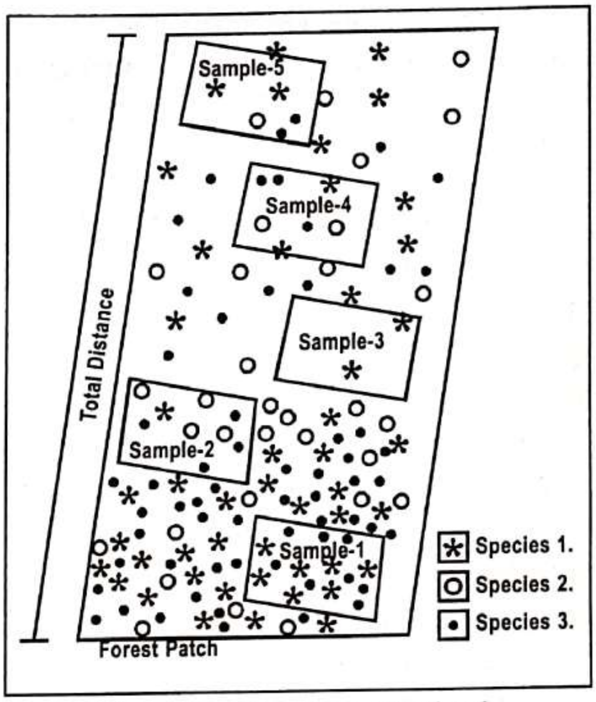


Fig. 3.5 : Quadrat Method

3.3.2 Methods

1 Random Sampling : Ecology is often referred to as the "study of distribution and abundance". The researcher usually has to estimate the abundance of organisms by sampling them or counting a subset of the population of interest. Random sampling using a quadrat involves the placing of quadrats at random coordinates. A random sample is one where every potential sample plot within the study area sample has an exactly equal chance of being chosen for sampling. True random sampling usually requires the use of a random number table or a random number generator. Frequency indicates the number of times a plant species is present within a given number of sample quadrats. It is measured by noting the presence of a species in random sample areas that are distributed as widely as possible throughout the area of study.

2 Quadrat Framing : Quadrat sampling is based on the measurement of replicated sample units referred to as quadrats or plots. Quadrat frames are uniform sizes and simple to move, making them useful for small sample plots. One-square-foot quadrat frame (1×1) is suitable for counting small plants and three-square-foot (3×3) or 1×3 square foot rectangular quadrat frame for counting larger plants. It is not mandatory that Quadrats have to be square. Any researcher may select other quadrat shapes commonly include circles and rectangles. If there is a large sample plot of counting shrubs and trees, wooden stakes with ribbon or flagging tape tied to one end can be used to mark each of the 4 corners. You can also use tent pegs instead of stakes.

3 Selecting a Sample Plot Size : Whether you will use the quadrat frame method or string-and-stakes method to establish sample plots, either choose the sample plots randomly throughout the study area or create a grid over the study area and place a sample plot in one corner of each grid unit.

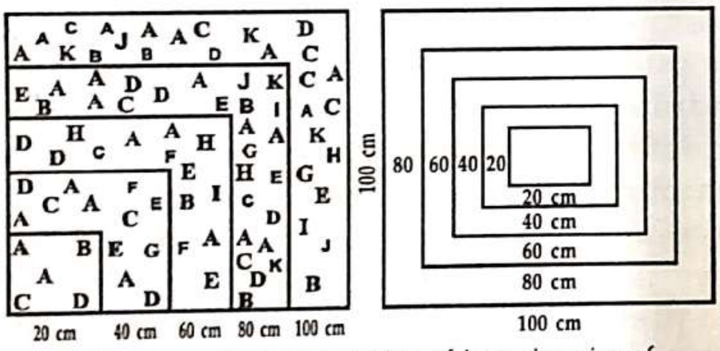
4 Calculation : Cover, density, and frequency are important aspects of the plant community which can be measured by quadrat sampling. The cover is the percentage of quadrat area beneath the canopy of a given species. Density is determined by the number of plants rooted within each quadrat. Frequency is the percentage of total quadrats containing at least one rooted individual of a given species. Frequency is affected by quadrat size.

3.3.3 Determination the Size of the Quadrat

A quadrat is a minimum sampling unit of any landscape whether physical or ecological. The shape of a quadrat may be of different types as discussed earlier. The size of the quadrat also varies with the type of work to be studied viz. type of vegetation, the character of a geomorphic feature, etc. The size of the quadrat, in which maximum diversity of species or geomorphic features can be recorded, is called as the minimum size of quadrat for that area. The minimum size of the quadrat suitable for a particular area can be estimated by species-area curve or geomorphic feature area curve method.

■ **Example :** 10 quadrats of several size starting from 10cm×10cm up to 100cm×100cm.

● **Procedure :** At first a small quadrat of 10cm×10cm is laid randomly in grassland and the number of species is noted. The size of the quadrat is increased from 20cm×20cm, 30cm×30cm....100cm×100cm and the number of species are noted in respect of each quadrat. A graph is drawn based on a number of species in respect of each quadrat. The point at which the curve starts flattening up should be the minimum size of the quadrant (Fig. 3.6).



Diagrammatic representation of increaing size of quadrats and the number of species

Observations :

Relationship between size of quadrat and number of species

Size of quadrat (cm × cm)	No. of species
10 × 10	5
20 × 20	17
30 × 30	27
40 × 40	30
50 × 50	30

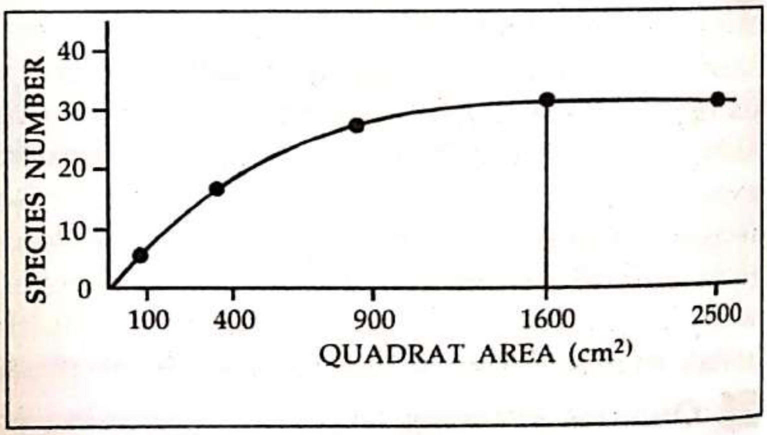


Fig. 3.6 : Species Area Curve

➡ **Result :** Result shows that 50cm×50cm=2500cm^2 is most effective for plant diversity studies in this study area.

3.3.4 Determination the Number of the Quadrat

After identification of the minimum size of the quadrat, it is necessary to find out the minimum number of quadrats to be used for the study. We will proceed here with the result of the previous method.

■ **Example :** Quadrat of size 50cm×50cm.

• **Procedure :** Quadrat of minimum size (50cm×50cm) is laid randomly in the field and the number of species falling in each quadrat is noted. By increasing the number of the quadrat, the effect of the species is observed. About 25 quadrats are studied. A graph is drawn based on the number of quadrats and the number of species in X and Y axis respectively (Fig. 3.7). The point, where the graph starts flattening gives the idea of a minimum requirement of number of quadrats.

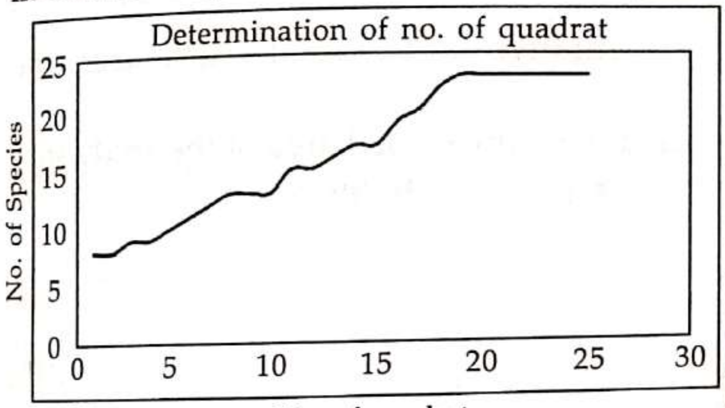


Fig. 3.7 : Quadrat Species Curve

Number of quadrats	Number of species	Number of quadrats	Number of species
1	8	14	17
2	8	15	17
3	9	16	19
4	9	17	20
5	10	18	22
6	11	19	23
7	12	20	23
8	13	21	23
9	13	22	23
10	13	23	23
11	15	24	23
12	15	25	23
13	16		

Result : The result shows that if the 20 quadrants are taken then the largest amount of species can be included in the study.

3.3.5 Determination of Population Size and Density

Population size and density can be estimated through calculations based on counts within a representative area or all of the selected areas. Average estimates of population size and density for the entire area can then be determined based on the following calculations. Quadrat sampling is most effective for stationary species, such as the populations of different tree species in a forest. For the most valid and reliable information, the sampling should be random and should make up about 10% of the total area being studied.

• **Formula :** Average Sample Technique = $\frac{\text{Total Number of individuals}}{\text{Total Sample Area}}$

Estimated Population Size = (Estimated population density) × (Total area of the study site)

■ **Question :** A student wants to estimate the population size and density of Sal trees in a Patch of forest measuring 100m by 100m. On a diagram of the woodlot, he splits the area into a 10m×10m grid and randomly selects 10 samples and registered them by a unique id namely A1 to A10. These areas of the forest patch are marked off, and the Sal trees are counted. He finds 15, 25, 40, 20, 10, 30, 25, 5, 15, and 35 trees in the ten quadrats. Estimate the density and size of the Sal tree population in that forest patch.

➡ **Solution :** An estimate of the population density of the Sal trees may be obtained by calculating the average density of the sampled quadrats. Each sample quadrat has an area of 10 x 10=100 m².

$$\text{Average Sample Technique} = \frac{\text{Total Number of individuals}}{\text{Total Sample Area}}$$

$$\text{Average Sample Technique} = \frac{15+25+40+20+10+30+25+5+15+35 \text{ Sal tress}}{(10\text{m} \times 10\text{m}) \times 10\text{m}}$$

$$= \frac{220 \text{ Sal tress}}{100\text{m}^2}$$

$$= 0.22 \text{ sal trees/m}^2$$

Now, assuming that the sample area is representative of the total study area, the estimated population density is,

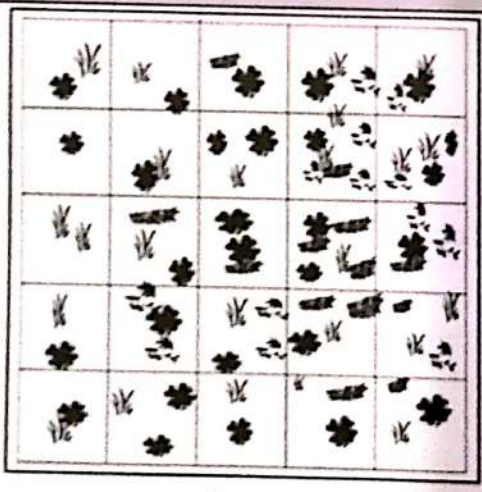
Estimated Population Size = (estimated population density) × (total area of the study site)

Estimated Population Size = (0.22 Sal trees/m²) × (100m × 100m)

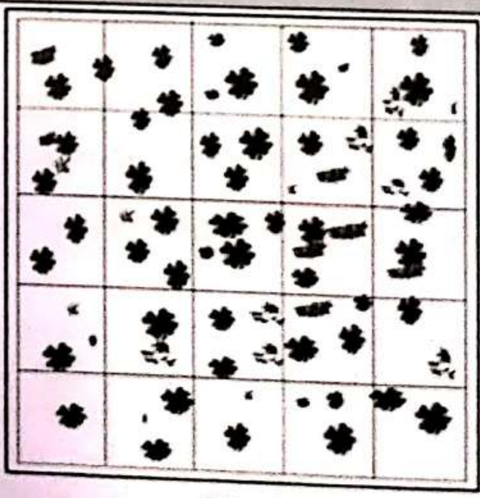
Estimated Population Size = 2200 Sal trees.

3.3.6 Determination of Species Diversity

■ **Question :** Try to calculate the plant diversity of two different sites (site 1 & site 2 sketches given below) using two quadrats. Which site exhibits more diversity?



Site-1



Site-2

➡ **Formula :** Plant Diversity can be calculated using the Shannon-Weiner Index(D′)

The formula of $D' = -\Sigma\left[\left(\frac{N_i}{N}\right) \times ln\left(\frac{N_i}{N}\right)\right]$

Where,

N_i = Number of individual or amount of each species

N = Total number of species in the site

Ln = The natural log of the number (it is available in any scientific calculator).

N.B : The Shannon index has been a popular diversity index in the ecological literature, where it is also known as Shannon's diversity index, the Shannon-Wiener index, the Shannon-Weaver index, and the Shannon entropy. Its value ranging between 0 and 5. There is a positive relation between Plant diversity and Shannon-Weiner Index(D′), i.e., the higher the index value, the higher the plant diversity

Solution :

Table 3.1 : Calculation table for plant diversity analysis of site 1

Site-1			
Species	**No. of the individual (N_i)**	**Total individual (N)**	$\left[\left(\frac{N_i}{N}\right)\times ln\left(\frac{N_i}{N}\right)\right]$
	13	78	– 0.2986
	13		– 0.2986
	28		– 0.3677
	24		– 0.3626
			$D' = -\Sigma\left[\left(\frac{N_i}{N}\right)\times ln\left(\frac{N_i}{N}\right)\right] = 1.3275$

Table 3.2 : Calculation table for plant diversity analysis of site 2

Site-2			
Species	**No. of the individual (N_i)**	**Total individual (N)**	$\left[\left(\frac{N_i}{N}\right)\times ln\left(\frac{N_i}{N}\right)\right]$
	8	75	– 0.2387
	7		– 0.2213
	53		– 0.2453
	7		– 0.2213
			$D' = -\Sigma\left[\left(\frac{N_i}{N}\right)\times ln\left(\frac{N_i}{N}\right)\right] = 0.9266$

• **Result :** We have counted the total no. of species and then the total number of individuals per species and properly tabulated them. After that Shannon-Weiner Index (D′) has been applied to calculate the plant diversity of two places namely site-1 and site-2. The result shows that, although the total number of individuals between the two sites is almost the same, there is a clear big difference in plant diversity. According to D′ there is a positive correlation between Plant diversity and Shannon-Weiner Index (D′), i.e., the higher the index value, the higher the plant diversity. As per result, the D′ of site-1 is 1.3275 whereas it is 0.9266 for site-2. So, it is clear that site-1 is more diversified than site-2 in plant species.

N.B. : Students can also count the number of individuals in a species on a more micro level. In that case, they have to divide a quadrat into several sub-quadrat and make the numbering of each sub-quadrat like A1, A2, A3, B1, B2 etc. After that, they have to count the same according to the sub-quadrat and calculate the plant diversity according to the method as mentioned above. From the diversity result of each sub-quadrat, they can initiate a choropleth map of plant diversity richness of the study area.

3.3.7 Evaluation of Quadrat Method

■ **Merits :** Compared to other sampling methods, quadrats are relatively simple to use. Quadrat plots are uniform in size and shape and distributed randomly throughout the sample area, which makes the study design straightforward. They are also one of the most affordable techniques because they require very few materials. Quadrat sampling is reasonably demanding since researchers usually count the individuals within each plot in the field.

■ **Demerits :** Despite the relative ease of designing quadrat studies, it is expected to introduce errors into a project. Quadrats that are too large, too small, or spaced inappropriately often result in errors. For example, larger species require larger plots. Randomly spaced quadrats that are too small might miss too many individuals, resulting in under-representative estimates of population size. Researchers who are inconsistent when counting or omit species that lie only partially within the boundaries may also introduce errors and the result represents biasness.

3.4 Constructing a Sketch, Photo and Video Recording

Data collection is one of the most important stages of conducting research. Researchers use different methods to collect data from the selected sample. Qualitative data collection methods include individual interviews, focus groups, observations, action research, and case studies, etc. On the other hand, questionnaires, experiments, survey interviews, etc. are the major quantitative methods in field research. Field researchers use a variety of strategies to record notes or information while in the field. A field researcher needs to record any potentially useful data thoroughly, accurately, and systematically, using field notes, sketches, audiotapes, photographs, and other suitable means considering ethical principles of research. Notebook, iPad, smartphones, laptop, digital camera, audio recorder, camcorder, etc. are the popular instruments or tools for recording data or observations. However, strategy for recording observations while in the field will be determined mostly by the site you choose and the role you play in that site.

There are many cases in the field to record what is being observed with or without the instruments. Most commonly these include taking notes, taking photographs, and drawing of sketches. But it is important to select the most effective and efficient method for recording what is being observed. Sometimes, more than one recording tool may be used.

3.5 Different Strategies

3.5.1 Field Sketch

■ **Concept :** Making field sketches is one of the important ways of recoding a real-world situation. Sketching provides a broad overview of the relevant features under study. Sketching is an ideal tool for studying micro-level land-use patterns. When taking sketches, students should note the date and time, sketch number, location/site number with the north line, and title of the sketches. Sketching may complement photographs. Sometimes, smaller bits of information may be stored in sketches that are left out in photographs. However, the main drawback of sketching is the scale of drawing this may be larger or smaller than the real.

■ **Construction :** Divide an A4-sized white or tracing paper into different sections and place the paper onto a clipboard as a support when you are sketching. Look through the sketching frame to view the area or landscape that you wish to sketch. Draw the objects as they are seen in each section—Include only feathers those are related to your study. Students should not seek to reproduce every element of the place (landscape) being observed. Label the features in your sketch and add brief notes to explain the features that you want to highlight. Include a title and information such as sketch serial number, date, time, and location for future reference. Location coordinates (latitudes and longitudes) along with photographs may be taken with the hand GPS to support your sketch as well as for referencing during map preparation.

3.5.2 Photographs

■ **Concept :** Photographs are largely used in any type of field study for recording features in the field site for future reference. This is a very quick way method to capture information about a landscape or feature. Photographs can be taken even by smartphones, or cameras. They are more accurate than field sketch. Proper data collection techniques may also be justified only with the photographs. Photographs are ideal for studying temporal changes of landscape features. But the three-dimensional landscaping may not be measured by simple photographs. Besides, students often take irrelevant photos (mainly photos of their friends) that are not worthy of the field report. However, the advantage of a digital camera is that it can be used for transmitting those images to a monitor screen when the need arises.

■ **Construction :** Capture actions or activities which are short-lived e.g. people movement, traffic flow, etc. simply by taking shoots. Before that, focus on object or feature(s) by holding a camera such that the subject fills the frame. Indicate the size of the feature(s) in the photograph. For larger features, take the photograph with people inside. For smaller features, place a pen or coin against the feature. Multiple photographs can be taken to capture a feature at different angles or to allow selection of the most suitable photograph. Write notes on a diary or notebook about photograph number, date, time, location, and a brief description for future reference. Co-ordinate location of the objects may be taken by hand GPS, if possible.

3.5.3 Audio and Video Recording

■ **Concept :** Recording Interviews is a common practice for qualitative data collection methods. Since interviews often contain open-ended questions and discussions may diverge from the interview guide, it is generally best to tape-record interviews and later transcript these tapes for analysis. Audio information also provides alternatives to print data collection system. However, respondents are often uncomfortable when they know their remarks will be recorded word-for-word.

Sometimes, during interviews, the data can be collected using both video recording and audio recording. The instrument is commonly known as a camcorder. Video recording may eliminate some of the challenges that occur in direct observation research since video recording accurately records real-time environment including all forms of feedbacks by the respondents. Video data can also give researchers insight into the consistency between self-assessment and observable behavior. However, for the collection of sensitive information during an interview, a camcorder might not help to maintain the subject's privacy.

■ **Construction :** Audio, video, and digital recordings (AVD) of research participants are considered identifiable data as they include images and/or voices of research participants. Therefore, when using AVD recordings, students must follow the ethical instructions designed by the IRB (Institutional Review Board, if any) for maintaining the confidentiality of the participant(s). Before recording, it is also important to convey participants about : how you will use AVD data, who will have access to the data, how you will protect the participant's identity and how the recordings will be kept secure. An informed consent document (ICD), regarding these issues, may be signed by the participants and should be kept in the institute custodian.

There are a few different ways to record an interview or discussion. This may be done with the recorder or camcorder. You may use your smartphone for the purpose by screen recording and/or video editing options. Audio recordings may pick up background noise that could be removed by different editing software. The microphone of your smartphone should be on before starting recording. The microphone button controls whether or not audio is recorded as part of your discussion. If you have a webcam attached to your computer, you can also record camera video during the discussion. Cloud App, SnagIt, Camtasia, Go play, etc. are the popular free software for smooth video recording.

GLOSSARY

- **Runnel** : A trough that runs parallel to the beach, often trapping water. Water may move out of the runnel between ridges. Runnels occur on sandy beaches with a low overall gradient, which often results from a surfeit of sand.
- **Ripple** : In sedimentology, wave-formed ripples or current-formed ripple marks are a feature of sand dominated beaches and dunes. These ripple marks are often characterised either by symmetric cross-sections with relatively straight crests or by asymmetric cross-sections with inclined crest.
- **Plant Diversity** : Plant diversity refers to how many species of trees in a specific area. It is worth mentioning that diversity and the number of plants is not the same. It is often seen that even if the number of trees in a particular area is less, but diversity is more and vice-versa.
- **Focus Group** : A focus group is a small, but demographically diverse group of people and whose responses are studied especially in research.