INTRODUCTION

Field studies of vegetation began in the early nineteenth century with the work of Alexander von Humboldt (1805) in plant geography (Randall, 1978). This was a study of the spatial distribution of taxa and their evolutionary relationships, and has become the classic of the natural sciences concerning dispersal. Over time, various areas of specialization within vegetation study have developed and the approaches that have developed towards vegetation study are very widespread. Geographers as a group have largely concerned themselves with only parts of the subject matter.

The vegetation cover of the earth is extremely complex and, thus, all vegetation data gathering must be selective since it would be impractical to undertake total recording or description of vegetation. This results in two considerations being of prime importance: the type of data to collect and the spatial location of the sampling points. Before any method of vegetation sampling is used in the field a large number of considerations must be examined:

1. Firstly, the primary aim in making the data collection must be appreciated since too little or too much data and a lack or excess of data must be avoided. A decision must be made concerning the subjectivity or objectivity required. Frequently this resolves itself according to the qualitative or quantitative nature of the synthesis.

2. Secondly, considerations both of time and expense are needed. Both are usually limited and the normal requirement is the most useful information with the least amount of time and money spent.

3. Thirdly, the nature of the vegetation cover must be assessed. If it is particularly homogeneous, then the questions required to be answered must de facto be quantitative in nature since the observable differences will be slight. Conversely, if the vegetation is of a heterogeneous nature, then there may be obvious qualitative differences, although these may not be the most important or even the most
interesting ones.

Without a doubt, the most important consideration is the problem under study. Within the limits of scientific accuracy it will be this, rather than theory that decides the logistics of the survey.

Vegetation Parameters

Within the biogeographic literature there has been considerable discussion regarding "what we should map". A number of parameters have been used by various biogeographers and the more common are briefly described.

Any detailed vegetation study is based on description and investigation of plant communities or vegetation segments that must first be recognized in the field. Then, the vegetation segments must be sampled through analysis of representative segments. A 100 percent survey of even one vegetation segment would for most purposes be much too time consuming. Therefore, the description must be based on samples. Also, one must decide what parameters or statistics of the vegetation one should record or measure and what size and shape the samples should take.

Physiognomic Characteristics

Physiognomic (superficial analysis) or structure is a visibly outstanding feature of vegetation. For instance, in a typical forest ecosystem, one can use the component strata as a general structural definition. These strata consist of tree layer, shrub layer, herb layer, and often mosses and lichen layers. The latter may form a ground stratum, but more commonly mosses and lichens occur also as epiphytes and they are often associated with specific microsubstrates in a habitat such as outcropping rocks or decaying logs.

Species Characteristics

Most plant species are clearly distinguishable in the field and are consistent in their behaviour towards the environment reflecting its changes in a varying manner. The most objective measurement of a plant species is whether it is present or absent, but this allows for no assessment of the importance of the fact, not does it allow for examination of the function of the vegetation community. Frequently this will be the prime reason for vegetation study.

The most useful data to collect are some measures of the importance of each species. Ideally counts based on individual specimens are the most informative data but with grasses, for instance, this would be impractical.
Types of Data

Estimations

The most basic data one can collect are the numbers of individuals of each species in an area. If these numbers are estimated they are generally called abundance and classed in a few abundance classes:

eg. Braun-Blanquet (1965)

<table>
<thead>
<tr>
<th>Abundance Class</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Very sparse</td>
</tr>
<tr>
<td>2</td>
<td>Occasional</td>
</tr>
<tr>
<td>3</td>
<td>Not numerous</td>
</tr>
<tr>
<td>4</td>
<td>Numerous</td>
</tr>
<tr>
<td>5</td>
<td>Very numerous</td>
</tr>
</tbody>
</table>

Scales

Numbers data have sometimes been integrated into scales including other quantitative measures of community structure, such as the following cover-abundance scale:

eg. the Domin scale of cover-abundance

+ occurring as a single individual with reduced vigour; no measurable cover.
1 occurring as one or two individuals with normal vigour; no measurable cover.
2 occurring as several individuals; no measurable cover.
3 occurring as numerous individuals but with cover less than 4% of area.
4 cover up to 1/10 (4-10%) of total area.
5 cover about 1/5 (11-25%) of total area.
6 cover 1/4 to 1/3 (26-33%) of total area.
7 cover 1/3 to 1/2 (24-50%) of total area.
8 cover 1/2 to 3/4 (51-75%) of total area.
9 cover 3/4 to 9/10 (76-90%) of total area.
10 cover 9/10 to complete (91-100%).

Like abundance classes these scales are difficult to use accurately. However, where extensive surveys are carried out in a relatively short time, abundance and/or cover estimates are often the best method of data gathering despite their shortcomings.

Dominance

Cover alone is a feature of the vegetation associated with dominance. It is an estimation of the area of foliage of a
species projected vertically down to the ground. One use of cover estimates is by stratum in a multi-layer community, as this will give considerable insight into the vegetation.

Foresters use dominance and cover in a slightly different manner:

- dominance is always related to presence in the superior layer of the forest canopy.
- cover is estimated from the basal area at breast height and is a measure of the stump area if the tree were cut down at 1.5 m.

Cover

Cover may be estimated quantitatively rather than visually by means of point quadrats. Frames of pins are lowered one at a time and the species touched by each pin is recorded. The accuracy of this method though is dependent upon pin diameter. Obviously such methods are very tedious and time-consuming and are only worthwhile for a really detailed survey of a small area, and then only for low-growing vegetation.

If the prime interest in cover is a study of vegetation productivity, and damage to the plot is immaterial, then a measure of the actual weight of material - the standing crop or biomass may be best. This is usually limited to above-ground parts of plants and is expressed as dry weight per unit area.

Frequency

The measure of species that is perhaps most difficult to apply is frequency: the proportion of sample units which contain a given species. The measure is simply obtained by recording presence or absence with a series of quadrats, such that a species would have a 25% frequency if it occurred in 50 quadrats out of 200 thrown. Local frequency may be obtained by sub-dividing each quadrat and averaging the frequency in each quadrat. Five classes are sometimes used to summarize data:

eg. Raunkiaer (1934)

<table>
<thead>
<tr>
<th>Class</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>1-20%</td>
</tr>
<tr>
<td>B</td>
<td>21-40%</td>
</tr>
<tr>
<td>C</td>
<td>41-60%</td>
</tr>
<tr>
<td>D</td>
<td>61-80%</td>
</tr>
<tr>
<td>E</td>
<td>81-100%</td>
</tr>
</tbody>
</table>

Errors in estimation are small when compared with cover or abundance, but the frequency figure may be seriously distorted by quadrat size, plant size.
Sampling Designs

When the researcher has resolved the problem of what to sample, they are still faced with the questions of how and where to sample. In aiming for a plant community\(^1\) sampling two major approaches can be distinguished:

1. The Classification Method

The classification method aims to obtain a complete checklist of plants in a series of relatively small, environmentally uniform habitats. It tends to work well with communities that are homogeneous with regard to both dominant and subdominant species and layers of vegetation. As a rule the sampling intensity necessary is high, because of the need to sample for easily distinguished, recurring plant assemblages. Species presence or absence is considered more important than minor variations.

2. The Ordination Method

The ordination method evolved primarily from timber surveys and usually ignores details in pattern and composition of undergrowth species during sampling. It works well with communities that are homogeneous with regard to dominant species. The aim of this method is to describe plant communities through ordination\(^2\) by sampling either randomly, systematically, or subjectively along floristic continua or environmental gradients. Species presence or absence is considered less important than minor variations in quantity. The method is, therefore, primarily quantitative.

In spite of their differences, both methods compete in obtaining a thorough description of a restricted vegetation region or widely dispersed vegetation formation, such as a forest

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\(^1\) A plant community can be understood as a combination of plants that are dependent on their environment and influence one another and modify their own environment. The form, together with their common habitat and associated organisms, an ecosystem which is also related to neighbouring ecosystems and to the macroclimate of the region. However, in spite of their close relationships, because each species can exist also outside the community. Therefore, the ultimate unit of vegetation is not the plant community but the individual plant type (Muller-Dombois and Ellenberg, 1974).

\(^2\) Ordination has been defined as an arrangement of units in a uni- or multidimensional order. The emphasis is on the arrangement of sample unit (species or stands) by individuals rather than by group values. Ordination of stands is intended to expose and continuity, or discontinuity between stands (Muller-Dombois and Ellenberg, 1974).
or grass cover.

An Example of Community Sampling: Timber Survey Methods

Numerous quantitative tree analysis techniques have been developed in North America because of the natural distribution and diversity of tree species. The following example is presented only as an introduction to the range of possible methodologies (see Muller-Dombois and Ellenberg, 1974). It is intended to permit you to collect data using a point or quadrat method on tree density, and complete an analysis of structural and basal area.

Step 1: Mark out the boundaries of small-area-sample plot. Note that the plot boundaries must be accurately located because counting is involved in this exercise. In forest inventory work, systematic vegetation sampling is often done by strips or transects. The strip-width method depends on the size of the trees and their spacing. It must be possible to count the trees conveniently.

Ideally, your plot will consist of a 6 m wide belt-transect of 20 m length (120 m²). However, you must ensure that a minimum of between 45 to 50 individual trees in two general size classes³ (trees under 2 m tall and trees over 2 m tall) are present in your plot and it may be necessary to shorten/lengthen your plot length to accommodate this requirement.

NOTE: In sloping terrain, plot sizes should be slightly enlarged to allow for relating the quantitative information to areas on maps, which are horizontal projections. Slope corrections are applied by obtaining the slope in degrees with an Abney level and then by multiplying the downslope distance of the plot with secant of the slope. (eq. - on a 15° slope, a 10 m long plot would have to be enlarged to 10 X 1.035 = 10.35 m).

Step 2: Vegetation data will be obtained within individual subplots, one subplot at a time. In the ideal plot described above a total of eight subplots would be identified - each with the dimensions 3 X 5 = 15 m². Mark the boundaries of your

³ One objective of the quantitative plot method is to analyze and interpret the trend of numbers of individuals in size classes of the tree species in a stand. However, a trend can only be established when a sufficiently large number of individuals has been recorded; arbitrarily a minimum of 30 individuals per species provides a useful guide.
Step 3: Within each subplot collect the following data from all of the trees present:

a) **identify** the species.

b) **establish the basal diameter** of each tree. Diameter can be measured with a large callipers in the field or established from a measure of basal circumference.

Note: Standard diameter records are normally measured above a minimum diameter class (2.5-10 cm) at breast height (1.5 m above the ground). Trees with less than the arbitrary lower limit (saplings and seedlings) are usually enumerated in 30 cm height classes.

c) **establish the height** of each tree.

d) within each subplot collect increment core samples at breast height from a tree representative of the largest examples present.

Step 4: Compile the data in a summary table.

eg. Stand-structure analysis by plot method.

<table>
<thead>
<tr>
<th>Diameter at base class (cm)</th>
<th>Range (cm)</th>
<th>Number of trees in species</th>
<th>Average Height (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Douglas Fir</td>
<td>Red Cedar</td>
</tr>
<tr>
<td>40</td>
<td>(38-42)</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>75</td>
<td>(73-77)</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>3</td>
<td>5</td>
</tr>
<tr>
<td>Total, &gt; 3 cm</td>
<td></td>
<td>3</td>
<td>5</td>
</tr>
</tbody>
</table>

a. number of trees with over 3 cm basal diameter on 100 m² = 30/1.2. (To obtain an estimate of number of trees per hectare, multiple by 100).

119
Step 6: Analysis and Interpretation

The enumeration of species in relation to strip-width and strip-length allows calculation of the density (number) of each species per unit area. The diameter class record provides for subdividing the density estimate per species by size classes. This information can be utilized for a structural analysis, which may indicate the trend of development of tree populations in the community. At the same time the diameter record permits the conversion to another important measure, basal area (ba), which is the actual space covered by the tree stem. This is obtained using:

$$ba = \left(\frac{1}{2}d\right)^2 \times \pi,$$

where \(d\) stands for diameter.

In North American ecological studies it has become customary to use tree basal area (stem cover) as an estimate of dominance (Curtis 1959). In forestry, however, height is used as an estimate of dominance and basal area as the basic value for timber volume estimations.

References


