3b

Transect Sampling

1. Introduction

In some types of vegetation, the use of plots (Section 3A) may be impractical and prohibitively time consuming. Also, the point-quarter method (Section 3C) is often difficult to apply due to nonrandom distribution of the sampled individuals. Transects are useful in these instances and are especially advantageous and efficient in studies of contiguous stages in ecological succession (see Section 5D) or of communities at transition zones. Three major types of transects are introduced here.

A **belt transect** is a long strip of terrain in which all organisms are counted and measured. Knowing the width and length of the transect, one may use the computational procedures of plot sampling (Section 3A), considering the belt transect to be a very long rectangular plot. In addition, the belt may be divided into intervals representing zones to be studied, and each interval may be treated as a plot.

Another transect method, used mainly by plant ecologists, is the **line-intercept** technique. Data are tabulated on the basis of plants lying on a straight line cutting across the community under study. Because an area is not being sampled, only density indices and relative estimates of density can be calculated. Line-intercept transects have been widely used in grassland community studies, as true estimates of absolute density either cannot be made or are difficult to interpret because of the problem of distinguishing between individual plants. In cases where relative estimates are sufficient, line-intercept transects may efficiently obtain them.

A third transect procedure, used widely by terrestrial vertebrate ecologists, is the **strip census, or line transect** (Plant ecologists use the term line transect synonymously with line-intercept, although the two are different sampling techniques.) A strip census involves walking a line established through an area and recording individuals observed from that line. The data recorded are a population index rather than an absolute measure of density (see the introduction to Unit 3). For example, the number of individuals observed per unit distance traveled, number per unit of time spent in observation, or number caught per trap per unit time would be such indices. Examples of using line transects in vertebrate population studies include road kill censuses, bird counts, and small mammal trapping (see Section 3H). This method can be quantified to yield density estimates useful in studies where the animals are highly mobile, yet often difficult to see until flushed. To do so, one walks a line through an area and records the distance to each animal seen. Mathematical methods have been developed to estimate density in this fashion, as explained in Section 3H.2.

2. Procedure

If the objective of transect sampling is to determine species composition in a given habitat, as it was in Section 3A, then the directional orientation of the transect should be determined by connecting two randomly selected points in the community to be studied (see Section 1A.2 for a discussion of randomness). If, however, the specific desire is to study a community transition or some ecological gradient, then the transect length should be oriented along that transition or gradient. Several replicate transects should be used in the same study area.

If a transect is used to sample mobile animals, such as by a strip census, the act of laying out and marking the transect may disturb and disperse the objects of the census. Therefore, first establish the transect on a map, afterward mark it in the field, and wait a while before censusing to allow the animals to resume normal activities.

If a transect is divided into contiguous segments, then the data for the several segments may be used to compute frequency by recording the presence or absence of species in each interval. This procedure is explained below for the line-intercept method, with which it is most commonly used.

For line-intercept sampling, extend a wire, cord, or measuring tape to mark the line between two points (identified by stakes, flags, or marked vegetation). The line may, for example, be 10, 20, 50, or 100 m long, with longer transects useful for more widely spaced organisms. Mark off 1-, 5-, or 10-m intervals on the line, using larger intervals for communities consisting of widely spaced individuals. Each interval will be treated as a separate unit of the transect.

Begin counting at one end of the line, and record data for each interval. In very dense vegetation (as some grasslands), count only those plants physically intercepted by

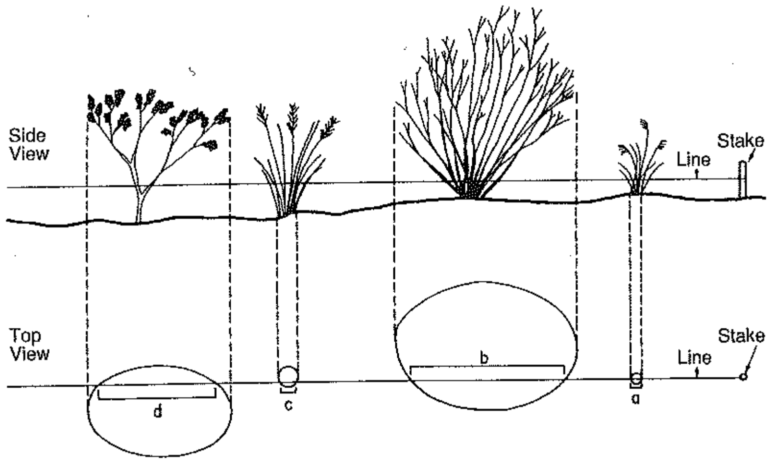

Figure 3B.1 The intercept length (brackets) is that portion of a line intercepted by a plant (or clump of plants, as the basal intercept length for plants a and c) or by a perpendicular projection of the foliage to the line (as the aerial intercept length for plants b and d).

the tape measure. Otherwise, count all plants that are intercepted within a 1-cm strip of the line. Include also those plants whose aerial foliage overlies the transect. In grassland communities, individual plants are difficult to distinguish and count. Though you could count individual stems, stalks, or shoots in such cases, it is more common to count clumps.

Coverage data collected from sampling plants by the line-intercept method differ from those obtained from plots or belt transects. In the latter sampling (Section 3A), coverage is estimated from areas covered, but in line-intercept sampling, the measurement of **intercept length** (or intercept distance) is used to estimate coverage. This length is that portion of the transect length intercepted by the plant, measured at or near the base of the plant or clump of plants or by a perpendicular projection of its foliage intercepted by the line (Figure 3B.1).

For each plant counted, measure the intercept length and record this value on the raw data sheet (Data Sheet 3B.1). Then summarize all such data on Data Sheet 3B.2. Where several strata exist, each stratum may be surveyed separately. Sampling only one component of the community, such as grasses, forbs, or shrubs, is often desired and may be done to simplify a class experience.

3. Data and Calculations

After the summarized data from Data Sheet 3B.1 have been recorded for each transect interval on Data Sheet 3B.2, the following quantities should be determined using Data Sheet 3B.3. If belt transects are used, then apply the equations for plot sampling in Section 3A.3 and treat each transect interval as an individual plot.

For a given species, i, the **linear density index** (ID_i) is calculated as

$$ID_i = n_i/L, \tag{1}$$

where n_i is the total number of individuals of species i collected and L is the total length of all transects sampled. The species' **relative density** (RD_i) is

$$RD_i = n_i/\Sigma n, \tag{2}$$

where Σn is the total number of individuals counted for all species, or

$$RD_i = ID_i/\Sigma ID, \tag{3}$$

where ΣID is the sum of the density indices for all species.

The **linear coverage index** (IC_i) for this species is

$$IC_i = l_i/L, \tag{4}$$

where l_i is the sum of the intercept lengths for species i (i.e, the total length of the transects intercepted by the species). And the **relative coverage** of species i (RC_i) is

$$RC_i = l_i/\Sigma l, \tag{5}$$

where Σl is the sum of the intercept lengths for all species, or

$$RC_i = IC_i/\Sigma IC, \tag{6}$$

where ΣIC is the sum of the values of the linear coverage index indices for all species. Note that because basal and aerial coverage distances of various individual plants may overlap, the sum of the intercept lengths (Σl) may be larger than the transect length (L).

The **frequency** of species i (f_i) is defined as

$$f_i = j_i/k, \tag{7}$$

where j_i is the number of line-intercept intervals containing species i, and k is the total number of intervals on the transects. The **relative frequency** of species i (Rf_i) is

$$Rf_i = f_i/\Sigma f, \tag{8}$$

where Σf is the sum of the frequencies of all species. As discussed in Section 3A.3, the **importance value** of species i (IV_i) is

$$IV_i = RI_i + RC_i + Rf_i. \tag{9}$$

In the line-intercept method, the probability of being sampled is dependent on the size of the plant. A large, rare plant is more likely to be detected than a small, rare plant. Large, dense species will appear more frequently than small, dense species. The pattern of distribution can also affect the estimates of frequency. The problems of interval length and number of transects desired are similar to the problems of plot size and number, discussed in Section 1A. Performance curves can be made, and one may graph species-interval curves as well as species-area curves (see Section 1A.3).

4. Suggested Exercises

1. Sample a forest or grassland community using the intercept technique.
   a. Determine the density index, relative density, frequency, relative frequency, coverage index, and relative coverage for the species sampled.
   b. Calculate importance values for the predominant species; interpret the meaning of these measures.
2. Compare two similar community types (such as two forests or two prairies). Analyze the data collected according to one or more of the following considerations:
   a. Species diversity (Section 5B)
   b. Community similarity (Section 5C)
   c. Species-interval length curve (Section 1A.3)
   d. Relative-abundance curve (Section 5A.7.1)
   e. Statistical significance (by Mann-Whitney testing, Section 1B.3.4) of the difference in the density (or coverage) index of the major species
3. Compare transect sampling results to those obtained from the plot (Section 3A) or point-quarter (Section 3C) methods.
   a. Compare species-sample size curves and performance curves (Section 1A.3).
   b. Evaluate the precision of the methods by determining the standard error for the density of a few of the more important species (see Sections 1B.2.2 and 1B.2.3). Which method has greater precision? Which has less bias? Which is more efficient in terms of the amount of data collected per time and effort sampling?

5. Selected References

Barbour, M. G., and W. D. Billings (eds.). 1988. North American terrestrial vegetation. Cambridge University Press, New York.

Becker, D. A., and J. J. Crockett. 1973. Evaluation of sampling techniques on tall-grass prairie. J. Range Manage. 26: 61–65.

Bonham, C. D. 1989. Measurements for terrestrial vegetation. John Wiley & Sons, New York.

Canfield, R. 1941. Application of the line interception method in sampling range vegetation. J. Forestry 39:338–394.

Greig-Smith, P. 1983. Quantitative plant ecology. University of California Press, Berkeley.

Lindsey, A. A. 1955. Testing the line-strip method against full tallies in diverse forest types. Ecology 36:485–494.

Mikol, S. A. 1980. Field guidelines for using transects to sample nongame bird populations. Office of Biological Services, Fish and Wildlife Service. U.S. Department of the Interior, Washington. FWS/OBS-80/58.

Parker, K. W., and D. A. Savage. 1944. Reliability of the line-interception method in measuring vegetation of the southern great plains. J. Amer. Soc. Agron. 36:97–110.

Seber, G. A. F. 1982. The estimation of animal abundance and related parameters. 2nd ed. Macmillan Publishing Co., New York.

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(See Section 3A.6.)