Review of Sampling Techniques used in Studies of Grassland Plant Communities

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Received: 1991 January 3

An annotated bibliography (1) was compiled on references pertaining to sampling methods for grassland and herbaceous communities. References from *Science Citation Index, Biological Abstracts,* selected textbooks, and current journals were included. All papers were in English.

This bibliography has 66 references arranged alphabetically by first author. With each citation are brief comments on sampling techniques used. Fourteen keywords, which pertain only to sampling techniques, were included to indicate the method(s) used. References were classified into the following five general sampling techniques: quadrat methods, transect methods, point methods, distance methods, and gradsect.

TABLE 1. Number of references in grassland bibliography (1) that use each sampling method.

Sampling Method	Number
Quadrat methods	47
Transect method	20
Distance methods	16
Point methods	11
Gradsects	2

Sampling techniques which study the vegetation or environment of a limited and definitely circumscribed area, a quadrat or plot, were placed in the quadrat method category. These included several variations of size and shape of the quadrat. Those techniques which measured the vegetation occurring along a line or narrow belt were classed as transect methods. Distance methods include point-to-plant, angle order, point-centered-quarter, and nearest neighbor techniques, all of which involved the measurement of distance between plants. Inclined and vertical point techniques were included in the category of point methods. Transects that incorporated significant environmental gradients, selected to represent the environmental variability present in an area, were placed in the gradsects category.

Quadrat methods were the most widely used among the 66 references (Table 1). The quadrat method is for grassland analysis (2, 3). In general, the chief value of the quadrat method lay in the results obtained when quadrats of sufficient number to adequately sample the study area and of a size suitable to the character of the vegetation are used (2, 4, 5, 6). The size of the quadrat must be based on the approximate cover of vegetation (2). For example, Mosley, Buning, and Hironaka (7) found that dense vegetation required larger quadrats (50×50 cm). Hanson and Love (8) found that a 1-m^2 area did not justify the additional time required. Van Dyne, Vogel, and Fisser (9) noted that quadrats 6 ft^2 or larger included few species more than did 2-4 ft^2 quadrats. Optimum plot size and shape may depend upon the distribution of the species measured (9). If several species with greatly varying plant sizes, distributions, and densities are to be measured, more than one quadrat size may be required (10). Data obtained from the use of quadrat methods were used to measure spatial pattern (11-14), to measure cover of vegetation (4, 5, 16), and to make quantitative analysis (5, 17). Quadrats were reliable samples of the true plant populations (18).

Transect methods were used to measure density and composition accurately (19) and were recommended by some authors as less time consuming than mapping in quadrats (3, 18, 20). Bauer (21) found that transect samples and quadrat samples indicate the actual percentage of cover with about equal accuracy when vegetation was of uniform size; with various vegetation sizes, transects indicated coverage with considerably more accuracy than quadrats.

The point method gave results agreeing with those of dry weight measures (22). When compared to quadrat and transect methods, points were more time consuming to obtain and gave less accurate results (8, 23). However, the point method was preferred over distance measures (24).

Distance methods were generally less accurate than others. The point-centered-quarter method gave data that underestimated density and frequency (25, 26). Angle-order methods gave values that were approximately equal to transect values and were more accurate than the point-centered-quarter or nearest-neighbor methods (25).

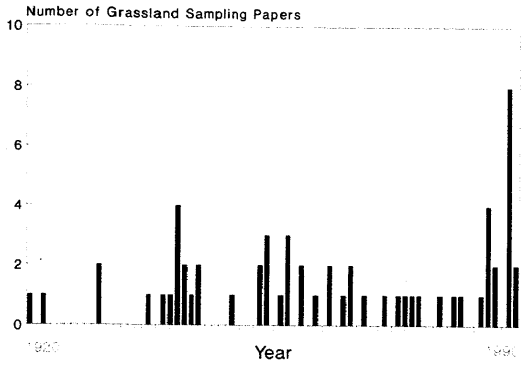

Figure 1. Number of grassland sampling papers published each year, as cited in Sorrells & Glenn (1).

Gradsects gave a representative floristic sample (22), and when compared to the transect methods, gradsects were preferred (28).

Most of the 66 references in this bibliography are post-1940 (see Fig. 1) Methodology papers dominate the early papers, with a trend later toward applications. The selection of an appropriate sampling procedure should follow directly from considerations of the objectives of the study (25). Sampling decisions in population and community ecology are dependent on context and should be consistent with the objectives of an investigation, and the methodology must be capable of providing data that can best answer the proposed question (29).

The complete annotated grassland bibliography is available from the authors.

ACKNOWLEDGEMENTS

We thank Scott Collins, Daniel Sorrells, and Ian Butler for their support and contributions, and the Oklahoma Natural Heritage Inventory and the Biological Survey for financial support.

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