Measurement of Grazing Use by the Line Interception Method

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Field experience in the Southwest has demonstrated the suitability of the line interception method for combining the measurement of utilization with plant density and composition estimates. It includes the advantages of actual measurement and random sampling. Moreover, the data obtained lend themselves readily to statistical analysis. The method operates equally well in sampling both large and small pastures.

DURING the past 3 years an adaptation of the line interception method[2] of sampling plant density and composition has been developed which makes it possible to measure the intensity of forage utilization by straight-line transects. In the Southwest perennial grasses only are usually measured, but weeds and shrubs may be included if a complete inventory of the plant population is desired.

Sampling Units

All sampling units should be located by random selection. With large areas greater precision is gained by stratifying the area in order to obtain a more even distribution of sampling units. Various tests indicate that the representative sample is the most efficient type of stratified sampling. This sampling design is based on subdividing the pasture or range into blocks of the same size and allocating equal numbers of sampling units to each of these blocks.

Field experience indicates that a sampling unit 50 feet long is adequate on ranges supporting a grass cover of 5 per cent or more, whereas ranges having less than 5 per cent of the area occupied by perennial grasses require a sampling unit 100 feet long. The latter was used in the field tests at the Santa Rita Experimental Range.

Field Measurements

Sampling and measurement procedure followed in the field is illustrated in Figure 1. As indicated by the figure, the plants on each transect are measured both for height and for lateral extent. Either the English or metric system of measurement may be used and any standard device is suitable for this purpose. In the present case a 5-foot collapsible steel tape measure scaled in hundredths of feet on one edge and in inches on the other proved satisfactory. Height measurements were recorded by class intervals.

The following stubble-height classification devised by Matt Culley at the Santa Rita Experimental Range was found adequate for southern Arizona mixed grama grass ranges. However, the class intervals given here may or may not be the most suitable arrangement for areas supporting a plant cover composed of different species. When tall, coarse-stemmed grasses are the principal forage plants, it may be necessary to have more height classes or to make the class intervals larger.

Class No.	Stubble height in inches
1	0 to ½
2	½+ to 1
3	1+ to 2
4	2+ to 4
5	4+ to 6
6	6+ to 8
7	8+ to 10
8	10+ and over
9	Ungrazed plant, any height

The height of each tuft is measured from the ground level in inches. Its lateral extent is measured at ground level and along the line of the transect to the nearest hundredth of a foot. In cases where the tufts are grazed to two or more stubble heights, the ground measurement is split between the height classes according to the portion of the tuft in each height class. All ungrazed tufts are placed in class 9 and their heights recorded to the nearest inch.[3]

Office Analysis

In analyzing the field data the first step is to bring together the information concerning

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During the past 5 years Mr. Canfield has analyzed the accumulated data, comprised of measurements and estimates pertaining to range vegetation, obtained since 1915 on the Jornada and Santa Rita experimental ranges and has developed the line interception method as a means of enlarging the scope and increasing the accuracy of grassland range measurements.

[2] Canfield, R. H. Application of the line interception method in sampling range vegetation. Jour. Forestry 39: 388-394. 1941.

[3] Samples of the forms used for recording and analyzing field data may be obtained on request from the director of the Southwestern Forest and Range Experiment Station, Tucson, Ariz.

each species. This is done by showing for each sampling unit the lateral extent (in hundredths of a foot) of the plants in each stubble-height class, with totals for all sampling units combined. The next step is to bring together on one sheet the totals for each species by stubble-height classes.

These totals, which are still in hundredths of a foot, can then be converted into percentages and summarized in the form indicated in Table 1. This summary shows by percentages (1) the part of the entire stand contributed by each species that makes up as much as 1 per cent of the total; (2) the proportion of each species in each stubble-height class; and (3) the weighted average for all species ("mean use") by stubble-height classes. The average density of the stand on this particular pasture was 1.9 per cent.

Utility and Cost

Information as to the relative degree of use of each kind of grass is especially valuable in a management program which is pointed toward range betterment. At the same time the weighted averages showing utilization by stubble-height classes for all species combined present a concrete picture of actual use from which one may visualize the exact condition of the range.

By and large the proper use factor, formerly

Table 1.—Summary of Grazing Use by Species and Stubble-Height Classes

Species	Per cent of total stand	Per cent by species and stubble-height classes in inches								
		0 to ½	½+ to 1	1+ to 2	2+ to 4	4+ to 6	6+ to 8	8+ to 10	10+	Ungrazed
Adi	9.3	.....	.....	13.8	21.4	8.0	10.4	3.1	12.5	30.8
Bch	18.0	.....	8.4	15.9	15.9	4.5	.....	.....	.....	55.3
Bcu	15.2	.....	2.8	15.5	14.6	4.2	.....	.....	.....	62.9
Ber	10.8	.....	4.2	3.0	4.5	.....	.....	.....	.....	88.3
Bfi	10.8	.....	11.9	15.7	24.0	8.9	.....	.....	.....	39.5
Hbe	5.2	.....	.....	52.8	36.6	.....	.....	.....	.....	10.6
Hco	16.2	.....	.....	3.0	6.2	8.1	2.0	1.8	.....	78.9
Tca	8.3	.....	.....	11.3	8.2	15.2	4.3	12.0	.....	49.0
Other	6.2	.....	8.9	2.1	15.6	13.5	8.9	.....	.....	51.0
Mean use-per cent	100.0	.....	2.9	11.5	14.7	8.6	3.0	1.6	1.0	56.7

Fig. 1.—Laying out and measuring a sampling unit in obtaining range forage utilization by the line interception method. A. The crew measuring the grasses on the line. B. Position of the ruler when measuring the tuft intercept. C. Position of the ruler when measuring the stubble height of a grass tuft.

expressed by the term "palatability," is an estimate of how closely a plant may be grazed and still be maintained on the range. Since this is based on observation of grazed plants, it is also in part an estimate of livestock preference for the various grasses. The line interception method provides a stubble-height scale of preference based on measured degree of grazing use. A number of repeated surveys made at yearly intervals should also establish the grazing resistance of individual grasses on the basis of actual grazing use as related to changes in density and composition.

The field and office costs of surveys by the line interception method are generally at least as low on a per-acre basis as those with other commonly used methods. While no standard reconnaissance cost figures from identical areas are available for comparison, experience indicates that the cost of the line interception method compares favorably with that of comparable intensive utilization surveys by range reconnaissance. With the line interception method two surveys of 20 pastures aggregating 50,000 acres and including the measurement of 361 100-foot lines in each case were completed in 11 days each with three 2-man crews—a total of 66 man-days. This 66-day period in each instance included the time expended in training. The number of pastures surveyed also influenced both the field time and the compilation time. Had not the area been subdivided into the 20 pastures which were sampled and summarized separately, the time required for the survey of this 50,000-acre range could have been appreciably decreased, thus reducing the total cost.

Pulpwood Needed

Production of 14,000,000 cords of domestic pulpwood will be necessary in 1944 to supply the expanded needs for paper and pulp products of our armed forces overseas and for essential home front war requirements, the War Production Board's Paper Division recently announced.

The 1944 goal is 1,000,000 cords greater than that estimated by WPB as the minimum need for 1943. The additional 1,000,000 cords is necessary for packaging materials, especially weather-proof paper and kraft board for packaging and shipping munitions, foods and medical, and other supplies to foreign battlefronts and for the multitude of containers needed for agricultural and civilian supplies.

The drive to increase production of pulpwood for war purposes received its greatest impetus through the newspaper pulpwood campaign, in which the daily press and more than 1,500 weekly newspapers in 27 of the producing states participated.

The 14,000,000-cord goal for 1944 has been apportioned to the five major pulpwood producing regions based on past production records, as follows:

Region	Goal
Appalachian	1,550,000
Northeast	1,900,000
Lake States	1,450,000
South	6,600,000
Pacific Northwest	2,500,000
Total for U. S.	14,000,000