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Getting Better Records of Vegetation Changes with the Line Interception Method

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BASICALLY the line interception method is a means of determining areas by the measurement of line segments. It has been adapted and applied to range work by several men since about 1937 (*1*). In the opinion of the writer, it is a very useful range technique. It is highly adaptable and in combination with other methods can be used to measure vegetation factors like density, composition, yield, utilization, vigor and reproduction; and soil factors like erosion, bare soil, rock, and litter cover. The line plot is an efficient sampling unit; it is easily established and quickly measured.

The line interception method has been described in detail by Canfield (*1*). The purpose of this paper is to point out a few ways in which the method can be employed more effectively in measuring changes in range vegetation. Particular attention is given to ways of increasing the accuracy of the method and of using the method to determine vegetation yield. The remarks are based on experiences with the method in pine timber, sagebrush, and meadow types in northeastern California and apply principally to bunchgrass types.

GREATER ACCURACY

Accuracy and consistency in the use of this method revolve around the determination of the end points of the line intercepts. The proper placement of these points depends on a knowledge of the growth habit of the plant. Two characteristics in particular must be clearly visualized: (1) the unit of plant measurement, and (2) the normal foliar density of the species.

The observer must hold to definite standards on what constitutes the plant unit to be measured. In many cases it is obvious. In bunchgrasses it is the tuft, and in shrubs the crown. However, in many species, for example mule-ears (*Wyethia mollis*), a tap-rooted perennial, and even in sod formers, like wire rush (*Juncus balticus*), there is a choice between using a portion of the plant, usually a fascicle, or the entire plant as the unit of measurement. The fascicle is simply the group of leaves and flower-stems that emerges from one of the buds on the root crown, rhizome, or branch of a plant. These fascicles are widely spaced on many species and stand out like distinct plant units. If the fascicle is chosen as the unit of measurement, the interspaces between fascicles would be recorded as soil or some form of ground cover. If the plant is chosen as a unit, the interspaces within the plant crown would be measured as vegetation. That is, in the case of mule-ears the distance across the entire root crown, and in the case of wire rush the distance across the sod area would be measured as vegetation. Uniformity in choosing the unit is essential for accuracy and consistency. That the plant is the most logical and soundest unit of plant measurement becomes clear with a consideration of foliar density.

Foliar density and the size of foliar interspaces vary with each species. For example, buds on the root crown of Idaho fescue (*Festuca idahoensis*), a perennial bunchgrass, are spaced about $\frac{1}{16}$ of an inch apart, in mule-ears one inch or more apart. In measuring these two species on the line plot, an interspace of one square inch in a tuft of Idaho fescue would be considered abnormal and would probably be classified either as a dead spot or as a soil area. The same size interspace in the root crown of mule-ears would be considered normal even though it consists of bare soil. Thus a one-inch soil intercept in the crown of one species may be classified as soil and in another as vegetation. The size of an interspace is judged normal or abnormal in relation to the average size of interspaces in normal plants of a species on a given site. This is simply to say that there is a normal foliar density for each species on a given site. And it follows that there is a normal density of interspaces. This concept provides the basis for deciding when a given size interspace is part of the plant and when it is part of the non-plant ground cover. It permits marking the edges of plant crowns and conditions within crowns more definitely and classifying the character of cover more uniformly. It points to the plant rather than any part of it as the unit of vegetation to be measured.

By using the normal density concept the line interception method can be used to measure annuals like cheatgrass (*Bromus tectorum*), ground smoke (*Gayophytum* spp.), Collinsia (*Collinsia* spp.), and others found in the interspaces between perennials in the bunchgrass type. It can also be used to measure sods and meadow type vegetation. In these kinds of vegetation it is the crown cover that is important. Measurements of stems and fascicles at ground level have little significance. Because the plant crowns interweave and overlap it is not practical to measure the crowns on individuals, so consideration has to be given the crown masses. Satisfactory records of density and composition can be obtained in terms of linear measurements in three steps: (1) Estimating the total vegetation density on short segments (6 to 12 inches long) of a belt plot located parallel and astride or adjoining the line plot; (2) converting these estimates to inches; and (3) proportioning the length of line representing the entire vegetation among the important species. A plot 6.27 inches wide and 100 inches long covering an area of 1/10,000 of an acre is a convenient size. The total vegetation density can be estimated most easily by judging the percentage of ground space, including abnormal foliar interspaces, on a segment and subtracting the figure from 1.0.

In long-time studies of vegetation changes, the line plots should be established precisely and permanently so remeasurements can be made on the same line and sampling errors between examinations largely eliminated. A 100-inch long (8′-4″) plot has been found satisfactory in bunchgrass types. It permits summarizing the data in original units and percentages without additional calculations. It is suggested that the end points of the line be marked to within $\frac{1}{8}$ of an inch on metal hubs set in concrete footings. So as not to interfere with the growth and use of the vegetation, the footings should be located from 1 to 2 feet beyond the ends of the 100-inch line segment on which the vegetation is measured. Changes in individual plants and plant groups can be followed by making measurements progressively along the line and recording each plant or plant group on a separate line on the form. With permanent hubs, information can also be obtained on soil erosion in many situations by stretching a straight rod between the hubs and measuring the distance to the soil surface at several points.

Yield

The yield of a given species can be obtained from an estimate of its basal area provided by the line plot and an estimate of yield per unit of basal area obtained from clippings on plots 100 inches long and 6.27 inches wide located at random on the site being studied. The density estimates obtained on the line plot can be expressed in square inches per acre, and the clippings in grams per square inch of basal area. Production in pounds per acre for each species can be calculated from these figures.

The clipping unit may be the entire plant or only a portion of it. In bunchgrasses and species like mule-ears and lupine, the entire plant is a practical unit. All plants of a given species whose crown centers are located within the boundaries of the plot are measured for basal area, clipped, dried and weighed. The yield per unit of basal area is calculated from a number of plots. In the case of shrubs the entire crown area within the boundaries of the plot is clipped.

Stands of annuals and sods are clipped on the same basis as shrubs, and the breakdown into species can be handled in three ways. In the first place, one can estimate crown densities and determine line intercepts for each species before clipping as on the line plots. This procedure assumes that the plant yield per unit of line is the same for all species. If greater accuracy is needed, the weight of the most important species or species groups (usually 3 to 5 in number) can be calculated by the method of least squares from several sample plots. The information needed from these plots is the total weight of all species under consideration and the line intercept measurements of each species. A third alternative for handling this type of vegetation is to segregate and weigh each species.

Determining yield by applying an average weight per unit of basal area of individual species to the basal area measurements of those species on line plots has several advantages over clipping the entire vegetation on sample plots and segregating and weighing each species. It provides a means of getting at yields of plants on which density and other basic measurements are made over a period of time without clipping the plants. It permits dealing with one or as many species as desired. The yield of any species can be determined to any degree of accuracy by varying the number of samples. Each species can be clipped at its peak yield. The tedious and time-consuming job of segregating species after clipping is avoided.

To get a full expression of yield and other measures, the treated and check plots should be protected from grazing in years measurements are made and the vegetation examined as close to the peak of growth as possible. Furthermore, vegetation changes should be measured by soil types since the yield, reproduction, vigor, and management of the vegetation is closely tied to the soil.

It should be appreciated that the accuracy of any method of measuring vegetation rests as much upon the judgment of the observer as upon the mechanics employed. In order to reduce errors in personal judgment and thereby to obtain greater accuracy with the line interception method, it is essential to study the growth habit of the important species to determine units of plant measurement and normal foliar densities prior to the start of measurements.

LITERATURE CITED

(*1*) Canfield, R. H. 1941. Application of the line interception method in sampling range vegetation. Jour. of Forestry 39: 388–394.