Metric Belt Transect System for Measuring Cover, Composition, and Production of Plants

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Measurement of vegetation characteristics has often been a tedious and time-consuming venture. As a result data have been limited and accuracy low. New procedures and the metric belt transect described here offer a way to speed up the process and increase accuracy in measuring cover, composition and production of vegetation. The method can also be used to calculate frequency, distribution, and numbers of plants per unit area.

The Metric Belt Transect

The metric belt transect uses a variable length of metric tape or other line stretched along the ground to mark the length of the plot and a tenth-square-meter frame to outline the width. Measurements of each individual species (as separate plants of groups of plants) are made as they are intercepted by the estimator walking along the side of the line using the frame to simultaneously outline the continuous transect and estimate the crown cover. For estimating crown cover on low vegetation the frame is held above the vegetation to estimate cover. For taller shrubs and trees the frame is used to estimate overstory intercepted by the transect.

The tenth-square-meter frame is 31.6 cm (1.04 ft) on the sides is divided into two halves with one half further divided into fifths to facilitate estimating area of crown cover by hundredths of a square meter (Fig. 1). To reduce variability, the length of the belt transect should be varied with the type, uniformity and density of the vegetation. In general, longer transects are needed for larger species and more sparse vegetation. Experience has shown that a 31.6-meter-long belt transect (a length equal to the width of 100 tenth-square-meter frames) is needed for small trees and large shrubs, 15.8 m for medium-sized shrubs, 7.9 m for small shrubs and sparse bunchgrasses, 6.3 m for semiarid short and mid grasses, and 3.2 m for dense grasses and meadows. The use of the above 100 tenth-square-meter transect and fractions thereof (which total 10, 5, 2.5, 2, and 1 square meters, respectively), facilitate conversion of data to percentages for cover and species composition and to hectares for production and plant numbers. Selection of a more accurate transect length for specific conditions can be determined statistically by taking and analyzing a preliminary sample of different length transects. If working in English units is preferred, a square-foot frame and 100-foot transect similarly divided can be used.

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Editor's Note: This metric belt system has been used to good advantage by professor Schmutz as a teaching tool and by Barry Freeman in foreign assignments.

The number of transects needed for a given level of accuracy will depend on the variability of the vegetation among transects, length of transects, the use planned for the data, and other factors. For example, 42, 6.3-meter-long belt transects were needed to provide a sample within 10% of the mean at the 90% level of significance on a semiarid desert

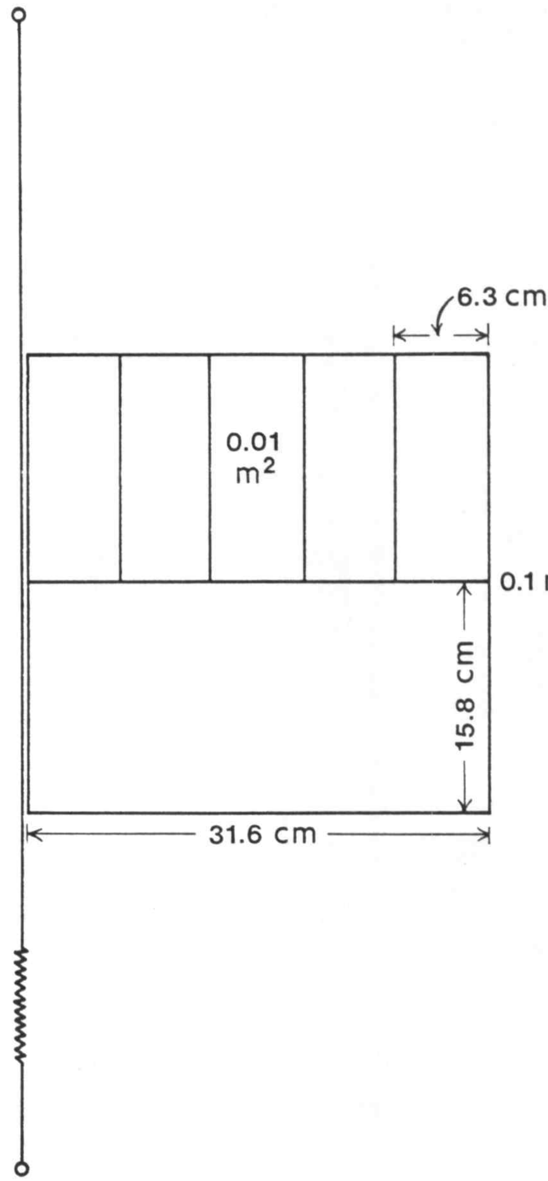

Fig. 1. *Tenth-square-meter frame for measuring crown cover, species composition and production of plants.*

grassland site; 20 to 25 15.8-meter-long transects in a chaparral type; 26, 31.6-meter-long transects in pinyon-juniper; and 21, 31.6-meter-long transects in a sparse southern desert shrub type. A common way to reduce the number of transects and/or increase the accuracy is to stratify the sample area for uniformity in species composition, site, and density of vegetation.

For uniform sampling and faster location of samples, the transects can be located systematically from a random start, the spacing depending on the size and shape of the area sampled. A crew with one estimator and one recorder works most efficiently. Experience in Arizona shows that in general it takes 7 to 10 minutes to lay out and measure crown cover on appropriate-length transects, depending on abundance of plants and roughness of terrain. Transects may be permanent or temporary.

Measurement of Crown Cover

Crown cover is the best visible measure of the area occupied by plants. As interpreted here, crown cover is the maximum horizontal area of the plant uniformly occupied by plant foliage regardless of density of foliage. Significant spaces between branches larger than one hundredth-square meter are excluded. Crown cover of plants rooted inside the belt transect that extend outside the transect are excluded and crown cover of plants rooted outside the transect that extend into the transect are included.

The area of crown cover in tenths of square meters obtained in the 31.6-meter belt transects (100 tenth-square-meter frames) converts directly to percentage of cover. Percentage of cover in fractional transects can be calculated by multiplying data with a proportionate factor (2 for 15.8-, 4 for 7.9-, 5 for 6.3-, and 10 for 3.2-meter transects), for by dividing the total crown cover (in tenths of square meters or square meters) of all or each individual species by the total area of the transect in the same units.

Although crown cover varies from year-to-year it still shows trends, and comparison of different areas within the same year are valid. Also, by using crown cover measurements for all plants, percentage comparisons can be made between all species—grasses, forbs, shrubs, and trees. Annuals and tall shrubs and trees may or may not be included depending on the purpose of the survey.

The major disadvantages are that immature plants must be projected to full growth stage and grazed plants must be reconstructed. These disadvantages can be largely overcome by experienced examiners making comparisons with fully developed plants in the area or can be avoided by estimating cover at the ungrazed full-growth stage of development.

Species Composition

Since crown cover is used as the measure on all species, crown cover data can be converted to percentage species composition by simply dividing the total (or average) transect crown cover of each species by the total (or average) transect crown cover, respectively, of all species in the transects. If preferred over crown cover, forage production data (determined as described later) can be used to estimate species composition. These data can be used to evaluate range condition and trend over time.

Production of Vegetation

To estimate production of vegetation using the metric belt transect system a modified double-sampling procedure is used to convert crown cover measurements to production. Crown cover is estimated for all species on a representative number of randomly or systematically selected transects. After crown cover is estimated in a transect, the species on that transect are clipped at ground line or other level and weighed in field condition. Portions of each species are sacked, field weighed, oven or air dried, and reweighed to use in converting field weights to oven or air dried weights. The weight of the species per unit of crown cover (in tenths of square meters or square meters) can then be calculated by dividing the average dry weight per transect of each species by the average units of crown cover per transect. These data can then be used to convert crown cover measurements of the same species on subsequent transects in the area to production. A test of this procedure in the desert grassland of Arizona gave regression coefficients ($\dot{r}$) of .93, .95 and .99 for lehmann lovegrass, black grama and sprucetop grama, respectively. Regression lines obtained in this manner can also be used to convert crown cover to production.

To obtain an adequate sample to convert crown cover to production, usually 10 to 15 samples containing a given species will be needed. For grasses, small shrubs and forbs, whole transects can be clipped to provide conversion factors. For large shurbs and trees, representative transect portions of individual plants can be clipped. The weight of vegetation per unit of crown cover for individual species times total crown cover for each species will provide total production per transect (or other unit of area) for that species. Minor species may be lumped together by categories—annuals, forbs, grasses, trees or shrubs—for estimation of crown cover and production estimates. Totaling the production of individual species and groups of species will give total production for all or individual transects. These data can then be extrapolated to estimate total production for the entire study area. To convert production to kilograms per hectare, multiply grams per transect by 1 for 31.6-, 2 for 15.8-, 4 for 7.9-, 5 for 6.3-, and 10 for 3.2- meter transects, or multiply grams per square meter by 10.

The above procedure can be used to estimate forage, standing crop or biomass production, depending on objectives. For total biomass data, several measurements will need to be made during the year at peak growth seasons for the various species.

The value of this system is that crown cover measurements can be made much faster than clipping measurements so a larger, more representative, and statistically more reliable sample can be made in less time than where only clipping measurements are made. The same procedure can be used on forbs, shrubs, trees and grasses and can be used to measure total vegetation or current foliage and twig growth.

Frequency, Distribution and Abundance of Plants

Species recorded by belt transect can be used to calculate frequency by simply dividing the transects containing a particular species by the total number of transects measured. The distribution of species can be observed by plotting the "hits" in the systematically located transects. Information on abundance can be obtained by estimating plant number by classes (e.g. 0, 1–5, 6–20, 21–50, 51–100, 100+) in addition to cover on each transect. To convert plant numbers to number per hectare, multiply plants per transect by 1,000 for 31.6-, 2,00 for 15.8-, 4,000 for 7.9-, 5,000 for 6.3-, and 10,000 for 3.2-meter transects, or multiply the number of plants per square meter by 10,000. These data will evaluate how abundant and widespread the species are and, if taken over a series of years, can show whether a particular species is increasing or decreasing on the area and in what portions of the area.

Conclusions

The metric belt transect offers a relatively fast, simple, highly accurate, and consistent method of estimating the crown cover, species composition, forage production, total biomass, abundance,distribution, and trends of plants. Disadvantages of the system, such as projecting plant growth or reconstructing grazed plants, can be avoided by making estimations at full season of growth and/or minimized by making comparisons with fully developed plants in the area. The system is widely adaptable for use in obtaining data for management of public and private lands, for evaluating ecological relationships, and for monitoring the effects of range treatments and management practices. ●

Legislation, Policy, and Survival in the Ranching Industry

Jeanne W. Edwards

Napoleon Bonaparte was a stickler for crystal clear communications. He had a saying that applies to much of today's world of legislation. An order that can be misinterpreted, will be misinterpreted. The story goes that Napoleon kept an idiot sitting on a camp chair outside his headquarters. The idiot wore corporal's stripes because he served a very important purpose. Whenever Napoleon wrote an order he would show it first to the idiot. If the idiot did not misinterpret the order, Napoleon felt it was safe to transmit it.

There is little need for me to tell you about impacts of legislation upon the private rancher. You *are* aware. When I look around this room I see some of the most sophisticated, best educated, most politically aggressive range professionals in this nation—and maybe in the world. Within this Texas section of the SRM, one can find an impressive list of members who have worked diligently to assist our federal law makers to produce good legislation—and, believe it or not, there really has been some good legislation. For those tireless efforts, we ranchers truly are grateful.

Because the Texas community is somewhat unique in its political awareness, I find myself, once again, in the bringing "coals to Newcastle" syndrome. Unlike many other sections, Texas is aware of the threats to the private rancher—and this can be seen in the theme of your annual meeting. Legislation, Policy and *Survival* in the Ranching Industry.

Survival is such an interesting and appropriate term when applied to the producer. Someone (and I can't remember who) once said, "If America dies, it won't be murder it will be suicide." And in truth, if this great nation *does* do herself in, it will be because in the malaise of our spirit, we have failed to recognize and/or failed to take action against, the ever increasing reasons for the producer *not* to produce.

Incentives to produce are the aortas in the body of success—and for the rancher—a giant aneurysm—has appeared. We would be most fool-hearty if we buried our heads and refused to recognize the symptoms—and causes—and the prognosis.

While we as Americans preen ourselves and then proudly letter the term "Free Market Place"—for the rancher and farmer—there is no such place. Getting our products to the market place is *very* expensive. And, as the recent years well attest, many never make it. In 1981, in Elko County, Nevada, four of my good colleagues have "thrown in the towel." As one of these ranchers said, "After three generations of giving her all we got, it just isn't worth it any longer."

Not only do we face the whims and caprice of nature, but today our own government often postures herself in the "opposition corner."

During these economically perilous times, we food producers desperately need our government to recognize her obligation to agriculture—not to guarantee that everyone who tries to run a ranch or farm will be successful, but to see that her federal policies give as many of us as possible the opportunity to try. In other words, not eliminate the incentive.

As a Nevada rancher, specific legislation impacting the Saval to a significant degree—and, in particular to our range management, are the Organic Act, Wild Horse and Burro Act, National Environmental Policy Act, Federal Water Pollution Control Act, Toxic Substances Control Act, Clean Water Act, National Pollution Discharge Elimination System, RPA, RCA, and the Wilderness Act. The activities that are impacted by these rules and regulations are soil and water conservation, nonpoint pollution abatement, pest control, predator control, brush management, feed lot waste disposal, land use patterns, land management plans, number of animals, and kinds of animals. These are just a small percentage of the actual "guide lines" under which we must operate. As a matter of fact, I can honestly say, *few* of our decisions are made without the "helpful hand" of big brother!

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