A Modification of the Line Intercept Method For Sampling Understory Vegetation

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No single technique of vegetation measurement is universally applicable. All approaches have features and limitations which control use to specific study or inventory requirements and area characteristics. Not excluded are problems of measuring the composition and density of forage-bearing twigs and stems in woody understories. Additional complications are met if study or inventory requirements introduce needs to assess utilization. For these reasons, and because small changes frequently must be measured with a high degree of sensitivity, several procedures (developed by other workers) were combined with some innovations to produce the understory measurement techniques described here.

Canfield (1941), in a major contribution, described the use of the line intercept method and provided a base for a number of important developments in line, line point, and loop techniques. Our innovation has its genesis in Canfield's method, for it is basically a line intercept approach—or perhaps, more specifically, a vertical plane intercept method. Because of a need to work in a definitive zone, an established or fixed height of sampling plane was designated (usually 4.5 feet). Also, because total density was of greater concern than length of crown intercept, the vertical plane served well as a basis for counting all forage or forage-producing intercepts.

Parker,[3] in his "three-step" method, employed a widely used system to mark and relocate line intercepts; his methods proved very useful in this approach. With only a slight change in location from Parker's procedure, three sharpened stakes (preferably angle iron or aluminum) driven into the ground at 0.5, 50.5, and 99.5 links or feet (depending on whether a chain or 100-foot tape is used) served as permanent references for relocating transects. Although originally designed for inventory of grassland communities, the method of line location is equally suited to understory conditions.

The advantages of permanent plots for most work involving measurement of change are obvious and need no elaboration. Where a single estimate of density or of species or group occurrence is desired and no remeasurement is desired, the use of

TRANSECT TALLY

Area Albany Date 3/15/62 Observer Moore-Downing

Type Uncult. Block 05 Cluster Open-N Transect 3

0–10	1-Ar-9	1-Ar-7	1-Ar-4	1-Ar-2						
10–20		1-Ar-2	2-Ar-2		1-Ar-3 1-Br-1		1-Ar-1 1-Br-1	1-Ar-1		
20–30			1-Qn-2	1-Qn-2			1-Qn-3		1-Qn-2 1-Br-1	1-Qn-1
30–40									2-Rub-2	2-Rub-5
40–50		2-Rub-1		2-Rub-1		2-Rub-2				
50–60	2-Rub-1							2-Rub-1	2-Rub-1	
60–70		2-Rub-1							1-Dv-1 2-Rub-1	
70–80	1-Rub-1			1-Rub-1		1-Dv-3		2-Rub-1	1-Dv-1	
80–90										
90–100				2-Rub-7			2-Rub-2			

FIGURE 1. A sample transect tally sheet.

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[3] *Parker, K. W. A method for measuring trend in range condition on national forest ranges. Forest Service, U. S. Dept. Agr. 1951. (Unpublished Plan for Administrative Studies.)*

TRANSECT SPECIES SUMMARY

Area Albany Date 3/15/62 Observer Moore-Downing

Type Uncult. Block 05 Cluster Open-N Transect 3

Species Symbol	Browse Class	Species or Species Group	Browse Intercepts: Total	By Degree of Utilization: 1	2	3	By Age Class: S	Y	M	D
Rub	2	*Rubus* sp.	28	2	26					
Qn	2	*Quercus nigra*	10	10						
Ar	2	*Acer rubrum*	31	29	2					
Dv	3	*Diospyros virginiana*	5	5						
Br	3	*Campsis radicans*	3	3						
		Totals	77	49	28	0				

FIGURE 2. A sample transect species summary.

TRANSECT SUMMARY
BY
BROWSE CLASSES

Area Albany Date 3/15/62 Observer Moore-Downing

Type Uncult. Block 05 Plot Cluster Open-N Transect 3

INTERCEPT SUMMARY

Class	Number
Preferred (1)	--
Staple (2)	69
Emergency (3)	8
Stuffing (4)	--
Total	77

AGE SUMMARY

Class	No. by preference (1)	(2)	(3)	(4)
Seedling				
Young				
Mature				
Decadent				
Total				

BROWSE SUMMARY

Class	No. by preference (1)	(2)	(3)	(4)
None		41	8	
< 30%		28		
> 30%				
Total		69	8	

FIGURE 3. A sample transect summary by browse classes.

permanent plots is unnecessary. In any case, whether the line is to be permanently or temporarily located, a tape or chain stretched in place serves as the unit of measurement.

Location of units can be systematic, random, or a combination of both, depending upon the needs of the study. Generally, where exclosures are used, pairs of fenced and open plots located randomly within strata or populations to be sampled are useful. Within these, it is desirable to locate systematically a series of protected and open lines. Again, number and length of lines and sizes of plots are controlled by study needs and variation in the understory. In several understories sampled in the Southeast, four one-chain transects appear to approach an optimum within 1x3-chain plots.

The procedures used in measuring each sampling unit or vertical plane 1-chain long involve recording all woody (or otherwise specified) plant parts intercepted by the vertical plane of established height usually corresponding to the upper limit of the zone of browsing (i.e., 4.5 feet). In the field, this plane is quickly and easily defined by running a vertical rod of the desired height along the edge of the chain (Ripley *et al.*, 1960). Any number of specifications can be imposed to govern the type of information collected, depending on the study needs. One useful approach is to record only those intercepts which produce browse below the upper surface of the designated sampling zone (4.5 feet) and distal to the point of intercept. This realistically eliminates all intercepts on major stems and trunks which do not contribute forage within the reach of browsing animals. For convenience in the field and to minimize recording errors, it seems convenient (though not essential) to subdivide the sampling plane into segments. For example, 100 onelink segments in a chain provide a useful subdivision and data are easily recorded on a tally sheet (Figure 1). Intercepts recorded by segments are also easily summarized for each plane (sampling unit). It appears convenient to record plant intercepts using a two- or three-letter symbol for each species (after Parker, *op cit.)* encountered, together with the number of intercepts.

In some instances, it is desirable to record also the degree of utilization by numerical entry. Entries of 1, 2, or 3, for example, are useful in specifying the average degree of use on plants contributing to each species entry shown: where 1 indicates no browsing, 2 up to 30 percent of available growing tips browsed, and 3 is 31 percent or more browsed. To avoid confusion, entries for use and numbers of intercepts can be separated by the species symbol (Figure 1). In some cases it is desirable to characterize the age of the material sampled by using convenient symbols such as those employed by Parker.[4]

Data summaries for sampling units are simple, direct, and useful in reducing transect data prior to analysis (Figures 2 and 3). Here, total intercepts are recorded by species showing totals and distributions by artificial utilization and age classes. Another summary which has utility in some cases involves sorting species into realistic browse preference classes. Summaries of numerous species frequently have little meaning, and study requirements can be met by comparing areas or time series using these meaningful preference groupings. Such a reduction has been shown in Figure 3 from species data provided in Figure 2. In order that the summary of data procedures outlined here can be readily followed, actual field data are shown in Figure 1, and these are summarized in Figures 2 and 3 (data taken from the middle coastal plain of Georgia).

A modification not illustrated here that appears to be quite useful is the recognition of vertical substrata in the sampling plane. By splitting the tally sheet into "layers," intercepts may be recorded in strata at any height above the ground. This technique is valuable in trying to detect browsing effects at different levels, especially if height development of certain species is a major consideration.

The deficiencies in this modification of the line intercept method are also great, though not unique. The procedure still provides no real solution for comparing various growth forms in understory vegetation, including the modifying effects of animals. Unless detailed records are maintained separately, no clear picture of crown spread changes can be examined. Further, unless some consideration is given to the size (e.g., diameter) of the intercepts, there is only a crude, probable relation to forage production or availability.

As a technique for measuring change, however, this method has a number of good features. First, it incorporates the advantages of the long, narrow plot in reducing between-plot variation with the attendant advantage of reducing replications. When established with permanent stakes, transect remeasurement provides a basis for analysis of difference—a desirable feature where time series are involved. The summaries shown here permit rapid examination of data using standard statistical testing procedures. Hypothesis concerning either continuous or discrete variables can be tested. Also, the method bypasses bias inherent in methods employing a loop (Cook and Box, 1961; Kinsinger *et al.*, 1960; and Johnston, 1957). Finally, larger volumes of data are obtained for comparable units of effort than with either point or loop sampling.

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