TECHNICAL NOTES

Effect of Woody Stems on Estimating Herbage Weights with a Capacitance Meter

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Highlight: *Ignoring woody stems significantly improved capacitance-meter estimates of herbage weight.*

Electronic capacitance meters have proven useful in estimating weights of herbaceous vegetation (Back et al., 1969). Equally good results have recently been obtained in shrub-dominated stands (Morris et al., 1970). The effect of woody stems on the relationship of capacitance measurements to herbage weight has not been well defined, however. Since it is a major task to cut large woody stems into pieces small enough to sack for subsequent weighing, the procedure could be greatly simplified if the effect of such stems on capacitance readings and weight estimates of herbage could be ignored. This study was conducted to determine the significance of such effects.

Study Area and Methods

The work was done in central Colorado in big sagebrush (*Artemisia tridentata* Nutt.) communities with Douglas rabbitbrush (*Chrysothamnus viscidiflorus* [Hook.] Nutt.), Saskatoon serviceberry (*Amelanchier alnifolia* Nutt.), antelope bitterbrush (*Purshia tridentata* [Pursh] DC.), and mountain snowberry (*Symphoricarpos oreophilus* Gray) as commonly associated shrubs. Grasses and forbs also occurred on most plots. The instrument used was Model 18-1000 of Neal Electronics, Burbank, Calif.[1]

For herbage estimates, the clipped material was air dried and stored about 4 weeks, then oven dried 24 hours at 100 C before weighing. Capacitance values customarily are used in a double-sampling technique, wherein a small sample of the total plots metered is subsequently clipped for a meter:weight relationship. The linear regression of herbage weight on meter readings from the small sample permits estimating weights from meter readings in the large sample.

Data from 450 metered and clipped plots were evaluated, with three different meter estimates being made on each plot (Fig. 1-3). The meter sensed vegetation in a 3-dimensional plot 12 by 24 inches horizontally and 18 inches high. When the meter was first placed on the plot, the

Fig. 1. *Herbage meter on plot prior to any clipping.*

Fig. 2. *Herbage meter on plot after leaves and current annual growth of shrub stems were removed.*

Fig. 3. *Final clipped plot after all vegetation, including large woody stems, was removed.*

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[1]Trade names and company names are used for the benefit of the reader and do not imply endorsement or preferential treatment by the U. S. Dep. Agr., or Colo. Div. of Wildlife.

Table 1. Statistics from the six computed regressions of weight on meter values.

Independent variable (meter values)	Dependent variable (weights)		r	Conf. Lim. .95 for r	r^2
A	Shrub leaves and current stems, grasses, and forbs	with wood	0.663a*	0.594–.732	0.440
A	" " " "	without wood	.799a	.744–.854	.638
A	Shrub leaves and current stems	with wood	.646	.575–.717	.417
A	" " " "	without wood	.771	.712–.830	.594
C	Shrub leaves and current stems	with wood	.671b	.611–.731	.450
C	" " " "	without wood	.849b	.800–.898	.721

*Pairs followed by same letter are significantly different at $\alpha = .05$.

location of the corner probes was marked with golf tees and meter value A was taken before any vegetation was clipped (Fig. 1). Then the corners of the plot were marked with steel pins to define the area sensed by the meter, and the meter was removed for the first clipping. In the first clipping, only leaves and current annual growth of shrub stems were removed and sacked.

For meter value B, the instrument was replaced on the golf tees and a second reading was taken (Fig. 2). It was again removed, and forbs, grasses, and the remaining large woody stems were clipped (Fig. 3). The effect of large stems was included in both A and B meter values. The A value indicated capacitance of total vegetation including wood; the B value, forbs and grasses plus remaining wood.

The difference between the A and B values (meter value C) indicated the capacitance of shrub leaves and current stem growth. Six regressions were computed for the meter values as shown in Table 1.

Results and Conclusions

As shown by the first and second regressions in Table 1, a single meter reading of the plot estimated weight of total herbaceous material more accurately than it estimated total herbaceous material plus woody stems. The difference between the correlation coefficients was significant at the 95% level. Twenty percent more variation in estimated weight (Y) was accounted for by excluding wood.

The third and fourth regressions reveal that a single meter reading estimated the weight of shrub leaves and current stems (despite the inclusion of forbs and grasses) more accurately than it estimated the same plus wood. Eighteen percent more variation in Y was accounted for by excluding wood, although the correlation coefficients were not significantly different at the 95% level.

The fifth and sixth regressions show that the difference (C) between a first reading of total vegetation and a second reading of forbs and grasses plus wood estimated the weight of shrub leaves and current stems alone more accurately than it estimated shrub leaves and stems plus wood. The correlation coefficients were significantly different. Twenty-seven percent more variation in Y was accounted for by the exclusion of wood. Our experience reveals that higher r^2 values can be obtained from more homogeneous sample units than from the lumped data we present here.

Excluding wood probably improved the regressions because (1) wood has little capacitance relative to herbaceous material, so that we were combining regressions with grossly different slopes, and (2) the amount of wood on plots varied so greatly (0 to 869 g) relative to herbaceous material (3 to 99 g).

The weight of shrub leaves and current stem growth can be estimated more accurately with a capacitance meter if the effect of forbs and grasses is removed (the sixth regression contrasted with the second in Table 1). If forbs and grasses are sparse and cannot be estimated accurately, however, the effort to take a second meter reading may not be justified.

Our records indicate that clipping and sacking woody stems requires nearly one-third more time spent at each plot; about 10% more time is added to the sorting, drying, and weighing operations. Since herbage weight can be estimated more accurately by ignoring the contribution of woody stems to capacitance readings, these stems should be clipped and measured only if an estimate of total biomass is desired.

Literature Cited

Back, H. L., F. E. Alder, and B. G. Gibbs, 1969. An evaluation of an electronic instrument for pasture yield estimation. 2. Use with double sampling for regression estimation. J. Brit. Grassland Soc. 24:168–172.

Morris, M. J., D. L. Neal, and K. L. Johnson. 1970. Estimating shrub component production with an electronic capacitance instrument. Abstr. Pap., 23rd Ann. Meet. Amer. Soc. Range Manage. 1970:9.