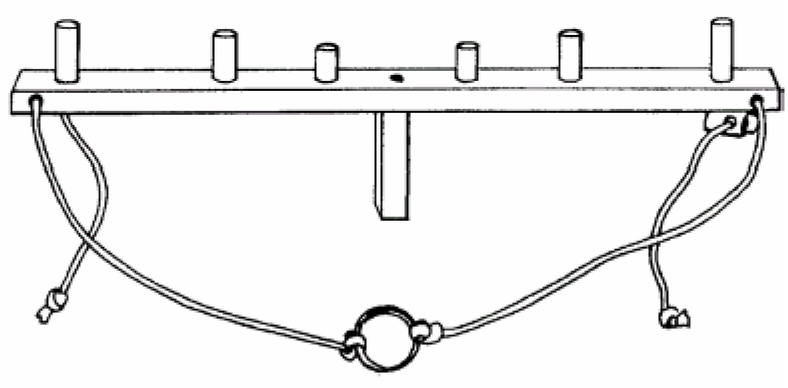
CRITIQUE: Point Relascope Sampling of Surface Fuels

Objective. Direct estimates of surface fuels in forests is a time consuming exercise. The standard approach in fire ecology research is to use line intersects to measure the components of the fuel bed (Brown 1974). While this approach returns reliable and "time-tested" results, the spatial scale is confined to the plot area. Thus in essence, it provides point estimates of a continuous and spatially heterogeneous variable (i.e., the size and distribution surface fuel loads). Plotless sampling techniques are commonly used in forest inventory as alternatives when defined-area techniques are either too laborious and/or spatially restricted. Here we evaluated the potential for a recent plotless sampling technique to inform forest fuel loads.

Data. In each of the 523 inventory plots in Sagehen Creek Basin, we made two independent measurements of surface fuel sampling. We used the standard technique of line intersect sampling as described in Brown's manual (1974). For each plot, ground and surface fuel loads were calculated using equations developed for Sierra Nevada forests. See Stephens and Moghaddas (2001) for details. In addition we estimated the volume of coarse woody debris (100+ hour fuels) at plot center using the point relascope method (Gove et al. 1999, Figure 7, see below) and sampling strategy described in Brissette et al. (2003). Details on our field methodology are in the document: METHOD_Sagehen_field_protocol.doc.

Fig. 7. Relascope device design used in the application of point and transect relascope sampling.



Analysis. We compared estimates of coarse woody debris volume (m^3/ha) from the point relascope with estimates of surface fuels (tons/ha). Our goal was to check for basic correlation between the techniques in terms of information about fuel loads. Since our ultimate goal was to use the surface fuel characterization to assign fire behavior fuel models, we assessed the relative importance of fuel bed information in our assignment of standard fuel models.

Table 1. Correlation coefficient (r) between estimates of coarse woody debris (CWD) and components of surface fuels. Data from 523 plots in Sagehen Creek Basin.

	tons/ha					
	1-hr fuels	10-hr fuels	100-hr fuels	1000hr-sound	1000hr-rotten	Sum all sizes
CWD (m^3/ha)	0.22	0.27	0.48	0.43	0.25	0.51

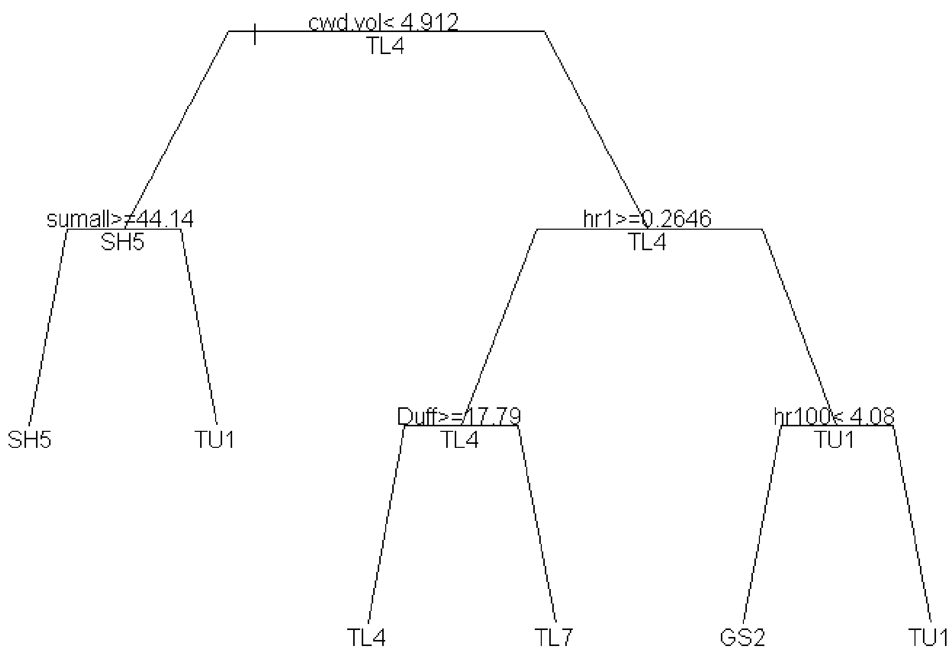


Figure 1. Classification and regression tree: Importance of fuel components in predicting Scott and Burgan (2005) standard fuel models.

cwd.vol = volume of coarse woody debris (minimum small end diameter = 5 cm) per area (m^3/ha); hr1 = mass of 1-hr fuels per area (tons/ha); hr100 = mass of 100-hr fuels per area (tons/ha); sumall = total mass of surface fuels per area (tons/ha, includes litter, duff, 1-hr, 10-hr, 100-hr, 1000-hr fuels); Duff = mass of duff layer (tons/ha).

Three-letter codes correspond to assigned fuel models.

Results. In general, point relascope estimates of surface fuels were positively and significantly correlated with the results from the line intersects (Table 1). Correlation was strongest when the size classes corresponded most closely. Of the 523 paired-comparisons, there were only three instances of extreme outliers. In two of these cases, estimates from point relascope sampling (PRS) greatly exceeded line intersect sampling estimates. In the other case, PRS greatly underestimated line intersect sampling.

The classification tree analysis (Figure 1) showed that volume of coarse woody debris (cwd.vol) as estimated by PRS was the most important determinant of fuel model assignment. Plots with less than 4.9 m^3/ha were consistently assigned a shrub fuel (SH) model while those with more woody debris were assigned a timber litter (TL) model. This initial classification is reasonably accurate (~20% misclassification rate). However beyond this general classification, there was little practical gain in classification accuracy (~70% misclassification rate).

Discussion. Point relascope sampling proved to be a viable alternative for estimating coarse woody debris in these forests. However, by design it does not sample the finer fraction of fuel loads and therefore its correlation with these estimates suffered. Moreover, the assignment of fire behavior fuel models incorporates a complex decision tree where surface fuel loads are only part of the equation (Scott and Burgan 2005). This complexity was clear from our classification tree results – in general fuel loads by size class were relatively poor determinants of fuel model assignments. Clearly other factors are important such as designation of the fire-carrying fuel type and the quality of the fine fuels (e.g., litter composition, density of duff).

A closer inspection of the three outlier cases highlights two practical considerations. In dense shrubs, it is very difficult to do a complete and thorough search for all wood pieces that qualify as CWD. In one case, this led to a large underestimate of CWD. On the other hand, in stands where there are very large pieces of CWD (i.e., downed trees), the plotless nature of point relascope included pieces that were beyond the plot boundaries. In these two cases, the point relascope method provided a much larger estimate of downed wood.

Recommendation. When the sampling design included plot-based tree inventories, there is little reason to include point relascope sampling. There is only a minimal increase in sampling efficiency when a fixed-area plot is being established for other reasons. Clearly, there is less detailed information collected. On the other hand, point relascope sampling would provide a quantitative check on qualitative surveys of fuel loads. For example, it could be used in conjunction with the natural fuel photo series method to standardize across stands and/or field technicians.

References

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