A LINE INTERSECT DISTANCE SAMPLING STRATEGY FOR DOWNED WOOD INVENTORY

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The growing recognition of the importance of downed woody material (DWM) in forest ecosystem processes and global carbon budgets has sharpened the need for efficient sampling strategies that specifically target this resource. Numerous large-scale inventory programs currently utilize line intersect sampling (LIS) for DWM survey but the sample sizes needed to achieve acceptable levels of precision with this method are prohibitive in many applications. More recently, perpendicular distance sampling (PDS) has emerged as a compelling alternative owing in part to its probability proportional-to-volume design. This research develops a selection protocol and design-unbiased estimators for a novel probability proportional-to-volume sampling strategy, termed line intersect distance sampling (LIDS). LIDS combines the transect sampling protocol of LIS with the distance sampling protocol of PDS, borrowing their respective field and statistical efficiencies. Under LIDS, estimates of aggregate DWM volume are obtained from counts of selected particles, obviating time-consuming and oftentimes biased measurements of the volumes of individual particles. Moreover, it is shown that unbiased linear homogeneous estimators of other DWM attributes can be derived using crude Monte Carlo estimates of particle volume. Simulations indicate that LIDS on multi-directional (e.g., Y-shaped) transects should perform similarly to PDS in terms of sampling error across a range of populations; however, it remains unclear how LIDS and PDS compare to LIS in field settings, especially when interest attaches to multiple DWM parameters. Among the strengths of LIDS is its potential to reduce measurement errors, including particle detection errors, relative to PDS when visibility is limited in the field by vegetation or terrain.