Sampling Methods for Snags and Large Trees Important to Wildlife[1]

Lisa J. Bate,[2] Edward O. Garton,[3] and Michael J. Wisdom[4]

Abstract
We developed efficient and accurate methods for sampling snags and large trees important to wildlife. These methods are described in detail in a recent Forest Service publication, which also includes spreadsheets, macros, and instructions to conduct surveys and analyses to estimate densities and distributions of snags and large trees on a landscape. These methods focus on optimizing sampling effort by choosing a plot size appropriate for specific forest conditions encountered. Two methods for assessing density are available. Method I requires sampling until a desired precision is obtained for a density estimate. Method II is designed to test for differences in observed snag density versus a desired target density. After collecting a minimum of 60 samples under method II, one may test for a significant difference between the observed and targeted densities. In addition, data can be used to calculate a distribution index. The value obtained from the distribution index helps managers assess whether the current distribution of snags and large trees across a subwatershed is adequate to meet the habitat needs of territorial cavity-nesters and other wildlife species. Wildlife use of snags and large trees may also be evaluated.

Introduction

Snags and large trees are important to a wide variety of wildlife species for survival and reproduction. (Bull and others 1997, Thomas and others 1979). Woodpeckers are an especially important group of species that rely on a continuous supply of snags and large trees. As primary cavity-excavators, woodpeckers create the cavities within snags or trees that they and a myriad of other species use as nest and roost sites. In turn, these same cavities also provide thermal and hiding cover for many resident wildlife species during the non-breeding season.

National Forests are required by law to maintain viable populations of all native wildlife species (Forest and Rangeland Renewable Resources Planning Act 1974). Specifically, National Forests are required to monitor native species or their habitat to ensure the presence of viable populations through maintenance of well-distributed habitats throughout the planning area (U.S. Laws, National Forest Management Act

---

[1] An abbreviated version of this paper was presented at the Symposium on the Ecology and Management of Dead Wood in Western Forests, November 2-4, 1999, Reno, Nevada.

[2] Cooperative Wildlife Biologist, University of Idaho/Pacific Northwest Research Station, USDA Forest Service, La Grande, Oregon; 389 LaBrant Road, Kalispell, MT 59901 (e-mail: lisabate@cyberport.net)

[3] Wildlife Professor, University of Idaho, Department of Fish and Wildlife, University of Idaho, Moscow, ID 83844.

[4] Research Wildlife Biologist, Pacific Northwest Research Station, USDA Forest Service, 1401 Gekeler Lane, LaGrande, OR 97850.

1976). Because woodpeckers play an integral role in forested ecosystems, they have been a primary focal species for monitoring efforts on National Forests (Bull and others 1991).

Monitoring requires considerable time and money. Consequently, if resource specialists are to monitor habitat for woodpeckers and other cavity-nesters accurately, these specialists need efficient and statistically valid sampling methods. In response to this need, we produced a Forest Service General Technical Report (GTR) as a guide for resource specialists in the sampling and monitoring of snags and large trees. Included in the report (Bate and others 1999) are the spreadsheets, macros, and instructions needed to conduct all surveys and analyses pertaining to the estimation of snag and large tree densities, and their distributions on a landscape.

This paper highlights the essential considerations for sampling snags and large trees on a landscape as a companion to the earlier GTR of Bate and others (1999). Specifically, this paper was written to facilitate a better understanding of the methods required for accurate estimation of snag and large tree density and distribution, in support of monitoring efforts for cavity-nesting birds on National Forests. Improvement in the understanding of these methods and their accuracy is particularly important in light of findings that indicate failure of National Forest management to provide adequate densities of snags and large trees for cavity-nesters (Bate 1995, Morrison and others 1986).

Key Considerations for Sampling Snags and Large Trees

Before beginning a sampling program for snags or large trees, resource specialists must first make two key decisions about plots: plot shape and size. In general, long, narrow or rectangular plots work better than circular or square plots (Krebs 1989). This is because the habitat components of a forest are never uniformly distributed; rather, habitat components such as snags tend to occur in clumps or patches. Consequently, rectangular plots are better for sampling because they cross through more clumps of snags or trees, rather than encircling, or missing clumps completely. The outcome is a lowered variance, which translates into smaller sample sizes. Rectangular plots, therefore, are recognized as the optimal plot shape for sampling in patchy habitats (Krebs 1989) and are the shape that we recommend.

The second decision, relating to what size of plot to use, is not readily discernible. This is because no single plot size is optimal for all forested conditions. We define the optimal plot size as that which minimizes sampling effort while maintaining accuracy and precision. Each forest situation must be analyzed independently, because the optimal plot size depends on a number of factors such as density and distribution of snags or large trees, topography, seral stage, and amounts of downed wood or shrub cover.

Analysis for Optimal Plot and Sample Size

Sometimes a plot size can be selected based on knowledge of the area, but in many forested areas the optimal plot size for sampling snags or large trees is unknown until a pilot sample is conducted. A pilot sample provides an initial estimate of the density of snags or trees likely to exist in a given area. A pilot sample also provides information about the distribution of snags or trees. Information from the pilot survey can be used in two specific ways with the spreadsheets found in Bate and others (1999): to identify optimal plot size and to calculate the number of samples needed to obtain a desired level of precision.

Eight plot sizes are available for use within the spreadsheets provided by Bate and others (1999). As part of the pilot sample, field observers record the perpendicular distance to a snag or large tree from the centerline of the transect. Based on these distances, a macro within the spreadsheets truncates the number of snags or trees in 5-meter intervals. This allows the user to estimate the density and variance of snags for each of the eight plot sizes. Subsequently, this information is used in the spreadsheets in a variety of ways. First, the spreadsheet calculates the total number of plots and hectares required for sampling with each plot size. Secondly, this information is combined with a cost factor to help determine which plot size is optimal based on the given forest conditions.

Cost seems to be a function of three factors: visibility, terrain, and density. Limited visibility owing to the seral stage or dense shrub cover within a stand can increase search time for snags, and therefore cost, if too wide of a plot is used for sampling. Too wide of a plot can also lead to biased estimates of density. Similarly, if field conditions are difficult for an observer to travel through, or a consistently high number of snags or large trees (>15 per plot) are encountered within each plot, a narrower plot width is likely a better choice. The optimal plot size is that which minimizes sampling effort while maintaining accuracy and precision.

Stratification

When sampling on a landscape scale of a subwatershed or watershed, it will be rare that forest conditions will be similar throughout such large areas. Consequently, stratification is critical in reducing variance, and in turn, reducing sampling intensity needed to meet sampling goals. As a result, Bate and others (1999) provide a high level of detail about effective methods of stratification or the creation of homogeneous forest categories to reduce sample size requirements. To guide the stratification process, Bate and others (1999) include a spreadsheet called “Sample Size.” This spreadsheet calculates the sample size required and how the samples should be allocated by stratum (homogeneous categories). Two allocation methods are provided: a proportional method and optimal method. The proportional method allocates samples among strata based on the proportion of the area within each stratum. In contrast, the optimal allocation method incorporates both the proportion of the total area and the variance of each stratum. There are advantages and disadvantages to both approaches (Bate and others 1999).

Density Analyses

Two options for obtaining a density estimate are available. Under the first option, a sufficient number of samples are collected to obtain a desired level of precision (e.g., within 20 percent of the true mean 90 percent of the time). In areas where snag densities are high and not severely clumped, obtaining a density estimate within a desired precision usually can be done with a reasonable amount of effort. In areas that have been intensively harvested and few snags have been retained, however, the number of samples required (in hectares) to obtain a desired precision can exceed the land area available. Consequently, Bate and others (1999) provide a second density analysis option, which is a straightforward statistical test to compare estimated densities with targeted densities. For example, is the density estimate of snags different from the Forest Plan standards, which requires five snags per hectare? One great advantage of this method is that the test can be conducted after a minimum of 60 samples has been collected.

Further Analyses

Another feature of the Bate and others (1999) GTR and its spreadsheets is the method presented for calculating a distribution index. The distribution index helps managers assess whether the current distribution of target snags and large trees across a subwatershed is adequate to meet the habitat needs of territorial cavity-nesters and other wildlife species. The distribution index is a useful complement to the estimation of snag density because small areas of subwatersheds sometimes contain a major proportion of all snags in the subwatershed, rendering most snags as unavailable to territorial species. Thus, application of the distribution index gives managers appropriate insight about how well their snag density goals can be met from the standpoint of distribution.

For resource specialists interested in more than density or distribution, the spreadsheets also offer an algorithm to calculate nesting use. This algorithm is given as a percent use value and can also be applied to calculate foraging use.

Acknowledgments

We thank Kim Mellen and Torolf Torgersen for kindly reviewing our manuscript.

References

Bate, Lisa J. 1995. **Monitoring woodpecker abundance and habitat in the central Oregon Cascades**. Moscow, ID: University of Idaho; 116 p. M.S. thesis.

Bate, Lisa J.; Garton, Edward O.; Wisdom, Michael J. 1999. **Estimating snag and large tree densities and distributions on a landscape for wildlife management.** Gen. Tech. Rep. PNW-GTR-425. Portland, OR: Pacific Northwest Research Station; U.S. Department of Agriculture, Forest Service; 76 p.

Bull, Evelyn L.; Holthausen, Richard S.; Marx, David B. 1990**. How to determine snag density.** Western Journal of Applied Forestry 5(2): 56-58.

Bull, Evelyn L.; Carter, Bernie; Henjum, Mark; Holthausen, Richard; Johnson, J.; Mellen, Kim; Raphael, Martin. 1991. **Protocol for monitoring woodpeckers and snags in the Pacific Northwest region of U.S. Forest Service**. Unpublished report on file with U.S. Department of Agriculture, Forest Service, Pacific Northwest and Range Experiment Station, Forestry and Range Sciences Laboratory, LaGrande, OR; 8 p.

Bull, Evelyn L.; Parks, Catherine G.; Torgersen, Torolf R. 1997. **Trees and logs important to wildlife in the interior Columbia River basin.** Gen. Tech. Rep. PNW-GTR-391. Portland, OR: Pacific Northwest Research Station, U.S. Department of Agriculture, Forest Service; 55 p.

Cochran, William G. 1977**. Sampling techniques**, 3d ed. New York: John Wiley and Sons; 428 p.

Krebs, Charles J. 1989. **Ecological methodology**. New York: Harper Collins Publishers, Inc.; 654 p.

Morrison, M. L.; Dedon, M. F.; Raphael, M. G.; Yoder-Williams, M. P. 1986. **Snag requirements of cavity-nesting birds**: **are USDA Forest Service guidelines being met?** Western Journal of Applied Forestry 1: 38-40.

Thomas, Jack W.; Anderson, Ralph G.; Maser, Chris; Bull, Evelyn L. Snags. 1979. In: **Wildlife habitats in managed forests—the Blue Mountains of Oregon and Washington**. Agric. Handb. 553. Washington, DC: U.S. Department of Agriculture; 60-77.