

Estimating Snag Densities and Down Wood Using Aerial Survey Data

Keith Sprengel¹, Julie Johnson², Bruce Hostetler³, Kim Mellen-McLean⁴, Beth Willhite⁵

USDA Forest Service

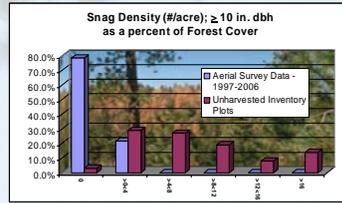


Pacific Northwest Region

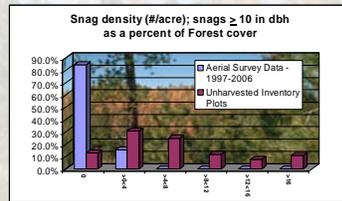
Introduction

Forest land managers interested in maintaining healthy ecosystems must evaluate effects of existing or proposed management activities on organisms that use snags, down wood and other wood decay elements. Recent development of the "DecAID Advisor" has provided an important tool for helping estimate dead wood requirements in analysis areas. DecAID is an internet-based synthesis of published scientific literature, research data, wildlife databases, forest inventory databases and expert judgment and experience. It addresses current vegetative conditions (unharvested and managed); provides relevant summaries of snags and down wood; and presents information on wildlife use of snags and down wood data. It also provides information on insects and pathogens and their role in creating and retaining dead wood. Information in DecAID should be applied at minimum scales of 5th field watersheds.

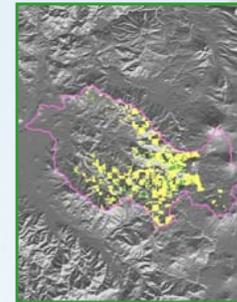
One important aspect of dead wood analyses is ascertaining the current status of snags and down wood within and in the vicinity of a project area. This project examines how aerial survey data can aid managers in developing a picture of the "current situation" for the incidence, distribution and condition of snags (which are potential down wood) across a landscape.



Distribution of the unharvested area of the SWOR Large tree Vegetation Condition among snag density classes (#/acre) for snags ≥ 10 in dbh, based on 165 unharvested inventory plots compared to Aerial Insect and Disease Survey data.



Distribution of the unharvested area of the SWOR Small/Medium Vegetation Condition among snag density classes (#/acre) for snags ≥ 10 in dbh, based on 274 unharvested inventory plots compared to Aerial Insect and Disease Survey data.



Little Butte Creek watershed (LBC) study area showing aerial survey reported cumulative mortality in the ≥ 10 in dbh class recorded between 1997 and 2006 for the SWOR wildlife habitat type.

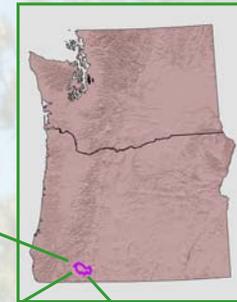
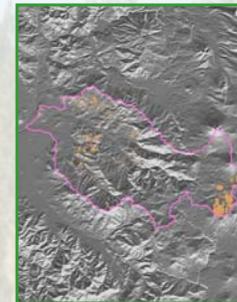
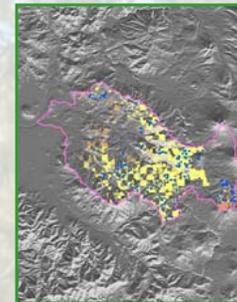


Photo by Alan Dyer



Little Butte Creek watershed (LBC) study area showing aerial survey reported cumulative mortality in the ≥ 10 in dbh class recorded between 1997 and 2006 for the PPWO wildlife habitat type.



Little Butte Creek Watershed Study area in Southwest Oregon showing wildlife habitat areas and sample points.

- Random sample points
- PPWO WHT
- SWOR WHT
- LBC Watershed



Pole/Sap Vegetation Condition

Down Wood Transect in the Pole/Sap Area

snags in the SWOR Wildlife Habitat Type

Methods

The study area, located in Southwest Oregon, consists of forested federal lands within the Little Butte Creek watershed. Two wildlife habitat types (WHT) were sampled: Ponderosa Pine – Eastside Oak Woodlands and Forests (PPWO) and Southwest Oregon Mixed Conifer-Hardwood Forest (SWOR). In order to use aerial survey data to estimate snag densities, we developed aerial survey code conversion factors based on inventory plot (CVS, FIA and BLM) summaries of snag data from each WHT. Ten years of cumulative mortality data, as recorded by aerial detection surveys from 1997 through 2006 (see <http://www.fs.fed.us/r6/nr/fld/data.shtml>) for more information on Pacific Northwest Region Aerial Surveys) were then compared to ground data collected from stratified systematic random samples in each of the wildlife habitat types.

Areas which were harvested or burned by wildfire from 1997 through 2006 were excluded from the study. Only cover types classified as either Conifer, Mixed or Hardwood Forest as defined in the District's vegetation data were used to represent "forested" conditions for inclusion in the study.

As a result of a pilot survey, the study area was stratified into five strata in each wildlife habitat area: closed pole/sap trees; Open, large tree (<70% cover); large tree closed (>70% cover) small saw trees; and hardwood woodland. WHT strata were used as defined by the Northwest Habitat Institute and Northwest Power and Conservation Council, 2000.

Using the ArcView Sample Point Generator (SPGen), developed by Vern Thomas and Maria Downing (USDA Forest Service, Forest Health Technology Enterprise Team) and Robin Reich (Colorado State University), a grid of 200 X 200 m cell polygons with centered points was placed over the entire study area and 5 cells were randomly selected from each stratum. At each selected point, azimuths were randomly selected using the random number function (RAND) in Excel. Starting at each sample point, two 164 foot samples were taken. Snags within 66 feet either side of the transect center line were measured for perpendicular distance to the line, species, diameter, height and structural decay class. Measured snags had to be ≥ 6 ft tall and ≥ 8 in dbh (most species); or ≥ 6 in dbh (lodgepole pine) or ≥ 3 in dbh (subalpine fir or whitebark pine). Diameter breakpoints were established relative to insect biology and what sizes of trees an aerial observer could be expected to see on an overview survey relative to various wildlife habitat types (Sprengel, Hostetler and Bridgwater, pers. comm.).

Pilot survey data were analyzed using protocols developed by Bate et al. (1999) to determine numbers of samples and optimal plot sizes needed for each strata to provide a mean density estimate with a 90% confidence interval for qualifying (class 1 & 2) snags sampled in the study area.

Down wood data were collected using the Line Intersect Method on all plots (Decay class, diameter at intersect, length, large and small end diameter, and species).

Key Findings

Aerial survey data provided an extremely conservative estimate of snag densities in the study watershed in both the SWOR and PPWO wildlife habitat types for all of the examined diameter classifications.

Mean snag densities predicted from analysis of 10 years of aerial survey data (1997-2006) were 0.14 snags per acre (SPA) in SWOR study area, and 0.05 SPA in PPWO study area. Summary of observed plot based data on hard snags ≥ 10 in dbh (class 1 & 2) resulted in an average of 7.68 SPA in the SWOR WHT and 4.27 SPA in PPWO.

Inventory plot generated conversion factors underestimated the percent of snags in all diameter classes for all species measured, providing conservative estimates of snag densities in diameter classes of interest (≥ 10 in dbh and ≥ 20 in dbh).

Analysis of aerial survey data provides a cost effective method for estimating relative snag densities and distributions at 5th field watershed scales for some wildlife habitat types.

Due to mapping thresholds and other environmental variables, estimates of snag densities in some habitat types based on aerial survey data are too variable.

Results of aerial survey data analysis may eliminate the need to conduct expensive ground surveys in some strata and/or for some size classes of snags in certain wildlife habitat types.

Snag & Down Wood Plot Data Summaries

	Class 1-2 >= 8" LED		Class 1-3 >= 8" LED		Class 1-5 >= 3" SED	
	PPWO	SWOR	PPWO	SWOR	PPWO	SWOR
Logs/acre	5.28	13.5	30.54	36.11	142.93	197.15
Length of logs/acre	135.28	356.86	481.93	807.96	1442.98	2277.13
Av. length/foot	25.6	26.44	15.78	22.38	9.78	11.55
Cubic feet/acre	140.42	274.47	482.44	760.75	1208.11	1382.51
Av. cubic feet/foot	25.57	20.34	15.8	21.07	8.19	7.01
Tons/acre	12.48	26.89	29.17	51.42	38.7	67.24
Percent cover					2.61	3.96

Summary of coarse woody debris (CWD) by decay condition class categories. LED = Large end diameter; SED = Small end diameter. Qualifying CWD measurements were: Length >= 3 ft and SED >= 3 in

	PPWO	SWOR
X_{st} (snags) =	4.266	7.683
Var_{st} =	0.038	0.158
S_{st} =	0.196	0.398
Bound =	0.327	0.664
Upper Limit =	4.593	8.347
Lower Limit =	3.940	7.019
Level of Precision (%) =	8	9

Snag density estimates for class 1 & 2 snags ≥ 10 in dbh and ≥ 6 ft tall: Results from field data collected from systematic stratified-random sample transects.

	PPWO	SWOR
X_{st} (snags) =	1.651	2.896
Var_{st} =	0.005	0.011
S_{st} =	0.071	0.107
Bound =	0.119	0.179
Upper Limit =	1.770	3.075
Lower Limit =	1.532	2.717
Level of Precision (%) =	7	6

Snag density estimates for class 1 & 2 snags ≥ 20 in dbh and ≥ 6 ft tall: Results from field data collected from systematic stratified-random sample transects.

Future Research and Applications

Assess the ability of aerial surveys to consistently make conservative estimations of snag and large tree densities and distributions at watershed scales in other wildlife habitat types, and to estimate the magnitude of the under estimation.

Investigate possible correlations between fuel loading and cumulative mortality as reported by aerial surveys.

Further evaluate efficacy of plot (FIA/CVS/BLM) derived conversion factors for aerial survey relative to wildlife habitat types and significant trees per acre and diameter breakpoints identified in the Decayed Wood Advisor (DecAID).

Continue development of an interactive aerial survey-derived cumulative mortality database for integration with DecAID.

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References Cited

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: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 76 p. http://www.fs.fed.us/pnw/pubs/gtr_425.pdf

Northwest Habitat Institute and Northwest Power and Conservation Council, 2000. <http://www.nwhi.org/index/gisdata>.

United States Geological Survey National Land Cover data <http://landcover.usgs.gov/prodescription.asp>.

Information on the Decayed Wood Advisor (DecAID) can be found at: <http://www.notes.fs.fed.us:81/pnw/DecAID/DecAID.nsf>

ArcView Sample Point Generator <http://permanent.access.gpo.gov/webistes/fsfedus/www.fs.fed.us/foresthealth/technology/spatialstatistics/sample.php.htm>