

# Estimating Snag Densities and Down Wood Using Aerial Survey Data

Keith Sprengel<sup>1</sup>, Julie Johnson<sup>2</sup>, Bruce Hostetler<sup>3</sup>, Kim Mellen-McLean<sup>4</sup>, Beth Willhite<sup>5</sup>

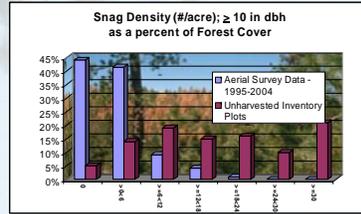
USDA Forest Service



## Introduction

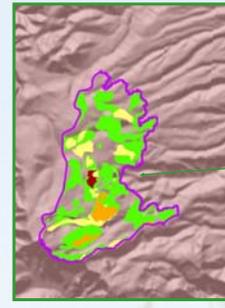
Forest land managers interested in maintaining healthy ecosystems must evaluate effects of existing or proposed management activities on organisms that use snags, down wood and other wood decay elements. Recent development of the "DecAID Advisor" has provided an important tool for helping estimate dead 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 MMC, S Vegetation Condition among snag density classes (#/acre) for snags ≥ 10 in dbh, based on 1271 unharvested inventory plots compared to Aerial Insect and Disease Survey data converted to snags ≥ 10 in dbh using conversion factors generated from inventory plot data.

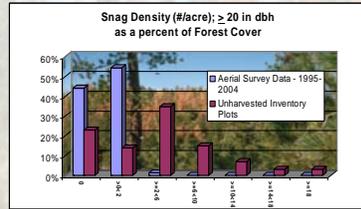
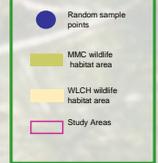
Headwaters 15 Mile Creek, Upper Eightmile Creek and Fivemile Creek subwatersheds (MMCSA) showing aerial survey reported mortality recorded in the ≥ 10 in dbh class between 1995 and 2004 for the MMC wildlife habitat type.



## Pacific Northwest Region



Watershed Study areas on Mt. Hood National Forest showing wildlife habitat areas and sample points.



Distribution of the unharvested area of the MMC, S Vegetation Condition among snag density classes (#/acre) for snags ≥ 20 in dbh, based on 932 unharvested inventory plots compared to Aerial Insect and Disease Survey data converted to snags ≥ 20 in dbh using conversion factors generated from inventory plot data.

North Fork Clackamas River, Lower Clackamas River and South Fork Clackamas River subwatersheds (WLCHSA) showing aerial survey reported mortality recorded in the ≥ 10 in dbh class between 1995 and 2004 for the WLCH wildlife habitat type.



## Methods

- The study area, located in Northwest Oregon, consists of forested federal lands within six subwatersheds. Two wildlife habitat types (WHT) were sampled, the Westside Lowland Conifer (WLCH) represented by: North Fork Clackamas River, Lower Clackamas River and South Fork Clackamas River subwatersheds and Montane Mixed Conifer (MMC), represented by: Headwaters 15 Mile Creek, Upper Eightmile Creek and Fivemile Creek. 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 1996 through 2005 (see <http://www.fs.fed.us/r6/nr/rid/data.shtml>) for more information on Pacific Northwest Region Aerial Surveys) were then compared to ground data collected from stratified systematic random samples in the WLCH wildlife habitat type and simple random samples in the MMC wildlife habitat type.
- Areas which were harvested or burned by wildfire from 1995 through 2005 were excluded from the study. Only cover types classified as either Evergreen or Mixed Forest as defined in the District's vegetation data for the WLCH WHT or the Interagency Vegetation Mapping Project (IVMP) for the MMC WHT were used to represent "forested" conditions for inclusion in the study.
- As a result of a pilot survey, the WLCH study area was stratified into four strata: WLCH closed pole/sap trees; WLCH Open (<70% cover); WLCH closed (>70% cover) small sap trees; and WLCH closed large tree. WHT strata were used as defined by the National Habitat Institute and Northwest Power and Conservation Council, 2000. Strata were developed using Clackamas River Ranger District vegetation data.
- As a result of the pilot survey, the MMC study area was treated as a single strata. Stratification based on data from IVMP yielded similar results as when analyzed as a single strata.
- Using the ArcView Sample Point Generator (SPGen), developed by Vern Thomas and Marla 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 along the continuous 328 foot transect. 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). 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 snags in the study area.
- Down wood data was 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 a conservative estimate of snag densities in the study watershed in both the WLCH and MMC wildlife habitat types for all of the examined diameter classifications.
- Mean snag densities predicted from analysis of 10 years of aerial survey data (1995-2005) in the MMC study area = 9.72 snags per acre (SPA). Inventory plot data based conversion factor applied to aerial survey data for summarizing snags ≥ 10 in dbh = 2.53 SPA. Snag density estimate derived from field study for Class 1 and 2 snags ≥ 10 in dbh = 36.90 SPA.
- Inventory plot generated conversion factors underestimated the percent of snags in all diameter classes and 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 the WLCH 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.

## Snag & Down Wood Plot Data Summaries

	Class 1-2 >= 8" LED		Class 1-3 >= 8" LED		Class 1-5 >= 3" SED	
	WLCH	MMC	WLCH	MMC	WLCH	MMC
Logs/acre	17.05	34.95	60.51	73.19	226.14	303.3
Length of logs/acre	484.52	1255.51	1354.56	2469.3	3191.54	5305.66
Av. length/log	28.42	35.93	22.39	33.74	14.11	17.49
Cubic feet/acre	592.6	656.36	1823.72	1551.09	3205.74	2633.03
Av. cubic feet/log	34.77	18.78	30.14	21.19	14.18	8.68
Tons/acre	2.8	3.11	8.63	7.34	15.17	12.46
Percent cover					6.72	8.07

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

	WLCH	MMC
$X_{st}(\text{snags}) =$	6.612	36.9
$Var_{st} =$	0.615	
$S_{st} =$	0.784	
Bound =	1.31	4.55
Upper Limit =	7.922	41.45
Lower Limit =	5.303	32.36
Level of Precision (%) =	20	12

Snag density estimates for Class 1 and 2 snags ≥ 10 in dbh and ≥ 6 ft tall: WLCH results from field data collected from systematic stratified-random sample transects. MMC results from field data collected from a systematic simple random sample.

	WLCH	MMC
$X_{st}(\text{snags}) =$	2.047	6.56
$Var_{st} =$	0.046	
$S_{st} =$	0.215	
Bound =	0.359	1.20
Upper Limit =	2.407	7.76
Lower Limit =	1.688	5.36
Level of Precision (%) =	18	18

Snag density estimates for Class 1 and 2 snags ≥ 20 in dbh and ≥ 6 ft tall: WLCH results from field data collected from systematic stratified-random sample transects. MMC results from field data collected from a systematic simple random sample.

## 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.
- 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).
- Develop an interactive aerial survey-derived cumulative mortality database for integration with DecAID.

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- United States Geological Survey National Land Cover data <http://landcover.usgs.gov/proddescription.asp>.
- Information on the Decayed Wood Advisor (DecAID) can be found at: <http://www.wnotes.fs.fed.us:81/pnw/DecAID/DecAID.nsf>
- ArcView Sample Point Generator <http://permanent.access.gpo.gov/websites/lsfedus/www.fs.fed.us/foresthealth/technology/spatialstatistics/sample.php.htm>