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Snag Dynamics in Western Oregon and Washington

Janet L. Ohmann
July 26, 2002

INTRODUCTION

To achieve desired amounts and characteristics of snags and down wood, managers require analytical tools for projecting changes in dead wood over time, and for comparing those changes to management objectives such as providing dead wood for wildlife and ecosystem processes. The following information on rates of snag recruitment, decay, and fall across forests of western Oregon and Washington may be useful in planning for future levels of dead wood. Eventually the information will be incorporated directly into dead wood dynamics models. In the meantime, existing dead wood dynamics models still can be used to predict changes in dead wood levels and comparing to target levels.

The summaries presented here are based on remeasurement data from permanent Forest Inventory and Analysis (FIA) plots. The plots sample several DecAID vegetation conditions on the west side of the crest of the Cascade Mountains in Washington and Oregon ("westside"), but are predominantly from the Westside Lowland Conifer-Hardwood wildlife habitat type. Similar tree remeasurement data are available for eastern Washington and Oregon, but have not yet been compiled. Repeat measurements on permanent plots to determine tree death and fall are very reliable, whereas estimates of change in snag height and decay class are less accurate and are not presented here. Also, because repeatable measurements of down wood along transects are problematic, data on down wood dynamics at the individual log level are unlikely to be provided by regional forest inventory plots. The information presented here therefore focuses on live tree mortality, snag creation, and snag fall.

This project was funded in part by the Forest Health Monitoring Program, USDA Forest Service. A poster version of this information is at http://fhm.fs.fed.us/posters/posters02/snag.pdf. Cartography is by Matt Gregory. Bruce Marcot provided the bibliographies on dead wood dynamics.

METHODS

Rates of snag recruitment, decay, and fall were summarized from repeat measurement data for FIA plots in western Oregon and western Washington (Table 1, Figure 1). Each plot and tree was measured twice over a 10-year period. On the initial visit to each plot, all live and standing dead trees were tallied and species, height, diameter at breast height (DBH), and decay class were recorded. At the second visit, trees previously tallied as

snags were noted as still standing, fallen, or harvested. If snags were still standing, their current DBH, height, and decay class were recorded. Trees that died since the first measurement (mortality) were noted as still standing (recruited snags) or fallen, and cause of death was recorded.

Because snag dynamics are strongly influenced by logging and forest management activities, data were analyzed separately for disturbed and undisturbed plots. 'Disturbed' plots were those where any kind of tree cutting or silvicultural treatment (clearcut, partial harvest, precommercial thin, commercial thin, incidental harvest) was recorded for the 10-year remeasurement period. Disturbances that occurred prior to the remeasurement period are not accounted for in the analysis. Snag recruitment (fall rate of mortality trees) and snag fall also are summarized by State and by tree size class.

KEY FINDINGS

Snag Recruitment

C Rates of mortality tree recruitment as snags varied by cause of death (Table 2). Trees killed by insects, animals, and suppression were most likely to remain standing as snags over the 10-year remeasurement period. Not surprisingly, trees killed by weather (including windthrow) and root disease were most likely to fall down soon after death.
C Nearly half of all mortality trees, dying from all causes combined, fell within 10 years of death and were not recruited as snags (Table 2).

Rates of Snag Fall and Harvest

C In undisturbed stands, 30% of all snags ≥25.4 cm (10.0 in) DBH fell down over the 10-year period (Table 3).
C Snag fall rates in undisturbed stands were substantially lower for the largest snags: most (93%) snags >100 cm (39 in) DBH remained standing over the remeasurement period (Table 3). Snags in the two smaller DBH classes fell at about the same rate (30% and 33%).
C Snag retention was strongly impacted by harvest activities. Only 15% of snags ≥25 cm (10 in) DBH remained standing after disturbance (Table 4). Most snags (62%) were cut down and either left on site or removed. A smaller percentage (16%) fell down naturally. Smaller snags were more likely to be cut down than larger snags.
C In undisturbed stands, western redcedar and 'other conifer' (mostly cedar) snags stood the longest (Table 5.). Hardwoods, Sitka spruce, and true firs fell at the greatest rates.

MANAGEMENT IMPLICATIONS

These findings have several implications for planning for desired future conditions of snags. The high fall rate (almost half) of recent mortality trees needs to be considered when planning for future recruitment of snags and down wood. Trees that fall soon after death provide snag habitat only for very short periods of time or not at all, but do contribute down wood habitat. In fact, these trees are a desirable source of down wood as they will often begin as mostly undecayed wood and, if left on the forest floor, will proceed through the entire wood decay cycle with its associated ecological organisms and processes that are beneficial to soil conditions and site productivity (see section on Ecosystem Processes Related to Wood Decay). Because many existing snag dynamics models assume that all mortality trees are recruited as snags, a major implication of these findings is that these models will substantially overestimate future snag abundance and underestimate amounts of down wood.

The cause of tree death also needs to be considered in planning for snags and down wood. Trees killed by

insects, animals, suppression, and diseases other than root disease are most likely to remain standing as snags. The quality of snag habitat also varies with mortality agent and should be considered as well -- see insect and disease discussions for more information.

Because snag retention is so strongly affected by harvest activities, dead wood should be planned for separately for disturbed and undisturbed stands. Although 62% of snags on disturbed plots in our study were cut down, it's likely that more snags could be retained in harvest units than our findings indicate, by applying creative approaches to snag placement that also address safety and operational concerns (see Rose et al. 2001, p. 605 and Neitro et al. 1985). Our findings suggest that snag size (DBH) and species should be considered when identifying particular snags to retain in harvest units. The larger the snag diameter, the more likely it is to survive harvest operations and remain standing in future years. Species of cedar can be expected to stand the longest (although cedar tends to have low overall wildlife value , whereas hardwoods, Sitka spruce, and true firs will be shortest-lived (but often have higher wildlife value (see the Ancillary Data section in summary narratives)). Again, both the quality and the longevity of snag habitat needs to be considered (see the Considerations for Stand Dynamics section in summary narratives).

Forest Vegetation Simulators and Dead Wood Dynamics Models

Dead wood dynamics models can be used to project the recruitment, fall, and decay of snags and down wood on a site to determine amounts and characteristics of dead wood over time (see Rose et al. 2001, p. 605). Dead wood dynamics models can guide efforts at green tree retention and snag and down wood creation. Estimates of tree mortality can be obtained from forest simulation models such as the Forest Vegetation Simulator (FVS), Organon , or Zelig, and entered into the dead wood dynamics models as recruited snags and down wood. Existing dead wood dynamics models do not yet incorporate all of the recently available information on tree dynamics from remeasurement of permanent plots such as presented in this paper. In the future, forest simulators and dead wood dynamics models will be updated and improved to include the best available information. Future improvements to DecAID will include more in-depth guidance on using dead wood dynamics models in planning for future dead wood to meet management objectives for wildlife, biodiversity, and ecosystem processes.

In the meantime, several existing dead wood dynamics models are available for use, which are described in Rose et al. 2001, p. 605: the Coarse Wood Dynamics Model (CWDM) (Mellen and Ager), the Snag Recruitment Simulator (SRS) (Marcot), and the Snag Dynamics Projection Model (SDPM) (McComb and Ohmann). In addition, the Forest Vegetation Simulator (FVS) now has a Fire and Fuels Extension (FFE) that tracks and simulates decay and fall of standing dead trees, and decay of down wood (i.e., 'surface fuels'). The variants for Oregon and Washington have recently (January 2006) been updated to include new information on snag dynamics.

More information on dead wood dynamics can be found in the published literature. Bibliographies on the dynamics of snags and down wood, and on dynamics of wood decay, are appended to the end of this paper.

Table 1. Forest Inventory and Analysis plot data in western Oregon and Washington.

	Western Oregon	**Western Washington**
Number of plots	338	669
% of plots undisturbed* over remeasurement period	68	72
Inventory dates	Mid-1980s, mid-1990s	Late 1970s, late 1980s

Number of mortality trees	--	499
Number of remeasured snags	1,128	2,076

* No tree cutting or silvicultural treatment.

Table 2. Fate of mortality trees of all species and ≥25.4 cm (10.0 in) DBH by cause of death over a 10-year period, western Washington.

Cause of death	Percent still standing	Percent fell down
Insects	96	4
Root disease	52	48
Other rots	63	37
Animals	100	0
Weather	28	72
Suppression	79	21
Other / unknown	61	39
All causes	56	44

Table 3. Fate of remeasured snags over a 10-year period by diameter class (DBH) in **undisturbed*** stands, western Oregon and Washington.

Snag fate	<25.4-50.0 cm (10-20 in)	50.1-100.0 cm (20-39 in)	>100.0 cm (39 in)	All sizes
Percent still standing	61	59	93	62
Percent fallen	30	33	4	30
Percent shrank to <25.4 cm (10.0 in) DBH or <2 m (7 ft) tall	9	8	3	8

* No tree cutting or silvicultural treatment over the 10-year remeasurement period.

Table 4. Fate of remeasured snags by snag size over a 10-year period by diameter class (DBH) in **disturbed*** stands, western Oregon and Washington.

Snag fate	<25.4-50.0 cm (10-20 in)	50.1-100.0 cm (20-39 in)	>100.0 cm (39 in)	All sizes
Percent still standing	8	15	42	15
Percent fallen	17	17	3	16
Percent shrank to <25.4 cm (10.0 in) DBH or <2 m(7 ft) tall	3	9	8	7
Percent cut down	72	59	47	62

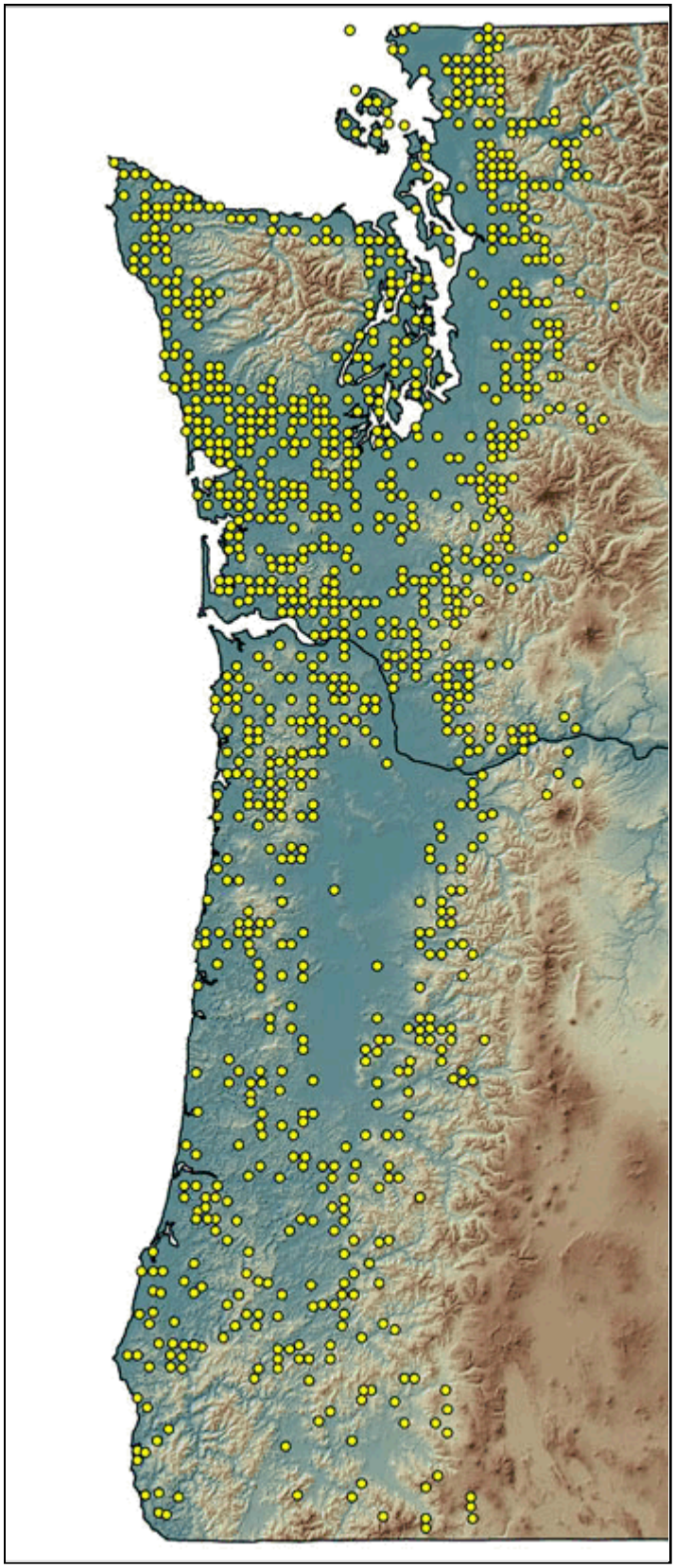
* Tree cutting or silvicultural treatment occurred over the 10-year remeasurement period.

Table 5. Fate of remeasured snags over a 10-year period by species in **undisturbed*** stands in western Oregon and Washington.

Snag fate	Douglas-fir	Western hemlock	Western redcedar	Sitka spruce	True fir	Other conifers**	Hard-woods
Percent still standing	70	67	76	30	37	78	29
Percent fallen	23	20	12	67	40	22	65
Percent shrank to <25.4 cm (10.0 in) DBH or <2 m (7 ft) tall	7	13	12	3	23	0	5

* No tree cutting or silvicultural treatment over the 10-year remeasurement period.
** Incense cedar, Alaska yellow-cedar, Port-Orford cedar, redwood, Pacific yew, and mountain hemlock.

Figure 1. Plot locations and topography.



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