WHITE PAPER

USDA Forest Service Pacific Northwest Region Umatilla National Forest

WHITE PAPER F14-SO-WP-SILV-43

Timber Volume Reductions Associated With Green-Tree Snag Replacements[1]

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INTRODUCTION

In June 1990, Regional Forester for Pacific Northwest Region approved a new Land and Resource Management Plan for Umatilla National Forest (NF) (USDA Forest Service 1990). This Forest Plan provides standards, guidelines, and other direction influencing how natural resources will be managed for Umatilla NF.

Wildlife sections of the Forest Plan specify how dead and down wood is to be managed, including provision of standing dead trees (snags) and green (live) trees identified as eventual replacements for existing snags.

According to the Forest Plan: "Snags, plus trees for replacement snags, will be left in areas where timber harvest is occurring, either as individual snags or in small clusters" (page 4-7 in USDA Forest Service 1990).

A policy of retaining standing dead trees (snags) as habitat for cavity-nesting wildlife species (primarily woodpeckers and related avian fauna) is a long-established practice (Thomas et al. 1979), but a notion of identifying and retaining living (green) trees as eventual replacement trees for existing snags was a relatively novel policy in 1990.

[1] White papers are internal reports; they receive only limited review. Viewpoints expressed in this paper are those of the author – they do not necessarily represent official positions of USDA Forest Service.

When the Forest Plan was approved in 1990, timber harvest was occurring at very high levels, including on Blue Mountains national forests (e.g., Malheur, Umatilla, and Wallowa-Whitman National Forests). During this 'maximum timber-production' era, any new policies or directives that might reduce timber volumes for managed stands were met with apprehension.

A 'new' policy of providing green-tree replacements for snags was one such concern for timber specialists, mostly because they believed that implementing this policy would cause future timber volume targets – those associated with managed-stand yield tables – to not be met.

This white paper provides estimated timber volume implications of a policy to retain live green trees, as future snag replacements, on predicted future yield of managed stands, as reflected in managed-stand yield tables prepared for the Forest Plan.

Information in this white paper, along with information contained in white paper F14-SO-WP-Silv-15, *Determining green-tree replacements for snags: A process paper*, supplements interim Umatilla NF snag guidance by providing additional documentation about snag and green-tree replacement tree assumptions and calculations.

ANALYSIS PROCESS AND ASSUMPTIONS

The following process was used to assess volume reductions associated with two levels of 'green-tree' replacements for existing snags – a Forest Plan level, and a level proposed in recently completed research by Bull and Holthausen (in press). [Research results were eventually published as Bull and Holthausen (1993).]

1. Whenever possible, similar processes and assumptions used in a previous evaluation of replacement snags were used for this assessment.
   Previous methodology and assumptions are contained in a Forest Plan process paper entitled "Yield Table Volume Reductions for Snag Management" (produced by Rob Mrowka, Forest Silviculturist, July 13, 1990).
2. 'Population level' and 'snag size' categories were obtained from a Umatilla NF process document prepared by Bill Krantz, Forest Wildlife Biologist (an unnumbered draft dated December 12, 1991).
   In Table 1 below, population levels are provided in column 1, and snag sizes in column 2.
3. Cubic-foot and board-foot volume per tree for each size category was obtained from Forest cruise/appraisal information (see columns 3 and 4 in Table 1).
   a. Volume for >10" size class was calculated for a 10-inch diameter tree, 50 feet tall, and containing 2 logs. Volume for >12" size class was calculated for a 15-inch diameter tree, 70 feet tall, and containing 3.5 logs. Volume for >20" size class was calculated for a 20-inch diameter tree, 95 feet tall, and containing 5 logs. Log lengths are assumed to be 16 feet.

b. All trees were assumed to be form class 76, and volume estimates were based on 16-foot logs between a 1-foot stump height and a 6-inch diameter top (inside bark).

4. Number of replacement trees associated with each snag size category was obtained from a draft Forest Plan process document described above (item 2).
   Replacement-tree objectives from Umatilla NF Land and Resource Management Plan are contained in column 5 of table 1; trees needed to satisfy recent research results from Bull and Holthausen are shown in column 8 of table 1, and labeled as a 'Bull' level.

5. Cubic-foot volumes per acre for each level of replacement trees are provided in columns 6 and 9 of table 1.
   These volumes were calculated by multiplying 'CF Vol Per Tree' values (column 3 of table 1) by number of trees ('Tr/Ac') associated with each replacement-tree level (provided in columns 5 and 8 of table 1).

6. Board-foot volumes per acre for each level of replacement trees are provided in columns 7 and 10 of table 1.
   These volumes were calculated by multiplying 'BF Vol Per Tree' values (column 4 of table 1) by number of trees ('Tr/Ac') associated with each replacement-tree level (provided in columns 5 and 8 of table 1).

7. To determine timber yield implications of retaining green trees as replacement snags, total volume contained in replacement trees was expressed as a percentage of volume that would have been available had replacement trees not been retained.
   Because replacement snags can be retained in both unmanaged (empirical) and regenerated (managed) stands, percentages were calculated for each situation.
   a. Total cubic-foot volumes per acre (without green-tree snag replacements) were obtained by computing a forest-wide average from both empirical and managed-stand yield tables. Averages were weighted by proportion of area in each of four Forest Plan working groups (lodgepole pine, ponderosa pine, north associated, south associated).
   b. Total volume without retention of green-tree replacements for snags was: 2,232 cubic feet/acre for unmanaged stands, and 5,000 cubic feet/acre for managed stands.
      A 'with/without' comparison was completed for cubic-foot volume only because board-foot values are not included in FORPLAN (Forest Plan) yield tables.

Table 1: Volume differences associated with 2 levels of 'green' replacement trees for snags.

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Pop	Snag	CF Vol	BF Vol	FOREST PLAN LEVELS			'BULL' LEVELS		
Level	Size	Per Tree	Per Tree	Tr/Ac	CF/Ac	BF/Ac	Tr/Ac	CF/Ac	BF/Ac
20	>20"	74	390	0.2	14.8	78.0	2.8	207.2	1092.0
	>12"	34	170	1.9	64.6	323.0	4.2	142.8	714.0
	>10"	11	50	1.1	12.1	55.0	2.1	23.1	105.0
			Total	3.2	91.5	456.0	9.1	373.1	1911.0
		Difference (Existing Stands):			- 4%			- 17%	
		Difference (Regenerated Stands):			- 2%			- 7%	
40	>20"	74	390	0.4	29.6	156.0	4.9	362.6	1911.0
	>12"	34	170	3.8	129.2	646.0	10.5	357.0	1785.0
	>10"	11	50	2.1	23.1	105.0	5.6	61.6	280.0
			Total	6.3	181.9	907.0	21.0	781.2	3976.0
		Difference (Existing Stands):			- 8%			- 35%	
		Difference (Regenerated Stands):			- 4%			- 16%	
60	>20"	74	390	0.6	44.4	234.0	7.7	569.8	3003.0
	>12"	34	170	5.7	193.8	969.0	12.6	428.4	2142.0
	>10"	11	50	3.2	35.2	160.0	6.3	69.3	315.0
			Total	9.5	273.4	1363.0	26.6	1067.5	5460.0
		Difference (Existing Stands):			- 12%			- 48%	
		Difference (Regenerated Stands):			- 5%			- 21%	
80	>20"	74	390	0.8	59.2	312.0	9.8	725.2	3822.0
	>12"	34	170	7.6	258.4	1292.0	16.8	571.2	2856.0
	>10"	11	50	4.2	46.2	210.0	9.1	100.1	455.0
			Total	12.6	363.8	1814.0	35.7	1396.5	7133.0
		Difference (Existing Stands):			- 16%			- 63%	
		Difference (Regenerated Stands):			- 7%			- 28%	
100	>20"	74	390	1.0	74.0	390.0	12.6	932.4	4914.0
	>12"	34	170	9.5	323.0	1615.0	21.0	714.0	3570.0
	>10"	11	50	5.3	58.3	265.0	11.2	123.2	560.0
			Total	15.8	455.3	2270.0	44.8	1769.6	9044.0
		Difference (Existing Stands):			- 20%			- 79%	
		Difference (Regenerated Stands):			- 9%			- 35%	

SUMMARY OF RESULTS

Yield reductions reported in Table 1 are significantly higher than those described in a previous process paper (authored by Rob Mrowka and dated 7/13/90). Primary reason for an increase in reductions is that number of replacement trees associated with Forest Plan and 'Bull' replacement levels are substantially greater than those used before (by Mrowka), even though previous levels were increased by 25% to account for losses from timber harvest and certain other factors.

Differences between three snag levels (Mrowka process paper, Forest Plan, and Bull/Holthausen) are provided in Table 2.

Table 2: Comparison of three characterizations of replacement snags. *

Snag Size	40% Snag Level			60% Snag Level			80% Snag Level			100% Snag Level		
	Proc	LRMP	Bull	Proc	LRMP	Bull	Proc	LRMP	Bull	Proc	LRMP	Bull
>20"	0.1	0.4	4.9	0.1	0.6	7.7	0.3	0.8	9.8	0.3	1.0	12.6
>12"	1.1	3.8	10.5	1.5	5.7	12.6	1.9	7.6	16.8	2.5	9.5	21.0
>10"	0.9	2.1	5.6	1.3	3.2	6.3	1.5	4.2	9.1	2.0	5.3	11.2
	2.1	6.3	21.0	2.9	9.5	26.6	3.6	12.6	35.7	4.8	15.8	44.8
	+200%	+233%		+228%	+180%		+250%	+183%		+229%	+184%	

* 'Proc' is a level used in a previous Forest Plan process paper (Mrowka, 7/13/1990); 'LRMP' is Forest Plan level shown in table 1; 'Bull' is Bull level shown in table 1. No figures are provided for a 20% snag level because it was not evaluated in a 7/13/1990 Forest Plan process paper.

What effect would replacement snag levels contained in Table 1 have on the Forest's regenerated (managed) stands? To analyze this question, number of trees per acre at culmination of mean annual increment (CMAI) was determined for each working group (from yield tables), and a weighted average was then calculated for Umatilla National Forest as a whole. Average number of live trees per acre for managed stands at CMAI was 81.

As shown in Table 3 below, proportion of those 81 live trees per acre retained as replacement snags was substantial, especially for the 'Bull' level.

Table 3: Percent of managed-stand tree density retained as replacement snags.

Population Level	Percentage of Live Trees Retained as Green-Tree Snag Replacements*	
	Forest Plan Level	'Bull' Level
20	4%	11%
40	8%	26%
60	12%	33%
80	16%	44%
100	20%	55%

* Percentage of 81 live trees per acre, at culmination of mean annual increment, that would be retained as green-tree replacements for snags. These figures pertain to regenerated (managed) stands only.

REFERENCES

Bull, E.L.; Holthausen, R.S. 1993. Habitat use and management of pileated woodpeckers in northeastern Oregon. Journal of Wildlife Management. 57(2): 335-345. doi:10.2307/3809431

Thomas, J.W.; Anderson, R.G.; Maser, C.; Bull, E.L. 1979. Snags. Chapter 5. In: Thomas, J.W., tech. ed. Wildlife habitats in managed forests: The Blue Mountains of Oregon and Washington. Ag. Handbook No. 553. Washington, DC: USDA Forest Service: 60-77. https://www.fs.usda.gov/treesearch/pubs/6630

USDA Forest Service. 1990. Land and resource management plan: Umatilla National Forest. Portland, OR: USDA Forest Service, Pacific Northwest Region. Irregular pagination. http://www.fs.usda.gov/main/umatilla/landmanagement/planning

APPENDIX: SILVICULTURE WHITE PAPERS

White papers are internal reports, and they are produced with a consistent formatting and numbering scheme – all papers dealing with Silviculture, for example, are placed in a silviculture series (Silv) and numbered sequentially. Generally, white papers receive only limited review and, in some instances pertaining to highly technical or narrowly focused topics, the papers may receive no technical peer review at all. For papers that receive no review, the viewpoints and perspectives expressed in the paper are those of the author only, and do not necessarily represent agency positions of the Umatilla National Forest or the USDA Forest Service.

Large or important papers, such as two papers discussing active management considerations for dry and moist forests (white papers Silv-4 and Silv-7, respectively), receive extensive review comparable to what would occur for a research station general technical report (but they don't receive blind peer review, a process often used for journal articles).

White papers are designed to address a variety of objectives:

(1) They guide how a methodology, model, or procedure is used by practitioners on the Umatilla National Forest (to ensure consistency from one unit, or project, to another).

(2) Papers are often prepared to address ongoing and recurring needs; some papers have existed for more than 20 years and still receive high use, indicating that the need (or issue) has long standing – an example is white paper #1 describing the Forest's big-tree program, which has operated continuously for 25 years.

(3) Papers are sometimes prepared to address emerging or controversial issues, such as management of moist forests, elk thermal cover, or aspen forest in the Blue Mountains. These papers help establish a foundation of relevant literature, concepts, and principles that continuously evolve as an issue matures, and hence they may experience many iterations through time. [But also note that some papers have not changed since their initial development, in which case they reflect historical concepts or procedures.]

(4) Papers synthesize science viewed as particularly relevant to geographical and management contexts for the Umatilla National Forest. This is considered to be the Forest's self-selected 'best available science' (BAS), realizing that non-agency commenters would generally have a different conception of what constitutes BAS – like beauty, BAS is in the eye of the beholder.

(5) The objective of some papers is to locate and summarize the science germane to a particular topic or issue, including obscure sources such as master's theses or Ph.D. dissertations. In other instances, a paper may be designed to wade through an overwhelming amount of published science (dry-forest management), and then synthesize sources viewed as being most relevant to a local context.

(6) White papers function as a citable literature source for methodologies, models, and procedures used during environmental analysis – by citing a white paper, specialist reports can include less verbiage describing analytical databases, techniques, and so forth, some of which change little (if at all) from one planning effort to another.

(7) White papers are often used to describe how a map, database, or other product was developed. In this situation, the white paper functions as a 'user's guide' for the new product. Examples include papers dealing with historical products: (a) historical fire extents for the Tucannon watershed (WP Silv-21); (b) an 1880s map developed from General Land Office survey notes (WP Silv-41); and (c) a

description of historical mapping sources (24 separate items) available from the Forest's history website (WP Silv-23).

The following papers are available from the Forest's website: Silviculture White Papers

Paper #	Title
1	Big tree program
2	Description of composite vegetation database
3	Range of variation recommendations for dry, moist, and cold forests
4	Active management of Blue Mountains dry forests: Silvicultural considerations
5	Site productivity estimates for upland forest plant associations of Blue and Ochoco Mountains
6	Blue Mountains fire regimes
7	Active management of Blue Mountains moist forests: Silvicultural considerations
8	Keys for identifying forest series and plant associations of Blue and Ochoco Mountains
9	Is elk thermal cover ecologically sustainable?
10	A stage is a stage is a stage…or is it? Successional stages, structural stages, seral stages
11	Blue Mountains vegetation chronology
12	Calculated values of basal area and board-foot timber volume for existing (known) values of canopy cover
13	Created opening, minimum stocking, and reforestation standards from Umatilla National Forest Land and Resource Management Plan
14	Description of EVG-PI database
15	Determining green-tree replacements for snags: A process paper
16	Douglas-fir tussock moth: A briefing paper
17	Fact sheet: Forest Service trust funds
18	Fire regime condition class queries
19	Forest health notes for an Interior Columbia Basin Ecosystem Management Project field trip on July 30, 1998 (handout)
20	Height-diameter equations for tree species of Blue and Wallowa Mountains
21	Historical fires in headwaters portion of Tucannon River watershed
22	Range of variation recommendations for insect and disease susceptibility
23	Historical vegetation mapping
24	How to measure a big tree
25	Important Blue Mountains insects and diseases
26	Is this stand overstocked? An environmental education activity
27	Mechanized timber harvest: Some ecosystem management considerations
28	Common plants of south-central Blue Mountains (Malheur National Forest)
29	Potential natural vegetation of Umatilla National Forest
30	Potential vegetation mapping chronology
31	Probability of tree mortality as related to fire-caused crown scorch
32	Review of "Integrated scientific assessment for ecosystem management in the interior Columbia basin, and portions of the Klamath and Great basins" – Forest vegetation
33	Silviculture facts

Paper #	Title
34	Silvicultural activities: Description and terminology
35	Site potential tree height estimates for Pomeroy and Walla Walla Ranger Districts
36	Stand density protocol for mid-scale assessments
37	Stand density thresholds related to crown-fire susceptibility
38	Umatilla National Forest Land and Resource Management Plan: Forestry direction
39	Updates of maximum stand density index and site index for Blue Mountains variant of Forest Vegetation Simulator
40	Competing vegetation analysis for southern portion of Tower Fire area
41	Using General Land Office survey notes to characterize historical vegetation conditions for Umatilla National Forest
42	Life history traits for common Blue Mountains conifer trees
43	Timber volume reductions associated with green-tree snag replacements
44	Density management field exercise
45	Climate change and carbon sequestration: Vegetation management considerations
46	Knutson-Vandenberg (K-V) program
47	Active management of quaking aspen plant communities in northern Blue Mountains: Regeneration ecology and silvicultural considerations
48	Tower Fire…then and now. Using camera points to monitor postfire recovery
49	How to prepare a silvicultural prescription for uneven-aged management
50	Stand density conditions for Umatilla National Forest: A range of variation analysis
51	Restoration opportunities for upland forest environments of Umatilla National Forest
52	New perspectives in riparian management: Why might we want to consider active management for certain portions of riparian habitat conservation areas?
53	Eastside Screens chronology
54	Using mathematics in forestry: An environmental education activity
55	Silviculture certification: Tips, tools, and trip-ups
56	Vegetation polygon mapping and classification standards: Malheur, Umatilla, and Wallowa-Whitman National Forests
57	State of vegetation databases for Malheur, Umatilla, and Wallowa-Whitman National Forests
58	Seral status for tree species of Blue and Ochoco Mountains

REVISION HISTORY

December 2016: First version of this white paper (3 p.) was prepared in December 1991 to examine volume implications of a new policy to retain green-tree snag replacements when harvesting timber.

This update reformatted the original white paper into a contemporary style by adding a first page 'white paper' header, assigning a white paper number, and adding an appendix describing a silviculture white paper system. An Introduction section was also added.