Appendix 12

Requirements for Snags and Downed Wood

Contents

Introduction

Background on the Snag and Downed Wood Interim Standards Tables

The snag and downed wood interim standards tables in this appendix (Tables 1 through 4) were assembled through a process that combined extensive reviews of the published and unpublished literature, numerous discussions with snag or downed wood experts, and GIS computer modeling. The term “downed wood” as used in this appendix is synonymous with “coarse woody debris”, which is used in Chapters 2 and 3. *Large* downed wood and *large* snags are dead trees greater than 21 inches diameter at breast height.

Following a detailed and extensive review of the literature, a revised set of snag and downed wood density-per-hectare classes for potential vegetation groups (PVGs), successional stages, structural stages, fire regimes, and management scenarios were devised. These were produced in the form of tables in which live tree, snag, and downed wood categories were assigned abundance values according to four stand succession-structure stages. One 24-cell table was produced for each of ten PVG—management scenario—fire regime combinations.

Information on snag and downed wood densities in the scientific literature has several limitations. The information specific to density values was surprisingly scarce, especially when limited to the Interior Columbia Basin. A number of studies contained very detailed snag or downed wood data, but were less applicable because they were conducted outside the study area. Also, a variety of methods was used to count, sample, measure, and report snag and downed wood abundances. Reports citing the number of snags per acre could not be used if all snags were lumped into a single diameter class. Similarly, detailed reports on downed wood abundance could not be used if abundance was reported in 100-hour fuel loads. A third limitation was the manner in which habitats were reported. Forests were often described as “mixed,” either in species composition, age, or both. This made it impossible to assign density figures to a particular potential vegetation group or successional stage. And finally, many studies on forest wildlife, particularly on snag-dependent birds, focused sampling on the particular stand where each species had nested. A number of these species select nest areas where snags are found in clumps or groups. Extrapolation of these figures to the landscape PVG level would have resulted in artificially inflated abundance values. Once all of these factors had been accounted for, the amount of detailed, applicable material was very small. The literature values were used whenever appropriate, then a series of discussions with experts was initiated to help determine appropriate values that could serve as proxies to fill in the gaps in the literature.

Table 1. Large Snags per Acre by Fire Regime and PVG, ICBEMP Project Area.

PVG	Fire Regime	Large Snags/Acre, HRV mid	Large Snags/Acre, HRV - 30%	Large Snags/Acre, HRV + 30%	Large Snags/Acre, Current
Cold Forest	HI	8.1	5.7	10.5	4.6
Dry Forest		2.6	1.8	3.3	1.1
Moist Forest		5.4	3.8	7.0	3.0
Cold Forest	LI	3.8	2.7	5.0	4.2
Dry Forest		0.6	0.4	0.7	2.4
Moist Forest		4.1	2.9	5.4	4.1

Abbreviations used in this table:
HI - High Intensity
LI - Low Intensity
HRV - Historical Range of Variability
PVG - Potential Vegetation Group

Table 2. Large Downed Wood per Acre by Fire Regime and PVG, ICBEMP Project Area.

PVG	Fire Regime	Large Snags/Acre, HRV mid	Large Snags/Acre, HRV - 30%	Large Snags/Acre, HRV + 30%	Large Snags/Acre, Current
Cold Forest	HI	10.1	7.1	13.2	7.9
Dry Forest		3.0	2.1	3.9	2.1
Moist Forest		7.4	5.2	9.6	6.3
Cold Forest	LI	9.2	6.4	11.9	9.2
Dry Forest		0.6	0.4	0.8	3.1
Moist Forest		1.0	0.7	1.3	8.3

Abbreviations used in this table:
HI - High Intensity
LI - Low Intensity
HRV - Historical Range of Variability
LDW - Large Downed Wood
PVG - Potential Vegetation Group

The snag and downed wood tables went through several reviews and iterations. The final tables were stratified by:

- three potential vegetation groups (dry forest, moist forest, and cold forest);
- four successional / structural stages (early seral stands, mid seral stands, late seral single story stands, and late seral multi-story stands);
- two fire regimes (low intensity, high-frequency stand-maintaining fires and high intensity, low-frequency stand-replacing fires); and
- three management—time period scenarios (pre-settlement or historical range of variability, current period unmanaged, and current period managed).

For each cell of the table, the components were assigned an abundance class of none, rare, uncommon, common, or abundant. The definitions of these classes varied by component. For instance, 'abundant' for small snags was more than 25 snags per acre, while 'abundant' for large downed wood was more than 10 pieces per acre. The low fire regime was not modeled for current managed conditions since active fire suppression on Forest Service- and BLM-administered lands has effectively removed that fire regime over most of the managed portions of the basin. Also, current conditions, both managed and unmanaged, for the cold forest PVG were not modeled because of the minimal amount of active management, on a basin-wide scale, that occurs in that PVG.

The other PVGs had to be assigned large snag and large downed wood abundance values for modeling purposes. Essentially, this consisted of assigning an abundance of 'none' to all the remaining PVGs, such as the rangeland PVGs, agriculture, rock, water, urban, etc. Once this process was completed, the tables were converted to a single spreadsheet file to be used as input to the ICBEMP GIS for modeling and simulation.

Modeling the snag and downed wood abundances across the basin required a sequence of computations and data layer combinations which were generalized into three major processes. First, a detailed vegetation layer was produced. This required the combination of terrestrial community group database information, potential vegetation group information, and current and historical fire regime data, with the historical year 0 vegetation, current year 0 (Alternative S1 year 0) vegetation, and projected future (Alternatives S1, S2, and S3 100 year) vegetation layers. The results were data layers describing the historical, current, and projected future vegetation distributions (including terrestrial community groups) at the subwatershed level.

Then, snag and downed wood data were combined with the historical, current, and projected future vegetation information to produce large snag and

Table 3. Large Snags per Acre by Fire Regime and PVG, by RAC/PAC.

RAC/PAC	Fire Regime	PVG	Large Snags/Acre, HRV mid	Large Snags/Acre, HRV-30%	Large Snags/Acre, HRV+30%	Large Snags/Acre, Current
Butte RAC	HI	Cold Forest	8.1	5.7	10.5	3.8
		Dry Forest	2.6	1.9	3.4	0.6
		Moist Forest	5.3	3.7	6.9	1.6
	LI	Cold Forest	4.1	2.9	5.3	2.6
		Dry Forest	0.6	0.4	0.8	0.7
		Moist Forest	4.3	3.0	5.6	2.9
Deschutes PAC	HI	Cold Forest	8.1	5.7	10.5	5.0
		Dry Forest	1.8	1.2	2.3	0.5
		Moist Forest	4.7	3.3	6.2	2.4
	LI	Cold Forest	2.4	1.7	3.1	4.6
		Dry Forest	0.5	0.3	0.6	0.6
		Moist Forest	2.0	1.4	2.6	1.4
Eastern Washington RAC	HI	Cold Forest	8.1	5.7	10.5	7.3
		Dry Forest	2.3	1.6	3.0	1.4
		Moist Forest	4.9	3.4	6.4	4.4
	LI	Cold Forest	3.4	2.4	4.5	4.1
		Dry Forest	0.7	0.5	0.9	1.5
		Moist Forest	3.6	2.5	4.7	4.7
Eastern Washington Cascades PAC	HI	Cold Forest	8.1	5.7	10.5	0.4
		Dry Forest	2.0	1.4	2.6	1.9
		Moist Forest	4.6	3.2	6.0	5.4
	LI	Cold Forest	2.8	2.0	3.7	3.1
		Dry Forest	0.4	0.3	0.5	0.6
		Moist Forest	3.8	2.7	4.9	5.2
John Day-Snake RAC	HI	Cold Forest	8.1	5.7	10.5	5.5
		Dry Forest	2.3	1.6	3.0	1.1
		Moist Forest	5.6	3.9	7.3	3.2
	LI	Cold Forest	3.7	2.6	4.9	6.4
		Dry Forest	0.6	0.4	0.8	2.4
		Moist Forest	2.7	1.9	3.5	4.3
Klamath PAC	HI	Dry Forest	1.7	1.2	2.3	0.6
		Moist Forest	4.5	3.1	5.8	3.1
	LI	Cold Forest	2.8	2.0	3.7	4.6
		Dry Forest	0.4	0.3	0.6	0.5
		Moist Forest	2.1	1.5	2.8	4.2
Lower Snake River RAC	HI	Cold Forest	8.1	5.7	10.5	4.7
		Dry Forest	3.6	2.5	4.6	1.3
		Moist Forest	5.5	3.8	7.1	1.1
	LI	Cold Forest	3.7	2.6	4.8	4.3
		Dry Forest	0.5	0.3	0.6	2.1
		Moist Forest	2.9	2.0	3.7	2.7

Table 3. Large Snags per Acre by Fire Regime and PVG, by RAC/PAC. (continued)

RAC/PAC	Fire Regime	PVG	Large Snags/Acre, HRV mid	Large Snags/Acre, HRV-30%	Large Snags/Acre, HRV+30%	Large Snags/Acre, Current
Southeastern Oregon RAC	HI	Cold Forest	8.1	5.7	10.5	2.2
		Dry Forest	2.1	1.5	2.8	0.6
		Moist Forest	4.7	3.3	6.2	2.0
	LI	Cold Forest	3.0	2.1	3.9	3.9
		Dry Forest	0.4	0.3	0.6	0.6
		Moist Forest	2.4	1.7	3.2	4.5
Upper Columbia Salmon-Clearwater RAC - R1	HI	Cold Forest	8.1	5.7	10.5	3.6
		Dry Forest	3.3	2.3	4.3	1.6
		Moist Forest	5.4	3.8	7.0	4.5
	LI	Cold Forest	4.8	3.3	6.2	4.5
		Dry Forest	0.6	0.4	0.8	3.0
		Moist Forest	4.3	3.0	5.6	4.9
Upper Columbia Salmon-Clearwater RAC - R4	HI	Cold Forest	8.1	5.7	10.5	4.7
		Dry Forest	2.9	2.1	3.8	1.9
		Moist Forest	6.6	4.6	8.5	4.8
	LI	Cold Forest	3.7	2.6	4.9	5.2
		Dry Forest	0.5	0.4	0.7	3.3
		Moist Forest	3.7	2.6	4.7	5.2
Upper Snake River RAC	HI	Cold Forest	8.1	5.7	10.5	4.4
		Dry Forest	7.8	5.5	10.2	3.5
		Moist Forest	8.1	5.7	10.5	5.5
	LI	Cold Forest	3.1	2.1	4.0	2.5
		Dry Forest	0.5	0.4	0.7	4.0
		Moist Forest	3.3	2.3	4.4	4.6
Yakima PAC	HI	Moist Forest	7.6	5.3	9.8	0.4
	LI	Dry Forest	0.4	0.3	0.5	0.4

Abbreviations used in this table:

HI - High Intensity
HRV - Historical Range of Variability
LI - Low Intensity
PAC - Provincial Advisory Committee
PVG - Potential Vegetation Group
RAC - Resource Advisory Council
R1 - Forest Service Northern Region
R4 - Forest Service Intermountain Region

Table 4. Large Downed Wood per Acre by Fire Regime and PVG, by RAC/PAC.

RAC/PAC	Fire Regime	PVG	LDW/Acre, HRV mid	LDW/Acre, HRV-30%	LDW/Acre, HRV+30%	LDW/Acre, Current
Butte RAC	HI	Cold Forest	10.1	7.1	13.2	10.1
		Dry Forest	3.0	2.1	4.0	3.2
		Moist Forest	7.6	5.3	9.9	3.7
	LI	Cold Forest	9.6	6.7	12.4	9.5
		Dry Forest	0.8	0.6	1.0	2.4
		Moist Forest	1.1	0.7	1.4	6.4
Deschutes PAC	HI	Cold Forest	10.1	7.1	13.2	10.1
		Dry Forest	1.9	1.4	2.5	0.9
		Moist Forest	6.1	4.3	7.9	5.7
	LI	Cold Forest	9.9	6.9	12.8	9.8
		Dry Forest	0.5	0.3	0.6	1.1
		Moist Forest	0.5	0.4	0.7	3.3
Eastern Washington RAC	HI	Cold Forest	10.1	7.1	13.2	9.3
		Dry Forest	2.6	1.8	3.4	4.9
		Moist Forest	7.2	5.0	9.3	9.6
	LI	Cold Forest	9.1	6.4	11.9	9.4
		Dry Forest	1.0	0.7	1.2	4.9
		Moist Forest	1.1	0.8	1.4	10.0
Eastern Washington Cascades PAC	HI	Cold Forest	10.1	7.1	13.2	1.6
		Dry Forest	2.2	1.6	2.9	0.8
		Moist Forest	6.0	4.2	7.8	9.9
	LI	Cold Forest	9.8	6.9	12.7	9.9
		Dry Forest	0.4	0.3	0.5	0.8
		Moist Forest	1.0	0.7	1.3	10.0
John Day-Snake RAC	HI	Cold Forest	10.1	7.1	13.2	7.9
		Dry Forest	2.7	1.9	3.4	1.2
		Moist Forest	7.1	5.0	9.2	5.6
	LI	Cold Forest	8.3	5.8	10.8	9.4
		Dry Forest	0.7	0.5	0.9	2.2
		Moist Forest	0.8	0.6	1.1	6.5
Klamath PAC	HI	Dry Forest	1.9	1.4	2.5	1.1
		Moist Forest	5.6	3.9	7.3	6.3
	LI	Cold Forest	6.0	4.2	7.8	5.8
		Dry Forest	0.4	0.3	0.6	1.2
		Moist Forest	0.7	0.5	0.9	7.9
Lower Snake River RAC	HI	Cold Forest	10.1	7.1	13.2	7.7
		Dry Forest	4.3	3.0	5.6	1.1
		Moist Forest	7.1	5.0	9.2	2.0
	LI	Cold Forest	7.8	5.5	10.2	7.9
		Dry Forest	0.6	0.4	0.7	1.4
		Moist Forest	0.8	0.5	1.0	4.8

Table 4. Large Downed Wood per Acre by Fire Regime and PVG, by RAC/PAC. (continued)

RAC/PAC	Fire Regime	PVG	LDW /Acre, HRV mid	LDW / Acre, HRV-30%	LDW / Acre, HRV+30%	LDW / Acre, Current
Southeastern Oregon RAC	HI	Cold Forest	10.1	7.1	13.2	6.3
		Dry Forest	2.5	1.7	3.2	0.9
		Moist Forest	5.9	4.1	7.7	4.6
	LI	Cold Forest	7.6	5.3	9.9	7.4
		Dry Forest	0.4	0.3	0.6	1.2
		Moist Forest	0.7	0.5	0.9	8.5
Upper Columbia Salmon-Clearwater RAC - R1	HI	Cold Forest	10.1	7.1	13.2	10.1
		Dry Forest	3.9	2.7	5.1	4.3
		Moist Forest	7.8	5.5	10.2	10.1
	LI	Cold Forest	9.8	6.8	12.7	10.0
		Dry Forest	0.7	0.5	0.9	5.0
		Moist Forest	1.1	0.7	1.4	10.1
Upper Columbia Salmon-Clearwater RAC - R4	HI	Cold Forest	10.1	7.1	13.2	7.3
		Dry Forest	3.4	2.4	4.5	4.1
		Moist Forest	8.8	6.1	11.4	8.8
	LI	Cold Forest	9.1	6.4	11.8	9.1
		Dry Forest	0.6	0.4	0.8	4.2
		Moist Forest	0.9	0.6	1.2	8.6
Upper Snake River RAC	HI	Cold Forest	10.1	7.1	13.2	8.3
		Dry Forest	9.8	6.9	12.7	3.8
		Moist Forest	10.1	7.1	13.2	9.8
	LI	Cold Forest	7.7	5.4	10.1	7.8
		Dry Forest	0.6	0.4	0.8	3.4
		Moist Forest	0.8	0.6	1.1	9.4
Yakima PAC	HI	Moist Forest	9.6	6.7	12.5	0.4
	LI	Dry Forest	0.4	0.3	0.5	0.4

Abbreviations used in this table:

HI - High Intensity
LI - Low Intensity
HRV - Historical Range of Variability
LDW - Large Downed Wood
PAC - Provincial Advisory Committee
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R1 - Forest Service Northern Region
R4 - Forest Service Intermountain Region

large downed wood density classes, class mid-point values, and strata totals for the historical, current, and projected future potential vegetation groups (PVGs) and terrestrial community groups. This produced snag and downed wood per hectare density values by historical, current, and projected future (100 year) PVGs and terrestrial community groups across the basin.

The third step was the use of a weighted averaging method based on subwatershed area. This provided data that were summarized to produce tables of small and large snag and downed wood densities by fire regime and PVG for each Resource Advisory Council / Provincial Advisory Committee (RAC / PAC) area and for the entire basin.

One caveat to consider is that the values for snags and downed wood for the riparian woodland PVG used modified values from the moist forest as proxies since no other data were available. Also, the riparian woodland PVG tended to occur in small, scattered clumps or in narrow stringers which were sometimes underestimated at the 1 square kilometer scale. The use of proxy values and the possibility of lower than actual amounts as a result of the mapping scale must be recognized and allowed for when using the values for this potential vegetation group.

Snag and Downed Wood Step-down Prototype

Refinement of Historic Range of Variability Interim Standards

The Supplemental Draft EIS includes interim standard densities for snags and downed wood to be used in designing field projects. Development of the interim densities of snags and downed wood used in the analysis of Supplemental Draft EIS effects has been previously described. The Supplemental Draft EIS direction recognizes that these broad standards may require fine-tuning for more local ecological conditions. Refinements to the Supplemetal Draft EIS snag and downed wood densities interim standards should be conducted with a standardized and consistent process within ecologically similar large landscapes (for example ecoregions) across the interior Columbia Basin project area. There are several important considerations for developing refinements:

- Refinements should be made across relatively large and ecologically similar landscapes. A consistent biophysical stratification should be used across the entire project area. Refinements should be developed within strata.
- Refinements should be within the disturbance regimes, potential vegetation groups, and structural stages from the Supplemental Draft EIS analysis to allow summarization and comparison at the broad scale. The stratification of disturbance regimes, potential vegetation groups, and structural stages should be coordinated across biophysical strata to minimize inconsistencies. Ecoregions (Bailey 1995) are suggested. There may be sufficient rationale to use different combinations in different strata, but this should be minimized to the extent possible.
- The refined snag and downed wood densities should be considered the desired range. Higher levels of snags and downed wood might be desirable or necessary to meet specific wildlife habitat needs, but may increase fire risks and affect such site factors as nutrient availability.
- Alternative methods should be available for refining snag standards based on the need for rigor and data availability.
- Forest Service and BLM administrative units will likely need to estimate both historical and current densities of snags and downed wood, using the same strata, as a context for finer scale analyses or designing field projects. It may also be desirable to estimate densities of large live trees by shade-tolerant and shade-intolerant (or finer) classes since these are the sources of large snags.

The step-down refinement of the interim standards could be accomplished by assigning large live tree, snag, and downed wood density (per acre numbers) classes by disturbance regime, potential vegetation group, structural stage, and management history strata within each ecological landscape area. This model refinement could be developed through vegetation dynamics modeling, sampling of historical densities using the general land office survey reports or other information, and expert opinion. Refined models could be extrapolated across the project area using the Hessburg et al. (1999) mid-scale estimates of Historical Range of Variability for structural stages by subregion or using some other biophysical stratification (ecological subregions, biophysical provinces, or RAC / PAC areas, for example).

General Process

Document assumptions, process, and results for all steps. Careful documentation of methods, data sources, and assumptions will reduce the difficulties that will arise from challenges to results. Good documentation will also allow future work to build on past efforts.

Step 1. Develop stratification of biophysical subregions, potential vegetation groups, and stand structure classes. The stratification used should be hierarchically linked to the Supplemental Draft EIS effects analysis and should be flexible for further refinement at finer scales. Hessburg's subregionalization work, Bailey's ecoregion or ecosubregion hierarchy, and maps of potential natural vegetation series, plant association groups or plant associations, RAC / PAC areas or other stratifications could be useful. In general, areas the size of subbasins or groups of subbasins will be most useful as biophysical stratifications. Finer stratifications run the risk of focusing on areas with anomalous disturbance or management histories. This does not imply that hydrologic units are the best biophysical stratification. Fire and vegetation processes are often not related to subbasin or watershed boundaries. Keep numbers of strata to a reasonable minimum.

Step 2. Estimate <u>current</u> large live tree, snag and downed wood densities by stratum within the ecological subregional area. Current densities of large, old trees may provide clues about the historical range of variability. In addition, summaries of the current condition will provide a basis for understanding the departure or change from historical conditions. Several options for estimating current snag and downed wood densities exist, the utility of each depending on the availability of statistically sound data, the degree of rigor required, and the availability of resources necessary to gather new data. Managed stands (for example, those with snags, downed wood, or live tree structure altered by direct human activity) should be separated from "natural" stands. "Natural" stands may provide useful clues about the composition and structure of vegetation since the end of the Little Ice Age (approximately 1820-1850) settlement conditions. Be aware that significant changes to disturbance patterns have generally occurred in the last 150 years and often have affected stand composition and structure.

Option 1. Use Existing Data. This option is useful where statistically sound data exist at the appropriate scale. The Forest Service's Pacific Northwest Region has Current Vegetation Survey sample plots at 1.7 mile and 3.4 mile spacing throughout National Forest lands. This is a statistically sound sample that can be analyzed using the Current Vegetation Survey Tools package in preparation; contact John Teply, the Forest Service's Pacific Northwest Region, Regional Office. Plot numbers are probably insufficient to analyze at landscape scales below individual subbasins or collections of several watersheds or subwatersheds. Similar data may be available in other areas.

Forest Inventory Analysis plot data may be available for National Forests and BLM-administered lands outside the Forest Service's Pacific Northwest Region. Forest Inventory Analysis plot data are available on non-Forest Service lands in the Forest Service's Pacific Northwest Region. These data sets may not include measurements of snags or downed wood, but the tree data may be useful for model calibration. Note – stand exams are not usually installed with a statistically valid design that allows aggregation to areas outside the examined stands, especially for snags and downed wood. Generally, stand exam data should not be aggregated to larger landscapes. Apply stratification to existing data, if those data are usable. Stratification within biophysical landscapes should be a hierarchical subdivision of the disturbance regimes and potential vegetation groups used in the EIS process. Potential vegetation types or plant association groups can be used down to groups of watersheds. Stratifications should be relatively broad at the mid-scale (for example, a few cover type / structure stage strata in each biophysical stratum). Available data may not support fine mid-scale stratification. Mid-scale stratification should recognize important ecological differences in a few, simple strata. Analyses at finer scales (for example, Ecosystem Analysis at the Watershed Scale) could recognize finer differences, if necessary.

Generate estimates and confidence intervals by stratum.

Option 2. Collect new data. This option is most appropriate where resource risks or expected legal challenges to management decisions are likely to justify the relatively high cost of data collection. Be aware that collecting new data, while tempting, may not provide useful information without careful attention to sample design and that the cost, difficulty, and time involved may not be justified without careful thought about the need for rigor or fine resolution (for example, many strata at the mid-scale).

Sampling costs go up in proportion to number of strata and samples required per stratum. Decide on the degree of confidence needed in the estimates per stratum and, hence, on the sample sizes needed per stratum. Input from the Science Advisory Group (SAG) can be beneficial in developing a sampling strategy. This involves making initial estimates of the variability within stratum. The time and resources may not be available to collect new data. If so, document possible impacts on end results.

Collect samples using standardized methods (Max et al. [1996], Bate et al. [1999]). It is essential that samples be representative of landscapes rather than of individual stands. Samples of individual stands (for example, stand exams) are notoriously difficult to aggregate to larger landscapes in a statistically rigorous fashion.

Generate estimates and confidence intervals by stratum.

Option 3. Use a formal process to summarize expert opinion. This would generally only be useful where there is little need for rigorous estimates. Some formal process (for example, Baysian belief network models or similar methods) should be used to document assumptions and models used. Document sources, experts participating, assumptions, process and results.

Step 3. Summarize historical live tree, snag and downed wood densities from available information. Gather existing information on historical densities of snags and downed wood from any sources that might seem relevant. Document sources and their limitations. Useful data may exist in the General Land Office Surveys (for live tree densities), historical records, and photographs. Data should be summarized for each stratum. If expert opinion is the only available data source, then consider using a system to formalize expert belief systems (for example, Baysian belief networks or similar methods). Gather experts with local knowledge for one or more knowledge-summarizing sessions. Be clear about assumptions. Document process and results.

Step 4. Project densities under historical conditions by stratum. The objective should be to develop probability distributions of snag and downed wood densities for historical conditions. Probability distributions would become the reference conditions that are the basis of revised standards by biophysical stratum. Stand or snag / downed wood models (TELSA / VDDT, FVS, Marcot / Mellen, Wright, etc.) will be useful and should be tested during a prototype study. Current large live tree, snag and downed wood estimates (from step 2), especially for lands that have not been directly altered by human activities, may be useful for model calibration. These must be used with caution because fire suppression has occurred on most lands. An integration of data from existing unmanaged areas, expert opinion, and historical records may be the most useful way to estimate historical conditions. Be clear about assumptions. Document process and results.

Prototype

A prototype process could develop, refine, and document methods. Ideally, a prototype (or more than one) would take place in a single large landscape area (for example, the Grande Ronde and / or John Day River subbasins) that contains useful existing data, substantial forested areas with no data, and sources of expert opinion. Methods for determining current densities and refining historical range of variability estimates should be developed, tested, and documented in published reports. A prototype should test several options for gathering and summarizing information about current live tree, snag, and downed wood densities.

Determine Current Snag and Downed Wood Density and Distribution

Review and summarize existing data. Compare to Harris (1998) data, and the Decadent Wood Advisory Model and OR-WA Species Habitat Project database, once available.

Collect new data, if necessary, where no data exist. Review and select sampling methods, considering Bate and others (1999) methods for snags and large trees (at the stand exam scale), Bull et al. (1990), Brown (1974), and Current Vegetation Survey (Max et al. 1996) methods. Collecting new data may prove too expensive or time-consuming. If so, consider using expert opinion, but be aware that results may have little or no statistical validity.

Determine Historical Range of Variability for Snag and Downed Wood Density and Distribution

Estimates of snag and down wood density probability distributions will likely require modeling stand dynamics over time using TELSA / VDDT, FVS, and other tools. The prototype should test and evaluate the utility of various existing modeling tools. Some information on the historic density of live trees, for model calibration, might be available from General Land Office surveys (generally done from 1860 to the early 1900s for some areas). These can be summarized to provide estimates of live tree stand structure in the early European settlement period (General Land Office methods from Ochoco National Forest, Dave Maercklein). Assumptions about the relation of snag and downed wood levels to live tree structure, as revealed by General Land Office data analysis, would need formulation and documentation. Also, see methods used by Arno et al. (1993), Beukema et al. (1999), Everett et al. (1997), Harris (1998), and Harrod et al. (1998) for historical stand structures and snag amounts. It may also be possible to use the FVS and VDDT models for historical range of variability simulation of stand, snag, and downed wood dynamics.

Wildlife Species Requirements

There is a large body of literature on wildlife (mostly birds) snag and downed wood requirements, and various methodologies and approaches to determining required amounts and distributions. These include Bate et al. (1999), Bull et al. (1997), Cline and Philips (1983), Lundquist and Mariani (1991), Marcot (1988), Neitro et al. (1985), Ohmann et al. (1994), Parks et al. (1997), Raphael et al. (1992), Raphael and White (1984), Raphael (1983), Saab and Dudley (1998), and Thomas et al. (1979). Much of this information is being summarized for the Forest Service's Pacific Northwest Region by Marcot and others for the OR-WA Species Habitat Project and Decadent Wood Advisory Model.

Project Future Amounts

A number of models are available that project snag dynamics over time. They include Beukema et al. (1999), Bull et al. (1980), Cimon (1983), Cline et al. (1980), Everett et al. (1997), Harcombe (1987), Harrod et al. (1998), Hessburg et al. (1995), Huggard (1997), Lambert et al. (1980), Marcot (1988), Morrison and Raphael (1993), Neitro et al. (1985), Raphael et al. (1992), Raphael and Morrison (1987), Raphael and White (1984), Raphael (1983), and Thomas et al. (1979). Unfortunately, many of these models do not include methods or processes for the projection of downed wood amounts. It may be possible to interactively link some of the models with the TELSA / VDDT models and the ICBEMP CRBSUM data layers.

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