Special Habitat Elements: Snags and Down Logs in Coniferous Forests

Timber management activities on public and private forest lands have altered the structural characteristics of a number of forest habitats. The conversion of old-growth forests to rapidly growing but structurally simpler younger forests is a notable example. Generally, the goal of intensive timber management is to reduce the amount of time required to produce a new crop of trees. Shortening or eliminating certain pathways of forest succession that are dominated by grass, shrubs, or hardwoods can be associated with this objective. Management of forestlands for timber production frequently alters forest structure from multi-aged stands of mixed species in patch sizes determined by natural events, to young, even-aged stands with reduced tree species diversity.

Standing snag and down logs.

Intensive management that concentrates on the production of wood products can make it difficult for resource managers to provide many of the diverse structural components such as snags and down logs desired to support biological diversity. Repeated logging over relatively short time periods and reforestation and other activities may accelerate the loss of snags, reduce new snag and down log recruitment, and decrease the likelihood of trees becoming large enough to provide the habitat required by some species (Thomas, 1979). Snags, down logs, and the capability of the land to produce these elements over time are of particular concern because adequate numbers, size, and decay classes of these habitat elements are required for the long-term persistence of dependent wildlife species.

Findings on the biological value of snags and down logs

Snags (standing dead trees) and down logs (portions of or entire trees that have fallen to the ground) have been shown to have significant positive habitat value for many plants and animals, and are considered "special habitat elements." This term refers to specific physical and biological attributes of the landscape without which certain species either are not expected to be present or will exist in greatly reduced numbers (Mayer and Laudenslayer, 1988). Snags and down logs provide one example of special habitat elements on forests and rangelands whose importance to wildlife is well documented in California. The value of snags to cavity-nesting wildlife has been a topic of study in California for nearly 30 years (Gale, 1973 fide Raphael and White, 1984). Reduction in population of snag and down log dependent wildlife has been consistently related to low snag and down log densities. The California Wildlife Habitat Relationships System indicates that 169 wildlife species at least partially utilize large snags of all decay classes (California Wildlife Habitat Relationships System, 2001)

Lower populations of snag dependent wildlife species has been related to reductions in snag densities and sizes.

Larger size snags are generally present in the forest for longer periods and provide for a wider range of wildlife species.

Every forest community supports a characteristic combination of primary excavators (species that create their own nesting cavities within snags) and secondary cavity-nesters (species using previously created snag cavities). In addition, each species has specific requirements relative to the minimum diameter and height of snags suitable for nesting and shelter (Thomas et al., 1979). Although snags of all size and decay classes are used to a varying degree by wildlife species, larger diameter snags are generally present in forest stands for longer periods. These snags also provide a larger surface area for cavity excavation, additional insulation from weather extremes, and sufficient space for the construction of the nest site. In general, it follows that snags of larger diameter will provide a suitable cavity-nesting substrate for a wider range of wildlife species.

The benefits of down logs are many, including their contribution to forest soil nutrient levels and provision of habitat for a large number of plant and

For example, snags in excess of 27 inches diameter at breast height (DBH) were nearly 20 times more preferred than those 9 to 15 inches in DBH in a Sierra Nevada study area (Raphael and White, 1984; Crocker-Bedford and Pyc, 1985). Another Sierra Nevada study found 30 percent more bird species utilizing brush fields with snags as opposed to brush fields where snags were absent (Beaver, 1972 fide Raphael and White, 1984).

The benefits of down logs are many, including their contribution to forest soil nutrient levels and habitat for a large number of plant and animal species. Logs found on the forest floor as well as within or adjacent to streamsides are key structural elements to terrestrial and aquatic ecosystem function. Over time, trees become part of the down-wood component of the forest floor or aquatic environment. Forest stand characteristics then are ultimately responsible for the species, size, and recruitment rate of down logs. Log habitats are used by a broad array of plants, invertebrates, and vertebrate species that change in composition and population density as the log moves through the decay process. Trees that fall into forest streams or are deposited by debris flows are an important influence on stream channel hydraulics and provide stream-rearing habitat for fish and insects. In coastal forest ecosystems, tree seedlings are frequently found rooted in “nurse” logs. These logs provide an opportunity for seedling establishment by reducing competition with other vegetation on the forest floor, ensure longer periods of water availability, and may enhance higher levels of root mycorrhizae fungi that are important for tree growth and nutrient capture. The fruiting bodies of these mycorrhizal-forming fungi are also an important forage resource for a variety of small mammal species.

Down logs in forest streams provide stream-rearing habitat for fish and insects.

Findings on forest management and habitat element dynamics

Snags and down logs are dynamic forest resources that change over time due to factors that include existing live tree density, fire, windstorm, pests and disease, and other environmental variables that influence decay rate.

Snags and down logs are a dynamic forest resource. They appear and disappear throughout the life of a forest stand. Snag and down log densities can be expected to change from a variety of factors, including existing live tree density, fire, windstorm, pests and disease, and other variables that influence decay rate. Similarly, tree species, cause of death, topographic location, climate, and subsequent level of wildlife use can influence down log and snag longevity.

Down logs are portions of or entire trees that have fallen to the ground.

Wood utilization standards employed by forest managers, as well as a variety of economic considerations that influence merchantability, also affect the degree to which snags and down logs are retained (Spies and Cline, 1988). For example, in the intensively managed forest plantation, establishment is generally preceded by the removal of coarse woody debris that includes down log accumulations that were present prior to logging. Down logs and coarse woody debris are removed for a variety of reasons but generally to increase wood utilization, clear the site for tree planting, and reduce fire risk.

Other differences exist between forests managed intensively for wood products and those that provide multiple uses. Short periods of time between harvest cycles, as when a forest is thinned regularly, minimizes the accumulation of down logs, and produces smaller diameter trees that decay faster than larger diameter material. Large plantations also reduce the input of coarse woody debris that alters the functional characteristics of the forested environment. Significant reductions in the amounts of coarse woody debris and down logs, below desired levels, impair habitat value, forest productivity, and biological diversity (Spies and Cline, 1988). Researchers continue to examine the relationship between snag and down log densities that would result from "natural" processes or conditions in contrast to the managed forest and extensive periods of fire exclusion. The scientific literature examining desired levels of snag density is largely derived from bird nesting preferences and not the capability of a particular location to sustain certain numbers and types of snags over time (Laudenslayer, 20003).

Where site conditions and forest management decisions result in live trees of smaller size classes, silvicultural and harvest prescriptions need to focus on desired and possible densities of large snags and down logs. A variety of forest management practices are available to recruit snags and down logs. These include retaining green trees adjacent to or within a stand scheduled for harvest and maintaining areas as part of a longer rotation, thus allowing trees to reach not only a desired size but also desired structural attributes.

Forest practice regulations provide for snag retention under certain conditions. In addition, over the last decade, more attention has been given to the importance of snag retention and other special habitat elements across the forested landscape. The role of large woody debris is now receiving special attention as an essential component of stream ecosystem function.

Findings on snag and down log requirements

The number of snags and down logs, as well as the size and condition requirements of individual species using these elements, remains an important research question. The traditional approach of wildlife researchers concentrates on the requirements of individual species as well as population dynamics to estimate the abundance and characteristics of snags to sustain populations of snag dependent species (Thomas et al., 1979; Menasco, 1983). The principal drawback of such an approach is that its focus on individual species requirements is likely inconsistent with the needs of the broader range of snag-using species or the capability of a particular piece of land to support the required number of snags in perpetuity.

Researchers now recommend snag densities and green trees for snag recruitment greater than those derived from approaches driven by the needs of individual species.

As additional information has been gathered regarding the importance of snags and down logs as a foraging substrate for wildlife, researchers now recommend snag and green tree densities for snag recruitment greater than those derived from approaches driven by the requirements of individual species (Bull and Holthausen, 1993; Bull et al., 1997). In the near future, snag management and modeling efforts will require incorporation of much more sophisticated information such as cavity-nester foraging substrates, the size of home ranges, the number and characteristics of roost trees, multiple occupancy of snags, and the need for other habitat structures (Bull et al., 1997). In addition, research on the capability of forests to produce the desired number of trees and snags, especially large trees and snags, is also needed to test the applicability of current snag guidelines ands standards.

Hard and soft snags—there is a difference: Minimum snag diameters required for nesting have been identified for numerous snag dependent species and are important measures to consider when evaluating snag size and density data. Snags are frequently categorized as either “hard” or “soft,” terms that describe the degree of decay and influence wildlife use. A number of factors influence whether a snag is hard or soft including tree species, density of the stand in which the snag originates, cause of death, agents of decomposition, and subsequent level of insect and other wildlife activity. In general, hard snags (or hard down logs) are relatively recent in origin and can be expected to remain a part of the forest stand for extended periods. Soft snags (or soft down logs) exhibit decay of at least the external sapwood (outer few inches of the tree bole) and provide a relatively easily excavated substrate for cavity construction or feeding. Where decay agents that attack the sapwood of a particular species are not present, these types of snags can be exceedingly rare.

Researchers evaluated snag usage by birds in a Tahoe National Forest study area according to U.S. Forest Service (USFS) snag retention guidelines (Morrison et al., 1986). The guidelines in place at that time required 1.5 snags per acre of 15 inches DBH, including 0.5 hard snags per acre of 20 inches DBH. Although this study was of limited duration, they concluded that the density of hard snags was 20 to 37 percent of that required by guidelines developed to maintain population levels of primary cavity-nesters at 40 percent of maximum in their study area. Birds exhibited a preference for snags at least 12 inches DBH since fewer than 5 percent of the nests located were in snags less than 12 inches DBH. However, most snags were in this smaller size class. Researchers working in other locations reached similar conclusions. These studies indicated that most cavity-nesters utilized snags of at least 12 to 18 inches DBH and that larger bodied species required larger snag classes (Thomas et al., 1979;Scott and Oldemeyer 1983).

A variety of species other than birds use snags. For example, a study found that black bear in Oregon used large cavities in western larch and grand fir averaging 45 inches DBH as den sites (Parks, 1996). Bats frequently roost in abandoned woodpecker cavities or under loose bark. Fisher and marten make use of large snags and down logs as denning and foraging sites.

Findings on snag and down log densities in California's forests

Plot data from the United States Forest Service (USFS) Forest Inventory and Analysis (FIA) program was used to describe the abundance and characteristics of snags and down logs in a variety of California forest types and ownership categories. Currently available snag and down log levels reflect conditions as of 2000 for public lands while private land data was collected between 1991 and 1994. Although plot data collected on National Forest reserve lands is more recent than that on private lands, snag and down log densities are assumed (for the purposes of the comparative analysis) to not have markedly changed on reserved ownerships during the intervening time period. It is important to note however that climatic conditions coupled with variation in destructive insect populations can markedly influence tree mortality over time periods shorter than those presented. The National Forest reserve ownership condition is used to represent forest conditions prior to the influence of post World War II forest and fire management policies. Undoubtedly, a number of plots in the Reserve ownership category have historically experienced at least some of the typical and more broadly applied management influences of other ownership categories, a likelihood that necessitates careful data interpretation. In addition, since the early 1990s, there has been an increased focus on snag and down log retention on actively managed public and private lands. These management efforts combined with infrequent fire and relatively slow rates of decay in many California forests have likely resulted in higher levels of snag and down log densities than those reflected in the 1994 data.

Information obtained from the FIA forest sampling was converted or "cross-walked" into a habitat type label for each forest type. This process facilitated the utilization of snag and down log data with existing wildlife habitat relationship analysis tools. In addition, certain habitat types were combined for those cases in which the sample size would have been too small for meaningful analysis or reporting. See FIA Snag and Down Log Sampling and Crosswalk Methods for a detailed description of methods.

For each snag and down log category, the number of plots examined indicates the sample size. The density data for categories with sample sizes of less than 30 plots is likely to exhibit higher levels of variation and consequently lower levels of confidence in the calculated average density. Because plot sizes represent large areas of ranging from hundreds to thousands of acres per plot," information is best used at bioregional or statewide scales and may not be applicable or reliable for any one forest stand. Variation among plots taken to measure snag and down log densities is generally high, particularly when small numbers of plots are considered or results are applied at small scales such as the forest stand or a small watershed. Similarly, in landscapes of mixed ownership, snag and down log densities may be well represented when considered independent of ownership class.

Private Industrial and Private Non-Industrial lands have 40 percent fewer snags of all size and decay classes than are found on National Forest reserve lands.

Comparing current densities of snags and down logs versus “historic” or “natural” levels can be problematic since historic information is only a snapshot of the conditions of that period. As such, the reference period is only a point in time within the natural range in variation of snag and down log densities and may not be representative of the historic reference period. In addition, there are few if any baseline reference areas from which to adequately sample and measure “naturally” occurring snag and down log densities and recruitment processes that have not been influenced by fire exclusion and historic management policies. Comparative historic data describing these structural attributes in forests of the nineteenth century are not available.

In general, Private Industrial and Private Non-Industrial lands have 40 percent fewer snags of all size and decay classes than are found on National Forest reserve lands (3.7 per acre versus 6.2 per acre) (Table 1). The relative abundance of large snags across ownerships and management emphasis is also noteworthy. Private Industrial and Private Non-Industrial ownerships possess 70 (0.3 snags per acre) and 80 (0.2 snags per acre) percent fewer snags of greater than 30 inches DBH, respectively, than do National Forest reserve lands. On National Forest reserve lands (as an ownership class) approximately 17 percent of all snags are in the largest size class, Private Industrial and Private Non-Industrial retain eight and five percent, respectively. Overall, these averages suggest that snag densities are markedly less on private versus National Forest reserve lands (Table 1).

The same general trends are also evident when specific conifer dominated forest types are examined that are well represented in the plot data (Table 2). For example, large snag densities in Sierra Mixed Conifer were 82 percent less on Private Industrial (0.3 snags per acre) and 94 percent less on Private Non-Industrial (0.1 snags per acre) ownerships than National Forest reserve lands (1.7 snags per acre). When considering all snag size classes in this forest type, densities improved to 44 percent less and 37 percent less, respectively. Similarly, in the Douglas-fir forest type, large snag densities were 79 percent less on Private Industrial lands (0.3 snags per acre) and 86 percent less on Private Non-Industrial (0.2 snags per acre) than those on National Forest reserve lands (1.4 snags per acre). Relative densities improved somewhat to 59 percent less and 82 percent less, respectively, when considering all snag size classes in this forest type.

Table 1. Average number per acre of snags and down logs by ownership category, size and decay class

	National Forest reserve	National Forest	Private Industrial	Private Non-Industrial	Total weighted statewide average*
Snags: all snag sizes and decay classes statewide**	6.2	5.8	3.7	3.7	4.8
Small snags (>10” to <15”)	2.6	2.7	1.9	2.2	2.4
Hard	1.8	1.9	1.4	1.8	1.8
Soft	.7	.8	.5	.4	.6
Medium snags (>15” to <30”)	2.5	2.1	1.4	1.4	1.8
Hard	1.5	1.3	0.8	1.0	1.1
Soft	1.0	0.9	0.6	0.3	.7
Large snags (>30”)	1.0	0.7	0.3	0.2	.5
Hard	0.4	0.3	0.1	0.1	.2
Soft	0.6	0.4	0.2	0.1	.3
Down logs: all sizes and decay classes statewide***	12.4	14.1	35.4	9.5	15.9
Small logs (>10” to <15”)	5.6	6.9	13.6	4.3	7.0
Hard	4.4	5.1	10.7	3.2	5.3
Soft	1.2	1.8	2.9	1.1	1.7
Medium logs (>15” to <30”)	5.2	5.7	17.4	4.5	7.2
Hard	3.4	3.5	12.5	2.9	4.8
Soft	1.8	2.2	5.0	1.6	2.4
Large logs (>30”)	1.6	1.5	4.4	0.7	1.7
Hard	1.0	.8	3.5	.6	1.2
Soft	.7	.7	1.0	.1	.5
Total acres represented	3,011,583	10,816,480	4,491,738	8,884,226	27,204,027
Total plots sampled	822	3,603	612	1,079	6,116

**Statewide weighted average excludes unsampled Public and Private Non-Industrial reserve areas such as Bureau of Land Management wilderness areas, National Parks, State Parks, and private conservancies but includes other public lands not shown in Table 1.*
*** Small snag is greater than 10 inches DBH but less than 15 inches DBH. Medium snag is greater than 15 inches DBH but less than 30 inches DBH. Large snag is greater than 30 inches DBH.*
**** Small log is greater than 10 inches in diameter on large end but less than 15 inches. Medium log is greater than 15 inches in diameter on large end but less than 30 inches. Large log is greater than 30 inches in diameter on large end.*

Source: Warbington and Beardsley, 2001

When compared to down log densities on National Forest reserve lands, those on private lands exhibit markedly higher densities. Private Industrial lands carry a high level of total down logs per acre (35.4 down logs per acre) when compared to other ownerships. Statewide, they possess down log densities 65 percent higher across all log sizes and decay classes than those on National Forest reserve lands (12.4 down logs per acre). Similar elevated percentages relative to National Forest reserve lands are apparent when examining only large log densities on Private Industrial lands (4.4 down logs per acre) (64 percent) or a combination of medium (17.4 down logs per acre) and small (13.6 down logs per acre) log densities (65 percent). (Table 1). On the National Forest reserve land ownership class, 13 percent of all logs are in the largest size class (1.6 per acre), whereas Private Industrial and Private Non-Industrial ownerships show 12 percent (4.4 down logs per acre) and seven percent (0.7 down logs per acre) respectively. (Table 1). Down log densities of all size classes and within all forest types sampled on Private Industrial lands exceeded densities found on National Forest reserve lands by a large margin (Table 2).

Small and large down logs.

Table 2. Average number per acre of snags and down logs by selected cover types, ownership category, and size class

	National Forest Reserve			National Forest			Private Industrial			Private Non-Industrial		
	Size*			Size*			Size*			Size*		
Cover type	**S**	**M**	**L**	**S**	**M**	**L**	**S**	**M**	**L**	**S**	**M**	**L**
Ponderosa Pine												
Snag	0.7	2.2	1.4	1.0	1.5	0.4	2.8	3.8	0.5	0.0	0.8	0.0
Log	5.7	7.2	0.1	7.5	5.1	1.2	11.1	8.3	1.9	3.4	0.0	0.0
Plots sampled			16			148			9			13
Acres represented			26,909			267,428			48,175			51,482
Sierra Mixed Conifer												
Snag	2.7	2.6	1.7	4.2	3.1	1.0	2.1	1.5	0.3	2.6	1.7	0.1
Log	5.7	6.8	2.4	9.2	8.2	1.9	13.0	17.4	3.1	10.1	5.6	0.6
Plots sampled			89			527			115			63
Acres represented			214,726			1,798,132			862,463			381,156
Douglas-fir												
Snag	3.6	4.8	1.4	2.7	2.0	1.1	2.6	1.1	0.3	0.2	1.4	0.2
Log	7.0	5.2	1.3	7.0	6.3	2.2	12.0	15.7	6.1	13.8	13.3	2.3
Plots sampled			34			192			49			35
Acres represented			181,762			789,241			342,377			191,491
White Fir												
Snag	3.8	4.0	1.7	6.0	4.7	1.4	4.0	2.0	0.3	5.3	3.7	1.6
Log	6.9	6.1	1.9	10.1	8.0	2.6	14.4	14.4	2.8	8.5	9.0	1.7
Plots sampled			110			414			88			14
Acres represented			384,046			1,288,039			650,479			87,503
Montane Hardwood												
Snag	2.2	1.2	0.3	1.4	1.0	0.5	0.8	1.0	0.2	3.2	1.6	0.1
Log	5.3	2.6	1.0	4.2	3.2	0.6	8.2	12.4	2.6	3.7	4.3	0.8
Plots sampled			79			384			47			204
Acres represented			355,021			1,229,741			323,209			1,579,035
Montane Hardwood Conifer												
Snag	1.7	1.5	0.7	2.0	1.7	0.8	1.0	1.4	0.2	3.6	2.2	0.4
Log	4.9	4.5	1.1	6.0	5.1	1.7	10.2	16.3	4.9	8.7	7.9	1.1
Plots sampled			94			367			81			111
Acres represented			280,765			1,169,694			617,171			729,970
Eastside Pine												
Snag	0.8	0.1	0.4	1.0	0.8	0.1	1.6	0.6	0.1	4.9	1.3	0.1
Log	3.7	5.9	0.8	4.9	3.8	0.6	7.2	7.3	0.8	8.0	4.3	0.0
Plots sampled			7			323			54			28
Acres represented			14,446			697,087			338,661			174,559
Klamath Mixed Conifer												
Snag	3.4	3.4	1.9	2.7	1.7	0.5	1.2	1.6	0.4	5.7	7.6	0.4
Log	4.3	6.1	1.8	5.7	5.8	1.6	8.7	15.7	1.9	3.5	1.6	1.5
Plots sampled			44			96			15			9
Acres represented			170,149			343,549			114,712			48,379

** Small snag is greater than 10 inches DBH but less than 15 inches DBH. Medium snag is greater than 15 inches DBH but less than 30 inches DBH. Large snag is greater than 30 inches DBH. Small log is greater than 10 inches in diameter on large end but less than 15 inches. Medium log is greater than 15 inches in diameter on large end but less than 30 inches. Large log is greater than 30 inches in diameter on large end.*

Source: Warbington and Beardsley, 2001

There are a variety of factors potentially responsible for the differences in snag and down log densities between National Forest reserve and Private Industrial or Private Non-Industrial lands.

- Different cutting practices on private lands were prevalent during the period from 1984 through 1994 in which plot data were collected. These practices may have resulted in higher levels of down log and woody material retention on the forest floor as a result of difficulties associated with its effective removal while protecting trees remaining onsite after harvest.
- Management policies on public lands include an active woody debris treatment program that reduces forest fuels as well as the amount of wood on the forest floor. Snag size and relative density could be expected to be higher on managed public lands given a concerted effort by managers to retain those elements along with a generally greater density of large sized live trees that provide snag recruitment to the larger size classes.
- Private lands generally exhibit a greater efficiency at salvaging tree mortality as merchantable harvest volume. This capability also reduces actual and potential snag density levels on private lands managed principally for wood fiber production.
- Utilization practices on private lands, regarding both live trees and salvage operations, concentrated on large tree removal and likely bypassed smaller trees during earlier decades. As such, higher levels of down logs resulting from previous utilization practices were expected on private land when sampled during the early 1990s.

Information used to generate snag and down log density tables according to habitat type, ownership and bioregion can be found at FIA Snags and Down Log Densities.

Additional information on snags and down logs

Information continues to emerge regarding the role and importance of snags and down logs as special habitat elements. A symposium entitled The Ecology and Management of Dead Wood in Western Forests was conducted in November 1999. Priorities identified at this conference included the need to promote the following objectives: 1) a greater understanding of the topic; 2) meaningful research, monitoring, and reporting; 3) discussions regarding management objectives; and 4) a new synthesis on dead wood management.

The Dead Tree Web Site concentrates on dead trees as an important ecological component of forests (Canadian Ministry of Forests, 2001). The site is a resource of information ranging from introductory information regarding the role of dead trees to specific information extrapolated from available research data. While the site directly addresses dead trees (snags and down logs) and their management in British Columbia, both its content and referrals to other sources of information (e.g., Internet sites) are pertinent to a wider international audience.

Glossary

biomass: Plant material that can be converted into fuel.

DBH: See **diameter at breast height**.

diameter at breast height: Tree trunk diameters measured at breast height, defined as the diameter of the tree 4.5 feet (1.37 meters) above ground on the uphill side of the tree.

down logs: Portions of trees that have fallen to the ground that are at least 10 feet long and at least 10 inches in diameter as measured on the large end.

even-aged stand: A forest stand or forest type in which relatively small (10-20 year) age differences exist between individual trees. Even-aged stands are often the result of fire, or a harvesting method such as clearcutting or the shelterwood method; Forest stand where more than 70 percent of the tree stocking falls within three adjacent, decadal, age classes.

external sapwood: Outer few inches of the tree bole.

FIA: See **Forest Inventory and Analysis**.

fire exclusion: the lack of natural or man-caused forest fires due to wildfire suppression activities**.**

Forest Inventory and Analysis: Forest land and timberland statistics reported by the Pacific Resource Inventory, Monitoring and Evaluation program (PRIME) of PNW. Every decade, PRIME conducts the Forest Inventory and Analysis, which is a national mandate authorized by the Forest and Rangeland Renewable Resource Research Act of 1978. The FIA is a plot-based survey and statistical analysis with representative field based plots of all forest lands outside the National Forest System.

mycorrhiza: The symbiotic association of the mycelium of a fungus with the roots of certain plants, such as conifers.

National Forest reserve: Lands not available for timber harvest including existing wilderness, wild and scenic rivers, research natural areas, and congressionally designated areas.

old-growth forest: a subjective description of a stand or stands of forest trees that exhibits large tree sizes, relatively old age, and decay characteristics common with over-mature trees; As defined by USDA FS ecologists, specific forest structure characteristics, by forest type and site class, such as size of trees, number of trees per acre, multiple canopies, degree of decay, and size and number of snags and down woody debris.

patch size: The area of a specific forest stand.

primary excavators: Species that create their own cavities within snags.

roost tree: a tree used by bird species for resting or a stationary point used during searches for food or territory defense.

rotational age: The age to which a single crop or generating of a forest stand of trees is allowed to grow.

sawlog: A log meeting minimum commercial tree bole requirements of diameter, length, and defect. The usual commercial requirements are a minimum of eight feet long with a small end inside bark diameter of six inches for softwoods and eight inches for hardwoods.

secondary cavity nesters: Species using previously created snag cavities.

silviculture: Generally, the science and art of cultivating (such as with growing and tending) forest crops, based on the knowledge of silvics. More explicitly, silviculture is the theory and practice of controlling the establishment, composition, constitution, and growth of forests.

snags: Standing dead trees with a minimum DBH of 10 inches and a height of 10 feet.

special habitat elements: Specific physical and biological attributes of the landscape without which certain species either are not expected to be present or will exist in greatly reduced numbers.

substrate: The woody material or substance in dead trees used by wildlife for life functioning activities such as nesting cavity construction or host habitat for food source.

THP: Timber Harvesting Plan.

USFS: U.S. Forest Service.

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