Boise National Forest
Land and Resource Management Plan

Appendix A

Appendix A.
Vegetation

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INTRODUCTION

Appendix A contains the mapping criteria, classification descriptions, and desired condition tables for vegetation outside of designated wilderness areas that fall within Management Area 22. Separate tables and/or narratives relate to desired conditions for 3 vegetation types: 1) components of forested vegetation; 2) woodland and shrubland; and 3) riparian vegetation, including vegetation in riparian conservation areas (RCAs). Desired conditions do not represent a static state; they are dynamic because the ecosystems are dynamic. The desired conditions will not be evident on every acre of the Boise National Forest (Forest) at every point in time; spatial and temporal variability will always exist. However, Forest management’s long-term goal is to achieve desired conditions distributed across the planning unit. The desired conditions are to be evaluated Forest wide for tree size class, canopy cover, and species composition; at the 5th field hydrologic unit (HU) for spatial pattern; and at the activity area for snags and coarse woody debris. Desired conditions for tree size class, canopy cover, and species composition are evaluated through Forest Plan monitoring. This evaluation process may result in Forest Plan amendments that will guide future project development. Snags and coarse woody debris are evaluated during project planning. Watershed or activity area scales of analysis may be used where a different reference is more appropriate to identify opportunities for a specific treatment.

The historical range of variability (HRV) was used as a basis for developing desired conditions. The HRV has been suggested as a framework for coarse filter conservation strategies (Hunter 1990) and is described as an appropriate goal for ecological conditions (Landres et al. 1999). The assumption is that if it is possible to produce or mimic a variety of historically functioning ecosystems across the landscape, then much of the habitat for native flora and fauna should be present. The desired conditions described below fall within a portion of the HRV and are also balanced with social and economic desired conditions.

In many areas, current conditions deviate strongly from desired conditions; this deviation may create opportunities for managing vegetation. However, even under careful management it may take several decades for these areas to approach desired conditions. During that time, managers will have to choose among several approaches to maintain progress toward desired conditions. There may be many different paths to a common endpoint that meet different management objectives, but each path has its own trade-offs. Navigating these paths and trade-offs will be the challenge of ecosystem management in trying to achieve desired vegetative conditions. As we move forward with vegetation management and learn more from monitoring and scientific research, desired conditions may change, or we may alter the paths we choose to achieve them. For these reasons, it is impossible to describe a completely prescriptive approach to desired conditions. We can only offer guidance on how to achieve desired conditions.

Exceptions to the desired vegetative conditions may exist, possibly as a result of management direction in other resource areas or undesirable site-specific conditions. In some cases, Management Area direction may have different goals and objectives for specific areas (e.g., developed campgrounds) that would override the Forest-wide desired conditions. Each Management Prescription Category (MPC) may also have a different theme regarding how to achieve desired conditions. All of these differences need to be considered when we design our projects.

The desired conditions are general conditions that can be modified at the local or project level based on site-specific biophysical conditions. Some examples of projects where desired conditions could deviate from those in Appendix A include restoring rare plant habitat or considering the needs of a threatened or endangered species where the Forest-wide desired conditions would not provide the site-specific conditions appropriate to the plant community. The rationale for deviating from Appendix A desired conditions would be documented through project-level analysis to help develop an alternate site-specific desired condition.

Appendix A provides the foundation for coarse filter forestland, woodland, shrubland, and grassland ecosystems and associated functions and processes. It also provides desired conditions for fine filter elements such as snags and coarse woody debris and sets a context for riparian areas, wetlands, and alpine communities. Desired conditions are defined as ranges rather than an "average" or "target" in order to provide for a diversity and variety of conditions within and across landscapes. The desired conditions are framed by the HRV and fire regimes and—though presented in terms of tangible attributes of structure, patch, and pattern—embody intangible attributes of function and process. These intangible attributes, particularly disturbance processes that contribute to ecosystem structure and function, are generally captured as Forest-wide goals and in the desired conditions for spatial pattern.

National Standards for Vegetation Classification

Ecosystem assessment and land management planning at national and regional levels require consistent standards for classifying and mapping existing vegetation. An existing standardized vegetation classification system provides a consistent framework for cataloging, describing, and communicating information about existing plant communities. The net value of using standardized existing vegetation classifications and maps is improved efficiency; accuracy; and defensibility of resource planning, implementation, and activity monitoring. Appendix A represents a vegetation classification for existing vegetation that precedes U.S. Department of Agriculture (USDA) Forest Service policy and protocol for consistent standards for classification; the *Existing Vegetation Classification and Mapping Technical Guide* (Brohman and Bryant 2005) documents and establishes these standards. Our vegetation inventories and maps do not match these standards. However, as new inventories and maps are completed, these will be consistent with USDA Forest Service existing vegetation classification standards for dominant vegetation, size class, and canopy cover. At that time, Appendix A will also be modified with desired conditions that are consistent with established classification standards.

Fire Regimes and Spatial Pattern

Recent advances in theory and empirical studies of vegetation and landscape ecology indicate that, to achieve long-term biological diversity across landscapes, management needs to consider the major disturbance processes, including variability and scale, which determine ecosystem components and their spatial pattern (Baker 1992; Baker and Cai 1992; Hessburg et al. 2007). Because fire was historically a major disturbance process in the west, historical fire regimes have been recommended to help set context for the individual components of the desired conditions (Wallin et al. 1996).

Fire regimes are summarized in Table A-1. Figure A-1 displays vegetative spatial patches and patterns that generally resulted from the historical fire regimes (i.e., fire disturbance that occurred on the landscape for approximately 500 years before European settlement [Hann et al. 2004]). Hann et al. (2004) state that appropriate landscapes for evaluating fire regimes are "relatively large-scale, contiguous areas big enough to exhibit natural variation in fire regimes and associated vegetation." They recommend basing the landscape size on the dominant historical fire regime within an area; appropriate landscapes can range from 500 to 300,000 acres in highly dissected topography. Spatial patterns are evaluated at the watershed (5th HU) landscape unit because, in most cases, this scale is large enough to represent the desired fire regime patch dynamics that created the largest patch sizes on the Forest (i.e., the lethal fire regimes). Much larger patches than would be appropriate to represent using a watershed context could be created from very large stand-replacing fires. However, such fires, even within the historical range of lethal fire regimes, are generally inconsistent with current management given the complexity of management goals and objectives within national forests (Wallin et al. 1996; Cissel et al. 1999). Therefore, depending on the mix of fire regimes, a watershed may be dominated by a few or many patches. For example, a watershed dominated by nonlethal fire regimes may be primarily large tree size class with fine-grained patches of smaller tree size classes. A watershed dominated by mixed fire regimes may have numerous small to large patches of different tree size classes, while a watershed dominated by lethal fire regimes may have primarily smaller tree size classes with fine-grained patches of larger-sized trees.

Table A-1. Fire Regimes

Fire Regime	Fire Interval	Fire Intensity	Vegetation Patterns (Agee 1998)
Nonlethal	5–25 years	≤10% mortality	Relatively homogenous with small patches generally less than 1 acre of different seral stages, densities, and compositions created from mortality.
Mixed1	5–70 years	>10–50% mortality	Relatively homogenous with patches created from mortality ranging in size from less than 1 to 600 acres of different seral stages, densities, and compositions.
Mixed2	70–300 years	>50–90% mortality	Relatively diverse with patches created by mixes of mortality and unburned or underburned areas ranging in size from less than 1 to 25,000 acres of different seral stages, densities, and compositions.
Lethal	100–400 years	>90% mortality	Relatively homogenous with patches sometimes greater than 25,000 acres of similar seral stages, densities, and compositions. Small inclusions of different seral stages, densities, and compositions often result from unburned or underburned areas.

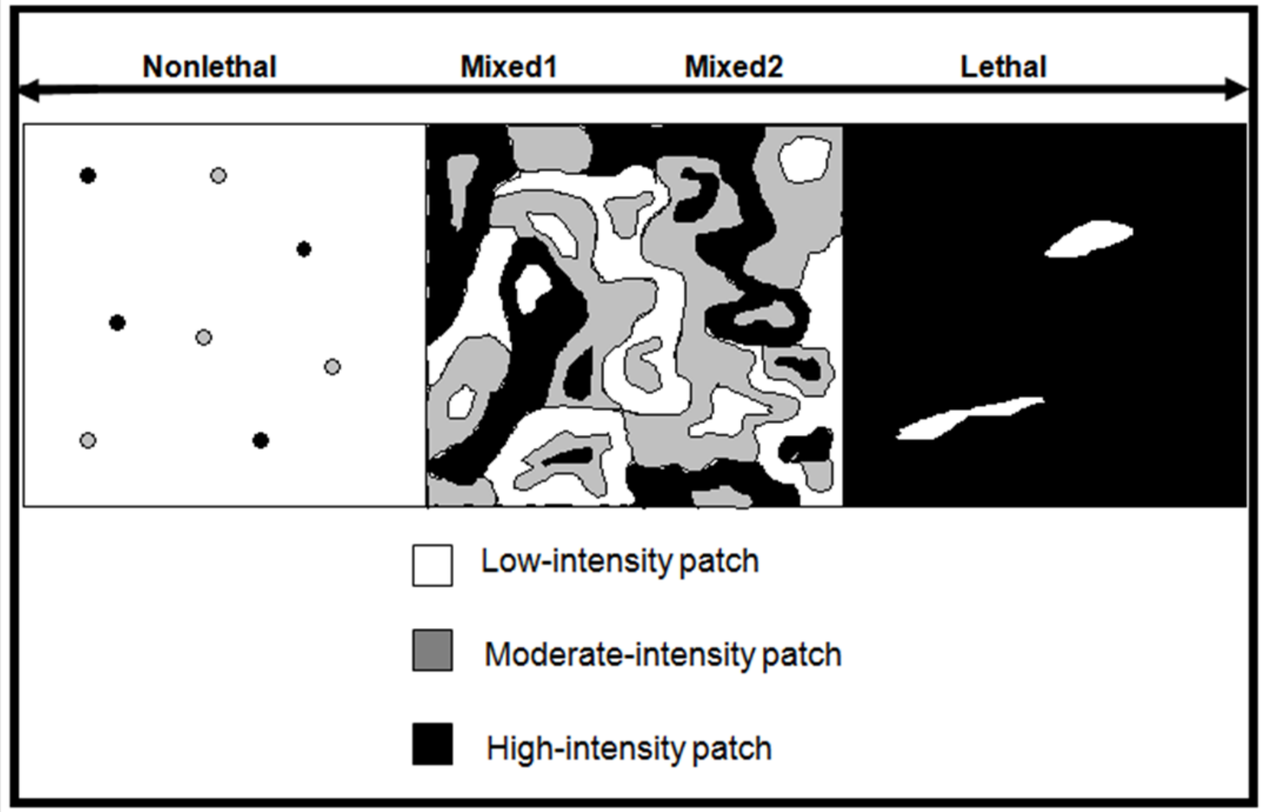

Figure A-1. Patch Dynamics of Fire Regimes (from Agee 1998)

Evaluating spatial pattern is a daunting task that requires both a conceptual framework to organize and simplify ecosystem complexity and knowledge of the details of particular systems (Spies and Turner 1999). Historically, patterns like those in Figure A-1 were the result of disturbance regimes and succession that created spatial elements within and between vegetation types, including amount, proportion, size, interpatch distance, patch size variation, and landscape connectivity.

Landscape spatial patterns affect ecological processes and can be illustrated through differences in plant species composition and structure and through habitat utilization by wildlife. Despite recent interest and progress in spatial patch and pattern research, it remains challenging to determine the conditions under which spatial heterogeneity is and is not important for various processes or organisms (Spies and Turner 1999). Ecosystems often include recognizable patchiness, usually corresponding to physical changes in topography, hydrology, and substrate or due to large disturbances (Whittaker 1956; Bormann and Likens 1979; Taylor and Skinner 2003). Patchiness in the landscape can create changes in microclimate at patch edges, resulting in demographic fluxes of many individual plant species, varied plant species distribution, and edge-oriented patterns (Matlack and Litvaitis 1999). These effects can subsequently alter ecological processes and habitat utilization.

Within a watershed, several forested vegetation types may be interspersed with several shrubland and/or grassland vegetation types. Additionally, several MPC designations may be superimposed upon these vegetation types. It is important to consider the composition of the landscape that contains a project area. At the project level, opportunities exist to consider spatial patterns, how a project can affect spatial patterns, and what those effects (positive or negative) will be to plant and animal species. During project design, spatial pattern considerations are dependent upon current conditions and overriding management concerns for the area. Generally, these conditions and concerns are site-specific, depending on the project scale. Repeating patterns of change emerge at landscape scales, and some order can be found through descriptions of successional pathways, patch mosaics, and seral stages that facilitate understanding and managing vegetation at landscape scales. The challenge and art of management is to simplify without losing important attributes or losing sight of the underlying complexity (Spies and Turner 1999). Another useful way of understanding vegetation dynamics is to characterize the landscape as a shifting mosaic of patches of different ages and developmental stages (Bormann and Likens 1979). The proportion of different age classes or seral stages across a landscape and over time is one of the fundamental characteristics of the vegetation mosaic.

In some cases, the prevailing landscape pattern has been altered so strongly that historical information may be necessary to determine appropriate landscape patterns. For example, fire was historically an important disturbance that maintained the dynamics between native grass and big sagebrush dominance. Frequent small fires opened the shrub canopy and aided the establishment of native perennial grasses at small scales, creating a mosaic of grassland and shrubland communities in different development stages at large scales (Knick 1999). The system dynamics changed when cheatgrass invaded the sagebrush ecosystem and provided continuous fuels, compared to more patchily distributed native bunchgrasses. This invasion facilitated fire spread and shrub loss, resulting in shrubland fragmentation into smaller, spread out patches. Ultimately, many patches did not persist (Knick and Rotenberry 1997). Patch and pattern have changed and may no longer provide for the processes and habitat associated with these systems (Rotenberry and Wiens 1980; Knick and Rotenberry 1995; Paige and Ritter 1999; Connelly et al. 2000; Knick and Rotenberry 2000). Spatial pattern considerations and subsequent management will be particularly difficult in these highly disrupted ecosystems and vegetation types.

DESIRED VEGETATION CONDITIONS

Forested Vegetation

The desired conditions for forested vegetation are described below. Forested vegetation refers to land that contains at least 10 percent canopy cover by forest trees of any size, or land that formerly had tree cover and is presently at an earlier seral stage. Forested vegetation is described by habitat types, which use potential climax vegetation as an indicator of environmental conditions. At the Forest Plan level, forested habitat types have been further grouped into potential vegetation groups (PVGs) that share similar environmental characteristics, site productivity, and disturbance regimes. These groupings simplify the description of vegetative conditions for use at the broad scale. For additional details on the specific habitat types and groupings into PVGs, see Mehl et al. (1998) and Steele et al. (1981).

Table A-2 displays the forested PVGs grouped by fire regimes. Additional information on PVGs is available in the Vegetation Classification and Mapping sections.

Table A-2. Forested potential vegetation groups by fire regimes

Fire Regimes	Potential Vegetation Group
Nonlethal	PVG 1—Dry Ponderosa Pine (*Pinus ponderosa*)/Xeric Douglas-fir (*Pseudotsuga menziesii*)
	PVG 2—Warm Dry Douglas-fir/Moist Ponderosa Pine
Nonlethal-Mixed1	PVG 5—Dry Grand Fir (*Abies grandis*)
Mixed1-Mixed2	PVG 3—Cool Moist Douglas-fir
	PVG 4—Cool Dry Douglas-fir
	PVG 6—Cool Moist Grand Fir
Mixed2	PVG 7—Warm Dry Subalpine Fir (*Abies lasiocarpa*)
	PVG 11—High Elevation Subalpine Fir
Mixed2-Lethal	PVG 10—Persistent Lodgepole Pine (*Pinus contorta*)
Lethal	PVG 8—Warm Moist Subalpine Fir
	PVG 9—Hydric Subalpine Fir

Tree Size Class

Tree size class is based on the largest diameter at breast-height (d.b.h.) of trees according to the following definitions (Table A-3). If none of the definitions apply, the size class is considered grass/forb/shrub/seedling (GFSS). Though a smaller size class may represent a greater canopy cover area than a larger size class, the tree size class is determined by the largest trees that meet the class definition, not the most abundant.

Table A-3. Tree size class definitions

Diameter at Breast-Height (Inches)	Total Nonoverlapping Canopy Cover Of Trees (%)	Tree Size Class
≥20.0	≥10	Large
≥12.0	≥10	Medium
≥5.0	≥10	Small
≥0.1	≥10	Sapling

A few individual trees (such as relic or legacy trees) representing a distinctly different tree size are not recognized as a size class if the total nonoverlapping canopy cover is <10 percent. For example, two or three 18-inch d.b.h. trees in a plantation may be legacies; these legacies would not define the tree size class even though they are the largest trees in the stand since their canopy cover would not meet or exceed 10 percent. In this example, the size class is defined by the plantation trees and not the legacies.

Table A-4 displays Forest-wide desired amounts for tree size classes other than large. For each PVG, this table shows the desired range of the forested vegetation for each tree size class. The range for each size class reflects the dynamic development of trees, considering growth rates, type and extent of disturbances, and varying growth conditions. The individual components are described in more detail below.

Table A-4. Forest-wide range of desired tree size classes for stages other than large tree, arranged by fire regime

Tree Size	Nonlethal		Nonlethal -Mixed1	Mixed1-Mixed2			Mixed2		Mixed2 -Lethal	Lethal	
	PVG 1 (%)[a]	PVG 2 (%)	PVG 5 (%)	PVG 3 (%)	PVG 4 (%)	PVG 6 (%)	PVG 7 (%)	PVG 11 (%)	PVG 10[b] (%)	PVG 8 (%)	PVG 9 (%)
GFSS	1–12	4–5	3–4	9	14–15	7–8	7–16	9–15	16–23	15–17	13–15
Saplings	2–12	3–7	3–7	9	7–9	7–9	11–15	14–15	11–16	11–15	8–15
Small	2–18	5–21	4–22	18–27	19–22	11–27	21–22	19–22	46–48	22–23	17–22
Medium	3–29	7–35	7–30	23–36	24–36	18–36	32–36	22–38	11–20	28–29	25–29

[a] Percentage of forested vegetation within each PVG
[b] See the large tree size class discussion below for the desired conditions for medium size class in PVG 10

Below, Table A-5 displays the Forest-wide desired amounts for the large tree size class, by PVG.

Canopy Cover Class

The tree size class is based on the largest d.b.h. trees that meet the definitions described in the Tree Size Class section. Canopy cover class represents the total nonoverlapping cover of all trees in a stand, excluding the seedling tree size class. Trees in the seedling tree size class are used to estimate canopy cover class only when they represent the only structural layer present.

Canopy cover classes are based on the following:

- Low = 10–39 percent canopy cover
- Moderate = 40–69 percent canopy cover
- High = 70 percent or more canopy cover

Canopy cover class may be determined from visual estimates using aerial photos or from algorithms in programs such as Forest Vegetation Simulator. Canopy cover is used in two different calculations; the first is to determine tree size class as described in the “Tree Size Class” section. In this case, the largest trees that contain >10 percent canopy cover determine the size class and the only canopy cover used is the cover of trees in that specific size class. Once the Tree Size Class is determined, the second calculation involving canopy cover is the one described in this section and uses trees of all sizes (except seedling) to determine nonoverlapping canopy cover. This calculation determines the total canopy cover used when evaluating desired conditions.

Species Composition

Table A-5 displays the Forest-wide desired condition ranges for the large tree size class, including canopy cover class and species composition. For species composition, finer scales are not expected to mirror these values because of the specific mix of habitat types present in individual analysis areas. For example, for PVG 1, the desired range of 96–99 percent ponderosa pine would be attained when evaluated at the Forest-wide scale, while the remainder of PVG 1, up to 4 percent of the area, would be any other combination of tree cover. However, the Douglas-fir/mountain snowberry habitat type, which occurs in PVG 1 only rarely, supports ponderosa pine. Therefore, managing for a species composition that reflects the Forest-wide desired condition would likely not be appropriate since managing for a predominance of Douglas-fir would be more ecologically suitable for this habitat type. Therefore, the proper species "mix" for a project area should be determined by habitat types and other concerns, such as wildlife or wildland/urban interface.

Table A-5. Forest-wide range of desired conditions for the large tree size class for forested vegetation within each potential vegetation group (PVG), arranged by fire regime

Fire Regime	PVG	Large Tree Size Class	Canopy Cover Class	Species Composition[a]
Nonlethal	PVG 1	47–91%	Low: 63–83% Moderate: 17–37% High: 0%	Aspen: Trace Ponderosa pine: 96–99% Douglas-fir: 0–2%
	PVG 2	59–80%	Low: 61–81% Moderate: 19–39% High: 0%	Aspen: Trace Lodgepole pine: Trace Ponderosa pine: 81–87% Douglas-fir: 10–16%
Nonlethal-Mixed1	PVG 5	66–84%	Low: 25–45% Moderate: 55–75% High: 0%	Aspen: Trace Lodgepole pine: Trace Ponderosa pine: 80–88% Western larch : 0–1% Douglas-fir: 7–17% Engelmann spruce : Trace Grand fir: 0–1%
Mixed1-Mixed2[b]	PVG 3	23–41%	Low: 5–25% Moderate: 75–95% High: 0%	Aspen: 1–11% Lodgepole pine: Trace Ponderosa pine: 26–41% Douglas-fir: 47–69%
	PVG 4	20–34%	Low: 8–28% Moderate: 72–92% High: 0%	Aspen: 4–13% Lodgepole pine: 10–20% Ponderosa pine: Trace Douglas-fir: 66–81%
	PVG 6	28–56%	Low: 0–20% Moderate: 80–100% High: 0%	Aspen: Trace Lodgepole pine: 1–5% Ponderosa pine: 23–41% Western larch: 15–29% Douglas-fir: 15–25% Engelmann spruce: 0–2% Grand fir: 9–23% Subalpine fir: 0–3%
Mixed2	PVG 7	10–21%	Low: 0–14% Moderate: 86–100% High: 0%	Aspen: 6–11% Lodgepole: 28–42% Ponderosa pine: Trace Western larch: Trace Douglas-fir: 24–34% Engelmann spruce: 3–5% Grand fir: Trace Subalpine fir: 12–21%
	PVG 11	14–27%	Low: 25–45% Moderate: 55–75% High: 0%	Aspen: Trace Lodgepole pine: 18–25% Whitebark pine : 32–47% Engelmann spruce: 8–13% Subalpine fir: 18–29%
Mixed2-Lethal	PVG 10	Medium Tree Size Class[b] (See Table A-3)	Low: 0–21% Moderate: 71–91% High: 0–18%	Aspen: Trace Lodgepole pine: 82–94% Whitebark pine: Trace Douglas-fir: Trace Engelmann spruce: Trace Subalpine fir: Trace

Fire Regime	PVG	Large Tree Size Class	Canopy Cover Class	Species Composition[a]
Lethal	PVG 8	18–21%	Low: 0%	Aspen: Trace Lodgepole pine: 25–34% Western larch: 9–16% Douglas-fir: 23–37% Engelmann spruce: 10–17% Subalpine fir: 11–17%
			Moderate: 51–71%	
			High: 29–49%	
	PVG 9	31–37%	Low: 0%	Aspen: Trace Lodgepole pine: 29–37% Western larch: Trace Douglas-fir: Trace Engelmann spruce: 28–33% Subalpine fir: 29–33%
			Moderate: 51–71%	
			High: 29–49%	

[a] Use this table as a reference. For project purposes, describe the desired species composition based on species composition of the habitat types present within the analysis area. Refer to the appropriate habitat type guide for the analysis area when determining the correct species mix, including those species that may occur as accidentals.
[b] Large tree size class was not modeled as part of the HRV.

While Table A-5 displays the Forest-wide desired species composition for the large tree size class, this same species composition can be used to help guide projects conducted in intermediate tree size classes. Individual species described as “trace” were not explicitly modeled when developing the HRV because they occur in habitat types that represent a minor part of the PVGs within the southern part of the Idaho Batholith and/or because little is known about their historical occurrence within a PVG. Aspen, which occurs in minor amounts in many PVGs, is an example. Because aspen is a minor component, it has not been extensively studied to fully understand its role. However, these “trace” species should be retained where they are found within the landscape, particularly species in decline, including aspen, whitebark pine, and western larch.

The appropriate species composition for a project area may vary from Table A-5 based on the mix of habitat types present, particularly for PVGs such as PVG 6, which includes several habitat types representing a broad environmental range. For project application in most PVGs, it is necessary to determine the mix of habitat types that comprise the PVGs within the project area. Since most project areas will generally contain fewer habitat types than are represented by the PVGs, the desired species composition should reflect that more limited set. Therefore, the project area desired species composition may deviate from the desired Forest-wide composition but should, where appropriate, result in landscapes dominated by early-seral species. These species are better adapted to site conditions and are usually more resilient to disturbances such as fire. For example, the desired species composition for sites dominated by warmer, drier habitat types in PVG 6, which supports ponderosa pine, would be different from sites dominated by cooler, more frost-prone habitat types that support lodgepole pine.

The ranges in Tables A-4 and A-5 were developed from HRV estimates adopted from Morgan and Parsons (2001). The high end of the range for the large tree size class is equal to the mean HRV value; the low end of the range equals the low end of the HRV. Although current conditions may prevent us from obtaining desired conditions for quite some time, management actions over a longer period (perhaps more than 100 years) should result in forested vegetation approaching Forest-wide desired conditions in Tables A-4 and A-5. For the large tree size class, Table A-5 shows the set of components that together achieve the desired conditions.

Shrub and Herb Communities within the Forested Potential Vegetation Groups

Like with the tree component, the shrub and herb communities historically occurred within some range of variability depending on disturbance processes and succession (Steele and Geier-Hayes 1987). The shrub and herb communities that occur across the landscape reflect environmental conditions such as elevation, aspect, topography, and soils and other factors, including management activities. The desired conditions for these communities are to have healthy, resilient, and resistant native shrub and herb species.

Snags and Coarse Woody Debris

Snags and coarse woody debris are created by disturbances and vary depending on vegetation type and stage of succession (Hutto 2006). In older forests, snags and coarse woody debris are generally products of disease, insects, lightning, low-intensity fire, and senescence (Spies et al. 1988). In postdisturbance forests, most snags and coarse woody debris are products of the disturbance that created the early-seral condition (Drapeau et al. 2002). Therefore, snags and coarse woody debris in older forests often exhibit more advanced stages of decay than postdisturbance forests, though some components of predisturbance snags and coarse woody debris may still be present (Nappi et al. 2003). In all forests, snags and coarse woody debris serve important ecological functions.

Much of the research regarding snags in older forests has focused on using them as nesting habitats, particularly for primary cavity nesters (Hutto 2006). Recent research has shown that while snags in postdisturbance forests provide nesting habitat, they are also an important resource for foraging (Nappi et al. 2003), particularly for species such as the black-backed and three-toed woodpeckers which forage on insects that infest recently burned trees. Although these trees only provide suitable foraging habitat for a short time, they are an invaluable resource for these woodpecker species.

Tables A-6 and A-7 display the snag and coarse woody debris desired conditions for green stands in PVGs. Snags and coarse woody debris are finer-scale elements than the coarse-scale vegetative components of species composition, size class, and canopy cover. Snags and coarse woody debris occur as more discrete components within stands, whereas the species composition, tree size class, and canopy cover class occur across stands. Therefore, snags and coarse woody debris are evaluated during project planning for an activity area (refer to the Glossary), which better reflects the appropriate scale to consider these elements. The activity area for snags and coarse woody debris is the specific site affected, whether the effects are positive or negative. Actions that need to be assessed include timber harvest, reforestation, timber stand improvement, and prescribed fire activities.

Table A-6. Desired range of snags per acre in green stands for potential vegetation groups

Diameter Group	Nonlethal		Nonlethal–Mixed1	Mixed1–Mixed2			Mixed2		Mixed2–Lethal	Lethal	
	PVG 1[a]	PVG 2[b]	PVG 5[b]	PVG 3[b]	PVG 4[b]	PVG 6[b]	PVG 7[b]	PVG 11[a]	PVG 10[a]	PVG 8[b]	PVG 9[b]
10–19.9 inches	0.4–0.5	1.8–2.7	1.8–5.5	1.8–4.1	1.8–2.7	1.8–5.5	1.8–5.5	1.4–2.2	1.8–7.7	1.8–7.5	1.8–7.5
≥20 inches	0.4–2.3	0.4–3.0	0.4–3.5	0.2–2.8	0.2–2.1	0.2–3.5	0.2–3.5	0.0–4.4	NA	0.2–3.0	0.2–3.0
Total	0.8–2.8	2.2–5.7	2.2–9.0	2.0–6.9	2.0–4.8	2.0–9.0	2.0–9.0	1.4–6.6	1.8–7.7	2.0–10.5	2.0–10.5

Note: This table is not meant to provide an even distribution of snags across every acre of the forested landscape, but to provide numbers that serve as a guide to approximate an average condition for an activity area.

[a] Minimum height = 15 feet. Snags at or greater than the minimum height contribute to the desired conditions. However, snags less than the minimum height contribute to ecological functions and should be retained.

[b] Minimum height = 30 feet.

Table A-7. Desired range of coarse woody debris in green stands, in tons per acre, and desired amounts in large classes for potential vegetation groups

Indicator	Nonlethal		Nonlethal–Mixed1	Mixed1-Mixed2			Mixed2		Mixed2–Lethal	Lethal	
	PVG 1	PVG 2	PVG 5	PVG 3	PVG 4	PVG 6	PVG 7	PVG 11	PVG 10	PVG 8	PVG 9
Dry Weight (Tons/acre) in Decay Classes I and II	3–10	4–14	4–14	4–14	4–14	4–14	5–19	4–14	5–19	5–19	5–19
Distribution ≥15 inches	>75%	>75%	>75%	>65%	>65%	>65%	>50%	>25%	>25%	>25%	>25%

Note: The recommended distribution is to try to provide coarse wood in the largest size classes, preferably over 15 inches (12 inches for PVG 10), that provide the most benefit for wildlife and soil productivity. This table is not meant to provide an even distribution of coarse wood across every acre of the forested landscape, but to provide numbers that serve as a guide to approximate an average condition for an activity area.

Because the desired conditions in Tables A-6 and A-7 are for green stands, in many cases they may not be appropriate for postdisturbance forests. While a portion of the snags and coarse woody debris in stands may be a legacy of postdisturbance communities, the kind of material created immediately postdisturbance and the role it plays is different than dead wood dynamics in green stands. Drapeau et al. (2002) found that snags in postdisturbance stands were generally less decayed than those in green stands. Postdisturbance communities are important habitats for primary cavity nesters, while green stands have a greater proportion of secondary cavity nesters.

Using historical fire regimes, Agee (2002) presents several diagrams that depict the spatial and temporal variability found in snag and coarse woody debris numbers. According to Agee, the landscape ecology of historical fire regimes is a function of place. Low-intensity fire regimes had small patches and little edge, while high-intensity regimes had the largest patch sizes and moderate amounts of edge (Figure A-1). Moderate- or mixed-intensity fire regimes had intermediate patch sizes and maximum amounts of edge.

Spatial distribution of snags and coarse woody debris is important. However, the desired conditions described in Tables A-6 and A-7 are not meant to provide an even distribution of snags or coarse woody debris across every acre of the forested landscape. The numbers serve as a guide to approximate an average condition for an activity area. It would be undesirable for all the dead material in an activity area to be clumped into one corner or one type of area, leaving little or no material in the remainder of the area. Though snags are generally found in clumps within patches, snag patches should be distributed across the activity area rather than clustered in a portion of the activity area; the activity area should have snag patches throughout, depending on what is appropriate for the PVG. In addition, snags eventually become coarse woody debris. Because coarse woody debris is also created from green trees it is often more uniformly distributed across the landscape than snags.

Agee (2002) also discusses how woody debris dynamics have historically varied by fire regime (Figure A-2). Frequent, low-intensity fires limited the amount of coarse woody debris. Figure A-2 displays fluctuations in course woody debris found in low-intensity fire regimes; the peaks may be as high as 13–16 tons/acre, the lows could be <0.5 tons/acre, and the average is around 5 tons/acre (Graham, personal communication 2001). Although fires were frequent, they rarely affected every acre. In moderate-intensity fire regimes, fires consumed and created coarse woody debris several times per century (Agee 2002). In high-intensity fire regimes, a "boom-and-bust" dynamic operated: substantial coarse woody debris was created postdisturbance, followed by a century or more without further substantial input. Therefore, it is important to understand the dynamics of the project area’s particular PVG to best determine desired levels.

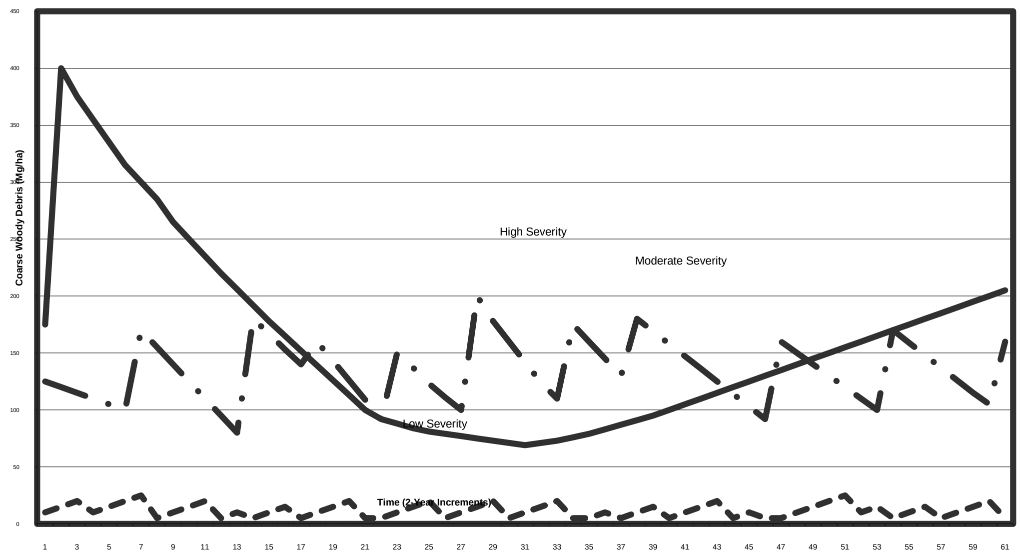

Figure A-2. Temporal cycling of coarse woody debris by fire regime (Agee 2002)

Large-diameter snags and coarse woody debris may not be available in seedling, sapling, and small tree size stands depending on the amount of material present from postdisturbance early-seral stands. In this case, some of the tonnage and snag numbers can be in smaller size classes. It is not expected that the total amounts, particularly for coarse woody debris, will be made up in smaller size classes, but there should be opportunities to progress toward the desired ranges. In particular, the amount of material retained with diameters <6 inches should be balanced against the fire hazard it—and the finer material that often comes with it—may create. Several factors determine the potential fire hazard created by surface fuels, including the kind, depth, continuity, and extent of surface fuels; connectivity to standing trees; and proximity to adjacent fuels. The risk of creating a potentially hazardous condition should also be considered relative to the area's management objectives.

Our primary objective is to provide the majority of coarse woody debris in larger size classes as this material is retained on-site longer. Although some small and intermediate stage stands may not have the larger material available, the expectation is not to compensate with an abundance of material in the small and medium size classes. If only smaller material is available, some should be left to assist with long-term soil productivity. Coarse woody debris with diameters ≥15 inches (≥12 inches for PVG 10) and lengths ≥6 feet are referred to as logs. These large pieces provide important material for meeting wildlife needs.

Single management treatments may not produce all the dead material in the amounts and/or decay classes desired. However, treatments should be designed to provide structural, compositional, and functional elements that contribute to long-term sustainability of snags and coarse woody debris. In many cases, actions will consume coarse wood (e.g., prescribed fire). However, if the action results in mortality that produces snags or coarse woody debris, it will contribute to desired levels of large snags and coarse woody debris over time. Furthermore, a range of dead wood sizes and age classes should be retained. Snag height minimums described in Table A-6 are just that—minimums—and do not preclude functions provided by smaller snags (Figure A-3). Large trees and snags provide nesting or denning sites longer than small snags do (Graham 1981; Morrison and Raphael 1993). However, smaller snags provide foraging sites, which are needed in greater abundance than nesting sites (Bunnell et al. 2002).

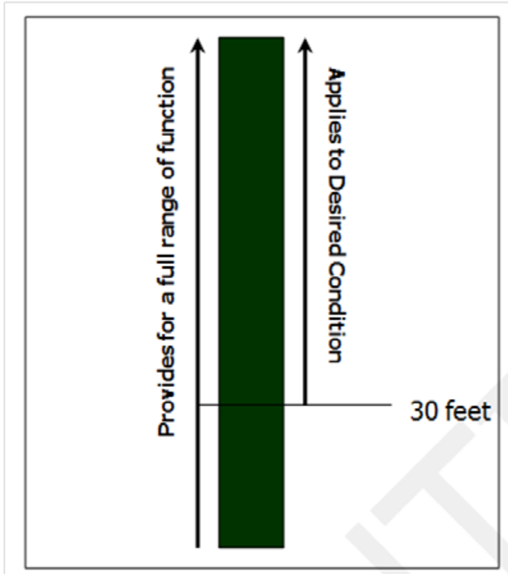

Figure A-3. Range of snag function relative to minimum height described in the desired condition (example for potential vegetation groups with 30-foot minimum height)

Historical fire regimes, particularly the nonlethal and mixed1 regimes, continually recycle material. Larger material may take several fire cycles before it is fully consumed. This constant recycling also helps provide decay class variety, another important component of achieving desired conditions. Therefore, management actions should result in a variety of snag and coarse wood decay classes. Some wildlife species prefer hard snags, while others prefer those with more decay. For soil productivity, inputs from these different decay classes need to occur at various temporal increments to ensure productivity gaps do not result over time. To provide for continual recruitment into decay class III, only decay classes I and II count towards the desired amounts; the goal is to provide snags and coarse woody debris in decay class III. In addition to decay, characteristics that affect the type and extent of wildlife use of coarse woody debris include physical orientation (vertical or horizontal), size (diameter and length), wood species, and overall material abundance (Harmon et al. 1986; Bunnell et al. 2002).

The increasing number of studies on tree mortality and decomposition are providing a global view of how these processes vary by forest type and climate. These data also provide the basis for a dynamic rather than a static approach to the management of woody material (Harmon 2002). However, to be successful, this perspective must be coupled with a detailed understanding of how certain species and ecosystem processes vary with snag and coarse woody debris amount and quality. The application of a static-state approach, as illustrated by the desired conditions, is based on a set of general objectives designed to provide snags and coarse woody debris across the Forest. However, applying a static-state approach does not account for the dynamic nature of ecosystem processes and the specific objective-oriented needs of species and their functions (Harmon 2002). Evidence suggests a variety of snags and coarse woody debris, with a variety of decay and size characteristics, may be needed to provide for all functional wildlife groups and may be necessary for continuous soil productivity. Therefore, project analysis should consider that greater range of function and process that cannot be captured by the desired conditions.

Legacy Trees

Perry and Amaranthus (1997) defined forest legacies as "anything handed down from a pre-disturbance ecosystem." These legacies can occur at different scales ranging from the landscape to the stand to individual components within a stand (Huckaby et al. 2003; Van Pelt 2008). For example, within a lethal fire area, unburned or underburned patches as well as individual trees are legacies. Legacies are not an artifact of current land-use activities—they also occurred in the historical landscape (Huckaby et al. 2003). Old live and dead ponderosa pine and western larch trees are an important legacy of the historical condition in many areas (see the Snags and Coarse Woody Debris section for a discussion on dead trees). They are generally resistant to nonlethal/mixed1 fire, provide food and habitat for wildlife, and genetic material reflective of the local site conditions (Huckaby et al. 2003), particularly when present in plantations. However, legacies may now be less common in number and/or distribution due to changes in disturbance regimes (Van Pelt 2008). Since legacies, in particular certain underrepresented old tree legacies, are deficient within many landscapes, retaining old trees, as well as trees that are transitioning into old, provides the greatest opportunity for creating and/or replacing these important components.

Vegetative Hazard and Wildfire within Forested Potential Vegetation Groups

Vegetative desired conditions are directly related to fire hazard: both define conditions that can occur on the landscape. Fire hazard describes potential fire behavior based on characteristics such as the horizontal and vertical arrangement of fuels, fuel continuity, and flammability. High fire hazard implies conditions where fires have a high likelihood of being lethal or difficult to suppress even without contributing factors such as drought or wind. In nonlethal and mixed1 fire regimes, near historical conditions are expected to reduce the risk of lethal wildfires due to the emphasis on larger trees, more fire resistant seral species, and discontinuous ladder and surface fuels. Ignitions within these conditions are more likely to stay on the ground, increasing the chances of keeping a wildfire small (Wagle and Eakle 1979; Omi and Martinson 2002). This scenario is not the case, however, in mixed2 and lethal fire regimes, which have a greater component of more flammable later-seral species and more continuous ladder and surface fuels. By definition, lethal fires are consistent with the way historically mixed2 and lethal fire regimes operate.

Wildfires, whether historically characteristic or uncharacteristic, are undesirable in some cases, particularly in wildland/urban interface areas. Although wildfire risks can partially be addressed by using defensible space, in many situations larger landscapes are a more appropriate scale to deal with concerns about firefighter and public safety and the multitude of infrastructures, resources, and values often associated with interface areas. Therefore, the juxtaposition and arrangement of vegetative conditions relative to wildland/urban interfaces need to be considered at a scale greater than the project area. It is important to consider the vegetative conditions adjacent to the wildland/urban interface because the desired vegetative conditions for some areas may contribute to a risk of stand-replacing wildland fire. In particular, the desired conditions for forested vegetation in mixed2 and lethal fire regimes are generally more hazardous than those found in nonlethal and mixed1 fire regimes. Since desired conditions are intended to create vegetative communities that reflect historical conditions, the resulting disturbances would also reflect historical disturbances. Therefore, by definition, desired conditions for PVGs in mixed2 and lethal fire regimes would produce more stand-replacing wildland fire.

Although desired conditions in certain PVGs increase the hazards associated with stand-replacing wildland fire, the risk of these events may be reduced using a variety of vegetation management techniques. These techniques can include strategically placing fuel breaks, surrounding vulnerable areas with vegetative conditions where fires can be more easily suppressed, or arranging treatments to break up continuous hazardous conditions (Deeming 1990; Graham et al. 1999; Finney 2001; Fulé et al. 2001; Omi and Martinson 2002). In some cases these types of strategic treatments can be effective without being extensive.

Although vegetative management techniques can reduce lethal wildland fire risk, they address only one of several factors (vegetative conditions). Vegetative manipulation alone cannot eliminate all the risks associated with wildland fire (Figure A-4). The efforts made by property owners on their own behalf are essential in protecting homes in the wildland/urban interface.

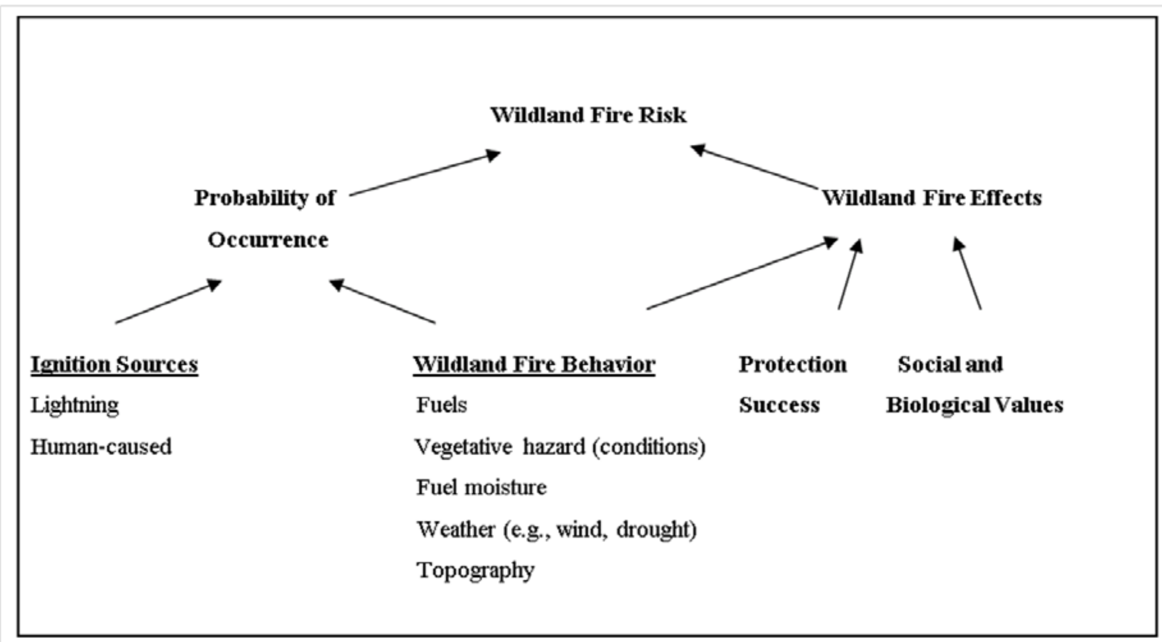

Figure A-4. Factors that contribute to wildland fire risk (adopted from Bachman and Allgöwer 1999)

Vegetation and Wildlife Restoration Strategy

A *Vegetation and Wildlife Restoration Strategy* was developed for forested vegetation to identify Forest-wide priorities for restoring the large tree size class. Watersheds were assigned to active and passive restoration categories and prioritized as high, medium, or low. Active watersheds are those with the most historically nonlethal and mixed1 fire regimes and high priority are those with the greatest number of acres in medium and large tree size class within these fire regimes. These watersheds were selected as high priority because they likely contain larger patches of conditions that can be restored faster toward desired conditions than areas that have fewer medium and large tree size class acres and likely smaller patches. Active restoration is generally where management activities such as thinning, planting, control of nonnative plants, and prescribed fire may be needed to create conditions that are more resilient and resistant to disturbance. In many cases within historically nonlethal and mixed1 fire regime areas, conditions are such that current disturbances often create structures, functions, and processes that are out of sync with historical conditions and therefore can have undesirable ecosystem consequences.

Passive restoration watersheds are those where current disturbances are likely to operate most similar to historical disturbances. In these areas, allowing disturbance processes creates desirable ecosystem results. High-priority watersheds are those that have been undisturbed for a long time and would benefit from disturbances that begin to diversify spatial patch, pattern, and structure. Low-priority watersheds are those that have experienced recent large-scale disturbance, such as wildfire, and need time to allow early-seral conditions to progress into other tree size classes.

Other Forested Vegetation Types

In addition to developing desired conditions for the 11 PVGs, one additional forest type, climax aspen, is found on the southern portion of the Boise National Forest. As is the case for the 11 PVGs, forested vegetation for this forest type refers to land that contains at least 10 percent crown cover by trees of any size or land that formerly had tree cover and is currently at an earlier seral stage. Table A-8 displays the desired condition ranges for climax aspen. Refer to the Vegetation Classification section below for a description of climax versus seral aspen, as these desired conditions do not apply to seral aspen.

Desired condition ranges for climax aspen are presented somewhat differently than ranges for other forest types. Rather than a range of desired values for specific components, the climax aspen desired condition is represented as ranges of acres found in the various aspen size classes. To reach the desired ranges, conditions would have to be within these ranges. Although current conditions may prevent us from obtaining the desired conditions for quite some time, over a longer period (perhaps more than 100 years), management actions should result in vegetation approaching Forest-wide desired conditions.

Table A-8. Desired condition ranges for climax aspen

Aspen Size Classes	Desired Amounts of Size Classes by Percent of Area
GFSS, <10% canopy cover or areas where tree height is <4.5 feet.	40–60% in this class
Saplings (0.1–4.9 inch d.b.h.), all canopy covers	20–35% in these two classes combined
Small (5.0–11.9 inch d.b.h.), all canopy covers	
Medium (≥12 inch d.b.h.), all canopy covers	20–25% in this class

Shrublands

Shrublands occur on areas not classified as forestland and where shrub cover has the potential to be >10 percent. Desired conditions have been developed for some shrubland communities that occur on the Forest. The shrubland groups reflect the LANDFIRE Environmental Site Potentials (ESPs) (refer to the Vegetation Classification section for descriptions of shrubland types). Like the forested vegetation, these groupings reflect similar environmental characteristics, site productivity, and disturbance regimes. Table A-9 displays the fire regimes for the shrubland communities.

Table A-9. Shrubland environmental site potential groups by fire regime

Fire Regime	Shrubland Environmental Site Potential Group
Mixed1	Low Sagebrush
Mixed1-Mixed2	Mountain and Wyoming Big Sagebrush
	Montane Shrub

Similar to forested vegetation, desired conditions for shrublands are expressed as ranges of acres found in the various conditions. To reach the desired ranges, conditions would have to be within these ranges. Although current conditions may prevent us from obtaining desired conditions for quite some time, over a longer period (perhaps more than 50 years), management actions should result in shrubland vegetation approaching Forest-wide desired conditions.

Canopy Cover Class

Shrubland desired conditions are represented by shrub canopy cover based on the following classes:

- Grass/Forb = <10 percent canopy cover
- Low = 10–25 percent canopy cover
- Moderate = 26–35 percent canopy cover
- High = 36 percent or more canopy cover

Canopy cover class may be determined through aerial photo visual estimates or while conducting on-site assessments. As expressed here, canopy cover represents the total nonoverlapping shrub cover.

Table A-10 presents the desired condition ranges for the Low Sagebrush ESP Groups, and Table A-11 represents the desired condition ranges for the Mountain Big Sagebrush ESP Groups. Although LANDFIRE ESPs were grouped together for Mountain and Wyoming Big Sagebrush for coarse-filter analysis, apply the desired conditions displayed in Table A-12 for projects in areas with Wyoming Big Sagebrush. Table A-13 contains the desired condition ranges for the Montane Shrub ESP Groups.

Table A-10. Desired condition ranges for Low Sagebrush Environmental Site Potential Groups

Canopy Cover Class	Area (%)
Grass/Forb	0–20
Low	80–100
Moderate	0
High	0

Table A-11. Desired condition ranges for Mountain Big Sagebrush[a] Environmental Site Potential Groups

Canopy Cover Class	Area (%)
Grass/Forb	13–33
Low	27–47
Moderate	12–32
High	8–28

[a] Includes Basin Big Sagebrush communities

Table A-12. Desired condition ranges for Wyoming Big Sagebrush[a.]

Canopy Cover Class	Area (%)
Grass/Forb	25–30
Low	20–35
Moderate	13–33
High	12–32

[a] Unlike the other vegetation groups, desired conditions for Wyoming Big Sagebrush are not within the HRV. Because these sites are extremely vulnerable to nonnative species invasion following disturbance, the intent is to limit disturbance in areas currently occupied by Wyoming Big Sagebrush. Lack of disturbance will increase the amount of area in higher canopy covers compared to historical conditions but will reduce the risk of increasing occupancy by invasive species.

Table A-13. Desired condition ranges for Montane Shrub Environmental Site Potential Groups

Canopy Cover Class	Area (%)
Grass/Forb	0
Low	5–25
Moderate	5–25
High	60–80

Similar to the forested vegetation types, in some cases it may take many years to develop the desired conditions. If an area has recently experienced a large wildfire, the necessary structural complexity can take many years to develop at a landscape level. Conversely, an area with little disturbance over many years may have dense canopy cover. Management actions that reduce the canopy covers would be an example of "trending toward" desired conditions, even if only applied on a small scale. When at desired conditions, maintenance activities would keep the balance of canopy cover classes within the range of desired conditions; as some acres become denser through succession, other acres may be treated to limit overall canopy cover density. For example, if the Mountain Big Sagebrush ESP Groups are currently at desired conditions but with acres of high canopy cover approaching the high end of the range, it may be necessary to move some of these acres into another canopy cover class to prevent conditions from exceeding desired ranges and creating insufficient amounts of other canopy cover classes. Natural disturbances will also play a role in the movement of acres in and out of canopy cover classes.

Herb Communities within the Shrubland Environmental Site Potentials Groups

Like with the tree and shrub component, the grass and forb communities that developed within shrubland ecosystems occurred within some HRV depending on disturbance processes and succession. These herb communities also reflect environmental conditions such as elevation, aspect, topography, and soils and other factors, including management activities that affect sites. Due to the high variability of these communities across the Forest, desired conditions should be determined at the site-specific scale. The desired conditions should focus on producing healthy, resilient, and resistant grass and forb communities dominated by native species.

Riparian Vegetation

For riparian vegetation made up of coniferous PVGs, refer to Tables A-3 and A-4 for the desired conditions. The desired conditions in Tables A-3 and A-4 include the upland portions of coniferous vegetation found in the RCAs. Additional information for RCAs is found in Appendix B, Table B–1.

Riparian vegetation is dominated by a variety of species, age classes, and structures—including deciduous trees, willows, alders, sedges, and hydric grasses—depending on stream substrate, gradient, elevation, soil hydrology, and disturbance processes. Riparian areas have their own disturbance processes that influence vegetative dynamics causing an almost continual readjustment in successional stages in many areas. Riparian vegetation is also influenced by upland and upstream processes. Site conditions are highly variable due to these factors, which will influence riparian vegetation desired conditions in any site-specific location. Therefore, site-specific desired condition determinations are needed, when and where appropriate.

Grasslands

Grasslands occur in areas where forest or shrubland canopy cover does not have the potential to exceed 10 percent. Grassland communities on the Forest are comprised of perennial grass species. The grassland groups reflect the LANDFIRE ESPs (refer to Vegetation Classification section at the end of this appendix for descriptions of grassland types). Like the forested and shrubland vegetation, these groupings reflect similar environmental characteristics, site productivity, and disturbance regimes. Two grassland communities are described for the Forest: Perennial Grass Slopes and Perennial Grass Montane. The fire regimes for these communities are mixed1 to mixed2 for the Perennial Grass Slopes and nonlethal to mixed1 for the Perennial Grass Montane. Desired conditions in these grasslands support native species and aim to reduce threats from nonnative species, particularly invasive annual grasses.

Wetlands/Marshes, Alpine, and Other Vegetation Types

Other vegetation types not described above exist on the Forest. Desired conditions need to be determined, as appropriate, on a project basis, using available local information. Other Forest-wide and Management Area direction may apply to these types, such as limiting potential establishment and spread of noxious weeds. Some of these communities may also be important habitats for rare plants.

VEGETATION MAPPING

Forested Vegetation Mapping

Forested vegetation is evaluated using habitat types, which use potential climax vegetation as an indicator of environmental conditions. Habitat types provide a way to describe the mix of vegetative communities that may occur within landscapes based on site potential. For example, subalpine fir habitat types—which generally occur on cooler sites—would support a different mix of vegetative communities than ponderosa pine habitat types, which are found on warmer sites. Existing vegetation is described using cover types, which represent the vegetation on the landscape. Cover types are often an earlier seral stage relative to the climax plant community. Cover types, and associated attributes of tree size class and canopy cover class, were mapped using a Landsat remote sensing classification developed at the University of Montana by Redmond et al. (1998). This information was updated in 2008 to reflect changes from wildland fires and other disturbances.

Forested PVGs were mapped using a modeling process. The Forest was divided into 5th field HU groupings that shared similar larger-scale environmental characteristics, such as climate and geology. Each of these groupings was modeled separately. Models were based primarily on slope, aspect, elevation, and land type associations but could also include forest inventory information, forest timber strata information, cover type information, existing habitat type mapping, and cold air drainage models. Where necessary, some field verification did occur. Modeling rules were developed and processed in ArcGrid. Draft maps were sent to ranger district personnel knowledgeable of the area for review, and refinements were made as necessary.

Non-forested Vegetation Mapping

Shrubland and grassland areas were identified using LANDFIRE ESPs, which are based on NatureServe's Ecological Systems Classification (Comer et al. 2003). ESPs represent the natural plant communities that would become established at late or climax stages of successional development in the absence of disturbance. They reflect the current climate and physical environment as well as the competitive potential of native plant species. The LANDFIRE ESP concept is similar to that used in potential vegetation classifications, including habitat types (Daubenmire 1968; Pfister et al. 1977). Therefore, the ESP groups described for the shrubland and grassland communities are conceptually similar to the PVGs used to describe the forested vegetation. The LANDFIRE ESP layer was generated using a predictive modeling approach that relates spatially explicit layers representing biophysical gradients and topography to field training sites assigned to ESP map units. Existing vegetation was described in LANDFIRE using Existing Vegetation Types (EVTs).

Vegetation Classification

Forest Vegetation—Potential Vegetation Groups

PVG 1—Dry Ponderosa Pine/Xeric Douglas-fir

This group represents the warm, dry extreme of the forested zone and typically occurs at lower timberline down to 3,000 feet and up to 6,500 feet on steep, dry, south-facing slopes. Ponderosa pine is a dominant cover type that historically persisted due to frequent nonlethal fire. Under such conditions, open, park-like stands of large, old ponderosa pine dominated the area, with occasional Douglas-fir, particularly at higher elevations. Understories are sparse and consist of low- to moderate-density perennial grasses, such as bluebunch wheatgrass and Idaho fescue. Shrubs—such as mountain snowberry and bitterbrush--dominate in some areas. This group is scattered throughout the Forest.

PVG 2—Warm, Dry Douglas-fir/Moist Ponderosa Pine

This group represents warm, mild environments at low to middle elevations but may extend upward to 6,500 feet on dry, south-facing slopes. Ponderosa pine, particularly at lower elevations, or large ponderosa pine mixed with smaller size classes of Douglas-fir are the dominant cover types in this group. Historically, frequent nonlethal fire maintained stands of large, park-like ponderosa pine. Douglas-fir occurred on moister aspects, particularly at higher elevations. Understories are mostly graminoids—such as pinegrass and elk sedge—with a cover of shrubs, such as common snowberry, white spirea, and mallow ninebark . This group is found in many places on the Forest.

PVG 3—Cool, Moist Douglas-fir

This group represents the cooler extremes in the Douglas-fir zone and can extend from 6,800 to 4,800 feet following cold air. This group has a relatively minor representation on the Boise National Forest. Ponderosa pine occurs as a major seral species in the warmest extremes of the group. In cold air areas, particularly where cold air accumulates to form frost pockets, lodgepole pine may dominate. In some areas, Douglas-fir is the only species capable of occupying the site.

Other areas may support grand fir, and adjacent sites are often subalpine fir. The conifer cover types that historically dominated resulted from several factors, including fire frequency and intensity, elevation, and topography. Understories in this group are primarily shrub species, including mountain maple, mountain ash, and blue huckleberry . Several other species—including Scouler's willow, thimbleberry, and chokecherry—may occur from disturbance, depending on its intensity. Historical fire regimes were mixed (generally mixed1 where ponderosa pine occurs and mixed2 where other species dominate), creating a diversity of vegetative combinations. Two habitat type phases occur within this PVG: 1) Douglas-fir/mountain maple on the Forest and west side of the Sawtooth National Forest and 2) Douglas-fir/mountain maple–mountain snowberry adjacent to the Forest and on the east side of the Sawtooth National Forest.

PVG 4—Cool, Dry Douglas-fir

Douglas-fir is the only species that occurs throughout this group's entire range. Lodgepole pine may be found in areas with cold air, and quaking aspen is also a common early-seral species. Understories are sparse due to the cool, dry environment and often support pinegrass and elk sedge. Understories of low shrubs—such as white spirea, common snowberry, Oregon grape, and mallow ninebark—occur in some areas that represent slightly different environments across the group. The historical fire regime ranged from mixed1 to mixed2 depending on the fuels present at the time of ignition. Organic matter accumulates slowly in this group, so fire effects depend on the interval between fires, stand density and mortality, and other factors. Fire regimes tend to be mixed1 in drier habitat types with discontinuous fuels and mixed2 in habitat types that support lodgepole pine as a major seral species. This group is most common on eastern portions of the Forest, though it may be found in minor amounts at higher elevations in the Douglas-fir zone in other parts of the Forest. In these cases, it is usually found above 6,000 feet on sites too cool to support ponderosa pine. Where it is common, this group occurs at lower elevations in areas beyond the extent of ponderosa pine.

PVG 5—Dry Grand Fir

This group is found throughout the distribution of grand fir; only on the Boise and Payette National Forests; and at elevations ranging from 4,300 to 6,400 feet, often on drier, upper slopes and ridges. Ponderosa pine and Douglas-fir are common cover types that appear to have been maintained by fire regimes that were historically nonlethal to mixed1 in micro-sites. In many areas, this group may have resembled PVG 1 and PVG 2, with open, park-like stands of large ponderosa pine. Mixed species stands were likely restricted to small micro-sites that burned less frequently. Understories are similar to PVG 2; pinegrass, elk sedge, and white spirea are common.

PVG 6—Moist Grand Fir

This group is found at elevations ranging from 3,400 to 6,500 feet and represents moister environments in the grand fir zone. It is found on the northern portion of the Forest and often occurs adjacent to dry grand fir. The two species may intermix depending on topography. Ponderosa pine is common at the drier extremes of the group, and lodgepole pine occurs in colder areas. Western larch may also be present as an early seral species. Douglas-fir and Engelmann spruce cover types also occur in this group. Understories are shrubby and include blue huckleberry, mountain maple, mountain ash, mallow ninebark, and occasionally pachistima. A conspicuous herb layer is also common in understories, particularly following disturbance. Historical fire regimes were mixed, ranging from mixed1 to mixed2, in part due to the wide environment represented by this group. Where ponderosa pine was maintained as a common seral species, it appears fires were more often mixed1 because ponderosa pine produces a heavy seed that generally disperses only short distances. Ponderosa pine is found in both phases of the grand fir/mountain maple habitat type and the grand fir/twinflower habitat type, twinflower phase. In other areas where western larch, Douglas-fir, or lodgepole pine were maintained as common seral species, mixed2 fire may have been more common. Mixed2 areas include the grand fir/blue huckleberry habitat type; grand fir/twinflower habitat type, beargrass phase; grand fir/queencup beadlily habitat type; grand fir/beargrass habitat type; grand fir/dwarf huckleberry habitat type; and grand fir/western goldthread habitat type. This difference within the PVG reflects a split described by Crane and Fischer (1986) of the grand fir habitat types in the Grand Fir Habitat Types Fire Group into warm, dry, cool, and moist subgroups.

PVG 7—Warm, Dry Subalpine Fir

This group is common and found in warmer, drier environments in the subalpine fir zone at elevations from 4,800 to 7,500 feet. At lower elevations on the Forest, this group is found on steep, north-to-east aspects but shifts to south-to-west aspects as elevation increases. On the eastern part of the Forest, the group is found on more rolling topography. Adjacent sites at lower elevations are Douglas-fir or grand fir, and these commonly intermix with subalpine fir where topography controls cold air flow. Douglas-fir is the most common cover type throughout the group. Ponderosa pine may be found at the warmest extremes, particularly where this group grades into the Douglas-fir or grand fir zone. Lodgepole pine or Engelmann spruce may occur at cool, moist extremes, but these cover types rarely dominate. Understories are commonly shrubby and include mountain maple, mountain ash, serviceberry, and Scouler's willow. On the eastern portion of the Forest, graminoids comprise the majority of the cover under the tree layer. Historical fire regimes were generally mixed2, though mixed1 fires may have occurred where ponderosa pine was maintained.

PVG 8—Warm, Moist Subalpine Fir

This group occurs mainly north of Cascade, Idaho, and is as a relatively minor PVG on the Forest. It becomes better represented on the Nez Perce National Forest. Elevations generally range from 5,000 to 7,200 feet but may follow cooler air down to 4,500 feet. This group occurs on moist, protected areas such as stream terraces; toe slopes; and steep, northerly aspects. Cover types include lodgepole pine, western larch, Douglas-fir, and Engelmann spruce but the presence and combination of these species depend on site conditions and past disturbances. Dense shrubs are common under the tree cover and include Sitka alder, menziesia, blue huckleberry, Utah honeysuckle, mountain maple, mountain ash, and serviceberry. Historical fire in this group was more commonly lethal, though underburns may have occurred on rare occasions. Ignitions likely occurred in adjacent areas due to the location of this group. Whether these areas burned or not may have depended on the weather prior to and at the time of ignition.

PVG 9—Hydric Subalpine Fir

Seasonally high water tables control this group, which is a minor component on the Forest, and the extent may be small in some areas depending on the presence of these conditions. This group is found at elevations ranging from 9,000 to as low as 4,500 feet in frost pockets and along cold air drainages. This group most commonly occurs on wet toe slopes, stream terraces, seep areas, and old bogs. The cover type is mostly lodgepole pine, followed by Engelmann spruce and subalpine fir. Early-seral conditions usually support lodgepole pine because this species tolerates intermittent high water tables and cold air that often accumulate in these areas. In severe frost-prone areas, lodgepole pine can persist for long periods. In other areas with better cold air drainage, Engelmann spruce and subalpine fir rapidly establish under lodgepole pine. Understories are primarily dominated by herbs and grasses that require the seasonal influence of a high water table. Shrubs are sparse, though Labrador tea can dominate some sites. Historically, fire was lethal in this group. Like PVG 8, ignitions more likely occurred on adjacent, drier slopes, and burning in this group likely depended on weather conditions before and at the time of ignition.

PVG 10—Persistent Lodgepole Pine

This group is common throughout the subalpine fir zone. It represents cold, dry subalpine fir sites that range in elevation from over 9,200 feet down to 5,200 feet in frost pockets. Lodgepole pine is the dominant cover type, though small amounts of other species may occasionally occur. Vegetation under the tree cover can be sparse. Generally, grasses and scattered forbs are the most common components. Shrubs are sparse and consist mainly of low-growing huckleberries, including dwarf huckleberry and grouse whortleberry. Historically, this group experienced lethal fire, though nonlethal fires may have occurred during stand development. Lodgepole pine is more often nonserotinous in western portions of Idaho and appears to become more serotinous moving easterly in the state. Within the Forest, lodgepole pine may reproduce in areas that experience nonlethal fires, resulting in more vertical stand diversity in some areas than is often found where lodgepole pine is mostly serotinous. Over time, the combination of these low-intensity events, subsequent reproduction, and mountain pine beetle mortality would have created fuel conditions that allowed lethal fires to occur under the right weather conditions.

PVG 11—High Elevation Subalpine Fir (with Whitebark Pine)

This group occurs at the highest elevations of the subalpine fir zone and generally represents the upper timberline conditions. It often grades into krummholz or alpine communities. Whitebark pine is a major seral species in this group and Engelmann spruce and subalpine fir are climax co-dominants. In some areas, whitebark pine serves as a cover for Engelmann spruce–subalpine fir establishment. Understories are primarily forbs and grasses tolerant of freezing temperatures, which can occur any time during the growing season. Shrubs are sparse due to the cold, harsh conditions. Historically, the fire regime in this group is characterized as mixed2, though the fire effects were highly variable. Ignitions are common in this group due to high elevation; however, fire effects were patchy because fuel conditions were historically sparse due to cold growing conditions and shallow soils. Fire regimes are mixed2.

Stand Structure

Stands can be classified as single- or multistoried. Historically, this structure reflected succession and disturbance, while current stand structure can also be attributed to management activities. Stands generally become multistoried in the absence of disturbance, with seral, shade intolerant species forming upper layers with later seral/climax, shade-tolerant species underneath. Single-storied stands historically resulted from disturbance processes such as nonlethal fire that killed regeneration. In some cases, single-storied stands can be even-aged, such as a lodgepole pine stand that results from a lethal fire and is unaffected by disturbance until the next lethal fire. In other cases, single-storied stands can be multi-aged, such as a ponderosa pine stand where small groups or individuals regenerated following disturbances that occurred at different times and survived, eventually becoming large enough to be defined as the largest tree size class.

Other Forested/Woodland Vegetation Types

Aspen

Aspen covers a broad environmental range across the Intermountain Region (Mueggler and Campbell 1982). It grows at elevations as low as 5,000 feet and as high as 11,000 feet. Aspen occurs both as a seral and climax tree species within its range (Mueggler 1985). Most aspen on the Forest is seral, although small areas of climax aspen do occur on the Mountain Home Ranger District. Where it is seral, aspen is an early-seral stage of forested PVGs. Throughout areas where it is seral, individual stands are relatively small, seldom exceeding 5 acres (Mueggler 1985), and are maintained on the landscape by disturbance. Historically, fire is considered a primary disturbance agent (Jones and DeByle 1985). Fires result in single-aged stands that develop from root suckering, and fire frequencies and severities vary greatly from low to high. Though aspen does not burn readily, all but the lowest intensity fires kill aspen because of its thin, uninsulated bark. Decline in aspen, particularly seral aspen, has been attributed to a lack of disturbances that allowed this shade-intolerant species to persist across the landscape where conifers could eventually shade it out (Jones and DeByle 1985).

Shrubland and Grassland Vegetation

Shrubland Environmental Site Potentials Groups

Low Sagebrush—The following LANDFIRE ESPs were assigned to this group:

- Columbia Plateau Low Sagebrush Steppe
- Great Basin Xeric Mixed Sagebrush Shrubland
- Columbia Plateau Scabland Shrubland

This ESP group is dispersed in patches overlapping Wyoming and Mountain Big Sagebrush sites. Patchiness is highly related to sites with strongly developed soil (clay hardpan) and sites where soils are generally derived from basalt or rhyolitic parent material. Typically, this group occurs in the precipitation zone from 8 to 16 inches and on slopes <40 percent. Canopies are generally open, with few areas of closed or dense canopies. Fires are seldom (every 40 to 60 years), with a mixed1 fire regime. Historical vegetation disturbances were related to frost heaving of fine soil, ungulate grazing of highly palatable sagebrush, and fast spring snowmelt conditions. Common species in this group are bluebunch wheatgrass, Sandberg bluegrass, wild onion , milk vetches , eriogonums, and fleabanes. Rabbitbrush may occur. Low sagebrush on the Forest is primarily little sagebrush; however, black sagebrush also occurs and was included in the low sagebrush cover type.

Mountain and Wyoming Big Sagebrush—The following LANDFIRE ESPs were assigned to this group:

- Shrubland Alliance
- Inter-mountain Basins Montane Sagebrush Steppe
- Inter-mountain Basins Big Sagebrush Steppe
- Inter-mountain Basins Big Sagebrush Shrubland

This ESP group connects with the greatest number of other forest, nonforest, and riparian cover types and consists of large, widely distributed blocks. This group occurs in the precipitation zone from 14 to over 18 inches, on well-drained sites, and on soils with high rock or gravel content. Sites generally have high ground cover and few cryptogams. Fires can be frequent (ranging from 20 to 60 years), with a mixed1 to mixed2 fire regime. Historical vegetation disturbances were related to ungulate grazing of southern exposures, which have less snow and an early green-up. Forb and grass species can vary. Bitterbrush, grey horsebrush and green rabbitbrush are frequently present. Snowberry is present on moister sites.

Montane Shrub—The following LANDFIRE ESPs were assigned to this group:

- Northern Rocky Mountain Montane-Foothill Deciduous Shrubland
- Rocky Mountain Lower Montane-Foothill Shrubland

This cover type is usually interspersed as stringers and patches within the Mountain and Wyoming Big Sagebrush, aspen, and conifer cover types. Its patchiness is strongly related to mesic soils with high water-holding capacities and/or northerly exposures. Typically, this group has multiple vegetation layers dominated by sprouting species, including chokecherry, snowberry, serviceberry, and wild rose. Several other browse species may occur. This group usually has a rich and diverse herbaceous component and extremely diverse wildlife habitats. Fire intervals are typically 20–40 years, with a mixed2 fire regime. Ungulate and grazing disturbances are common components. Insects and diseases may be common, with occasional outbreaks.

Grassland Environmental Site Potentials Groups

Perennial Grass Slopes—The following LANDFIRE ESPs were assigned to this group:

- Columbia Basin Foothill and Dry Grassland
- Columbia Basin Palouse Prairie
- Inter-mountain Basins Semi-desert Grassland
- Inter-mountain Basins Semi-desert Shrub Steppe

This ESP group connects with dry forested cover types and Mountain and Wyoming Big Sagebrush communities and is more prevalent in the northern and northwestern foothills and Forest canyonlands. The group usually occurs in the precipitation zone from 10 to 18 inches on southern and western aspects. The group predominantly consists of bluebunch wheatgrass. Perennial grasses are dominant on the sites, comprising 80–90 percent of production. Sandberg bluegrass is a lesser but constant associate. The forb component contains a large number of species, few of which are common throughout. The most common forbs are Indian wheat , shining chickweed, salsify, yarrow , lupine, balsamroot, biscuit root, (hawksbeard, fleabane, milkvetch, and phlox. This ESP group can be susceptible to damage under very hot and dry conditions, and stand recovery is very difficult and slow in the Idaho Batholith. Historical fire intervals are short (20 years), typically with a mixed1 to mixed2 fire regime depending on the amount of Idaho fescue present. This group is highly susceptible to several invaders, including annual bromes, rush skeletonweed, yellow starthistle, several knapweeds, dyer's woad, and Dalmatian toadflax.

Perennial Grass Montane—The following LANDFIRE ESPs were assigned to this group:

- Columbia Plateau Steppe and Grassland
- Northern Rocky Mountain Lower Montane Foothill-Valley Grassland

This ESP group connects with numerous forested, Mountain and Wyoming Big Sagebrush, and bluebunch communities. In terms of ecotone diversity, it is very highly rated. The group usually occurs in the precipitation zone from 18 to 30 inches on southern aspects and 14 to 30 inches on northern aspects. The group represents slightly moister and cooler conditions than Perennial Grass Slopes. Idaho fescue is the predominant grass in this group, but other grass species include slender wheatgrass, sedges, intermediate oatgrass, western needlegrass, and Richardson needlegrass. Forbs compose 40–65 percent of overall production. Common forbs are yarrow, bessaya, Indian paintbrush, lupines, phlox, and balsamroot. Historical fire intervals are short (20 years), typically with nonlethal to mixed1 regimes. Certain species within the community are susceptible to fire damage under very hot and dry conditions, but recovery occurs in a few years. Trampling damage is minimal to nonexistent and primarily occurs at higher elevations. Bluegrass is a common invader, but this group is highly susceptible to several invaders, including annual bromes, rush skeletonweed, yellow starthistle, several knapweeds, dyer's woad, and Dalmatian toadflax.

Riparian Cover Types

No comprehensive riparian classifications or vegetative community descriptions exist for the Forest. However, a riparian classification is being developed and is forthcoming. Hall and Hansen (1997) have developed a riparian habitat type classification for Bureau of Land Management districts in southern and eastern Idaho that includes portions of the South Hills on the Sawtooth National Forest. Riparian community type classifications have been developed by Youngblood et al. (1985) for eastern Idaho and western Wyoming and by Padgett et al. (1989) for Utah and southeastern Idaho. Due to the lack of comprehensive classification information for our area, the Forest Plan Revision Team chose to use the Utah Landsat cover types to describe these communities.

Riverine Riparian

This cover type consists of vegetative communities dominated by conifer species and shrubs. The primary conifers are subalpine fir, Engelmann spruce, and Douglas-fir, with some aspen. Other trees and shrubs include mountain maple, serviceberry, chokecherry, thinleaf alder, currants, and willows. These communities generally occur on steep slopes and occupy edges of riparian zones with A and B stream channel types. Padgett et al. (1989) and Youngblood et al. (1985) stated that these community types, in their areas, likely represent successional stages within described forested communities. For this reason, Padgett et al. (1989) recommended consulting available forest habitat type classifications for additional information.

Deciduous Tree

This cover type consists predominantly of black cottonwood or narrowleaf cottonwood tree cover. Associated tree species include thinleaf alder, mountain maple, water birch, and aspen. Primary shrub species include chokecherry and willows. This cover type is generally below 5,500 feet along stream channels in lower canyons and usually requires a moist and coarse substrate.

Shrub Riparian

This cover type is dominated by willow species. Primary associated tree and shrub species include cottonwoods, swamp birch, thinleaf alder, mountain maple, shrubby cinquefoil , and chokecherry. Grasses and forbs include sedges, tufted hairgrass , Geranium, louseworts, and American bistort This cover type is found in mid-to-upper elevations in broad, wet meadows and alluvial terraces on relatively low gradients (1–3 percent).

Herbaceous Riparian

This cover type is typically found in mountain meadows where soil moisture is abundant throughout the growing season. Principle species include sedges, woodrush,reedgrass, pinegrass, timothy, bluegrass, tufted hairgrass, saxifrage, and fireweed. This cover type occurs widely and is typically found in broad, flat meadows.

Other Vegetation

Wetlands

Wetlands are areas inundated or saturated by surface or ground water at a frequency and duration sufficient to support vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, wet meadows, seeps, and similar areas. These lands are transitional between terrestrial and aquatic systems. Vegetative species found in wetlands are heavily influenced by local site conditions.

Marshes—This cover type is permanently or semipermanently flooded and dominated by hydric species adjacent to small streams, beaver ponds, lakes, and meadows. Sedges are the most common species. This cover type usually occurs around the 7,000-foot elevation level. Sites are dominated or co-dominated by bulrushes, cattails, woodrushes, or sedges.

Bogs, Fens, and Peatlands—These wetlands typically have subirrigated, cold water sources. Peatlands are generally defined as wetlands with waterlogged substrates and at least 12 inches of peat accumulation (Moseley et al. 1994). The vegetation in these wetlands is often dense and dominated by low-growing perennial herbs (Skinner and Pavlick 1994).

Wet Meadows and Seeps—These wet openings contain grasses, sedges, rushes, and herbaceous forbs that thrive under saturated, moist conditions. These habitats can occur on a variety of substrates and may be surrounded by grasslands, forests, woodlands, or shrublands (Skinner and Pavlick 1994).

Alpine

Alpine habitats are defined as the area above the tree line in high mountains. Rocky or gravelly terrain is generally prevalent and grasses and sedges often form thick, sodlike mats in meadows. Most alpine plant species have unique adaptations to survive the harsh conditions of this habitat (Billings 1974). Many plants grow in mats or cushions. Perennials predominate in the alpine floras, as the growing season is often too short for annuals to complete their life cycle (Strickler 1990).

REFERENCES

Agee, James K., 1998, *The Landscape Ecology of Western Forest Fire Regimes*, Northwest Science, Vol. 72, Special Issue 1998, pp. 24-34

Agee, James K., 2002, *Fire as a Coarse Filter for Snags and Logs,* In: Proceedings of the Symposium on the Ecology and Management of Dead Wood in Western Forests, USDA Forest Service, Pacific Southwest Research Station, General Technical Report, PSW-GTR-181

Baker, William L., 1992, *The landscape ecology of large disturbances in the design and management of nature reserves,* Landscape Ecology, Vol. 7, No. 3, pp. 181-194.

Baker, William L. and Yunming Cai, 1992, *The r.le programs for multiscale analysis of landscape structure using the GRASS geographical information system*, Landscape Ecology, Vol. 7, No. 4, pp. 291-302

Billings, W. D., 1974, *Adaptations and Origins of Alpine Plants*, Arctic and Alpine Research, Vol. 6, No. 2, 1974, pp. 129-142

Bormann, F.H., and G.E. Likens, 1979, *Pattern and Process in a Forested Ecosystem: disturbance, development and the steady state based on the Hubbard Brook ecosystem study*. Springer-Verlag, New York.

Brohman, R. and L. Bryant eds, 2005. *Existing vegetation classification and mapping technical guide*. Gen. Tech. Rep. WO-67. Washington, DC: U.S. Department of Agriculture, Forest Service, Ecosystem Management Coordination Staff. 305 p.

Bunnell, F.L.; Houde, I.; Johnston, B. and E. Wind, 2002, *How dead trees sustain organisms in western forests*. Gen. Tech. Rep. PSW-GTR-181. Albany, CA: U.S. Department of Forest Service, Pacific Southwest Research Station. pp. 193-205.

Cissel, John H.; Swanson, Frederick J. and Peter J. Weisberg, 1999, *Landscape management using historical fire regimes: Blue River, Oregon*, Ecological Applications, Vol. 9, No. 4, pp. 1217-1231.

Comer, P., D. Faber-Langendoen, R. Evans, S. Gawler, C. Josse, G. Kittel, S. Menard, M. Pyne, M. Reid, K. Schulz, K. Snow, and J. Teague, 2003, *Ecological Systems of the United States: A Working Classification of U.S. Terrestrial Systems*, NatureServe, Arlington, Virginia.

Connelly, John W., Michael A. Schroeder, Alan R. Sands, and Clait E. Braun, 2000, *Guidelines to manage sage grouse populations and their habitats*, Wildlife Society Bulletin, Vol. 28, No.4, pp. 967-985

Crane, Marilyn F. and William C. Fischer, 1986, *Fire ecology of the forest habitat types of central Idaho*. Gen. Tech. Rep. INT-218. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Research Station, 86 pages

Daubenmire, R. 1968, *Communities: a textbook of plant synecology*. Harper and Row Publ. New York. 300 p.

Deeming, John E., 1990, *Effects of Prescribed Fire on Wildfire Occurrence and Severity*, Natural and Prescribed Fire in the Pacific Northwest Forests, pp. 95-104, Oregon State University Press, Corvallis, Oregon

Drapeua, P.; Nappi, A.; Jean-Francois, G.; Leduc, A, and Jean-Pierre Savard. 2002. *Distribution patterns of birds associated with snags in natural and managed boreal forests*. Gen. Tech. Rep. PSW-GTR-181. Albany, CA: U.S. Department of Forest Service, Pacific Southwest Research Station. pp. 193-205.

Finney, Mark A., 2001, *Design of Regular Landscape Fuel Treatment Patterns for Modifying Fire Growth and Behavior*, Forest Science, Vol. 47, No. 2, p. 219-228

Fule, Peter Z., Charles McHugh, Thomas A. Heinlein, and W. Wallace Covington, 2001, *Potential Fire Behavior is Reduced Following Forest Restoration Treatments*, USDA Forest Service Proceedings RMRS-P-22, pp. 28-35

Graham, Robin L.L., 1981. *Biomass dynamics of dead Douglas-fir and western hemlock boles in mid-elevation foresets of the Cascade Range*, Corvallis, OR: Oregon State University, 152 p. Ph.D dissertation.

Graham, Russell, 2001, pers. comm., coarse woody debris field trip to Boise Basin Experimental Forest

Graham, Russell T., Alan E. Harvey, Theresa B. Jain, and Jonalea R. Tonn, 1999, *The Effects of Thinning and Similar Stand Treatments on Fire Behavior in Western Forests*, USDA Forest Service, Pacific Northwest Research Station, USDI Bureau of Land Management, General Technical Report PNW-GTR-463

Green, P.; Joy, J.; Sirucek, D.; Hann, W.; Zack, A. and B. Naumann, 1992, *Old-growth forest types of the Northern Region*. U.S. Department of Agriculture, Forest Service, Northern Region, R-1 SES 4/92. 60 p.

Hall, James B. and Paul L. Hansen, 1997, *A Preliminary Riparian Habitat Type Classification System for the Bureau of Land Management Districts in Southern and Eastern Idaho*, USDI Bureau of Land Management, Idaho State Office, Technical Bulletin No. 97-11.

Hann, W.; Shlisky, A.; Havlina, D.; Schon, K.; Barrett, S.; DeMeo, T.; Pohl, K.; Menakis, J.; Hamilton, D.; Jones, J.; Levesque, M.; Frame, C. 2004. Interagency Fire Regime Condition Class Guidebook. Last update January 2008: Version 1.3.0 [Homepage of the Interagency and The Nature Conservancy fire regime condition class website, USDA Forest Service, US Department of the Interior, The Nature Conservancy, and Systems for Environmental Management]. [Online]. Available: www.frcc.gov.

Hamilton, Ronald C. 1993, *Characteristics of Old-Growth Forests in the Intermountain Region*, USDA Forest Service, Intermountain Region, Ogden, Utah

Harmon, M.E. 2002. *Moving towards a new paradigm for woody debris management*. Gen. Tech. Rep. PSW-GTR-181. Albany, CA: U.S. Department of Forest Service, Pacific Southwest Research Station. pp. 929-944.

Harmon, M.E.; Franklin, J.F.; Swanson, F.J.; Sollins, P.; Gregory, S.V.; Lattan, J.D.; Anderson, N.H., Cline, S.P.; Aumen, N.G.; Sedell, J.R.; Lienkaemper, G.W.; Cromack, Jr, K. and K.W. Cummins. 1986. *Ecology of coarse woody debris in temperate ecosystems*. Advances in Ecological Research Vol 15, pp. 133-302

Hessburg, Paul F.; Salter, R. Brion and Kevin M. James, 2007, *Re-examining fire severity relations in pre-management era mixed conifer forests: inferences from landscape patterns of forest structure*, Landscape Ecology, Special Feature, Vol. 22, No. 1, pp. 5-24

Hunter, M.L., 1990. *Wildlife, forests, and forestry: principles of managing forests for biological diversity*, Prentice Hall Neglewood Cliffs, NJ. 370 p.

Hutto, Richard L. 2006, *Toward meaningful snag-management guidelines for postfire salvage logging in North America conifer forests*. Conservation Biology, Vol. 20, No. 4, pp. 984-993.

Jones, John R. and Norbert V. DeByle, 1985, *Fire in Aspen: Ecology and management in the western United States*, USDA Forest Service, Rocky Mountain Forest and Range Experiment Station, Fort Collins, Colo. General Technical Report RM-119.

Knick, Steven T, 1999. *Requiem for a sagebrush ecosystem,* Northwest Science, Vol. 73, no. 1

Knick, Steven T., and John T. Rotenberry, 1995, *Landscape Characteristics of Fragmented Shrubsteppe Habitats and Breeding Passerine Birds*, Conservation Biology, Vol. 9, No. 5, pp. 1059-1071

Knick, S.T., and J.T. Rottenberry, 1997, *Landscape characteristics of disturbed shrubsteppe habitats in southwestern Idaho.* Landscape Ecology 12: 287-297.

Knick, Steven T., and John T. Rotenberry, 2000, *Ghosts of Habitats Past: Contribution of Landscape Change to Current Habitats used by Shrubland Birds*, Ecology. 81(1), pp. 220-227.

Landres, P.B.; Morgan, P. and F.J. Swanson, 1999, *Overview of the Use of Natural Variability Concepts in Managing Ecological Systems*, Ecological Applications, 9(4): 1179-1188.

Matlack, Glenn and John Litvaitis, 1999, Forest edges, in, *Maintaining Biodiversity in Forest Ecosystems*, edited by Malcolm L. Hunter, Jr., pp. 210-233, Cambridge University Press, New York

Mehl, Carolyn A., Robert Steele, Steven Warren, Brad Holt, Jonathan B. Haufler, and Gary J. Roloff, 1998, *The Ecosystem Diversity Matrix for the Idaho Southern Batholith Landscape: A Users Manual*, Boise Cascade Corporation, 1111 West Jefferson Street, Boise, Idaho

Morgan, Penelope and Russ Parsons, 2001. *Historical Range of Variability of Forests of the Idaho Southern Batholith Ecosystem*, Revised Final Report, June 12, 2001

Morrison, Michael L., and Martin G. Raphael, 1993, *Modeling the dynamics of snags*, Ecological Applications, 3: 322-330.

Moseley, Robert K., Robert J. Bursik,, Fred W. Rabe, and Linda D. Cazier, 1994, *Peatlands of the Sawtooth Valley, Custer and Blaine Counties, Idaho,* Cooperative Cost Share Project with the Sawtooth National Forest, The Nature Conservancy, and the Idaho Department of Fish and Game, pp. 1-15.

Mueggler, W.F., 1985, *Vegetation Associations, in Aspen, Ecology and management in the western United States*, USDA Forest Service General Technical Report RM-119, 283 p. Rocky Mountain Forest and Range Experiment Station, Fort Collins, Colo.

Mueggler, Walter F. and Robert B. Campbell, Jr., 1982, *Aspen Community Types on the Caribou and Targhee National Forests in Southeastern Idaho,* USDA Forest Service, Intermountain Forest and Range Experiment Station, Research Paper INT-294

Nappi, A.; Drapeau, P.; Giroux, J-F. and J-P Savard, 2003, *Snag use by foraging black-backed woodpeckers (Picoides arcticus) in a recently burned eastern boreal forest*, Auk, Vol. 120, pp. 505-511

Omi, Philip N., and Erik J. Martinson, 2002, *Effects of Fuel Treatment on Wildfire Severity,* Western Forest Fire Research Center, Colorado State University

Padgett, Wayne G., Andrew P. Youngblood, and Alma H. Winward, 1989, *Riparian Community Type Classification of Utah and Southeastern Idaho,* USDA Forest Service, Intermountain Region, R4-Ecol-89-0.

Paige, Christine and Sharon A. Ritter, 1999, *Birds in a Sagebrush Sea, Managing Sagebrush Habitats for Bird Communities*, Partners In Flight, Western Working Group, 1999.

Pfister, R.D., Kovalchik, B.L., Arno, S.F., and R.C. Presby, 1977, *Habitat-types of Montana*, Gen. Tech. Rep. GTR-INT- 34, Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Research Station, 174 p.

Redmond, Roland L., Troy P. Tady, Foster V. Fisher, Michele Thornton, and J. Chris Winne, 1998, *Landsat Vegetation Mapping of the Southwest and Central Idaho Ecogroups*, Executive Summary, Contract #53-0261-6-25, Wildlife Spatial Analysis Lab, Montana Cooperative Wildlife Research Unit, University of Montana, Missoula, MT

Rotenberry, John T. and John A. Wiens, 1980, *Habitat Structure, Patchiness, and Avian Communities in North American Steppe Vegetation: A Multivariate Analysis*, Ecology, Vol. 61, No. 5, pp. 1228-1250

Rust, S.K., 1990, *Process based attributes: a key to the conservation of old-growth forest communities,* The Northwest Environmental Journal 6(2): 425-427.

Skinner & Pavlick, eds, 1994. *California Native Plant Society's inventory of rare and endangered vascular plants of California*, Fifth Edition, California Native Plant Society, Sacramento, California

Spies, Thomas A. and Monica G. Turner, 1999, Dynamic forest mosaics, *Maintaining Biodiversity in Forest Ecosystems*, edited by Malcolm L. Hunter, Jr., pp. 95-160, Cambridge University Press, New York.

Spies, Thomas A., Franklin, Jerry F., and Ted B. Thomas, 1988, *Coarse woody debris in Douglas-fir forests of western Oregon and Washington*, Ecology 69(6): 1689-1702

Steele, Robert, and Kathleen Geier-Hayes, 1987, *The Grand Fir/Blue Huckleberry Habitat Type in Central Idaho*: Succession and Management, USDA Forest Service, Intermountain Research Station, General Technical Report INT-228

Steele, Robert, Robert D. Pfister, Russell A. Ryker, and Jay A. Kittams, 1981, *Forest Habitat Types of Central Idaho*, USDA Forest Service, Intermountain Forest and Range Experiment Station, General Technical Report INT-114

Strickler, D., 1990, *Alpine Wildflowers: Showy wildflowers of Alpine and Subalpine Areas of the Rocky Mountain State,* Falcon Press Publishing Co., pp. 5-7

Taylor, Alan H. and Carl N. Skinner, 2003, Spatial patterns and controls on historical fire regimes and forest structure in the Klamath Mountains, *Ecological Applications*, Vol. 13, No. 3, pp. 704-719

Thomas, J.W., Buggiero, L.F., Mannan, R.W., Schoen, J.W., and R.A. Lancia, 1988, *Management and conservation of old-growth forests in the United States*, Wildl. Soc. Bull 16: 252-262.

Wagle, R. F., and Thomas W. Eakle, 1979, *A Controlled Burn Reduces the Impact of a Subsequent Wildfire in a Ponderosa Pine Vegetation Type*, Forest Science, Vol. 25, No. 1, pp. 123-129

Wallin, David O.; Swanson, Frederick J.; Marks, Barbara; Cissel, John H. and Jane Kertis, 1996, *Comparison of managed and pre-settlement landscape dynamics in forests of the Pacific Northwest*, USA, Forest Ecology and Management, Vol. 85, pp. 291-309

Whittaker, R.H., 1956, *Vegetation of the Great Smoky Mountains*, Ecological Monographs, 26:1-80.

Wisdom, Michael J., Richard S. Holthausen, Barbara C. Wales, Christina D. Hargis, Victoria A. Saab, Danny C. Lee, Wendel J. Hann, Terrell D. Rich, Mary M. Rowland, Wally J. Murphy, and Michelle R. Eames, 2000, *Source Habitats for Terrestrial Vertebrates of Focus in the Interior Columbia Basin: Broad-Scale Trends and Management Implications, Volumes 1, 2, and 3*, USDA Forest Service, Pacific Northwest Research Station, and USDI Bureau of Land Management, General Technical Report PNW-GTR-485

Youngblood, Andrew P., Wayne G. Padgett, and Alma H. Winward, 1985, *Riparian Community Type Classification of Eastern Idaho—Western Wyoming*, USDA Forest Service, Intermountain Region, R4-Ecol-85-01