Chapter 3 – Affected Environment

Chapter 3 of this draft environmental impact statement describes the affected environment for the six resource management plans of the planning area that are being revised.

In this chapter:

Introduction **181**

Ecology **192**

Socioeconomics **216**

Timber **247**

Special Forest Products **251**

Botany **257**

Invasive Plants **268**

Wildlife **282**

Fish **335**

Water **359**

Fire and Fuels **392**

Air **401**

Recreation **405**
Wilderness Characteristics **417**
Visual Resources **420**
National Landscape Conservation System **422**
Soils **425**
Grazing **428**
Wild Horses **433**
Areas of Critical Environmental Concern and Research Natural Areas **435**
Cultural Resources **439**
Lands, Realty, Access, and Transportation **445**
Energy and Minerals **454**

Introduction

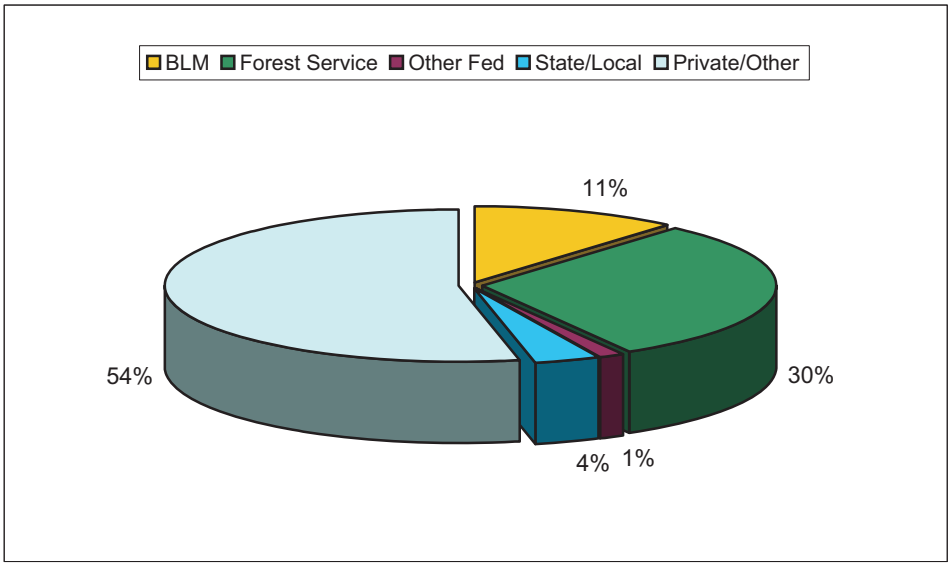
Chapter 3 describes the affected environment. The description of the affected environment is designed to support and facilitate the understanding of the analysis of the environmental consequences that are presented in *Chapter 4*. The amount of information provided in this chapter is proportionate to the importance, scope, and sensitivity of the environmental consequences and is no longer than necessary to understand the analysis.

Planning Area

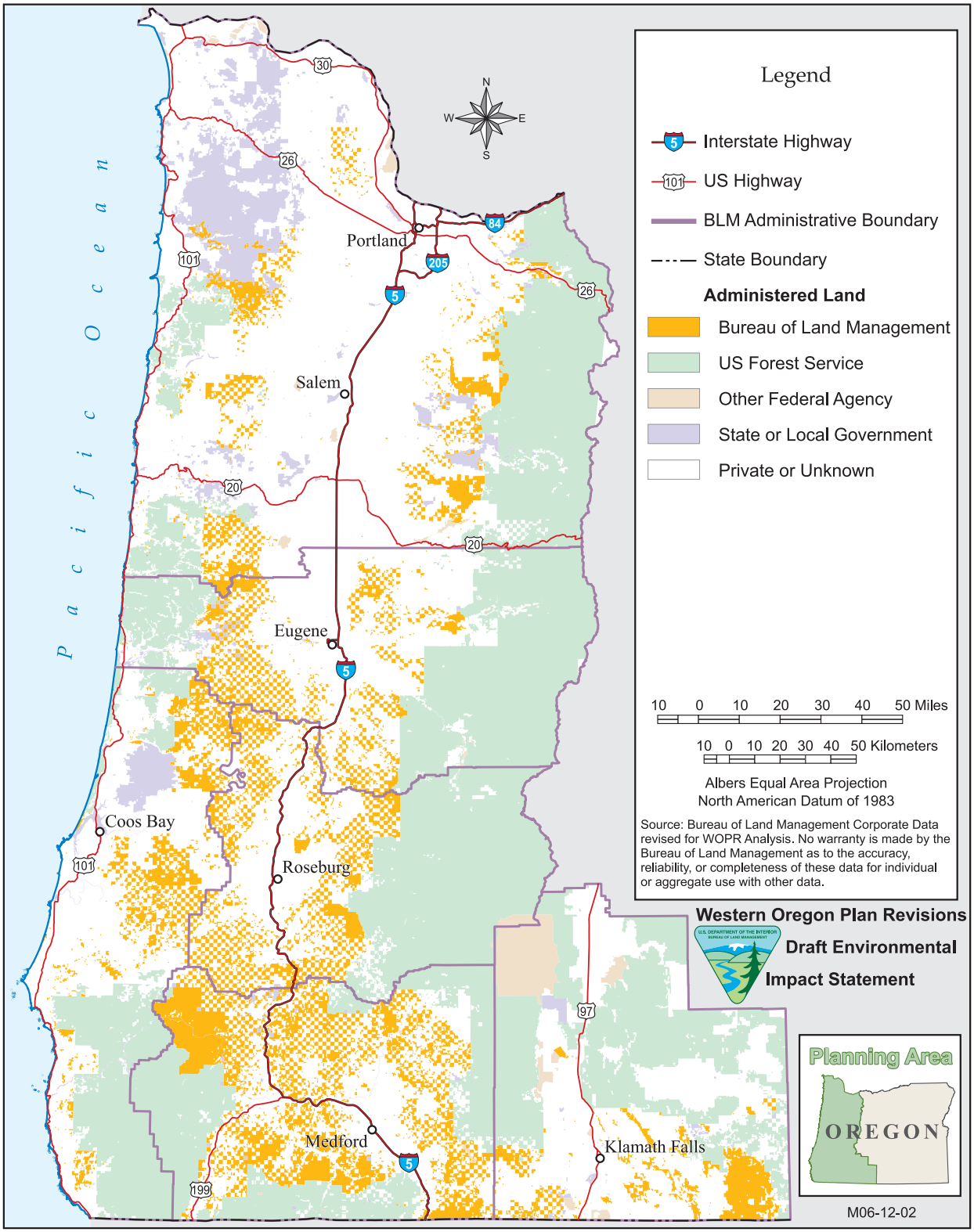
The planning area for the six resource management plans that are being revised includes the public lands and resources that are administered by the Salem, Eugene, Roseburg, Coos Bay, and Medford districts, and the Klamath Falls Resource Area of the Lakeview District. See *Map 30 (BLM lands within the planning area)*.

The entire planning area includes approximately 22 million acres, but only approximately 2.5 million acres are public lands that are administered by the BLM. The BLM-administered lands, therefore, represent only about 11% of the planning area. The majority of the lands within the planning area are owned and managed by private landowners and other government agencies. See *Figure 9 (Major ownerships within the planning area)*.

Figure 9. Major ownerships within the planning area

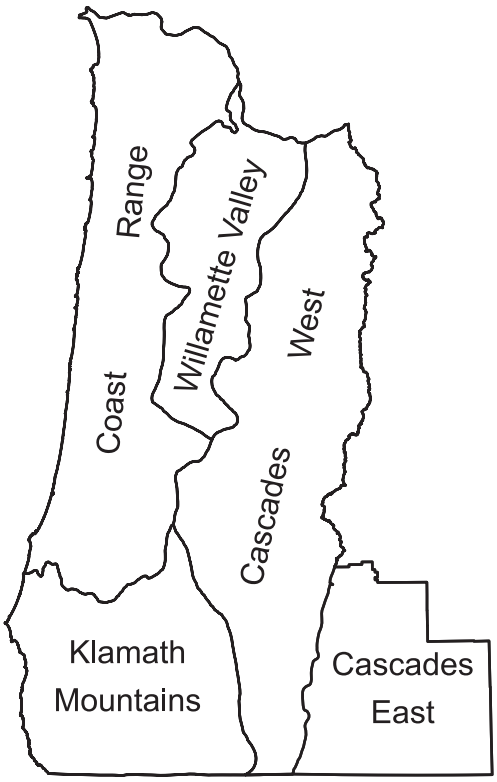


Map 30. BLM lands within the planning area



There are five physiographic provinces within the planning area. See *Figure 10 (Physiographic provinces within the planning area)*. Physiographic provinces vary by the type and structure of their vegetation and the differences in their hydrology, geology, and other processes (e.g., fire-return intervals) (FEMAT 1993).

Figure 10. Physiographic provinces within the planning area



Land Ownerships within the planning area

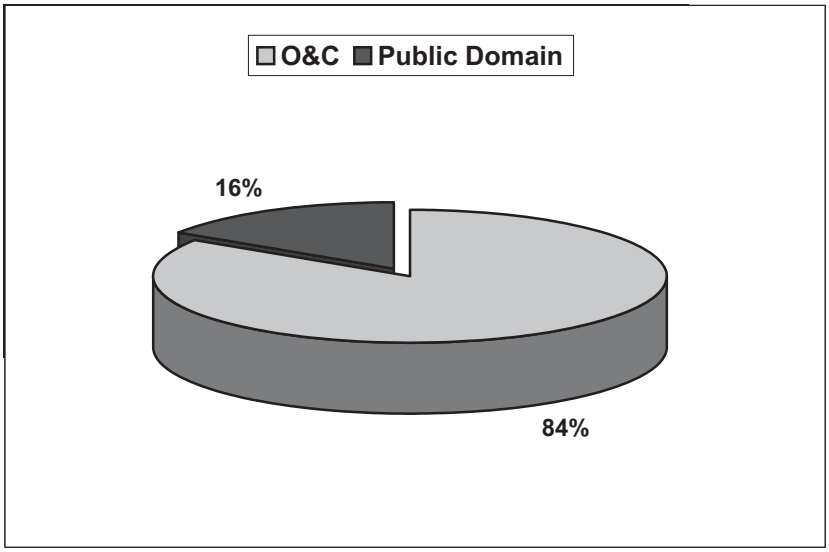
The public lands in Oregon include the O&C lands, public domain lands, and other public lands. See *Table 64 (Legal status of the lands administered by the BLM within planning area)*. The O&C lands in western Oregon are managed differently than the other public and public domain lands of Oregon, which are located mostly in eastern Oregon. The O&C lands are mostly scattered and intermingled with private, industrial forest lands. The public domain lands are about half scattered and intermingled with O&C lands and about half existing as larger blocks in the Salem, Coos Bay, and Lakeview districts (with the majority being concentrated in the Klamath Falls Resource Area of the Lakeview District). See *Figure 11 (BLM surface ownership by legal authority within the planning area)* for the amount of BLM surface ownership by source of administrative authority within the planning area.

Table 64. Legal status of the lands administered by the BLM within the planning area

BLM Districts	O&C Lands (acres)	Public Domain Lands (acres)	Other Public Lands* (acres)	Total (acres)
Salem	349,300	51,600	2,100	403,000
Eugene	304,200	10,500	400	315,100
Roseburg	406,500	19,800	0	426,300
Coos Bay	279,400	41,800	1,500	322,700
Medford	764,900	96,100	4,800	865,800
Klamath Falls Resource Area (Lakeview District)	46,900	174,800	3,200	224,900
Total	**2,151,200**	**394,600**	**12,000**	**2,557,800**

*Federal lands acquired by purchase or donation under an authorization other than the Federal Land Policy and Management Act.

Figure 11. BLM surface ownership by legal authority within the planning area



The O&C land pattern has a checkerboard character that results from the grid of the Public Land Survey System. O&C land is generally located in the odd-numbered sections with the intermingled private lands being located in the even-numbered sections. A section in the checkerboard is normally one mile on a side and encloses approximately 640 acres. The BLM administers approximately 2.5 million acres of these checkerboard parcels of public land within the approximately 22 million acres that comprise the planning area. The management of the intermingled private lands usually differs from that of the BLM-administered lands. See *Figure 12 (Sample portion of the intermingled checkerboard of private and BLM-administered lands)*.

Public Land Survey System

For details about this system of subdividing and identifying public domain lands, see http://nationalatlas.gov/articles/boundaries/a_plss.html.

Figure 12. Sample portion of the intermingled checkerboard of private and BLM-administered lands

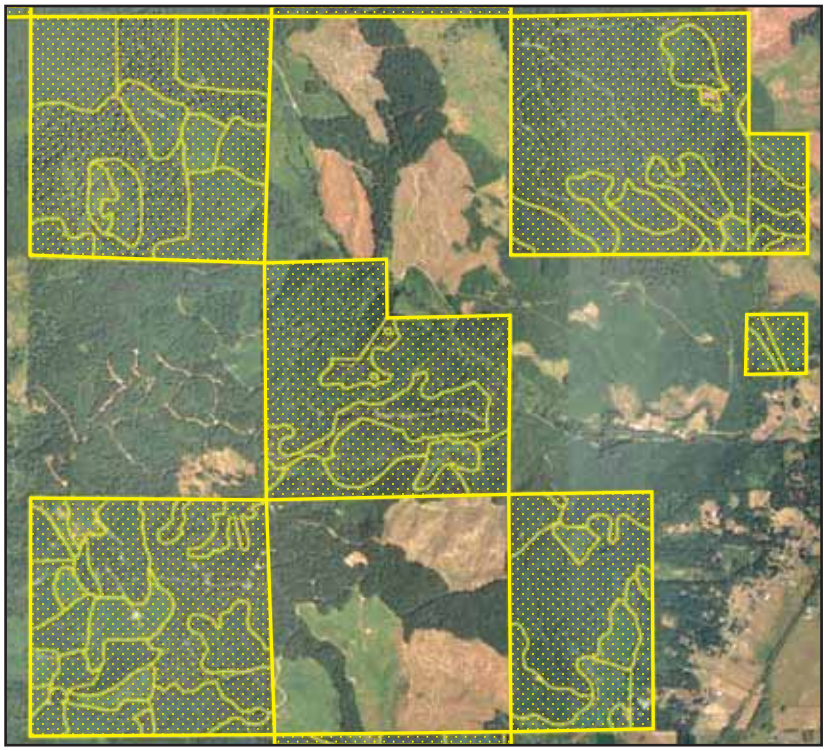


Figure 12 illustrates the intermingled checkerboard pattern of the BLM and private land ownerships. The BLM-administered lands in the figure are within the squares that contain the small polygons. Note that many parcels of BLM-administered lands are smaller than a square mile and are disconnected and isolated from other BLM-administered lands. The dark green areas in the image are older forests while the brown areas are recently harvested units.

Land Management

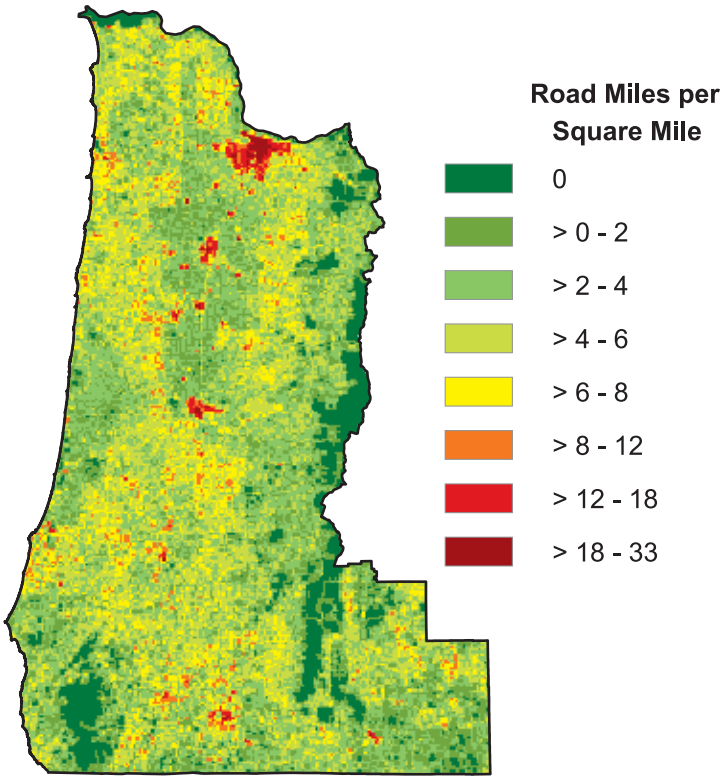
The existing land management plans for the individual national forests and BLM districts (including the six districts within the planning area) that are west of the Cascade Range in Washington, Oregon, and northern California have incorporated the management direction that is contained in the Northwest Forest Plan. Most, but not all, of the planning area falls within the Northwest Forest Plan area. See *Figure 13 (Areas of the Northwest Forest Plan and the planning area)*.

Figure 13. Areas of the Northwest Forest Plan and the planning area

The current vegetation condition of the private, state, and federal lands within the planning area has been calculated using the 1996 satellite data from the Interagency Vegetation Mapping Project. This data includes the major fire and regeneration harvesting data that is available as of 2002. The vegetative condition of non-BLM lands varies from nonforest to the four forest structural stage classifications (stand establishment, young (or recently harvested), mature, and structurally complex).

The intensity of the land management activities across all ownerships within the planning area is partly indicated by the number of miles of roads that exist per square mile (i.e., road density). See *Figure 14 (Road density across all land ownerships within the planning area)*.

Figure 14. Road density across all land ownerships within the planning area



The BLM has also developed a geospatial database of the lands and resources it administers. This geographic information system contains data regarding various resources, such as forests, streams, roads, recreation, and wildlife. This information was captured from on-the-ground surveys and aerial and satellite photography. See *Figure 15 (Example of geospatial data from the Forest Operations Inventory database)*.

Figure 15. Example of geospatial data from the Forest Operations Inventory database

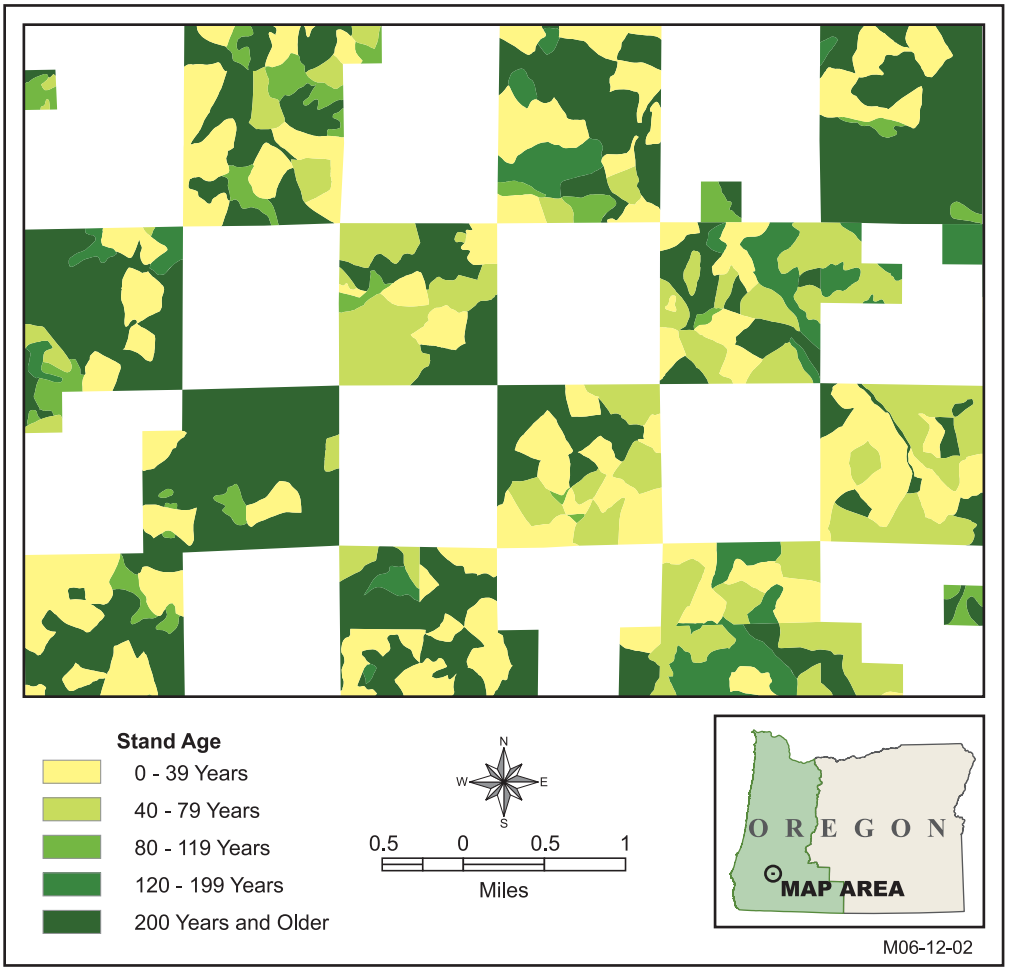


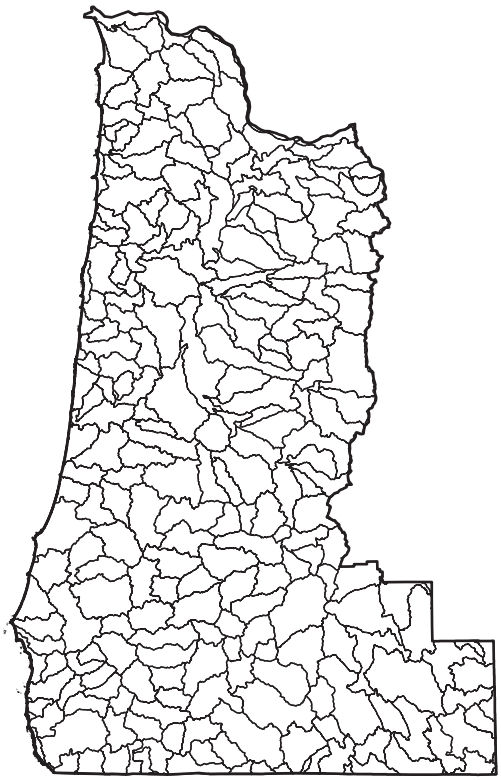
Figure 15 shows aggregated sections within individual forest stands. Non-BLM lands are not mapped. The areas mapped in the figure represent a somewhat typical BLM landscape, which is a mixture of older stands and younger stands that that have been harvested and replanted. These stands are intermixed on a larger landscape of private timber management, agriculture, and urbanization. The BLM manages over 80,000 mapped individual stands.

Watersheds are also useful as a unit of measure for summarizing certain natural resources. There are 260 fifth-field watersheds, which average 87,000 acres in size, located all or partially within the planning area. For a discussion of watersheds, see *Water* in *Chapter 3*. See *Figure 16 (Fifth-field watersheds within the planning area)* for the size and distribution of these watersheds within the planning area.

Watersheds

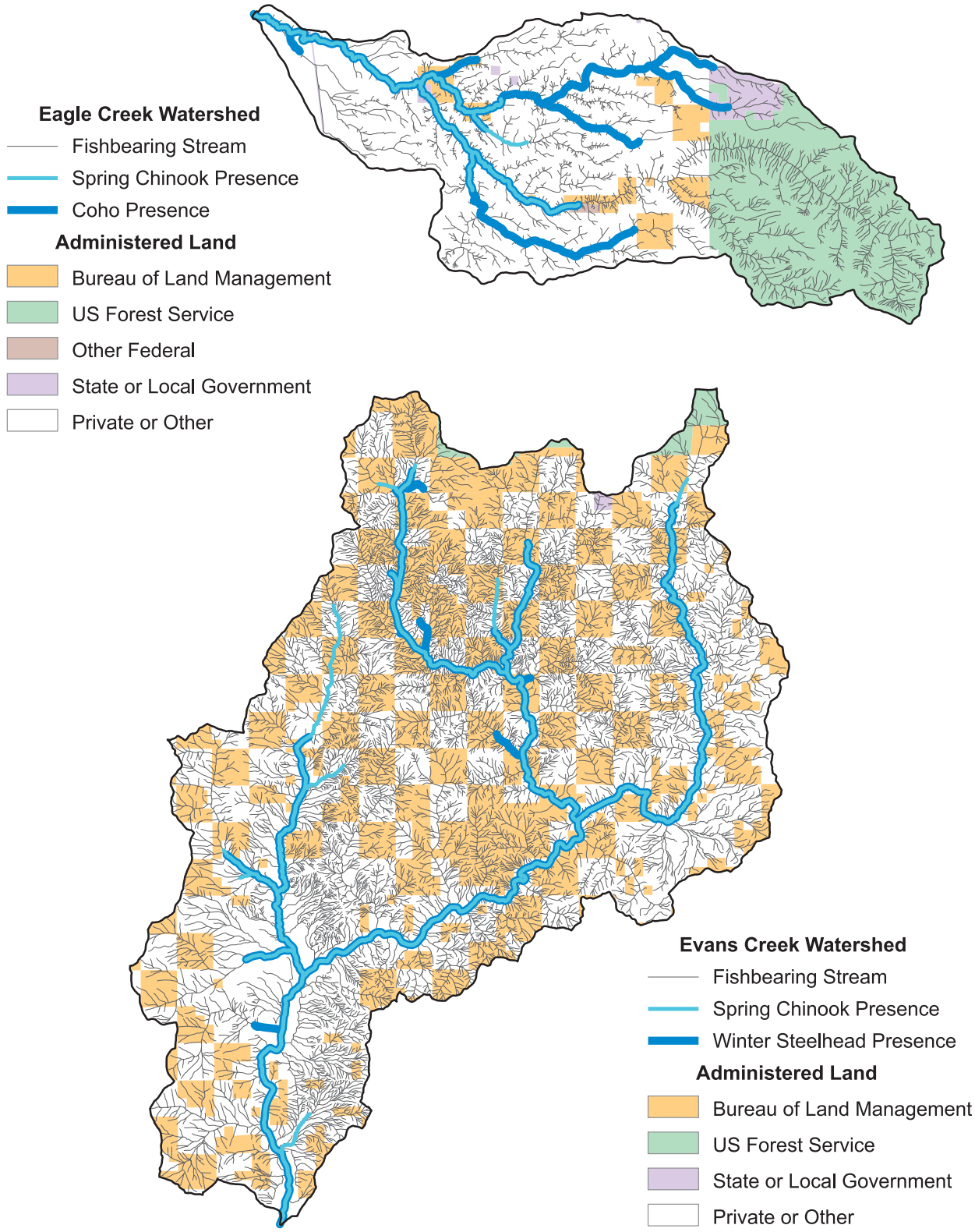
To learn more about watersheds in our area, see http://www.epa.gov/owow/watershed/whatis.html and http://cfpub.epa.gov/surf/

Figure 16. Fifth-field watersheds within the planning area



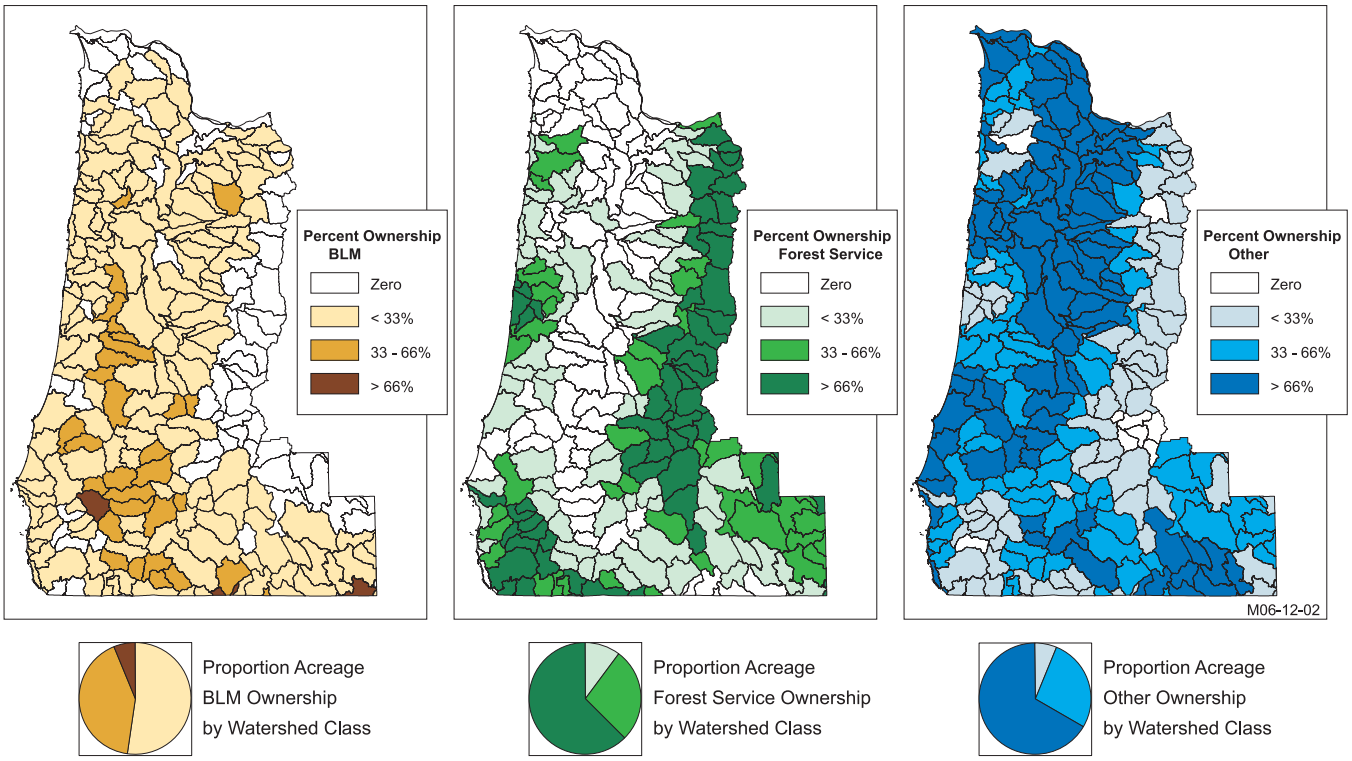
The BLM in western Oregon is rarely the predominant landowner within a fifth-field watershed. See *Figure 17 (Two example watersheds showing various BLM ownership patterns)*. *Figure 17* shows that BLM ownership at the fifth-field watershed level ranges from a few scattered parcels to large areas. Therefore, activities on adjacent lands have implications for the management of BLM lands. The BLM's ability to influence resource outcomes often depends upon the amount and location of its land ownership in relation to a particular resource.

Figure 17. Two example watersheds showing various BLM ownership patterns



Over half of BLM lands are located within fifth-field watersheds where the BLM-administered lands comprise less than one-third of the watershed. By contrast, most of the lands managed by the Forest Service are in large, contiguous blocks. See *Figure 18 (BLM, Forest Service, and private ownership as a percent of the fifth-field watersheds within the planning area)*, which illustrates the comparative proportion of land ownership at the fifth-field watershed scale for the BLM, Forest Service, and private land owners. In only 8 of the 260 fifth-field watersheds within the planning area does the BLM-administrated lands comprise the majority of the watershed.

Figure 18. BLM, Forest Service, and private ownership as a percent of the fifth-field watersheds within the planning area



Ecology

Key Points

- The abundance of stand establishment forests is above the average for historic conditions.
- Stand establishment forests that are created by timber harvesting usually lack the habitat complexity and legacy components that are typical of stand establishment forests following natural disturbances.
- Stand establishment forests have declined on federally managed forests over the past decade and are becoming restricted to nonfederal lands.
- The abundance of young forests is above the average for historic conditions.
- Young forests on BLM-administered lands are predominately high-density, even-aged stands that are developing along a trajectory that is fundamentally different from that experienced by most of the existing structurally complex forests on BLM-administered lands.
- The abundance of mature and structurally complex forests within the planning area is below the average for historic conditions.
- The growth of forests into a mature and structurally complex forested condition has far outpaced the loss of mature and structurally complex forests from harvesting and wildfires within the planning area over the past 10 years.

This section of Chapter 3 analyzes the ecological condition of conifer forests. Forest stands can be described by their structure, composition, and function. This analysis will focus on forest structure, because structure is the most easily analyzed, responds most predictably and apparently to management actions, and is closely related to many of the issues for analysis.

The structural development of conifer stands in the Pacific Northwest is a complex and continuous process. Pacific Northwest conifer forests are notable for the potential longevity and massive size of live trees, and enormous accumulations of coarse woody debris. Forest structure in the Pacific Northwest continues to develop for tremendously long time spans, perhaps even a millennium in the absence of stand-replacing disturbances (Spies 2004; Franklin et al. 2002). Therefore, there is more complexity in classifying the later stages of structural development in the conifer forests of the Pacific Northwest than in most forested regions.

The report titled *Forest Ecosystem Management: An Ecological, Economic, and Social Assessment* (FEMAT 1993) described ecological conditions throughout the range of the northern spotted owl. The FEMAT report described the history of forest management in the region (p. II-2, II-3), the terrestrial forest ecosystems with an overview of biological communities and ownership patterns (p. IV-3 to IV-8), and the current forest conditions with an emphasis on the structure, composition, and processes of late-successional forests (p. IV-8 to IV-12, IV-27 to IV-31). Those descriptions are incorporated by reference and the following paragraphs summarize them.

FEMAT
(Forest Ecosystem Management Assessment Team)

The 1993 presidentially assigned team of scientists, researchers, and technicians from seven federal agencies that created the report that was used as the basis for the Northwest Forest Plan.

The final supplemental environmental impact statement (USDA, USDI 1994) for the Northwest Forest Plan FEIS also analyzed the ecological conditions within the range of the northern spotted owl. The Northwest Forest Plan FSEIS relied partly on the FEMAT report, which was included as an appendix to the Northwest Forest Plan FSEIS. The Northwest Forest Plan FSEIS provided some additional discussion within each of the descriptions incorporated below, and those analyses are incorporated by reference (p. 3&4-11 to 3&4-29).

The FEMAT report and the Northwest Forest Plan focused on "late-successional and old-growth forest" (FSEIS, I-4 to I-6). As defined in the FEMAT report and the Northwest Forest Plan, the concept of late-successional forest included both mature and old-growth forests (FEMAT, IX-19; FSEIS, Glossary 9). The FEMAT report and the Northwest Forest Plan developed a management plan that was "based on returning the federal landscape toward an extent of old-growth forest more in line with what was here before widespread logging on federal lands. The historical extent was assumed to be adequate to sustain the native biological diversity associated with older forest." (Spies 2006, 83).

Late-successional forests are heterogeneous in structure and diverse in composition and function (FEMAT, IV-28 to IV-31). Since the publication of the FEMAT report in 1993, research has continued to refine scientific understanding of the development of existing late-successional forests. There are multiple developmental pathways to late-successional forest structure and composition across the region (Franklin and Van Pelt 2004; Spies 2004; Franklin et al. 2002). Research reconstructing the stand development of late-successional forests on BLM-administered lands in western Oregon suggests that large, old-growth trees generally developed under low stand densities (Spies 2006; Poage and Tappeiner 2002; Sensenig 2002; Tappeiner et al. 1997). In contrast, research by Winter et al. (2002), reconstructing a late-successional stand in western Washington, concluded that the stand initiated under high-density conditions (Winter et al. 2002). Although the research by Winter et al. (2002) represents only a single stand, its contrasting finding to the above research suggests that there may be strong regional differences in the development of late-successional forest conditions. The large data set from BLM-administered lands within the planning area make the conclusions from Poage and Tappeiner and Tappeiner et al. more relevant to this analysis.

The FEMAT report and the Northwest Forest Plan FSEIS described the role of silviculture, including the use of stand thinning, to accelerate the development of late-successional forest structural characteristics and to reduce the risk of stand-replacing fire (FEMAT, IV-33 to IV-36; FSEIS, 3&4-45, 3&4-47, 3&4-49). The Northwest Forest Plan FSEIS observed that late-successional forest development in young, managed stands may be retarded, or not occur at all, without silvicultural treatment (FSEIS, 3&4-49). Research in the last decade has reinforced the potential roles of silviculture and has provided a more detailed understanding of the effects of thinning on forest resources (Franklin et al. 2006; Spies 2006; Hayes et al. 2003; Muir et al. 2002; Carey 2000). The monitoring report titled *Northwest Forest Plan–The First Ten Years (1994-2003): A Synthesis of Monitoring and Research Results* (commonly known as the *Monitoring Synthesis Report*) affirmed the conclusions in the FEMAT report and the Northwest Forest Plan that thinning would restore ecological diversity and reduce the potential for loss from high-severity fires (Spies 2006, 110-111).

Ecological Conditions at the Regional Scale

The analysis in this section of *Chapter 3* (*Ecology*) will not provide a new analysis of forest conditions at the scale of the Northwest Forest Plan, which is the range of the northern spotted owl. The discussions below will summarize previous analyses and monitoring results and provide the context for this analysis, which is conducted at the scale of the planning area and physiographic provinces. The discussions below at the regional scale use the forest stage terminology (e.g., late-successional forest) of the original analyses rather than the structural stage classification terminology that was developed in this analysis.

Physiographic province

A region of the landscape with distinctive geographical features. There are five within the planning area:

- Coast Range
- Eastern Cascades
- Klamath
- Western Cascades
- Willamette Valley

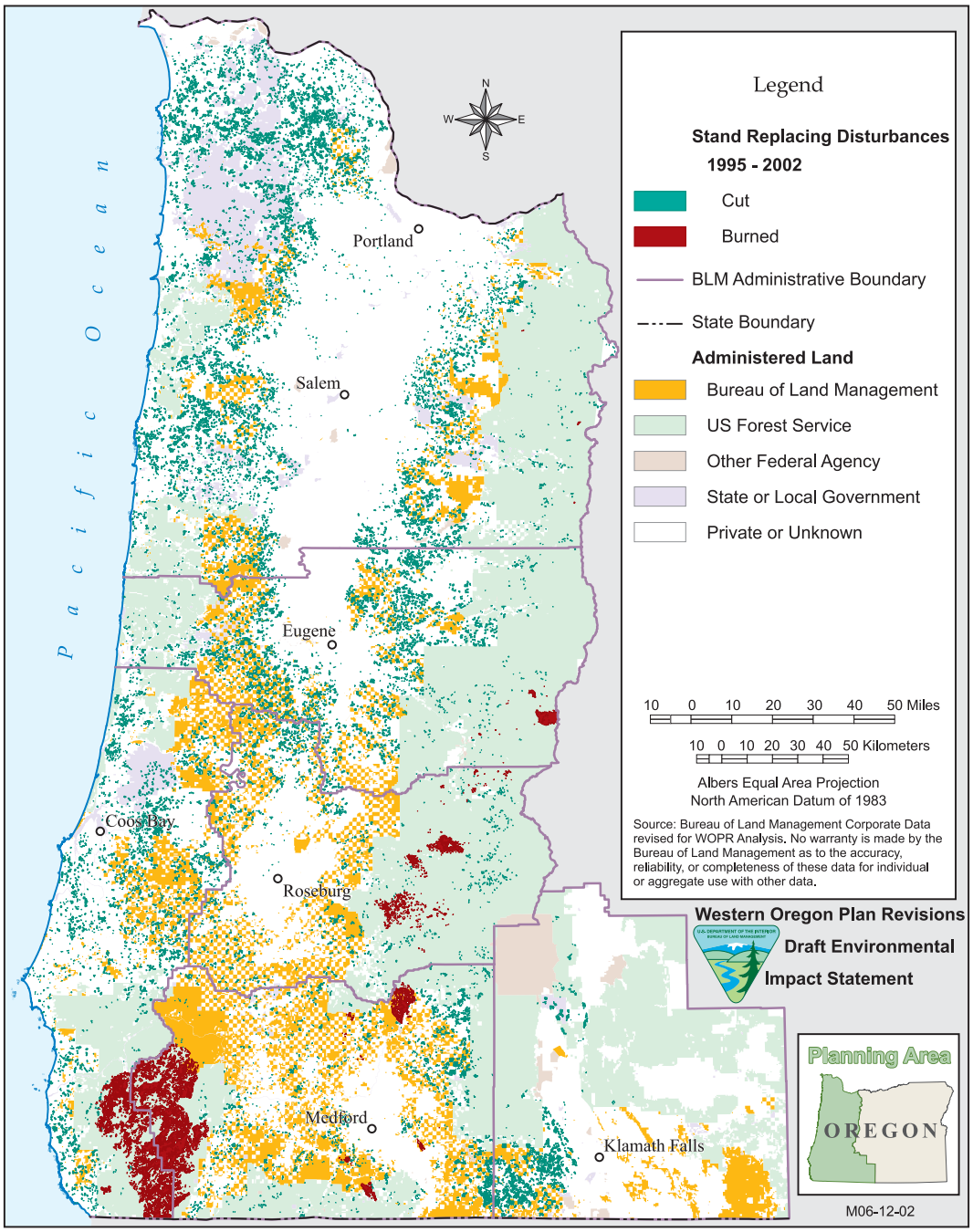
The Northwest Forest Plan FSEIS evaluated the abundance of late-successional forest by comparing abundance under each alternative to estimates of historic conditions (FSEIS, 3&4-36, 3&4-37):

- a "long-term average" of 65% of the region in late-successional forest, and
- a "long-term average low" of 40% of the region in late-successional forest.

The Northwest Forest Plan FSEIS estimated that there were 8.55 million acres of late-successional forest (described as medium and large conifer), which is approximately 35% of the 24.5 million acres of federally managed lands within the range of the northern spotted owl in 1994 (p. 3&4-27). The monitoring report titled *Northwest Forest Plan–The First Ten Years (1994-2003): Status and Trend of Late-Successional and Old-Growth Forest* (commonly known as the *Late-Successional Forest Monitoring Report*), using a similar definition but a remotely sensed data source, concluded that there were 7.87 million acres of late-successional forest on federally managed lands in 1994, and concluded that the plan was founded on valid assumptions about the extent of the remaining older forests (Moeur et al. 2005). The *Late-Successional Forest Monitoring Report* contains detailed descriptions of the abundance and distribution of late-successional forest by different measures, and those descriptions are incorporated by reference (Moeur et al. 2005, 44-110).

Since 1994, there has been a net increase of late-successional forest approximately twice the increase anticipated in the Northwest Forest Plan FSEIS. Growth of forests into the lower size range of late-successional forests has far outpaced losses of late-successional forest from harvesting and wildfire. Harvesting of late-successional forest has been far below the amount anticipated in the Northwest Forest Plan FSEIS. Loss of late-successional forest from wildfire in total has been approximately consistent with the amount anticipated in the Northwest Forest Plan FSEIS, though losses have been higher in the fire-prone forests of the Klamath province. See *Figure 19 (Disturbance map from the Northwest Forest Plan's Late-Successional Forest Monitoring Report)* (Spies 2006; Moeur et al. 2005, 39, 85-100, 104-106; FSEIS, 3&4-42).

Figure 19. Disturbance map from the Northwest Forest Plan's *Late-Successional Forest Monitoring Report*



At least 1.7 million acres of existing late-successional forests are in fire-adapted vegetation types that are characterized by high fire frequency and low fire severity in the Eastern Cascades and Klamath provinces, and up to 1 million acres are in dry mixed conifer types in the Western Cascades province. The *Late-Successional Forest Monitoring Report* and the *Monitoring Synthesis Report* identified that this large acreage of late-successional forest that is susceptible to catastrophic wildfire may be a concern,

and concluded that the possibility of major losses of late-successional forest in fire-prone ecosystems cannot be ignored (Spies 2006; Moeur et al. 2005, 100-102, 107-108).

Nonfederal forests within the range of the northern spotted owl are predominately young, even-aged, managed stands, and provide mostly early and mid-successional forest habitat. The Northwest Forest Plan FSEIS characterized typical management on nonfederal forest lands as including timber harvesting in a stand's fifth or sixth decade (FSEIS, 3&4-5 to 3&4-8). Since 1994, harvest rotations on forest industry lands have generally shortened (Nonaka and Spies 2005; Kennedy 2005, 110-117; Alig et al. 2000, 9). The Northwest Forest Plan assumed that nonfederal forests would contribute little to late-successional goals, but the *Monitoring Synthesis Report* acknowledged that this assumption may not have been correct, and that nonfederal lands, especially state lands, provide substantial late-successional forest (Spies 2006, 108).

The implementation of the Northwest Forest Plan reduced harvest levels on federally managed forests from recent historic levels. The vast majority of harvests and subsequent creation of early successional habitat is now occurring on nonfederal lands. The *Monitoring Synthesis Report* acknowledged that the Northwest Forest Plan did not explicitly provide for the biological diversity that is associated with early successional habitats. The *Monitoring Synthesis Report* observed that nonfederal lands cannot be assumed to provide for these elements of biological diversity because of the lack of diverse, early successional habitat with structural legacies on nonfederal lands (Spies 2006, 109).

The FEMAT report and the Northwest Forest Plan FSEIS provided a brief, qualitative evaluation of the existing spatial patterns of late-successional forests. Those analyses stated that what little late-successional forest remained on private and state lands occurred in small, isolated patches, and that most late-successional forests on federal forests are highly fragmented by harvested areas and young stands (FEMAT, IV-12; FSEIS, 3&4-29). The Northwest Forest Plan FSEIS evaluated the spatial patterns of alternatives by the connectivity of late-successional forest—measuring the distances between late-successional forested patches (FSEIS, 3&4-38 to 3&4-40). The Northwest Forest Plan FSEIS concluded that implementation of the Northwest Forest Plan would likely result in "moderate to strong" connectivity among late-successional forests (Spies 2006; FSEIS, 3&4-44, 3&4-46). However, that analysis did not project the retention or development of late-successional forests within the harvest land base unless explicitly reserved through the standards and guidelines (FSEIS, 3&4-42, 3&4-43).

Ecological Conditions at the Planning Area Scale

The ecological conditions at the scale of the planning area are discussed in terms of the structural stages of forests and physiographic provinces. See *Figure 20 (Percent of BLM-administered land within each of the physiographic provinces within the planning area)* and *Figure 21 (Physiographic provinces and BLM lands within the planning area)*.

Figure 20. Percent of BLM-administered land within each of the physiographic provinces within the planning area

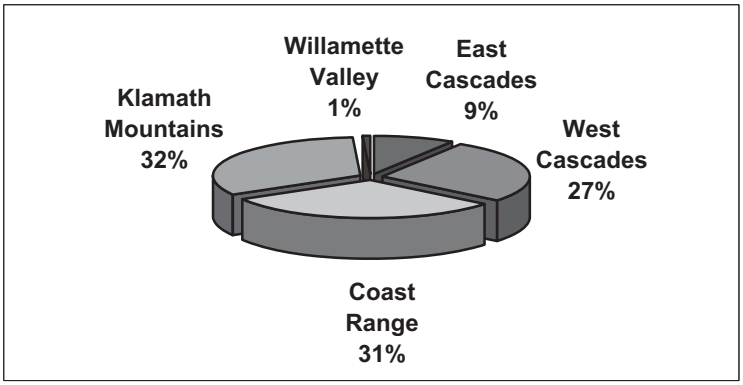
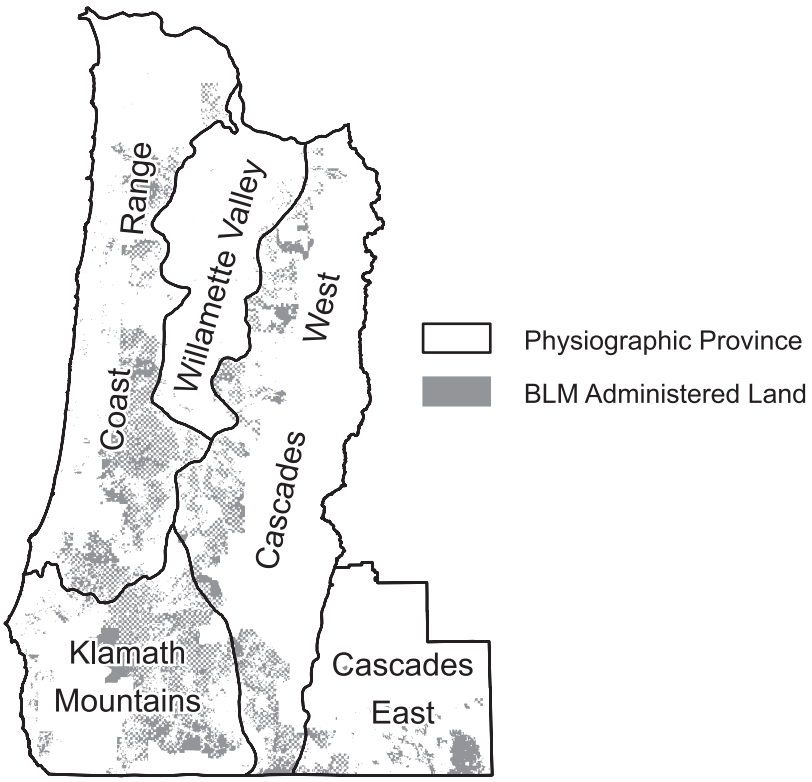


Figure 21. Physiographic provinces and BLM lands within the planning area



Forests are classified in this analysis by four structural stage classifications:

- stand establishment
- young
- mature
- structurally complex.

These four structural classes are further subdivided by additional structural descriptors See *Table 65 (Structural stage subdivisions)*. Most discussions in this section will only use the four classes described above. The subdivisions are applied only to BLM-administered lands and are used in this section only where needed to address specific analytical questions. A detailed description of the structural classifications is provided in *Appendix B. Ecology*.

Table 65. structural stage subdivisions

Structural Stages	Subdivisions	Descriptions
Stand Establishment	Stand Establishment without Structural Legacies	Very young forest (< 50 ft. tall) without larger trees
	Stand Establishment with Structural Legacies	Very young forest (< 50 ft. tall) with some larger trees
Young	Young without Structural Legacies	Taller than stand establishment, but still small (< 20 in. dbh) and without larger trees
	Young with Structural Legacies	Taller than stand establishment, but still small (< 20 in. dbh) and with some larger trees
Mature	Mature with Single-Layered Canopy	Larger trees (> 20 in. dbh) with little variation in tree size
	Mature with Multilayered Canopy	Larger trees (> 20 in. dbh) with more than one canopy layer
Structurally Complex	Existing Old Forest[ab]	Stands currently 200 years or older
	Developed Structurally Complex[c]	Larger trees (> 20 in. dbh) with some very large trees (> 40 in. dbh) and more than one canopy layer

Notes:

[a]Stands identified in the current inventory as 200 years or older remain in this subdivision in the future unless harvested.

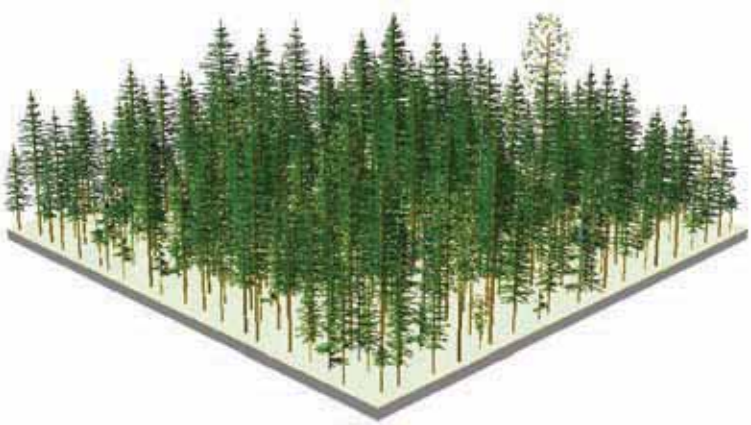
[b]A subset of this subdivision (Existing Very Old Forest, which represents stands that are 400 years or older) is also identified based on current inventory. The assignment of ages to these unmanaged stands is imprecise, but represents the only available data across BLM-administered lands within the planning area.

[c]Forests are classified in this subdivision if they have the structural attributes identified but are not 200 years or older in the current inventory. It includes stands that currently have the attributes of structurally complex stands and those stands that develop the attributes of structurally complex stands in the future.

This classification uses only measures of live trees. The dynamics of coarse woody debris and snags are integral to ecological definitions of late-successional forests, and there is increasing understanding of the importance of dead wood in early-successional forests (Franklin et al. 2002; Spies and Franklin 1988). However, this classification does not include measures of dead wood because of inadequate inventory of dead wood (Spies 2006), the high variability of dead wood levels in unmanaged forests (Spies and Franklin 1991), and the difficulty in modeling future creation of dead wood from such disturbances as fire or wind (Kennedy 2005, 97-160).

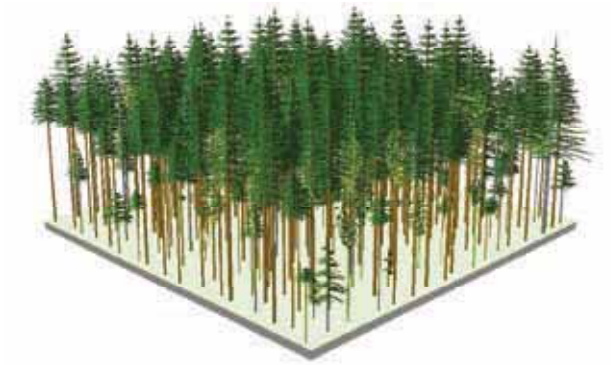
The stand establishment structural stage describes the early-successional conditions of a forest following such disturbances as timber harvesting or wildfires. This classification is comparable to the cohort establishment stage in Franklin et al. (2002). This classification is subdivided based on whether the new forest includes trees from the previous forest (with or without structural legacies). See *Figure 22 (Stand establishment forest without structural legacies)*. Natural disturbances within the planning area typically do not kill all trees within a stand, and surviving trees have important influences on stand development (Franklin et al. 2002; Aber et al. 2000).

Figure 22. Stand establishment forest without structural legacies



Young forests approximate small conifer forests as used in the FEMAT report and the Northwest Forest Plan. This classification is subdivided, like stand establishment, based on whether the young forest includes trees from the previous forest. See *Figure 23 (Young forest without structural legacies)*. Young forests with structural legacies develop from stand establishment forests that have structural legacies. Young forests with structural legacies typically develop directly into mature forests with multilayered canopies, whereas young forests without structural legacies typically develop into mature forests with a single-layered canopy.

Figure 23. Young forest without structural legacies



Mature forests are defined similarly to mature forests as described in the FEMAT report and the Northwest Forest Plan (although the definition in this analysis uses a lower threshold for the density of large trees in the southern portion of the planning area to reflect the generally lower site quality). This classification is subdivided based on whether the forest has a single-layered or multilayered canopy. See *Figure 24 (Mature forest with multilayered canopies)*. The development of multiple canopy layers may arise from the development of a new cohort of shade-tolerant trees below an older overstory or from prolonged or continuous tree regeneration in open young forests. This classification uses the diversity of tree diameters as a surrogate for direct modeling of tree crowns. (Development of continuous tree canopies may also arise from canopy trees re-establishing lower branches as the stand becomes more open. This process would not be detected by the subdivision in this classification. However, this process is typically associated with later stages of stand development, and therefore is part of the structurally complex structural stage in this classification scheme).

Figure 24. Mature forest with multilayered canopies

Mature forests with single-layered canopies typically must develop into mature forests with multilayered canopies first, before developing into structurally complex forests. This is because one of the defining characteristics of structurally complex forests is multiple canopy layers. Mature forests with multilayered canopies provide the precursors

to structurally complex forests, ensuring a replacement of structurally complex forests that are removed by timber harvesting or natural disturbances. Mature forests with multilayered canopies would provide more of the functions that are associated with structural complex forests, such as habitat for species that are associated with late-successional forests, than would mature forests with single-layered canopies (Spies 2006, 93; Washington State Department of Natural Resources 2005, 9-10).

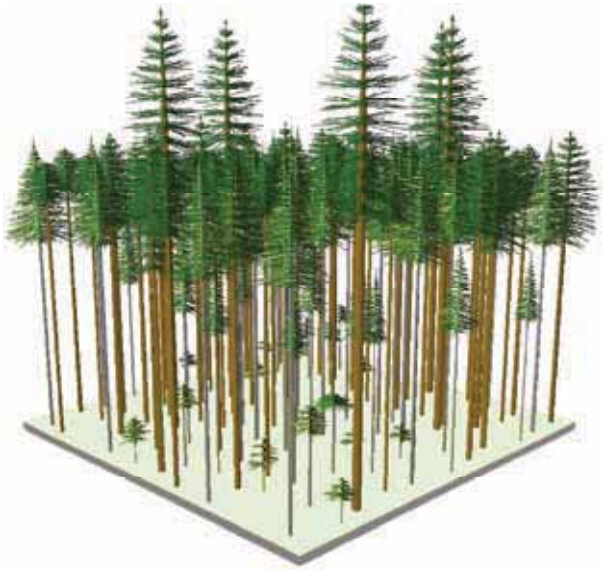
Together, mature and structurally complex forests approximate what is termed late-successional forest in the FEMAT report, the Northwest Forest Plan, and the district resource management plans.

Structurally complex forests approximate what is termed:

- old-growth forests in many analyses (e.g., district resource management plans and environmental impact statements);
- medium and large conifer multistory forests in the FEMAT report; and
- large, multistoried older forest in the *Late-Successional Forest Monitoring Report* (Moeur et al. 2005).

See *Figure 25 (Structurally complex forest)*.

Figure 25. Structurally complex forest



The structural development of structurally complex forests is a continuous and variable process, and the structure and composition of very old stands is not equivalent to those of the younger, less developed forests that are classified as structurally complex (Spies 2006; Washington State Department of Natural Resources 2005; Franklin and Van Pelt 2004; Spies 2004; Franklin et al. 2002). The structural complexity of forests continues to develop for many centuries after meeting the minimum criteria for a structurally complex forest (Franklin et al. 2002). The older, more complex forests provide superior habitat for some species, such as *Nephroma occultum* and *Pseudocyphellaria*

rainierensis, that are slow to colonize habitats, are highly sensitive to disturbance, or prefer highly complex canopy structure (USDA, USDI 2004a). However, there is inadequate information to evaluate whether older structurally complex forests would provide superior habitat to younger structurally complex forests for most species that are related to late-successional forests.

This analysis does not classify forests by age alone (though some parts of the analysis use stand age), because stand age alone does not reliably describe the structural conditions of stands (Franklin et al. 2006; Spies 2006; Moeur et al. 2005; Spies and Franklin 1991; Spies and Franklin 1988). The rate of development of several forest structural characteristics that are relevant to the issues in this analysis, such as large individual trees and multiple canopy layers, is dependent partly on the forest management actions that would differ among the alternatives. This differential rate of structural development would be masked by classifying the forest solely by age. Furthermore, classifying stands by age is problematic in mixed-aged stands. Stand age is used here to distinguish between existing old forest and existing very old forest within the broader classification of structurally complex forests.

There is inadequate information on existing stands to distinguish among levels of complexity among structurally complex forests. Current structurally complex forests are mostly or exclusively unmanaged stands, and the BLM has less stand-level inventory information regarding these stands than for managed stands. Therefore, this classification describes a subdivision of structurally complex forest as existing old forest (stands identified in the current inventory as 200 years or older), and a further subset of this subdivision of existing very old forest (stands identified in the current inventory as 400 years or older). The assignment of ages to these unmanaged stands is imprecise and was usually made based on qualitative and subjective evaluation, but this represents the only available data on stand age across the BLM-administered lands within the planning area. The existing old forest subdivision and existing very old forest subset labels do not directly describe structurally complex stands with the greatest structural complexity. However, without more detailed stand structural information, these forests are most likely to have the most developed structure and the longest time since a disturbance of the structurally complex forests.

Some analyses have evaluated forest structural complexity using an index approach rather than discrete thresholds for classifications (e.g., Washington State Department of Natural Resources 2005; Spies and Franklin 1991; Spies and Franklin 1988). An index approach can be effective and informative when used to classify existing conditions at the stand level, if there is an abundance of stand-level data (e.g., Spies and Franklin 1991). However, an index approach would produce an analysis of bewildering complexity if used to analyze multiple alternatives modeled into the future.

The structural stages for all lands other than the BLM-administered lands are classified using data from the Interagency Vegetation Mapping Project (IVMP), which uses satellite imagery to classify attributes of forest vegetation. See *Appendix B. Ecology*. Moeur et al. (2005) discuss the accuracy of mapping forest vegetation from IVMP data and conclude that it provides the best practice for classifying forest vegetation across all

ownerships in a region (Moeur et al. 2005, 18-30, 108-109, 123-128). Those discussions are incorporated by reference. The BLM-administered lands are classified for both the current and future conditions based on OPTIONS model outputs rather than IVMP data.

For analyses across all ownerships, the four classes of structural stages that are defined above are reduced to three classes—combining structurally complex and mature, which is equivalent to late-successional forest in other analyses. IVMP data cannot reliably distinguish between mature and structurally complex forests (Spies 2006; Moeur et al. 2005, 103-104). This analysis will refer to this combined class as mature&structurally complex forest.

Average Historic Conditions

This analysis compares the abundance and spatial patterns of the structural stages to average historical conditions, as did the FEMAT report and the Northwest Forest Plan FSEIS.

The FEMAT report estimated that 60 to 70% of the region was historically in mature&structurally complex forests (FEMAT, IV-51). At the scale of the physiographic provinces (e.g., the Coast Range), the amount of mature&structurally complex forests probably fluctuated between approximately 50 to 85% of the landscape (Spies 2006; Nonaka and Spies 2005; Wimberly 2002; Wimberly et al. 2000; Rasmussen and Ripple 1998).[1] The FEMAT report (with its focus on late-successional forest) did not characterize the abundance or spatial patterns of forest conditions other than for late-successional forests.

This analysis uses the descriptions of average historic conditions from Nonaka and Spies (2005) and the draft Rapid Assessment Reference Condition Model (USDA, USDI 2005a). Historic landscape conditions were dynamic, and the abundance of structural stages varied over time. Spies (2006) noted further that "no single point or short period can realistically be used to characterize this dynamic system." However, comparing effects over time under multiple alternatives to a range of conditions would have the following problems.

- There are no existing characterizations of the range of historic conditions that match the geographic scale of the planning area.
- The magnitude of the range of historic conditions is highly dependent upon the spatial scale of analysis, and the range is so wide at fine scales as to be uninformative (Wimberly et al. 2000).
- A comparison to a range of conditions would not provide for a clear comparison of the alternatives.

[1] Note that these studies modeled the historic range of variability for the Coast Range. Descriptions of the reference conditions vary for the other provinces (USDA, USDI 2005a), but these results are consistent with the region-wide estimates in the FEMAT report.

See *Appendix B. Ecology* for the average historical conditions and the historic range of variability). Therefore, this analysis uses average historic conditions rather than a historic range of variability as a benchmark for comparing the effects of the alternatives.

For the entire planning area, this analysis uses average structural stage abundance and spatial patterns from Nonaka and Spies (2005), which modeled historic conditions in the Coast Range. Although this research was conducted on only a portion of the planning area, it presents the only available description of historic spatial patterns at a broad scale, and the abundance results are consistent with the region-wide estimates of late-successional forest in the FEMAT report. The age classes in Nonaka and Spies were combined for comparison to the structural stages in this analysis. Average historic conditions adapted from Nonaka and Spies approximately correlate to 5% stand establishment, 15% young, 25% mature, and 55% structurally complex.

Wimberly (2002) also modeled historical ranges of variability in the Coast Range and found slightly different median average values, which would correlate to 17% stand establishment; 21% young; 16% mature; 42% structurally complex. Forest classes were defined differently in Wimberly. Notably, Wimberly defined the early successional forests, which correlate to stand establishment forests here, more broadly than Nonaka and Spies. Also, Wimberly assumed that both high-severity and moderate-severity fires reestablished early successional forests, whereas Nonaka and Spies assumed that only high-severity fires reestablished early successional forests (Nonaka and Spies 2005, 1737). Finally, comparison of mean averages from one model to median averages from another model is inherently problematic. Neither of these characterizations of average historic conditions is definitive, and the analysis here is attempting to make use of average values rather than a range describing the variability of a dynamic system. Using the average historic conditions from Wimberly as a benchmark for the comparison of alternatives would necessarily yield different conclusions about the absolute relationship of the effects of a specific alternative to average historic conditions. However, using a different benchmark for average historic conditions would not alter conclusions about the relative effects of the alternatives.

For individual physiographic provinces, this analysis uses the description of structural stage abundance from the draft Rapid Assessment Reference Condition Model (USDA, USDI 2005a). These models derive historic abundances by modeling disturbance probabilities that are generated from mean fire-return intervals combined with the probabilities of other disturbances (such as wind, insect, and pathogens). These models describe the average amount of the landscape that would be expected in each of the broad vegetation classes, which are roughly equivalent to the structural stages used in this analysis. The Coast Range and Western Cascades provinces are compared to

the Douglas fir hemlock wet-mesic model.[2] The Klamath province is compared to the mixed conifer-southwest Oregon model. The Eastern Cascades province is compared to the dry ponderosa pine-mesic model. These reference condition models provide representative descriptions of common conditions in each province. However, the provinces include other models, some of which describe other patterns of abundance. For example, the Coast Range and Western Cascades provinces include the Douglas fir Willamette Valley foothills model, which describes more stand establishment and young forest (15% and 25%, respectively). The Klamath province includes the Oregon coastal tanoak model, which describes more young forest (60%).

Abundance of Structural Stages

Stand establishment forests currently comprise 48% of the forested lands within the planning area across all ownerships. See *Table 66 (Current structural stage abundance on forested lands)*.[3] Stand establishment forests have declined on BLM-administered and Forest Service lands and are becoming restricted to nonfederal lands. Despite the decline on federal forests, stand establishment forests across all ownerships are still above average historical conditions.

Intensive forest management practices on forest industry lands (including site preparation, rapid and dense replanting, and herbicide application) simplify the structure and composition of stand establishment habitat and shorten the time until canopy closure. As a result, stand establishment forests created by timber harvesting lack the habitat complexity and legacy components typical of stand establishment forests following natural disturbances (Spies 2006; Ohmann et al. 2005; Cohen et al. 2002; Franklin et al. 2002; Aber et al. 2000; Perry 1998).

On BLM-administered lands, stand establishment forests currently comprise 7% of forest-capable lands, which is close to average historical conditions. These forests are predominately (79%) stand establishment forests without structural legacies, resulting from regeneration harvesting before the Northwest Forest Plan.

Young forests currently comprise 17% of the forested lands within the planning area across all ownerships. See *Table 66 (Current structural stage abundance on forested lands)*, which is above average historical conditions. Young forests on BLM-administered lands are predominately high-density, even-aged managed

[2] Analysis of structural stage abundance by physiographic province splits the small acreage of BLM-administered lands in the Willamette Valley province at Interstate 5 and combines the resultant portions with the Coast Range and West Cascades provinces.

[3] Current condition structural stage abundance differs slightly among the alternatives because of differences in how the inventory information is assembled for modeling under each alternative. The structural stage classification is made based on the Organon growth and yield curve attributes. The assignment of groupings of stands to specific yield curves varies among the alternatives, which results in slightly different current conditions. In addition, the classification for Alternatives 2 and 3 improved the identification of open water as non forest. Therefore, the following descriptions of current conditions use the 2006 data from Alternative 3.

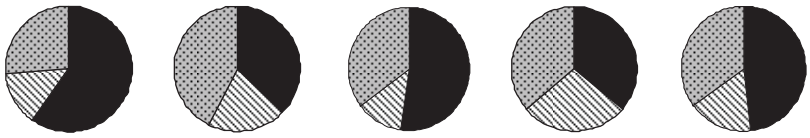
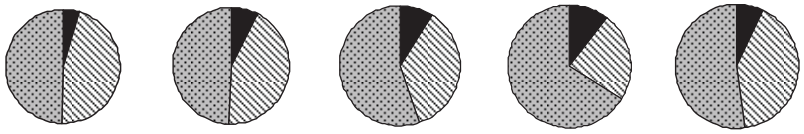
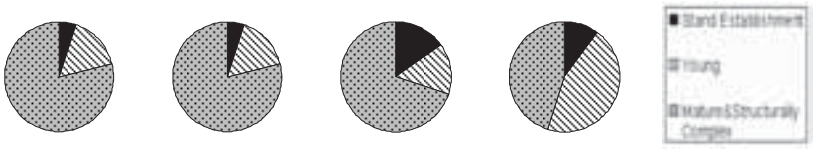
stands. Most of these stands were established following timber harvesting and intensive site preparation practices. This management history has created stands with a homogeneous structure, uniform tree composition, and high tree density. These young forests are developing along a trajectory that is fundamentally different from that experienced by most of the existing structurally complex forests on BLM-administered lands (Muir et al. 2002; Poage and Tappeiner 2002; Sensenig 2002; Tappeiner et al. 1997).

On BLM-administered lands, young forests currently comprise 42% of forest-capable lands. These are predominately (78%) young forests without structural legacies.

Mature&structurally complex forests currently comprise 35% of forested lands within the planning area across all ownerships. See *Table 66 (Current structural stage abundance on forested lands)*. The abundance of mature&structurally complex forests within the planning area is well below the average historical condition of 80%.

On BLM-administered lands, mature&structurally complex forests together currently comprise 51% of forest-capable lands. Mature forests comprise 28% and structurally complex forests comprise 23% of forest-capable lands. Mature forests are predominately (82%) mature forests with multilayered canopies. Structurally complex forests are predominately existing old forest (60%) with a smaller amount of developed structurally complex (37%) (i.e., stands that meet the defining attributes of structurally complex but are identified as less than 200 years old in the current inventory), and only a very small amount of existing very old forest (3%). While establishing accurate stand ages for unmanaged stands is problematic, as described above, structurally complex forests on BLM-administered lands are dominated by stands that are less than 400 years old. This is in contrast to the extensive acreage of structurally complex forest in national forests in the Western Cascades province (most of which is 400 to 500 years old) (Weisberg and Swanson 2003).

Table 66. Current structural stage abundance on forested lands

Structural Stage Abundance	Acres	Physiographic Provinces				Totals per Stage
		Coast Range	Western Cascades	Klamath	Eastern Cascades	
Stand Establishment	All ownerships	3,393,000	2,362,000	1,812,000	209,000	**7,776,000**
	BLM only	34,000	48,000	68,000	5,000	**155,000**
Young	All ownerships	790,000	1,295,000	441,000	159,000	**2,685,000**
	BLM only	340,000	274,000	278,000	11,000	**902,000**
Mature&Structurally Complex	All ownerships	1,487,000	2,694,000	1,225,000	211,000	**5,617,000**
	BLM only	370,000	311,000	427,000	32,000	**1,140,000**
Totals per Province	**All ownerships**	**5,670,000**	**6,352,000**	**3,478,000**	**578,000**	**16,078,000**
	BLM only	**743,000**	**633,000**	**773,000**	**49,000**	**2,197,000**
Current Condition	All ownerships					
	BLM only					
Historical Average Condition of Forested Lands (USDA, USDI 2005a)						

Hardwood stands are typically dominated by red alder or big leaf maple in the Coast Range and Western Cascades provinces, by madrone and oaks in the Klamath province, and by tanoak in the coastal portion of the Klamath province. Hardwood stands provide many ecological functions that are distinct from conifer stands and are hotspots for biological diversity (Kennedy and Spies 2005). Red alder stands are particularly noted for nitrogen fixation and high-nitrogen litter (Harrington 2006; Compton et al. 2003). The nitrogen levels in alder stands generally contribute to high growth rates for trees, but nitrogen inputs by alder stands on sites that are already nitrogen rich may lead to nutrient imbalances, which may predispose coastal Douglas fir stands to intensification of Swiss needle cast disease (Perakis et al. 2006; Compton et al. 2003; Maguire et al. 2000). Other hardwood stands, especially dry upland sites dominated by oaks, madrone, or tanoak, are characterized by a lower soil fertility and have nitrogen levels that are more limited.

It is not possible to quantify the abundance or map the location of hardwood stands at this scale of analysis. Hardwood stands are often interspersed with conifer stands throughout the planning area. For example, red alder-dominated riparian stands are typically classified together with the adjacent upland conifer stand. In southwestern Oregon, oak, madrone, or tanoak stands are typically finely interspersed with conifer stands without discrete boundaries. Both cases generally result in classifying the stand as mixed or conifer-dominated in forest inventories. In the Coast Range province, Ohmann et al. (2005) modeled hardwood stand abundance as approximately 7% of the landscape across all ownerships. Hardwood abundance is likely lower in the Western Cascades and Eastern Cascades provinces, and higher in the Klamath province.

Spatial Patterns of Structural Stages

The spatial arrangement of forest structural stages influences fundamental ecosystem processes, such as the flows of energy, materials, and organisms (Nonaka and Spies 2005; Forman 1995). In addition to the abundance of structural stages, this analysis describes the spatial patterns of structural stages to evaluate forest fragmentation and connectivity.

Fragmentation is the breaking up of large habitat areas into smaller patches. Fragmentation is often coupled with habitat loss. The two processes together have a cumulative effect that can result in an overall reduction in biological diversity. The populations of species that are associated with mature&structurally complex forests are more likely to decline in a fragmented landscape because of the smaller patches of suitable habitat and the greater isolation from neighboring populations (Jules 1998; Forman 1995; FSEIS, 3&4-29 to 3&4-31). As habitat is fragmented, the connectivity of the habitat decreases. Beyond some threshold, fragmentation disrupts connectivity of the habitat and contributes to population declines. Such thresholds are poorly understood for most species and depend on the scale at which a species interacts with its habitat (With and Crist 1995).

Larger habitat patches can support greater species diversity. For many species that are associated with mature&structurally complex forests, patches below a certain size are no longer suitable habitat. However, these minimum patch sizes are highly species-specific (to the limited extent they have been quantified). For example, Carey et al. (1992) suggest that a breeding pair of northern spotted owls requires a mature&structurally complex forest patch of about 2,000 acres in mixed conifer forests, whereas marbled murrelets use much smaller patches for nesting (ranging from 7 to 368 acres) (Ralph et al. 1995). Smaller patch size leads to increased amounts of edge habitat and decreased amounts of interior forest habitat. Edge habitats are created where contrasting habitat types abut. Edges between mature&structurally complex forests and stand establishment or young forests are characterized by altered microclimate and altered biological interactions (Forman 1995, 412-415). The depth of edge habitat varies for specific biophysical characteristics and ecological processes, and is strongly

influenced by the degree of contrast between habitat types and such physical conditions as slope and aspect.

This analysis examines spatial patterns of the forested landscape using FRAGSTATS, a spatial patterns analysis program for categorical maps. See *Appendix B. Ecology*. FRAGSTATS quantifies the aerial extent and spatial configuration of patches within a landscape. The user defines and scales the landscape (including the extent and grain of the landscape) and the scheme upon which patches are classified and delineated. For a given landscape mosaic, FRAGSTATS computes several metrics for:

- each patch in the mosaic;
- each patch type (class) in the mosaic; and
- the landscape mosaic as a whole.

For this analysis, patches are delineated as stand establishment, young, or mature&structurally complex forest. As noted above, the IVMP data used to classify non-BLM-administered lands cannot reliably distinguish between mature and structurally complex forest, and therefore these structural stages are combined for this portion of the analysis. Additionally, the contrast between mature and structurally complex forest patches is too low to constitute an edge for many important ecological processes (such as the habitat for the northern spotted owls). Nonforest is not included in the spatial analysis.

FRAGSTATS produces a wealth of metrics, many of which are highly correlated. For any given analysis of spatial patterns, many of the metrics do not reveal clear patterns. The analysis here uses the following metrics:

- mean patch size (mean average of the distribution of patch sizes); and
- connectance index (number of functional joinings between patches of the same structural stage; this analysis defines patches as functionally joined if they are within 1,969 feet (600 m)).

Results for additional metrics are included in the *Appendix B. Ecology*.

Spatial patterns are analyzed by province for BLM-administered lands, because the entire planning area comprises too large a database for computing many of the metrics. For all ownerships, even the province comprises too large a database for computing most metrics, including connectance. Therefore, only mean patch size is computed for all ownerships at the province scale. See *Table 67 (Current mean patch size by structural stage by province)*.

Table 67. Current mean patch size by structural stage by province

Structural Stages	Current Mean Patch Size (acres)	Physiographic Provinces			
		Coast Range	Western Cascades	Klamath	Eastern Cascades
Stand Establishment	All ownerships	25.5	29.2	30.2	44.4
	BLM only	44.3	21.5	41.9	14.5
Young	All ownerships	104.4	82.1	65.0	49.3
	BLM only	5.8	8.0	6.2	11.1
Mature&Structurally Complex	All ownerships	110.8	106.6	137.3	182.8
	BLM only	15.3	28.4	28.8	28.2

Note: Because the 2006 data differs slightly for the alternatives (as explained above), the spatial configuration differs among the alternatives. As with the abundance data above, the spatial pattern results for 2006 use data from Alternative 3.

The changes in spatial patterns over time from this analysis can be compared to the measures of spatial patterns from other studies or estimates of average historic conditions of spatial patterns to provide a qualitative evaluation of overall trends. However, a direct comparison of the absolute values of the spatial pattern measures should be made with caution. Measures of spatial patterns are highly dependent on the spatial extent of the analysis, the resolution of the data (i.e., the grain size), and the classification scheme (in this analysis, the structural stage classification). As these factors differ, the absolute values in the results will differ. For example, connectance is higher in the Eastern Cascades province than in other provinces for all structural stages partly because the spatial extent of this province is much smaller than the other provinces. See *Table 68 (Current connectance on BLM-administered lands by structural stage by province)*. The spatial extent, grain size, and classification scheme in this analysis differ from studies of historic spatial patterns within the planning area (Nonaka and Spies 2005; Wimberly 2002). Therefore, the results here should be compared to the results from those studies only to evaluate relative trends in spatial patterns, not to make a direct comparison of the absolute values of the specific spatial pattern measures.

Table 68. Current connectance on BLM-administered lands by structural stage by province

Structural Stages	Physiographic Provinces			
	Coast Range	Western Cascades	Klamath	Eastern Cascades
Stand Establishment	0.13	0.13	0.10	2.42
Young	0.09	0.10	0.08	1.22
Mature & Structurally Complex	0.09	0.11	0.10	1.64

Ecological Conditions at the Province Scale

The FEMAT report and the Northwest Forest Plan FSEIS provide general descriptions of the existing conditions at the province scale (FEMAT, IV-6 to IV-11; FSEIS, 3&4-16 to 3&4-28), but did not explicitly analyze the effects of the alternatives at the province scale. The six resource management plans and environmental impact statements (RMPs/EISs) for the six districts within the planning area described the vegetation communities, the characteristics of the stages of forest development, and the biological diversity and ecological health of the forest ecosystems within each BLM district. Each district analysis concluded, consistent with the FEMAT report and Northwest Forest Plan FSEIS, that late-successional forests have been reduced in abundance and highly fragmented by past timber harvesting and other land management activities (USDI, BLM 1994a, 3-23 to 3-39; USDI, BLM 1994b, 3-34 to 3-46; USDI, BLM 1994c, 3-18 to 3-45; USDI, BLM 1994d, 3-30 to 3-57; USDI, BLM 1994e, 3-17 to 3-42; USDI, BLM 1994f, 3-21 to 3-41, 3-63 to 3-66, 3-79 to 3-82). Those analyses are incorporated by reference.

Current conditions across in the Coast Range, Western Cascades, and Klamath provinces generally reflect the structural stage abundance and spatial patterns described for the planning area as a whole. The Eastern Cascades province differs from the other provinces in many measures of structural stage abundance and spatial patterns partly because of its differing ecological conditions and management history. However, these different patterns have little effect on the overall pattern for the planning area, because the Eastern Cascades province makes up only 2% of the BLM-administered forest lands modeled within the planning area.

Coast Range

The natural disturbance regime in much of the Coast Range province is characterized by infrequent, high-intensity fires and windstorms. Average historic forest conditions were 79% mature&structurally complex forests, 16% young forests, and 5% stand establishment forests (USDA, USDI 2005a).

Currently, the Coast Range province has more stand establishment forests and less mature&structurally complex forests than it did historically. The Coast Range province has little remaining mature&structurally complex forests, most of which are mature forests with highly fragmented patches of structurally complex forests, primarily on BLM-administered lands (FSEIS, 3&4-21, 3&4-25, 3&4-27). The mature&structurally complex forests currently comprise 26% of all forest lands in the province (50% of BLM-administered lands). Stand establishment forests currently comprise 60% of all forest lands in the province (5% of BLM-administered lands). See *Table 66 (Current structural stage abundance on forested lands)*.

The spatial patterns of structural stages in the Coast Range province has been strongly altered from historic conditions (Nonaka and Spies 2005; Wimberly 2002). Current spatial patterns in the Coast Range are characterized by small, scattered patches of mature&structurally complex forest set in a matrix of young and stand establishment forests. Mean patch size and connectance of mature&structurally complex forest is lower than average historic conditions (Nonaka and Spies 2005).

On BLM-administered lands, stand establishment forests are in fewer and smaller patches than young or mature&structurally complex forest, which is consistent with the overall abundance of structural stages.

Red alder stands in the Coast Range have increased in abundance since the 1930s (Wimberly and Ohmann 2004), but it is unknown how current hardwood abundance compares with the historical range of variability (Ohmann et al. 2005; Long et al.1998). The current distribution and abundance of red alder stands in the Coast Range has been considered by some to be an unnatural artifact of past timber harvesting practices (FEMAT, V-25). The increase in red alder stands is not continuing throughout the Coast Range. The abundance of red alder stands in the central Coast Range has been declining in recent decades, in contrast to the southern Coast Range (Kennedy and Spies 2005; Wimberley and Ohmann 2004). Forest management practices will likely reduce the abundance of red alder stands within the planning area (Spies 2006; Alig et al. 2000).

Swiss needle cast, caused by the native fungus, *Phaeocryptopus gaeumannii,* has recently caused substantial growth loss of Douglas fir, primarily in young plantations within 30 miles of the coast (Kanaskie et al. 2005; Maguire et al. 2000; USDI, BLM 1994a, 3-27). Possible reasons for the increased effects of Swiss needle cast include shifting plantation composition to pure Douglas fir on sites that previously supported Sitka spruce, western red-cedar, and western hemlock; past planting of off-site Douglas fir; climate changes; and soil nutrition changes (Perakis et al. 2006; Campbell and Liegel 1996).

Western Cascades

The natural disturbance regime in the Western Cascades is complex with moderate or highly variable fire frequencies and intensities. Average historical conditions are similar to the Coast Range (USDA, USDI 2005a).

Like the Coast Range and Klamath provinces, the Western Cascades province currently has more stand establishment forest and less mature&structurally complex forest than average historical conditions. Nevertheless, the Western Cascades province currently has greater amounts of mature&structurally complex forests than other provinces, especially on Forest Service lands (FSEIS, 3&4-19, 3&4-20, 3&4-25, 3&4-27). Mature&structurally complex forests currently comprise 43% of all forest lands in the province (49% of BLM-administered lands). Stand establishment forests currently comprise 37% of all forest lands in

the province (8% of BLM-administered lands). See *Table 66 (Current structural stage abundance on forested lands)*.

There are no studies modeling the historic spatial patterns in the Western Cascades comparable to those done in the Coast Range, which approximated a range of historic patch sizes (Cissel et al. 1999). The overall comparison to current conditions is likely similar to the Coast Range with a current mean patch size and connectance of mature&structurally complex forest that is lower than average historic conditions.

As in the Coast Range, stand establishment forests on BLM-administered lands are in fewer and smaller patches than young or mature&structurally complex forest, which is consistent with the overall abundance of structural stages.

Klamath

The natural disturbance regime in much of the Klamath province is characterized by frequent, low-intensity fires. Forests in the Klamath province are highly fragmented by natural factors, and past cutting has resulted in many mixed-age stands (FSEIS, 3&4-22, 3&4-25, 3&4-27). Average historic forest conditions in most of the province were 70% mature&structurally complex forests, 15% young forests, and 15% stand establishment forests (mixed conifer southwest Oregon reference condition model; USDA, USDI 2005a). Other reference condition models are applicable in smaller portions of the province. For example, the Oregon coastal tanoak model, applicable to the coastal portions of the province, describes average historical forest conditions as 30% mature&structurally complex forests, 60% young forests, and 10% stand establishment forests (USDA, USDI 2005a). The dry ponderosa pine-mesic model, applicable to the dry sites in the eastern portion of the province, describes average historical forest conditions as 45% mature&structurally complex forests, 45% Young forests, and 10% Stand Establishment forests (USDA, USDI 2005a).

Like the Coast Range and Western Cascades, the Klamath province currently has more stand establishment forests and less mature&structurally complex forests than it did historically. Mature&structurally complex forests currently comprise 35% of all forest lands in the province (55% of BLM-administered lands). Stand establishment forests currently comprise 52% of all forest lands in the Klamath province (9% of BLM-administered lands). See *Table 66 (Current structural stage abundance on forested lands)*.

There are no studies modeling the historic spatial patterns in the Klamath province comparable to those done in the Coast Range. Historic spatial patterns were likely more variable and difficult to characterize, because of the complex interaction of highly variable geology and climate with the highly variable disturbance regimes. Therefore, comparisons to the historic spatial patterns for the province would be speculative.

As in the Coast Range and Western Cascades provinces, stand establishment forests on BLM-administered lands are in fewer and smaller patches than young or mature&structurally complex forests. The disparity in the patch size between stand establishment forests and young forests is less. The patch size of mature&structurally complex forests is larger than in the Coast Range or Western Cascades, which is consistent with the overall abundance of structural stages.

In the coastal Klamath province, Port-Orford cedar root rot, caused by the introduced pathogen, *Phytophthora lateralis*, has been killing Port-Orford cedar (*Chamaecyparis lawsoniana*). The supplemental environmental impact statement for management of Port-Orford cedar in southwest Oregon (USDA, USDI 2004b) described the ecological role of Port-Orford cedar, the spread of the disease, and the effects of different management actions to control the disease. That analysis concluded that the rate of the spread of the disease is decreasing, and that Port-Orford-cedar is not in danger of extirpation (USDA, USDI 2004b, 3&4-19 to 3&4-52). That analysis is incorporated by reference.

In the Klamath province, fire suppression has shifted fuel loads and tree species composition, which has made these stands more susceptible to drought-induced mortality, insect and disease mortality, and high-intensity, stand-replacing fires (Taylor and Skinner 2003; Frost and Sweeney 2000; FSEIS, 3&4-22; USDI, BLM 1994e, 3-24 to 3-26).

Eastern Cascades

Forests in the Eastern Cascades are highly fragmented by natural factors. The natural disturbance regime in much of the region is characterized by frequent, low-intensity fires. (FSEIS, 3&4-20, 3&4-21, 3&4-25, 3&4-27). The average historic forest conditions in the province were 45% mature&structurally complex forests, 45% young forests, and 10% stand establishment forests (USDA, USDI 2005a).

The Eastern Cascades province currently has slightly less mature&structurally complex forests, less young forests, and more stand establishment forests than it did historically. The mature&structurally complex forests currently comprise 36% of all forest lands in the province (66% of BLM-administered lands). Young forests currently comprise 27% of all forest lands in the province (23% of BLM-administered lands). Stand establishment forests currently comprise 37% of all forest lands in the province (11% of BLM-administered lands). See *Table 66 (Current structural stage abundance on forested lands)*.

The classification of structural stages in the Eastern Cascades province and the characterization of average historic conditions is more challenging than in any other province. The prevailing frequent, low-intensity fire regime produced stands that are difficult to classify. Most descriptions of the average historic abundance, including the estimates used above, would estimate greater abundance of stand establishment forest if all stands that were partially disturbed (such as by moderate- or low-severity fires) were classified as stand establishment forest.

There are no studies that are modeling the historic spatial patterns in the Eastern Cascades province comparable to those that were done in the Coast Range. The historic spatial patterns were likely very different from the Coast Range, because the frequent, low-intensity fire regime in the Eastern Cascades province would have produced a more fine-grained mosaic of structural stages.

The total acreage of the Eastern Cascades province within the planning area is far less than in the other provinces, which complicates the direct comparison of the measures of spatial patterns with other provinces. The extent of the landscape analyzed alters the absolute values of spatial pattern metrics, as explained above. As in the other provinces, stand establishment forests on BLM-administered lands in the Eastern Cascades province are in fewer and smaller patches than mature&structurally complex forests. However, unlike other provinces, the spatial patterns of young forests are similar to stand establishment forests, which is consistent with overall abundance. The Eastern Cascades has the lowest percentage of Young forest on BLM-administered lands of all the provinces within the planning area.

In the Eastern Cascades province, as in the Klamath province, fire suppression has shifted fuel loads and tree species composition, which has made these stands more susceptible to drought-induced mortality, insect and disease mortality, and high-intensity, stand-replacing fires (FSEIS, 3&4-20, 3&4-21; USDI, BLM 1994f, 3-24, 3-63 to 3-66, 3-79 to 3-82).

Socioeconomics

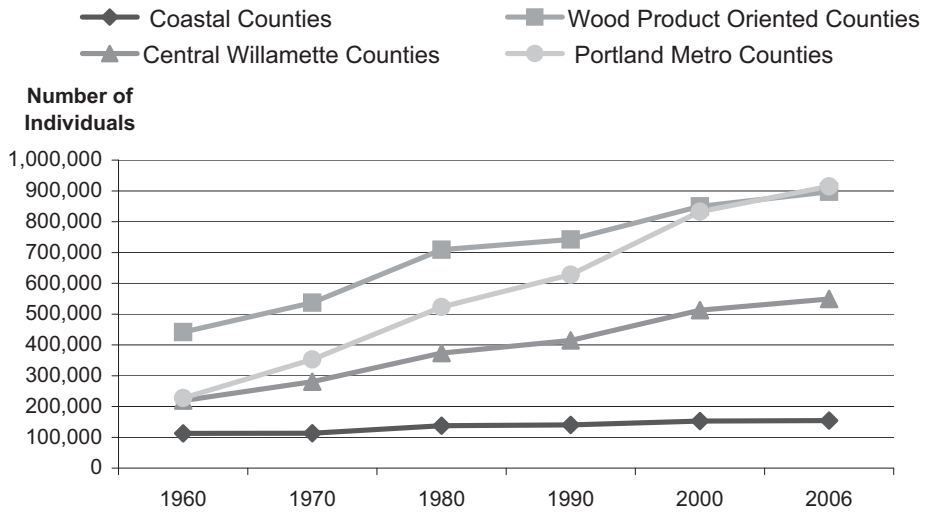
Key Points
• A comprehensive measure of community health and resiliency does not exist. • The Oregon primary wood products sector employs 51,900 workers that earn $1.9 billion annually, which is about 3.2% of Oregon's total wages. • In total, the counties rely on BLM-associated revenues for about 2.7% of their budgets. BLM revenues, however, account for 9.2% of their discretionary revenue ranging from less than 1% for larger metropolitan counties to up to 70% for rural counties. • Without funding under the Secure Rural Schools Act, BLM payments to counties would fall about 90%. • There is currently a strong market for wood products in western Oregon. There is adequate capacity to process larger logs that would come from BLM lands.

The management of BLM-administered lands contributes to the economic activity in western Oregon communities and can be measured. For example, timber harvesting and manufacture of wood products creates jobs and income in these sectors, which in turn stimulates economic activity in other sectors of local and regional economies. BLM employees, and BLM management expenditures also contribute to local economies. Approximately 50% of revenues received from timber harvesting on O&C lands, furthermore, flow directly to the county governments and is used to fund a variety of social services and investments.

Receipts from such nontimber sources as special forest products (approximately $300,000 annually) and grazing receipts ($30,000 to $40,000 annually) is relatively minor and would not vary between the alternatives. The nonmarket values (e.g., wildlife, recreation, and water quality) are not included in this analysis.

Oregon is a growth state with a history of relatively steady in-migration. The 2006 state population of 3.7 million has slightly more than doubled (109%) since 1960. In western Oregon, population growth is spatially concentrated and rates vary considerably by the nature of the economic base. See *Figure 26 (Oregon population growth by county group)*. Portland's metro counties (Clackamas, Columbia, and Washington, excluding Multnomah) started from a relatively low base but grew three times more rapidly (302%) during the same era. The central Willamette Valley counties (Benton, Marion, Polk, and Yamhill) grew 151%. Counties that are focused on wood products (Douglas, Jackson, Josephine, Klamath, Lane, and Linn) kept pace with state growth (103%). Only the coastal county group (Coos, Curry, Lincoln, and Tillamook) had significantly below average population growth (37%).

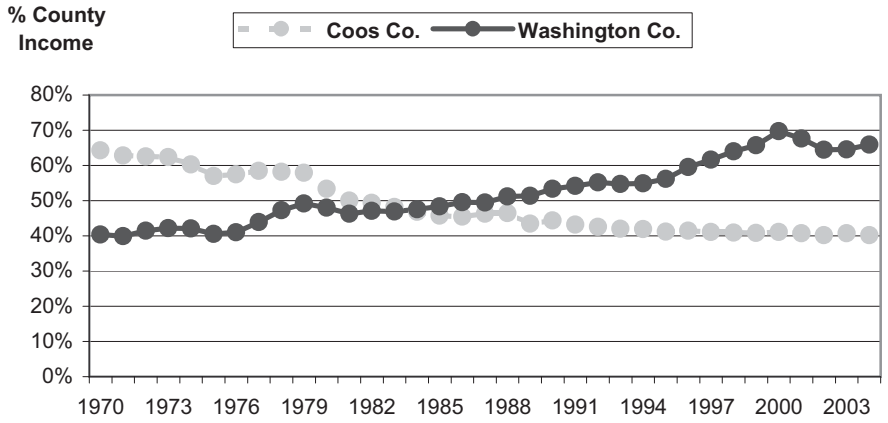
Figure 26. Oregon population growth by county group



County economies typically had a resource-based history (agriculture and wood products). A dominance of public land ownership gave federal forest policy shifts large influences over the evolution of those economies. Through most of the twentieth century, increasing federal harvests expanded local wood products industries. Since World War II, technological progress gradually decreased worker/output ratios. During the 1990s, federal harvest reductions under the Northwest Forest Plan led to a reduction in wood products sector jobs, wages, and salaries in most of the county economies.

Changes in county economies vary by county. There are differences in timber substitution capacity, contemporary economic diversity, and opportunities for alternative economic development. See *Figure 27 (Coos and Washington county wage and salary income as a percent of total income)*. Both counties experienced declining wage and salary income from the wood products sector but differed in the nature of income replacement. In Coos County, the percentage of income attributable to wages and salaries declined continuously due to decreasing wood products manufacturing and an increasing share of unearned income derived from retirement. Growth in the diversified Washington County economy, on the other hand, replaced resource sector incomes with increased wages in other developing sectors. The figure's comparison is in proportional terms to normalize the fact that the Washington County economy is 25 times larger.

Figure 27. Coos and Washington county wage and salary income as a percent of total income



In most cases, these new trajectories become permanent redirections. As returning these economies to their historic structures is unlikely, this analysis considers the 2005 base year structure as a stable reference point for evaluating any new economic changes.

The economies of the O&C counties vary in the magnitude, type, and diversity of economic activity. These differences affect the patterns of how each economy might be changed by new external effects. The initial size of each county economy can be profiled with three primary indicators. These are industrial output, total employment, and earnings. See *Table 69 (2005 county economy indicators)*.

These measures show a wide range of differences between the county economies. Curry County is a small economy with the region's lowest output, employment, and earnings. Washington County, on the other hand, has 49 times more industrial output, 25 times more employment, and 45 times more earnings. More detailed indicators (not shown) reveal quality-of-life implications as well. Curry County's average annual wage is $26,200 compared to $46,400 for Washington County.

Table 69. 2005 county economy indicators

County	Industrial Output ($1,000)	Employment (total jobs)	Earnings ($1,000)
Benton	4,208,367	37,603	1,416,139
Clackamas	19,046,826	197,405	6,994,767
Columbia	1,708,099	14,182	390,413
Coos	2,171,795	28,792	797,151
Curry	762,355	10,726	281,937
Douglas	4,732,462	52,770	1,469,009
Jackson	8,364,619	103,612	3,247,024
Josephine	2,676,289	37,253	1,033,446
Klamath	2,719,816	34,179	1,024,239
Lane	15,445,518	178,924	5,729,986
Lincoln	1,797,597	21,560	606,118
Linn	5,010,081	50,568	1,619,544
Marion	14,249,826	157,199	5,782,895
Polk	1,682,760	22,499	624,709
Tillamook	1,170,965	10,985	306,070
Washington	37,563,913	272,210	12,626,678
Yamhill	3,492,580	37,928	1,129,303
Region Total	126,803,868	1,268,395	45,079,428

The economic impact analysis (see *Chapter 4*) estimates the implications of three large external effects on each county economy between the base reference year of 2005 and the impact year of 2009.

These large external effects on each county are (Adams and Latta 2007):

- loss of Secure Rural School payments to counties,
- BLM's selection and implementation of one of the management alternatives in the plan revision, and
- structural changes in the plywood industry projected by the WOR model.

By artificially isolating the first two policy-driven effects, the county-level input-output models can estimate the roles of each effect in these county economies. *Table 70 (2005 county economy dependence on Secure Rural Schools and BLM effects)* shows the relative influence of combined Secure Rural School payments and current BLM harvest levels as of 2005. Using current employment as an indicator of impact, *Table 70 also* shows that the Secure Rural School funding and BLM expenditures account for a very small portion of the jobs in Washington County and up to 4.18% of the jobs in Douglas County. Counties with small portions of their economies dependent on Secure Rural School and BLM activities (less than 0.5%) would likely experience little overall impact from projected changes.

Table 70. 2005 county economy dependence on Secure Rural Schools and BLM effects

County	Industrial Output (%)	Employment (%)	Earnings (%)
Benton	0.23%	0.31%	0.28%
Clackamas	0.18%	0.13%	0.16%
Columbia	0.29%	0.37%	0.46%
Coos	1.63%	1.42%	1.80%
Curry	1.83%	2.19%	2.39%
Douglas	4.33%	4.18%	4.70%
Jackson	1.69%	1.56%	1.70%
Josephine	1.40%	1.26%	1.57%
Klamath	2.12%	1.67%	2.13%
Lane	1.18%	1.11%	1.35%
Lincoln	0.50%	0.66%	0.70%
Linn	0.84%	0.78%	0.99%
Marion	0.20%	0.17%	0.23%
Polk	0.24%	0.24%	0.30%
Tillamook	0.49%	0.72%	0.81%
Washington	0.01%	0.01%	0.01%
Yamhill	0.23%	0.16%	0.21%
Region Total	0.65%	0.71%	0.71%

Higher percentages in *Table 70* typically reflect a higher dependence on Secure Rural Schools funding, an economic concentration in woods products industries, and the location of BLM administrative units. Even though influence percentages appear small, their effects would be concentrated in specific sectors, which could concentrate the effects of any changes.

Together, the three external effects are expected to cause somewhat countervailing impacts spread to different sectors. The loss of the Secure Rural School payments would reduce jobs and income in county government. Increased BLM timber harvesting would increase wood products employment, but industrial contractions in the plywood sector would reduce jobs there. As a result, the economic response in any county depends as much on the internal economic structure of the county as well as its overall size. *Table 71 (2005 county economy grouped income patterns)* classifies each county into one of four indicative types defined by their general economic structure and diversity. Each type would react to changes differently.

Table 71. 2005 county economy grouped income patterns

Counties by Indicative Type	Sources of Income					
	Wage and Salary	Business **Profits**	Unearned DIR	Unearned Transfers	Commuting	Seasonal Homes
Coastal Counties						
Coos	46%	13%	16%	22%	1%	2%
Curry	26%	9%	31%	27%	5%	3%
Lincoln	31%	11%	17%	30%	2%	10%
Tillamook	38%	13%	16%	16%	3%	14%
Wood Products						
Douglas	49%	17%	7%	22%	4%	1%
Jackson	53%	13%	16%	16%	2%	0%
Josephine	45%	13%	14%	22%	5%	1%
Klamath	39%	10%	19%	28%	2%	2%
Lane	53%	16%	14%	15%	3%	1%
Linn	44%	13%	10%	16%	17%	0%
Central Willamette						
Benton	47%	17%	18%	8%	8%	0%
Marion	53%	13%	11%	13%	10%	0%
Polk	30%	7%	16%	13%	33%	0%
Yamhill	40%	12%	12%	12%	23%	0%
Portland Metro						
Clackamas	41%	14%	12%	8%	25%	0%
Columbia	22%	10%	19%	23%	25%	0%
Washington	48%	26%	8%	6%	11%	0%

The indicative types that the counties fit into are described as follows:

- **Coastal.** Counties on the coast have a relatively small percent of income derived from wage and salary employment. Seasonal home spending is proportionately larger than the rest of Oregon, particularly nearer Portland on the northern coast. Curry County has relatively larger property income (DIR) and transfers indicating retirees with higher incomes.[4]
- **Wood Products.** Counties that are based on wood products combine the highest proportions of wage and salary income with lower property incomes. Linn County is a bit of anomaly because of its high commuting rates--presumably to high wage jobs in Salem, Corvallis, and Eugene.

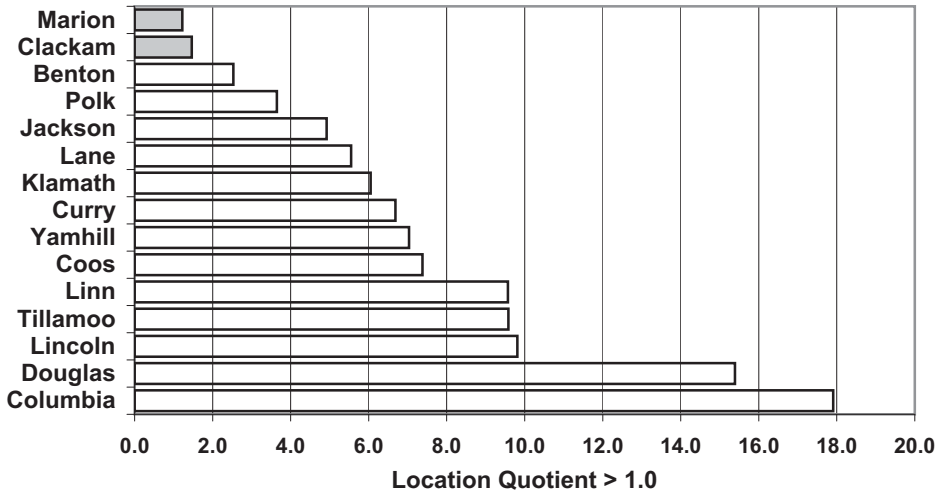
[4] DIR is the aggregate total of a category of unearned (or property) income "dividend, interest and rents". High DIR is typically associated with a retirement services economy.

- **Central.** Counties in the central Willamette Valley have significantly more commuting and earned income proportions (wage and salary income plus commuting). Earned income accounts for more than 60% of total income in these counties. These counties have the lowest overall percent of retirees and the lowest proportion of social security income.
- **Portland Metro.** Counties surrounding the Portland metropolitan area have very high commuting. Washington County has the lowest commuting, because its high tech jobs cluster is itself a job magnet. Retirement income (transfers) tends to be low except for Columbia County which contains a significant retiree population.

Another way of describing the county economic structures is through location quotients. This index measures how the economic concentration for one economic sector in a county compares to the national average concentration for that same sector. A location quotient much larger than 1.0 in the wood products sector, for example, indicates that the county has a higher than average concentration in that sector, and may reflect a relatively specialized economic base that is more sensitive to changes.

Location quotients reveal that western Oregon is still a wood products region. County wood products cluster location quotients are very large for 15 of the 17 counties. See *Figure 28 (County economies with high wood products sector location quotients (LQ))*. The large number of high location quotients indicate how sensitive those county economies might be to BLM harvest changes.

Figure 28. County economies with high wood products sector location quotients (LQ)



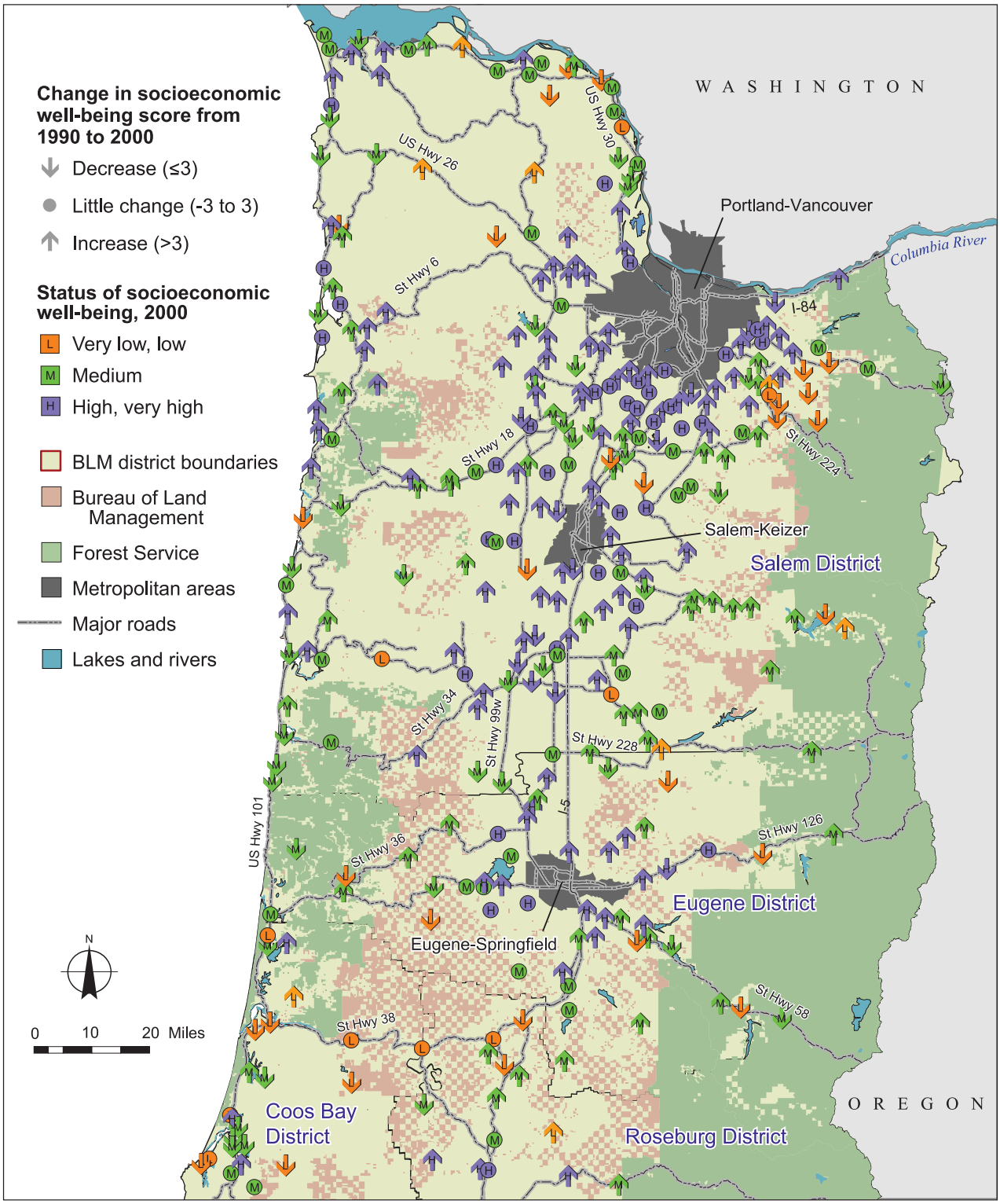
Although several measures of socioeconomic well-being, community capacity, and community resiliency have been developed, no universally accepted measures exist. Community capacity and community resiliency are fundamentally about dynamic processes that involve the actions of community leaders and residents. Leadership, social cohesion, and decision making are important to how a community adapts to change and betters the lives of its residents, but they are not attributes that can be easily measured.

Causality between changes in forest management policy and some community socioeconomic conditions is difficult to demonstrate. The social and economic well-being index and scores for western Oregon communities were developed as part of the Northwest Forest Plan Socioeconomic Economic Monitoring report (USDA, U.S. Forest Service 2006a). The index consists of six indicators:

- diversity of employment by industry
- percentage of population that is 25 years and older with a bachelor's degree or higher
- percentage unemployed
- percentage of persons living below the poverty level
- household income inequality
- average travel time to work

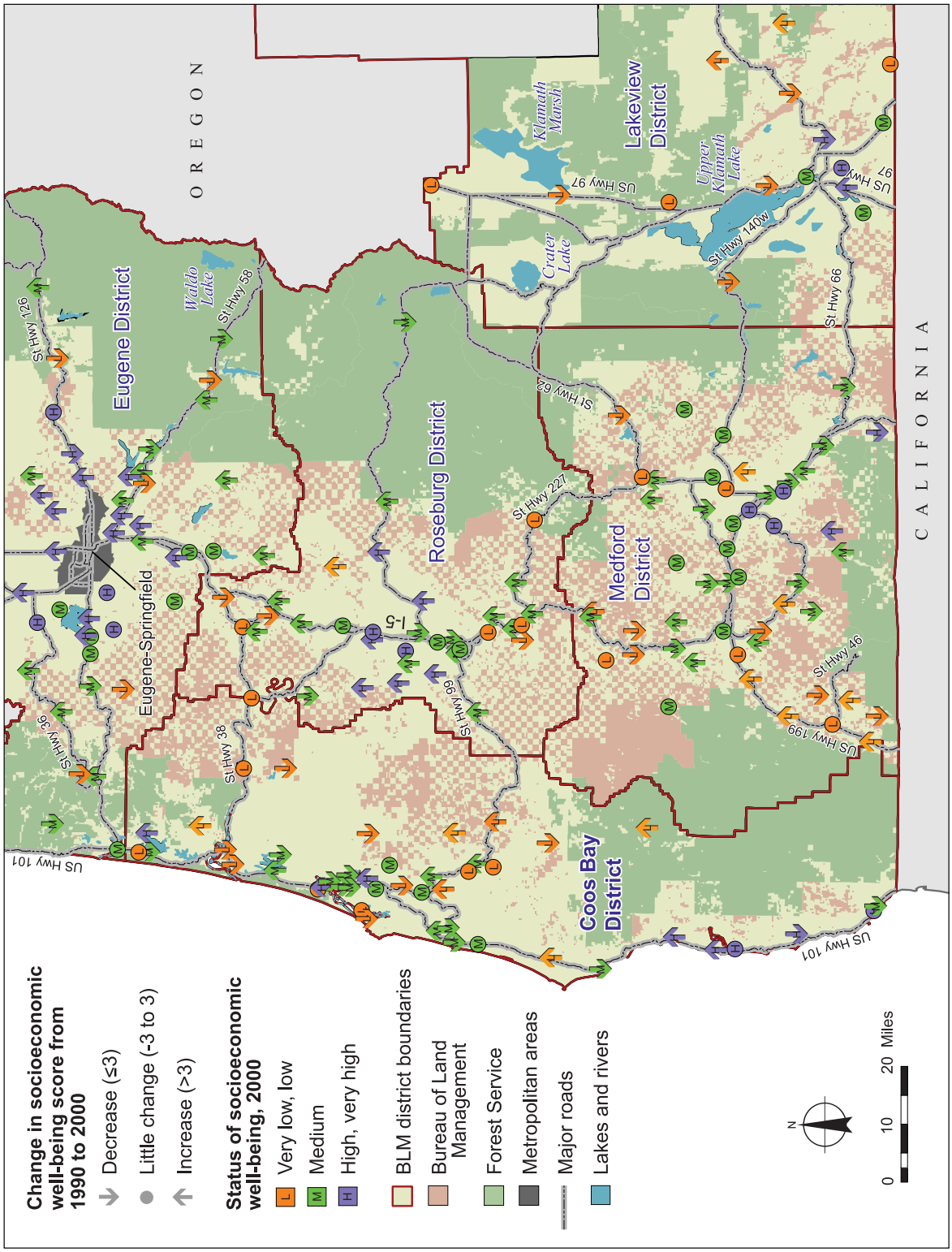
Many communities in western Oregon either increased or decreased in their social and economic well-being score between 1990 and 2000. See *Figure 29 (Change in socioeconomic well-being scores from 1990 to 2000 in the northern portion of the planning area)* and Figure 30 *(Change in the socioeconomic well-being scores from 1990 to 2000 in the southern portion of the planning area)* for a summary of the direction and magnitude of change in this index. The communities were examined by population size class; small, medium, and large communities. The smaller community size classes of 501 to 2,000 people had proportionately more communities with relatively lower social and economic well-being scores, whereas the larger population size classes of 2,001 to 5,000 people and 5,001 to 50,000 people had proportionately more communities with higher scores. Recent regional social assessments suggested that the higher the population in a rural community, the greater the infrastructure and the higher the socioeconomic resilience (Harris et al. 2000).

Figure 29. Change in the socioeconomic well-being scores from 1990 to 2000 in the northern portion of the planning area



Source: USDA 2006

Figure 30. Change in the socioeconomic well-being scores from 1990 to 2000 in the southern portion of the planning area



Source: USDA 2006

O&C Revenues and County Budgets

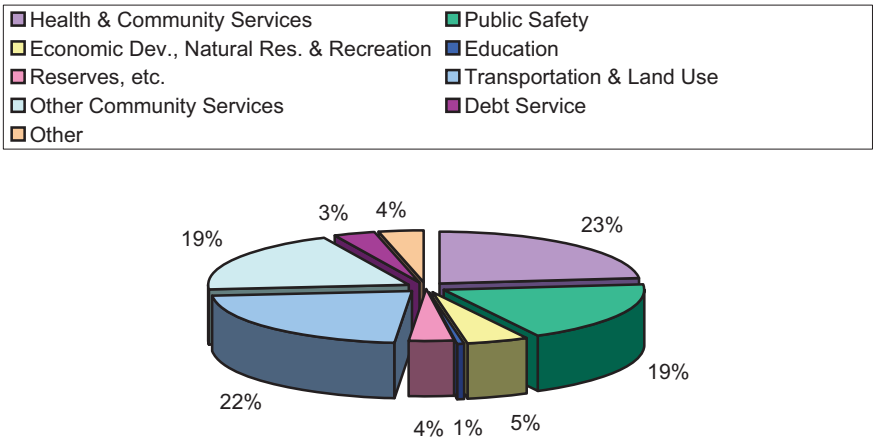
The O&C Act specifies that counties with O&C lands will receive 75% of the revenue generated from these lands. In 1953, the O&C counties agreed to receive 50% of the revenue and that the other 25% would be used by the BLM for roads, reforestation and silvicultural treatments, recreation sites, fire protection, and other forest management. Historically, the bulk of the revenue generated from the BLM has been and continues to be associated with timber harvesting and is the focus of this discussion.

County governments provide a variety of public services. A survey of the O&C counties was conducted to understand the source and use of county revenues. See *Appendix C. Socioeconomics*. See *Table 72 (Public services that county revenues support)* for a list of service categories and the services within each category. Also see *Figure 31 (Fiscal year 2005 county expenditures)* for a summary of the $3.9 billion spent in fiscal year 2005 by the O&C counties.

Table 72. Public services that county revenues support

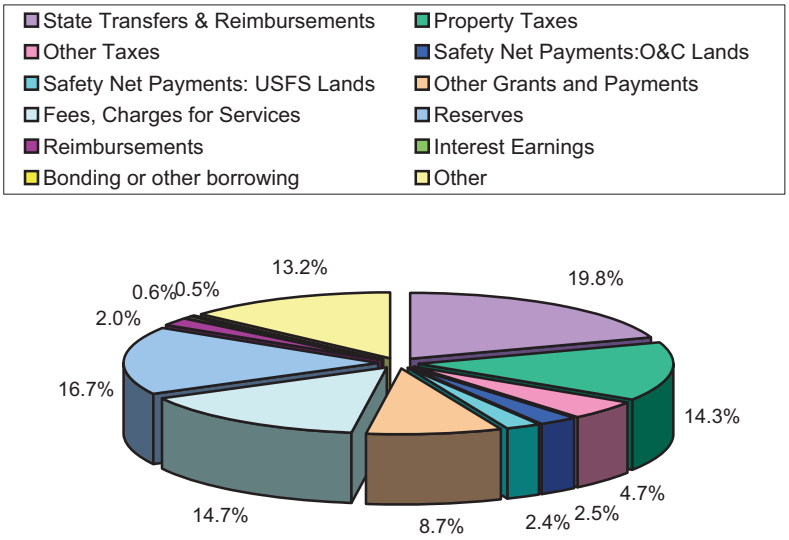
Service Categories	Types of Services	
Health and Community Services	Aging services	Veterans services
	Alcohol and drug addiction services	Public health services
	Services for children and families	Environmental health services
	Developmentally disabled	Housing services
	Mental health services	Medical examiner
	Oregon health plan services	Solid waste disposal/recycling
Public Safety	Trial courts	Community corrections
	District attorney	Court security
	County jail	Juvenile services
	911/emergency communications	County law library
	Emergency management	Sheriff patrol
	Homeland security	Animal control
Economic Development, Natural Resources and Recreation	Oregon plan implementation	Watermaster
	State forest management	County forests
	Federal land policy	County library
	Extension services	County parks
	Telecommunications	County museums
	County fair	
Transportation and Land Use	Highway and road systems	Engineering
	Land use planning and coordination	Building permitting and inspections
	Senior and disabled transportation	Surveying
	Development services	Capital projects
Other Community Services	Management and administration	Property and facilities management
	Elections	Procurement
	Assessment and taxation	Recording public documents
	Human resources and employee relations	

Figure 31. Fiscal year 2005 county expenditures



County governments are funded from sources such as local taxes, transfers from federal and state governments, and fees and charges for services. In addition, the O&C counties receive 50% of the revenue generated by the sale of timber and other goods and services produced from the O&C lands. See *Figure 32 (Fiscal year 2005 revenues for the O&C counties)* for the source of the $4.2 billion in revenues received by the O&C counties in the 2005 fiscal year.

Figure 32. Fiscal year 2005 revenues for the O&C counties



In fiscal year 2005, O&C-related revenues accounted for about $114 million (or about 2.7% of the total funds available to the O&C counties[5]).The importance of O&C revenues varies by county. See *Table 73 (Total revenue, discretionary revenue, and O&C funding)*. O&C revenues account for more than 20% of the Douglas County revenue but only 0.1% of the metropolitan Multnomah and Washington county revenues.

The counties also reported receiving about $99 million of Secure Rural Schools funding that was associated with land that is managed by the U.S. Forest Service. The U.S. Forest Service reports a distribution of $123.3 million for western Oregon counties. (The difference could be related to the fact that U.S. Forest Service funding is distributed through the state rather than directly to the counties.) The U.S. Forest Service funds are typically not considered discretionary in that they are earmarked for schools and roads.

Table 73. Total revenue, discretionary revenue, and O&C funding for fiscal year 2005

County	Revenue			O&C Revenue as % of	
	All Sources		BLM		
	Total	Discretionary	Total O&C	Total (%)	Discretionary (%)
Rural Counties					
Benton	72,288,316	24,114,009	2,920,490	4.0	12.1
Columbia	47,303,696	9,881,991	2,250,622	4.8	22.8
Coos	45,315,118	13,113,030	6,537,510	14.4	49.9
Curry	54,959,478	6,920,829	3,424,000	6.2	49.5
Douglas	136,784,970	39,942,546	28,105,526	20.5	70.4
Jackson	290,614,408	77,040,445	15,145,237	5.2	19.7
Josephine	109,802,550	29,278,099	12,092,595	11.0	41.3
Klamath	160,315,525	15,522,030	2,206,000	1.4	14.2
Lane	466,328,935	56,786,868	14,583,629	3.1	25.7
Lincoln	74,031,888	32,218,773	388,968	0.5	1.2
Linn	83,070,524	25,287,488	2,518,846	3.0	10.0
Marion	314,833,911	70,333,962	1,360,000	0.4	1.9
Polk	60,207,240	13,956,261	2,385,000	4.0	17.1
Tillamook	57,560,514	14,622,039	730,820	1.3	5.0
Yamhill	82,504,377	13,211,916	807,500	1.0	6.1
Rural Subtotals	2,055,921,450	442,230,286	95,456,743	4.6	21.6
Metropolitan Counties					
Clackamas	406,647,713	82,829,267	5,890,071	1.4	7.1
Multnomah	1,092,793,083	409,015,566	1,000,000	0.1	0.2
Washington	607,731,836	121,402,176	707,861	0.1	0.6
Metro Subtotals	2,107,172,632	613,247,009	7,597,932	0.4	1.2
Totals (all counties)	4,163,094,082	1,055,477,295	103,054,675	2.5	9.8

[5] In the survey, the counties reported receiving $103 million from the BLM, whereas the BLM reports total payments of $114 million. Most of that difference is accounted for as Title II funds, which are expended by the agency under the direction of the county-level resource advisory committees but do not go directly through the county budgets.

Much of the funding received by county governments is directed to specific programs. For fiscal year 2005, the O&C Counties reported that only about 25% of total revenue received was discretionary—the rest of the revenue received by the county governments is earmarked for specific programs. Counties consider most the BLM revenue as discretionary in that it can be used for whatever purpose the county commissioners deem suitable.

See *Figure 33 (Fiscal year 2005 discretionary spending for the O&C counties)* for how the O&C counties spent the funds considered discretionary. About 43% of the discretionary budget is spent on public safety. The next largest category is for other community services, which includes such services as management, administration, and elections.

Figure 33. Fiscal year 2005 discretionary spending for the O&C counties

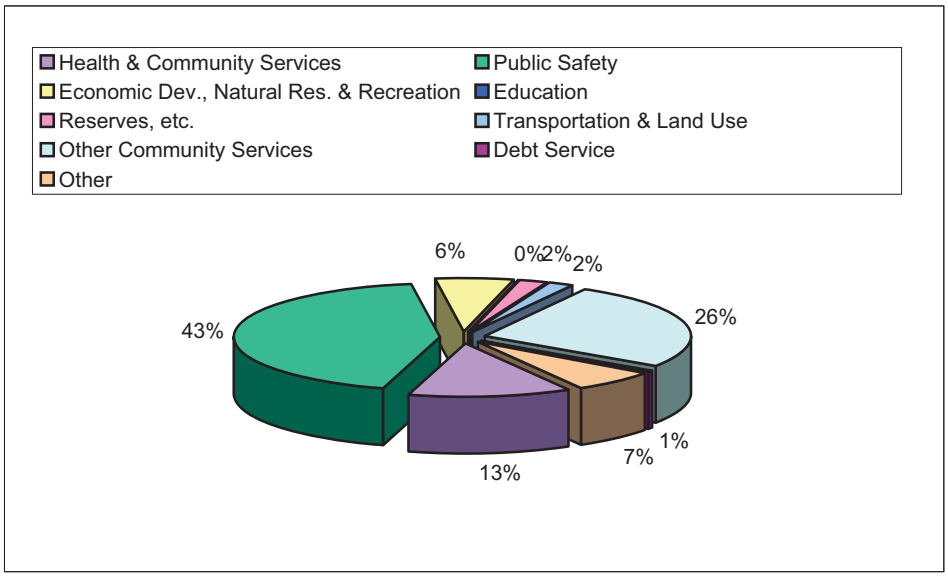


Table 73 (Total revenue, discretionary revenue, and O&C funding for fiscal year 2005) shows that across the O&C counties, O&C revenues accounted for 9.8% of the discretionary funding. Some counties, however, rely on O&C revenues much more to fund discretionary programs than others. Over 70% of the discretionary funding in Douglas County, for example, is based on O&C revenues. A number of counties rely on O&C revenues for more than 20% of discretionary funding. O&C revenues make up only a small portion of the discretionary funding for the larger metropolitan counties.

Timber harvesting from O&C lands began dropping in the 1990s as a result of the listing of the northern spotted owl and the adoption of the Northwest Forest Plan. In response, Congress established safety net payments for 72 counties in Oregon, Washington, and California through the Omnibus Budget Reconciliation Act of 1993. This provided a stabilized income flow to timber-dependent communities through the remainder of the 1990s.

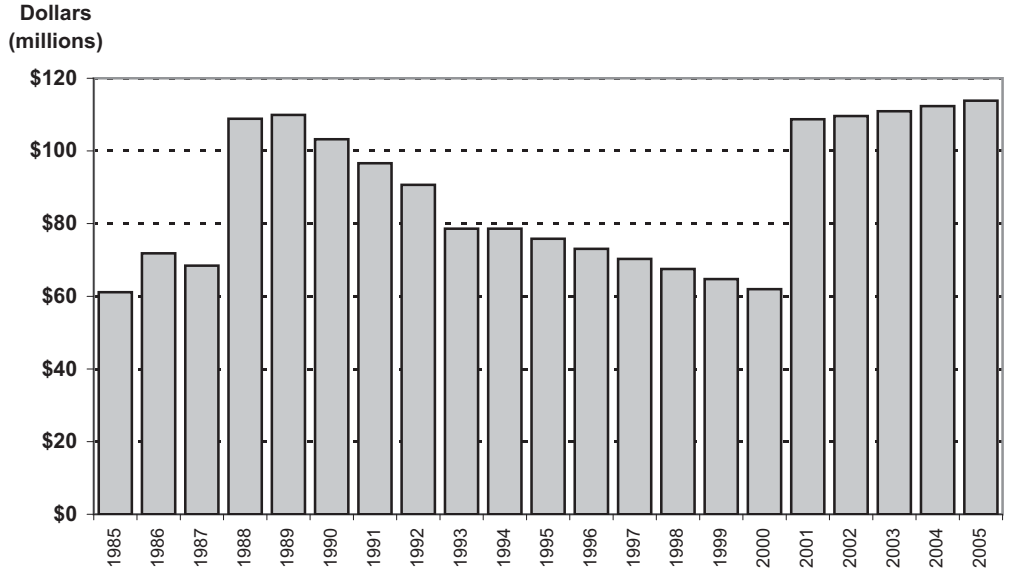
In 2000, Congress repealed the safety net payments and passed the Secure Rural School and Community Self Determination Act (P.L. 106-393). This law established a stable level of payments to counties at an amount equal to the average of their three highest

timber receipts from 1986 through 1999. Under the Act, counties elect the percentage of payment (80 to 85%) to be distributed directly to the county (Title I), and the percentage (15 to 20%) to be allocated between Title II projects and Title III projects.

- **Title I.** These are funds that are distributed to the county and may be used for any purpose the previous 50% revenue sharing funds were used for, as a supplement to other county funds. Typically, these revenues go to county general fund budgets.
- **Title II.** These are funds that are used to support cooperative projects under the guidance of a resource advisory committee to restore healthy conditions on public lands or on private lands for the benefit of public land resources. Such projects include wildfire hazard reduction, stream and watershed restoration, forest road maintenance, road decommissioning or obliteration, control of noxious weeds, and improvement of fish and wildlife habitat.
- **Title III.** Under Title III of the Act, counties may use funds for search, rescue, and emergency services; community service work camps; purchase of easements for recreation or conservation; forest related educational programs; and fire prevention activities.

See *Figure 34 (BLM payments to counties for fiscal years 1985 to 2005)* for the trend in BLM payments to counties since 1985. In fiscal year 2005, BLM payments to counties totaled about $115 million.

Figure 34. BLM payments to counties for fiscal years 1985 to 2005



Historically, payments authorized under the O&C Act account for the bulk of the total BLM payments to counties. Counties do, however, receive revenue associated with other BLM funding sources. Douglas and Coos Counties receive payments from the Coos Bay Wagon Road grant fund. There are 15 counties that receive payments in lieu of taxes (PILT) from public domain lands that are located within their county. A few counties also

receive grazing and mineral lease income. Altogether, these other sources of payments averaged just over $1.0 million annually over the last five years.

Table 74 (BLM payments to counties within the planning area for selected years ($million)) summarizes the total payments to counties from western Oregon BLM lands including timber receipts, safety net payments, and Secure Rural Schools Self Determination Act payments under Title I, II and III, Coos Bay Wagon Road grants, payments in lieu of taxes, and mineral and grazing income. The average annual BLM payment to all counties since implementation of the Secure Rural Schools legislation has been $112 million.

Table 74. BLM payments to counties within the planning area for selected years ($million)

County	1985	1990	1995	2000	2001	2002	2003	2004	2005
Benton	1.7	2.9	2.1	1.7	3.1	3.1	3.1	3.2	3.2
Clackamas	3.4	5.8	4.2	3.4	6.0	6.1	6.2	6.2	6.3
Columbia	1.3	2.1	1.6	1.3	2.2	2.3	2.3	2.3	2.3
Coos	4.0	6.8	5.0	4.1	7.2	7.3	7.4	7.5	7.6
Curry	2.2	3.8	2.8	2.3	4.0	4.0	4.1	4.1	4.2
Douglas	15.4	26.0	19.1	15.6	27.4	27.6	27.9	28.3	28.7
Jackson	9.6	16.2	11.9	9.7	17.0	17.2	17.4	17.6	17.8
Josephine	7.4	12.5	9.2	7.5	13.1	13.2	13.4	13.6	13.8
Klamath	1.5	2.4	1.8	1.5	2.6	2.6	2.6	2.7	2.7
Lane	9.3	15.8	11.6	9.5	16.6	16.7	16.9	17.2	17.4
Lincoln	0.2	0.4	0.3	0.2	0.4	0.4	0.4	0.4	0.4
Linn	1.6	2.7	2.0	1.6	2.9	2.9	2.9	3.0	3.0
Marion	0.9	1.5	1.1	0.9	1.6	1.6	1.6	1.6	1.7
Multnomah	0.7	1.1	0.8	0.7	1.2	1.2	1.2	1.2	1.2
Polk	1.3	2.2	1.6	1.3	2.3	2.4	2.4	2.4	2.5
Tillamook	0.3	0.6	0.4	0.3	0.6	0.6	0.6	0.6	0.6
Washington	0.4	0.7	0.5	0.4	0.7	0.7	0.7	0.7	0.7
Yamhill	0.4	0.7	0.5	0.4	0.8	0.8	0.8	0.8	0.8
Totals	61.7	104.2	76.5	62.5	109.8	110.6	112.0	113.4	114.9

The O&C revenue is allocated between counties based on an acre-weighted proration formula. The largest recipients of payments from western Oregon BLM lands are Douglas, Jackson, Lane, and Josephine counties, which together received 68% of total payments in 2005.

The Secure Rural Schools legislation was not reauthorized for 2007. Absent a reauthorization or new legislation, the size of the BLM payment to counties will be highly dependent on the amount and price of timber sold from O&C lands. For example, without the Secure Rural Schools legislation the fiscal year 2005 BLM payment to counties would have totaled about $12.2 million, which is a reduction of about 90% from the total with the legislation.

In addition, many of the O&C counties would also lose Secure Rural School funding attributable to land that is managed by the U.S. Forest Service. For fiscal year 2005, such funding totaled $123.3 million.

O&C counties have a limited ability to replace BLM revenues with other sources of revenue. Oregon income taxes are paid to the state, not the counties. As a result of several ballot measures, Oregon counties are not able to raise tax rates and the growth in taxable property value is capped at 3% a year. The federal government, furthermore, owns a large portion of the land in some of the O&C counties. See *Table 75 (Percent public land in O&C counties)*. These lands are not on the tax rolls. The O&C Counties believe that neither economic growth nor tourism can be reasonably expected to offset a shortfall in O&C-related revenues (Davis 2006). See *Appendix C. Socioeconomics*.

Table 75. Percent public land in O&C counties

O&C County	Total (acres)	BLM (acres)	BLM (%)	Government (acres)	Government (%)
Benton	433,500	58,100	13.4%	106,300	24.5%
Clackamas	1,205,000	75,400	6.3%	632,200	52.5%
Columbia	440,800	10,800	2.5%	32,100	7.3%
Coos	1,041,000	162,900	15.6%	261,100	25.1%
Curry	1,047,100	67,600	6.5%	688,700	65.8%
Douglas	3,244,500	655,100	20.2%	1,670,500	51.5%
Jackson	1,792,700	449,700	25.1%	914,200	51.0%
Josephine	1,050,200	299,800	28.5%	714,900	68.1%
Klamath	3,137,900	224,900	7.2%	1,651,300	52.6%
Lane	2,957,900	288,100	9.7%	1,740,400	58.8%
Lincoln	635,600	20,200	3.2%	216,800	34.1%
Linn	1,477,000	87,200	5.9%	581,400	39.4%
Marion	762,600	20,900	2.7%	258,800	33.9%
Multnomah	297,500	4,200	1.4%	88,400	29.7%
Polk	476,000	40,200	8.4%	53,100	11.2%
Tillamook	719,500	48,500	6.7%	450,200	62.6%
Washington	465,000	11,500	2.5%	67,700	14.6%
Yamhill	459,700	32,600	7.1%	65,100	14.2%
Totals	21,643,500	2,557,700	11.8%	10,193,200	47.1%

The economics of BLM timber harvesting are directly linked to western Oregon's timber economy and market.

The counties in western Oregon comprise the relevant market area for this analysis. Although some of the BLM timber may be shipped outside of this area for primary processing, the most recent information about log flow suggests that it is likely that the bulk of the BLM timber will be processed within the market area. As shown below, western Oregon is a net importer of logs—more timber is processed than harvested in the area.

There are 413 bbf of sawtimber on 16.3 million acres of timberland[6] within the planning area of western Oregon (Miles et al. 2006). See *Table 76 (2005 timberland area and inventory within the planning area)*. The BLM administers about 13% of the timberland and 16% of the sawtimber in western Oregon.

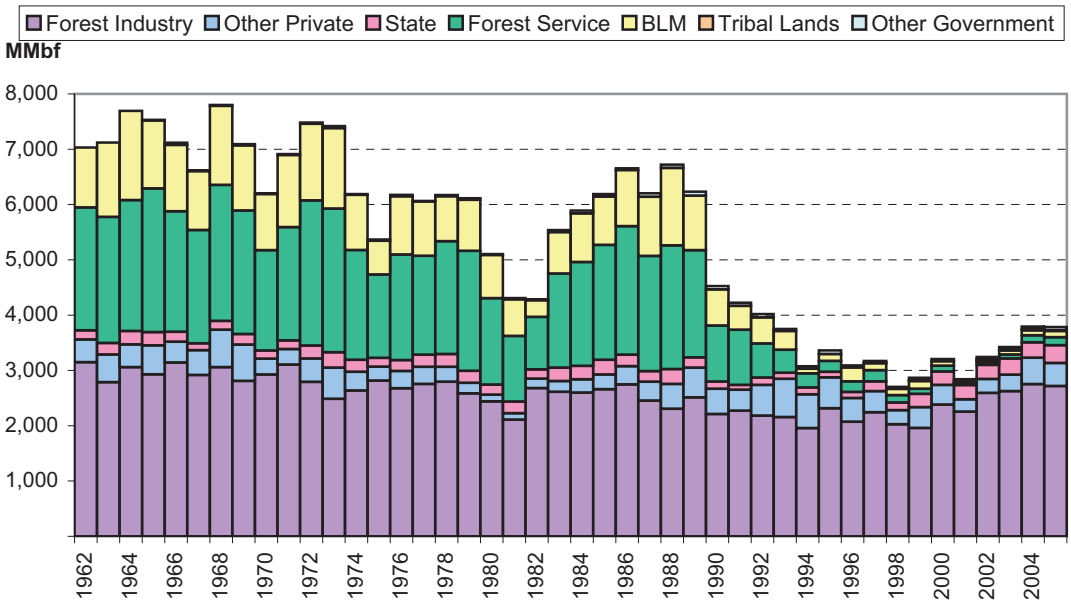
[6] Not all of the 2.5 million BLM acres within the planning area are classified as timberland.

Table 76. 2005 timberland area and inventory within the planning area

Ownership Class	Timberland Area (acres)	Sawtimber Inventory (bbf)
National Forest	5,937,000	210
Bureau of Land Mgmt	2,068,000	66
Other federal	27,000	1
State	839,000	29
County and Municipal	116,000	2
Other local government	10,000	-
Private	7,323,000	105
Totals	16,320,000	413

See *Figure 35 (Harvest by land owner within the planning area)* for the western Oregon harvest by owner. Since 2000, western Oregon harvests have averaged about 3.4 bbf[7]—a 47% reduction from the average 6.4 bbf average harvest prior to the 1990 listing of the northern spotted owl. Most of the reduction came from federal timberlands (U.S. Forest Service and BLM).

Figure 35. Harvest by land owner within the planning area



During the 1970s, BLM harvests averaged 1.05 bbf, which is about 16% of the total.[8] BLM harvests averaged 0.87 bbf in the 1980s, which is about 15% of the total. Under the Northwest Forest Plan (since 1994), BLM harvests have averaged about 0.11 bbf annually, which is about 3.4% of the total harvest.

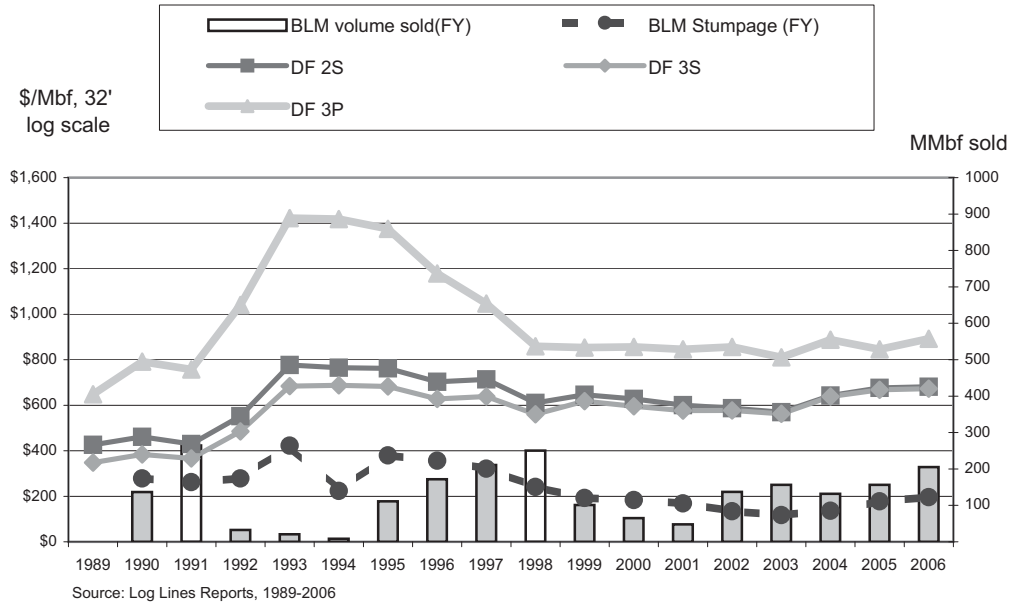
[7] bbf – billion board feet, Scribner log scale.

[8] In this discussion, BLM timber volumes have been converted from the 16 foot log scale used by the BLM, to the 32 foot log scale used by other western landowners. The conversion factor varies with timber species and log size. Generally, a factor of 0.80 can be used to convert BLM 16 foot log volumes to 32 foot log volumes.

Harvests from private lands trended down slightly through the 1990s (3.08 bbf in the 1970s, 2.79 bbf in the 1980s, and 2.61 bbf in the 1990s). Private harvests have been trending up since 1995 and have averaged 2.89 bbf since 2000. Currently, private lands provide about 85% of the harvest within the planning area.

See *Figure 36 (Willamette Valley Douglas fir delivered log prices and BLM volume and average stumpage)* for log price trends since 1989 (Log Lines 1989-2006)[9]. Log prices rose dramatically in the early 1990s, due primarily to a reduction in federal harvests during a time of strong demand for lumber and wood products. High log prices and increased penetration of U.S. markets by Canadian lumber manufacturers led to a reduction in mill capacity in western Oregon. Log prices declined through the 1990s. Log prices began trending up again in 2003 as housing markets strengthened. Western Oregon mills added capacity with the sawmills still operating in 2005 and producing about 37% more wood in 2005 than they did in 2001 (Ehinger 2006a). In Western Washington, mills have added about 1.0 bbf in net capacity over the last five years. This has further strengthened log prices (Ehinger 2006b.)

Figure 36. Willamette Valley Douglas fir delivered log prices and BLM volume and average stumpage



Source: Log Lines Log Price Reporting Service 2006

Figure 36 (Willamette Valley Douglas fir delivered log prices and BLM volume and average stumpage) also shows that the premium for higher grade logs has been shrinking (2S and 3S logs[10] sell for about the same price and 3P log margins are narrowing). This reflects recent investment in smaller log mills and the ongoing shift toward dimension lumber.

[9] Log Lines is a log price reporting service that began reporting log prices in 1988.
[10] 3P, 2S and 3S are log grades reflecting size and quality.

Figure 36 also shows the total volume and average stumpage price of the BLM timber sold in western Oregon.[11] Note that since 1995, when the BLM began selling smaller timber under the Northwest Forest Plan, stumpage prices have followed a trend similar to the current market for 2S and 3S logs.

Logs harvested in one area are often manufactured into wood products in another area. Understanding how logs flow helps to establish the geographic extent of the market area. Predicting future log flows, furthermore, is important to establishing impact at the county level.

See *Table 77 (2003 mill study log flows)* for a summary of log flows reported in the 2003 mill study (Brandt et al. 2003; USDA, U.S. Forest Service 2006a). About 3.757 bbf was consumed by western Oregon mills in 2003. About 8% of the total was imported into western Oregon from outside the state and another 4% was imported from eastern Oregon.

Table 77 (2003 mill study log flows) also suggests that the difference between local log supply and local log demand is greatest in southwest Oregon. These mills imported 412 mmbf from northwest Oregon, whereas only 58 mmbf went from southern Oregon to northwest Oregon.

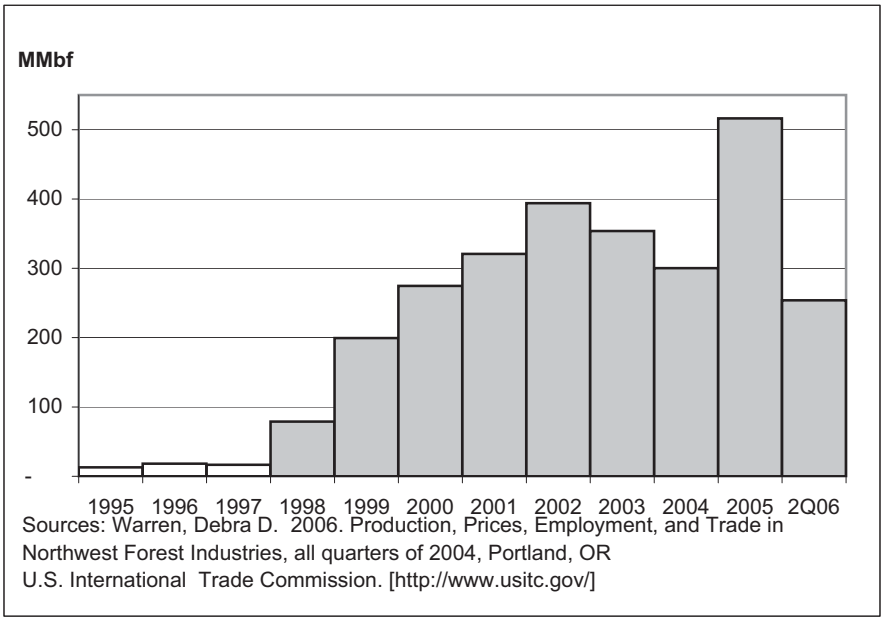
Table 77. 2003 mill study log flows

Destination	Log Volume (mmbf)				
	Total Utilization	Source			
		Northwest Oregon	Southwest Oregon	Eastern Oregon	Other States
Northwest Oregon	1,667	1,378	58	0	231
Southwest Oregon	2,090	412	1,460	158	60
Total Western Oregon	3,757	1,790	1,518	158	291

Current estimates are that log imports into western Oregon have increased since the 2003 mill study. *Figure 37 (Log imports from Canada to Washington and Oregon ports)* shows that Canadian logs imported into western ports exceeded 500 mmbf in 2005 and is on a similar track in 2006. Oregon log buyers expect that about 500 mmbf is currently flowing into Oregon from Washington and Canada. Many consider the Canadian volume to be subject to intense competition by more favorably located mills in Washington, or by new in ventures in Canada (Rasmussen, personal communication 25 August 2006).

[11] Stumpage is the price paid for timber on the stump. A BLM timber purchaser pays stumpage to the BLM and then incurs the costs of logging and hauling the logs to the mill.

Figure 37. Log imports from Canada to Washington and Oregon ports

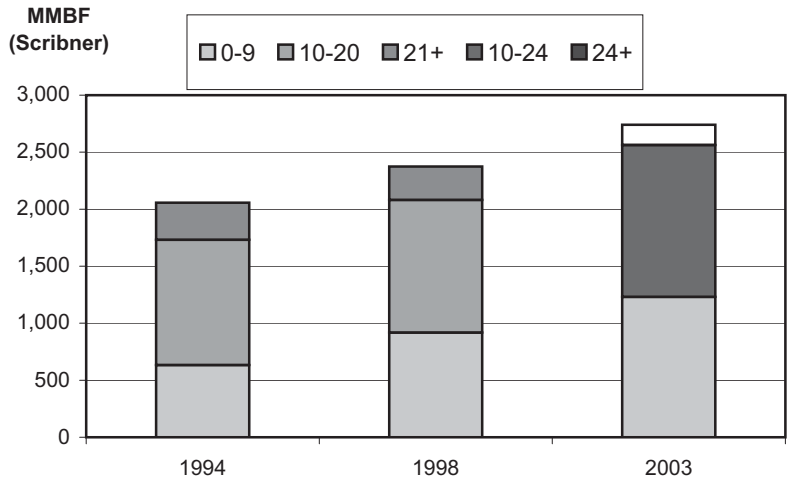


Source: Warren 2006

The log market in western Oregon is competitive. In 2005, for example, only 28% of the timber used by Oregon's sawmills was fee timber (timber owned by the manufacturing company). The rest of the timber harvested was purchased by manufacturers from timberland owners (Western Wood Products Association 2006). Much of this timber is sold in an open, competitive market to the highest bidder. BLM timber is appraised and sold at auction to the highest qualified bidder, which ensures that the agency receives fair market value.

Mills are typically optimized to process certain species and sizes of logs. The log market allocates logs to the mills that can most efficiently and effectively process particular types of logs. Prior to the Northwest Forest Plan, the U.S. Forest Service and the BLM were key suppliers of large, high-quality logs. Decisions made in the Northwest Forest Plan substantially reduced the volume of large logs available to Oregon mills. Much of the recent investment made in Oregon mills focused on more efficient processing of the smaller logs harvested from private lands. *Figure 38 (Oregon sawmill consumption by diameter class)* shows that logs that are less than 9 inches DIB (diameter inside the bark at the small end of the log) being processed by Oregon mills has doubled from 632 mmbf in 1994 to 1,230 mmbf in 2003.

Figure 38. Oregon sawmill consumption by diameter class



Even with the investment in smaller log processing, there remains in Oregon a sizeable capacity for the larger logs that could be harvested from BLM land.

- *Figure 38 (Oregon sawmill consumption by diameter class)* shows that about 300 mmbf of logs greater than 21 inches DIB were processed in 1994 and 1998. The 2003 study changed the classification—179 mmbf of logs greater than 24 inches DIB were processed in that year.
- Ehinger (2006) defines large logs as those over 48 inches DIB, lists eleven mills that process large logs, and reports that 10% of western Oregon mill capacity is capable of handling large logs (about 450 mmbf), and that more large log capacity is being added.
- An Oregon State University study defined large logs as those over 30 inches DIB and found 18 mills that handle large logs (Wagner et al. 2003).

The primary wood products manufacturing sector is a large contributor to the Oregon economy. In 2003, 249 firms used 4.3 billion board feet of wood to produce $6.7 billion of annual sales (Brandt et al. 2006). While this sector accounts for less than 0.1% of Oregon firms, it produces 14.6% of annual manufacturers' shipments (U.S. Census Bureau 2000-2004). This estimate does not include substantial secondary wood products sectors such as furniture and cabinetry.

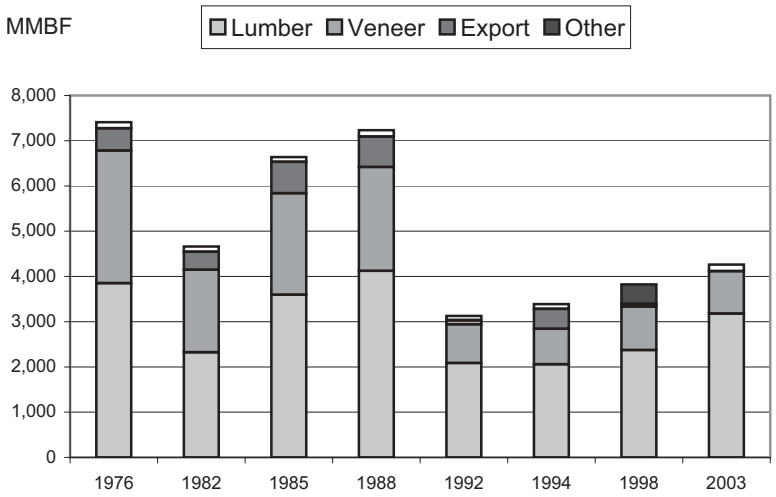
The Oregon primary wood products sector employs 51,900 workers that earn $1.9 billion annually (OLMIS[12] 2006), which is about 3.2% of total Oregon wages. Using a conservative employment multiplier of 2.5, the primary wood products sector accounts for about 130,000 nonfarm Oregon jobs, which is about 7.6% of the total.

Periodic surveys of wood product manufacturers show how the wood products manufacturing sector has changed (Brandt 2006). This information, coupled with annual production data, suggests that the current manufacturing sector could absorb additional timber from BLM lands.

[12] Oregon Labor Market Information System

Since the early 1990s, western Oregon's wood products manufacturing capacity has been shifting toward lumber production. See *Figure 39 (Log consumption by product in western Oregon)*. Lumber mills now account for about 75% of the wood consumed in western Oregon mills. Oregon's plywood and veneer mills were heavily dependent on larger logs, much of which came from federal forests. With the reduction in federal timber harvests, larger logs became more expensive at the same time that manufacturers in the Midwest and southern United States added lower cost panel capacity to oriented strand board mills. Very few logs are exported from Oregon's ports.

Figure 39. Log consumption by product in western Oregon



New investments in lumber mills have been concentrated in larger mills. *Figure 40 (Western Oregon sawmills by capacity)* shows that most of the remaining mills are larger mills, which produce over 120 mbf per shift. The average production per mill for this largest class, in fact, is now over twice what it was in 1976. The apparent increase in the number of small mills in 2003 is due to a difference in survey techniques.

Figure 40. Western Oregon sawmills by capacity

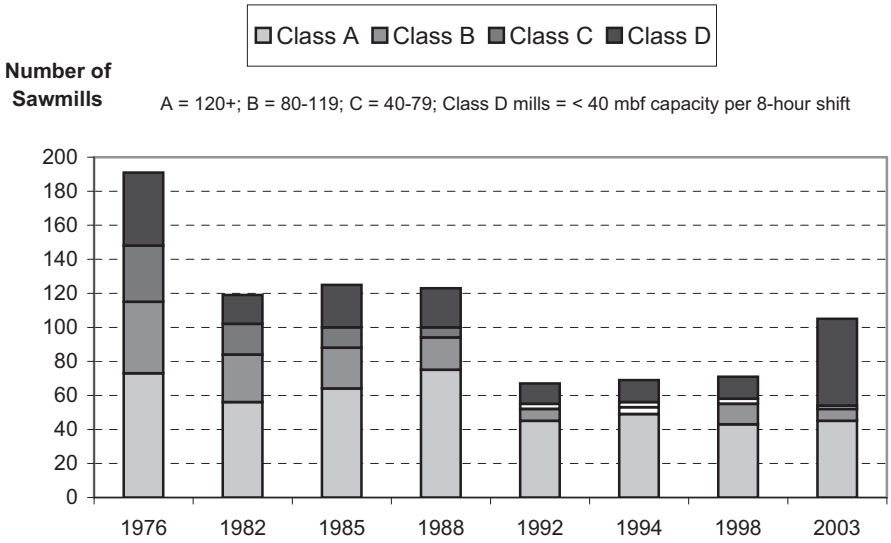
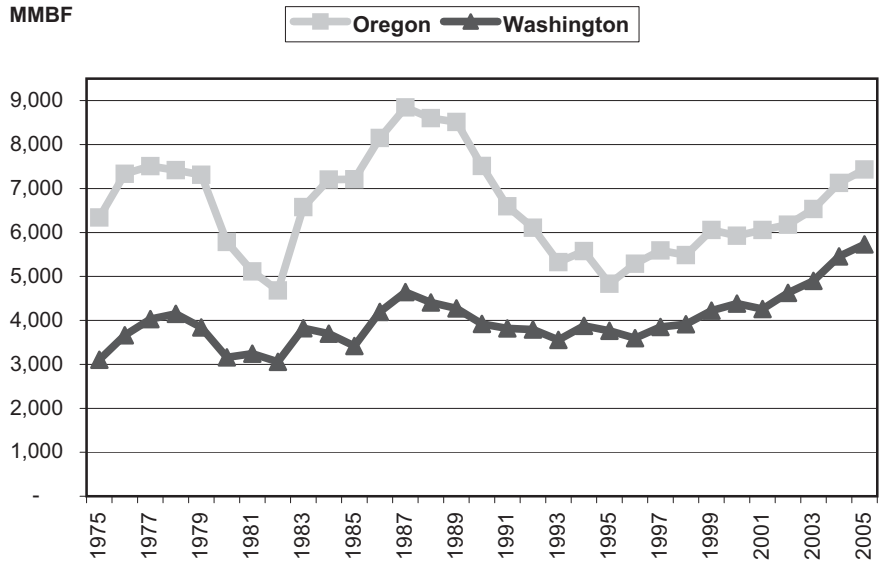


Figure 41 (Lumber production in Oregon and Washington) shows lumber production in Oregon and Washington (Western Wood Products Association 2006). Lumber production in western Oregon fell by about 45% between 1989 and 1995, primarily due to reduced federal log supplies. Production began increasing as mills invested in more equipment that could process smaller timber. A softening log export market, furthermore, resulted in a greater portion of the harvest becoming available to domestic mills.

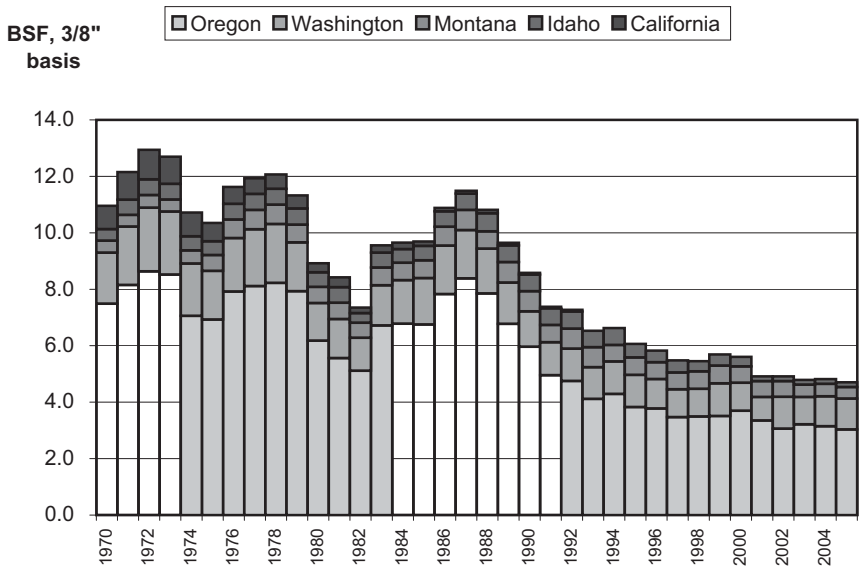
Figure 41. Lumber production in Oregon and Washington



Washington production trends are important as western Oregon mills currently compete for Washington logs. Lumber production in western Washington did not fall off as sharply as it did in Oregon, primarily because much of the western Washington timber was exported as logs rather than sawn into lumber. The reduction in log exports made more timber available to sawmills in both states. Since 1999, western Washington mills have added 1.0 bbf of net new lumber production capacity (Ehinger 2006) and production has been increasing steadily.

Western plywood production began a downward trend in the early 1990s. See *Figure 42 (Western plywood production)*. At 3.04 billion square feet for 2005, Oregon plywood is about 58% below the 1970 to 1990 average.

Figure 42. Western plywood production



The reduction in federal timber harvest, which is a source of large, clear veneer logs, created upward pressure on plywood prices. At the same time, panel manufactures in the Midwest, the southern United States, and Canada were adding capacity to produce less expensive oriented strand board (OSB) panels from low cost timber. U.S. Forest Service projections suggest that plywood will lose additional market share to OSB. *Figure 43 (U.S. panel production)* shows US plywood production at just half of current levels by 2020.

Figure 43. U.S. panel production

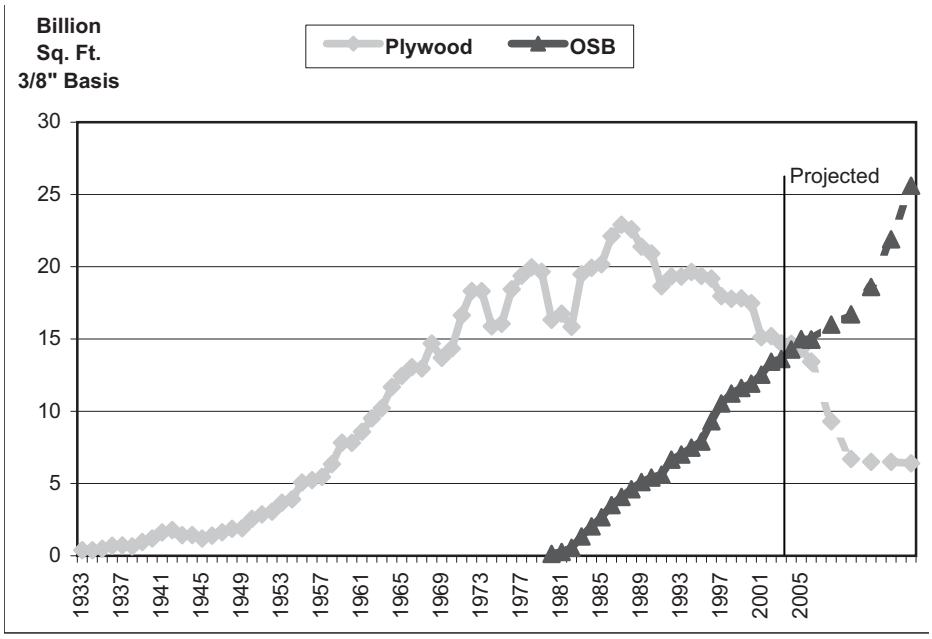
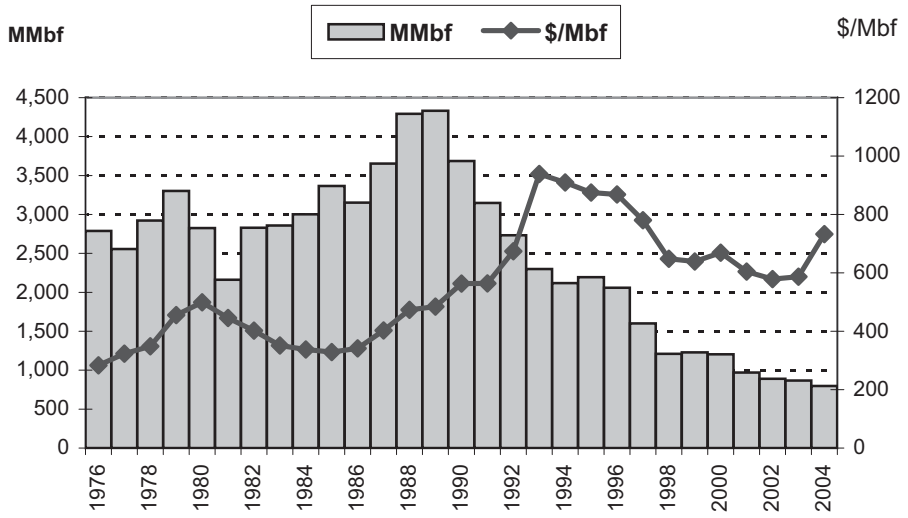


Figure 44 (Log exports from western United States ports) shows the volume and price of logs exported from western United States ports. Currently, about 800 mmbf of logs are exported, which is down 80% from the 4.4 bbf peak in 1989. The Asian financial crisis, the weakening of the Yen against the United States dollar, a shift toward Asian log suppliers, and stronger US domestic log markets account for most of the change.

Figure 44. Log exports from western United States ports



The BLM conducted an information gathering meeting with log buyers and timber industry representatives. There was a common concern that current western Oregon wood product production levels cannot be maintained without additional timber supplies. Current production relies on log imports from Canada and western Washington. Both those sources of supply are vulnerable to competition from the new mills in Washington and to export restrictions in Canada. (Rasmussen, pers. comm. 25 August 2006)

Changes in the level of employment in Oregon's forest product industry are indicated by U.S. Department of Commerce employment statistics, which tally forest products sector jobs into four sectors:

- forestry and logging (NAICS 113)
- forestry support activities (NAICS 1153)
- wood products manufacturing (NAICS 321)
- paper manufacturing (NAICS 322)

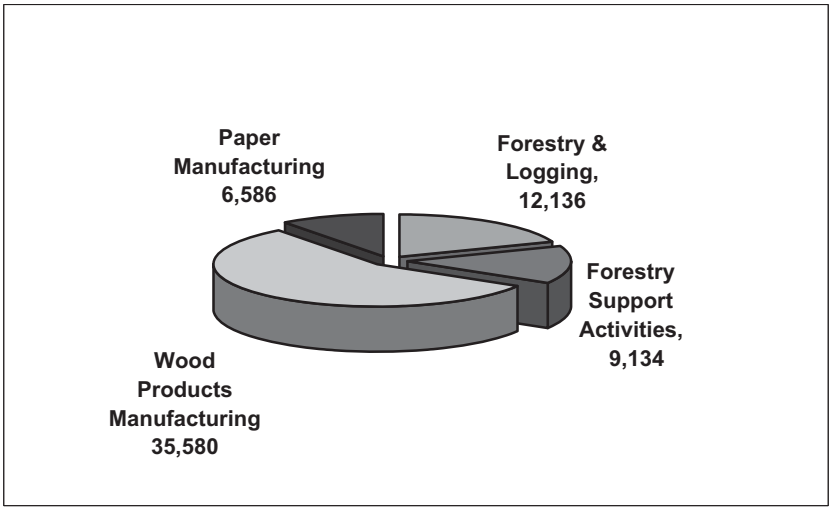
These sectors include both primary and secondary manufacturers along with the infrastructure (forestry workers, loggers, etc.) required to manage the growing and harvesting of timber crops.[13]

[13] The previous discussion of the economy of the wood products sector in western Oregon is based on research conducted for this DEIS, and resulted in adjustments to the U.S. Department of Commerce figures. Such adjustments are not available for previous periods, however. The U.S. Department of Commerce data, therefore, are used for the purpose of analyzing historic employment trends.

Primary manufacturing includes logging, processing of logs into lumber and other wood products, processing wood residues from timber-processing plants into such outputs as paper or electricity, and private sector forest management services. The secondary industry includes firms processing outputs from the primary industry. These outputs may come from mills in Oregon or elsewhere. Secondary products include prefabricated buildings, molding, millwork and cut stock, doors, windows, laminated veneer lumber, and other products (Brandt et al. 2006).

Employment in Oregon in these four sectors totaled nearly 63,400 workers in 2005 (U.S. Department of Commerce 2006). Wood products manufacturing represents the largest sector, which comprise 61% of the jobs. See *Figure 45 (Employment in Oregon's forest products sector (2005))*.

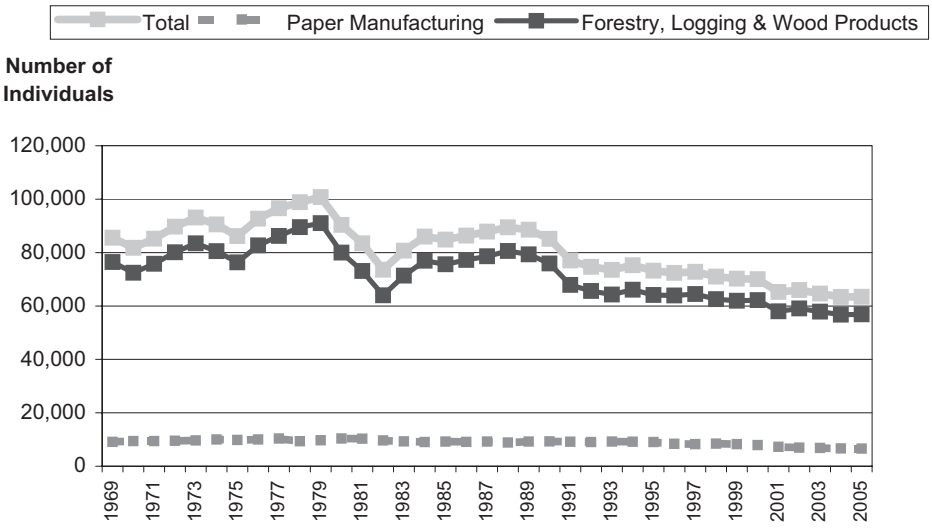
Figure 45. Employment in Oregon's forest products sector (2005)



Source: USDC 2006

Employment in 2005 was down 37% from peak employment of more than 100,700 workers in 1979. See *Figure 46 (Employment in Oregon's forest products industry (1969 to 2005))*. The decline in forest sector employment is due to the reduction in total timber harvest and technological change (Brandt et al. 2006; USDA, U.S. Forest Service 2006a). Oregon's forest sector job loss might have been greater, but was offset to some degree by a concurrent decrease in log exports, an increase in log imports from surrounding states, and an expansion of secondary wood products manufacturing (Brandt et al. 2006).

Figure 46. Employment in Oregon's forest products industry (1969 to 2005)



Source: Adapted and updated from Brandt et al. 2006

Forest industry employment trends for the coastal Pacific Northwest were recently studied as part of a 10-year review of the implementation of the Northwest Forest Plan. Across the region included in the Northwest Forest Plan—western Oregon, western Washington, and northern California—it has been estimated that 45,000 direct, indirect, and induced jobs were affected by reduced timber harvesting between 1990 and 2000. Of that, 30,000 were direct jobs including 7,500 in the logging industry and 22,500 in other primary wood industries.

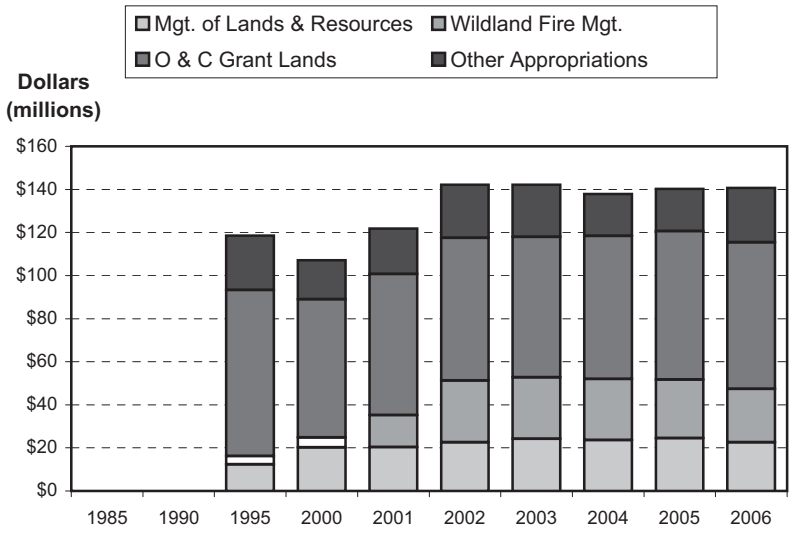
About 19,000 jobs were lost in the region between 1990 and 1994 as the volume of timber harvested but not exported fell from 10.1 bbf to 7.4 bbf. An additional 11,000 direct job losses occurred between 1994 and 2000, even though the volume of wood available for manufacture stabilized and even rose slightly. These latter job loses are attributable largely to additional industry restructuring and changes in technology (USDA, U.S. Forest Service 2006a).

Technological change has also impacted employment in the logging industry. In Oregon, for example, increased mechanization of harvest operations has increased annual productivity per worker from 544,000 board feet harvested per worker in 1990 to 592,000 board feet per worker in 2004, which is an 8% increase (Rooney 2006).

Oregon employment in the solid-wood industry was hit disproportionately hard compared to Washington and California. Oregon represented approximately 50% of solid-wood employment in the region. However, about 61% of the decline in jobs occurred in Oregon. The reverse is true of paper manufacturing—Oregon represented 30% of primary pulp and paper industry employment during the 1990's but only 21% of the job losses in that sector (USDA, U.S. Forest Service 2006a).

In addition to timber harvest, the western Oregon BLM budget contributes to local economic activity. The western Oregon BLM budget for 1995 to 2005 is summarized in *Figure 47 (Western Oregon BLM budget for selected fiscal years)*. The largest expenditure of funds, representing 64% of the current budget, is for the O&C land grants and management of lands and resources programs. These programs provide for forest management, reforestation and forest development, rangeland, recreation, soil, water and air, and wildlife and fish habitat on the O&C grant lands and public domain lands in western Oregon.

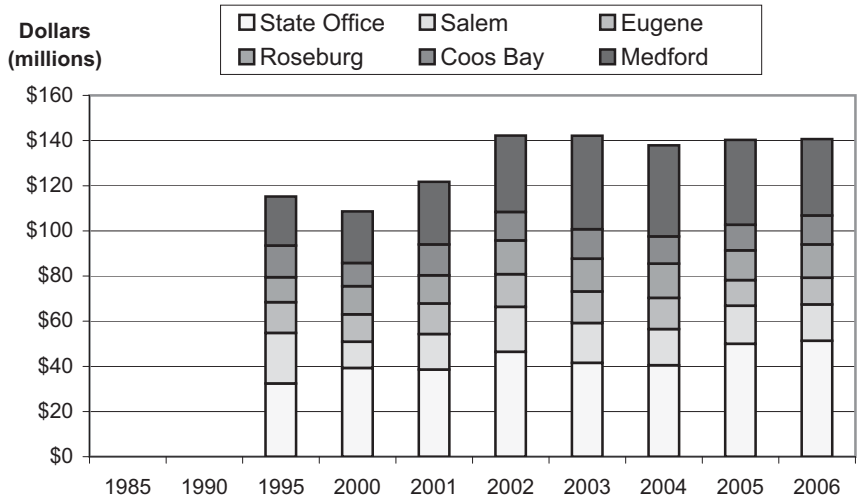
Figure 47. Western Oregon BLM budget for selected fiscal years



The wildland fire management program, which is 18% of the current budget, provides for fire preparedness, fire suppression operations, and other operations. Funding for hazardous fuels reduction and burned area rehabilitation is included in the latter category. Other appropriations represent another 18% of the total budget. This includes funding for acquisitions, construction projects, and other needs.

Over the past few years, the BLM budget for western Oregon has been relatively constant (averaging about $141 million annually). See *Figure 48 (BLM budget by district and state office for selected fiscal years)*.

Figure 48. BLM budget by district and state office for selected fiscal years



In addition to employment in the forest products industry, the management of the BLM-administered lands in western Oregon requires the employment of a staff of natural resource specialists, managers, and administrative personnel. *Figure 49 (Full-time equivalent positions by BLM district and state office)* shows that BLM staffing has been relatively constant. The state office in Portland provides administrative oversight and support for all BLM lands in Oregon and Washington. The full-time employee data shown includes all positions at this office.

Figure 49. Full-time equivalent positions by BLM district and state office

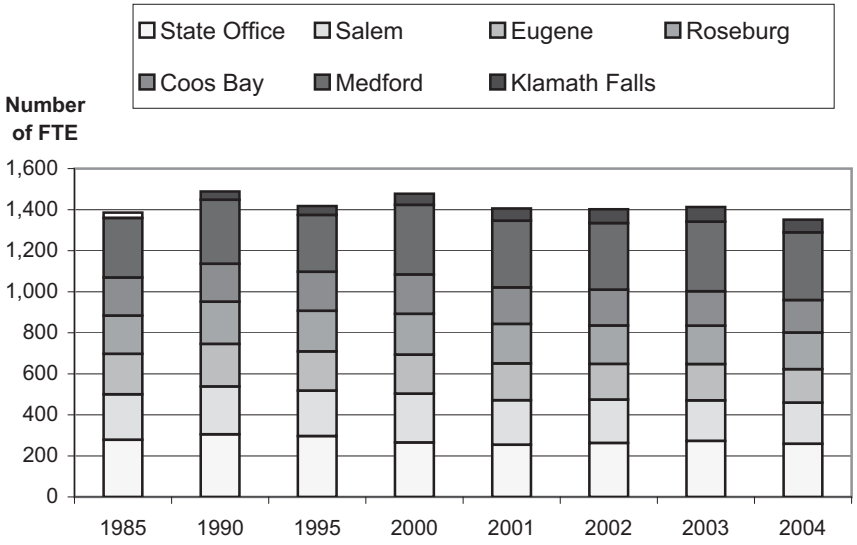
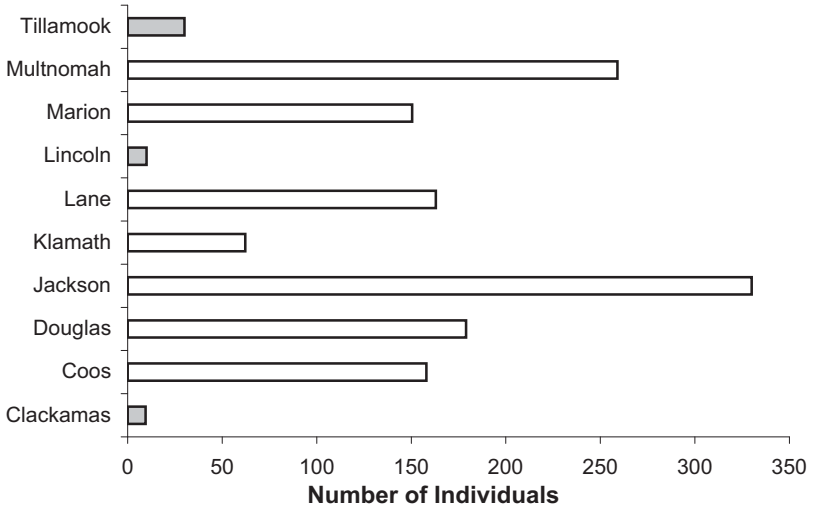


Figure 50 (Number of BLM full-time equivalent positions by county) shows the number of BLM full-time equivalent positions by the county in which the position is based for the fiscal year 2004. The jobs shown for Multnomah County are in the state office.

Figure 50. Number of BLM full-time equivalent positions by county



Timber

Key Points

- Recent inventories have indicated an increase in the standing inventory on BLM lands.
- The BLM lands contain a substantial amount of large, high-grade logs in older stands (i.e., mature and structurally complex forests).
- The majority of the younger stands (i.e., stand establishment and young forests) within the planning area have resulted from harvesting and the application of intensive forestry practices on the reforested acres.
- Stands with a management history comprise approximately 46% of the BLM forested lands, which are classified as suitable for a sustained harvest of timber.

The forests on BLM-administered lands can be characterized by their standing volume and their acres of existing age classes. The current standing volume is shown in *Table 78 (Current standing volume and acres of forested lands)*.

Table 78. Current standing volume and acres of forested land

BLM Districts	Forested Lands[a] (acres)	Standing Volume (bbf[b])
Salem	365,000	16.8
Eugene	296,000	13.4
Roseburg	399,000	15.5
Coos Bay	302,000	12.8
Medford	788,000	14.8
Klamath Falls Resource Area of the Lakeview District (west)	47,000	--[c]
Totals	2,197,000	73.3

Notes:

[a]See *Chapter 4* for definition.

[b]Billion board feet.

[c]Included in the Medford District inventory.

The volume figures in *Table 78* are based on current vegetative survey plots. See *Appendix Q. Vegetation Modeling* for further information on the continuous vegetative survey inventory system. The Klamath Falls Resource Area is not included in the above inventory and acres are rounded to nearest thousands

See *Table 79 (Historic timber volume estimates)* for the previous estimates of the volumes on portions of the BLM-administered lands. These figures are the best estimate of merchantable volume for the acreage and include the definitions of use at the time period indicated. Note that the definitions of use did change over time. Although these inventories were conducted using different inventory systems, different assumptions, and different portions of the BLM lands, they provide the basis for broad comparisons and general trends. These inventories also show that overall growth on the BLM lands has kept pace with harvesting, and that there is no evidence that cutting has exceeded growth.

Table 79. Historic timber volume estimates

Historic Estimates	1940[b]	1960[c]	1970[d]	1980[e]	1990[e]
Timber volume (mbf[a])	46,000,000	49,059,900	50,308,000	46,856,721	49,865,870
Acres	2,165,900	2,145,072	2,391,172	1,771,657	1,794,420
Diameter at breast height (dbh)	≥ 16 in.	≥ 11 in	≥ 11 in.	≥ 7 in.	≥ 7 in.

Notes:

[a]Thousand board feet.

[b]Andrews and Colvin 1940

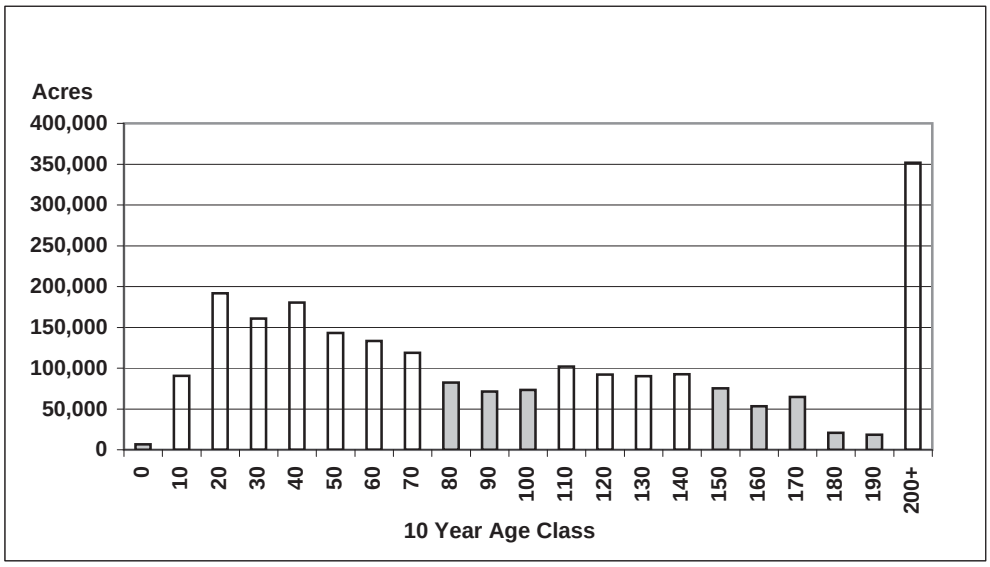
[c]USDI, BLM 1960

[d]USDI, BLM 1970

[e]USDI, BLM 1991

In addition to the total standing volume, the forest can be characterized by the acres of existing age classes. The age class distribution is shown in *Figure 51 (Acres of forested lands within the planning area for 2006 by 10-year age class)*.

Figure 51. Acres of forested lands within the planning area for 2006 by 10-year age class

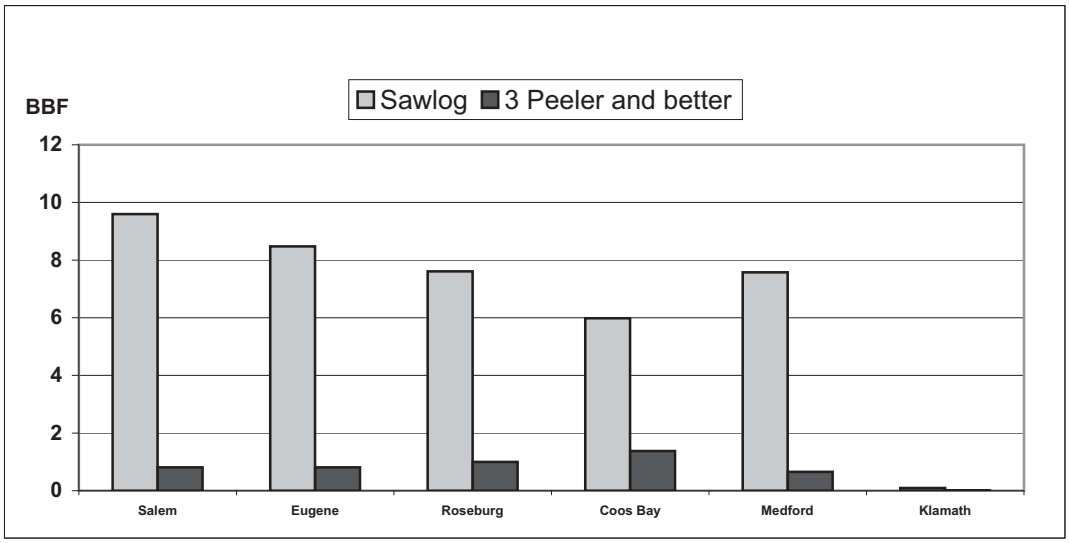


The above figure does not include the eastern management lands of the Klamath Falls Resource Area (of the Lakeview District) since no starting age class was assigned to these acres. The Salem, Eugene, Roseburg, Coos Bay, and Medford districts contain predominately Douglas fir by volume. Historical volume harvested by species shows that for most districts, forest stands average about 80% of their volume harvested from Douglas fir. See *Appendix D. Timber*. The Klamath Falls Resource Area of the Lakeview District has white fir as the primary commercial species along with ponderosa pine.

The inventory systems that the BLM maintains are not designed to record log quality by level of expected size and grades. Therefore, only general information is available. Log sizes and grades are highly variable depending on the stand type that is harvested. This is particularly true in older stands where substantial peeler grade logs might be expected. Some general information can be derived from examining the historical level of peeler versus sawlogs as a percent of

volume in past harvesting actions. This historic information can then be used to predict the future levels from different types of stands using the structural stage of stands as a classification with anticipated levels of peeler grade for each structural stage. See *Appendix D. Timber*. See *Figure 52 (Peeler versus sawlog grade of Douglas fir logs by district within the planning area)* for the level of anticipated peeler grades of Douglas fir on the BLM lands that are suitable for timber harvesting and not part of the National Landscape Conservation System.

Figure 52. Peeler versus sawlog grade of Douglas fir logs by district within the planning area

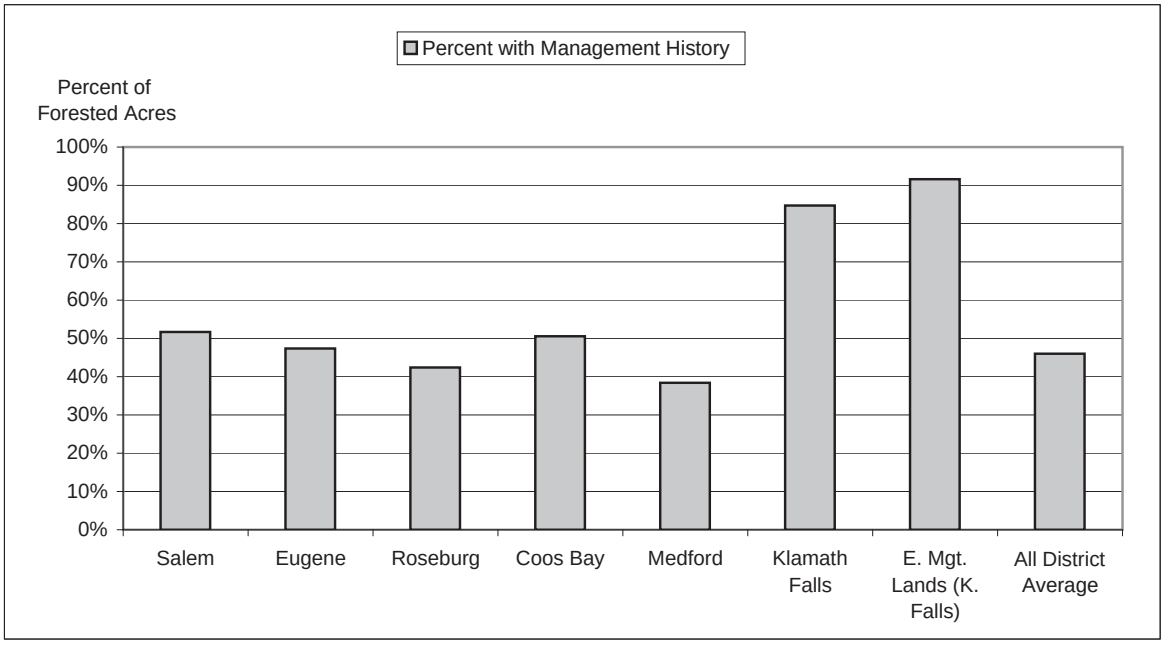


Existing stand condition is a codified classification system for inventory that separates stands into classes with similar management histories and conditions. This system is used to predict future growth and development trajectories of stands. As follows, past management history and current stand density can affect the future growth that is anticipated from stands:

- Managed stands are expected to have considerably higher volumes of timber per acre than natural stands of similar age due to the more consistent spacing, the changes in species composition, and the use of improved genetic stock during reforestation.
- Young stands resulting from regeneration harvesting where a component of the original stand is left as a legacy often have lower growth rates for the understory component of those stands.

See *Figure 53 (Percent of BLM lands within the planning area with management history that are suitable for sustained timber production)* for the percentage of BLM lands within the planning area with management history that are suitable for sustained timber production. In general, the BLM lands have had a substantial amount of past management from either regeneration harvesting or thinning.

Figure 53. Percent of BLM lands within the planning area with management history that are suitable for sustained timber production



Special Forest Products

Key Points

- There are 84 forest products in 10 categories that were harvested or collected over the past five years on BLM lands.
- Wood products (including firewood), mushrooms, and floral and greenery are consistently the highest three special forest product categories by the number of permits sold and by revenue.
- Collectors normally focus their harvesting efforts in areas where the commercial forest product is abundant and is easy and economical to harvest.

Special forest products are plant and fungi resources that are harvested, gathered, or collected, and have social, economical, or spiritual value. Common examples include conifer boughs, Christmas trees, mushrooms, edibles and medicinals, floral and greenery, mosses and lichens, ornamentals, seed and cones, tree burls, transplants and wood products including posts, poles, firewood, shakes, and rails. The types of special forest products are continually expanding as entrepreneurs develop new products and create new markets.

Most special forest products are common, widespread, and generalists (i.e., tolerant of a broad range of environmental conditions), while some require a specific community or habitat, or even a specific host. The demand for special forest products varies as markets conditions change. These changes can be seasonal variable or cyclical from year to year depending upon economic factors and environmental conditions. The availability of road access, particularly roads to harvest areas, and land use restrictions influences the type and amount of forest products available for harvest.

Although most commercial harvesters in the Pacific Northwest do not rely on special forest products for their sole source of income, these products do provide important supplemental or seasonal sources of income that contribute to household economies (Charnley 2006).

Special forest products are generally harvested from common plants and fungi that are associated with vegetative communities on BLM managed lands that include conifer forests, grasslands, shrublands, and hardwood communities. The 84 special forest products are grouped into 10 special forest product categories based on a retrospective analysis of BLM permit data over the past five years.

Following is a list of the special forest product categories and the number of products included in each category.

- boughs (coniferous) (12)
- burls and miscellaneous (2)
- Christmas trees (4)
- edibles and medicinals (8)
- floral and greenery (8)
- mosses (bryophytes) (3)
- mushrooms (fungi) (12)
- seeds and seed cones (5)
- transplants (13)
- wood products (17)

A general description of the common special forest products is provided below. See *Table 80 (Special forest products by category)* for a complete list of the special forest products.

Boughs. The typical species from which boughs are collected are western red cedar and incense cedars, true firs, pines, juniper, and Douglas fir. Conifer boughs are used by individuals and the floral industry primarily during the Christmas season for seasonal decorations. Boughs are generally collected from young or mature forest stands. Western red cedars occur in riparian zones.

Burls. Burls are used for woodcrafting in the manufacture of specialty items, such as clocks, tables, veneers, and other decorative items. Burls are found on either the bole (cluster burls) or on the stumps (stump burls) of trees. Burls are harvested from hardwood trees in mature and structurally complex forest stands of hardwood and mixed conifer and hardwoods forest types.

Christmas trees. Christmas trees are sold as seasonal decorations for personal or commercial use. Christmas trees are harvested from stand establishment conifer plantations.

Floral and greenery. Floral and greenery is collected and used as decorative arrangements. Common plants include salal, evergreen huckleberry, sword fern, and beargrass that generally occur in the understory of conifer forests. Floral and greenery are harvested from upland areas in conifer forest types in mature and structurally complex forests stands. Manzanita is harvested for decorative greens and bird perches and occurs in woodland and shrubland communities, mostly in southern Oregon.

Medicinals. Cascara and yew bark is peeled from the bole of trees and used to make laxatives and tonics. The majority of Cascara and yew occur along streams or seasonally wet areas. Harvest areas are limited because they occur in riparian zones.

Mushrooms. Mushrooms that are commonly harvested include golden chanterelle, winter chanterelle (yellow foot), morels, matsutake, shaggy parasols, coral mushrooms, truffles, and hedgehogs. Each mushroom is associated with one or more specific hosts in forested conifer or mixed hardwood stands. Mushrooms are generally harvested from hardwood and conifer forest communities of mature and structurally complex forests stands. Morels are harvested immediately after a wildfire.

Seeds and cones. Cones are collected commercially for seed or harvested for ornamental purposes from mature and structurally complex forests.

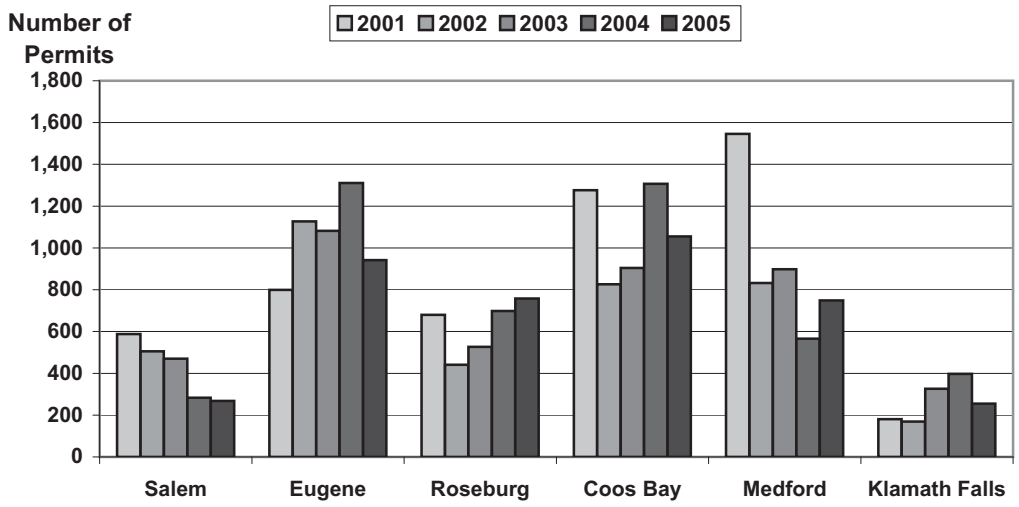
Transplants. Transplants include various native ground covers or shrubs, forbs, and tree species including root stock for medicinal purposes. These plant species are found in riparian and upland areas in all vegetation communities.

Wood products. Wood products include firewood, posts and poles, rails, cedar shake bolts, biomass, or pulp wood. Poles can be any length, but no more than 6 inches in diameter on the large end. Wood products are harvested from young, mature, and structurally complex forests. Wood products also includes ornamental wood species that include red alder, big leaf maple, madrone, vine maple, and willows. These are used to construct furniture and cabinetry, veneers, and bow staves. Ornamental wood species also include cut sticks, which are generally red alder or other hardwood species that measure less than 4 inches in diameter at the large end. Ornamental wood species are harvested from all forest communities, but generally from mature and structurally complex forests.

Permits for special forest products include restrictions to help meet renewable resource standards and to protect other sensitive resource values. Permits may restrict the type of species, the quantity harvested, the harvest or collection method, the location, access, and the season.

The types and abundance of special forest products vary across the planning area. The location of the commercial harvesting sites and the product and site conditions may change from year to year. These differences are reflected in the forest product permits issued by BLM district. See *Figure 54 (Trend in the total number of permits issued over five years by BLM district)*. The overall trend is mixed with a slight increase by three districts and a slight decrease by three districts.

Figure 54. Trend in the total number of permits issued over five years by BLM district



Many special forest products, such as firewood, Christmas trees, evergreen boughs, huckleberries, and mushrooms are broadly distributed throughout the planning area. Other special forest products are limited to a particular plant community, special environments, or narrow geographic area.

Overharvesting is not known to occur across the range of a species or to the extent that it creates concern for the sustainability of the product or species, except in a few local situations. When these situations are discovered, harvesting permits are discontinued or issued in other areas.

Natural disturbances, such as wildfire, storms, and floods, shape the types and productivity of special forest products over time. Wildfires change vegetative and structural components of the

landscape by consuming biomass, but can promote productive responses of some special forest products. For example, morel mushrooms respond quickly after wildfires. Wildfires can create conditions suitable for other vegetative products in subsequent years, such as willow whips, beargrass and other floral and greenery products, and medicinal forbs. Wildfires char and degrade the value of such special forest wood products as boughs, Christmas trees, firewood, and poles.

Floods alter vegetation and the special forest products found in riparian plant communities. Although initially floods may appear to destroy the existing riparian vegetation, the changed conditions provide vigor to the resprouting and reseeding shrubs and forbs, and within a few years provide a new potential crop of alder and willow products along streams and wetland areas.

Timber harvesting changes the forest condition and increases or decreases opportunities and quality depending on the product. Species composition, age, distribution of age classes, growth rate, and density of forest stands influence the type and productivity of special forest products.

Timber harvesting and associated fuels reduction treatments routinely alter stand structure and forest floor conditions, and combined, modify forest conditions on more acres than all other planned activities. The method of timber harvesting particularly influences special forest products. Ground-based harvesting operations disturb more area and at heavier levels of disturbance on the understory vegetation (and associated special forest products, such as mushrooms and floral and greenery) than cable operations. Helicopter harvesting has even less disturbance. Timber management activities, however, do provide road access to harvest areas that would otherwise not be available.

Regeneration harvesting reduces suitable conditions for numerous special forest products, while at the same time providing abundant biomass, fiber, and firewood as commercial by-products. For example, chanterelles do not fruit for the first 15 years after a regeneration harvest and matsutakes rarely fruit in stands under 40 years of age (Vance et al. 2001). Many commercial floral and greenery products, as well as boughs, may be lost from the harvest units. Huckleberries for greenery and moss products may be lost for decades. Commercial thinning generally provides conditions where understory greenery products can persist and the commercial value may even improve within a short period of time due to an increase in the light to the understory vegetation. Silviculture treatments in regeneration harvest units generally cut evergreen vegetation and hardwoods that would reduce the amount and commercial quality of other forest products. Understory greenery products can increase within a short period of time due to an increase in the light to the understory vegetation during thinning harvests.

Silviculture treatments in regeneration harvest units generally cut evergreen vegetation and hardwoods that reduces the amount and commercial quality of other forest products.

Fuels treatments target the pole component of forest stands as well as the hardwood and shrub understory. Fuels treatments include broadcast burning, hand, and mechanical treatments. Broadcast burning disposes logging slash and other forest floor fuels, burns wood products, and degrades quality. Manual treatments have less impact to understory vegetation and the forest floor duff layer and associated special forest products than mechanical treatments (such as slash-buster operations) due to the size of the equipment. Opportunistic situations occur where pole harvesting is coordinated with fuels projects. Flora and greenery products and mushrooms respond quicker to manual operations than mechanical operations.

The available data regarding the quantities and value of special forest products is limited to a basic comparison over time (trend) by the number of permits sold by category, units sold, and revenue. The number of units sold of special forest products has declined slightly for wood products, boughs, and floral and greenery over the last five years. Mushrooms is the only category that has increased.

The total number of special forest product permits varies by approximately 20% between any two-year interval. Each forest product group varies based on relevant market and environmental conditions.

Permit sales have averaged over $200,000 per year and totaled over $1,100,000 over the past five years. In the last two years, revenue from wood products, floral and greenery, and boughs has declined, while mushroom revenue has increased during the last three years. Wood product revenue has varied more than other special forest products due to pole sale fluctuations in Medford.

Field inventories of special forest products, harvest areas, and actual harvest data on BLM lands is not available. Detailed studies and analysis have been conducted where concerns for overharvesting and long-term sustainability existed in the past, such as moss harvesting in Eugene (Muir 2004) and yew wood harvesting (USDA, USDI 1993a).

See *Table 80 (Special forest products by category)* for the 10 categories of 84 specific forest products that are found on BLM-administered land within the planning area.

Table 80. Special forest products by category

Category	Special Forest Products		
Boughs (coniferous)	Douglas fir Grand fir Incense cedar Juniper	Noble fir Pacific silver fir Port Orford cedar Shasta red fir	Sugar pine Western hemlock Western red cedar White fir
Burls and miscellaneous	Big leaf maple Pacific madrone		
Christmas trees	Douglas fir Grand fir	Noble fir Shasta red fir	
Edibles and medicinals	Bay leaves Cascara bark Elderberries Oregon grape root	Pacific yew bark Pacific yew boughs Prince's pine St. John's wart	
Floral and greenery	Beargrass Bracken fern Cactus species Huckleberry	Manzanita Oregon grape Salal sp. Sword fern	
Mosses (bryophytes)	Lichen sp. Sheet moss Tree moss		
Mushrooms (fungi)	Black picoa Cauliflower Coral tooth Golden chanterelle	Horn of plenty King bolete Matsutake sp. Morel sp.	Shaggy parasol Spreading hedgehog White chanterelle Yellowfoot mushroom
Seeds and seed cones	Douglas fir Noble fir Ponderosa pine	Sugar pine Western hemlock	
Transplants	Bleeding heart Douglas fir Huckleberry Incense cedar Mountain mahogany	Oregon grape Rhododendron Sword fern Vine maple	Western hemlock Western red cedar Wild iris Willow sp.
Wood products	Alder stick (large) Bolts and shakes Corral poles Fence stays Fuelwood Hobby wood	Large poles Marginal logs Pitchwood Posts (corner) Posts (line) Pulpwood	Rails (split) Round wood Small poles Tepee poles (4 in. x 16 ft.) Whip stock (misc.)

Botany

Key Points

- Rare plants and fungi are not evenly distributed or predictable across the landscape, even when good potential habitat exists.
- There are 134 plant and fungi species that are listed as bureau special status species that exist on approximately 4,000 acres of BLM-administered lands and that consist of approximately 5,000 known populations.
- Of the 134 bureau special status species, 32 occur only on BLM-administered lands.

The BLM administers diverse ecosystems across the planning area. These lands include habitat and populations of some of the rarest plant and fungi species in the Pacific Northwest, including:

- 134 species that occur on BLM-administered lands within the planning area (not including the West Eugene Wetlands or the Cascades-Siskiyou National Monument);
- 59 species that have 20 or fewer populations;
- 32 species that occur *only* on BLM-administered lands; and
- 21 species that have five or fewer populations.

Since the landscape and the habitats of the planning area are extraordinarily diverse, they include a unique combination of geology, climate, and topography and these contribute to the presence of many rare and locally endemic plant and fungi species. Southwest Oregon and northern California have some of the highest rates of plant endemism in the United States (Della Salla et al. 1999). These rare species, also called bureau special status species, are distributed throughout the planning area and are found in nearly every habitat type.

Over 4,500 plant species are found in Oregon and the majority of the species occur within the planning area. Most of these plant species are considered common and are of no conservation concern from the standpoint of being threatened with, or trending toward, extinction. However, approximately 7% (324) of these species are considered bureau special status species and are of conservation concern due to the small number of known populations, loss of habitat, or the threats to their existence that are posed by human activity or other biological factors.

Habitats

The flora in Oregon is shaped by geologic history, topography, regional climatic factors, and natural disturbances. The geographic extent of the planning area is so broad that a wide range of conditions shape the diversity of plant communities and habitats. For example, rare plant and fungi species are known to occur on BLM-administered lands in the following physiographic provinces in the stated numbers:

- 38 within the Coast Range province
- 13 species within the Eastern Cascades and Willamette Valley provinces
- 59 within the Western Cascades province

In the planning area, over 250 plant species are endemic to serpentine soils with about 10% being considered rare (Kruckeberg 1984). Crinite mariposa-lily (*Calochortus coxii)* and Howell's mariposa-lily (*Calochortus howellii)* are examples of rare, narrow endemics found only on soils influenced by a serpentine substrate. Approximately 88 rare plant species and nearly two-thirds of the total known populations that occur on BLM-administered lands occur in the Klamath province.

Many plants are associated with the unusual habitat types that are generally shaped by the unusual features, climate, and hydrologic influences that exist throughout the planning area. The innumerous unusual habitats within the planning area range from rock substrates and outcrops of different origins with variable soil types and conditions (including sand dunes) to seasonal and permanent wetlands, vernal pools, fens, bogs, and marshes. The range of unusual habitats also includes the forest communities of conifer and mixed hardwoods and the communities of steppe juniper and sage. These habitats include a wide range of conditions and, because they have persisted over time, have become refuges for unusual plant communities (Franklin and Dyrness 1973). Many uncommon and rare species have adapted to these unique conditions over time and generally occur infrequently on associated habitat types.

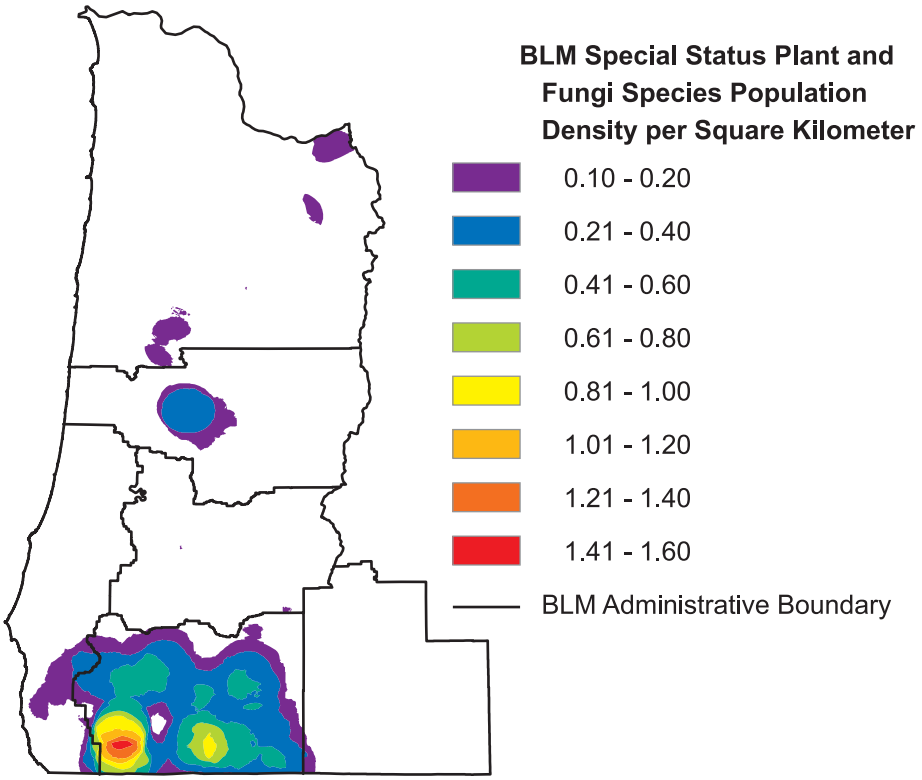
Rare plant and fungi species are generally not evenly distributed or predictable across the landscape, even when good potential habitat exists. Some species are generally associated with a specific plant series, habitat type, or an ecological feature that narrows their potential habitat. However, other rare species are associated with broader and less defined habitat types. Kaye et al. (1997) describes types of rarity, patterns, distribution, and threats to rare plant species in Oregon.

Biological factors (e.g., reproductive strategies, inbreeding depression, pollinators and pollination, consumption by herbivores, weed invasion, habitat connectivity, disease, predation, habitat change, and global climate change) play important roles in determining the distribution and abundance of a species. Some rare Oregon species appear to be lingering remnant populations from historic plant communities at the edge of their range with few remaining populations (e.g., Baker Cypress). Others are narrow endemics adapted over long periods of time to specific habitats or substrates, such as the serpentine endemic group. Other rare species may be isolated populations that are diverging morphologically from metapopulations, or may be the result of cross-pollination between two or more species (e.g., Gentner's fritillary (*Fritillaria gentneri*)). Other rare species of lichen and bryophytes appear to be more mobile within widespread ranges (e.g., *Usnea longissima*), but adapted to narrow environmental conditions. Other species in Oregon are rare because of a loss of habitat due to an expanding human population and the introduction and spread of invasive plants (USDA, USFWS 2003a; USDA, USFWS 1998a).

Searches for rare plants have occurred on more than 433,000 acres in the past six years and resulted in the discovery of more than 1,600 new populations in the past three years alone. Over 85% of all populations (and the greatest increase in new populations over the past three years), occurs in the Medford District, which includes the Klamath Mountains. At the opposite end of the range, approximately 1% of all populations occur in the Lakeview District in the Klamath Falls Resource Area.

Areas of high special status species richness (the number of different species in an area) and density (the number of one species in an area) can be mapped across the landscape as hot spots (greater richness and density) and cold spots (lesser richness and density). Hot spots occur at fine spatial scales (such as special habitat features—like meadows, wetlands, rock outcrops) and at larger geographic regions, which are helpful for large-scale planning. Areas of high levels of endemism at the broader landscape level, such as the Klamath- Siskiyou region or the Eugene Wetlands area, are easily identified. Cold spots result from low occurrence levels of rare species and populations, or areas where survey intensity is lower. See *Figure 55 (Special status species density shown as hot spots and cold spots)*.

Figure 55. Special status species density shown as hot spots and cold spots



Natural disturbances (wildfires, storms, and floods) occur frequently and change plant community and habitat conditions for rare plant and fungi species. Many factors determine whether a population will survive the disturbance, such as:

- the type, duration, and intensity of the disturbance;
- the season;
- the species habit and life-cycle requirements; and
- the adaptability of a species to a changed environment.

Some rare plant species (e.g., Bradshaw's desert parsley (*Lomatium Bradshawii*)) are adapted to frequent, low-intensity fires and respond positively (Kaye et al. 2001). Such species as Gentner's fritillaria, Kincaid's lupine, and coral seeded allocarya (*plagiobothrys* sp.) can respond positively to the increased light and moisture from the loss of overtopping and competing vegetation, and the increase in nutrients that are available after a wildfire. On the other hand, many rare lichen, bryophytes, and fungi, along with some vascular plants, are consumed in a fire and these populations can be lost, along with their habitat and hosts, unless they are protected in a niche or island where the fire was absent or less severe (S. Copeland, unpublished data).

Floods and debris flows can alter riparian and aquatic plant communities and can also alter the rare plant populations that occur in the disturbed areas. These types of events are very dynamic with some rare plant populations benefiting and others being lost. Although, initially, floods may appear to destroy the existing riparian and aquatic vegetation, they also deposit sediment, distribute seed, and reduce excess and nonnative vegetation, which provides vigor to resprouting and reseeding shrubs, perennial and annual grasses, and forbs. For example, many populations of rare species of juncus and sedges, along with popcorn flowers (*plagiobothrys*), are associated with streams and wetlands and adapted to periodic floods with their prolific seed production.

Special Status Species

Some species are both state and federally listed species. Special status species are rare plant and fungi species that include all federally listed, Oregon state-listed, proposed, and candidate species, as well as, bureau sensitive species, bureau assessment species, and bureau tracking species. Bureau tracking species have no management associated with them and are not further discussed in this draft environmental impact statement. The special status species list is based on federal listings, state listings, and the Oregon Natural Heritage Information Center rankings of species.

There are currently 324 plant and fungi species that occur in the planning area that are on the special status species list. However, only 134 species (41%) have documented populations on BLM-administered lands. The remaining 190 species (59%) are suspected or likely to occur on BLM lands because known sites occur nearby, their range coincides with the planning area, or suitable habitat exists on BLM-administered lands. Only 95 of 230 vascular plants (14 of which are federally listed and candidate species) are known on BLM-administered lands, as well as, 14 of 47 mosses and liverworts (i.e., bryophytes), 15 of 26 lichens, and 10 of 21 fungi.

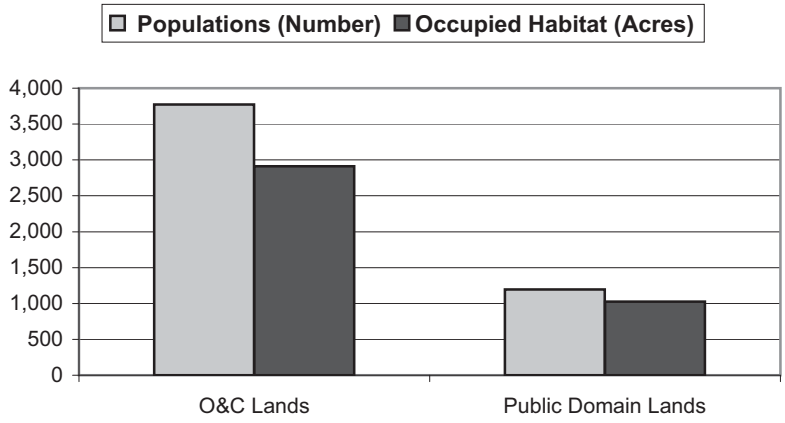
Table 81. Number of documented and suspected plant and fungi special status species

Special Status Plants and Fungi Species	Total Species	Vascular Plants	Bryophytes	Lichens	Fungi
Suspect	324	230	47	26	21
Documented	134	95	14	15	10

Special status species occupy approximately 4,000 acres of the approximately 2.5 million acres of BLM-administered lands within the planning area, which is itself approximately 22 million acres. Those 4,000 acres have approximately 5,000 populations of the 134 documented special status species, along with five additional species that occur in the West Eugene Wetlands and the Cascade-Siskiyou National Monument.

Approximately 74% of the occupied habitat (the 4,000 acres that are occupied by special status species) and 76% of the populations (the 5,000 populations of the documented special status species) occur on O&C lands, while 26% of the occupied habitat and 24% of the populations occur on public domain lands. See *Figure 56 (Populations and occupied habitat of bureau special status species on O&C and public domain lands within the planning area)*.

Figure 56. Populations and occupied habitat of special status species on O&C and public domain lands within the planning area



Federally Threatened, Endangered, and Candidate Species

There are 13 species that are listed under the federal Endangered Species Act that occur within the planning area, along with one federal candidate species—for a total of 14 federally listed and candidate species. Only 5 of the 13 federally listed species occur on BLM-administered lands, along with the one federal candidate species. There are eight species that are not documented on BLM-administered lands or do not occur on lands where management activities are proposed, but they are suspected and included because the range of the species overlaps public lands and suitable habitat exists. See *Table 82 (Federal status of federally listed plant species within the planning area)*. Also see *Appendix E. Botany*.

Table 82. Federal status of federally listed plant species within the planning area

Federal Status	Federally Listed Plant Species	
	Scientific Name	Common Name
FTO	*Castilleja levisecta*	Golden paintbrush
FTO	*Howellia aquatilis*	Water howellia
FTO	*Lupinus sulphureus ssp. kincaidii*	Kincaid's lupine
FTO	*Sidalcea nelsoniana*	Nelson's checker-mallow
FEO	*Arabis mcdonaldiana*	McDonald's rock-cress
FEO	*Astragalus applegate*	Applegate's milk-vetch
FEO	*Erigeron decumbens var. decumbens*	Willamette valley daisy
FEO	*Fritillaria gentneri*	Gentner's fritillary
FEO	*Lilium occidentale*	Western lily
FEO	*Limnanthes floccosa ssp. grandiflora*	Large-flowered wooly meadowfoam
FEO	*Lomatium bradshawii*	Bradshaw's desert parsley
FEO	*Lomatium cookii*	Cook's lomatium
FEO	*Plagiobothrys hirtus*	Rough popcorn flower
FCO	*Calochortus persistens*	Siskiyou mariposa-lily

FTO (federally threatened Oregon) FEO (federally endangered Oregon) FCO (federal candidate Oregon)

The federally listed and candidate species are vascular plants and they occur in every BLM district within the planning area. In general, federally listed plant species are adapted to special habitats within narrow geographic ranges, although some are broader and wider ranging. Individual population sizes are generally small and the area of occupied habitat is small. See *Appendix E. Botany* for a list of federally listed species, the number of known sites, the area occupied in acres, and the general habitat descriptions.

Oregon State Threatened, Endangered, and Proposed Species

The BLM policy for special status species applies to state-listed species that are under the authority of the Sikes Act. Species listed by the state of Oregon occur in every BLM district within the planning area and all are vascular plants. There are 29 plant species, along with 50 candidate species, that are listed under the Oregon Endangered Species Act. Of the Oregon listed species, 11 are also federally listed. In general, most of these species are narrow endemics that occur within restricted geographic areas or unique habitats. The populations of state-listed species are few and normally small in size. See *Appendix E. Botany*.

Bureau Sensitive Species and Bureau Assessment Species

Bureau sensitive species receive the same level of protection as federal candidate species under the BLM's special status species policy. Bureau assessment species are species of concern in Oregon, and impacts to populations and individual species are considered along with other resource considerations on a case-by-case basis.

There are 116 bureau sensitive species (of which are 19 state-listed species) and 194 bureau assessment species within the planning area. Of those 310 species, 216 are vascular plants (not including the 14 species that are federally listed and candidate species), 47 are mosses or liverworts (bryophytes), 26 are lichens, and 21 are fungi.

The vascular plants occur in a variety of habitat types and substrates including aquatic, riparian, and terrestrial. Bryophytes and lichen are associated with a variety of habitats (including rock, soils, and riparian, although primarily conifer and hardwood communities). Fungi are mycorrhizal and associated with host species in conifer and hardwood forest communities. The habitat groups (listed in the last section of this *Botany* section) delineate species by habitat types. Additional habitat descriptions can be found in *Appendix E. Botany*.

Conservation Plans

The following sections outline the recovery plans, conservation agreements, and conservation strategies that exist for rare plant species.

Recovery Plans for Federally Listed Plant Species

Recovery plans have been written for nine species within the planning area that are listed under the federal Endangered Species Act. Some recovery plans were written more than 15 years ago. The content, style, and vocabulary varies greatly between earlier and later plans. The primary conservation components of each recovery plan that applies to land management activities have been extracted and listed in *Appendix E. Botany*.

Table 83. Federally listed plant species with recovery plans

Scientific Name	Common Name
Arabis mcdonaldiana	McDonald's rock-cress
Astragalus applegatei	Applegate's milk-vetch
Castelleja levisecta	Golden paintbrush
Fritillaria gentneri	Gentner's fritillary
Howellia aquatilis	Water howellia
Lilium occidentale	Western lily
Lomatium bradshawii	Bradshaw's desert parsley
Lupinus sulphureus sp. kincaidii	Kincaid's lupine
Plagiobothrys hirtus	Rough popcorn flower
Sidalcea nelsoniana	Nelson's checker-mallow

Conservation Agreements

Conservation agreements outline mutual conservation goals that are necessary to reduce, eliminate, or mitigate specific threats to species that are at risk. They provide general guidance for the management of species. There are four interagency conservation agreements between the BLM and other agencies (usually involving the U.S. Fish and Wildlife Service) for species within the planning area. See *Table 84 (Plant species with conservation agreements)*. Three of the agreements are single-species agreements and one agreement covers a suite of rare species that occur in serpentine Darlingtonia wetlands and fens.

Table 84. Plant species with conservation agreements

Scientific Name	Common Name
Single-species agreements	
Calochortus coxii	Crinite mariposa lily (Oregon State listed as endangered)
Calochortus umpquensis	Umpqua mariposa lily (Oregon State listed as endangered)
Lupinus sulphureus sp. kincaidi	Kincaid's lupine (federally listed as threatened)
Multispecies agreement for the serpentine Darlingtonia wetlands and fens of southwestern Oregon and northwestern California	
Epilobium oreganum	Oregon willow-herb
Gentiana setigera	Mendocino gentian
Hastingsia bracteosa	Large-flowered rushlily (Oregon State listed as threatened)
H. atropurpurea	Purple-flowered rushlily
Viola primulifolia sp. occidentalis	Western bog violet

Conservation Strategies

Conservation strategies are more detailed than conservation agreements. They not only contain the information that is included in a conservation assessment, but they also provide specific details on species populations and habitat management. Conservation strategies have been written for five species within the planning area. See *Table 85 (Plant species with conservation strategies)*.

Table 85. Plant species with conservation strategies

Scientific Name	Common Name
Aster gormanii	Gorman's aster
Cimicifuga elata	Tall bugbane
Frasera umpquaensis	Umpqua gentian
Phacelia argentea	Silvery phacelia (Oregon State listed as threatened)
Rorippa columbiae	Columbia cress

See *Appendix E. Botany* for a complete list of conservation strategies and conservation agreements, which includes species, key conservation components that apply to land management actions, participating agencies, and field units.

Survey and Manage

Survey and manage is a mitigation measure for little known or rare species that was adopted as a set of standards and guidelines in the 1995 resource management plans of the districts within the planning area to direct management.

For comprehensive information regarding the species, refer to the:

- *January 2004 Final Supplemental Environmental Impact Statement To Remove or Modify the Survey and Manage Mitigation Measure Standards and Guidelines*; and the
- *January 2007 Supplement to the July 2006 Draft Supplement to the 2004 Final Supplemental Environmental Impact Statement To Remove or Modify the Survey and Manage Mitigation Measure Standards and Guidelines*.

For the management direction, refer to the:

- *January 2001 Record of Decision and Standards and Guidelines for Amendments to the Survey and Manage, Protection Buffer, and other Mitigation Measures Standards and Guidelines in Forest Service and Bureau of Land Management Planning Documents Within the Range of the Northern Spotted Owl*.

The information in these environmental impact statements is incorporated by reference.

See *Table 86 (Distribution of survey and manage species)* for the total number of survey and manage species within the area of the Northwest Forest plan (NWFP), the number that occur on BLM-administered lands, the number that are also bureau sensitive species (BSS), the number that are also bureau assessment species (BAS), and the number that have been removed from the survey and manage list in Oregon.

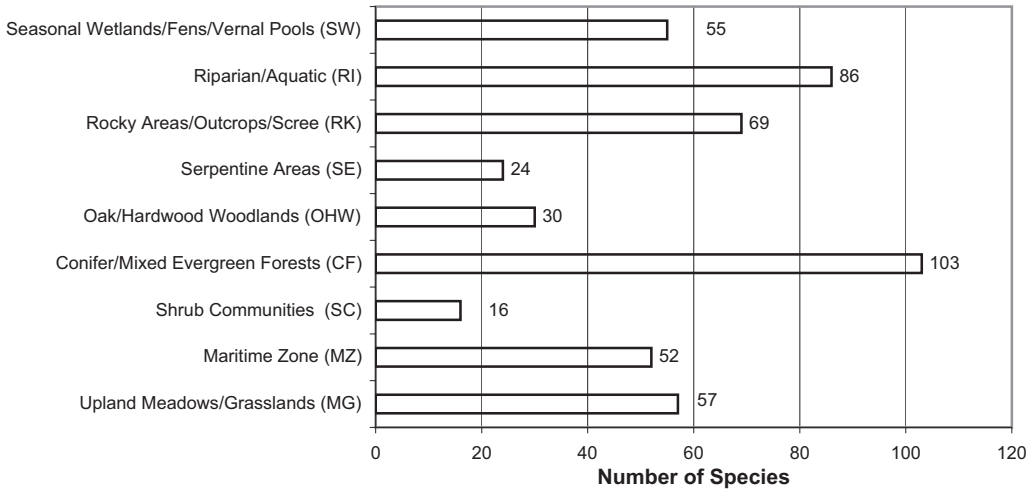
Table 86. Distribution of survey and manage species

Survey and Manage Species	Total Survey and Manage	Vascular Plants	Bryophytes	Lichens	Fungi
Number that occur within the area of the NWFP	254	10	17	40	187
Number that occur on BLM lands	246	10	13	39	184
Number that are also BSS	20	3	0	2	15
Number that are also BAS	21	3	8	10	0
Number that have been removed from Oregon listing	8	2	2	1	3

Habitat Groups and Rare Plant and Fungi Species

One method of grouping rare plant and fungi species is by the habitat associations that are based on biotic and abiotic features. See *Figure 57 (Number of special status species by habitat group)*. There are 324 special status plant and fungi species within the planning area from approximately 14 life-forms (e.g., forb, grass, tree, lichen, and fungi) that are found in numerous habitat-specific substrates, plant communities, and environments. There are nine habitat groups that were formed based on aggregating together similar habitat types that exist throughout the planning area. Each of the 324 species was placed into one or more groups. Each species was included in the broadest number of habit groups based on the variety of habitats and conditions that are associated with the species. See *Appendix E. Botany*.

Figure 57. Number of special status species by habitat group



The habitat groups used in this analysis include:

- conifer and mixed evergreen forests (CF)
- maritime zone (MZ)
- oak and hardwood woodlands (OHW)
- riparian and aquatic (RI)
- rocky areas, outcrops, and scree (RK)
- seasonal wetlands, fens, and vernal pools (SW)
- serpentine areas (SE)
- shrub communities (SC)
- upland meadows and grasslands (MG)

The above habitat groups relate to biotic and abiotic conditions as follows:

- Four habitat groups (CF, MG, OHW, and SC) relate to broad vegetative community types.
- Two habitat groups (RI and SW) relate to hydrologic and aquatic dependencies.
- Two habitat groups (RK and SE) relate to parent material substrates (one specifically to serpentine areas).
- One habitat groups (MZ) relates to wind and rain and is defined as taxa that is normally associated with coastal conditions within approximately 10 miles of the coast.

Invasive Plants

Key Points

- Invasive plant infestations are numerous and many are well-distributed on BLM-administered lands within the planning area.
- Invasive species are introduced and spread through a variety of mechanisms, including land management activities.

Invasive plants are alien plant species whose introduction causes economic or environmental harm, or harm to human health. Noxious weeds are a subset of invasive plant species. Noxious weeds are plant species that are designated by federal or state law, and generally possess one or more of the following characteristics:

- aggressive and difficult to manage
- parasitic
- carrier (or host) of serious insects or disease
- nonnative, new to, or not common to the United States

Invasive plants have been introduced into the planning area by various means. Some introductions were intentional—to make use of ornamental or erosion-control species. Examples include Scotch broom and purple loosestrife. Other species were introduced unintentionally—by air, water, or transportation routes. Frequently, invasive plants are introduced by the movement of contaminated seed, agricultural materials, or animals; the use of contaminated equipment; the spreading of infested gravel, road fill, and topsoil; and the sale of invasive species for ornamental purposes (USDI, BLM 1996).

Once introduced, these invasive species are spread primarily by vehicles, human activities, water, and wildlife. The initial infestations are often along roads and trails, landings, campgrounds, and other areas of high disturbance (Hansen and Clevenger 2005). Occasionally, infestations are also introduced into relatively undisturbed areas (USDI, BLM 2005a, 3-39).

More than 130 invasive plant species have been documented within the planning area. Of these, 61 are also listed as noxious weeds in Oregon. See *Table 87 (Number of invasive plant and noxious weed species on BLM-administered lands within the planning area)*. Several of the other identified invasive plants are also listed as noxious weeds in other states.

Table 87. Number of invasive plant and noxious weed species on BLM-administered lands within the planning area

Plant Category	Planning Area	BLM Districts					
		Salem	Eugene	Roseburg	Coos Bay	Medford	Klamath Falls
Invasive Plants	136	74	64	81	51	50	50
Noxious Weeds	61	26	28	28	29	36	28

An accurate accounting of the total acreage and distribution of invasive plant infestations and treatments is unavailable for the following reasons:

- No central source exists for compiling invasive plant infestation and treatment information within Oregon.
- There is no requirement for county, private, or corporate land owners to report invasive plant information.

Despite the limited reporting on weed locations, a good picture of the distribution of noxious weed species is available on a species-by-species basis by WeedMapper (a website).

> **WeedMapper**
>
> An interagency cooperative effort with Oregon State University to collect spatial information on the distribution of noxious weeds in the state of Oregon. See www.weedmapper.org.

The condition of invasive plant infestations on BLM-administered lands within the planning area can be characterized by analyzing a few invasive species. The following representative list of invasive species is used to describe the condition of invasive plants on BLM-administered lands within the planning area.

- Canada thistle
- dyer's woad
- false brome
- knotweeds
- leafy spurge
- meadow knapweed
- Scotch and French brooms
- spotted and diffuse knapweeds
- yellow starthistle

Each of these species or species groups has a unique distribution pattern and strategy for spreading and resisting different treatment methods. Many of the identified invasive species are well-distributed across the planning area. Some are limited in distribution and others have very few sites on BLM-administered lands. Although each species is unique, these sample invasive species represent a range of life histories and methods of introduction and spread sufficient to describe the condition of invasive species on BLM-administered lands within the planning area.

Canada Thistle

Canada thistle, a perennial with an extensive root system, occurs in a wide variety of open, moist, disturbed habitats including roadsides, streambanks, pastures, meadows, waste areas, campgrounds, clear-cuts, roads, fires, and landslides (Hansen 2005; Turner 1999; Titus 1998; Jensen 1991; Schoenberger 1982; Neiland 1958). Canada thistle is rarely found in undisturbed forests (Heckman 1999; Bailey 1998; Hutchison 1992; Chen 1996; Dewey 1991; Parendes 2000; Young 1967). A study at Yellowstone National Park revealed that Canada thistle was found in habitats with varying levels of disturbance and that there is a direct relationship with species abundance and the level of disturbance (Allen 1999; Turner 1997).

Canada thistle spreads sexually by seed and vegetatively by root and stem fragments. Most seeds are spread by animals, hay, contaminated crop seed, machinery, and irrigation water. Fewer are dispersed by wind (Nuzzo 2000). The majority of the seeds germinate

the year they are produced. Seeds are generally viable for less than 5 years, but could remain viable for up to 20 years in soil (Nuzzo 2000; Donald 1994).

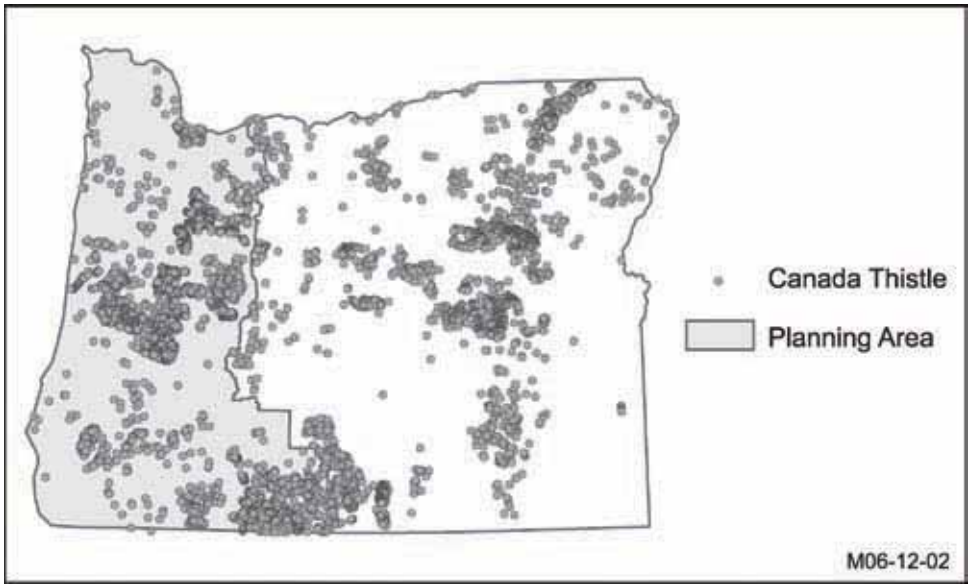
Once germinated, Canada thistle seedlings require space to grow and relatively high levels of light (Nuzzo 2000; Donald 1994). Once established, Canada thistle spreads rapidly by vegetative growth in the root and underground stems systems. Within one season a plant can grow up to 20 feet horizontally in good growing conditions (Magnusson 1987).

Canada thistle may establish in natural areas as part of the initial plant community after logging (Jensen 1991; Kellman 1969; Chen 1996; Young 1967), fire (Schoenberger 1982), grazing, and road building (Meier 1997).

A study in northern Idaho documented the establishment of Canada thistle following clear-cutting activities with varying levels of soil displacement. Timber harvesting activities with high levels of soil disturbance favor the establishment of forbs, including Canada thistle, to the detriment of tree seedling establishment (Jensen 1991). Canada thistle establishment may take two or more seasons after disturbance events (Doyle 1998; Willard 1995; Jensen 1991).

Canada thistle is well-distributed across the state and is present on BLM lands in every district within the planning area. See *Figure 58 (Distribution of Canada thistle)* (WeedMapper 2004a).

Figure 58. Distribution of Canada thistle



Source: WeedMapper 2004a

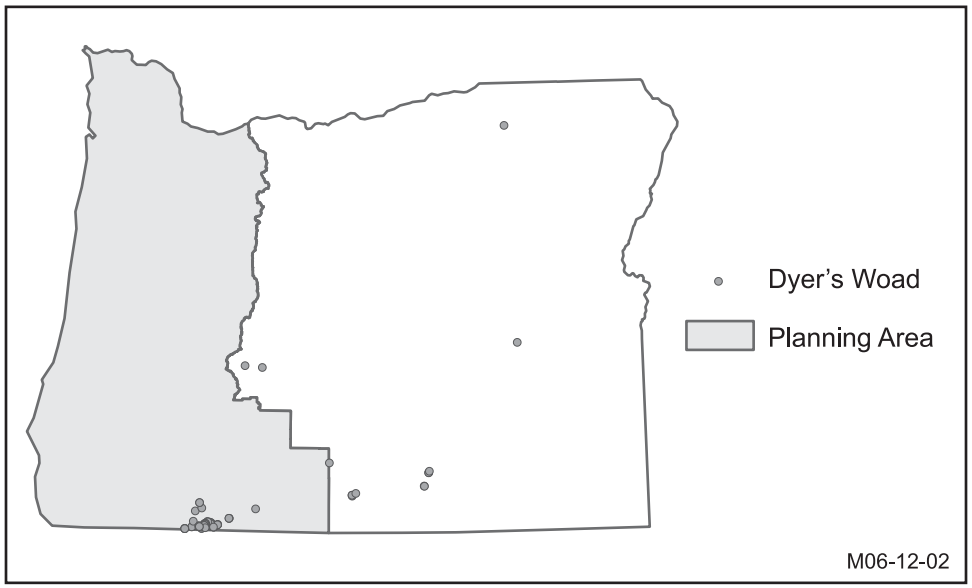
Dyer's Woad

Dyer's woad is an invader of rangelands and pastures. Dyer's woad behaves as a winter annual, biennial, or short-lived perennial. It is a prolific seed producer. The seeds are toxic to other plants and may remain viable in the soil for several years. This species only reproduces by seed (Kadrmas 2002; Forest Health Technology Enterprise Team *Update Team*. Spring 1997).

Dyer's woad is spread by the transport of contaminated livestock, machinery, and soil; the sowing of contaminated seed; and the feeding of contaminated hay. Natural movements of wind and water also contribute to the spread of dyer's woad (Kadrmas 2002).

The apparent distribution of dyer's woad in western Oregon is limited to the southeastern portion of the planning area. Dyer's woad infestations are reported from the Klamath Falls Resource Area of the Lakeview District and the Medford District. See *Figure 59 (Distribution of dyer's woad)* (WeedMapper 2004a).

Figure 59. Distribution of dyer's woad



Source: WeedMapper 2004a

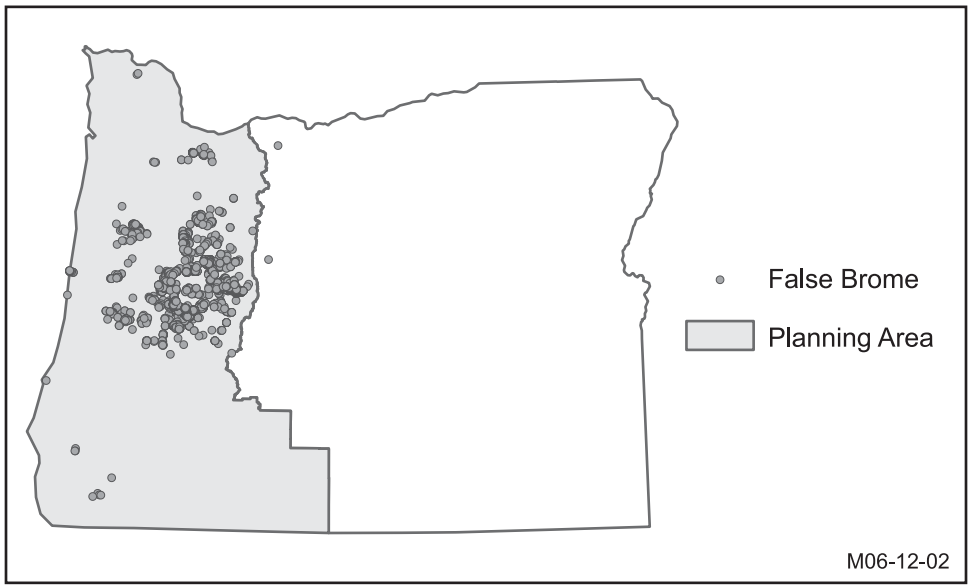
False Brome

False brome, a perennial grass, reproduces by producing large quantities of seed. The seeds are dispersed by water, gravity, animals, and are often spread long distances by vehicles, off-highway vehicles, people, and road construction and maintenance equipment (Kaye 2003; False-brome Working Group Newsletter 2004).

False brome is shade tolerant but can be easily crowded out by other shrubs and forbs. It grows in a wide variety of habitats including dry meadows and along streams, roads, trails, and under forest canopies. Infestations spread along roads, trails, and down streams (Kaye 2003; False-brome Working Group Newsletter 2004).

False brome has been reported on BLM lands in the Eugene, Salem, and Medford districts, and is also known to occur on nonfederal lands in southwestern Oregon and just over the crest of the Cascade Mountains in Jefferson County. See *Figure 60 (Distribution of false brome)* (WeedMapper 2004a).

Figure 60. Distribution of false brome



Source: WeedMapper 2004a

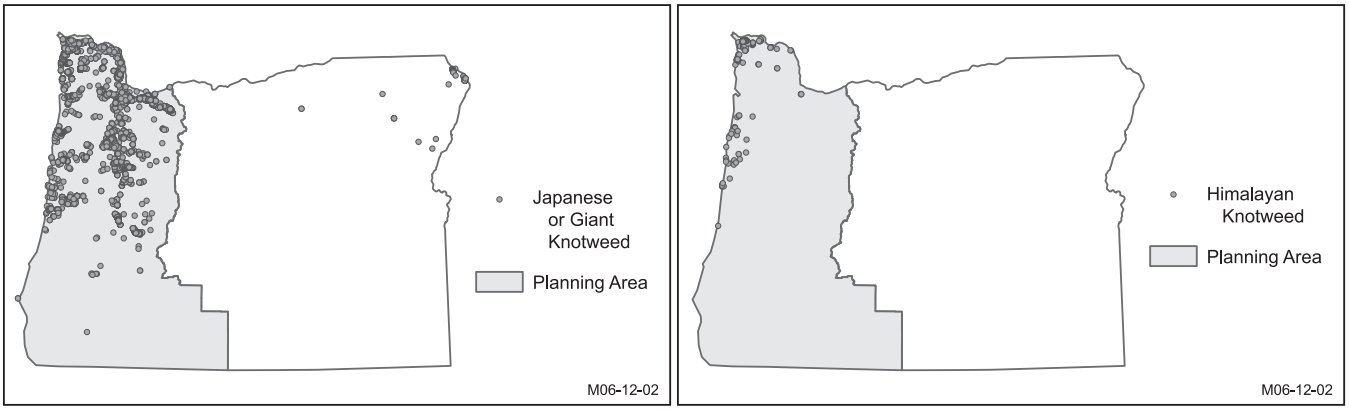
Knotweeds

The knotweeds are long-lived perennials that create dense infestations in disturbed areas, like stream banks, roads, and in waste areas. Roots and rhizomes can reach depths of 7 feet and distances of more than 20 feet from the parent plant. These infestations become dense and outcompete most native plant communities (Soll 2007; Seiger 1991).

Knotweeds favor habitats that are mostly light, but can persist in areas of partial shade, particularly where the overstory is dominated by broadleaf tree species. Knotweed infestations spread downstream during flood events, and are introduced along roads and waste areas as a result of human activity (Soll 2007; Seiger 1991).

Knotweeds are present on the BLM-administered lands in all of the planning area, except the Klamath Falls Resource Area of the Lakeview District. See *Figure 61 (Distribution of Japanese and giant knotwood and the Himalayan knotweed)* (WeedMapper 2004a). These figures only reflects the sites that have been reported. Considerable effort has gone into inventorying the invasive knotweed species in some watersheds. It is likely that these figures underrepresent the actual distribution of knotweeds within the planning area.

Figure 61. Distribution of Japanese and giant knotweed (left) and the Himalayan knotweed (right)



Source: WeedMapper 2004a

Japanese and giant knotweed

Himalayan knotweed

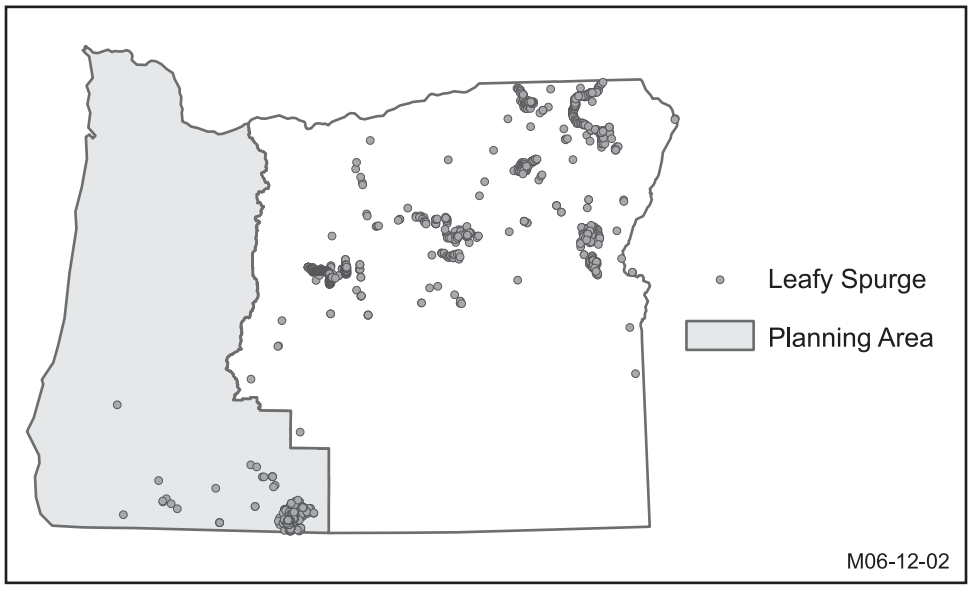
Leafy Spurge

Leafy spurge is known to occur in a wide variety of habitats including agricultural, urban areas, grasslands, shrublands, and forests. This species is most vigorous in full sunlight and dry habitats but can also inhabit woodlands, prairies, and other habitats. The root system of leafy spurge is extensive and can reach depths beyond 12 feet into the soil profile and reach more than 30 feet from side to side. Infestations tend to grow into dense stands, easily outcompeting native plant communities (WeedMapper 2004b; Global Invasive Species Database 2005).

Leafy spurge can be introduced to new locations by accidentally including seeds in agricultural seed mixes and may be used as an ornamental in landscapes. Infestations can grow from a single established plant at a rate of 4 feet per year (Global Invasive Species Database 2005).

The distribution of leafy spurge in Oregon is primarily east of the crest of the Cascade Mountains and has been reported on BLM lands in both the Medford District and Klamath Falls Resource Area of the Lakeview District. See *Figure 62 (Distribution of leafy spurge)* (WeedMapper 2004a).

Figure 62. Distribution of leafy spurge



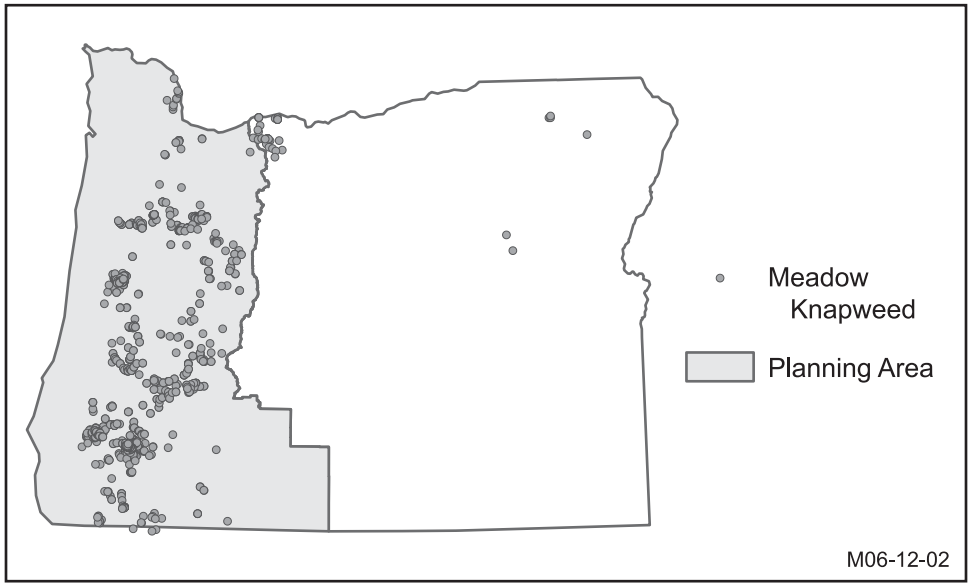
Source: WeedMapper 2004a

Meadow Knapweed

Meadow knapweed was introduced into Oregon as a forage plant and today invades a variety of habitats within the planning area including roadsides, pastures, meadows, native prairies, oak savannahs, and forest openings. In western Oregon, meadow knapweed is becoming more common in clear-cuts (Coombs et al. 2004). This species outcompetes native plant communities—reproducing by seed and spreading by both natural processes and human activity (WeedMapper 2004).

The reported distribution of meadow knapweed in Oregon is primarily west of the crest of the Cascade Mountains and has been documented on BLM lands in every district within the planning area. See *Figure 63 (Distribution of meadow knapweed)* (WeedMapper 2004a).

Figure 63. Distribution of meadow knapweed



Source: WeedMapper 2004a

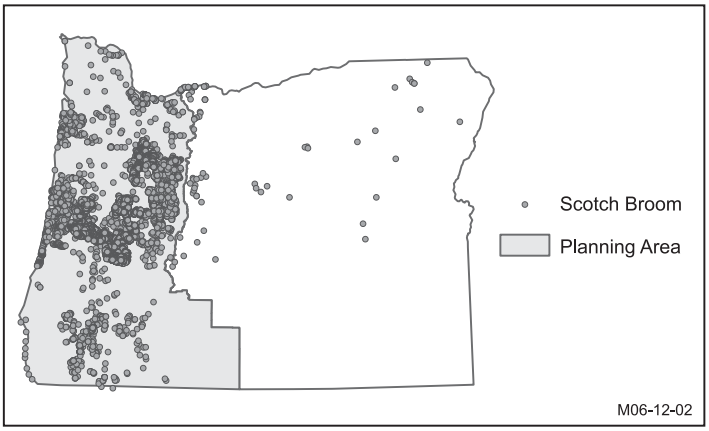
Scotch and French Brooms

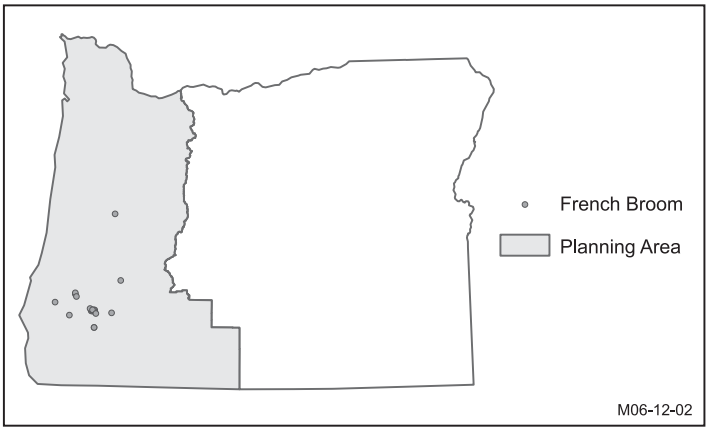
Scotch and French brooms are pioneer species known to displace native plant species and increase the costs of timber production. They readily invade disturbed sites in natural areas, dunes, recreational areas, dry riverbeds, utility right-of-ways, open habitats, and forest lands. Scotch broom is shade intolerant but, given a chance, it invades areas soon after logging, clearing, and burning (Coombs et al. 2004). French broom has similar characteristics (Oregon Department of Agriculture 2007; Hoshovsky 1986).

Scotch and French brooms reproduce primarily by long-lived and hard-coated seeds. Mature plants produce a multitude of seeds that can remain viable in the soil for more than 50 years (Soll 2007; Coombs et al. 2004 160-161). The seeds are transported in soils, down streams, on machinery, and sometimes by birds and other animals that carry the seeds to new isolated areas (Watterson 2006; Hoshovsky 1986).

Scotch broom infestations are present across Oregon, except in the southeastern portion of the state. In western Oregon, the species is well-distributed north to south and is reported on BLM lands in every district within the planning area. French broom infestations are currently limited to western Oregon and are reported to occur on BLM lands in the Coos Bay, Eugene, Medford, and Roseburg districts. See *Figure 64 (Distribution of French and Scotch brooms)* (WeedMapper 2004a).

Figure 64. Distribution of Scotch broom (left) and French (right) brooms





Source: WeedMapper 2004a

Scotch broom

French broom

Spotted and Diffuse Knapweeds

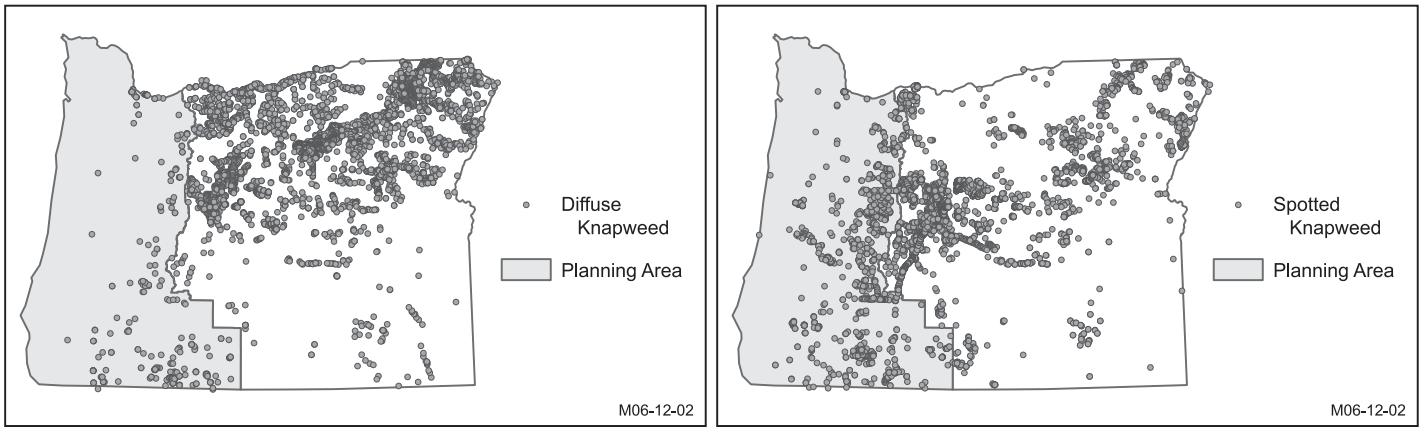
Spotted and diffuse knapweeds are tap-rooted biennials or short-lived perennials that are successful in outcompeting desirable species and native plant communities by growing into dense infestations in open habitats (WeedMapper Team 2004c, 2004d).

Spotted and diffuse knapweed seeds are often spread by being carried along on vehicle frames and shoes to new roadside or trail environments (Sheley et al. 1998). In British Columbia, logging trucks, off-highway vehicles, and trail bikes are documented sources of knapweed spreaders. These knapweeds are also spread along waterways in crop seed and in hay (Strang et al. 1979). Undisturbed infestations spread their seed by wind and water. The seeds can persist in the soil for more than five years (Coombs et al. 2004 198-199).

Transportation corridors, water ways, gravel pits, and industrial areas are common sites for diffuse knapweed infestations (Coombs et al. 2004 198-199; Roche and Roche 1988). Diffuse knapweed is also known to invade well-managed rangelands (Sheley et al. 1998).

Diffuse and spotted knapweeds have similar distribution patterns within the planning area but diffuse knapweed is reported less frequently. See *Figure 65 (Distribution of diffuse knapweed and spotted knapweed)* (WeedMapper 2004a). Both species are spread throughout the state. Diffuse knapweed has been documented on BLM lands in all of the districts within the planning area, except for Coos Bay and Medford. Spotted knapweed occurs in all of the districts within the planning area, except for Eugene and Roseburg.

Figure 65. Distribution of diffuse knapweed (left) and spotted knapweed (right)



Source: WeedMapper 2004a

Diffuse knapweed

Spotted knapweed

Yellow Starthistle

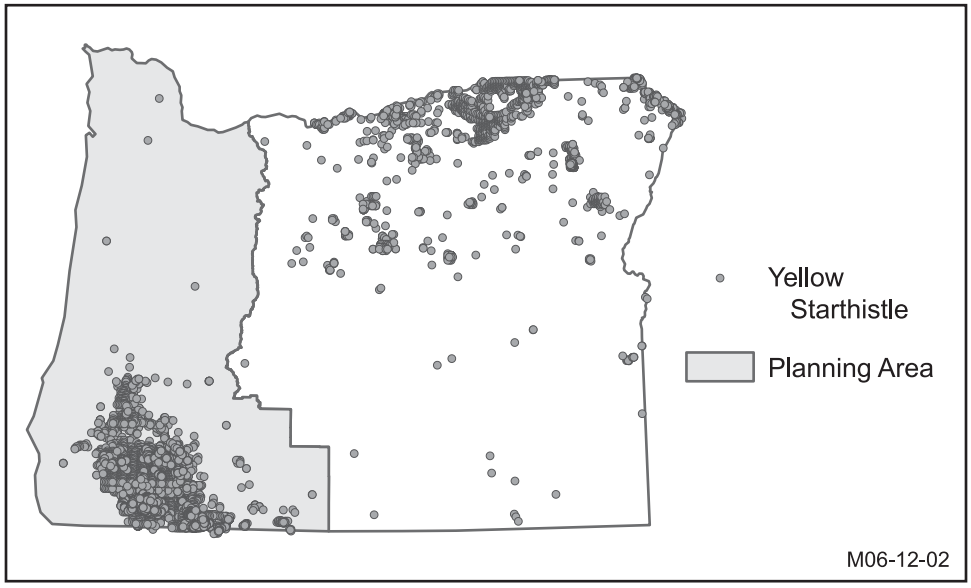
Yellow starthistle is an invasive winter annual or, rarely, a biennial or short-lived perennial forb, which grows best in full light and dry conditions and is almost always found in disturbed areas or open grasslands that are dominated by annuals.

Yellow starthistle infestations can reach more than 6 million plants per acre (Callihan 1993). At this density, yellow starthistle effectively displaces native plants; reduces wildlife habitats, species diversity, and land values; and limits access to recreational areas.

Seeds of yellow starthistle are dispersed short distances by wind and longer distances by animals and people. Yellow starthistle seeds may remain viable for up to 10 years (Callihan 1993). Seeds are most often distributed long distances by such human activities as the movement of livestock, the movement of seeds on the undercarriage of vehicles and on road maintenance equipment, and the use of contaminated hay and crop seed (Healy 2000; DiTomaso 2001). Yellow starthistle infestations have also been spread from gravel out of infested gravel pits to roadsides and other management activity sites (Roche 1988).

The yellow starthistle distribution pattern in Oregon is clustered in the northeast and southwest but is present in every physiographic province in the state. See *Figure 66 (Distribution of yellow starthistle)* (WeedMapper 2004a). Infestations of yellow starthistle are reported on BLM lands in all of the districts within the planning area, except Salem.

Figure 66. Distribution of yellow starthistle



Source: WeedMapper 2004a

Infestations of Invasive Species

Reported weed sites for the invasive species that are described above show high densities of reported invasive plant sites in portions of all of the planning area. See *Figure 67 (Reported infestations of representative invasive species within the planning area)* and *Figure 68 (Distribution categories of invasive species for the fifth-field watersheds within the planning area)*.

Figure 67. Reported infestations of representative invasive species within the planning area

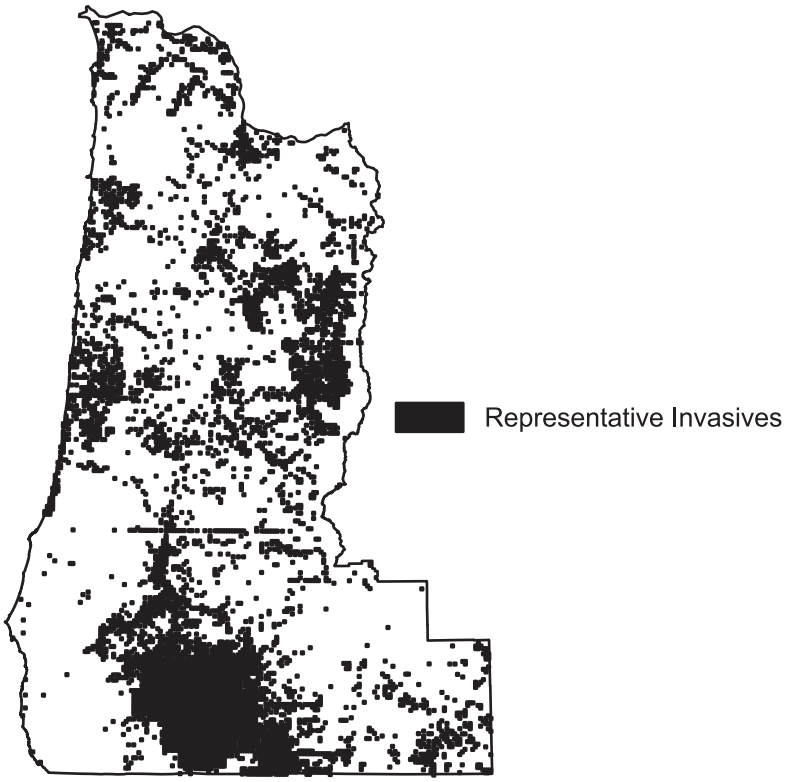
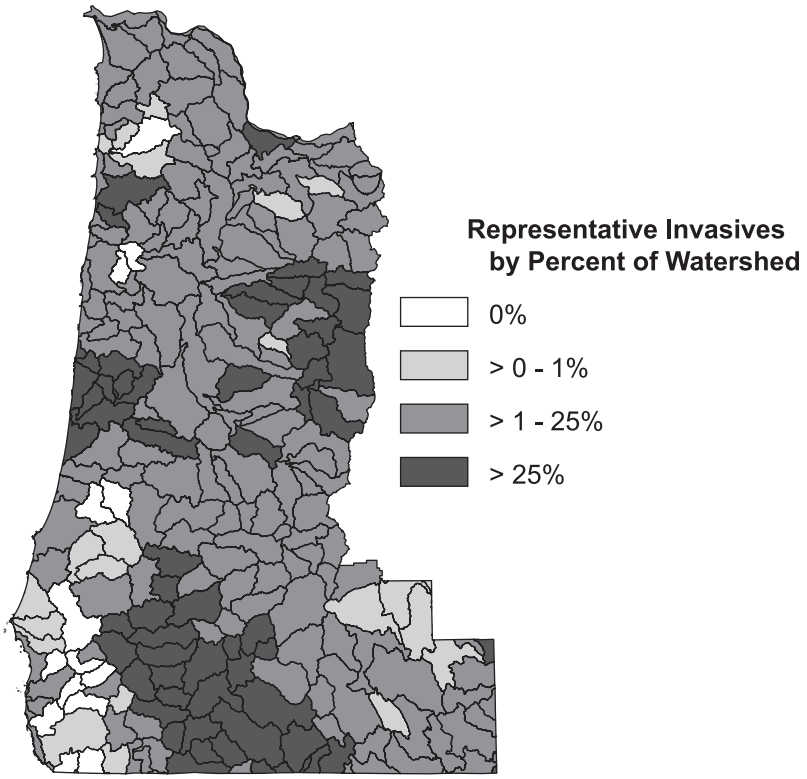


Figure 68. Distribution categories of invasive species for the fifth-field watersheds within the planning area



The highest density fifth-field watersheds (shown in black) are those that have reported infestations in more than 25% of the square miles within them. The lightest gray areas represent fifth-field watersheds with reported infestations in 1% or fewer of the square miles within them, and the white areas show fifth-field watersheds with no reported infestations. The most expansive high-density invasive plant area is located in the Medford District and extends north into the Roseburg and Coos Bay districts.

Roads, trails, high recreation use areas, urban areas, and gravel sources can serve as the primary source locations for many invasive plant species (USDA, U.S. Forest Service 2005, 3-18). These source locations are present on both BLM- and non-BLM-administered lands throughout the planning area.

Common methods of introduction (USDI, BLM 1996a) include the movement of:

- contaminated seed, feed grain, other plant materials;
- contaminated equipment across uncontaminated lands;
- wildlife;
- livestock;
- gravel, road fill, and topsoil; and
- the selling and trading of plants and seeds as ornamentals.

Once introduced, invasive plants are spread primarily by vehicles, humans, livestock, wind, water, and wildlife. Disturbed sites, like trailheads, landings, recreation areas, logging sites, and roads regularly support infestations (Watterson 2006; USDA, U.S. Forest Service 2005, 3-39).

Invasive plants are generally introduced and spread by human and management activities that result in ground disturbances and increased light levels. Examples are:

- Knotweed infestations are introduced along roads and waste areas as a result of human activity and then spread downstream during flood events (Hutchison 1992; Seiger 1991).
- False brome, knapweeds, Scotch broom, and other species also spread downstream once they are introduced into stream systems (Watterson 2006).
- Logging trucks, off-highway vehicles, and trail bikes have been documented sources of spreading knapweed (Strang 1979).
- Transportation corridors, waterways, gravel pits, and industrial areas are common sites for diffuse knapweed infestations (Roche 1988).

The association between disturbance and increased light levels, created by management activities (like logging and road maintenance activities), and the vigor of infestations are well-documented (Allen 1999; Turner 1997). The likelihood of successful invasions is increasingly high with more extensive ground disturbance activities. The factors that are associated with timber harvesting activities that increase the chances of invasion include (Nuzzo 2000; Parendes 2000; Heckman 1999; Bailey 1998; Doyle 1998; Titus 1998; Outcalt 1981; Chen 1996; Donald 1994; Kellman 1969; Nieland 1958):

- increased light levels reaching the forest floor;
- increased soil temperatures; and
- soil disturbances, which can increase the germination rates of seeds in a seed bank or create seed beds.

Harvesting methods and the size of logging units increases the susceptibility to invasive plant introductions. Timber harvesting activities and methods that disturb more soil and leave less postharvest shade would be more susceptible to invasive plant introduction and spread (USDA, U.S. Forest Service 2005, 3-14, 3-5).

Knotweeds, false brome, and Scotch broom tolerate moderate levels of shade. Spotted and meadow knapweeds, Canada thistle, dyer's woad, and yellow starthistle can be described as being fairly shade intolerant.

Infestations are introduced and spread readily in areas with frequent human activity, such as wildland urban interface and high recreational use areas (USDA, U.S. Forest Service 2005, 3-23, 3-25). These areas have more intensive disturbance activities occurring in higher concentrations than do areas with less human activity.

Invasive plants are more likely to spread throughout a landscape where disturbance activities are evenly distributed than in landscapes where the disturbance activities are spatially confined (USDA, U.S. Forest Service 2005, 3-14, 3-15, Appendix D 7-17).

Wildlife

Key Points
• The populations for the northern spotted owl in the Roseburg, Coos Bay, and Medford districts, and the Klamath Falls Resource Area of the Lakeview District, have been stable since 1985, while populations have declined in the Salem and Eugene districts. • The habitat for the northern spotted owl within the planning area has increased since 1995, while the habitat for the marbled murrelet has remained relatively unchanged. • The populations for the marbled murrelet in Oregon have declined approximately 50% from 1992 to 1995 and have experienced no change from 1997 to 2006.

Within the planning area, the BLM manages habitats that range from coastal beaches to montane forests and great basin sagebrush. There are several thousand vertebrate and invertebrate species that occur in the western and montane forests of Oregon. There are 11 species that are protected under the federal Endangered Species Act. A subset of individual species is specifically addressed in this draft environmental impact statement because of their importance in the analysis of the alternatives, the consultation with the U.S. Fish and Wildlife Service, or high public interest.

Northern Spotted Owl

The northern spotted owl (*Strix occidentalis caurina*) was federally listed as threatened by the U.S. Fish and Wildlife Service in June 1990 (Federal Register 1990, 26114-26194). The U.S. Fish and Wildlife Service issued a recovery plan as a draft in 1992, but did not issue a final recovery plan (USFWS 1992). A new recovery planning effort is currently underway and the final recovery plan is scheduled for completion in November 2007. Critical habitat was designated for the northern spotted owl in January 1992 and includes 3,257,000 acres of federal lands in Oregon, including 1,009,000 acres of land that is administered by the BLM (Federal Register 1992a, 1796-1838). A draft rule for the redesignation of critical habitat is expected in the summer of 2007.

The northern spotted owl was listed as threatened throughout its range “due to loss and adverse modification of suitable habitat as a result of timber harvesting and exacerbated by catastrophic events such as fire, volcanic eruption, and wind storms” (Anderson et al. 1990). More specifically, significant threats to the northern spotted owl included the following (Federal Register 1992a, 1796-1835):

- low or declining populations
- limited or declining habitat
- distribution of habitat or populations
- isolation of provinces
- predation and competition
- lack of coordinated conservation measures
- vulnerability to natural disturbance

These threats were characterized for each province within the range of the northern spotted owl as severe, moderate, low, or unknown. The following were identified as a severe or moderate threats to the northern spotted owl in all or most of the provinces, and represent the greatest concern to the conservation of the northern spotted owl:

- declining habitat in all 12 provinces
- isolation of provinces in 11 provinces
- declining populations in 10 provinces

The following were identified as severe or moderate threats to the northern spotted owl in many of the provinces, which suggests a concern throughout the majority of its range:

- limited habitat in nine provinces
- low populations in eight provinces

Vulnerability to natural disturbances was rated as low in five provinces. Since the listing of the northern spotted owl, new information suggests that hybridization with the barred owl is less of a threat (Kelly and Forsman 2004) and competition with the barred owl is a greater threat than previously anticipated, as detailed below (Courtney et al. 2004).

The following recent documents summarize the condition of the northern spotted owl across its range and are incorporated by reference:

- *Status and Trends in Demography of Northern Spotted Owls*, 1985-2003 (Anthony et al. 2006)
- *Scientific Evaluation of the Status of the Northern Spotted Owl* (Courtney et al. 2004)
- *Northern Spotted Owl Five-year Review: Summary and Evaluation* (USDI, USFWS 2004a)
- *Status and Trends of Northern Spotted Owl Population and Habitat* (Lint 2005)

Anthony et al. (2006) analyzed information gathered from 14 demographic study areas across the range of the northern spotted owl—11 include federal lands, 1 is located on private timberlands, and 2 are on tribal forest lands. The primary objectives of Anthony's analysis were:

- Estimate the age-specific survival and fecundity rates and their sampling variances for territorial owls on individual study areas.
- Determine if there were any trends in the apparent survival or fecundity rates among study areas.
- Estimate the annual rates of population change and the sampling variances for individual study areas and across study areas.
- Compare the demographic performance of the northern spotted owls on the eight areas that are the basis of the monitoring plan for the Northwest Forest Plan (Lint et al. 1999) to that of owls on other areas.

Courtney et al. (2004) was contracted by the U.S. Fish and Wildlife Service to "produce a report on the status of the northern spotted owl, summarizing and evaluating new information available since its listing, and any new understanding for information that existed at the time of listing" (USDI, USFWS 2004a). The U.S. Fish and Wildlife Service used the Courtney et al. (2004) report to conduct their five-year status review of the northern spotted owl as required under section 4(c) of the Endangered Species Act. The status review sought to answer three questions (USDI, USFWS 2004a):

1. Is the northern spotted owl a valid subspecies under the Endangered Species Act?
2. Is there new information about the threats or population status of the northern spotted owl?
3. If so, does the new information suggest that a change in listing status may be warranted?

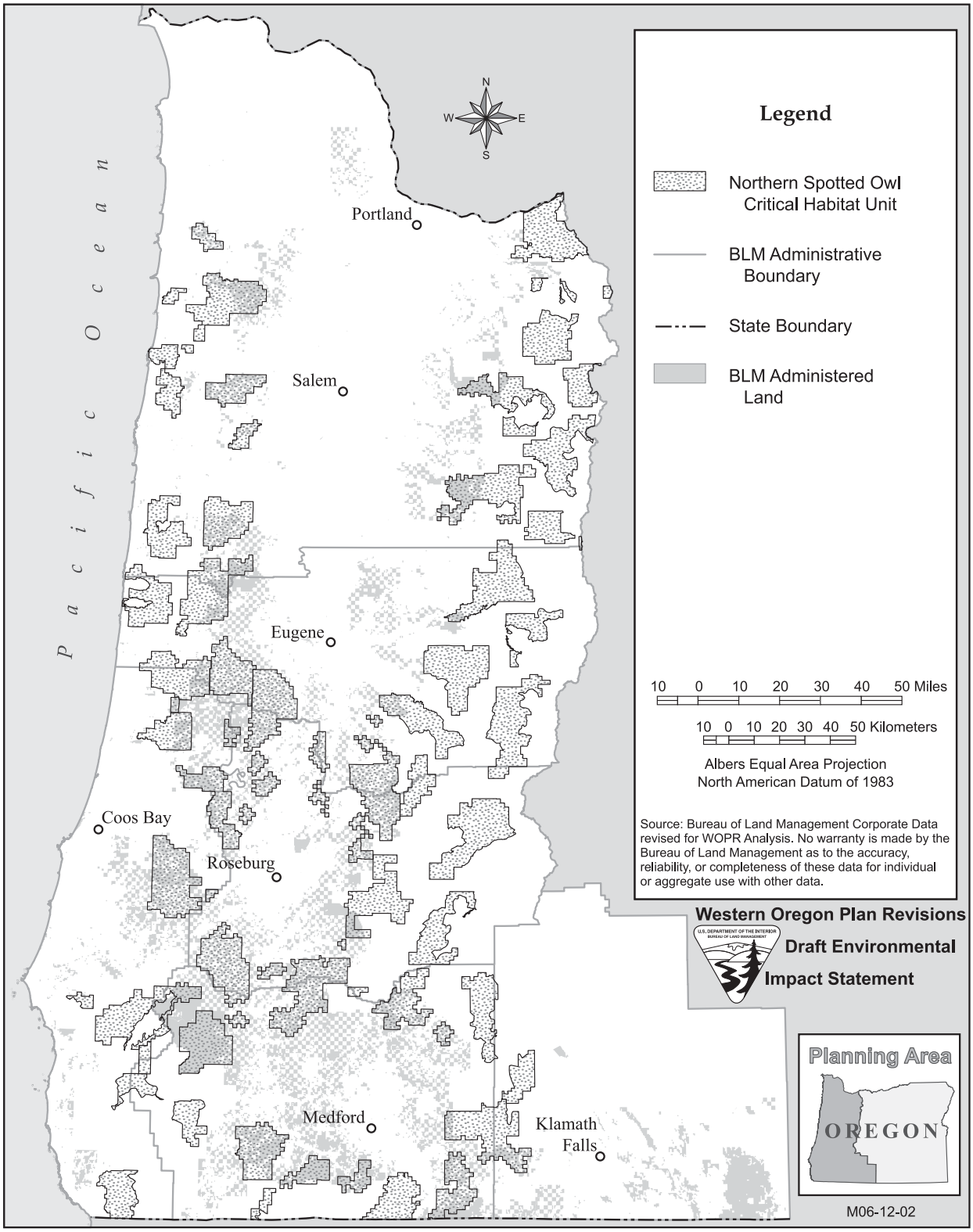
In 2004, the U.S. Fish and Wildlife Service determined that the listing of the northern spotted owl as a threatened species was still warranted (USDI, USFWS 2004a). Even though some risk factors had declined (e.g., habitat loss due to timber harvesting and existing regulations), other factors had continued unchecked (e.g., habitat loss due to wildfire and population decline) and new risk factors with uncertain effects had developed since 1990 (e.g., the barred owl (*Strix varia*), West Nile virus, and sudden oak death) (USDI, USFWS 2004a).

Lint et al. (2005) was one component of the effectiveness monitoring strategy of the Northwest Forest Plan and reports on the effects of the first 10 years of implementing the plan on the population and habitat of the northern spotted owl. The report established baselines for 1994 and then reported on the change from the subsequent 10 years of Northwest Forest Plan implementation. A summary of the findings in the report includes:

- The estimated decline of the northern spotted owl population varied from 0 to 10% across the study areas in the Northwest Forest Plan area. The presence of barred owls (*Strix varia*), weather, past and present harvesting of habitat, and wildlife and insect infestations that alter habitat are all possible contributors to these declines.
- Approximately 74% of the federal lands within the range of the northern spotted owl are capable of providing suitable habitat. Approximately 50% of the habitat-capable area was providing suitable owl habitat.
- Precipitation, owl age, and habitat influence the survival and productivity of the northern spotted owl.
- The barred owl is present throughout the range of the northern spotted owl, so the likelihood of competitive interactions between the species raises concerns as to the future of the northern spotted owl.
- Barred owls, West Nile virus, and the management of suitable habitat for the northern spotted owl in fire-prone areas are likely to be future management concerns.

The Endangered Species Act requires the U.S. Fish and Wildlife Service to designate critical habitat to the maximum extent prudent and determinable concurrently with listing a species as endangered or threatened. Critical habitat units have been identified based on the need to protect current primary constituent elements, as well as to provide for the future development of primary constituent elements necessary for the conservation of the northern spotted owl. See *Figure 69 (Designated critical habitat units for the northern spotted owl within the planning area)*. These elements include nesting, roosting, foraging, and dispersal habitat designated by the U.S. Fish and Wildlife Service in 1992 (Federal Register 1992a, 1797). The U.S. Fish and Wildlife Service designated 1,009,000 acres of northern spotted owl critical habitat on BLM-administered lands (see *Appendix G. Wildlife*). The land use allocations under the current resource management plans are not aligned with designated northern spotted owl critical habitat, and the resource management plans do not include management direction specific to critical habitat units.

Figure 69. Designated critical habitat units for the northern spotted owl within the planning area



Northern spotted owl suitable habitat is the common term for those forest stands that provide for foraging, roosting, and nesting for the northern spotted owl. Thomas et al. (1990, 164) described it as a "multi-layered, multispecies canopy dominated by large (greater than 30 inches diameter at breast height) conifer overstory trees, and an understory of shade-tolerant conifers or hardwoods; a moderate to high (60 to 80%) canopy closure; substantial decadence in the form of large, live conifer trees with deformities—such as cavities, broken tops, and dwarf mistletoe infections; numerous large snags; ground cover characterized by large accumulations of logs and other woody debris; and a canopy that is open enough to allow owls to fly within and beneath it."

The habitat classifications that are used for the analysis of effects for the planning area is based on five habitat criteria:

- quadratic mean diameter
- canopy cover
- presence of snags
- presence of down wood
- multilayered or single-layered canopies

See *Table 88 (Classification schedule for the habitat of the northern spotted owl)*.

In this analysis, northern spotted owl habitat is classified and mapped as:

- nonhabitat;
- dispersal habitat only (habitat capable of providing for the dispersal needs of the owl, but not nesting, roosting, and foraging); or
- suitable habitat (nesting, roosting, and foraging habitat).

Table 88. Classification schedule for the habitat of the northern spotted owl

Quadratic Mean Diameter	Canopy Cover (%)	Presences of Snags[a]	Presence of Down Woody Debris (dwd)[b]	Single-Layered or Multilayered Canopy	Habitat Category
11-20	0-40	absent	absent	n/a[c]	non
11-20	0-40	present	absent	n/a	non
11-20	0-40	absent	present	n/a	non
11-20	0-40	present	present	n/a	non
0-11	0-100	n/a	n/a	m/a	non
20-30	0-40	absent	absent	single	non
20-30	0-40	present	absent	single	non
20-30	0-40	absent	absent	multiple	non
20-30	0-40	present	absent	multiple	non
20-30	0-40	absent	present	single	non
20-30	0-40	present	present	single	non
20-30	0-40	absent	present	multiple	non
20-30	0-40	present	present	multiple	non
30-100	0-40	absent	absent	single	non
30-100	0-40	present	absent	single	non
30-100	0-40	absent	absent	multiple	non
30-100	0-40	present	absent	multiple	non

Quadratic Mean Diameter	Canopy Cover (%)	Presences of Snags[a]	Presence of Down Woody Debris (dwd)[b]	Single-Layered or Multilayered Canopy	Habitat Category
30-100	0-40	absent	present	single	non
30-100	0-40	present	present	single	non
30-100	0-40	absent	present	multiple	non
30-100	0-40	present	present	multiple	non
11-20	40-60	absent	absent	n/a	dispersal
11-20	40-60	present	absent	n/a	dispersal
11-20	40-60	absent	present	n/a	dispersal
11-20	60-100	absent	absent	n/a	dispersal
11-20	60-100	present	absent	n/a	dispersal
20-30	40-60	absent	absent	single	dispersal
20-30	40-60	present	absent	single	dispersal
20-30	40-60	absent	absent	multiple	dispersal
20-30	40-60	absent	present	single	dispersal
20-30	60-100	absent	absent	single	dispersal
20-30	60-100	absent	absent	multiple	dispersal
30-100	40-60	absent	absent	single	dispersal
30-100	40-60	present	absent	single	dispersal
30-100	40-60	absent	absent	multiple	dispersal
30-100	40-60	present	absent	multiple	dispersal
30-100	60-100	absent	absent	single	dispersal
30-100	60-100	absent	absent	multiple	dispersal
11-20	40-60	present	present	n/a	dispersal
11-20	60-100	absent	present	n/a	suitable
11-20	60-100	present	present	n/a	suitable
20-30	40-60	present	absent	multiple	dispersal
20-30	40-60	present	present	single	dispersal
20-30	40-60	absent	present	multiple	dispersal
20-30	60-100	present	absent	single	suitable
20-30	60-100	present	absent	multiple	suitable
20-30	60-100	absent	present	single	suitable
20-30	60-100	present	present	single	suitable
30-100	40-60	absent	present	single	dispersal
30-100	40-60	present	present	single	dispersal
30-100	60-100	present	absent	single	suitable
30-100	60-100	absent	present	single	suitable
20-30	40-60	present	present	multiple	suitable
20-30	60-100	absent	present	multiple	suitable
20-30	60-100	present	present	multiple	suitable
30-100	40-60	absent	present	multiple	suitable
30-100	40-60	present	present	multiple	suitable
30-100	60-100	present	absent	multiple	suitable
30-100	60-100	present	present	single	suitable
30-100	60-100	absent	present	multiple	suitable
30-100	60-100	present	present	multiple	suitable

[a] Snag presence (4 snags per acre that are greater than 10 in.)
[b] dwd presence (2% ground cover)
[c] n/a (has no bearing on habitat category)

Suitable habitat currently comprises 49% of habitat-capable acres on BLM-administered lands within the planning area. See *Table 89 (Summary of current northern spotted owl habitat on BLM-administered lands within the planning area by province)*.

Table 89. Summary of current northern spotted owl habitat on BLM-administered lands within the planning area by province

Province	Habitat-Capable (acres)	Suitable Habitat		Total Dispersal Habitat	
		(acres)	(%)	(acres)	(%)
Coast Range	742,500	315,200	42	641,800	86
West Cascades	634,500	308,300	49	543,800	86
Klamath	773,000	431,600	56	681,800	88
East Cascades	46,700	30,700	66	39,400	84
Totals	2,196,700	1,085,800	49	1,906,800	87

In 1994, about 7.4 million acres of suitable northern spotted owl habitat were estimated to exist on federal lands managed under the Northwest Forest Plan. See *Appendix G. Wildlife* for details. As of April 12, 2004, the U.S. Fish and Wildlife Service had consulted on the proposed removal of 575,447 of these acres (7.8% of 7.4 million acres) as a result of all management activities. Of the total acres consulted on for removal, approximately 190,429 acres (2.6% of 7.4 million acres) occurred on federal lands. Of the total federal acres consulted on for removal, approximately 167,134 acres (2.3% of 7.4 million acres) were removed as a result of timber harvesting.

From 1994 through April 12, 2004, habitat lost due to natural events was estimated at approximately 186,931 acres. See *Appendix G. Wildlife* for details. About two-thirds of this loss was attributed to the 2002 Biscuit Fire, which burned more than 500,000 acres in southwest Oregon (Rogue River basin) and northern California. This fire resulted in a loss of approximately 113,451 acres of northern spotted owl habitat, including habitat within five late-successional reserves. Approximately 18,630 acres of northern spotted owl habitat were lost due to the B&B Complex and Davis fires in the Eastern Cascades province.

From 1994 through July 19, 2005, the U.S. Fish and Wildlife Service has consulted on the removal or downgrading of 46,945 acres (1.49 %) of critical habitat due to management-related activities. The majority of these acres (33,008 acres) have been concentrated in the Western Cascades and Klamath provinces. In addition, natural events (including fire and insect outbreaks) have resulted in the removal or downgrading of 42,679 acres. See *Appendix G. Wildlife* for details. In general, fires have had more of an impact to northern spotted owl critical habitat in the interior provinces of Washington and California and the southern and interior provinces of Oregon than the coastal provinces. At the time of listing there was recognition that large-scale wildfire posed a threat to the northern spotted owl and its habitat (Anderson et al. 1990). New information suggests fire may be more of a threat than previously thought (Lint 2005; Moeur et al. 2005).

Moeur et al. 2005 estimated an increase of approximately 1.25 to 1.5 million acres of medium and large older forest (greater than 20 inches diameter at breast height, single and multilayered canopies) on federal lands in the Northwest Forest Plan area between 1994 and 2003. The increase occurred primarily in the lower end of the diameter range for older forest. In the higher end of the diameter range (greater than 30 inches diameter at breast height) the area increased from 102,000 to 127,000 acres.

The estimates of changes in habitat were based on change-detection data for losses due to harvesting and fires, and remeasured inventory plot data for increases due to ingrowth. Transition into and out of medium and large older forest over the 10-year period was extrapolated from inventory plot data based on a subpopulation of U.S. Forest Service land types and applied to all federal lands. Because size class and general canopy layer descriptions do not necessarily account for the complex forest structure that is often associated with northern spotted owl habitat, the significance of these increases in acres to northern spotted owl conservation remains unknown.

The types of forest that are used by the northern spotted owl have been studied recently and study results show the following:

- "Studies consistently showed that mature/old forest patch area was an important predictor of forest occupancy by northern spotted owls. While a fragmentation index was negatively associated with site occupancy in some studies, a trade-off between large patches of mature/old forest and juxtaposition of land cover types appear to benefit Spotted Owls in other studies"(Courtney et al. 2004, 5-13).
- Studies in the Klamath province in southern Oregon reinforce Courtney et al. (2004) finding that the apparent survival and reproductive rate of owl territories are positively associated with older forest types closer to the activity center (Dugger et al. 2005).
- Olson et al. (2004) found that survival in the Oregon Coast Range had a quadratic relationship with the amount of late- and mid-seral forest near nesting centers. Reproductive rates fluctuated biennially and were positively related to the amount of edge between late- and mid-seral forests and other habitat classes. Olson et al. (2004) conclude that their result indicates that while mid- and late-seral forests are important to owls, a mixture of these forest types with younger forest and nonforest may be best for owl survival and reproduction in their study area.
- Survival decreased dramatically when the amount of nonhabitat exceeded approximately 50% (Dugger et al. 2005). Northern spotted owl territories with habitat fitness potentials (i.e., expressed as a lambda estimate for the territory) of less than 1.0 were generally characterized by less than 40 to 50% old-forest habitat near the territory center (Dugger et al. 2005). The authors conclude that they found no support for either a positive or negative direct effect of intermediate-aged forest on either the survival or reproduction of the northern spotted owl.

There have been 1,333 known northern spotted owl sites located on BLM-administered lands since 1984. Surveys are currently being conducted primarily where they are

required for timber sale clearances and within the demography study areas (Coast Range, Tyee, Klamath, and South Cascades) that overlap BLM-administered lands. There are 645 sites (48%) that have survey data indicating occupancy between 2000 and 2004.

Numerous studies, summarized in Courtney et al. (2004), illustrate that the northern spotted owl feeds predominantly on small mammals. Northern flying squirrels and woodrats are usually the predominant prey both in biomass and frequency (Barrows 1980; Forsman et al. 1984; Ward 1990; Bevis et al. 1997; Forsman et al. 2001, 2004) with a clear geographic pattern of diet, paralleling differences in habitat (Thomas et al. 1990).

- Northern flying squirrels are generally the predominant prey item in the more mesic Douglas fir and western hemlock forests characteristic of the northern portion of the range, whereas woodrats are generally the predominant prey item in the drier mixed conifer and mixed evergreen forests typically found in the southern portion of the range (Forsman et al. 1984; Thomas et al. 1990; Ward et al. 1998; reviewed by Courtney et al. 2004). These prey items were found to be codominant in the southwest interior of Oregon (Forsman et al. 2001, 2004). Zabel et al. (1995) showed that northern spotted owl home ranges are larger where flying squirrels (*Glaucomys sabrinus*) are the predominant prey and are smaller where woodrats (*Neotoma* sp.) are the predominant prey.
- Other prey species, such as the red tree vole (*Arborimus longicaudus),* red-backed voles (*Clethrionomys gapperi),* mice, rabbits and hares, birds, and insects, may be seasonally or locally important (reviewed by Courtney et al. 2004). For example, Rosenberg et al. (2003) showed a strong correlation between the annual reproductive success of northern spotted owls (number of young per territory) and abundance of deer mice (*Peromyscus maniculatus*), despite the fact that they only made up 1.6% ±0.5% of the biomass consumed. However, it is unclear if the causative factor behind this correlation was prey abundance or a synergistic response to weather (Rosenberg et al. 2003). The secondary species play important roles locally and seasonally.
- Forest heterogeneity and structure effect prey species occurrence and abundance. Ward (1990) found that northern spotted owls foraged in areas that had lower variance in prey densities (prey were more predictable in occurrence) within older forests and near ecotones of old forest and brush seral stages. Habitat components such as snags, down wood, shrub and herbaceous components, and edge are all important to prey species and therefore the northern spotted owl (Courtney et al. 2004). Where woodrats are the predominant prey in southwestern Oregon, studies suggest that some amount of forest heterogeneity may benefit owls as a result of increased prey abundance (Franklin and Gutierrez 2002; Ward et al. 1998).

Sudden oak death presents a potential influence on northern spotted owl habitat, but there is inadequate information to analyze the affects on habitat. Sudden oak death is a recently recognized disease that is killing tanoak (*Lithocarpus densiflorus*), oaks (*Quercus* sp.), and other plant species in California. The disease has been confirmed in one location in

Curry County in southwestern Oregon (Kanaskie et al. 2006). The disease is caused by the introduced pathogen, *Phytophthora ramorum*. Widespread infections could affect suitable northern spotted owl habitat in southwestern Oregon through the removal of subdominant canopy and shrub species; impacting habitat structure and prey base numbers. However, there is inadequate information on the potential spread and influence on forest structure and northern spotted owl prey species to analyze effects (see the *Incomplete and Inadequate Information* section in *Chapter 4*).

The conservation needs of the northern spotted owl include:

- providing large blocks of suitable habitat that is distributed across a variety of ecological conditions and is spaced so as to facilitate owl movement between the blocks;
- providing dispersal habitat within and between large blocks; and
- providing habitat within areas of concern for genetic interchange between owl populations (Raphael 2006; Lint 2005; Courtney et al. 2004; USFWS 1992; Thomas et al, 1990).

Northern spotted owl conservation is predicated on providing blocks of suitable habitat that support clusters of owls. A cluster is at least 20 breeding pairs of owls that support each other demographically and thereby maintain a stable population (Thomas et al. 1990, 24). The Interagency Scientific Committee strategy (Thomas et al. 1990), 1992 draft northern spotted owl recovery plan (USDI, USFWS 1992), northern spotted owl critical habitat designation (Federal Register 1992a, 1796), and the Northwest Forest Plan (USDA, USDI 1994b) used this principle in developing systems of large blocks of habitat.

Several studies have suggested that some amount of forest heterogeneity or intermingling of forest types may improve foraging habitat, especially where woodrats are the predominant prey as described above. However, there is a strong association of nesting and roosting habitat with older, structurally complex forests (Olson 2004; Ward et al. 1998). As noted by Raphael (2006, 128): “no new evidence suggests that large blocks of habitat are not critical to the persistence of the owl.” Therefore, large blocks of suitable habitat remain a fundamental conservation need of northern spotted owls throughout the planning area (Courtney et al. 2004, 5-9 to 5-12, 9-11).

In addition to large blocks of suitable habitat, owl conservation requires habitat within and between blocks that supports roosting, protection from predators, and foraging to allow for successful dispersal among blocks (FSEIS, Appendix G 16, G-9; Thomas et al. 1990). Owls not only leave their territories and move across the landscape as juveniles dispersing from their natal territories but also as single adults seeking mates or new territories (Forsman et al. 2002). As owls fly across the landscape, they require stands that have room beneath the branches to provide:

- protection from predators and weather;
- foraging opportunities, including prey base and hunting perches; and
- potential nesting sites.

Data on the movements of 1475 adult and juvenile northern spotted owls found that the median movement distance was between 22.9 to 24.5 km for females and 13.5 to 14.6 km for males; only 8.9% of juveniles dispersed distances greater that 50 km (Forsman et al. 2002). Northern spotted owls have not been shown to disperse across the types of large nonforested lowlands found within the planning area, including the Willamette Valley, Umpqua Valley, and Rogue Valley (Forsman et al. 2002). In a study on habitat use by dispersing juvenile northern spotted owls in the Coast Range, Klamath, and Western Cascades provinces (Miller et al. 1997), mature and old-growth forest were used slightly more than expected based on availability during the transient phase and nearly twice its availability during the colonization phase. Closed pole-sapling-sawtimber habitat was used roughly in proportion to availability in both phases; open sapling and clear-cuts were used less than expected based on availability during colonization.

Dispersal habitat is comprised of both suitable habitat and additional habitat that supports only owl dispersal. The quality of dispersal quality increases with the portion of that habitat that is comprised of suitable habitat. Thomas et al. (1990) noted that "[h]abitats between blocks function better to allow owls to move (disperse) through them the more nearly they resemble suitable habitat …" (p. 23).

The science on the northern spotted owl does not provide a specific threshold for the quantity, quality, and distribution of dispersal habitat against which this analysis could evaluate the effect of alternatives. Thomas et al. (1990, 27, 327) suggested that if 50% of the land base in a regulated forest supported forest stands with a minimum 11-inch average diameter at breast height and 40% canopy cover, then that land base would support owl dispersal (the so-called 50-11-40 rule). The 50-11-40 rule as presented in Thomas et al. (1990) was measured at the quarter-township scale (approximately 5,760 acres). The 50-11-40 rule does not present a definitive threshold for evaluating dispersal habitat, because it does not reflect dispersal quality (NWFP FSEIS, Appendix G, 18, G-24), and because its application to the scattered federal land ownership is problematic.

In the Northwest Forest Plan FSEIS, the 50-11-40 rule was incorporated into several alternatives, although not the selected alternative. However, in contrast to the recommendation of Thomas et al. (1990), the Northwest Forest Plan alternatives applied the 50-11-40 rule as "50% of the federal forest landscape" (NWFP FSEIS, 2-27, emphasis added), instead of 50% of the entire landscape. In the current analysis, applying the 50-11-40 rule to the planning area as "50% of the federal forest landscape" would have dramatically different results than applying the rule as "50% of the forest landscape" on all ownerships, because BLM-administered lands are typically interspersed among nonfederal lands.

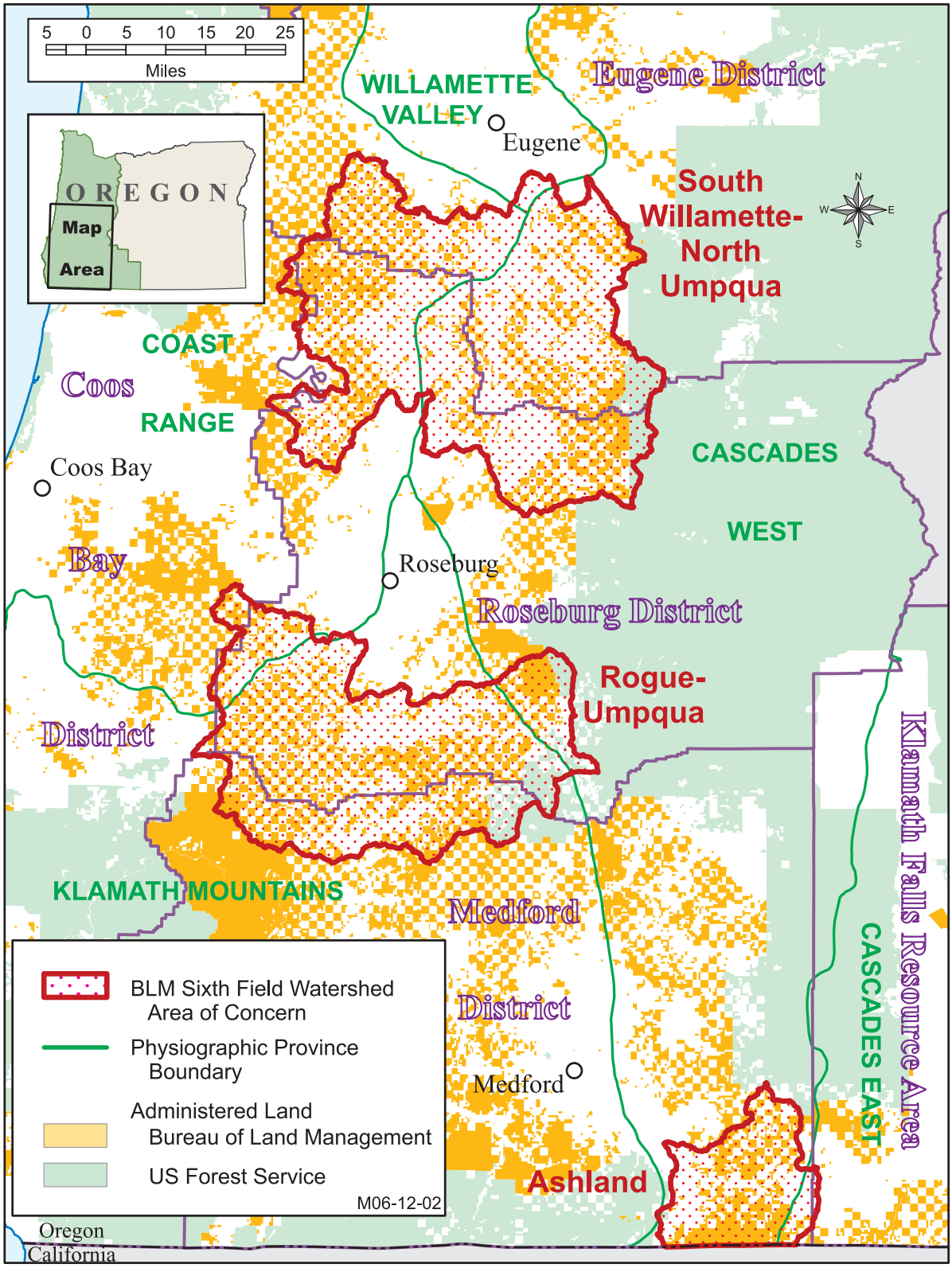
Forsman et al. (2002) demonstrated the importance of forested bridges linking the Coast Range, West Cascades, and Klamath provinces. These bridges have been identified by one term or another since 1988 (USDA, U.S. Forest Service 1988). The movement records provide evidence that northern spotted owls are currently dispersing across the landscape and genetic or demographic isolation of local populations is not likely because dispersal between reserves is likely to be a common occurrence even if the landscapes

between these reserves consists of highly fragmented forests (Lint 2005; Forsman et al. 2002). Forsman et al. (2002) pointed out three areas through which dispersing northern spotted owls moved between the provinces:

- between Cottage Grove and Drain, Oregon (South Willamette-North Umpqua);
- between Canyonville and Grants Pass, Oregon (Rogue-Umpqua); and
- south of Ashland, Oregon (Ashland).

These three areas of concern were identified but not specifically delineated by the USDA (1988), the USDA (1991), Anderson et al. (1991), Tweten (1992), and the USDI (1992) because of "poor distribution and quality of existing habitat in some areas; high level of natural and man-made fragmentation; and localized deficiencies in habitat connectivity" (USDA 1991, 3&4:27). These three areas of concern were not mapped or described in detail prior to this analysis, but they have been identified and discussed in ESA (Endangered Species Act) consultation documents between the BLM and the U.S. Fish and Wildlife Service. The areas of concern are mapped here for the purposes of this analysis.

Figure 70. Areas of concern for the northern spotted owl



Northern spotted owl populations are currently being affected by other factors besides habitat, especially competition with barred owls, and may be affected in the future by West Nile virus.

Barred owls compete with northern spotted owls through a variety of mechanisms including prey overlap (Hamer et al. 2001), habitat overlap (Hamer et al. 1989; Dunbar et al. 1991; Herter and Hicks 2000; Pearson and Livezey 2003), and agonistic encounters (Leskiw and Gutiérrez 1998; Pearson and Livezey 2003). New information on encounters between barred owls and northern spotted owls comes primarily from anecdotal reports that corroborate the initial observations that barred owls react more aggressively towards northern spotted owls than the reverse (Courtney et al. 2004). The evidence of barred owl predation on northern spotted owls, however, is limited and circumstantial (Leskiw and Gutiérrez 1998; Johnston 2002). Information collected to date indicates that encounters between these two species tend to be agonistic in nature, and that the outcome is unlikely to favor the northern spotted owl (Courtney et al. 2004).

Kelly et al. (2003) also found that in northern spotted owl territories where barred owls were detected, northern spotted owl occupancy was significantly lower ($P < 0.001$) after barred owls were detected within 0.8 km of the territory center. Occupancy was only marginally lower ($P = 0.06$) if barred owls were located more than 0.8 km (0.5 mi) from northern spotted owl territory centers. In a Roseburg, Oregon study area, 46% of northern spotted owls moved more than 0.8 km (0.5 mi), and 39% of northern spotted owls had not relocated again in at least two years after barred owls were detected within 0.8 km (0.5 mi) of the territory center. Observations provided by Gremel (2000) from the Olympic National Park are consistent with those of Kelly et al. (2003). He documented significant displacement of northern spotted owls following barred owl detections "coupled with elevational changes of northern spotted owl sites on the east side of the park" (Courtney et al. 2004). Pearson and Livezey (2003) reported similar findings on the Gifford Pinchot National Forest where unoccupied northern spotted owl sites were characterized by significantly more barred owl sites within 0.8 km, 1.6 km, and 2.9 km (0.5, 1.0, and 1.8 miles) from the territory center than in occupied northern spotted owl sites. Since barred owl presence is increasing within the range of northern spotted owls, Olson et al. (2005) suggests that further declines in the proportion of sites occupied by northern spotted owls are likely.

Olson et al. (2005) showed that barred owl presence had a negative effect on northern spotted owl detection probabilities, and it had either a positive effect on local extinction probabilities (at the territory scale) or a negative effect on colonization probabilities for three study areas in Oregon. Olson et al. (2005) conclude that future analyses of northern spotted owls must account for imperfect and variable detectability and barred owl presence to properly interpret results. Thus, some proportion of seemingly vacant territories may be an artifact of reduced detection probabilities. Nonetheless, previously occupied territories that were apparently vacant of both northern spotted owls and barred owls suggests that factors other than barred owls alone are contributing to declines in northern spotted owl abundance and territorial occupancy (Courtney et al. 2004).

Although the barred owl currently constitutes a significantly greater threat to the northern spotted owl than originally thought at the time of listing (Courtney et al. 2004), at present it is unclear whether forest management influences the outcome of interactions between barred and northern spotted owls (Courtney et al. 2004; summarized by Lint 2005). Gutierrez et al. (2004) identified three clearly plausible outcomes:

- Barred owls will replace the northern spotted owl throughout its range.
- Barred owls will replace the northern spotted owl in the northern, more mesic portion of its ranges.
- Barred and northern spotted owl populations will reach equilibrium in most but not all of the present northern spotted owl range.

West Nile virus is known to be fatal to many species of birds, including the northern spotted owl, and has been documented in wild bird populations in Oregon. There is no known connection between forest management and West Nile virus. The future impacts of West Nile virus are unknown and if the northern spotted owl is especially susceptible, it could cause widespread mortality (Courtney et al. 2004).

Marbled Murrelet

The marbled murrelet (*Brachyramphus marmoratus*) was federally listed as threatened by the U.S. Fish and Wildlife Service in October 1992 (Federal Register 1992b, 45328-45337). A recovery plan was finalized in 1997 (USDI, USFWS 1997). The recovery plan outlines the conservation strategy for the species. A draft rule for the revision of critical habitat was published in September 2006.

The short-term actions that are necessary to stabilize the population include:

- maintain occupied habitat
- maintain large blocks of suitable habitat
- maintain and enhance buffer habitat
- decrease risks of nesting habitat loss due to fire and windthrow
- reduce predation
- minimize disturbance

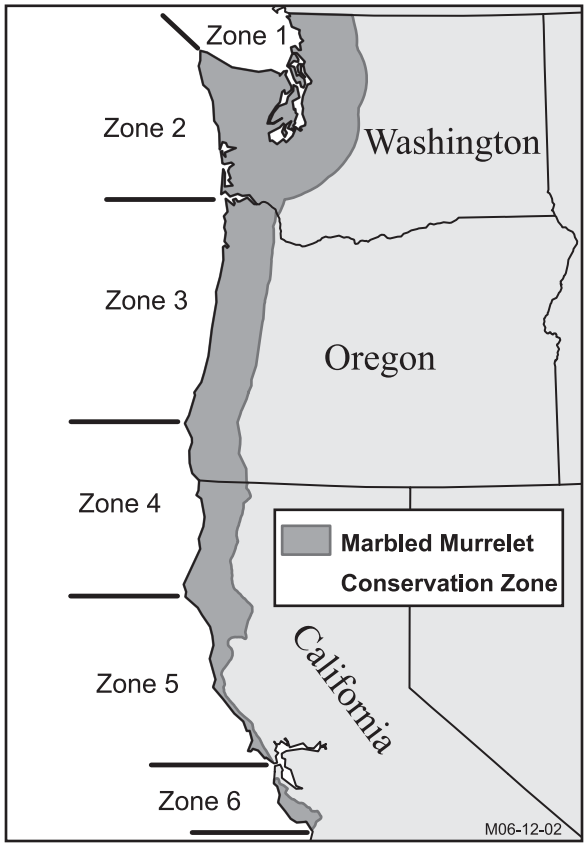
The long-term conservation needs include:

- increase productivity (abundance, the ratio of juveniles to adults, and nest success) and population size
- increase the amount (stand size and number of stands), quality, and distribution of suitable nesting habitat
- protect and improve the quality of the marine environment
- reduce or eliminate threats to survivorship by reducing predation in the terrestrial environment and anthropogenic sources of mortality at sea

The U.S. Fish and Wildlife Service (USDI, USFWS 1997) estimates recovery of the marbled murrelet will require at least 50 years.

Six conservation zones were designated in the marbled murrelet recovery plan (USDI, USFWS 1997). The recovery objectives for the marbled murrelet are measured in each conservation zone with the objective of ensuring a well-dispersed population of marbled murrelets. Recovery Zone 3 (in its entirety) and the northern half of conservation Zone 4 overlay the planning area. See *Figure 71 (Marbled murrelet conservation zones)* (USDI, USFWS 1997). Conservation Zone 3 extends from the Columbia River, south to North Bend, Oregon; extending 1.2 miles out to sea and approximately 35 miles inland (coinciding with conservation Zone 1, as designated by the Northwest Forest Plan (USDA, USDI 1994)). Conservation Zone 4 extends from North Bend, Oregon to the southern end of Humbolt County, California; extending 1.2 miles out to sea and approximately 35 miles inland (coinciding with conservation Zone 1, as designated by the Northwest Forest Plan (USDA, USDI 1994)).

Figure 71. Marbled murrelet conservation zones



The following recent documents summarize the condition of the marbled murrelet across its range and are incorporated by reference:

- the evaluation report for the five-year status review of the marbled murrelet in Washington, Oregon, and California (McShane et al. 2004);
- the marbled murrelet five-year review (USDI, USFWS 2004b); and
- the status and trends of populations and nesting habitat for the marbled murrelet (Huff et al. 2006).

A panel of scientific experts was convened by the U.S. Fish and Wildlife Service to evaluate, synthesize, and interpret the information pertaining to the relevant scientific issue concerning the marbled murrelet. The threats to marbled murrelets and any changes since the 1992 listing were also evaluated. The report was used in the five-year status review (USDI, USFWS 2004b) of the marbled murrelet. The status review sought to answer the following questions:

- Does the currently listed distinct population segment meet the criteria established in the U.S. Fish and Wildlife Service 1996 Distinct Vertebrate Species Policy?
- Is there new information about the threats or population status of the marbled murrelet?
- If so, does the new information suggest that a change in listing status may be warranted?

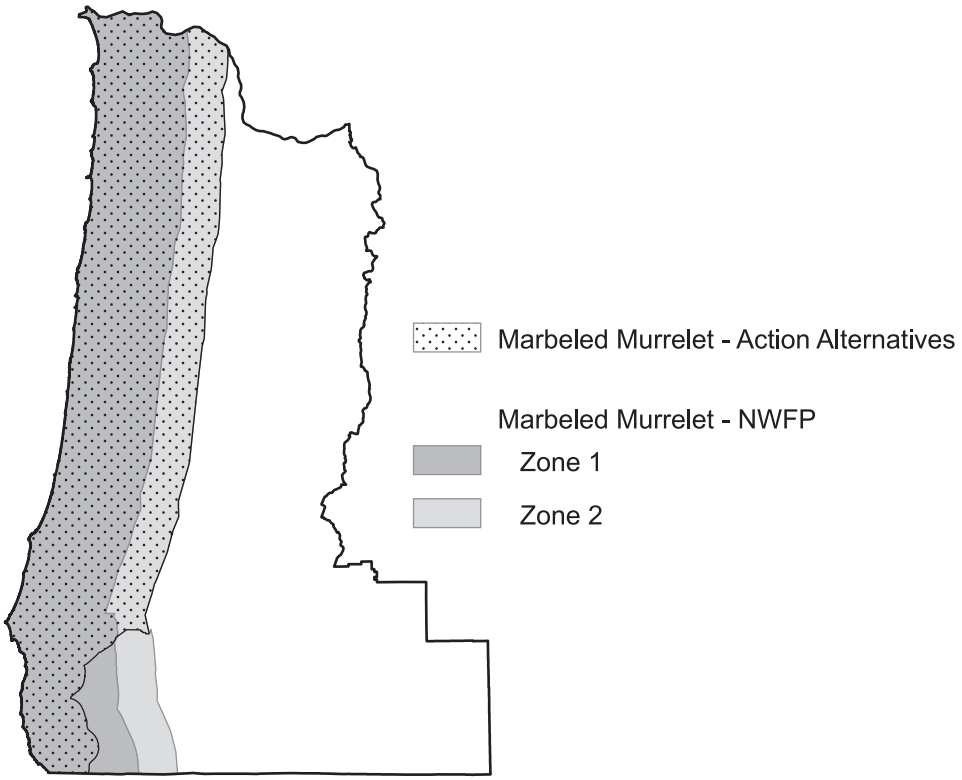
The U.S. Fish and Wildlife Service determined:

- The Washington, Oregon, and California populations do not constitute a discrete population from the remainder of the species and therefore does not constitute a distinct population segment.
- All of the threats to the species identified in the listing are still relevant, new information confirms the importance of predation in limiting nesting success, and new gill-netting regulations in California and Washington may reduce impacts to the species.

The marbled murrelet remains listed as a threatened species at this time (USDI, USFWS 2004b).

The Northwest Forest Plan established two management zones for the marbled murrelet. Zone 1 extended from the coast to approximately 35 miles inland. Zone 2 extended from the eastern boundary of Zone 1 to approximately 50 miles inland from the coast. Combined, these zones include 14,825 square miles. See *Figure 72 (Range of the marbled murrelet within the planning area)*.

Figure 72. Range of the marbled murrelet within the planning area



Systematic surveys in the Klamath province have indicated that marbled murrelets are likely confined to the hemlock-tanoak vegetation zone (USDA, USDI 2002). The portion formally considered part of the range of the marbled murrelet in the Medford District is highlighted in *Figure 72*.

The range of the marbled murrelet for this management plan increases approximately 6,010,000 acres in Zone 1 and 2,553,000 acres in Zone 2, and incorporates portions of the Salem, Eugene, Roseburg, and Medford districts, and incorporates the Coos Bay District in its entirety.

A report by Huff et al. (2006) regarding the effects of the first 10 years after the implementation of the Northwest Forest Plan on the population and habitat of the marbled murrelet was completed as part of the Northwest Forest Plan's 10-year effectiveness monitoring effort. The team reported:

- An estimated marbled murrelet population of 22,000 birds for coastal waters adjacent to the Northwest Forest Plan area.
- The available sampling effort was insufficient to detect significant population change.
- The highest densities of marbled murrelets occurred along the Oregon and northern Californian coasts.
- The lowest densities of marbled murrelets occurred from the Mendocino and Humboldt county line south to San Francisco Bay.

- Habitat models predicted that marbled murrelet nesting habitat is more likely at sites that:
  - are closer to the sea;
  - are on relatively flat terrain;
  - are topographically cooler;
  - have relatively fewer conifers that are greater than or equal to 10 inches (diameter at breast height);
  - have great base areas of trees that are greater than or equal to 10 inches (diameter at breast height); or
  - have greater basal areas of trees that are greater than or equal to 30 inches (diameter at breast height).
- Inland management Zone 2 (furthest from the coast) accounted for less than two percent of the estimated high-quality habitat on federally administered lands.
- Only 13% of the federal lands provide more than medium-quality nesting habitat for the marbled murrelet.

Nelson et al. (2006) completed a recent review of marbled murrelet biology and nesting habitat. The results included:

- Marbled murrelet are secretive, noncolonial nesters, who forage at sea and nest inland.
- The majority of marbled murrelets nest within 37 miles of the coast, although nests have been documented up to 52 miles inland in Washington and 47 miles inland in Oregon (Espinosa, pers. comm. 2007).
- The most important component in the nesting habitat for the marbled murrelet is the presence of large platforms—limbs or other structures that are at least 4 inches in diameter with a substrate capable of forming a nest cup (moss or other duff).
- Other important factors include vertical and horizontal cover location with respect to forest openings or edge, and height of platform. Platforms should be high enough to provide for jump-off departures and open enough to provide for stall landings, while still providing protection from predators and the weather.
- Nest trees documented in the Northwest Forest Plan area are greater than 19 inches (diameter at breast height) and greater than 98 feet tall. Nest trees are typically taller than the average nonnest tree.
- Vertical cover (cover above the nest) is typically above 70%.

Nest stands typically possess a high density of large trees with platforms, have multiple canopy layers, and are typically older. Studies summarized for Oregon indicate that the density of trees with platforms and the number of platforms in general were the most important variable in predicting marbled murrelet nesting habitat at the stand level.

Actual nests and behaviors indicate that marbled murrelets select old-growth forests for nesting. The proportion of older forest (mature and old growth) on the landscape and size of the forest patch were greater in occupied sites than unoccupied. Marbled murrelets nest in landscapes with larger stands with less edge, farther from logged areas than random watersheds. Habitat modeling efforts have shown that distance from the coast is an important factor in determining marbled murrelet occurrence. Patches of suitable nesting trees of only a few acres and with only a few suitable nesting trees are thought to be capable of supporting marbled murrelet nesting. The resolution and attributes of the vegetation maps used in this planning effort limited the identification of small stands with only a few suitable nesting trees.

For this plan revision, marbled murrelet nesting habitat was modeled as those stands in the mature (with multilayered canopy) and structurally complex structural stages of forest within the range described in *Figure 72 (Range of the marbled murrelet within the planning area)*.

Mature stands in the western hemlock and tanoak retention zones are those that contain more than 23 trees per acres with a diameter at breast height greater than or equal to 20 inches. In the Douglas fir zone, mature stands are those with more than 11 trees per acre with a diameter at breast height greater than or equal to 20 inches.

There are approximately 373,000 acres of marbled murrelet nesting habitat within the planning area. See *Table 90 (Summary of marbled murrelet nesting habitat on BLM-administered lands within the planning area)*.

Table 90. Summary of marbled murrelet nesting habitat on BLM-administered lands within the planning area

BLM Districts	Habitat-Capable (acres)	Nesting Habitat	
		(acres)	(%)
Salem	215,000	77,000	36
Eugene	147,000	49,000	33
Roseburg	179,000	99,000	55
Coos Bay	302,000	123,000	41
Medford	47,000	25,000	53
Totals	890,000	373,000	42

Studies to determine the characteristics of marbled murrelet nesting habitat at the landscape scale include:

- McShane et al. (2004, 4-103) reported that "[a]t the landscape level, areas with evidence of occupancy tended to have higher proportions of large, old-growth forest, larger stands and greater habitat complexity, but distance to the ocean (up to about 37 miles [60 km]) did not seem important."
- Elevation had a negative association in some studies with marbled murrelet habitat occupancy (Burger 2002). Hamer and Nelson (1995) sampled 45 nesting trees in British Columbia, Washington, Oregon, and California and found the mean elevation to be 1,089 feet (332 m).

- Multiple radar studies (Burger 2001; Cullen 2002; Raphael et al. 2002; Steventon and Holmes 2002) in British Columbia and Washington have shown radar counts of marbled murrelets to be positively associated with total watershed area, increasing amounts of late-seral forests, and with increasing age and height class of associated forests.
- The radar counts of marbled murrelets are also negatively associated with increasing forest edge and areas of logged and immature forests (McShane et al. 2004).
- There are also several studies concluding marbled murrelets do not pack into higher densities within remaining habitat when nesting habitat is removed (Burger 2001; Manley et al. 2001; Cullen 2002).

Studies about the relationship between the proximity of human-modified habitat and an increased abundance of avian predators and increased predation on marbled murrelet nests include:

- Luginbuhl et al. (2001, 565) reported in a study, which used simulated marbled murrelet nests, that "[c]orvid numbers were poorly correlated with the rate of predation within each forested plot." Luginbuhl et al. (2001, 569), conclude, "that using measurements of corvid abundance to assess nest predation risk is not possible at the typical scale of homogenous plots (0.5 to 1.0 km^2 in our study) [0.19 to 0.39 mi^2]. Rather this approach should be considered useful only at a broader, landscape scale on the order of 5 to 50 km^2 [1.93 to 19.31 mi^2] (based on the scale of our fragmentation and human-use measures)".
- Artificial marbled murrelet nest depredation rates were found to be highest in western conifer forests where stand edges were close to human development (De Santo and Willson 2001; Luginbuhl et al. 2001).
- Bradley (2002) found increased corvid densities within 3 miles of an urban interface (probably due to supplemental feeding opportunities from anthropogenic activities).
- Golightly et al. (2002) found extremely low reproductive success for marbled murrelets nesting in large old-growth blocks of redwoods in the California Redwoods National and State Parks. Artificially high corvid densities from adjacent urbanization and park campgrounds are suspected to be a direct cause of the high nesting failure rates for marbled murrelets in the redwood parks (Golightly et al. 2002).
- If the surrounding landscape has been permanently modified to change the predators' numbers or densities due to agriculture, urbanization, or recreation, and predators are causing unnaturally high nest failures, then reproductive success of the marbled murrelet may remain depressed. Because corvids account for the majority of depredations on marbled murrelet nests and corvid density can increase with human development, corvid predation on marbled murrelet habitat is a primary impact consideration. The threat of predation on marbled murrelet populations (both nests and adults) appears to be greater than previously anticipated (McShane et al. 2004).

The present population estimates for the marbled murrelet include 9,500 (± 3,000) in Oregon and 23,700 (± 5,200) within the conterminous United States (Huff et al. 2003; Strong 2003a; Strong 2003b). Spiech and Wahl (1995) concluded that marbled murrelet populations in Puget Sound are lower now than they were at the beginning of this century, and total estimates for Washington are still about 9,800 marbled murrelets (Huff et al. 2003). Ralph and Miller (1995) estimated the California population to be approximately 6,500 birds, and this estimate remains within the statistical confidence interval (Strong 2003a and Strong 2003b).

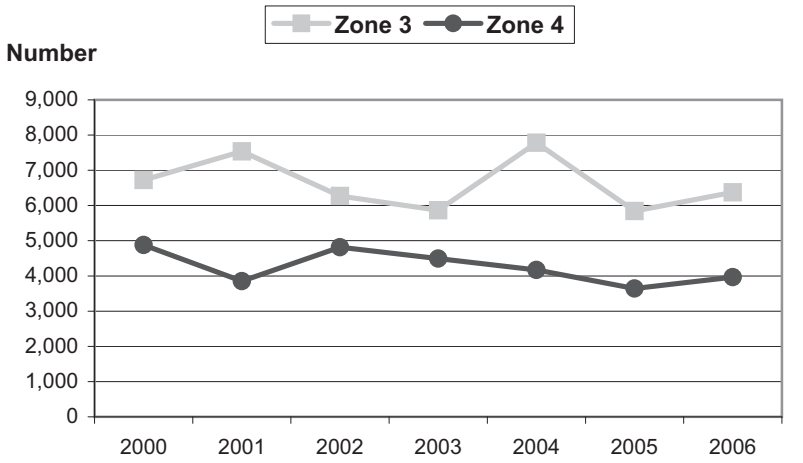
The estimates of marbled murrelet populations that are based on monitoring data have fluctuated between approximately 5,800 and 7,800 birds in conservation Zone 3 and between approximately 3,600 and 4,900 birds in conservation Zone 4. See *Table 91 (Marbled murrelet population estimates for conservation Zones 3 and 4)* and *Figure 73 (Marbled murrelet population estimates in conservation Zones 3 and 4)*. Conservation Zones 3 and 4 overlay the planning area. See *Figure 71 (Marbled murrelet conservation zones)* (USDI, USFWS 1997). Estimates are based on at-sea monitoring (USFWS, pers. comm. 2006).

Table 91. Marbled murrelet population estimates for conservation Zones 3 and 4

Year	Conservation Zones			
	Zone 3		Zone 4	
	Density*	Number of Birds	Density*	Number of Birds
2000	10.9	6,724	10.9	4,880
2001	12.2	7,538	8.6	3,851
2002	10.2	6,271	10.8	4,816
2003	9.5	5,866	10.0	4,495
2004	12.6	7,781	9.3	4,169
2005	9.5	5,843	8.1	3,642
2006	10.3	6,375	8.9	3,968

*Density equals the number of birds per square mile.

Figure 73. Marbled murrelet population estimates in conservation Zones 3 and 4



Studies on the demographic trends of the marbled murrelet include:

- Beissinger (1995) constructed a demographic model of the marbled murrelet and concluded that the population may be declining at rates of 4 to 6% per year, but this estimate is hampered by the possibility that the age-ratio data used in the model are reflective of a relatively temporary decline due to unusual ocean conditions (Ralph et al. 1995).
- Boulanger et al. (1999) found that change in adult survivorship is the single most important factor when projecting demographic trends for marbled murrelets.
- Similarly, Strong and Carten (2000) suggest that there may have been a 50% decline from 1992 to 1996 in the Oregon population, but the population appears to have stabilized since then (Strong 2003a; Strong 2003b).
- Ralph et al. (1995) summarized some of the reasons for variability in population estimates among researchers, including differences in methodology, assumptions, spatial coverage, and survey and model errors.
- Lank et al. (2003) states that "[r]egardless of the approaches taken to estimate [(sic) vital rate] parameter values, the output from the Leslie Matrix models representing survivorship and fecundity values for all populations in Washington, Oregon and California (Beissinger and Nur 1997) suggest negative population growth rates." Present at-sea surveys for effectiveness monitoring have a 95% chance of detecting annual population changes of ± 20% or greater.

McShane et al. (2004) produced a demographic model of marbled murrelet populations in Washington, Oregon, and California by each of the six conservation zones. Similar to previous studies, they found that populations in all conservation zones are in decline with mean annual rates of decline between 2.1% and 6.2%. The highest rates of decline were in Zone 6 at the southern extent of the range. Furthermore, they conclude it is likely that populations in Zone 5 and 6 could become nonviable in the near future.

At the conservation zone scale, marbled murrelet abundance is positively correlated with the estimated amount of inland habitat (McShane et al. 2004). The precise number of acres of nesting habitat in Washington, Oregon, and California is unknown. However, suitable habitat for the marbled murrelet on federal lands is estimated at 2,223,048 acres of which 154,838 acres (7%) are classified as remnant habitat within the listed range of this species (McShane et al. 2004). Approximately 93% of the suitable habitat occurs on federal lands. The BLM in Oregon manages approximately 249,000 acres of nesting habitat. See *Table 92 (Summary of critical habitat units and marbled murrelet nesting habitat on BLM-administered lands within the planning area)*. There are 177 known occupied marbled murrelet sites on BLM-administered lands. Surveys are currently being conducted in conjunction with timber sales.

The recovery plan identified the primary threats to the species as:

- predation
- loss of nesting habitat
- by-catch in gill nets
- oil pollution both chronic and from major spills

More recently, McShane et al. (2004) has concluded that all of these threats are still present, although loss of nesting habitat, particularly on federal lands, has declined, and the new gill-netting regulations in northern California and Washington have reduced the threat from by-catch in gill nets. The threat from oil pollution continues to be unpredictable and effects are variable. New information on predation indicates a high threat level due to limiting marbled murrelet nesting success (Hebert and Golightly 2003; Peery et al. 2004; Luginbuhl et al. 2001; Marzluff and Restani 1999).

Marbled murrelets, adult and chicks, appear to be fairly tolerant of disturbance, both visual and auditory. Several studies noted changes in adult feeding behaviors, but not nest abandonment. Chicks appear to be very tolerant of visual and auditory disturbance, habituating very quickly. The predominant response of marbled murrelet chicks to disturbances is to freeze or flatten out in the nest cup. Noise disturbance to nest sites is thought to be minimal, although much is unknown (Nelson et al. 2006).

The recovery plan states that four of the six zones must be functional in order to effectively recover the marbled murrelet in the short- and long-term (e.g., to maintain viable populations that are well-distributed). However, based on the newest population estimates, it appears only three of the zones contain relatively robust numbers of marbled murrelets (Zones 1, 3, and 4). Zones 1 and 4 contain the largest number of marbled murrelets compared to the other four zones, but areas of concern remain. Of the population in Zone 4, 10% was killed in oil spills in 1997 (Bentivoglio et al. 2002; Ford et al. 2002).

Marbled murrelets in conservation Zones 3, 5, and 6 are also experiencing significant declines in reproduction, numbers, and distribution, resulting in reduced population viability. Marbled murrelets have suffered variously from past oil spills, which killed a large number of birds (Zone 3) (Ford et al. 2002), extremely small population sizes (Zones 5 and 6), and alarmingly low reproductive rates (Zone 6) (Peery et al. 2002). In at least two of these four zones (Zones 5 and 6), these factors taken singly or in combination have brought the status of the species to a point where recovery in Conservation Zones 5 and 6 may be precluded (Beissinger 2002). The poor status of marbled murrelet populations in the southern zones emphasizes the importance of supporting marbled murrelet populations in Zones 1 and 2 in order to achieve marbled murrelet recovery objectives.

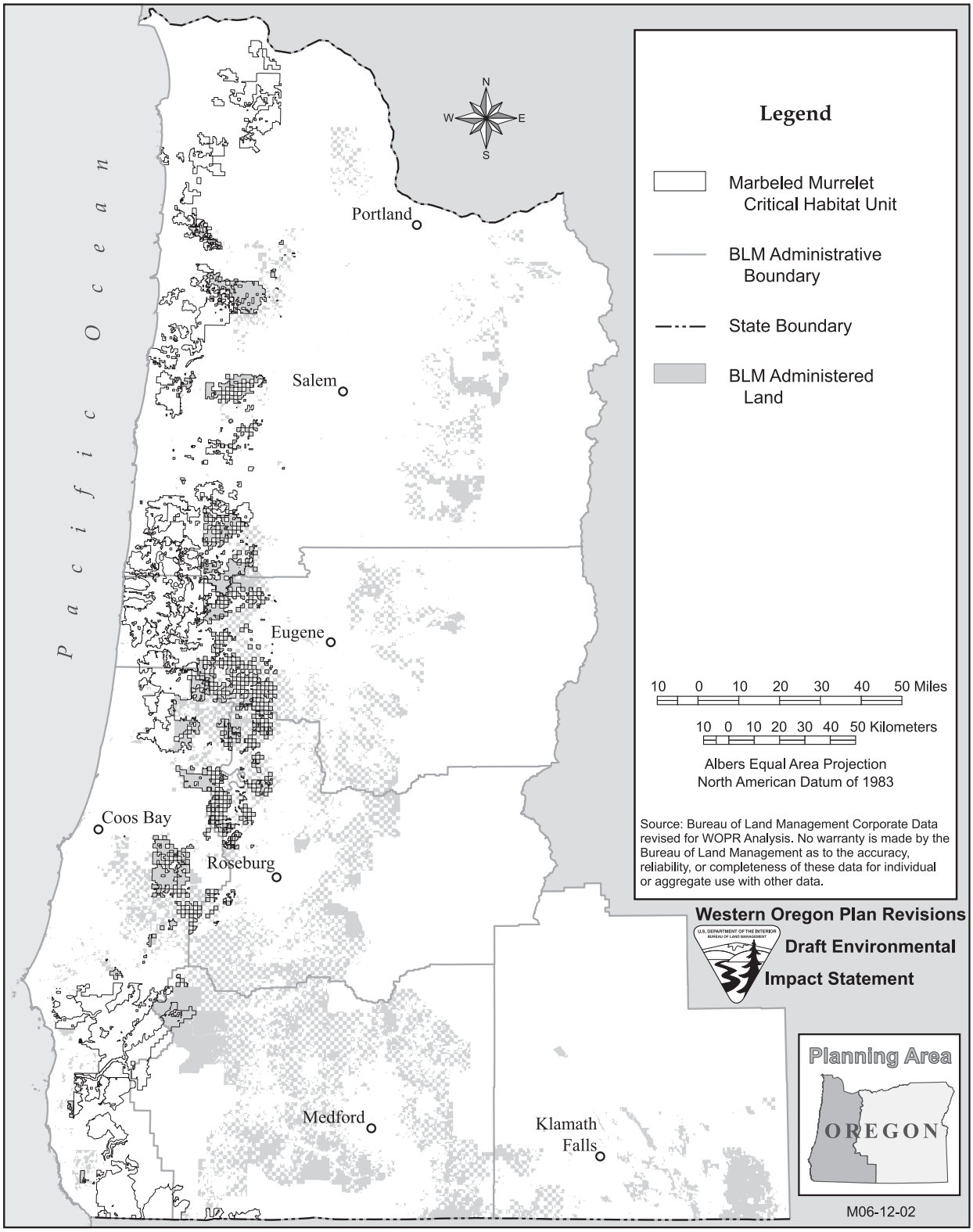
Critical habitat was designated for the marbled murrelet in January 1996 and encompasses 1,515,300 acres of land in Oregon; 1,338,200 acres of federal land (Federal Register 1996a, 26256-26320). The U.S. Fish and Wildlife Service is currently reviewing the critical habitat designation. Critical habitat includes those lands that may be needed for a species' eventual recovery and delisting. Critical habitat units were identified based upon the need to protect current and provide for future development of the primary constituent elements necessary for the conservation of the marbled murrelet. The primary constituent elements include individual trees with potential nesting platforms and forested areas within 0.5 miles that possess a canopy height of at least one-half the site-potential tree height (Federal Register 1996a, 26264). Approximately 463,000 acres of critical habitat occur on Bureau of Land Management managed lands. See *Table 92 (Summary of*

critical habitat units and marbled murrelet nesting habitat on BLM-administered lands within the planning area) and *Figure 74 (Critical habitat for the marbled murrelet within the planning area)*.

Table 92. Summary of critical habitat units and marbled murrelet nesting habitat on BLM-administered lands within the planning area

Critical Habitat Unit	Habitat-Capable (acres)	Nesting Habitat	
		(acres)	(%)
CA-01-e	14	10	71
OR-01-b	1	1	100
OR-01-c	7,217	5,025	70
OR-02-a	--	--	--
OR-02-b	11	1	9
OR-02-c	3,526	1,898	54
OR-02-d	25,937	6,731	26
OR-02-e	38,666	20,858	54
OR-03-a	41	41	100
OR-03-c	8,530	4,012	47
OR-04-a	1,300	802	62
OR-04-b	1,084	940	87
OR-04-c	13,388	8,012	60
OR-04-d	20,073	11,097	55
OR-04-e	50,534	27,656	55
OR-04-f	20,109	12,220	61
OR-04-g	15,368	8,354	54
OR-04-i	79,983	40,807	51
OR-04-j	56,450	30,882	55
OR-04-k	25,919	16,083	62
OR-06-a	39	26	67
OR-06-b	49,904	28,609	57
OR-06-c	4,608	3,524	76
OR-06-d	16,178	8,792	54
OR-07-a	2,366	1,252	53
OR-07-b	2,171	990	46
OR-07-d	1,840	845	46
OR-07-f	15,611	8,616	55
OR-07-g	2,086	984	47
Totals	462,953	249,069	

Figure 74. Critical habitat for the marbled murrelet within the planning area



Sage Grouse

Sage grouse (*Centrocercus urophasianus*) were once found throughout most of the sagebrush (*Artemisia sp.*) habitat of eastern Oregon (Hagan 2005). There are currently no known populations within the planning area. However, there is currently suitable habitat and the potential to restore additional lands to a suitable condition within the planning area (specifically, the Klamath Falls Resource Area of the Lakeview District). There are currently 28,000 acres of sage grouse habitat and four historic leks within the Klamath Falls Resource Area.

The major threat to the species is habitat modification and its resultant effects on reproductive capacity and predation (Holloran and Anderson 2005; Gregg et al. 1994; Hagen 2005). Within Oregon, since the 1940s, the sage grouse population has exhibited an overall decline (Hagan 2005; Gregg et al. 1994). Population indices in the last decade have shown a stable to slightly increasing population (Hagan 2005).

From 2002 until 2004, the U.S. Fish and Wildlife Service received multiple petitions to list one or more sage grouse populations. In 2005, they came out with a combined finding that the petitions were not warranted (Federal Register 2005a, 2244). Concurrent with the status reviews, there was an assessment of the nationwide condition of the sage grouse. Connelly et al. (2004) compiled a comprehensive review of the status of the sage grouse and sagebrush habitats entitled *Conservation Assessment of Greater Sage-grouse and Sagebrush Habitats*.

The Oregon Department of Fish and Wildlife, in conjunction with the BLM and other land management organizations, produced the *Greater sage-grouse conservation assessment and strategy for Oregon: a plan to maintain and enhance populations and habitat* (Hagan 2005). The information contained within the Oregon conservation assessment regarding natural history and habitat condition is incorporated by reference. The following is a brief synopsis:

- Sage grouse are a sagebrush obligate species. Sagebrush provides important habitat components necessary for their nesting and diet. There are three main habitat requirements for the sage grouse: breeding (lekking and nesting), brood rearing, and over-wintering habitat.
- Males attract females by displaying (strutting) on open sites called leks. Leks are used annually. Leks are typically devoid of or contain short vegetation. Adjacent sagebrush provides escape cover.
- Females use areas rich in forbs to facilitate egg development. Nesting habitat consists of a sagebrush community containing sagebrush and a herbaceous understory of grasses and forbs. Nests are typically located under sagebrush plants.
- Cover, both overhead and vertical, are critical to nesting success. Good habitat provides concealment from predators, herbaceous forage for prelaying and nesting females, and insect forage for chicks.

- Once broods move off the nest, they move to a more open sagebrush habitat—a habitat that still maintains a rich growth of grasses and forbs, and at least 15% canopy closure. Chicks feed on forbs and invertebrates. Later in the summer broods move to moister habitats were succulent vegetation is still available.
- Winter diets consist mainly of sagebrush. Sage grouse may congregate in areas of higher canopy closure and taller big sagebrush.
- Oregon sagebrush habitats have been reduced 21% from the late 1800s. The lack of connectivity (contiguity) between patches compounds the loss of habitat. High viability patches are those that have greater than 2,500 acres of contiguous habitat.
- The greater loss of sagebrush habitat in eastern Oregon has been due to the conversion of such habitat to agricultural and grazing uses. Fire and seeding with nonnative species continue play a significant role in converting sagebrush habitat to grasslands. Roads and utility corridors play an additional role in habitat degradation by providing corridors and perches for predators, spreading nonnative vegetation, and introducing disturbances. Human disturbances, both low-keyed bird-watching and intense off-highway vehicle use, may cause lek and nest abandonment.

Bald Eagle

The bald eagle of North America (*Haliaeetus leucocephalus*) is listed under the Endangered Species Act as threatened in Oregon. Breeding and wintering populations occur throughout the planning area and are addressed in the Pacific States Bald Eagle Recovery Plan (USDI, USFWS 1986). In 1999, the bald eagle was proposed for delisting in the contiguous 48 states. A recovery plan was completed in 1986 (USDI, USFWS 1986). The planning area includes portions of six bald eagle management zones (10, 11, 12, 13, 22, and 23) (USDI, USFWS 1986, 29).

Bald eagles in the Pacific Northwest nest predominantly in conifer stands adjacent to or near large rivers or other large bodies of water (USDI, USFWS 1986; Anthony et al. 1982; Buehler 2000; Federal Register 2006a, 71 FR 8239).

- Distances to water bodies from nests varies but could extend up to 1,378 yards in portions of the planning area (USDI, USFWS 1986; Buehler 2000; Anthony et al. 1982). Vessely et al. (2001) modeled potential nesting habitat up to 3 km (1.9 miles) away from water.
- Nesting habitat can encompass a wide range of stand types but they all can be described has having a variety of canopy layers and some component of large diameter or old-growth trees. Anthony et al. (1982) found that the diameter of nesting trees vary by forest types, but, invariably, they were some of the largest trees in the stand. The average diameters of nesting trees varied between:
  - 41 inches (diameter at breast height) in Oregon mixed conifer stands
  - 46 inches in ponderosa pine forests
  - 69 inches in Douglas fir forests.

- Douglas fir is the dominant species for nesting trees west of the Cascade Mountains, while ponderosa pine is dominant east of the Cascade Mountains (Anthony et al. 1982).

Fish, waterfowl, jackrabbits, and carrion provide the most common source of food for eagles in the Pacific Northwest (USDI, USFWS 1986). Nesting sites, roosts, and wintering areas tend to be associated with sources of food (Anthony et al. 1982; USDI, USFWS 1986; Buehler 2000; Federal Register 2006a, 8242), although overwintering area locations may also be driven by remoteness (Federal Register 2006a, 8239; USDI, USFWS 1986).

There are 3,600 miles of stream and 291,000 acres of ponds and lakes that provide foraging habitat for the bald eagle. There are approximately 1,630,000 acres of BLM lands that are capable of growing eagle nesting and roosting habitat in the planning area (those forest-capable lands within 4 miles of foraging waters) and approximately half of those are currently providing bald eagle nesting and roosting habitat. See *Table 93 (Potential bald eagle nesting habitat within the planning area)*.

Table 93. Potential bald eagle nesting habitat within the planning area

BLM Districts	Habitat-Capable (acres)	Nesting Habitat	
		(acres)	(%)
Salem	377,379	192,786	51
Eugene	169,928	71,399	42
Roseburg	264,901	134,901	51
Coos Bay	231,863	97,106	42
Medford	536,924	279,736	52
Klamath Falls	166,179	50,761	31
Totals	1,747,174	826,689	50

Communal roosts are selected for and favor those stands that have a high degree of stratification (Anthony et al. 1982). Roost trees are the largest trees in the stand or have open branching patterns, provide visibility, and may be close to a consistent food source (Anthony et al. 1982; Buehler 2000).

There are 149 bald eagle nesting trees located on BLM lands within the planning area. These nests are contained within 89 known territories (Isaacs and Anthony. 2005). Monitoring data indicates that bald eagle numbers have increased steadily since 1973 (Isaacs and Anthony 2005). The bald eagle was proposed for delisting in 1999 (Federal Register 1996b, 36454). See *Table 94 (Summary of the 2005 monitoring data for the bald eagle)* for the current population data for the management zones that overlap the planning area (Isaacs and Anthony 2005).

Table 94. Summary of the 2005 monitoring data for the bald eagle

Bald Eagle Conservation Zones	Breeding Areas Surveyed (number)	Breeding Areas Occupied[a] (number)	Occupied Breeding Areas with Known Outcomes	Successful Breeding Areas[b] (%)	5-year Average of Successful Breeding Areas (%)	Young/Breeding Areas (number)	5-Year Average of Young/ Breeding Areas (number)	Young/Successful Breeding Pairs (number)
10 – Columbia River (OR)	12	11	71	70.0	63.8	1.00	1.04	1.43
11 – High Cascades	69	64	63	61.9	65.7	0.94	1.01	1.51
12 – Willamette Basin	63	61	55	70.9	68.8	1.15	1.17	1.62
13 – Oregon Coast	93	91	90	72.2	70.0	1.11	1.10	1.54
22 – Klamath Basin	134	129	119	60.5	62.2	0.87	0.96	1.43
23 – CA/OR Coast	25	22	20	70.0	67.3	1.05	1.05	1.50

[a]Where one or two adults and a nest were observed.

[b]Breeding areas where 1 or more nestlings or fledglings were observed.

There are 161 bald eagle management areas designated on BLM lands within the planning area. They range in size from 4 to 960 acres and total 16,220 acres. See *Table 95 (Bald eagle management areas within the planning area)*. Bald eagle management areas were carried forward from the previous plan and were created for sites found since 1994. Bald eagle management areas are designed to protect existing nest sites, winter and communal roosting areas, and potential nesting habitat.

Table 95. Bald eagle management areas within the planning area

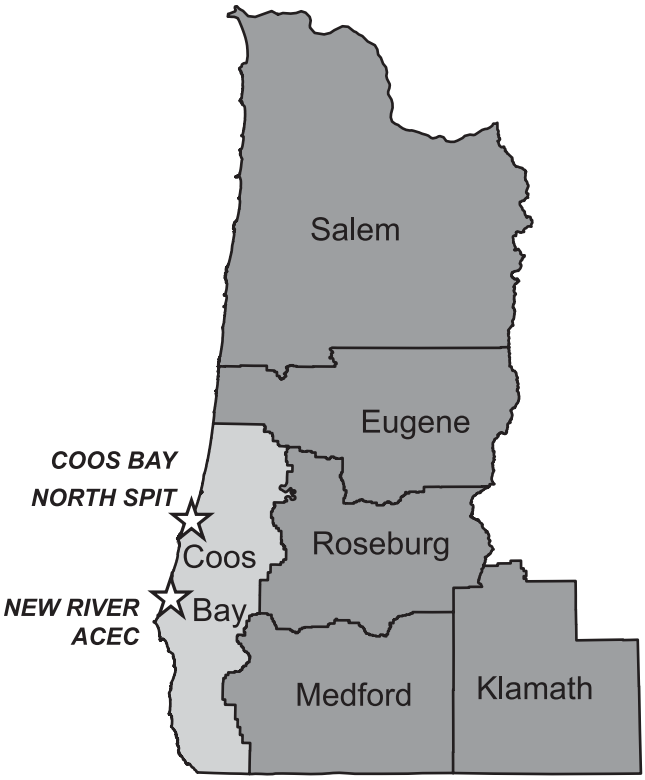
BLM District	Number of Areas	Acres
Salem	10	2,227
Eugene	73	8,266
Roseburg	25	3,682
Coos Bay	26	769
Medford	21	1,091
Klamath Falls	22	1,931
Totals	177	17,966

Western Snowy Plover

The Pacific Coast population of the western snowy plover (*Charadrius alexandrinus nivosus*), hereafter referred to as the snowy plover, is listed as threatened under the federal Endangered Species Act (Federal Register 1993,12864) and by the state of Oregon (ODFW 2006). The primary threats to the snowy plover were identified as the loss and degradation of habitat from human activities (Federal Register 1993, 12864). The snowy plover occurs along the Pacific Coast from British Columbia, Canada to Baja California, Mexico; and at interior areas in Oregon, California, Nevada, Utah, New Mexico, Colorado, Kansas, Oklahoma, and north-central Texas (Federal Register 1993, 12864; Page et al. 1995). The coastal population is genetically distinct from the interior population (Federal Register 1993, 12864; Federal Register 2006b, 20607).

The coastal population occurs within the geographic boundaries of the Salem, Eugene, and Coos Bay districts. The BLM manages snowy plover nesting and wintering habitat only on the Coos Bay District. The Coos Bay District manages 436 acres of snowy plover nesting and overwintering habitat, which is located on the Coos Bay North Spit (138 acres) and the New River Area of Critical Environmental Concern (298 acres). See *Figure 75 (Locations of the Pacific coast population of the western snowy plover on BLM lands within the planning area)*.

Figure 75. Locations of the Pacific coast population of the western snowy plover on BLM Lands within the planning area



Snowy plovers nest above the high tide line on "wide-open sandy beaches, river mouths, or dredge spoils, often with scattered driftwood or vegetation. Driftwood, wrack, and native dune plants often harbor snowy plover food sources, and provide cover for chicks hiding from predators" (OPRD 2004, 42-43) Much open sand habitat was lost in Oregon when European beachgrass was introduced in the early to mid 1900s. European beachgrass created extensive vegetated foredunes that narrowed beaches and provided thick cover for predators.

The Coos Bay North Spit has been the most productive snowy plover breeding area since intensive monitoring began in the early 1990s. Unique to Oregon, snowy plover habitat on the Coos Bay North Spit is found along the beach as well as inland of the ocean foredune on old dredge material deposits and restored open sand habitat. Through time much of this habitat was lost or degraded due to beachgrass encroachment. Most of the BLM-administered lands in this area are designated as an area of critical environmental concern. The North Spit Plan (USDI, BLM 2005a) contains direction for plover management. The management measures were developed in cooperation with the U.S. Fish and Wildlife Service and Oregon State agencies. Management measures include recreational restrictions, predator control, outreach activities, and habitat restoration.

In cooperation with the Army Corps of Engineers, the Oregon Department of Fish and Wildlife, and the U.S. Fish and Wildlife Service, the BLM has restored and maintained approximately 76 acres of habitat inland of the ocean foredune. A variety of methods have been used to remove European beachgrass and other invasive plant species from these habitat restoration areas (including heavy equipment, saltwater treatments, hand pulling, and herbicides). In addition to the habitat restoration areas, snowy plovers also nest on the adjacent ocean beach.

Snowy plover numbers have increased on the Coos Bay North Spit since active management measures and monitoring began in the early 1990s. The total number of fledglings has risen from a low of 3 in 1990 to a high of 35 in 2004 (Lauten et al. 2006). Plover reproductive success is measured by the number of chicks fledged per male and is currently estimated of 1.57 fledglings per male at the Coos Bay North Spit, which is approximately 10% below the 15-year average of 1.71 fledglings per male (Lauten et al. 2006).

Snowy plovers also use a long, relatively isolated stretch of beach from the southern portion of Bandon's beaches to Floras Lake. This approximately 16 mile length of beach is managed under several jurisdictions (including 5.75 miles that are included in the BLM New River Area of Critical Environmental Concern). The New River Area of Critical Environmental Concern Management Plan (USDI, BLM 2004a) contains direction for plover management. Management measures were developed in cooperation with the U.S. Fish and Wildlife Service and Oregon State agencies. Management measures include recreation restrictions, predator control, outreach activities, and habitat restoration.

Approximately 120 acres of habitat (nearly 2.75 miles in length) have been restored and maintained using heavy equipment, burning, and hand pulling to remove European beachgrass and other invasive plant species. In addition, the BLM cooperatively

manages approximately 1 mile of ocean beach and inland snowy plover habitat north of Floras Lake.

Over the past several years, locations of snowy plover activity have varied in the New River area. In general, numbers have increased on the New River spit, including the area of critical environmental concern since active management measures and monitoring began in the early 1990s. The total number of fledglings associated with the New River spit has risen from a low of zero in 1993 to a high of 21 in 2004 (Lauten et al. 2006). Snowy plover reproductive success is measured by the number of chicks fledged per male. This fledgling rate has increased through time and is currently at 1.33 chicks per male at New River, which is 49% higher than the 15-year average of 0.89 fledglings per male (Lauten et al. 2006). Predation is a greater problem at this location than other Oregon snowy plover sites (Lauten et al. 2006). The New River area is the only location with nonnative red fox present in the area. The beaches also abut extensive ranch lands with sheep and cattle operations.

The final rule for listing the snowy plover (Federal Register 1993, 12864) and the draft recovery plan (Federal Register 2001a) provides comprehensive discussions of the following threats to the snowy plover:

- loss or degradation of habitat through
- over utilization for commercial, recreational, scientific, or educational purposes
- disease and predation
- inadequacy of existing regulatory mechanism
- other natural or manmade factors affecting their continued existence

The state of Oregon describes threats to the snowy plover as habitat degradation, introduction of nonnative vegetation, beach development, resource extraction, human disturbance, and predation (OPRD 2004).

Beaches are unstable habitats—they change with each winter storm event and are constantly broken down and renewed. Human activities (building jetties and seawalls, and stabilizing dunes) modify or eliminate these natural destabilizing cycles (OPRD 2004). The introduction of European beachgrass (*Ammophila arenaria*) has stabilized foredunes and prevented the replenishment of the open sand areas thus diminishing the availability of snowy plover habitat and changing the natural vegetative and sand dynamics (OPRD 2004; Federal Register 2001a). Beachgrass also provides cover for predators, which benefit from its dense growing habit.

Nest losses due to predation at some sites on the Oregon coast have been as high as 68% (Sterns et al. 1990 and Hogan 1991; Federal Register 1993, 12871). Predator numbers are thought to increase with increased human presence for a number of reasons. Trash near nesting areas attracts such predators as crows, ravens and rats; European beachgrass, and the subsequent vegetation changes to dune plant communities results in increased hiding cover; and greater human presence may lead to an increase in human disturbance, which flushes adult and snowy plover chicks from nests and increases their vulnerability to predation.

Human activity has been documented as a major threat to the breeding success of the snowy plover (OPRD 2004). Human disturbance, either on foot or in off-highway vehicles, may flush birds from nests, resulting in nest abandonment or lengthening of the incubation period, as birds stay off of the eggs for extended periods of time; may result in trampled or crushed birds or eggs; and may separate broods from adults.

Critical habitat was designated for the Pacific coast population of the snowy plover in 2005 (Federal Register 2005b, 26970). The primary constituent elements for the designated critical habitat units are:

- sparsely vegetated areas above daily high tides that are relatively undisturbed by the presence of humans, pets, vehicles, or human–attracted predators;
- sparsely vegetated sandy beach, mud flats, gravel bars, or artificial salt ponds that are subject to daily tidal inundation, but not currently under water, that support such small invertebrates as crabs, worms, flies, beetles, sand hoppers, clams, and ostracods; and
- surf or tide cast organic debris (such as seaweed or driftwood) located on open substrates (such as those mentioned above) (Federal Register 2005b, 56994).

The latter provide essential habitat for invertebrate food sources, and provide shelter from predators and inclement weather. Two critical habitat units contain BLM lands—OR 9 and OR 10—which overlay BLM-administered lands in the Coos Bay District. See *Table 96 (Critical habitat for the Pacific coast populations of the western snowy plover)* and *Figure 75 (Locations of the Pacific coast population of the western snowy plover on BLM lands within the planning area)*.

Table 96. Critical habitat for the Pacific coast populations of the western snowy plover

Critical Habitat Units	Total Area (acres)	Federal Area (acres)	BLM Area (acres)	Habitat Capability (number of breeding birds)
OR 9 (Coos Bay North Spit)	278	278	138	54
OR 10A (Bandon to Floras Creek)	632	304	178	54

Special Status Species

BLM special status species are those species that include federal- and state-listed species, proposed and candidate species, and BLM sensitive and assessment species. Some species are both state and federally listed.

The primary objectives of the BLM special status species policy are:

- to conserve listed species and the ecosystems on which they depend;
- to ensure that actions requiring authorization and approval by the BLM are consistent with the conservation needs of special status species and do not

contribute to the need to list any special status species under the provisions of the Endangered Species Act; and

- to use all methods and procedures necessary to improve the condition of special status species and their habitats to a point where their special status recognition is no longer warranted.

There are two categories of BLM-designated special status species:

- **Sensitive Species.** In Oregon and Washington, BLM sensitive species are those taxa that are eligible for listing as federal-listed, federal-candidate, state-listed or state-candidate (plant) status.
- **Assessment Species.** Plant and vertebrate species that are not included as federal threatened, federal endangered, federal proposed, federal candidate, state listed, or BLM sensitive, and are on List 2 of the Oregon Natural Heritage Database.

As of March 14, 2005, 117 special status animal species (amphibians, reptiles, birds, invertebrates, and mammals) are documented or suspected to occur within the planning area. See *Appendix G. Wildlife*. The numbers vary, but between 28 and 57 species occur in each district. See *Table 97 (Animal special status species in BLM districts within the planning area)*.

Table 97. Animal special status species in BLM districts within the planning area

Status*	District					
	Salem	Eugene	Roseburg	Coos Bay	Medford	Klamath Falls
Amphibians and Reptiles						
FE	0	0	0	0	0	0
FT	0	0	0	0	0	0
FC	0	0	0	0	1	1
BS	4	3	1	1	2	1
BA	4	2	1	2	2	1
Totals	8	5	2	3	5	3
Birds						
FE	0	1	0	1	1	0
FT	3	3	3	4	3	2
FC	0	1	0	1	1	0
BS	10	11	5	14	12	10
BA	4	4	3	8	4	5
Totals	17	20	11	28	21	17
Invertebrates						
FE	1	1	0	0	0	0
FT	1	0	0	0	1	0
FC	1	2	0	1	1	0
BS	17	12	8	14	14	9
BA	0	0	0	0	0	0
Totals	20	15	8	15	16	9
Mammals						
FE	1	0	0	3	0	0
FT	0	0	0	1	0	0
FC	0	1	0	1	1	1
BS	2	1	2	1	1	1
BA	4	4	5	5	4	5
Totals	7	6	7	11	6	7
Total All	52	46	28	57	48	36

*Status Codes:
FE (federally listed as endangered); FT (federally listed as threatened); FC (candidate for federal listing); BS (bureau sensitive species); BA (bureau assessment species)

The federally listed threatened and endangered animal species addressed individually inhabit significant portions of the planning areas. There are other threatened and endangered animal species that either occur on the periphery of the planning area (i.e., in the ocean) or inhabit habitats that constitute a very small portion of the planning area. See *Table 98 (Documented or suspected federally listed animal species within the planning area that are not typically found in forested habitat)* and *Table 99 (Habitat requirements for federally listed animal species within the planning area that are not typically found in forested habitat)*.

Table 98. Documented or suspected federally listed animal species within the planning area that are not typically found in forested habitat

Status*	Scientific Name	Common Name
FC	*Eremophila alpestris strigata*	Streaked horned lark
FC	*Euphydryas editha taylori*	Whulge checkerspot (butterfly)
FC	*Polites mardon*	Mardon skipper (butterfly)
FC	*Rana pretiosa*	Oregon spotted frog
FT	*Branchinecta lynchi*	Vernal pool fairy shrimp
FT	*Eumetopias jubatus*	Steller sea lion
FT	*Speyeria zerene hippolyta*	Oregon silverspot butterfly
FE	*Balaenoptera musculus*	Blue whale
FE	*Eschrichtius robustus*	Gray whale
FE	*Icaricia icarioides fenderi*	Fender's blue butterfly
FE	*Megaptera novaeangliae*	Humpback whale
FE	*Pelecanus occidentalis californicus*	California brown pelican

*Status Codes:
FC (federal candidate for listing); FT (federally listed as threatened); FE (federally listed as endangered)

Table 99. Habitat requirements for federally listed animal species within the planning area that are not typically found in forested habitat

Common Name	Habitat Conditions
Streaked horned lark	• Found in the Willamette Valley • Nesting habitat included native prairies and a wide range of agricultural fields (Marshall et al. 2003)
Whulge checkerspot (butterfly)	• Low-elevation upland prairies • Host plant is narrow-leaved plantain (*Plantago lanceolata*) (ODFW 2006)
Mardon skipper (butterfly)	• Meadow habitats • Host plants are native fescues (ODFW 2006)
Oregon spotted frog	• Permanent ponds, marshes and meandering streams through meadows • Bottom of dead and decaying vegetation • Springs and other slow moving water (ODFW 2006)
Vernal pool fairy shrimp	• Small, cooler ephemeral pools (ODFW 2006) • Found on BLM lands in the Medford District • Recovery plan (USDI, USFWS 2005) and designated critical habitat (Federal Register 2006c, 7118-7166) available
Steller sea lion	• Marine habitats include coastal waters near shore and over the continental slope • Sometimes rivers are ascended in pursuit of prey • Terrestrial habitats include beaches that are commonly used as rookeries and haulouts (NatureServe 2006)

Common Name	Habitat Conditions
Oregon silverspot butterfly	• Salt spray meadows • Host plants early blue and western blue violets (*Viola sp.*) (ODFW 2006) • Recovery plan (USDI, USFWS 2001b) and designated critical habitat (Federal Register 1980, 44935-44938) available
Blue whale	• Mainly pelagic • Generally prefers cold waters and open seas (NatureServe 2006)
Gray whale	• Mostly in coastal and shallow shelf waters • Young are born in lagoons and bays (NatureServe 2006)
Fender's blue butterfly	• Seasonally wet native prairies • Host plant is Kincaid's lupine (*Lupinus sulphureus kincaidii*) (ODFW 2006) • Draft critical habitat (Federal Register 2005c, 66492-66540) available
Humpback whale	• Pelagic and coastal waters • Sometimes frequenting inshore areas such as bays (NatureServe 2006)
California brown pelican	• A coastal marine species rarely found inland • Roosts on sandy shores and offshore rocks • Nests on islands and offshore rocks (Marshall et al. 2003)

Bureau sensitive and assessment species have been grouped according to habitat requirements to facilitate effects analysis. See *Table 100 (Bureau sensitive species and bureau assessment species found within the planning areas and grouped by habitat requirements to facilitate analysis)* and *Appendix G. Wildlife*. For many groups, habitat requirements are similar to those of species receiving individual analysis. Therefore, any additional analysis for those groups would be redundant.

Table 100. Bureau sensitive species and bureau assessment species found within the planning areas and grouped by habitat requirements to facilitate analysis

Habitat Association or Group	Common Name
Species effects that are common to all alternatives. Includes species that are associated with special habitats or features. Also includes accidental or occasional migrants where impacts are unlikely.	Yellow rail
	American peregrine falcon
	Rhinoceros auklet
	Cassin's auklet
	Tufted puffin
	Upland sandpiper
	Fork-tailed storm petrel
	Aleutian Canada goose
	Dusky Canada goose
	American white pelican.
	Red-necked grebe
	Trumpeter swan
	Ferruginous hawk
	Common nighthawk (Willamette Valley population)
	Tule goose
	Merlin
	White-tailed kite
	Insular blue (butterfly)
	Hoary elfin (butterfly)
	Newcomb's littorine snail
	Larch mountain salamander
	American grass bug
	Siskiyou short-horned grasshopper
	Diminutive pebblesnail
	Fall creek pebblesnail
	Keene creek pebblesnail
	Klamath pebblesnail
	Nerite pebblesnail
	Crater lake tightcoil (snail)
	Montane pea clam
	Evening fieldslug
	Crowned tightcoil (snail)
	Robust walker
	Pacific walker
	Toothed pebblesnail
	Townsend's big-eared bat
	Spotted bat
	Fringed myotis*
	Pallid bat (Pacific Pallid and Pallid considered the same)

Habitat Association or Group	Common Name
Neotropical Birds	Purple martin
	Yellow breasted chat
	White-headed woodpecker
	Three-toed woodpecker
	Black-backed woodpecker
	Grasshopper sparrow
	Tricolored blackbird
	Burrowing owl
	Flammulated owl
	Lewis woodpecker
	Oregon vesper sparrow
	Western meadowlark
	Streaked horned lark
Snag Dependent	Fringed myotis
	Pallid bat (Pacific Pallid and Pallid considered the same)
Older Forest Associates	Red tree vole
	Northern goshawk
	Johnson's hairstreak (butterfly)
	Survey and manage species
Aquatic and Riparian Associates	Haddock's rhyacophilan caddis fly
	Cope's giant salamander
	Scott's apatanian caddis fly
	Cascade torrent salamander
	Columbia torrent salamander
	Willamette floater (mussel)
	Harlequin duck
	Foothill yellow-legged frog
	Oregon spotted frog
	Scale lanx (snail)
	Rotund lanx (snail)
	Northwestern pond turtle
	Painted turtle

Habitat Association or Group	Common Name
Forest Floor Associates	Puget Oregonian
	Tillamook westernslug
	Salamander slug
	Spotted tail-dropper
	Bald hesperian
	Oak springs hesperian
	Oregon giant earthworm
	Roth's blind ground beetle
	Oregon slender salamander
	Traveling sideband (snail)
	Klamath taildropper
	Modoc sideband (snail)
	Siskiyou hesperian
	Chase sideband (snail)
	California slender salamander
	Oregon shoulderband (snail)
	Black salamander
	Siskiyou mountains salamander
	Sisters hesperian
	Green sideband (snail)
Gophers	Pistol river pocket gopher
	Gold beach pocket gopher

Fisher

The west coast population of the fisher (*Martes pennanti*) was petitioned for listing under the federal Endangered Species Act in 2000. In 2004, the U.S. Fish and Wildlife Service found that listing was "warranted but precluded" by higher priority actions (Federal Register 2004, 18770). Subsequently, the fisher was added to the U.S. Fish and Wildlife Service's candidate species list (Federal Register 2004, 18770). Within the planning area, the fisher has been documented to occur in two districts and suspected to occur in two others. See *Appendix G. Wildlife*.

Fisher historically occurred throughout the Cascades, Coast Range, and the Siskiyou and Blue mountains of Oregon (Bailey 1936). They have declined since the late 1800s and early 1900s as a result of overtrapping, loss of habitat, and predator control programs (Aubry and Lewis 2003). Aubry and Lewis (2003) recognized two disjunct populations of fisher within the planning area—one in the southern Cascade Range and another in the northern Siskiyou Mountains. The southern Cascade fisher population is separated from the northern Siskiyou Mountains population by Interstate 5, large expanses of nonhabitat (nonforested and agricultural lands), and the populated Rogue River Valley.

Genetic studies found the population in the southern Cascades originated from animals that were introduced from British Columbia and Minnesota at various times from

the 1960s through the early 1980s (Aubrey and Lewis 2003). Genetic analysis has determined that "[t]he high degree of relatedness among fishers in the southern Cascade Range (R-.56) is consistent with the hypothesis that this population is small and isolated" (Aubry et al. 2003).

Small population sizes and isolation make the "Oregon populations vulnerable to extirpation" (Federal Register 2004, 18789). Recent survey efforts in southwestern Oregon have detected fisher in the landscape between the southern Cascade and other northern Siskiyou Mountains population centers, but the extent of connectivity between the two populations is still believed to be limited (Aubrey et al. 2004; Aubrey and Lewis 2003; Federal Register 2004, 18771).

Forest structure and associated prey are thought to be the critical features of habitat requirements for the fisher (Buskirk and Powell 1994). Powell (1993) (as cited in Federal Register 2004, 18773) stated "that forest type is probably not as important to fishers as the vegetative and structural aspects that lead to abundant prey populations and reduced fisher vulnerability to predation, and they may select forest that have low and closed canopies." The fisher uses different forest structures for the various stages of life:

- natal sites (where young are born and weaned)
- maternal habitat (where young are raised)
- resting sites
- foraging habitat

Aubry and Raley (2002) found that female fishers use trees (alive or dead) with hollows created by heart rot for natal sites. Natal den trees ranged from 61 to 138 cm (24 to 54 inches) in diameter (average 93 cm (37 inches)) (Aubry and Raley 2002). Elsewhere along the Pacific coast, natal dens are typically located in the largest diameter trees. Weir and Harestad (2003) reported natal dens in cottonwoods that were averaging 103 cm (40 inches) in diameter. The U.S. Fish and Wildlife Service (Federal Register 2004, 18774) cited studies in northern California reporting average diameters of natal den trees of 62.5 to 295 cm (24 to 116 inches). Maternal dens were located in cavities in live trees and snags between the bole and sloughing bark on mistletoe brooms, on a rodent nest, and in large hollow logs that were greater than 50 cm (20 inches) in diameter (Aubry and Raley 2002). Approximately 56% of natal and maternal den sites in the southern Cascade study were located in unmanaged forests, 38% in managed forests (some evidence of past harvest activities), and 6% in second growth forests (Aubry and Raley 2002).

Rest sites occur predominantly in live trees. Aubry and Raley (2002) found that mistletoe brooms were used more than any other platform or microsite. Snags and down logs were also used for resting sites (Aubry and Raley 2002; Zielinski et al. 2004; Yeager 2005). In the southern Cascades, resting sites were found in unmanaged forests 63% of the time, 25% in managed second growth, and 22% in managed forest (Aubry and Raley 2002). In the Klamath province of northern California, Yeager (2005) determined that rest sites were located in trees significantly larger diameter at breast height than the four largest tree on a plot (0.4 ha) (1 acre) centered on the rest site structure.

Trees providing rest sites in the Shasta-Trinity National Forest and the Hoopa Valley Indian Reservation averaged from 87 to 124 cm (34 to 40 inches) in diameter at breast height (Yeager 2005). Rest sites in the north coast study area (northern California) averaged approximately 118 cm (46 inches) in diameter (Zielinski et al. 2004). Resting structures need to be sufficiently large in diameter to provide resting substrates that can accommodate the large-bodied fishers. Trees must be old enough for ecological processes to form cavities of sufficient size to be of use to fishers (Zielinski et al. 2004). Zielinski et al. (2004) described resting locations in their coast study areas (northern California) as being best distinguished from random locations by having large trees, dense canopies, and large diameter snags.

Foraging habitat is a function of coarse woody debris and stand structural complexity, which translates into a diverse prey base (Weir and Harestad 2003; Buskirk and Powell 1994). The fisher is a predator of small- to medium-sized mammals and birds. They also feed on a variety of vegetable matter, including berries and nuts (Powell and Zielinski 1994). Fungal spores found in fisher scats indicate that fishers may also directly consume fungi (Zielinski *et al*. 1999). Throughout their range, fishers commonly feed on ungulate carrion (e.g., deer, elk, moose, and cattle), especially in the winter, when other prey species are less available.

Fishers may select prey based upon their availability (Banci 1989). Fishers tend to occur in habitat that provides both prey numbers and the opportunity to capture them (Powell 1993, as cited in Federal Register 2004, 18772; Weir and Harestad 2003).

Literature reviews have shown that home ranges for fishers vary up to 122 km^2 for males and 53 km^2 for females (Banci 1989; Powell and Zielinski 1994). Zielinski et al. (2003) found that home ranges averaged 5,806 ha (14,350 acres) for males and 1,498 ha (3,700 acres) for female fisher in their coastal study area (northern California). Approximately 76% of the home range was composed of mature and older Douglas fir and true fir habitat types (Zielinski et al. 2004). Fishers avoid habitats without overstory or shrub cover (Weir and Harestad 2003; Federal Register 2004, 18773).

Approximately 2.2 million acres of BLM-administered lands are commercial forest lands capable of growing into fisher natal (including denning) and foraging habitat. See *Table 101 (Available fisher natal and foraging habitat on BLM-administered lands with in the planning area)*. Within the planning area, fisher natal habitat comprises from 13 to 39% of the BLM forest lands. Foraging habit constitutes 61% of the BLM forest lands, which varies from 45% in the Eugene District to 81% in the Klamath Falls Resource Area of the Lakeview District. The Medford District contains the most fisher foraging habitat at approximately 605,000 acres.

Table 101. Available fisher natal and foraging habitat on BLM-administered lands with in the planning area

BLM Districts	Habitat-Capable (acres)	Natal Habitat		Foraging Habitat	
		(acres)	(%)	(acres)	(%)
Salem	365,000	48,428	13	204,866	54
Eugene	296,000	51,052	17	135,093	45
Roseburg	399,000	154,948	39	226,978	57
Coos Bay	302,000	84,035	28	143,933	48
Medford	788,000	213,342	27	604,753	77
Klamath	47,000	7,840	17	38,484	81
Totals	2,197,000	559,646	25	1,354,107	61

In their finding on the petition to list the fisher, the U.S Fish and Wildlife Service concluded that habitat loss and fragmentation appeared to be significant threats to the fisher (Federal Register 2004, 18780). Timber harvesting is a primary threat (Powell 1993) by reducing the amount of suitable habitat, fragmenting the remaining landscape, and changing the forest structure. Timber management activities tend to simplify stands by reducing species diversity, removing snags and down wood, and creating simple canopy structures (Federal Register 2004, 18778-18779).

Land Birds

"The temperate rain forests of the Pacific Northwest support the highest abundance of birds of any coniferous forest system in North America" (Altman 1999). There are potentially 164 species of birds that could occur within the planning area. See *Table 102 (Bird occurrence within the montane and western forest habitat types of Oregon and Washington)* (Olsen et al. 2001).

Table 102. Bird occurrence within the montane and western forest habitat types of Oregon and Washington

Total number of bird species	Bird Occurrence			
	Montane Mixed Conifer	Southwest Oregon Mixed Conifer-Hardwood	Westside Oak and Dry **Douglas fir and** Woodlands	Westside Lowlands and Conifer-Hardwoods
164	107	161	119	120

Detailed descriptions of the habitat needs and conservation concerns land birds are detailed in *Birds of Oregon* (Marshall et al. 2003) and *Wildlife-Habitat Relationships in Oregon and Washington* (Johnson and O'Neil 2001), and in the numerous species accounts contained within the *The Birds of North America* (Poole and Gill 2002).

Threats facing land birds include loss of habitat, habitat fragmentation, declining populations, and forest simplification (Altman 1999; Marshal et al. 2003; Rich et al. 2004; Pashley et al. 2000). Past management practices (including clear-cutting,

commercial thinning, fire suppression, salvage, slash burning, and herbicide use) has tended to simplify the forest habitat (Altman 1999). More recent management has begun to improve habitat structure and diversity by recognizing the need to provide for diverse forest structures (including legacy trees, snags, down wood, multiple canopy layers, and variable densities of tree retentions).

The Oregon/Washington Partners in Flight has developed a tiered scheme of segregating species into management groups based on forest condition and habitat attribute. Focal species are then identified for each group (Altman 1999, 2000a, 2000b). "By managing for a group of species representative of important components in a functioning…forest ecosystem, many other species and elements of biodiversity also will be conserved" (Altman 1999).

Data is not available to analyze all the combination groups of forest conditions and habitat attributes. Habitat analysis will be conducted based on the four structural stages of forests and plant group combinations. See *Table 103 (Analytical groups of land birds with the planning area)* (Altman 1999, 2000a, 2000b). Eastside conifer forests are composed of the true fir, Douglas fir, conifer/hardwood, and mixed conifer plant groups in the Klamath Falls Resource Area of the Lakeview District. Westside conifers are comprised of all plant groups with the exception of junipers and hardwoods.

Table 103. Analytical groups of land birds within the planning area

Plant Group	Habitat Feature or Conservation Focus	Focal Land Bird Species
Structurally Complex Forests		
Eastside conifer	Large trees	Brown creeper
	Large snags	Williamson's sapsucker
	Multi-layered dense canopy	Hermit thrush
Westside conifer	Large snags	Vaux's swift
	Large trees	Brown creeper
	Conifer cones	Red crossbill
Mature Forests with Multilayered Canopies		
Westside Conifer	Large snags	Pileated woodpecker
	Large trees	Brown creeper
	Conifer cones	Red crossbill
	Closed canopy	Hermit warbler
	Deciduous canopy trees	Pacific-slope flycatcher
	Mid-story tree layers	Varied thrush
	Open mid-story	Hammond's flycatcher
	Deciduous understory	Wilson's warbler
	Forest floor complexity	Winter wren

Plant Group	Habitat Feature or Conservation Focus	Focal Land Bird Species
Young Forests (young stand initiation and pole stem exclusion*)		
Westside Conifer	Closed canopy	Hermit warbles
	Deciduous canopy trees	Pacific-slope flycatcher
	Open mid-story	Hammond's flycatcher
	Deciduous canopy trees	Black-throated gray warbler
	Deciduous understory	Wilson's warbler
	Forest floor complexity	Winter wren
	Deciduous subcanopy and understory	Hutton's vireo
Stand Establishment Forests		
Westside conifer	Residual canopy trees	Olive-sided flycatcher
	Snags	Western bluebird
	Deciduous vegetation	Orange-crowned warbler
	Nectar-producing plants	Rufous hummingbird

*Altman's seral stages (Altman 1999).

Habitat objectives from the land bird conservation strategies of the Oregon/Washing Partners in-Flight for the eastern Oregon forests include (Altman 2000a):

- "no net loss" of habitat;
- maintenance of existing large diameter trees; and
- maintain existing structurally complex forests.

Habitat objectives from the land bird conservation strategies of the Oregon/Washing Partners in-Flight for the western Oregon forests include (Altman 1999):

- retain existing old-growth forest;
- manage for more than 15% of the landscape to be comprised of old-growth forest;
- manage mature forests in the same manner as the landscape targets;
- maintain 20 to 40% of the landscape in a combination of pole and young forest structures;
- maintain 20 to 40% of the landscape in an early successional stage.

These objectives provide "benchmarks for measuring the success of management actions" in providing for land birds (Altman 1999).

Deer and Elk

Deer (*Odocoileus sp.*) and elk (*Cervus elaphus*) occur across the planning area. Two species of deer (Columbian white-tailed deer (*Odocoileus virginianus leucurus*) and mule and black-tailed deer (*Odocoileus hemionus*)) occur within the planning area. This includes two subspecies of *Odocoileus hemonius*. Columbian black-tailed deer (*Odocoileus hemionus columbianus*) occur west of the crest of the Cascades and mule deer (*Odocoileus hemionus*) occur east of the Cascades (ODFW 2003a; Verts and Carraway 1998). Two subspecies of elk are found within the planning area. Roosevelt elk (*Cervus elaphus roosevelti*) occurs west of the Cascades and Rocky Mountain elk (*Cervus elaphus nelsoni*) are found east of the Cascades (ODFW 2003b; Verts and Carraway 1998). For management purposes, the Oregon Department of Fish and Wildlife divides the range of the two subspecies along State Highway 97 (ODFW 2003b).

There are two populations of Columbian white-tailed deer in Oregon—one along the Columbia River in the Clatsop, Columbia, and Multnomah counties, and a second population in Douglas County (Verts and Carraway 1998; Federal Register 2003, 54647; USDI, USFWS 1983). These populations were one of the first species listed under the Endangered Species Act. In 2003, the U.S. Fish and Wildlife Service determined that (Federal Register 2003, 43658):

- the Columbia River and Douglas County populations were "distinct population segments," and
- the Douglas County population had reached recovery goals and no longer warranted listing.

The Columbia River population is still listed as a federally endangered species (Federal Register 2003, 43658).

All subspecies of elk and of mule and black-tailed deer are classified as game animals by the state of Oregon.

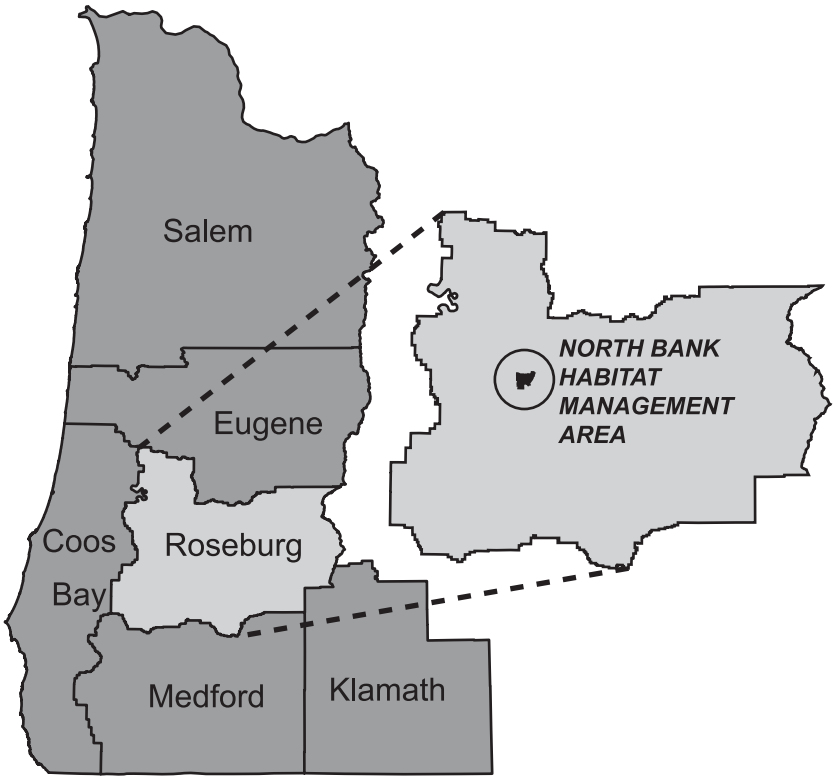
Columbian White-tailed Deer

White-tailed deer inhabit more mesic habitats (Smith 1987; Verts and Carraway 1998). White-tailed deer in the Columbia River population are found on the islands of the Columbia River and on the bottomlands that are adjacent to the river (USDI, USFWS 1983). Preferred habitats are plant communities that provide both forage and cover, including the park forest community (Suring 1975; Suring and Vohs 1979; USDI, USFWS 1983). White-tailed deer in Douglas County are found in habitats that are associated with riparian areas (Ricca 1999; Ricca 2003; Smith 1987; USDI, USFWS 1983). The U.S. Fish and Wildlife Service (1983) suggests that the oak woodland/grassland ecotone is very important to white-tailed deer in Douglas County. Open areas, oak savannah, and grasslands are important for feeding (Ricca 1999, 2003).

White-tailed deer in both populations consume a variety of forbs, shrubs, grasses, and other plants (in order of preference) (Federal Register 2003, 43647; Whitney 2002).

The BLM manages 6,100 acres of Columbian white-tailed deer habitat on the North Bank Habitat Management Area, in the Roseburg District. See *Figure 76 (North Bank Habitat Management Area in the Roseburg District)* (USDI, BLM 2001a). This area was acquired in 1994 with the expressed purpose of providing secure habitat (habitat managed primarily for the Columbian white-tailed deer).

Figure 76. North Bank Habitat Management Area in the Roseburg District



Mule/Black-tailed Deer

Mule deer occur across a broad range of habitat types from the Coast Range and Cascade Mountains to the desert shrublands, generally occupying open habitat types (Verts and Carraway 1998; ODFW 2003a). Black-tailed deer prefer dense communities early in the forest sere (Verts and Carraway 1998; Brown 1961; Bender et al. 2004). Hanley (1984) found that where black-tailed deer overlapped elk, they preferred the more xeric habitat. During summer, both mule and black-tailed deer may be found at higher elevations—migrating to lower elevations in the fall and winter (McCullough 1960 (Verts and Carraway 1998); ODFW 2003a). In the Coast Range, where winters are less severe, seasonal migration does not occur. Cover is an important habitat component for each subspecies and is found in stands of dense vegetation (Kremsater and Bunnell 1992; ODFW 2003a).

Both subspecies are characterized as browsers, which forage in the younger seral stages

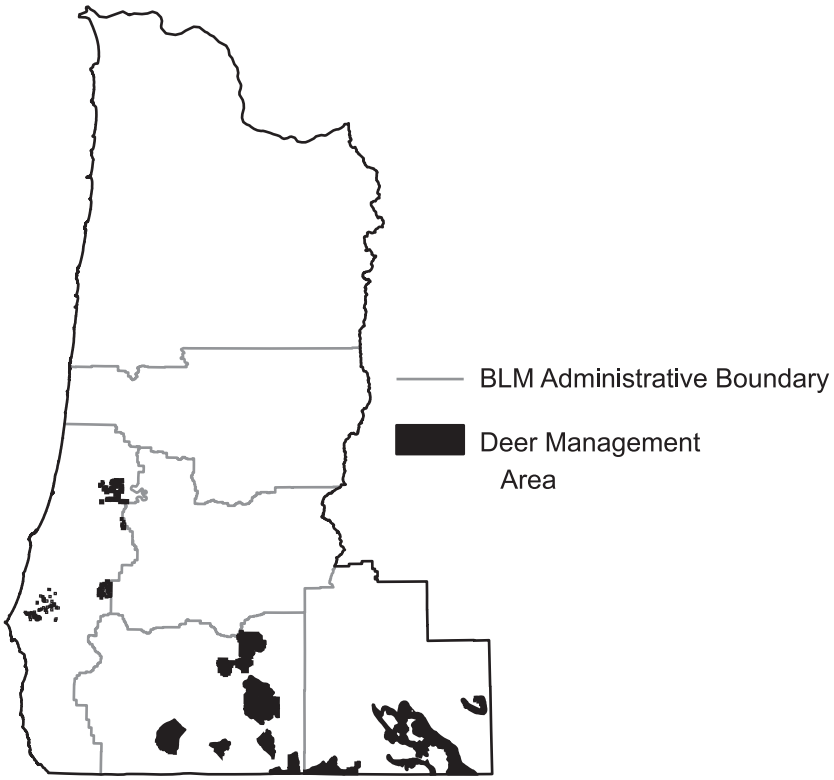
(Hanley 1984; Verts and Carraway 1998; Anderson and Wallmo 1984). Forbs are an important component of the summer diets of mule deer. In winter, sagebrush (*Artemisia sp.*), bitter-brush (*Purshia tridentata*), rabbit-brush (*Chrysothamnus sp.*), juniper (*Juniperus* sp.), mountain- mahogany (*Cercocarpus sp.*), and winterfat (*Eurotia lanata*) are common components (Verts and Carraway 1998).

Winter range and associated forage are important components for those mule and black-tailed deer herds that migrate (ODFW 2003a). The BLM has identified 193,000 acres of winter range to be managed with consideration for deer. See *Table 104 (Deer management areas within the planning area)* and *Figure 77 (Deer habitat management areas on BLM lands within the planning area)*. Threats to deer include loss of forage habitat, loss of cover, and unregulated road use. Unregulated road use also causes an increase in deer vulnerability during hunting seasons, increases the potential for illegal kills, and provides opportunities for other disturbances to foraging, fawning, breeding, and resting habitat.

Table 104. Deer management areas within the planning area

BLM Districts	Deer Habitat Management Areas	Season of Concern	Gross Area (acres)	BLM (acres)
Coos Bay	Camp Creek	Summer	12,554	12,518
	Edson Butte	Summer	4,113	4,079
	Millicoma Tree Farm N Edge	Summer	607	601
	Millicoma Tree Farm NE Edge	Summer	6,112	6,095
	Rock Creek	Summer	6,865	6,834
Klamath Falls Resource Area (Lakeview District)	Bly	Winter	17,461	4,513
	Bly Mt	Winter	46,008	6,311
	Hogback	Winter	17,998	2,311
	Horton Windy	Winter	24,973	7,952
	Keno Worden	Winter	8,393	557
	Lorella	Winter	14,585	4,070
	South Bryant	Winter	7,768	2,718
	South Gerber	Winter	41,370	4,893
	Stukel	Winter	12,506	1,812
	Swan Lake	Winter	20,789	6,549
	Topsy Pokegama	Winter	30,578	13,485
Medford	DHMA Ash Deer Winter Little Applegate	Winter	14,244	11,094
	DHMA Ash Deer Winter Little Butte Creek South3	Winter	83,911	25,662
	DHMA BFRA Burnt Peak	Winter	3,602	1,771
	DHMA BFRA Elk Creek	Winter	43,036	19,039
	DHMA BFRA Salt Creek	Winter	40,813	17,487
	DHMA BFRA Shady Cove West	Winter	17,239	7,673
	DHMA Camel Hump	Winter	14,107	8,892
	DHMA -GP-Williams-Important Deer Area	Winter	55,341	29,188
	DHMA Monument East	Winter	16,605	10,355
	DHMA Monument West	Winter	6,460	6,422
		Totals	568,038	222,880

Figure 77. Deer habitat management areas on BLM lands within the planning area



Elk

Elk are found across a wide range of habitats within the planning area. The dominant factors for elk occurrence are the availability of forage and access to cover (Harper et al. 1987; Verts and Carraway 1998). Early seral habitat provides important foraging habitat (Verts and Carraway 1998; Witmer and Wisdom 1986; Hanley 1984). Like deer, elk will migrate from high elevation summer habitat to low elevation winter range in areas with harsh winter conditions. However, elk in the Coast Range do not display this migratory behavior (Verts and Carraway 1998; ODFW 2003b).

Elk forage on grasses, forbs, shrubs, and trees (ODFW 2003b; Hanley 1984; Verts and Carrawy 1998; Findholt et al. 2004). Forage value decreases with distance from cover (Witmer and Wisdom 1986; ODFW 2003b). Cover was originally thought to provide both a hiding function and to ameliorate the effect of harsh weather (ODFW 2003b). Recent work in northeastern Oregon has shown that this is not the case (Cook et al. 1998). No positive effects of thermal cover were demonstrated. In fact, possible negative effects may occur (Cook et al. 1998). Cook et al. (2004) reviewed three other studies that looked at the effects of thermal cover and all studies failed to find any benefits.

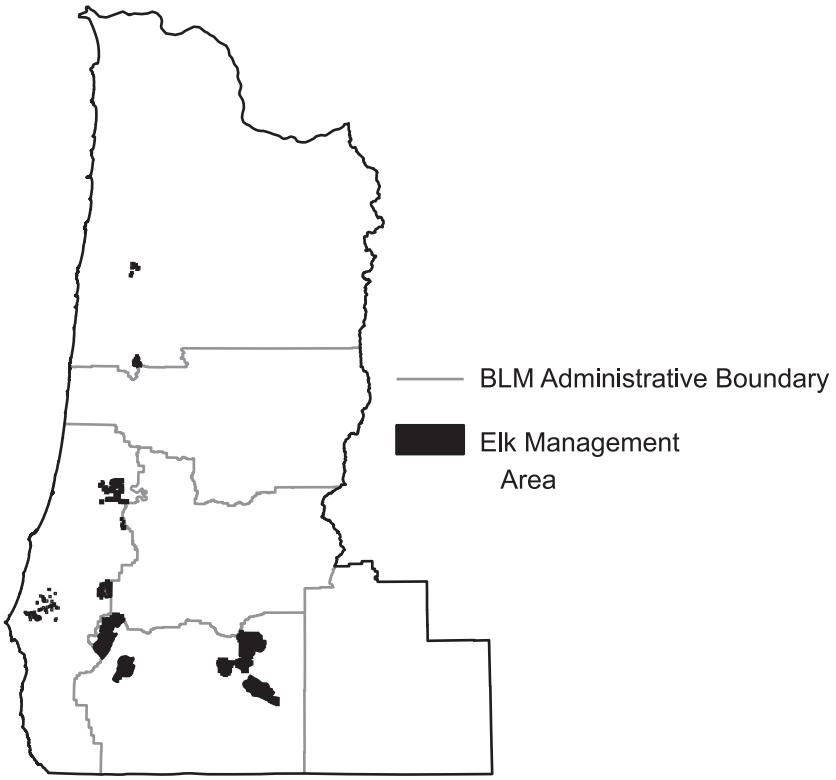
Threats to elk include loss of forage habitat, loss of cover, and unregulated road access. Unregulated roads also cause an increase in elk vulnerability during hunting seasons, increases the potential for illegal kills, provides opportunities for other disturbances during critical calving periods and winter, and causes elk to move away from available forage (ODFW 2003b; Rowland et al. 2000; Wisdom et al. 2004; Rowland et al. 2004; Cole 1996; Cole et al. 1997).

The BLM has identified 118,000 acres of winter range to be managed with consideration for deer and elk. See *Table 105 (Elk management areas within the planning area)* and *Figure 78 (Elk habitat management areas on BLM lands within the planning area)*.

Table 105. Elk management areas within the planning area

BLM Districts	Elk Habitat Management Areas	Season of Concern	Gross Area (acres)	BLM (acres)
Salem	Bummer Ridge Elk Emphasis Area	General	3,647	3,641
	Luckiamute Elk Emphasis Area	General	1,977	1,968
Coos Bay	Camp Creek	Summer	12,554	12,518
	Edson Butte	Summer	4,113	4,079
	Millicoma Tree Farm N Edge	Summer	607	601
	Millicoma Tree Farm Ne Edge	Summer	6,112	6,095
	Rock Creek	Summer	6,865	6,834
Medford	Ehma Bfra Burnt Peak	Winter	3,602	1,771
	Ehma Bfra Camel Hump	Winter	14,107	8,892
	Ehma Bfra Elk Creek	Winter	43,036	19,039
	Ehma Bfra Salt Creek	Winter	41,593	17,479
	Ehma Bfra Shady Cove West	Winter	17,239	7,673
	Ehma Glendale Mule Creek Important Elk Area	Winter	20,882	19,372
	Ehma-Gp-Far Out-Important Elk Area	Winter	9,323	8,869
	Ehma-Gp-Peavine-Important Elk Area	Winter	27,447	26,303
	Glendale Elk Valley Important Elk Area	Winter	24,220	14,266
		Totals	237,325	159,400

Figure 78. Elk habitat management areas on BLM lands within the planning area



Fish

Key Points

- There are eight anadromous fish populations and two resident fish population segments that occur on BLM-administered lands within the planning area that are listed as threatened or endangered under the Endangered Species Act. Habitat degradation is a factor of decline for most of these populations, and is a major risk factor that continues to threaten all of the population segments.
- Large wood, stream temperature, sediment, and water flow have the greatest influence on the ability of aquatic habitat to support fish populations.
- The abundance and survival of salmonids is often closely linked to the abundance of large woody debris in stream channels. The current amount of large woody debris in streams is low and is hindering the recovery of salmonid populations.
- The fine sediments that are in the streams on BLM-administered lands are generally at levels that would not reduce the availability of fish-spawning habitat.
- The past land use practices that most severely degraded fish habitat—splash damming and stream cleaning—no longer occur. Additionally, improvements in road construction and grazing practices have reduced or eliminated adverse affects to fish habitat on BLM-administered lands.

Aquatic ecosystems within the planning area include (USDA, USDI 1994):

- large river systems (e.g., the Rogue, Umpqua, and Columbia rivers)
- small headwater streams originating from glaciers in the Cascade Range
- coastal rain-influenced streams
- lakes and ponds
- wetlands

Past management activities have degraded aquatic and riparian conditions and contributed to declines in fish populations. Improvements have been made, but additional opportunities exist across the landscape to continue improving conditions and further contribute to restoring the impaired ecological processes. The BLM's ability to contribute to reducing the threats to fish species and improving habitat conditions varies with the amount and location of BLM land ownership. The BLM is rarely the predominant landowner within a fifth-field watershed. Therefore, threats to listed species may continue regardless of the BLM's contribution to improving habitat trends because of the other influences on the populations and their habitat.

The analysis in this section focuses on the current condition of listed fish species. There are also several nonlisted fish species that are identified by the BLM as special status species (the Oregon coast coho salmon, Columbia River/Southwest Washington coastal cutthroat trout, Jenny Creek sucker, and Jenny Creek redband trout). Habitat for these special status fish species is affected by the same processes that affect the listed fish species. Therefore, the description of current conditions for listed fish species provides a sufficient description of conditions for the special status fish species. (There is also some specific discussion and data presented related to Oregon coast coho because of the wealth of information available on this species.)

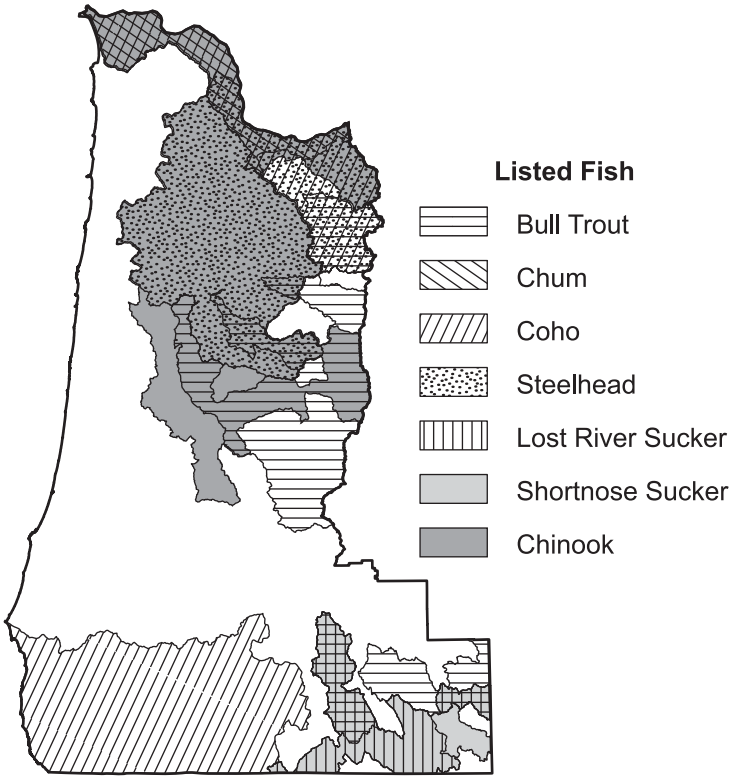
Within the planning area, there are eight anadromous fish population segments that are listed as threatened or endangered under the Endangered Species Act. There is less than one stream mile with bull trout on BLM-administered land. There are two resident fish populations that are listed as threatened or endangered under the Endangered Species Act that are unique to the Klamath Basin (the Lost River sucker and the shortnose sucker). The Oregon chub is a resident species that is listed as threatened or endangered and occurs within the planning area, but it occurs only on private land.

Evolutionary significant unit

A population of an organism that is considered distinct for the purposes of conservation under the Endangered Species Act. Such a distinct population can be a species, subspecies, variety, geographic race, or population.

See *Figure 79(Listed fish populations and evolutionary significant units within the planning area)* for the evolutionary significant unit boundaries within the planning area. See *Appendix H. Fish*.

Figure 79. Listed fish species and evolutionary significant units within the planning area



Fish populations are cyclic by nature and trends can be driven by a variety of factors. Those fish species within the planning area that have been listed as threatened or endangered have been listed as a result of the following factors (Good et al. 2005):

- habitat degradation and loss,
- hydropower development,
- overharvest, and
- hatchery propagation.

Currently, the shortnose sucker and the Lost River sucker occupy only a fraction of their historic range and are restricted to a few areas in the Upper Klamath Basin (i.e., the drainages of the

Upper Klamath, Tule, and Clear lakes). Poor water quality, reduced suitable habitat for all sizes and ages, and the impacts of nonnative fishes continue to threaten remaining shortnose sucker and Lost River sucker populations (USDI, USFWS 2003d). Although a number of factors have contributed to the decline of these species, habitat degradation is considered the primary cause. Streams, rivers, and lakes have been modified by channelization and dams. Grazing in the riparian zone has eliminated streambank vegetation, and has added nutrients and sediment to river systems (USDI, USFWS 2003d).

A biological review team, consisting of scientists from the National Marine Fisheries Service and the Southwest Fisheries Science Centers, updated biological information for the listed salmon and steelhead evolutionary significant units and made conclusions regarding the current and future major risk factors for each evolutionary significant unit. See *Table 106 (Major risk factors by evolutionary significant unit)*.

Table 106. Major risk factors by evolutionary significant unit

Evolutionary Significant Unit (species)	Major Risk Factors
Bull trout	• Barriers • Habitat degradation
Lower Columbia River chinook salmon	• Habitat degradation • High hatchery production
Lower Columbia River chum	Unknown
Lower Columbia River coho	• Habitat degradation • High hatchery production
Lower Columbia River steelhead	• Dams • Habitat degradation • High hatchery production
Shortnose and Lost River suckers	Freshwater habitat degradation
Southern Oregon and northern California coho	Freshwater habitat degradation
Upper Willamette River chinook salmon	• Dams • Habitat degradation • High hatchery production
Upper Willamette River steelhead	• Dams • Habitat degradation

Habitat degradation is a factor of decline for all the listed fish species and is a major risk factor that continues to threaten fish populations.

Recovery plans have been established for populations of the bull trout (draft recovery plan), the Lost River sucker, and the shortnose sucker. Recovery plans are in progress for the other population segments.

Critical habitat is designated for the following fish species within the planning area (Federal Register 2005d):

- Lower Columbia River Chinook salmon (threatened)
- Lower Columbia River steelhead (threatened)
- Columbia River chum salmon (threatened)
- Upper Willamette River Chinook salmon (threatened)
- Upper Willamette River steelhead (threatened)
- Southern Oregon and northern California coast coho salmon (threatened)

This analysis determines the effect of each alternative on fish habitat using current fish distribution data. The fish distribution is greater than the critical habitat distribution; therefore, the designated critical habitat is included for this analysis.

The BLM can contribute to improving fish habitat, but the BLM within the planning area is rarely the predominant landowner in a fifth-field watershed. Therefore, limiting factors (habitat and nonhabitat) for listed species may continue regardless of the BLM's contribution to improving habitat trends because of the other influences on the populations and their habitat.

Survival traits of fish (Reeves et al. 1995) include:

- straying of adults
- multiple life histories
- high fecundity
- mobility of juveniles

The BLM can contribute to the survival of anadromous salmonids. For example, replacing culverts can increase fish distribution by improving mobility.

Some streams have a higher potential than others to provide high-quality habitat for salmonids. High intrinsic potential is a scientific, topographical approach used to determine the potential of a stream to provide high-quality habitat for salmonids. See *Appendix H. Fish*. The Coastal Landscape Analysis and Modeling Study developed intrinsic potentials to prioritize stream reaches throughout the Coast Range province for restoration and protection (Coastal Landscape Analysis and Modeling Study). Using attributes of topography and flow, streams are ranked by their intrinsic potential to provide habitat for chinook, coho salmon, and steelhead. High intrinsic potential streams have not been determined for bull trout, Lost River suckers, or shortnose suckers.

The BLM's ability to influence aquatic habitat and fish populations depends not only on the overall amount of land ownership in a watershed, but also on the location of the ownership relevant to areas that can influence high intrinsic potential streams. See *Figure 80 (Percentage of miles of fish-bearing streams on and off BLM lands within the planning area)* and *Figure 81 (Percentage of miles of high intrinsic potential streams on and off BLM land per evolutionary significant unit within the planning area)*. Analysis from the Coastal Landscape Analysis and

Modeling Study also revealed that high-quality steelhead streams are located primarily on federally managed lands (Forest Service and BLM), whereas the majority of the best potential habitat for coho salmon is on private lands that are managed for such uses as agriculture and urbanization (Burnett et al. 2007).

Figure 80. Percentage of miles of fish-bearing streams on and off BLM lands within the planning area

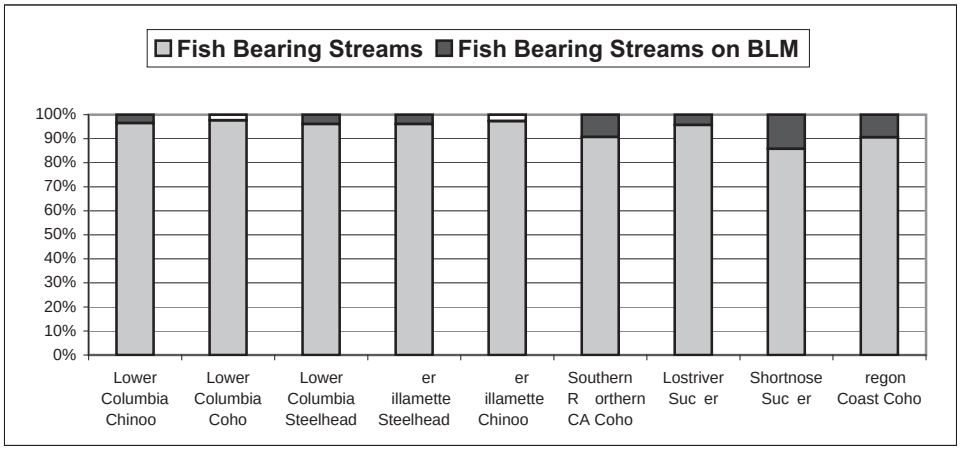
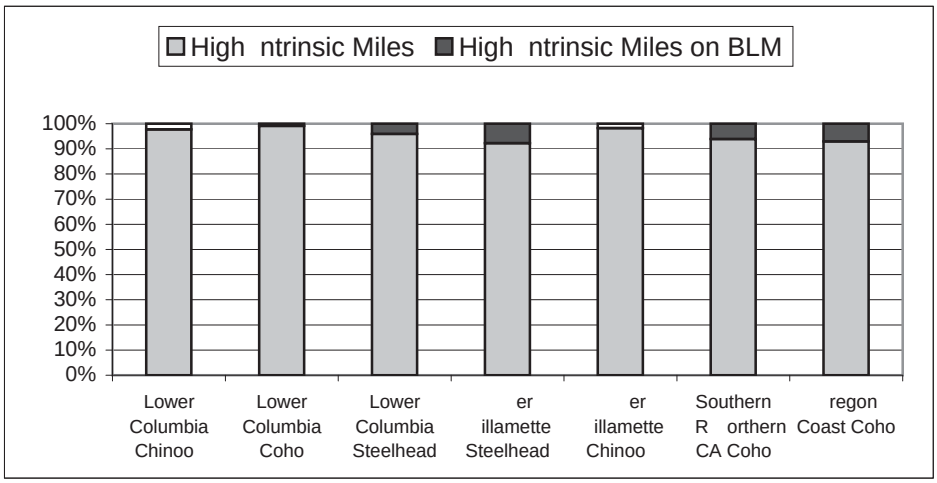


Figure 81. Percentage of miles of high intrinsic potential streams on and off BLM land per evolutionary significant unit within the planning area



Aquatic ecosystems are dynamic environments and change over time from natural disturbances. The recognition that such dynamic processes as periodic large disturbances can have large impacts on aquatic ecosystems represents a relatively new perspective (Naiman et al. 1992). This perspective implies that aquatic ecosystems and their conditions vary because of such periodic events as wildfires and large storms, and the subsequent floods, hillslope failures, landslides, and debris flows (Haynes et al. 2006). This analysis focuses on the key ecological processes that shape fish habitat over time, rather than static conditions at one point in time.

The following are examples of key ecological processes that shape aquatic and riparian habitat in the planning area:

- tree growth and mortality, which affect stream shade and large wood delivery
- hydrology (water flow and temperature)
- sediment routing

Large wood, stream temperature, sediment, and flow have the greatest influence on the ability of aquatic habitat to support fish populations (Meehan 1991; OWEB 1999). In forested landscapes, the important delivery mechanisms of large wood and sediment to stream channels are landslides, debris flows, and floods. In nonforested landscapes, the important processes are water flow, water temperature, and sediment routing.

Large Wood

Past management practices throughout the Pacific Northwest have reduced the abundance of large woody debris in channels throughout the region. Historically, large wood source areas did not produce large wood all the time, but rather fluctuated both spatially and temporally. Natural disturbances like fires, wind, and floods do not affect all of the landscape equally. Because of the dynamic spatial effects of natural disturbance regimes, large wood loading and stream habitat features across natural landscapes vary greatly. At any one time, some stream channels may have large amounts of large wood and highly complex habitats, but other channels, even in the same watershed, may lack wood and have simplified habitats (Reeves et al. 1995). Prior to the twentieth century, large channels and large rivers, like the Willamette River as described by Sedell and Froggatt (1984), were full of wood or blocked by wood jams and accumulations.

Wood loading in large Pacific Northwest rivers has generally declined to 1/100th of historical amounts (Sedell and Froggatt 1984). Rivers were cleared of large wood during settlement to improve access for transportation. Large wood was later removed from rivers and streams as a stream-cleaning regime, because log jams were believed to obstruct fish migration. Smaller streams were cleared through a splash-damming process in which a dam-break flood was induced to transport trees. These torrents scoured sediment and wood from streambeds and banks and left many channels scoured to bedrock (Sedell and Luchessa 1984; Montgomery et al. 2003).

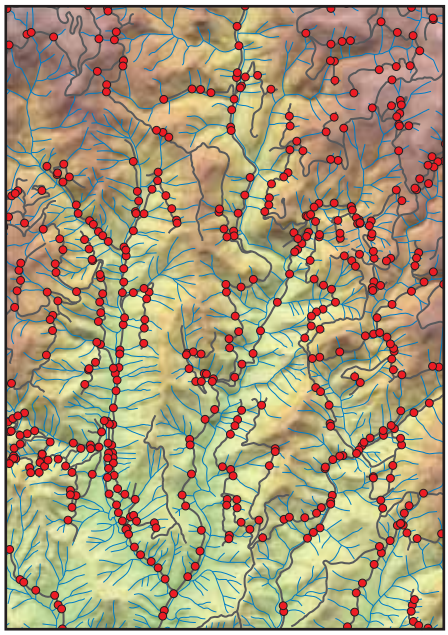
The decline in beaver populations from trapping also reduced the large wood found in streams and consequently reduced the complexity of aquatic habitats. Dam building by beavers provides accumulations of large wood and pools, which are an important component of high-quality habitat for fish species (ODFW 2005b; Pollock et al. 2003; Nickelson et al. 1992). By 1900, trapping had nearly extirpated beaver in the Pacific Northwest (Naiman et al. 1998). The decline in beaver populations resulted in incised channels, loss of riparian and wetland areas, and loss of channel complexity, which is important to fish and invertebrate production. For example, the greatest reduction in the productive capacity of coho smolt has been associated with the extensive loss of beaver ponds (ODFW 2005b). A 94% reduction in smolt production potential in a western

Washington basin is attributed to the loss of beaver pond habitat (ODFW 2005b).

In the twentieth century, mining, urbanization, agriculture, and logging began to change the physical and biological characteristics of streams by removing trees from upland and streamside areas, which increased sedimentation from ground disturbances and road construction and directly altered stream channels. Large fires and the subsequent salvage logging, such as the Tillamook Burn, removed both upland and riparian forests, which reduced stream shading, reduced future sources of large wood, and increased sedimentation.

Roads were often constructed along stream channels in the past. See *Figure 82 (Number of road and stream crossings in the Evans Creek Watershed)*.

Figure 82. Number of road and stream crossings in the Evans Creek Watershed



Large wood is an important component of aquatic habitats from headwater channels to estuaries in forested ecosystems (Dolloff and Warren 2003). Large wood accumulation within stream channels is necessary for many functions including:

- providing cover for fish
- sediment storage for food supply and spawning grounds
- nutrient retention
- pool formation
- formation of off-channel habitat

Woody material of all sizes from tiny fragments to intact trees plays a role in stream systems. Because decay rate and probability of displacement are a function of size, larger pieces have a greater influence on habitat and physical processes in stream channels than small pieces (Dolloff and Warren 2003). In general, pieces greater than 24 inches in diameter and 50 feet in length are considered large wood west of the Cascade Mountains, while pieces greater than 12 inches in diameter and 35 feet in length are considered large wood east of the Cascade Mountains (Foster et al. 1999; USDC, NOAA, NMFS 1996). For this analysis, trees greater than 20 inches in diameter are considered large wood because the structural stage classification of forests uses the density of trees greater than 20 inches in diameter as a threshold for the definition of mature&structurally complex forests (see the *Ecology* section of *Chapter 3*).

For many aquatic organisms, particularly fish, large wood is an important factor in creating and maintaining deep water or pool habitat. See *Figure 83 (Example of deep pool and habitat diversity caused by large wood)* and *Figure 84 (Example of a stream with high wood volume)*. Salmonids inhabit pools as refuges from high water velocities. Juvenile salmonids use pools and side channels created by wood as overwintering habitat. Large wood can capture and store sediment, which provides spawning habitat (Dolloff and Warren 2003). Large wood is also an important source of cover, which makes fish harder for predators to see. Stream complexity is important for many fish, particularly aggressive species like salmonids, which do not tolerate close proximity to each other. Wood partitions the habitat and visually isolates fish, which allows more fish per unit of available space (Dolloff 1986).

Figure 83. Example of deep pool and habitat diversity caused by large wood

Source: Roger Peters, USFWS

Figure 84. Example of a stream with high wood volume

Source: Gallo et al. 2005

One of the most important factors that can influence fish populations is the quantity of high-quality habitat (Nickelson 2001). The abundance and survival of salmonids is often closely linked to the abundance of large woody debris, particularly during winter (Meehan 1991). In general, streams with high amounts of large wood and complex habitats tend to have more fish species and higher populations than those lacking complexity (Dolloff and Warren 2003). It is generally accepted that improved habitat complexity correlates to improved fish survival and production (Hartman et al. 1996, 237, 243, 248; Reeves et al. 1993, 314; Bustard and Narver 1975, 684, 686; Tschaplinski and Hartman 1983, 452; Murphy et al. 1986, 1526; Hartman and Brown 1987, 262). Researchers have documented an increase in the density of salmon following the addition of wood to stream reaches. Roni (2000) reported a 180% increase during summer and 332% increase during winter in the density of juvenile coho following the addition of wood to 30 streams in Washington and Oregon. Similarly, Cederholm et al. (1997) showed a twentyfold increase in juvenile coho during winter in response to the addition of wood. Reeves et al. (1997) found that the number of steelhead did not increase in response to wood additions but that smolts were significantly larger.

Large wood is delivered to stream channels through a variety of complex ecosystem processes (Benda et al. 2003). The amount of large wood in stream channels is dependant on the amount of trees available on the landscape that can be delivered to a stream channel. Not all areas across the landscape have the potential to deliver trees to stream channels. Large wood source areas are defined as those areas on the landscape that are capable of delivering wood to stream channels, such as:

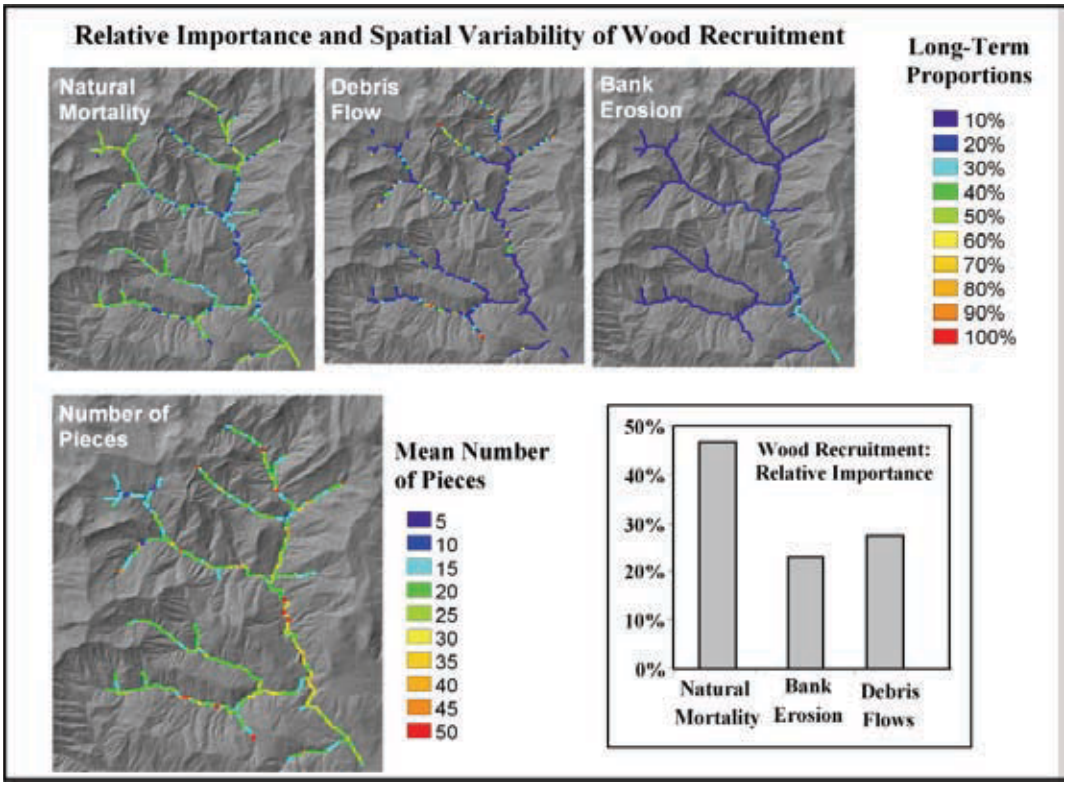
- streamside areas within a distance of one site potential tree height from the channel,
- valley floors and floodplains as streams migrate, and
- landslide and debris-flow prone intermittent channels.

Wood delivered from forests to stream channels occurs from both chronic and episodic events (Naiman et al. 2000).

- **Chronic events.** Events that occur frequently, such as tree mortality along stream banks. Trees eventually fall over, and, if they are close enough to a stream channel, land in the channel (McDade et al. 1990). Trees along stream edges are also undercut as a result of bank erosion and eventually fall into the stream. The majority of wood that falls into stream channels from adjacent forests occurs within a distance of one tree height away from the channel (FEMAT 1993, V-27).
- **Episodic events.** Events that typically occur sporadically and infrequently, such as landslides, debris flows, and floods. Although these events occur infrequently, they can deliver large amounts of wood to stream channels (Bilby and Bisson 1998; Benda et al. 2003; Naiman et al. 2000).

The relative importance of each delivery process varies by province, stream channel, riparian vegetation, position in the landscape, and time (Bilby and Ward 1989). Episodic processes deliver large amounts of wood during infrequent events (windstorms or mass movements), while chronic processes (suppression mortality and bank erosion) consistently provide small amounts of wood over extended time periods. Wind throw, debris flows, landslides, and avalanches are the primary delivery mechanisms in steep headwater channels (Bilby and Bisson 1998). Bank erosion and delivery from upstream sources contributes the majority of large woody debris in larger unconfined channels (Murphy and Koski 1989). See *Figure 85 (Relative importance and spatial variability of wood recruitment processes)* for the relative rates of wood recruitment from each process in the Coast Range province (Reeves et al. 2006).

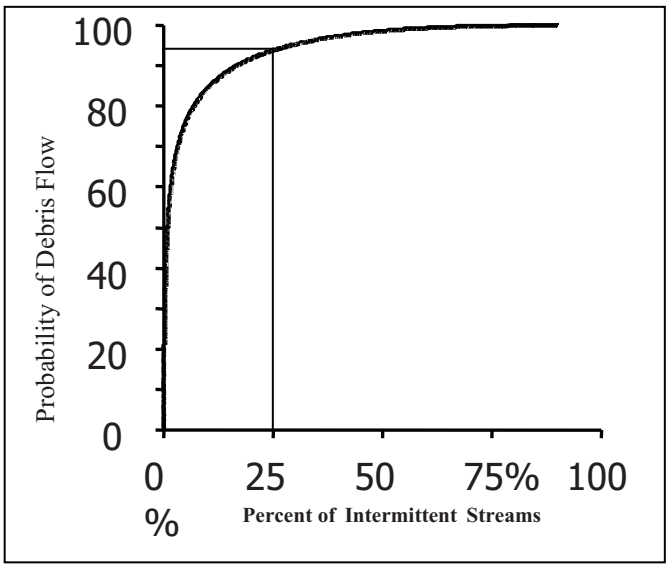
Figure 85. Relative importance and spatial variability of wood recruitment processes



Source: Benda et al. 2003

Headwater streams differ in susceptibility to debris flows. See *Figure 86 (Probability of debris flow from intermittent streams)* for an illustration of intermittent channels that are more likely to deliver large wood to fish-bearing stream channels.

Figure 86. Probability of debris flow from intermittent streams

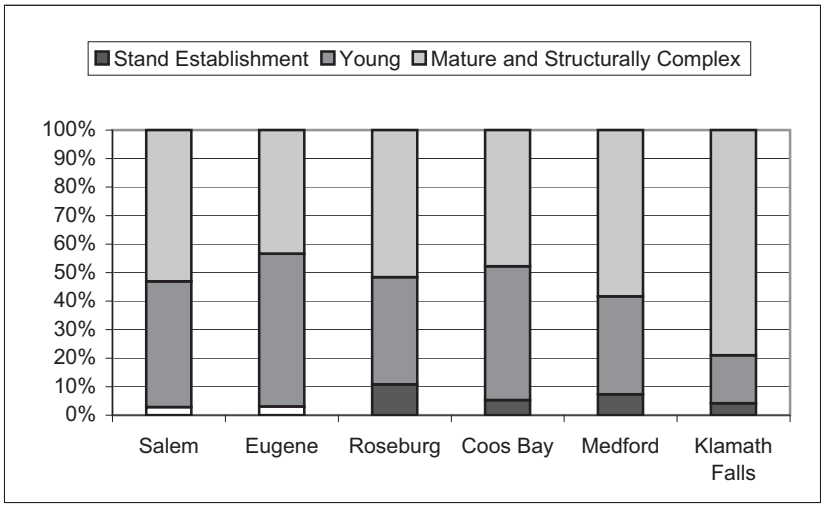


Analysis from the Coastal Landscape Analysis and Modeling Study indicates that a small portion of the headwater stream network is important in producing landslides and debris flows that can provide large wood to streams (Miller and Burnett, in press).

Despite the high variability in the natural levels of large wood in streams, the amount of large wood in rivers and streams within the planning area is currently far outside the historic range and is hindering the recovery of wild salmonids (IMST 1999). Watershed monitoring completed within 55 watersheds in the area of the Northwest Forest Plan in 2004 concluded that large wood levels are below benchmark values in nearly 70% of the sample (Gallo et al. 2005).

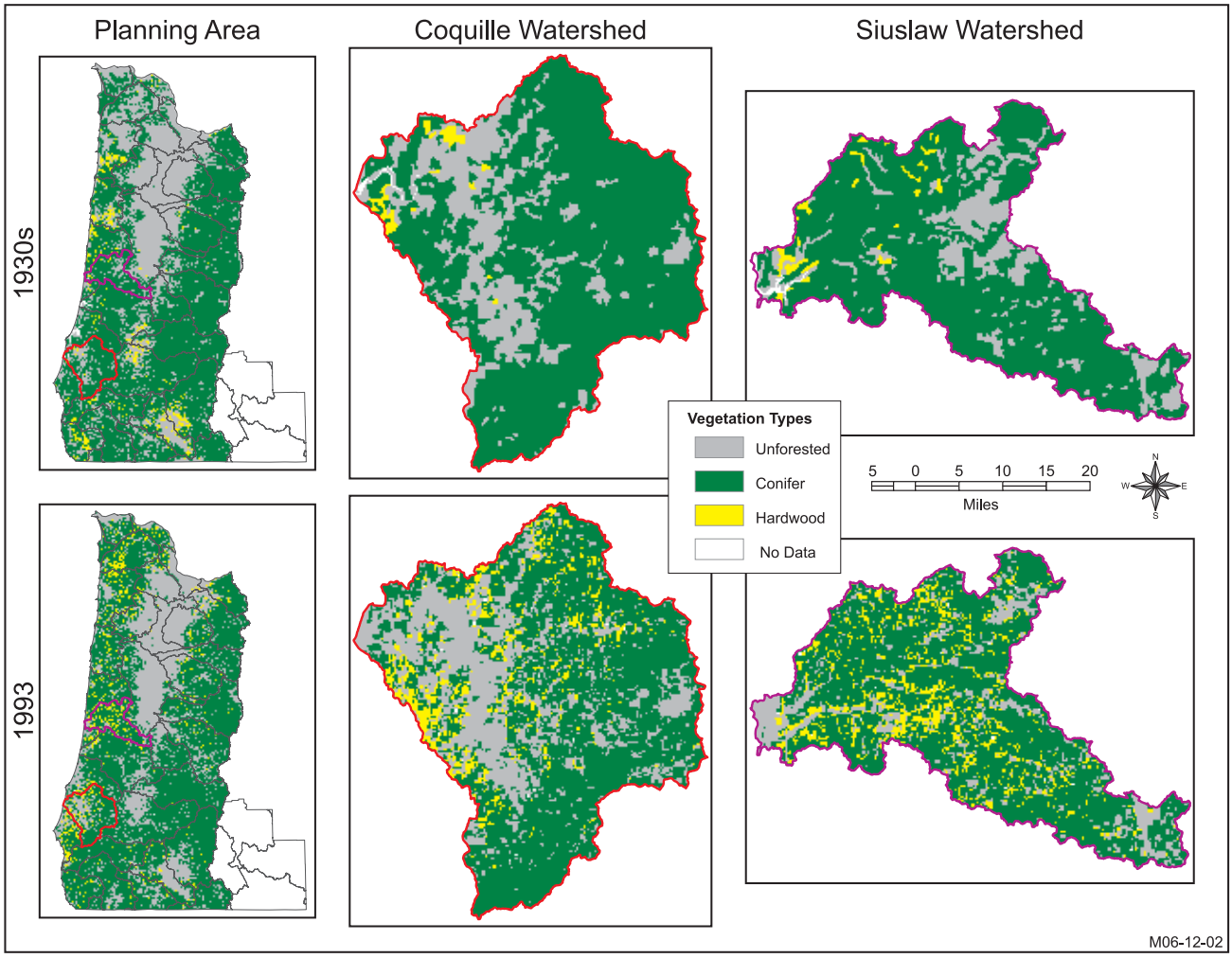
Most riparian areas have been harvested at least once over the last 150 years (Dolloff and Warren 2003), and the trees in the resultant second-growth forests are generally too small to provide large wood to streams. The stand establishment and young structural stage classes generally have few trees greater than 20 inches in diameter. Trees in the mature&structurally complex structural stage class contain trees that are large enough to provide large wood. See *Figure 87 (Current riparian conditions by BLM district)* for the current riparian condition on BLM lands within the planning area. Within the riparian reserves that are allocated under the No Action alternative, 52% are in a mature&structurally complex structural stage class and 48% are in the stand establishment and young structural stage classes.

Figure 87. Current riparian conditions by BLM district



Red alder is an important source of nutrients for macroinvertebrates, and, subsequently, for fish (Romero et al. 2005). However, red alder stands in the Coast Range have increased in abundance since the 1930s (see the *Ecology* section in *Chapter 3*). Large conifer trees must also be available in the stream channel to trap and store the nutrients from the alder input (Findlae et al. 1973). During the same time period that alder have increased in the Coast Range, the amount of large conifers in stream channels and the amount available from riparian areas have declined. A lack of conifers along streams can contribute to simplified aquatic habitat, which is a limiting factor for many listed salmonids. Red alder cannot provide large, persistent stream structure as well as conifers can. Red alder that fall into streams are more likely to be broken down and transported out of the streams than are conifers (Hyatt and Naiman 2001). See *Figure 88 (Changes in western Oregon vegetation types)* for the difference in the abundance of hardwoods in the Coast Range from the 1930s to 1993.

Figure 88. Changes in western Oregon vegetation types

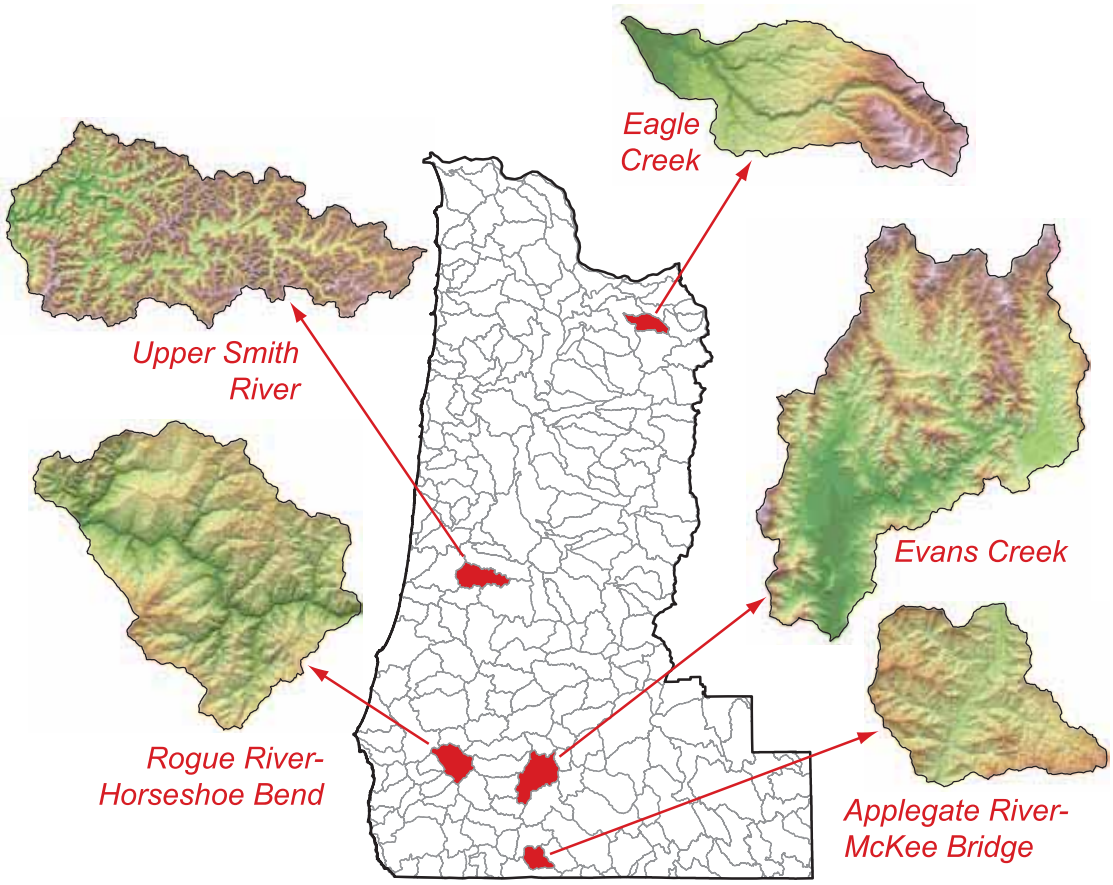


The BLM is rarely the predominant landowner within a fifth-field watershed within the planning area, and therefore the potential for large wood contribution from BLM-administered lands is generally less than from other land owners. To show the typical large wood contribution from BLM and non-BLM-administered lands, fifth-field watersheds were selected that represent a range of BLM ownership patterns and physiographic provinces. Of the 260 fifth-field watersheds within the planning area, 84 have no BLM-administered land. See *Table 107 (BLM land ownership patterns and representative watersheds)* and *Figure 89 (Representative watersheds)* for the range of BLM ownership in the watersheds that have some BLM-administered land and the representative watershed selected for that range.

Table 107. BLM land ownership patterns and representative watersheds

Land Ownership Categories	Watersheds (number)	Representative Watershed (actual percentage of BLM ownership)	Province	BLM District
Less than 1/3 BLM (0 to 33%)	138	Eagle Creek (6%)	Western Cascades	Salem
1/3 to 2/3 BLM (34 to 66%)	30	Applegate-McKee Bridge (34%)	Klamath	Medford
		Evans Creek (41%)	Klamath	Medford
		Upper Smith River (59%)	Coast Range	Coos Bay
Greater than 2/3 BLM (67 to 100%)	3	Rogue-Horseshoe Bend (93%)	Klamath	Medford

Figure 89. Representative watersheds



This analysis uses a large wood model to determine the maximum potential large wood contribution to fish-bearing streams from BLM-administered lands in the representative watersheds. The model uses topographic characteristics from the 10 meter digital elevation models to identify all debris-flow initiation points across the landscape (Benda and Miller 2003; Miller and Burnett, in press). See *Appendix H*. Fish for a complete description of the large wood model.

The model ranks all initiation points by their probability of initiating and transporting a debris flow to a fish-bearing channel. The model calculates a mean annual large wood contribution, which can be used to compare alternatives and can be compared against a maximum potential large wood contribution. The maximum potential large wood contribution is the maximum biological potential of the watershed to provide large wood to streams. It is calculated as the number of pieces of large wood per year that could be delivered to a fish-bearing stream in a fifth-field watershed if all forested acres in the watershed were capable of delivering large wood.

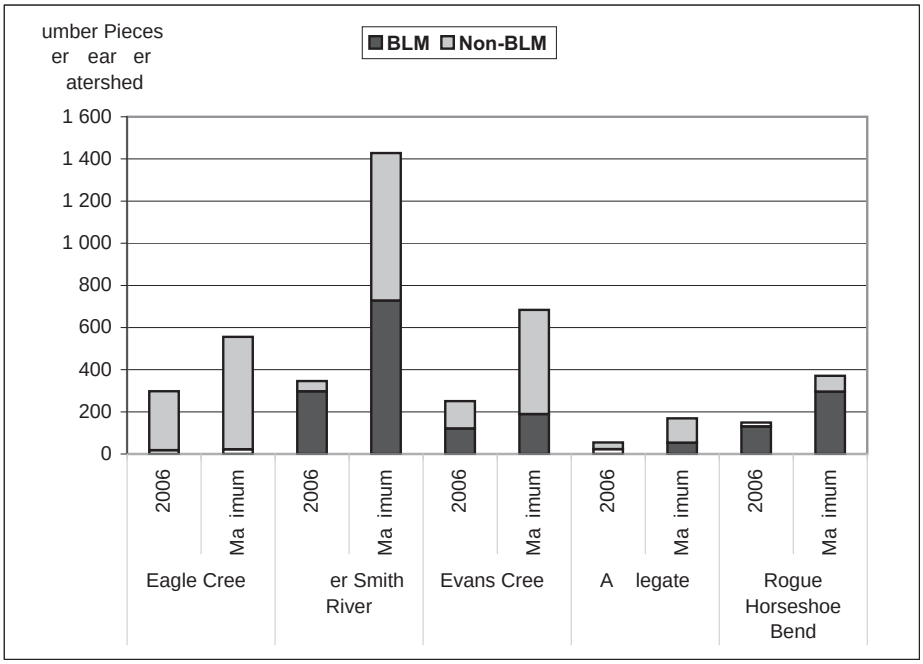
The maximum potential large wood contribution reflects a maximum biological potential, and does not necessarily reflect average historic conditions. The average historic conditions at the province scale ranged from 79% in a mature&structurally complex structural stage class in the Coast Range and Western Cascades provinces to 45% in a mature&structurally complex structural stage class in the Eastern Cascades province (see the *Ecology* section in *Chapter 3*).

However, at the scale of an individual fifth-field watershed, the variability in historic amounts of mature&structurally complex structural stage class would have been extremely high, likely with long periods of time in which the watershed was nearly all in the mature&structurally complex structural stage class (Wimberley et al. 2000). These periods of time in which a fifth-field watershed would be nearly all in the mature&structurally complex structural stage class, which would correspond to the maximum large wood contribution calculated in the model, would represent the maximum potential for large wood delivery.

Periodic large disturbance events, such as wildfires, large storms, and the subsequent floods, hillslope failures, landslides, and debris flows, would deliver large wood to stream channels and alter the structural stage abundance of the forest. Delivery from disturbance events when the watershed would be nearly all in the mature&structurally complex structural stage class would provide accumulations of large wood in streams that would last longer than it would take the watershed to return to the mature&structurally complex structural stage class after the disturbance.

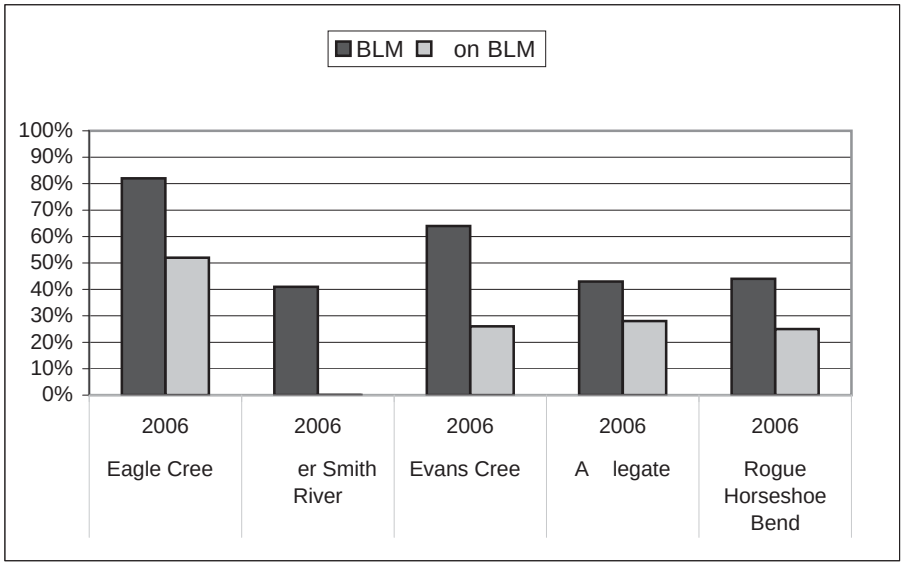
The model output of mean annual large wood contribution is not a prediction of actual instream conditions at a specific point in time. The mean annual large wood contribution cannot be directly compared to large wood benchmarks that have been developed by the Oregon Department of Fish and Wildlife. The mean annual large wood contribution represents a potential contribution to instream wood based on forest conditions over time, whereas the large wood benchmarks are based on actual reference instream conditions. The model cannot predict actual instream conditions, because large wood input is episodic (delivery events are stochastic and unpredictable) and cumulative (large wood accrues over time). Therefore, this analysis summarizes large wood contribution in terms of the proportion of the maximum potential large wood contribution instead of a comparison with large wood benchmarks. See *Figure 90 (Current and maximum large wood contribution by ownership)* for the current mean annual large wood contribution and the maximum potential large wood contribution.

Figure 90. Current and maximum large wood contribution by ownership



In all representative watersheds, the current large wood contribution is lower than the maximum potential, because not all forests that are capable of delivery to streams are currently in the mature&structurally complex structural stage class. See *Figure 91 (Proportion of current large wood contribution compared to maximum potential)*. The proportion of current large wood contribution from BLM-administered land compared to the maximum potential from BLM-administered land varies widely (e.g., from 37% in Upper Smith River to 85% in Eagle Creek). In each watershed, the proportion of current large wood contribution of the maximum potential is higher on BLM-administered lands than non BLM-administered lands, which varies from 1% in Upper Smith River to 57% in Eagle Creek.

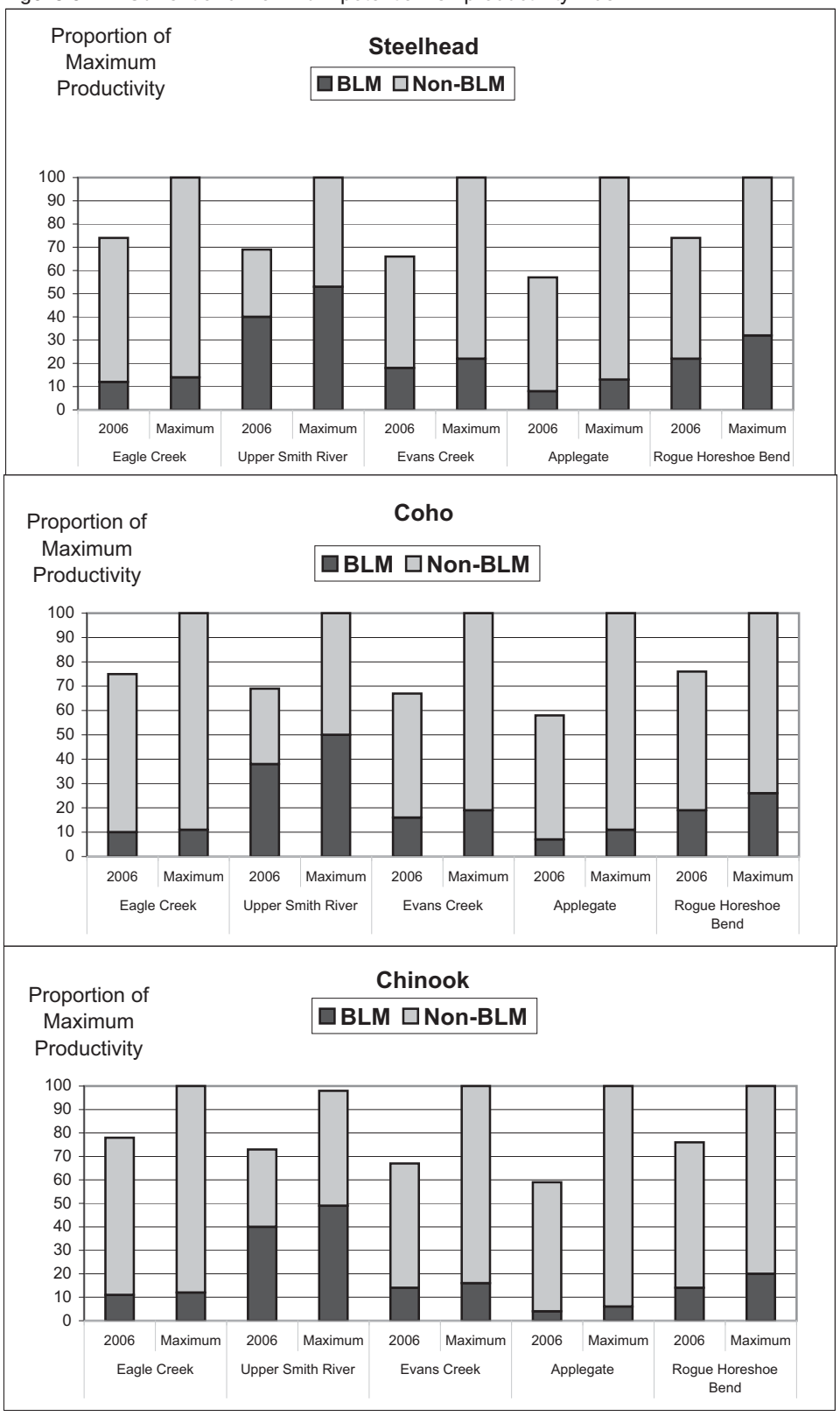
Figure 91. Proportion of current large wood contribution compared to maximum potential



In order to determine how the large wood contribution effects fish productivity, a fish productivity index approach was developed for this analysis. The analysis uses the mean annual large wood contribution to determine fish productivity using a population model developed for coho salmon by Lawson et al. (2004). This modified model provides the best information to evaluate the effects of large wood on fish productivity in the absence of species-specific population models. The linkage of mean annual large wood contribution with the fish population model allows for comparative analysis of the effects of the alternatives. However, it is an index and is not a prediction of the absolute population numbers and should be interpreted with caution, because other limiting factors for listed species, such as ocean conditions, fish harvesting, and hatcheries, continue to influence populations.

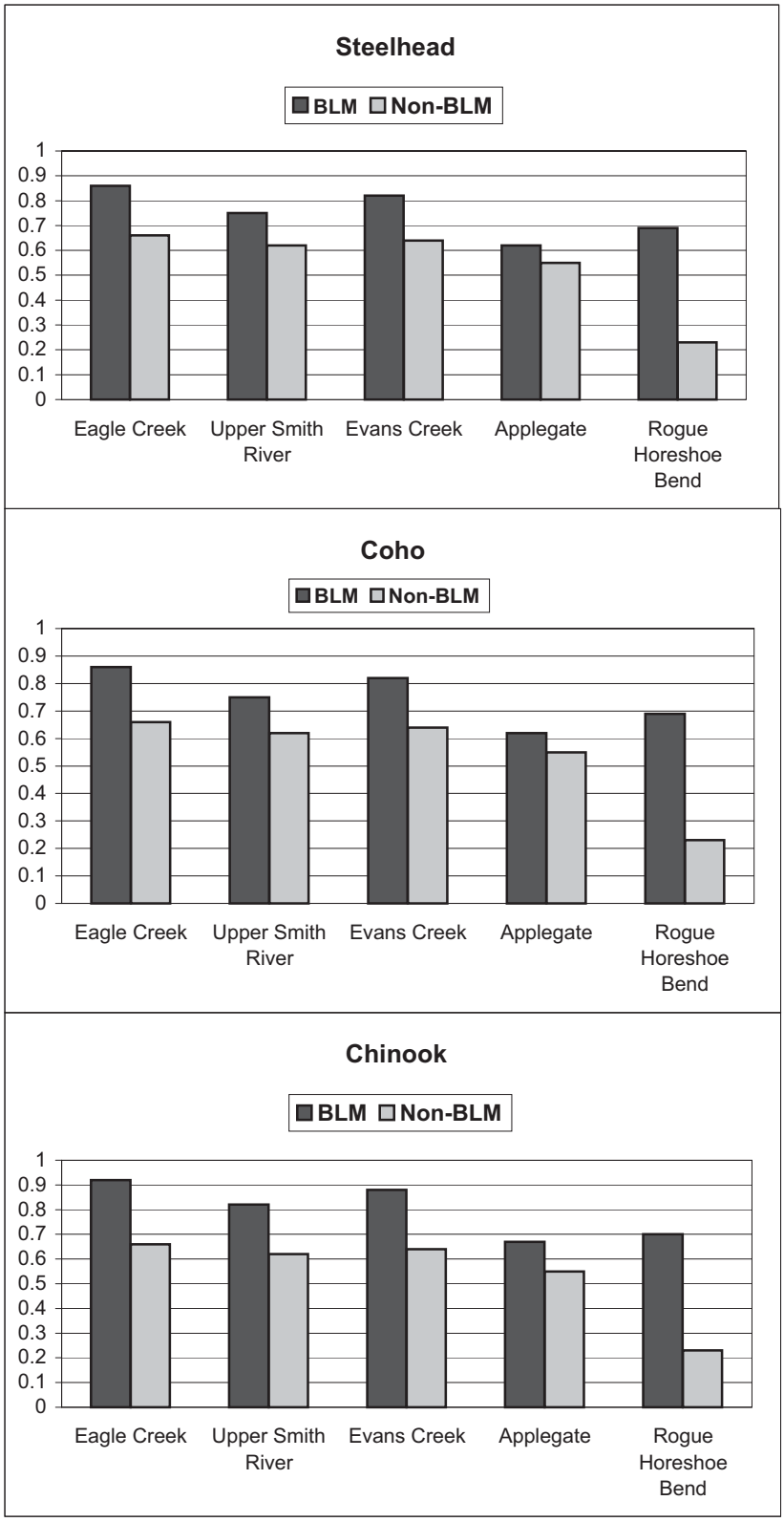
For this analysis, the fish population model is modified to be dependant on large wood contribution. For each watershed, the fish productivity index is estimated based on the surface area of the available stream habitat weighted by the intrinsic habitat potential value. The intrinsic habitat potential is based on topographical attributes of each stream reach including valley width, channel width, and channel gradient. This provides a comparison of potential fish production between BLM and other ownerships. As the proportion of the large wood contribution changes compared to the maximum potential large wood contribution, the fish productivity index would be modified based on the proportion. See *Figure 92 (Current and maximum potential fish productivity index)* for the current potential fish productivity from BLM-administered lands and non-BLM-administered lands compared to the maximum potential fish productivity for each watershed.

Figure 92. Current and maximum potential fish productivity index



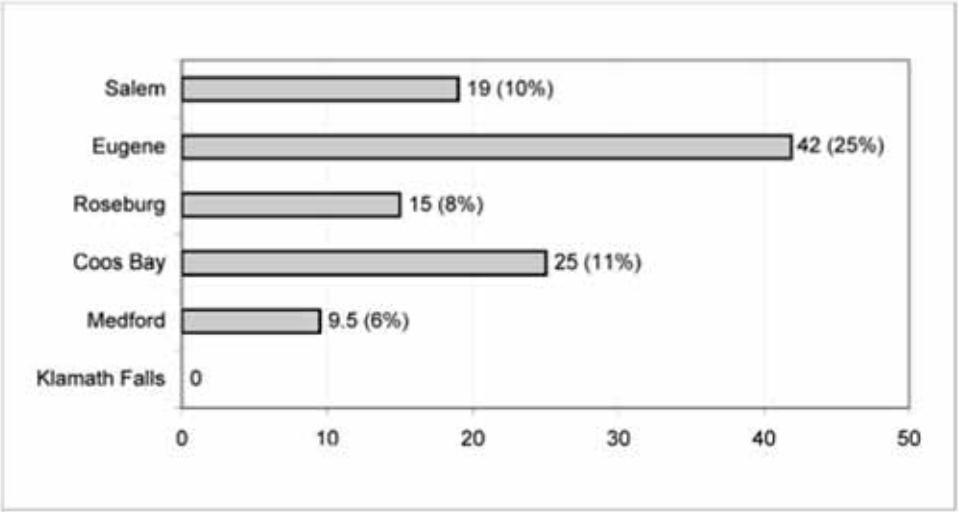
In all of the representative watersheds, the current potential fish production is below the maximum potential fish production. See *Figure 93 (Proportion of current fish production compared to the maximum potential)*. Unlike the mean annual large wood contribution, the current fish production on non-BLM-administered lands is higher than on BLM-administered lands in Eagle Creek partly because non-BLM-administered lands include most of the high intrinsic potential streams in the watershed.

Figure 93. Proportion of current fish production compared to the maximum potential



Since 1995, the BLM has implemented instream habitat projects on 110 miles of streams with anadromous and listed fish within the planning area to improve stream complexity. See *Figure 94 (Miles of treated anadromous or listed fish streams by the BLM districts within the planning area)* for the total stream miles that have been treated by the BLM districts within the planning area and the percent treated of the total miles of anadromous or listed fish-bearing streams.

Figure 94. Miles of treated anadromous or listed fish streams by the BLM districts within the planning area



* Percentages are based on total "known" anadromous and/or listed fish stream miles that need in-stream treatment

Sediment

Streamside vegetation provides organic matter to stream channels when leaves, needles, and woody debris fall into the stream channel. The supply of organic material determines the amount of food produced for fish species in forested ecosystems. The effectiveness of riparian forests to deliver leaf and other particulate organic matter declines at distances that are greater than approximately one-half a tree height (59 to 112 feet) away from the stream channel (FEMAT 1993, V-27). The input and processing of organic material is better served by a heterogeneous landscape with varying amounts of forest cover, species composition, and age classes than by the creation of a single forest type across the landscape (IMST 1999). It is unknown what is the current condition and thresholds for the amount of organic input that would be adequate to maintain food supplies for fish.

There are 27 miles of stream listed by the Oregon Department of Environmental Quality as turbidity impaired that occur on BLM-administered lands. Fine sediment was measured in 55 sample stream channels as part of the watershed monitoring that was completed for the Northwest Forest Plan 10-year review in 2004. Sediment levels in nearly 64% of the sampled reaches were considered low (less than 11% embeddedness) and were not reducing fish-spawning or rearing habitat.

Fine sediments (sand, silt, and clay at less than 2 mm) enter and leave river channels naturally, but increased suspended sediment (turbidity) and sedimentation (embeddedness) can adversely affect fish (Anderson et al. 1996).

Increased concentrations of suspended sediment can have direct effects on fish behavior, physiology, and growth (Anderson et al. 1996). Sigler et al. (1984) found that turbidities of 25 nephelometric turbidity units caused a reduction in juvenile steelhead and coho growth. Fish may avoid high concentrations of suspended sediment and at lower concentrations cease feeding (Hicks et al. 1991). Bisson and Bilby (1982) found that juvenile coho salmon avoided water with turbidities that exceeded 70 nephelometric turbidity units.

Increases in sedimentation or embeddedness can reduce fish-spawning and rearing habitat, fish egg and fry survival, and food availability (Chamberlin et al. 1991; Hicks et al. 1991). Infiltration of fine sediment can reduce fish emergence from spawning beds. Generally, fine sediment levels that exceed 20% of the stream bed are considered detrimental to fish species (Everest et al. 1987; USDC, NOAA, NMFS 1997; Shelton and Pollock 1966; Cooper 1977). Cederholm et al. (1981) documented up to a 3.4% decrease in fish survival for each 1% increase in fine sediment.

The timing of the sediment inputs relative to the biological vulnerability of each fish species is more important than the absolute quantity of sediment. In most streams, there are periods when the water is relatively turbid, and this sediment is generally mobilized during large storms (Everest et al. 1987). Larger juvenile and adult salmonids and trout species appear to be little affected by ephemerally high concentrations of suspended sediments that occur during most storms (Cordone and Kelley 1961; Sorenson et al. 1977). If sediment is introduced to streams in the absence of a runoff event, then sediment deposition may create localized adverse impacts (Everest et al. 1987). The tolerances of fish species to sediment vary seasonally. For example, Noggle (1978) demonstrated that the tolerance of juvenile coho salmon to suspended sediment was highest in the fall when increased suspended sediment normally occurs in streams.

There is no model that can predict the exact mechanism of sediment delivery and instream routing. Therefore, it is not possible to quantify or accurately predict the affects that sediment delivery has on fish species. Fish species have the ability to cope with some level of sediment at various life stages. However, thresholds beyond which impairment occurs in the field have not been established, despite scientific efforts to quantify the relationship between fine sediment and fish species. This analysis assumes that a 3.4% decrease in fish survival could potentially occur for every 1% increase in fine sediment from management activities. This may be an overestimate of the actual effects to fish species, because:

- Fine sediment can be cleaned from the stream bottom gravel by scouring during peak flows. High velocity flows tend to carry sediment rapidly out of the drainages, particularly in the Coast Range province. Within the planning area, the amount of fine sediment stored and routed through stream channels is highly variable, and some aquatic systems may function with high background

levels of fine sediment. For example, in Evans Creek, a tributary to the Rogue River, a viable salmonid population exists even though the stream has a high sediment load.

- Spawning salmonids can improve their chances of reproductive success through behavioral adaptations (Everest et al. 1987). During redd construction (e.g., digging nests in the stream bottom) fish can remove large amounts of fine sediments from the gravel (Everest et al. 1987). Everest, Meehan, and Lotspeich found that chinook salmon in Evans Creek reduced fine sediments from 30% prior to spawning to 7.2% after spawning. Secondly, when a female salmonid has completed spawning and burying eggs, the redd is left with a large pit on its upstream perimeter and a mounded tailspill downstream that contains the eggs. The pit acts as a natural settling basin for fine sediments and may capture up to 0.25 cubic meters of sediment before they reach the tailspill where the eggs are buried (Everest et al. 1987).

Temperature

The water temperature in streams can affect the biological cycles of fish. See *Table 108 (Temperature standards for fish species)* for the temperature standards for several species within the planning area (ODEQ 2004).

Table 108. Temperature standards for fish species

Species	7-Day Average Maximum Temperature Standard (degrees Fahrenheit (°F))
Bull trout spawning and juvenile rearing	53.6
Lahontan cutthroat trout or redband trout	68.0
Salmon and steelhead spawning	55.4
Salmon and trout rearing and migration, shortnose and Lost River suckers	64.4

When stream temperatures rise above these levels fish become stressed. Food availability can decrease and the ability of fish to absorb oxygen decreases. There are currently 569 stream miles on BLM-administered lands (4% of all listed stream miles in Oregon) that are listed by the Oregon Department of Environmental Quality for temperature.

Stream Flow

Stream flow is an important element of fish habitat. Stream flow is highly variable in mountainous areas within the planning area and is strongly influenced by the form of precipitation (e.g., rain, snowmelt, or rain on snow) (Naiman and Bilby 1998). For fish species, flow affects many components of the aquatic system including:

- migration
- rearing
- sediment routing and deposition

The 2-year, 24-hour peak flow is typically the channel-forming flow for streams in mountainous areas within the planning area (Lisle 1981). When 5-year flows begin to occur at the 2-year, 24-hour interval, stream channels become unstable and streambank erosion increases (Harr 1992).