Appendix D

Biological Assessment and Biological Evaluation, Wildlife

McKenzie River Ranger District

Biological Assessment for the Bridge Thin Project

January 10, 2008

I. INTRODUCTION

The McKenzie River Ranger District is requesting formal consultation for the proposed Bridge Thin Timber Sale project in Lane County.

This Biological Assessment was prepared pursuant to the Endangered Species Act of 1973, as amended (ESA), to describe and evaluate potential effects of the proposed action on the northern spotted owl (*Strix occidentalis caurina*). The proposed action complies with the Record of Decision and the Standards and Guidelines of the Northwest Forest Plan (USDA and USDI 1994a), as amended by the Land and Resource Management Plans for Nineteen National Forests Within the Range of the Northern Spotted Owl (USDA and USDI 2004), and with the Land and Resource Management Plan for the Willamette National Forest.

The project was reviewed by the Terrestrial Level 1 Team on October 11, 2007.

A. Scope of the Assessment

The action area is the proposed project plus all federal and non-federal lands within 1.0 miles. This assessment describes and evaluates the potential affects of specific activities that would modify habitat, including critical habitat of the northern spotted owl. The assessment also evaluates disturbances associated with these activities within the distances shown in Table 1.

B. Definitions

For the purposes of this assessment, the following definitions are used.

Northern Spotted Owl

***Suitable habitat*:** Consists of stands used by owls for nesting, roosting and foraging. Generally these stands are conifer-dominated, 80 years old or older and multi-storied in structure, and have sufficient snags and downed wood to provide opportunities for owl nesting, roosting and foraging. The canopy closure generally exceeds 60 percent.

Dispersal habitat: Conifer and mixed mature conifer-alder habitats with a canopy cover greater than or equal to 40 percent and conifer trees greater than or equal to 11 inches average dbh. Generally, spotted owls use dispersal habitat to move between blocks of suitable habitat, roost, forage and survive until they can establish a nest territory. Juvenile owls also use dispersal habitat to move from natal areas. Dispersal habitat lacks the optimal structural characteristics needed for nesting.

Breeding Period: The breeding period for northern spotted owls is March 1 through September 30. The critical breeding period is March 1 through July 15.

Known Owl Site: A site that was or is occupied by a pair or resident single as defined by protocol (1990-2007). The specific site location is determined by the unit biologist based on the best and/or most recent information. A known site may be determined to be inactive only in accordance with the survey protocol.

Predicted Owl Site: An area able to support resident spotted owls (i.e. a potential breeding pair) as determined by the USFWS occupancy template (USFWS 2007). This is used for determining effects to spotted owls where survey data are insufficient.

Nest Patch (or Stand): 200 meters around a known or predicted owl site, where a spotted owl would be likely to select a nesting tree. This is based on habitat usage of spotted owls within the Central Cascades Study Area, located on the Willamette National Forest.

Core Area**:** 0.5 mile around a known or predicted owl site, which delineates the area most heavily used during the nesting season.

Home Range**:** An estimated area for habitat use of a spotted owl pair. For the Oregon Cascades, this estimate is 1.2 miles around a known or predicted owl site (Thomas et al. 1990).

C. Disturbance and Disruption Distances

Disturbance distance: the distance from the project boundary outward within which the action is likely to cause a northern spotted owl, if present, to be distracted from its normal activity. Except as stated Table 1, the disturbance distance is 0.25 mile from nesting spotted owls. The unit wildlife biologist may increase or decrease these disturbance distances according to the best available scientific information and site-specific conditions.

Disruption distance: the distance from the project boundary outward within which the action is likely to cause a northern spotted owl, if present, to be distracted to such an extent as to significantly disrupt its normal behavior and create the likelihood of harm or loss of reproduction. The disruption distance is a subset of the disturbance distance. Proposed activities that would occur within the distances shown in Table 1, of northern spotted owl might disrupt the normal behavior patterns of individual owls or breeding spotted owls. The unit wildlife biologist may increase or decrease these disturbance distances according to the best available scientific information and site-specific conditions.

D. Habitat Modification

Maintained: refers to silvicultural activities that alter forest stand characteristics but maintain the components of spotted owl habitat within the stand such that spotted owls can continue to have their life history requirements supported (ie. the functionality of the habitat used by spotted owls remains intact post silvicultural activity). For spotted owl dispersal-only habitat this means that a canopy cover of >40 percent along with other habitat elements (e.g. including snags, down wood, tree-height class-diversity, and older hardwoods) will be maintained post silvicultural activity to adequately provide for spotted owl dispersal. For spotted owl suitable habitat (also known as NRF[1]) a canopy cover of >60 percent along with other habitat elements (e.g. including snags, down wood, dominated by large overstory trees, tree-height class-diversity, and older hardwoods) will be maintained post silvicultural activity to adequately provide for spotted owl nesting, roosting, and foraging within the stand. The administrative unit biologist is responsible for ensuring that proposed silvicultural activities that are described as being in this category will maintain the characteristics of spotted owl suitable and dispersal habitat in affected stands for each site-specific action. In addition, in the case of suitable-maintained, the administrative unit biologist is responsible for assessing the juxtaposition[2] of the affected stand within the surrounding forest landscape to ensure that appropriate effects to spotted owls are documented.

[1] Nesting, roosting and forage habitat formally referred to as NRF.

[2] Site specific information may reveal a local concern for an owl pair that is relying on the harvest unit. An example: a spotted owl pair's home range contains sub optimal levels of foraging habitat that any impact, even when minor, may contribute to the inability of the spotted owl pair to support successful reproduction.

Available scientific literature provides support for the finding that forest stands can be altered in a manner that does not necessarily change the habitat function for spotted owls (e.g., Forsman et al. 1984, USFWS 2007a). Examples of silvicultural activities that may fall into this category are light to moderate thinning, down salvage, individual tree removal, and prescribed burning.

***Downgrade*:** to change spotted owl suitable habitat to dispersal habitat.

***Remove*:** Alter spotted owl suitable so that the habitat no longer supports nesting, roosting or foraging, and dispersal or alter spotted owl dispersal habitat so that the habitat no longer supports dispersal.

Table 1 Disturbance and disruption distances[1] for the northern spotted owl during the breeding period

Source of Disturbance/ Disruption	Disturbance Distance	Disruption Distance	
	Entire Breeding Period (March 1 – September 30)	**Critical Breeding Period** (March 1 – July 15)	**Late Breeding Period** (July 16 – September 30)
Blasting	1,760 yards (1 mile)	1,760 yards (1 mile)	440 yards (0.25 mile)
Burning	440 yards (0.25 mile)	440 yards (0.25 mile)	0 yards
Chainsaw use	440 yards (0.25 mile)	65 yards	0 yards
Hauling on open roads	0 yards	0 yards	0 yards
Heavy equipment	440 yards (0.25 mile)	35 yards	0 yards
Helicopter – Type I[2]	880 yards (0.5 mile)	440 yards (0.25 mile)	440 yards (0.25 mile)
Helicopter – other[3]	440 yards (0.25 mile)	120 yards	0 yards
Rock crushing	440 yards (0.25 mile)	180 yards	0 yards

[1] Noise distances were developed from a threshold of 92 dB (USFWS 2003). Smoke disturbance distances are based on a FWS white paper (USFWS 2007)

[2] Type I helicopters seat at least 16 people and have a minimum capacity of 5,000 lbs. Both a CH-47 (Chinook) and UH-60 (Blackhawk) are Type I helicopters.

Kmax helicopters are considered "other" for the purposes of disturbance. Sound readings from Kmax helicopter logging on the Olympic NF registered 86 dB at 150 yards (Piper 2006).

[3] All other helicopters (including Kmax)

II. DESCRIPTION OF PROPOSED ACTION

Proposed Action

Table 2 describes the types of activities evaluated by this assessment and the conditions under which each activity may proceed and Table 3 and Table 4 shows activities within suitable and dispersal habitat for the proposed project. Together, these activities constitute the proposed action. All project units are in an Adaptive Management Area (AMA) allocation. Some units are within Critical Habitat Unit OR-16.

The proposed action includes all processes needed to plan, evaluate, survey, prepare and complete activities including, but not limited to, falling, bucking, hauling, post-harvest burning, and post-harvest firewood cutting. The existing rock quarry in Unit 41 will be used as rock source. The Bridge Thin project is expected to occur between fall of 2008 and fall 2011. No other actions are interrelated to or interdependent on the proposed action.

Table 1 Description of proposed habitat modification by activity type.

Activity Type	Description
Rock Quarry Operation	Blasting, crushing, and rock hauling would occur at the existing rock quarry in Unit 41. This rock quarry is not located in a CHU.
Road Reconstruction	Roads would be cleared of vegetation, restored to grade and surfaced as needed for log or rock hauling. Road reconstruction would occur inside and outside a CHU.
Heavy thinning of dispersal for Big game Forage Enhancement	Heavy thinning would maintain a minimum of 30-50 percent average canopy closure throughout the stands. Functionality of dispersal habitat is temporarily reduced to non-habitat habitat. These fast growing trees are expected to recover to the 40% canopy closure within 7-10 years. No helicopters will be used for yarding on these treatment units. Unit of measure is acres thinned. These big game forage enhancement units are not located within a CHU.
Light to Moderate thinning in dispersal habitat	Light to moderate thinning is the partial removal of the overstory. Such thinning in dispersal habitat would maintain a minimum 60 percent average canopy cover throughout the stands. Unit of measure is acres thinned. Ten of these thinning units are located within a CHU.
Regeneration Harvest for Savanna Restoration	This activity restores a portion of the McKenzie River / Elk Creek 6th field watershed from the present closed canopy coniferous forest to a pre-settlement condition of open savanna with scattered Douglas-fir, Oregon white oak and a variably dense grass understory. Canopy cover is reduced below 30 percent. Unit of measure is acres treated. Helicopter use would occur on units 84 and 85. No savanna restoration units are located in a CHU.
Helicopter Yarding	It is assumed that a type I helicopter will be used to yard logs from the unit to the log landings on units 1,2,4,5,6,13-18,26,29-31,56,57,59,63,84, 85 and 88. Two helicopter units (57 and 63) are located in a CHU.
Log and rock Haul	Log trucks would transport logs from the unit to the mill and rock trucks would transport rock to reconstruction sites. No hauling would occur within 35 yards of a known or predicted nest site. Some log and rock haul would occur in a CHU.
Fuels Reduction	Fuel reduction treatments can include burning and the shredding and chipping of small <7” diameter materials in dispersal habitat that maintains a canopy cover greater than 60 percent. No commercial harvest would occur. No fuels reduction units are in a CHU.
Post harvest Burning	Treatment of harvest generated fuels can include grapple piling, hand piling and under burning.
Firewood Cutting	Firewood would be cut from decks placed during timber sale operations. Firewood cutting will occur once harvest is complete or the following season if timing does not permit.

Table 2 Proposed actions by activity in suitable habitat.

Activity	Acres*	NSO Habitat		Owl Home ranges within the Action Area						
		Current Condition	After Treatment	0029	0104	0856	2034	2422	2443	2836
Light/Mod Thin for Fuels Reduction (units 101 and103)	38	Suitable	Suitable	This fuels reduction activity is not within the home range of any known or predicted site.						

Table 4 Proposed actions by activity in dispersal habitat.

Activity	Acres* (Miles for Road Reconstruction)	NSO Habitat		Owl Home ranges within the Action Area						
		Current Condition	After Treatment	0029**	0104	0856	2034	2422**	2443	2836**
Road Reconstruction (in miles)	32	N/A	N/A	X	X	X	X	X	X	X
Heavy Thin for Big game Forage (40,42,43,44,45, 68,80)	237	Dispersal	Nonhabitat	X	X					X
Regen for Oak Savanna Restoration (84,85,86,87,89)	38 18	Dispersal Nonhabitat	Nonhabitat Nonhabitat							
Light/Mod Thin (all remaining units)	1774	Dispersal	Dispersal	X	X	X	X	X	X	X
Light/Mod Thin for Fuels Reduction (50,95,96,97,98, 99,100, 102)	140	Dispersal	Dispersal							X

* acres shown are total for activity and may fall completely or partially inside owl home range(s) and include post harvest burning and firewood cutting.

** Known owl site located in Critical Habitat Unit OR-16

In addition to the descriptions and activity types in 2, the following standards are common to all proposed activities:

Standards

a. A wildlife biologist participated in the planning and design of all activities affecting listed species.

b. A known nest tree may be removed *only* when it is an immediate hazard *and* when the tree is unoccupied by nesting birds or their young. A 50 foot defensible space will be maintained around a historic nest tree for MSNO 2836 during post harvest burning.

c. Seasonal restrictions will be in place for burning activities on unit 60 and blasting at the rock quarry in unit 41 during the critical breeding season for spotted owls.

d. No activity that, in the opinion of the unit wildlife biologist, would remove spotted owl habitat in areas where the amount of post-activity habitat would be insufficient for owl dispersal is addressed by this assessment.

e. At the end of each calendar year, the McKenzie River Ranger District will complete a project implementation and monitoring form to show actual levels of adverse effects and actions that remove, downgrade or maintain spotted owl suitable habitat or remove dispersal habitat. This form should be forwarded to the Fish and Wildlife Service to fulfill the monitoring report requirements. Monitoring completes the regulatory requirements of the ESA by documenting the actual effects to the subject species.

   Monitoring will ensure that actual levels of adverse effect and incidental take, whether from habitat modification, associated disturbance or impacts to critical habitat, resulting from implementation of the proposed action, do not exceed the levels anticipated by this assessment. Before exceeding an anticipated level of incidental take or adverse effect, the administrative unit shall inform the Interagency Level 1 Team and re-initiate formal consultation with the Fish and Wildlife Service.

f. No activity that would remove or downgrade northern spotted owl habitat in an Area of Concern (AOC) is addressed by this assessment.

III. Environmental Baseline

Northern spotted owl

Legal Status

The spotted owl was listed as threatened on June 26, 1990 due to widespread loss and adverse modification of suitable habitat across the owl's entire range and the inadequacy of existing regulatory mechanisms to conserve the owl (USFWS 1990a). The Service recovery priority number for the spotted owl is 6C, on a scale of 1C (highest) to 18 (lowest) (USFWS 1983a, 1983b, 2004). This number reflects a high degree of threat, a low potential for recovery, and the owl's taxonomic status as a subspecies. The "C" reflects conflict with development, construction, or other economic activity. The spotted owl was originally listed with a recovery priority number of 3C, but that number was changed to 6C in 2004 during the 5-year review of the species (USFWS 2004).

Life History

Taxonomy

The northern spotted owl is one of three subspecies of spotted owls currently recognized by the American Ornithologists' Union. The taxonomic separation of these three subspecies is supported by genetic (Barrowclough and Gutiérrez 1990, Barrowclough et al. 1999, Haig et al. 2004), morphological (Gutiérrez et al. 1995), and biogeographic information (Barrowclough and Gutiérrez 1990). The distribution of the Mexican subspecies (*S. o. lucida*) is separate from those of the northern and California (*S. o. occidentalis*) subspecies (Gutiérrez et al. 1995). Recent studies analyzing mitochondrial DNA sequences (Haig et al. 2004, Chi et al. 2004, Barrowclough et al. 2005) and microsatellites (Henke et al., unpubl. data) confirmed the validity of the current subspecies designations for northern and California spotted owls. The narrow hybrid zone between these two subspecies, which is located in the southern Cascades and northern Sierra Nevadas, appears to be stable (Barrowclough et al. 2005).

Physical Description

The northern spotted owl is a medium-sized owl and is the largest of the three subspecies of spotted owls (Gutiérrez et al. 1995). It is approximately 46 to 48 centimeters (18 inches to 19 inches) long and the sexes are dimorphic, with males averaging about 13 percent smaller than females. The mean mass of 971 males taken during 1,108 captures was 580.4 grams (1.28 pounds) (out of a range 430.0 to 690.0 grams) (0.95 pound to 1.52 pounds), and the mean mass of 874 females taken during 1,016 captures was 664.5 grams (1.46 pounds) (out of a range 490.0 to 885.0 grams) (1.1 pounds to 1.95 pounds) (P. Loschl and E. Forsman, pers. comm. cited in USFWS 2007c). The northern spotted owl is dark brown with a barred tail and white spots on its head and breast, and it has dark brown eyes surrounded by prominent facial disks. Four age classes can be distinguished on the basis of plumage characteristics (Forsman 1981, Moen et al. 1991). The northern spotted owl superficially resembles the barred owl (*Strix varia*), a species with which it occasionally hybridizes (Kelly and Forsman 2004). Hybrids exhibit physical and vocal characteristics of both species (Hamer et al. 1994).

Current and Historical Range

The current range of the spotted owl extends from southwest British Columbia through the Cascade Mountains, coastal ranges, and intervening forested lands in Washington, Oregon, and California, as far south as Marin County (USFWS 1990a). The range of the spotted owl is partitioned into 12 physiographic provinces (see Figure 1) based on recognized landscape subdivisions exhibiting different physical and environmental features (Thomas et al. 1993). These provinces are distributed across the species' range as follows:

- Four provinces in Washington: Eastern Washington Cascades, Olympic Peninsula, Western Washington Cascades, Western Washington Lowlands
- Five provinces in Oregon: Oregon Coast Range, Willamette Valley, Western Oregon Cascades, Eastern Oregon Cascades, Oregon Klamath Mountains
- Three provinces in California: California Coast, California Klamath, California Cascades

The spotted owl is extirpated or uncommon in certain areas such as southwestern Washington and British Columbia. Timber harvest activities have eliminated, reduced or fragmented spotted owl habitat sufficiently to decrease overall population densities across its range, particularly within the coastal provinces where habitat reduction has been concentrated (Thomas and Raphael 1993).

Behavior

Spotted owls are territorial. However, home ranges of adjacent pairs overlap (Forsman et al. 1984, Solis and Gutiérrez 1990) suggesting that the area defended is smaller than the area used for foraging. Territorial defense is primarily effected by hooting, barking and whistle type calls. Some spotted owls are not territorial but either remain as residents within the territory of a pair or move among territories (Gutiérrez 1996). These birds are referred to as "floaters." Floaters have special significance in spotted owl populations because they may buffer the territorial population from decline (Franklin 1992). Little is

known about floaters other than that they exist and typically do not respond to calls as vigorously as territorial birds (Gutiérrez 1996).

Spotted owls are monogamous and usually form long-term pair bonds. “Divorces” occur but are relatively uncommon. There are no known examples of polygyny in this owl, although associations of three or more birds have been reported (Gutiérrez et al. 1995).

Habitat Relationships

Home Range. Home-range sizes vary geographically, generally increasing from south to north, which is likely a response to differences in habitat quality (USFWS 1990a). Estimates of median size of their annual home range (the area traversed by an individual or pair during their normal activities (Thomas and Raphael 1993)) vary by province and range from 2,955 acres in the Oregon Cascades (Thomas et al. 1990) to 14,211 acres on the Olympic Peninsula (USFWS 1994b). Zabel et al. (1995) showed that these provincial home ranges are larger where flying squirrels are the predominant prey and smaller where wood rats are the predominant prey. Home ranges of adjacent pairs overlap (Forsman et al. 1984, Solis and Gutiérrez 1990), suggesting that the defended area is smaller than the area used for foraging. Within the home range there is a smaller area of concentrated use during the breeding season (~20% of the home-range), often referred to as the core area (Bingham and Noon 1997). Spotted owl core areas vary in size geographically and provide habitat elements that are important for the reproductive efficacy of the territory, such as the nest tree, roost sites and foraging areas (Bingham and Noon 1997). Spotted owls use smaller home ranges during the breeding season and often dramatically increase their home range size during fall and winter (Forsman et al. 1984, Sisco 1990).

Although differences exist in natural stand characteristics that influence home range size, habitat loss and forest fragmentation effectively reduce habitat quality in the home range. A reduction in the amount of suitable habitat reduces spotted owl abundance and nesting success (Bart and Forsman 1992, Bart 1995).

Habitat Use. Forsman et al. (1984) reported that spotted owls have been observed in the following forest types: Douglas-fir (*Pseudotsuga menziesii*), western hemlock (*Tsuga heterophylla*), grand fir (*Abies grandis*), white fir (*Abies concolor*), ponderosa pine (*Pinus ponderosa*), Shasta red fir (*Abies magnifica shastensis*), mixed evergreen, mixed conifer hardwood (Klamath montane), and redwood (*Sequoia sempervirens*). The upper elevation limit at which spotted owls occur corresponds to the transition to subalpine forest, which is characterized by relatively simple structure and severe winter weather (Forsman 1975, Forsman et al. 1984).

Roost sites selected by spotted owls have more complex vegetation structure than forests generally available to them (Barrows and Barrows 1978, Forsman et al. 1984, Solis and Gutiérrez 1990). These habitats are usually multi-layered forests having high canopy closure and large diameter trees in the overstory.

Spotted owls nest almost exclusively in trees. Like roosts, nest sites are found in forests having complex structure dominated by large diameter trees (Forsman et al. 1984, Hershey et al. 1998). Even in forests that have been previously logged, spotted owls select forests having a structure (i.e., larger trees, greater canopy closure) different than forests generally available to them (Folliard 1993, Buchanan et al. 1995, Hershey et al. 1998).

Foraging habitat is the most variable of all habitats used by territorial spotted owls (Thomas et al. 1990). Descriptions of foraging habitat have ranged from complex structure (Solis and Gutiérrez 1990) to forests with lower canopy closure and smaller trees than forests containing nests or roosts (Gutiérrez 1996).

Habitat Selection. Spotted owls generally rely on older forested habitats because such forests contain the structures and characteristics required for nesting, roosting, and foraging. Features that support nesting and roosting typically include a moderate to high canopy closure (60 to 90 percent); a multi-layered, multi-species canopy with large overstory trees (with diameter at breast height [dbh] of greater than 30 inches); a high incidence of large trees with various deformities (large cavities, broken tops, mistletoe infections, and other evidence of decadence); large snags; large accumulations of fallen trees and other woody debris on the ground; and sufficient open space below the canopy for spotted owls to fly (Thomas et al.

1990). Forested stands with high canopy closure also provide thermal cover (Weathers et al. 2001) and protection from predators.

While spotted owls nest almost exclusively in trees, foraging habitat generally has attributes similar to those of nesting and roosting habitat, but such habitat may not always support successfully nesting pairs (USFWS 1992b). Dispersal habitat, at a minimum, consists of stands with adequate tree size and canopy closure to provide protection from avian predators and at least minimal foraging opportunities (USFWS 1992b). Although Forsman et al. (2002) found that spotted owls could disperse through highly fragmented forest landscapes, the stand-level and landscape-level attributes of forests needed to facilitate successful dispersal have not been thoroughly evaluated (Buchanan 2004).

Spotted owls may be found in younger forest stands that have the structural characteristics of older forests or retained structural elements from the previous forest. In redwood forests and mixed conifer-hardwood forests along the coast of northwestern California, considerable numbers of spotted owls also occur in younger forest stands, particularly in areas where hardwoods provide a multi-layered structure at an early age (Thomas et al. 1990, Diller and Thome 1999). In mixed conifer forests in the eastern Cascades in Washington, 27 percent of nest sites were in old-growth forests, 57 percent were in the understory reinitiation phase of stand development, and 17 percent were in the stem exclusion phase (Buchanan et al. 1995). In the western Cascades of Oregon, 50 percent of spotted owl nests were in late-seral/old-growth stands (greater than 80 years old), and none were found in stands of less than 40 years old (Irwin et al. 2000).

In the Western Washington Cascades, spotted owls roosted in mature forests dominated by trees greater than 50 centimeters (19.7 inches) dbh with greater than 60 percent canopy closure more often than expected for roosting during the non-breeding season. Spotted owls also used young forest (trees of 20 to 50 centimeters (7.9 inches to 19.7 inches) dbh with greater than 60 percent canopy closure) less often than expected based on this habitat's availability (Herter et al. 2002).

In the Coast Ranges, Western Oregon Cascades and the Olympic Peninsula, radio-marked spotted owls selected for old-growth and mature forests for foraging and roosting and used young forests less than predicted based on availability (Forsman et al. 1984, Carey et al. 1990, Thomas et al. 1990). Glenn et al. (2004) studied spotted owls in young forests in western Oregon and found little preference among age classes of young forest.

Habitat use is influenced by prey availability. Ward (1990) found that spotted owls foraged in areas with lower variance in prey densities (that is, where the occurrence of prey was more predictable) within older forests and near ecotones of old forest and brush seral stages. Zabel et al. (1995) showed that spotted owl home ranges are larger where flying squirrels (*Glaucomys sabrinus*) are the predominant prey and smaller where wood rats (*Neotoma* spp.) are the predominant prey.

Recent landscape-level analyses in portions of Oregon Coast and California Klamath provinces suggest that a mosaic of late-successional habitat interspersed with other seral conditions may benefit spotted owls more than large, homogeneous expanses of older forests (Zabel et al. 2003, Franklin et al. 2000, Meyer et al. 1998). In Oregon Klamath Mountains and Western Oregon Cascade provinces, Dugger et al. (2005) found that apparent survival and reproduction was positively associated with the proportion of older forest near the territory center (within 730 meters) (2,395 feet). Survival decreased dramatically when the amount of non-habitat (non-forest areas, sapling stands, etc.) exceeded approximately 50 percent of the home range (Dugger et al. 2005). The authors concluded that they found no support for either a positive or negative direct effect of intermediate-aged forest—that is, all forest stages between sapling and mature, with total canopy cover greater than 40 percent—on either the survival or reproduction of spotted owls. It is unknown how these results were affected by the low habitat fitness potential in their study area, which Dugger et al. (2005) stated was generally much lower than those in Franklin et al. (2000) and Olson et al. (2004), and the low reproductive rate and survival in their study area, which they reported were generally lower than those studied by Anthony et al. (2006). Olson et al. (2004) found that reproductive rates fluctuated biennially and were positively related to the amount of edge between late-seral and mid-seral forests and other habitat classes in the central Oregon Coast Range. Olson et al. (2004) concluded that their results indicate that while mid-seral and late-seral forests are important to spotted owls, a mixture of these forest types with younger forest and non-forest may be best for spotted owl survival and reproduction in their study area.

Reproductive Biology

The spotted owl is relatively long-lived, has a long reproductive life span, invests significantly in parental care, and exhibits high adult survivorship relative to other North American owls (Forsman et al. 1984, Gutiérrez et al. 1995). Spotted owls are sexually mature at 1 year of age, but rarely breed until they are 2 to 5 years of age (Miller et al. 1985, Franklin 1992, Forsman et al. 2002). Breeding females lay one to four eggs per clutch, with the average clutch size being two eggs; however, most spotted owl pairs do not nest every year, nor are nesting pairs successful every year (USFWS 1990b, Forsman et al. 1984, Anthony et al. 2006), and renesting after a failed nesting attempt is rare (Gutiérrez 1996). The small clutch size, temporal variability in nesting success, and delayed onset of breeding all contribute to the relatively low fecundity of this species (Gutiérrez 1996).

Courtship behavior usually begins in February or March, and females typically lay eggs in late March or April. The timing of nesting and fledging varies with latitude and elevation (Forsman et al. 1984). After they leave the nest in late May or June, juvenile spotted owls depend on their parents until they are able to fly and hunt on their own. Parental care continues after fledging into September (USFWS 1990a, Forsman et al. 1984). During the first few weeks after the young leave the nest, the adults often roost with them during the day. By late summer, the adults are rarely found roosting with their young and usually only visit the juveniles to feed them at night (Forsman et al. 1984). Telemetry and genetic studies indicate that close inbreeding between siblings or parents and their offspring is rare (Haig et al. 2001, Forsman et al. 2002).

Dispersal Biology

Natal dispersal of spotted owls typically occurs in September and October with a few individuals dispersing in November and December (Miller et al. 1997, Forsman et al. 2002). Natal dispersal occurs in stages, with juveniles settling in temporary home ranges between bouts of dispersal (Forsman et al. 2002, Miller et al. 1997). The median natal dispersal distance is about 10 miles for males and 15.5 miles for females (Forsman et al. 2002). Dispersing juvenile spotted owls experience high mortality rates, exceeding 70 percent in some studies (USFWS 1990a, Miller 1989). Known or suspected causes of mortality during dispersal include starvation, predation, and accidents (Miller 1989, USFWS 1990a, Forsman et al. 2002). Parasitic infection may contribute to these causes of mortality, but the relationship between parasite loads and survival is poorly understood (Hoberg et al. 1989, Gutiérrez 1989, Forsman et al. 2002). Successful dispersal of juvenile spotted owls may depend on their ability to locate unoccupied suitable habitat in close proximity to other occupied sites (LaHaye et al. 2001).

There is little evidence that small openings in forest habitat influence the dispersal of spotted owls, but large, non-forested valleys such as the Willamette Valley apparently are barriers to both natal and breeding dispersal (Forsman et al. 2002). The degree to which water bodies, such as the Columbia River and Puget Sound, function as barriers to dispersal is unclear, although radio telemetry data indicate that spotted owls move around large water bodies rather than cross them (Forsman et al. 2002). Analysis of the genetic structure of spotted owl populations suggests that gene flow may have been adequate between the Olympic Mountains and the Washington Cascades, and between the Olympic Mountains and the Oregon Coast Range (Haig et al. 2001).

Breeding dispersal occurs among a small proportion of adult spotted owls; these movements were more frequent among females and unmated individuals (Forsman et al. 2002). Breeding dispersal distances were shorter than natal dispersal distances and also are apparently random in direction (Forsman et al. 2002).

Food Habits

Spotted owls are mostly nocturnal, although they also forage opportunistically during the day (Forsman et al. 1984, Sovern et al. 1994). The composition of the spotted owl's diet varies geographically and by forest type. Generally, flying squirrels (*Glaucomys sabrinus*) are the most prominent prey for spotted owls in Douglas-fir and western hemlock (*Tsuga heterophylla*) forests (Forsman et al. 1984) in Washington and Oregon, while dusky-footed wood rats (*Neotoma fuscipes*) are a major part of the diet in the Oregon Klamath Mountains, California Klamath, and California Coastal provinces (Forsman et al. 1984, 2001, 2004, Ward et al. 1998, Hamer et al. 2001). Depending on location, other important prey include deer

mice (*Peromyscus maniculatus*), tree voles (*Arborimus longicaudus, A. pomo*), red-backed voles (*Clethrionomys* spp.), gophers (*Thomomys* spp.), snowshoe hare (*Lepus americanus*), bushy-tailed wood rats (*Neotoma cinerea*), birds, and insects, although these species comprise a small portion of the spotted owl diet (Forsman et al. 1984, 2004, Ward et al. 1998, Hamer et al. 2001).

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 annual reproductive success of spotted owls (number of young per territory) and abundance of deer mice (*Peromyscus maniculatus*) (r2 = 0.68), despite the fact they only made up 1.6±0.5 percent 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). Ward (1990) also noted that mice were more abundant in areas selected for foraging by owls. Nonetheless, spotted owls deliver larger prey to the nest and eat smaller food items to reduce foraging energy costs; therefore, the importance of smaller prey items, like *Peromyscus*, in the spotted owl diet should not be underestimated (Forsman et al. 1984, 2001, 2004).

Population Dynamics

The spotted owl is relatively long-lived, has a long reproductive life span, invests significantly in parental care, and exhibits high adult survivorship relative to other North American owls (Forsman et al. 1984, Gutiérrez et al. 1995). The spotted owl's long reproductive life span allows for some eventual recruitment of offspring, even if recruitment does not occur each year (Franklin et al. 2000).

Annual variation in population parameters for spotted owls has been linked to environmental influences at various life history stages (Franklin et al. 2000). In coniferous forests, mean fledgling production of the California spotted owl (*Strix occidentalis occidentalis*), a closely related subspecies, was higher when minimum spring temperatures were higher (North et al. 2000), a relationship that may be a function of increased prey availability. Across their range, spotted owls have previously shown an unexplained pattern of alternating years of high and low reproduction, with highest reproduction occurring during even-numbered years (e.g., Franklin et al. 1999). Annual variation in breeding may be related to weather (i.e., temperature and precipitation) (Wagner et al. 1996 and Zabel et al. 1996 *In*: Forsman et al. 1996) and fluctuation in prey abundance (Zabel et al. 1996).

A variety of factors may regulate spotted owl population levels. These factors may be density-dependent (e.g., habitat quality, habitat abundance) or density-independent (e.g., climate). Interactions may occur among factors. For example, as habitat quality decreases, density-independent factors may have more influence on survival and reproduction, which tends to increase variation in the rate of growth (Franklin et al. 2000). Specifically, weather could have increased negative effects on spotted owl fitness for those owls occurring in relatively lower quality habitat (Franklin et al. 2000). A consequence of this pattern is that at some point, lower habitat quality may cause the population to be unregulated (have negative growth) and decline to extinction (Franklin et al. 2000).

Olson et al. (2005) used open population modeling of site occupancy that incorporated imperfect and variable detectability of spotted owls and allowed modeling of temporal variation in site occupancy, extinction, and colonization probabilities (at the site scale). The authors found that visit detection probabilities average less than 0.70 and were highly variable among study years and among their three study areas in Oregon. Pair site occupancy probabilities declined greatly on one study area and slightly on the other two areas. However, for all owls, including singles and pairs, site occupancy was mostly stable through time. Barred owl presence had a negative effect on these parameters (see barred owl discussion in the New Threats section below). However, there was enough temporal and spatial variability in detection rates to indicate that more visits would be needed in some years and in some areas, especially if establishing pair occupancy was the primary goal.

Threats

Reasons for Listing

The 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" (USFWS 1990a: 26114). More specifically, threats to the spotted owl included low populations, declining populations, limited habitat, declining habitat, inadequate distribution of habitat or populations, isolation of provinces, predation and competition, lack of coordinated conservation measures, and vulnerability to natural disturbance (USFWS 1992b). These threats were characterized for each province as severe, moderate, low or unknown (USFWS 1992b) (The range of the spotted owl is divided into 12 provinces from Canada to northern California and from the Pacific Coast to the eastern Cascades; see Figure 1). Declining habitat was recognized as a severe or moderate threat to the spotted owl throughout its range, isolation of populations was identified as a severe or moderate threat in 11 provinces, and a decline in population was a severe or moderate threat in 10 provinces. Together, these three factors represented the greatest concerns about range-wide conservation of the spotted owl. Limited habitat was considered a severe or moderate threat in nine provinces, and low populations were a severe or moderate concern in eight provinces, suggesting that these factors were also a concern throughout the majority of the spotted owl's range. Vulnerability to natural disturbances was rated as low in five provinces.

The degree to which predation and competition might pose a threat to the spotted owl was unknown in more provinces than any of the other threats, indicating a need for additional information. Few empirical studies exist to confirm that habitat fragmentation contributes to increased levels of predation on spotted owls (Courtney et al. 2004). However, great horned owls (*Bubo virginianus*), an effective predator on spotted owls, are closely associated with fragmented forests, openings, and clearcuts (Johnson 1992, Laidig and Dobkin 1995). As mature forests are harvested, great horned owls may colonize fragmented forests, thereby increasing spotted owl vulnerability to predation.

New Threats

The Service conducted a 5-year review of the spotted owl in 2004 (USFWS 2004), for which the Service prepared a scientific evaluation of the status of the spotted owl (Courtney et al. 2004). An analysis was conducted assessing how the threats described in 1990 might have changed by 2004. Some of the key threats identified in 2004 are:

- "Although we are certain that current harvest effects are reduced, and that past harvest is also probably having a reduced effect now as compared to 1990, we are still unable to fully evaluate the current levels of threat posed by harvest because of the potential for lag effects…In their questionnaire responses…6 of 8 panel member identified past habitat loss due to timber harvest as a current threat, but only 4 viewed current harvest as a present threat" (Courtney and Gutiérrez 2004:11-7)
- "Currently the primary source of habitat loss is catastrophic wildfire, although the total amount of habitat affected by wildfires has been small (a total of 2.3% of the range-wide habitat base over a 10-year period)." (Courtney and Gutiérrez 2004:11-8)
- "Although the panel had strong differences of opinion on the conclusiveness of some of the evidence suggesting [barred owl] displacement of [spotted owls], and the mechanisms by which this might be occurring, there was no disagreement that [barred owls] represented an operational threat. In the questionnaire, all 8 panel members identified [barred owls] as a current threat, and also expressed concern about future trends in [barred owl] populations." (Courtney and Gutiérrez 2004:11-8)

Barred Owls. With its recent expansion to as far south as Marin County, California (Gutiérrez et al. 2004), the barred owl's range now completely overlaps that of the northern spotted owl. Barred owls may be competing with spotted owls for prey (Hamer et al. 2001) or habitat (Hamer et al. 1989, Dunbar et al. 1991, Herter and Hicks 2000, Pearson and Livezey 2003). In addition, barred owls physically attack spotted owls (Pearson and Livezey 2003), and circumstantial evidence strongly indicated that a barred owl killed a spotted owl (Leskiw and Gutiérrez 1998). Evidence that barred owls are causing negative effects on spotted owls is largely indirect, based primarily on retrospective examination of long-term data

collected on spotted owls (Kelly et al. 2003, Pearson and Livezey 2003, Olson et al. 2005). It is widely believed, but not conclusively confirmed, that the two species of owls are competing for resources. However, given that the presence of barred owls has been identified as a negative effect while using methods designed to detect a different species (spotted owls), it seems safe to presume that the effects are stronger than estimated. Because there has been no research to quantitatively evaluate the strength of different types of competitive interactions, such as resource partitioning and competitive interference, the particular mechanism by which the two owl species may be competing is unknown.

Barred owls were initially thought to be more closely associated with early successional forests than spotted owls, based on studies conducted on the west slope of the Cascades in Washington (Hamer 1988, Iverson 1993). However, recent studies conducted in the Pacific Northwest show that barred owls frequently use mature and old-growth forests (Pearson and Livezey 2003, Gremel 2005, Schmidt 2006). In the fire prone forests of eastern Washington, a telemetry study conducted on barred owls showed that barred owl home ranges were located on lower slopes or valley bottoms, in closed canopy, mature, Douglas-fir forest, while spotted owl sites were located on mid-elevation areas with southern or western exposure, characterized by closed canopy, mature, ponderosa pine or Douglas-fir forest (Singleton et al. 2005).

The only study comparing spotted owl and barred owl food habits in the Pacific Northwest indicated that barred owl diets overlap strongly (76 percent) with spotted owl diets (Hamer et al. 2001). However, barred owl diets are more diverse than spotted owl diets and include species associated with riparian and other moist habitats, along with more terrestrial and diurnal species (Hamer et al. 2001).

The presence of barred owls has been reported to reduce spotted owl detectability, site occupancy, reproduction, and survival. Olson et al. (2005) found that the presence of barred owls had a significant negative effect on the detectability of spotted owls, and that the magnitude of this effect did not vary among years. The occupancy of historical territories by spotted owls in Washington and Oregon was significantly lower ($p < 0.001$) after barred owls were detected within 0.8 kilometer (0.5 miles) of the territory center but was “only marginally lower” ($p = 0.06$) if barred owls were located more than 0.8 kilometer (0.5 miles) from the spotted owl territory center (Kelly et al. 2003:51). Pearson and Livezey (2003) found that there were significantly more barred owl site-centers in unoccupied spotted owl circles than occupied spotted owl circles (centered on historical spotted owl site-centers) with radii of 0.8 kilometer (0.5 miles) ($p = 0.001$), 1.6 kilometer (1 mile) ($p = 0.049$), and 2.9 kilometer (1.8 miles) ($p = 0.005$) in Gifford Pinchot National Forest. In Olympic National Park, Gremel (2005) found a significant decline ($p = 0.01$) in spotted owl pair occupancy at sites where barred owls had been detected, while pair occupancy remained stable at spotted owl sites without barred owls. Olson et al. (2005) found that the annual probability that a spotted owl territory would be occupied by a pair of spotted owls after barred owls were detected at the site declined by 5 percent in the HJ Andrews study area, 12 percent in the Coast Range study area, and 15 percent in the Tyee study area.

Olson et al. (2004) found that the presence of barred owls had a significant negative effect on the reproduction of spotted owls in the central Coast Range of Oregon (in the Roseburg study area). The conclusion that barred owls had no significant effect on the reproduction of spotted owls in one study (Iverson 2004) was unfounded because of small sample sizes (Livezey 2005). It is likely that all of the above analyses underestimated the effects of barred owls on the reproduction of spotted owls because spotted owls often cannot be relocated after they are displaced by barred owls (E. Forsman, pers. comm., cited in USFWS 2007c). Anthony et al. (2006) found significant evidence for negative effects of barred owls on apparent survival of spotted owls in two of 14 study areas (Olympic and Wenatchee). They attributed the equivocal results for most of their study areas to the coarse nature of their barred owl covariate.

In a recent analysis of more than 9,000 banded spotted owls throughout their range, only 47 hybrids were detected (Kelly and Forsman 2004). Consequently, hybridization with the barred owl is considered to be “an interesting biological phenomenon that is probably inconsequential, compared with the real threat—direct competition between the two species for food and space” (Kelly and Forsman 2004:808).

The preponderance of evidence suggests that barred owls are exacerbating the spotted owl population decline, particularly in Washington, portions of Oregon, and the northern coast of California (Gutiérrez et al. 2004, Olson et al. 2005). There is no evidence that the increasing trend in barred owls has stabilized in

any portion of the spotted owl's range in the western United States, and "there are no grounds for optimistic views suggesting that barred owl impacts on northern spotted owls have been already fully realized" (Gutiérrez et al. 2004:7-38).

Wildfire. Studies indicate that the effects of wildfire on spotted owls and their habitat are variable, depending on fire intensity, severity and size. Within the fire-adapted forests of the spotted owl's range, spotted owls likely have adapted to withstand fires of variable sizes and severities. Bond et al. (2002) examined the demography of the three spotted owl subspecies after wildfires, in which wildfire burned through spotted owl nest and roost sites in varying degrees of severity. Post-fire demography parameters for the three subspecies were similar or better than long-term demographic parameters for each of the three subspecies in those same areas (Bond et al. 2002). In a preliminary study conducted by Anthony and Andrews (2004) in the Oregon Klamath Mountains Province, their sample of spotted owls appeared to be using a variety of habitats within the area of the Timbered Rock fire, including areas where burning had been moderate.

In 1994, the Hatchery Complex fire burned 17,603 hectares in the Wenatchee National Forest in Washington's eastern Cascades, affecting six spotted owl activity centers (Gaines et al. 1997). Spotted owl habitat within a 2.9-kilometer (1.8-mile) radius of the activity centers was reduced by 8 to 45 percent (mean = 31 percent) as a result of the direct effects of the fire and by 10 to 85 percent (mean = 55 percent) as a result of delayed mortality of fire-damaged trees and insects. Direct mortality of spotted owls was assumed to have occurred at one site, and spotted owls were present at only one of the six sites 1 year after the fire. In 1994, two wildfires burned in the Yakama Indian Reservation in Washington's eastern Cascades, affecting the home ranges of two radio-tagged spotted owls (King et al. 1997). Although the amount of home ranges burned was not quantified, spotted owls were observed using areas that burned at low and medium intensities. No direct mortality of spotted owls was observed, even though thick smoke covered several spotted owl site-centers for a week. It appears that, at least in the short term, spotted owls may be resilient to the effects of wildfire—a process with which they have evolved. More research is needed to further understand the relationship between fire and spotted owl habitat use.

At the time of listing there was recognition that large-scale wildfire posed a threat to the spotted owl and its habitat (USFWS 1990a). New information suggests fire may be more of a threat than previously thought. In particular, the rate of habitat loss in the relatively dry East Cascades and Klamath provinces has been greater than expected (see "Habitat Trends" below). Moeur et al. (2005) suggested that 12 percent of late-successional forest rangewide would likely be negatively impacted by wildfire during the first 5 decades of the Northwest Forest Plan. Currently, the overall total amount of habitat affected by wildfires has been relatively small (Lint 2005). It may be possible to influence through silvicultural management how fire prone forests will burn and the extent of the fire when it occurs. Silvicultural management of forest fuels are currently being implemented throughout the spotted owl's range, in an attempt to reduce the levels of fuels that have accumulated during nearly 100 years of effective fire suppression. However, our ability to protect spotted owl habitat and viable populations of spotted owls from large fires through risk-reduction endeavors is uncertain (Courtney et al. 2004). The NWFP recognized wildfire as an inherent part of managing spotted owl habitat in certain portions of the range. The distribution and size of reserve blocks as part of the NWFP design may help mitigate the risks associated with large-scale fire (Lint 2005).

West Nile Virus. West Nile virus (WNV) has killed millions of wild birds in North America since it arrived in 1999 (McLean et al. 2001, Caffrey 2003, Marra et al. 2004). Mosquitoes are the primary carriers (vectors) of the virus that causes encephalitis in humans, horses, and birds. Mammalian prey may also play a role in spreading WNV among predators, like spotted owls. Owls and other predators of mice can contract the disease by eating infected prey (Garmendia et al. 2000, Komar et al. 2001). Recent tests of tree squirrels from Los Angeles County, California, found over 70 percent were positive for WNV (R. Carney, pers. comm., cited in USFWS 2004). One captive spotted owl in Ontario, Canada, is known to have contracted WNV and died.

Health officials expect that WNV will eventually spread throughout the range of the spotted owl (Courtney et al. 2004), but it is unknown how WNV will ultimately affect spotted owl populations. Susceptibility to infection and mortality rates of infected individuals vary among bird species, even within groups (Courtney et al. 2004). Owls appear to be quite susceptible. For example, breeding Eastern screech owls

(*Megascops asio*) in Ohio experienced 100 percent mortality (T. Grubb, pers. comm., cited in Courtney et al. 2004). Barred owls, in contrast, showed lower susceptibility (B. Hunter, pers. comm., cited in Courtney et al. 2004). Some level of innate resistance may occur (Fitzgerald et al. 2003), which could explain observations in several species of markedly lower mortality in the second year of exposure to WNV (Caffrey and Peterson 2003). Wild birds also develop resistance to WNV through immune responses (Deubel et al. 2001). The effects of WNV on bird populations at a regional scale have not been large, even for susceptible species (Caffrey and Peterson 2003), perhaps due to the short-term and patchy distribution of mortality (K. McGowan, pers. comm., cited in Courtney et al. 2004) or annual changes in vector abundance and distribution.

Courtney et al. (2004) offer competing propositions for the likely outcome of spotted owl populations being infected by WNV. One proposition is that spotted owls can tolerate severe, short-term population reductions due to WNV, because spotted owl populations are widely distributed and number in the several hundreds to thousands. An alternative proposition is that WNV will cause unsustainable mortality, due to the frequency and/or magnitude of infection, thereby resulting in long-term population declines and extirpation from parts of the spotted owl's current range. Thus far, no mortality in wild, northern spotted owls has been recorded, however, WNV is a potential threat of uncertain magnitude and effect (Courtney et al. 2004).

Sudden Oak Death. Sudden oak death was recently identified as a potential threat to the spotted owl (Courtney et al. 2004). This disease is caused by the fungus-like pathogen, *Phytopthora ramorum* that was recently introduced from Europe and is rapidly spreading. At the present time, sudden oak death is found in natural stands from Monterey to Humboldt Counties, California, and has reached epidemic proportions in oak (*Quercus* spp.) and tanoak (*Lithocarpus densiflorus*) forests along approximately 300 km of the central and northern California coast (Rizzo et al. 2002). It has also been found near Brookings, Oregon, killing tanoak and causing dieback of closely associated wild rhododendron (*Rhododendron* spp.) and evergreen huckleberry (*Vaccinium ovatum*) (Goheen et al. 2002). It has been found in several different forest types and at elevations from sea level to over 800 m. Sudden oak death poses a threat of uncertain proportion because of its potential impact on forest dynamics and alteration of key prey and spotted owl habitat components (e.g., hardwood trees - canopy closure and nest tree mortality); especially in the southern portion of the spotted owl's range (Courtney et al. 2004).

Inbreeding Depression, Genetic Isolation, and Reduced Genetic Diversity. Inbreeding and other genetic problems due to small population sizes were not considered an imminent threat to the spotted owl at the time of listing. Recent studies show no indication of reduced genetic variation and past bottlenecks in Washington, Oregon, or California (Barrowclough et al. 1999, Haig et al. in press, Henke et al. unpublished). However, in Canada, the breeding population is estimated to be less than 33 pairs and annual population decline may be as high as 35 percent (Harestad 2004). It is possible (but not necessarily the case) that the Canadian populations may be more adversely affected by issues related to small population size including inbreeding depression, genetic isolation, and reduced genetic diversity (Courtney et al. 2004). Low and persistently declining populations throughout the northern portion of the species range (see "Population Trends" below) may be at increased risk of losing genetic diversity.

Climate Change. Climate change, a potential additional threat to northern spotted owl populations, is not explicitly addressed in the NWFP. Climate change could have direct and indirect impacts on spotted owls and their prey. However, the emphasis on maintenance of seral stage complexity and related organismal diversity in the Matrix under the NWFP should contribute to the resiliency of the Federal forest landscape to the impacts of climate change (Courtney et al. 2004). There is no indication in the literature regarding the direction (positive or negative) of the threat.

Based upon a global meta-analysis, Parmesan and Yohe (2003) discussed several potential implications of global climate change to biological systems, including terrestrial flora and fauna. Results indicated that 62 percent of species exhibited trends indicative of advancement of spring conditions. In bird species, trends were manifested in earlier nesting activities. Because the spotted owl exhibits a limited tolerance to heat relative to other bird species (Weathers et al. 2001), subtle changes in climate have the potential to affect this. However, the specific impacts to the species are unknown.

Disturbance-Related Effects The effects of noise on spotted owls are largely unknown, and whether noise is a concern has been a controversial issue. The effect of noise on birds is extremely difficult to

determine due to the inability of most studies to quantify one or more of the following variables: 1) timing of the disturbance in relation to nesting chronology; 2) type, frequency, and proximity of human disturbance; 3) clutch size; 4) health of individual birds; 5) food supply; and 6) outcome of previous interactions between birds and humans (Knight and Skagan 1988). Additional factors that confound the issue of disturbance include the individual bird's tolerance level, ambient sound levels, physical parameters of sound and how it reacts with topographic characteristics and vegetation, and differences in how species perceive noise.

Although information specific to behavioral responses of spotted owls to disturbance is limited, research indicates that recreational activity can cause Mexican spotted owls (*S. o. lucida*) to vacate otherwise suitable habitat (Swarthout & Steidl 2001) and helicopter overflights can reduce prey delivery rates to nests (Delaney et al. 1999). Additional effects from disturbance, including altered foraging behavior and decreases in nest attendance and reproductive success, have been reported for other raptors (White & Thurow 1985, Andersen et al. 1989, McGarigal et al. 1991).

Northern spotted owls may also respond physiologically to a disturbance without exhibiting a significant behavioral response. In response to environmental stressors, vertebrates secrete stress hormones called corticosteroids (Campbell 1990). Although these hormones are essential for survival, extended periods with elevated stress hormone levels may have negative effects on reproductive function, disease resistance, or physical condition (Carsia & Harvey 2000, Saplosky et al. 2000). In avian species, the secretion of corticosterone is the primary non-specific stress response (Carsia & Harvey 2000). The quantity of this hormone in feces can be used as a measure of physiological stress (Wasser et al.1997). Recent studies of fecal corticosterone levels of spotted owls indicate that low intensity noise of short duration and minimal repetition does not elicit a physiological stress response (Tempel & Gutiérrez 2003, Tempel & Gutiérrez 2004). However, prolonged activities, such as those associated with timber harvest, may increase fecal corticosterone levels depending on their proximity to spotted owl core areas (see Wasser et al. 1997, Tempel & Gutiérrez 2004).

Post-harvest fuels treatments may also create above-ambient smoke or heat. Although it has not been conclusively demonstrated, it is anticipated that nesting northern spotted owls may be disturbed by heat and smoke intrusion into the nest grove.

Conservation Needs of the Spotted Owl

Based on the above assessment of threats, the spotted owl has the following habitat-specific and habitat-independent conservation (i.e., survival and recovery) needs:

Habitat-specific Needs

1. Large blocks of habitat capable of supporting clusters or local population centers of spotted owls (e.g., 15 to 20 breeding pairs) throughout the owl's range distributed across a variety of ecological conditions within the spotted owl's range to reduce risk of local or widespread extirpation;

2. Habitat conditions and spacing between local spotted owl populations throughout its range that facilitate survival and movement;

3. A coordinated, adaptive management effort to reduce the loss of habitat due to catastrophic wildfire throughout the spotted owl's range, and a monitoring program to clarify whether these risk reduction methods are effective and to determine how owls use habitat treated to reduce fuels; and

4. In areas of significant population decline, sustain the full range of survival and recovery options for this species in light of significant uncertainty.

Habitat-independent Needs

1. A coordinated research and adaptive management effort to better understand and manage competitive interactions between spotted and barred owls; and

2. Monitoring to better understand the risk that WNV and sudden oak death pose to spotted owls and, for WNV, research into methods that may reduce the likelihood or severity of outbreaks in spotted owl populations.

Conservation Strategy

Since 1990, various efforts have addressed the conservation needs of the spotted owl and attempted to formulate conservation strategies based upon these needs. These efforts began with the ISC's Conservation Strategy (Thomas et al. 1990); they continued with the designation of critical habitat (USFWS 1992b), the Draft Recovery Plan (USFWS 1992b), and the Scientific Analysis Team report (Thomas et al. 1993), report of the Forest Ecosystem Management Assessment Team (Thomas and Raphael 1993); and they culminated with the NWFP (USDA and USDI 1994a). Each conservation strategy was based upon the reserve design principles first articulated in the ISC's report, which are summarized as follows.

- Species that are well distributed across their range are less prone to extinction than species confined to small portions of their range.
- Large blocks of habitat, containing multiple pairs of the species, are superior to small blocks of habitat with only one to a few pairs.
- Blocks of habitat that are close together are better than blocks far apart.
- Habitat that occurs in contiguous blocks is better than habitat that is more fragmented.
- Habitat between blocks is more effective as dispersal habitat if it resembles suitable habitat.

Federal Contribution to Recovery – NWFP (Conservation Strategy for the spotted owl)

Since it was signed on April 13, 1994, the NWFP has guided the management of Federal forest lands within the range of the spotted owl (USDA and USDI 1994a, 1994b). The NWFP was designed to protect large blocks of old growth forest and provide habitat for species that depend on those forests including the spotted owl, as well as to produce a predictable and sustainable level of timber sales. The NWFP was designed around reserve/connectivity functions that are expected to be achieved through a variety of LUAs. Each LUA has a distinct set of Standards and Guidelines that established goals and directs management actions that are consistent with NWFP expectations for ensuring appropriate management of reserves (large blocks) of late-successional and old-growth forest habitat to support multiple pairs of nesting owls and for connectivity between reserves in the intervening matrix. LUAs in the plan that are designed to support or contribute to supporting population clusters are: LSRs, Managed Late-successional Areas, and Congressionally Reserved areas. Riparian Reserves, Adaptive Management Areas and Administratively Withdrawn areas can provide both demographic support and connectivity/dispersal between the larger blocks, but were not necessarily designed for that purpose. Matrix areas may, in the short-term, contribute demographic support but is designed to support timber production while also retaining biological legacy components important to old-growth obligate species (in 100-acre owl cores, 15 percent late-successional provision, etc. (USDA and USDI 1994a, USFWS 1994a)) which would persist into future managed timber stands.

The NWFP with its rangewide system of LSRs was based on work completed by three previous studies (Thomas et. al. 2006): the 1990 Interagency Scientific Committee (ISC) Report (Thomas et. al. 1990), the 1991 report for the Conservation of Late-successional Forests and Aquatic Ecosystems (Johnson et. al. 1991), and the 1993 report of the Scientific Assessment Team (Thomas et. al. 1993). In addition, the 1992 Draft Recovery Plan for the Northern Spotted Owl (USFWS 1992b) was based on the ISC report.

The Forest Ecosystem Management Assessment Team predicted, based on expert opinion, the spotted owl population would decline in the Matrix land use allocation over time, while the population would stabilize and eventually increase within LSRs as habitat conditions improved over the next 50 to 100 years (Thomas and Raphael 1993, USDA and USDI 1994a, 1994b). Based on the results of the first decade of monitoring, Lint (2005) could not determine whether implementation of the NWFP would

reverse the spotted owl's declining population trend because not enough time had passed to provide the necessary measure of certainty. However, the results from the first decade of monitoring do not provide any reason to depart from the objective of habitat maintenance and restoration as described in the NWFP (Lint 2005, Noon and Blakesley 2006). Bigley and Franklin (2004) suggested that more fuels treatments are needed in east-side forests to preclude large-scale losses of habitat to stand-replacing wildfires. Other stressors that occur in suitable habitat, such as the range expansion of the barred owl (already in action) and infection with WNV (which may or may not occur) may complicate the conservation of the spotted owl. Recent reports about the status of the spotted owl offer few management recommendations to deal with these emerging threats. The arrangement, distribution, and resilience of the NWFP land use allocation system may prove to be the most appropriate strategy in responding to these unexpected challenges (Bigley and Franklin 2004).

Under the NWFP, the agencies anticipated a decline of spotted owl populations during the first decade of implementation. Recent reports (Courtney et al. 2004, Anthony et al. 2006) identified greater than expected spotted owl declines in Washington and northern portions of Oregon, and more stationary populations in southern Oregon and northern California. The reports did not find a direct correlation between habitat conditions and changes in vital rates of spotted owls at the meta-population scale. However, at the territory scale, there is evidence of negative effects to spotted owl fitness due to reduced habitat quantity and quality. Also, there is no evidence to suggest that dispersal habitat is currently limiting (Courtney et al. 2004, Lint 2005). Even with the population decline, Courtney et al (2004) noted that there is little reason to doubt the effectiveness of the core principles underpinning the NWFP conservation strategy.

The current scientific information, including information showing northern spotted owl population declines, indicates that the spotted owl continues to meet the definition of a threatened species (USFWS 2004). That is, populations are still relatively numerous over most of its historic range, which suggests that the threat of extinction is not imminent, and that the subspecies is not endangered; even though, in the northern part of its range population trend estimates are showing a decline.

In April 2007, the Service published the 2007 Draft Recovery Plan for the spotted owl (USFWS 2007c). This draft plan outlines a three-part approach to recovering the spotted owl, including addressing the impacts of the barred owl on the spotted owl, establishing a network of habitat blocks to be managed for reproducing spotted owls, and monitoring the population trends and range of the spotted owl. The draft recovery plan recommends the experimental removal of barred owls to better understand the impact the species is having on spotted owls (USFWS 2007c). The plan also includes two separate options for establishing the habitat network; one which is a mapped option within the plan, and one which is a rule set that outlines how the BLM and Forest Service would establish a network on their lands (USFWS 2007c). The draft recovery plan estimates that recovery of the spotted owl could be achieved in approximately 30 years (USFWS 2007c).

The effect of barred owls on NWFP Implementation

The Service believes that the NWFP still provides the backbone of the federal contribution to spotted owl recovery even with the uncertainty surrounding the effect of barred owls on spotted owls.

Reserve Network. The most important aspect of NWFP for spotted owls are the substantial forest reserves and related management standards. These reserves are separated by matrix habitat (suitable for dispersal and some breeding) and non-federal lands (which also have some roles as breeding and dispersal habitats). Invasion of protected reserves (such as the Olympic National Park area) by barred owls may lead to the loss of some conservation function of the reserve network. For example, Schmidt (2003) reported a decline of spotted owls in one such reserve in northern California. Pearson and Livezey (2003) established that the density of barred owls was highest in Gifford Pinchot National Forest LSRs and other reserve areas and lower in areas subject to harvest. Annual reports by Anthony et al. (2006) in both the central and southern Oregon Cascades show continued annual declines in spotted owl pair occupancy in the major land-use allocations of LSR, AMA and Matrix, while barred owl frequency is increasing, although the latter information is not given by land-use allocation. No information is provided in terms of spotted owl survival by land-use allocation.

If late-successional reserves fail to protect breeding populations of spotted owls, then the overall conservation strategy for the species is could be based on an untenable premise and may be questionable, unless the LSRs are not optimal habitat for spotted owls; see Franklin et al. (2000). The above data suggests that reserves are no protection against invasive owls, and other habitat management options, such as increased habitat protection (although see habitat discussion below) outside reserves may not have an additive affect helping spotted owl populations against barred owls.

One major limitation of the NWFP appears to be the inability of a reserve strategy, which comprises 80 percent of the NWFP federal land base (Thomas et al. 1994), to deal with invasive species, such as the barred owl. It is recognized that the NWFP has made important conservation contributions, and without the plan the situation of northern spotted owls would be far bleaker.

*Dispersal-Matrix Habitat***.** The NWFP provision of dispersal habitat in the matrix is an important component of long-term spotted owl conservation. Management of matrix habitat (15 percent of the NWFP federal land base) has been of lower impact on spotted owls than anticipated (Courtney et al. 2004, Lint 2005), yet decline in spotted owl populations are occurring in some areas. The NWFP provided for some protection of northern spotted owl nesting and foraging habitat within the matrix (e.g., reserves around nest sites) as well as maintenance of general conditions within the matrix that would facilitate dispersal of northern spotted owls and recovery of owl habitat following logging (e.g., variable retention harvesting). For these reasons, northern spotted owls are likely using matrix habitat more than anticipated as a consequence of lack of harvest activity in the matrix. However, the long-term suitability of matrix areas under a fully-implemented NWFP is impossible to assess at this point (Courtney et al 2004) and dispersal remains a difficult topic to study (Buchanan 2004).

Because dispersal habitat in the matrix is important for spotted owl conservation and if barred owls now occupy matrix habitat, one suggestion is that such areas may be less suitable for dispersal of young spotted owls, due to both direct antagonism (and possibly predation) and indirect inhibition (Courtney et al. 2004). An alternative view, and tenable under the current understanding of dispersal dynamics of northern spotted owls (Forsman et al. 2002), is that barred owl presence in matrix habitat may promote a faster progression of dispersing northern spotted owl juveniles through lower quality habitat. If barred owls exclude spotted owls, then spotted owls will likely spend less time in matrix habitat occupied by barred owls. If this were accomplished without reduced survivorship of spotted owls, there might be few or no negative consequences of barred owls occupying matrix habitat (Courtney et al. 2004).

Barred owls are known to use a wide variety of forest types, including early successional habitats, and some authors have suggested that timber harvest activities may favor the species. For instance, fragmentation of forest habitat may have created favorable conditions for survival and reproduction. By contrast, spotted owls appear to be more generally associated with old growth forest or forests that are structurally complex over a greater part of the species' range (Courtney et al. 2004). Under such conditions, timber harvest may have increased interpolation and contact of the two species' preferred and potential habitats, leading to increased competition between the species. Hicks et al. (2001) have attempted to examine this hypothesis in the northern part of the range by determining the amounts of different habitat types surrounding spotted owl territories that either have or have not been invaded by barred owls. They detected no effect of surrounding habitat on the probability of replacement. Also, under the Plum Creek HCP, harvest was deferred for areas of nesting, roosting and foraging habitat around 30 productive spotted owl sites. After six years, only 10 sites had any spotted owl presence – this rate of decline is very similar to that seen at other areas where timber harvest occurred. These results suggest something other than timber harvest is influencing occupancy in this location. However, overall, it is unclear if forest management affects the outcome of the interaction between the two species (Courtney et al. 2004, Chapter 8).

It is also clear that, in some portions of the northern spotted owl's range, barred owls are increasing and spotted owls are declining to some degree independently of forest management history in the area. For example, the population of spotted owls has decreased on both the Plum Creek Cascades HCP area (with extensive harvest) and nearby reserve areas without harvest (Courtney et al. 2004). Similarly, barred owls are increasing while spotted owls are declining throughout the Olympic peninsula in both industrial and national forest land, but also in the National Park (in areas never harvested) (Anthony et al. 2006 for trend information). On the Gifford Pinchot National Forest (Washington), the density and impact

of barred owls appears higher in areas without timber harvest (Pearson and Livezey 2003). Although there is a strong overall correlation between barred owl increases and spotted owl declines, many historical spotted owl sites are not currently known to be occupied by either species (Wiedemeier and Horton 2000, Herter and Hicks 2000). Large numbers of truly vacant sites are not to be expected if the main cause of spotted owl decline is barred owl invasion and pre-emption of suitable sites (Courtney et al. 2004). Habitat loss to timber harvest is often postulated to be a major factor in spotted owl decline, but habitat is still present in the study areas (indeed some areas where spotted owls are in the worst decline, such as Olympic National Park, have never been harvested). Further, these results are not inconsistent with other factors that are known to negatively affect spotted owls. For example, Franklin et al. (2000) predicted, based on past weather data that there could be long periods of decline in a spotted owl population due solely to weather effects.

The Reserve and Matrix strategy of the NWFP has been successful in that northern spotted owl populations are persisting, and (largely) performing as predicted (Courtney et al. 2004). Continued cutting of northern spotted owl suitable habitat, in absence of a NWFP, might have accelerated the decline of the species and, possibly, facilitated more rapid displacement or occupation of vacated habitat by barred owls. However, the provision of suitable habitat for northern spotted owls was an essential contribution of the NWFP but has not protected it from competition from the invasive and highly competitive barred owl. At present, based on the habitat use patterns of both species and what little is known of interspecific competition, it is unclear whether additional habitat protection would improve conditions from the northern spotted owl.

Spotted Owl Population Declines and NWFP. Anthony et al. (2006) noted precipitous adult northern owl population declines on all four study areas in Washington. In northern Oregon, northern spotted owl population declines were noted in all three of the study areas, however, the declines were generally less than those in Washington (Anthony et al. 2006). The northern spotted owl has continued to decline in the northern portion of its range, despite the presence of a high proportion of protected habitat on Federal lands in that area. Although Courtney et al. (2004) indicate that the population decline of the northern spotted owl over the last 14 years was expected, they conclude that the greater than expected downward trends in certain study areas in Washington where little timber harvest was taking place suggest that something other than timber harvest is responsible for the recent decline. Anthony et al. (2006) stated that determining the cause of this decline was beyond the scope of their study, and that they could only speculate among the numerous possibilities including: competition from barred owls, loss of habitat from wildfire, timber harvest including lag effects from prior harvest, poor weather conditions, and defoliation from insect infestations. Not unexpectedly, considering the fact that the northern spotted owl is a predator species, Anthony et al. (2006) also noted the complexities of the relationships of prey abundance on predator populations, and identified declines in prey abundance as another possible reason for declines in apparent survival of northern spotted owls.

In southern Oregon and northern California, northern spotted owl populations are more stationary than in Washington (Anthony et al. 2006) despite the fact that more harvest is taking place in these areas than in areas experiencing greater than expected declines. The fact that northern spotted owl populations in some portions of the range were stationary was not expected within the first ten years, given the general prediction of continued declines in the population over the first several decades of NWFP implementation (Lint. 2005). The cause of the better demographic performance on the southern Oregon and northern California study areas, and the cause of declines in the Washington study areas are both unknown (Anthony et al. 2006). Although population declines in the Washington demographic areas exceeded anticipated levels, Courtney et al. (2004) noted that a range wide decline in the northern spotted owl population was not unexpected during the first decade, and that the observed range wide population change during this period was not a reason to doubt the effectiveness of the core NWFP conservation strategy. It is clear that there is no simple correlation with timber harvest patterns for instance (AFRC 2004), and barred owl invasion is certainly a viable hypothesis for this regional pattern (Courtney et al. 2004).

The synergistic effects of past threats and new threats are unknown. Although, the science behind the NWFP appears valid, new threats from barred owls, and potential threats from West Nile Virus and Sudden Oak Death may result in northern spotted owl populations in reserves falling to lower levels (and/or at a faster rate) than originally anticipated, which would further retard northern spotted owl

recovery (Courtney et al. 2004). According to the Service (November 2004), the current scientific information, including that showing the declines in Washington and northern Oregon, and Canada, indicate that the northern spotted owl continues to meet the definition of a threatened species. Populations are still relatively numerous over most of the species' historic range, which suggests that the threat of extinction is not imminent, and that the subspecies is not endangered even in the northern part of its range where greater than expected population declines were documented (USFWS 2004). The Service (November 2004) did not consider the increased risk to northern spotted owl populations due to the uncertainties surrounding barred owls and other factors sufficient to reclassify the species to endangered at this time. However, a problem in assessing this decline is that we lack a strong benchmark to know whether this decline is greater or less than that predicted under NWFP (Courtney et al. 2004).

A complication noted by some biologists in studying spotted owls is their belief that spotted owls are silent in the presence of barred owls (Olson et al. 2005, Crozier et al. 2006). Hence, an area may be recorded as vacated by spotted owls, when in fact the birds are merely unresponsive to surveyors' calls. Evidence contradictory to this hypothesis comes from the meta-analysis, where, if this scenario were true, we would expect to observe a decline in recapture rates for banded spotted owls in areas where barred owls are increasing, but this does not seem to be the case for any study area (Anthony et al. 2006).

Given the observed inverse correlations of some barred owl and spotted owl population trends, it is important to evaluate the relative effects of interspecific competition as a cause of spotted owl decline, as compared to other factors such as habitat loss. Historically, much of the observed loss of old-growth habitat occurred well before barred owls arrived in the region. Hence, there must have been substantial effects of habitat loss on spotted owl populations prior to the period 1965 to 1980 (when the barred owl arrived in western states). However, the arrival of the barred owl has introduced a new factor.

Previous estimates of spotted owl demographic parameters in 1994 (Burnham et al. 1994; Franklin et al. 1999) have produced substantial evidence that some populations at least are in decline. Of particular concern was the 1994 meta-analysis result that there was an accelerating rate of adult female mortality over the period study for the various demographic study areas. This trend was not apparent in the 1998 meta-analysis although some populations apparently were declining. Although habitat loss is one plausible explanation for such population trends, an alternative explanation is that barred owl invasion has been depressing spotted owl survival and reproduction. Recent studies have shown strong effects (Franklin et al. 2000) and relatively weak effects (Olsen et al. 2005) of some habitat conditions on spotted owl survival and reproduction. In demographic study areas where barred owls have been present the longest, and have been increasing through time, Anthony et al. (2006) noted strong evidence for negative effect of barred owl on survival on the Olympic and Wentachee, weak evidence for a barred owl effect on survival on the Cle Elum, but no effect of barred owls on fecundity on any demographic study population. Even a low level of competition may contribute to depressed demographic parameters.

Demographic data collected over 15 years document declining populations across the species range with the most pronounced declines in BC, WA, and northern Oregon. This area of pronounced decline constitutes approximately 50 percent of the geographic range of the northern spotted owl, but supports about 25 percent of all known northern spotted owl activity centers, and contains approximately 25 percent of all northern spotted owl habitat, greater than 90 percent of which is federally managed. These declines in Washington and northern Oregon demographic study areas, as well as Canada, indicate the northern spotted owl meets the definition of a threatened species. However, populations are still relatively numerous over most of the species historic range, suggesting the threat of extinction is not imminent, and the subspecies in not "endangered" even in the northern part of the range where the demographic results are least promising (USFWS 2004, p. 54)

In summary, a decline of northern spotted owl populations under the NWFP during the past decade was anticipated, however, Anthony et al. 2006 and Courtney et al. 2004 identified greater than expected northern spotted owl population declines in Washington and northern portions of Oregon, and more stationary populations in southern Oregon and northern California. These reports did not find a direct correlation between habitat conditions and changes in northern spotted owl populations, and they were inconclusive as to the cause of the declines. Lag effects from prior harvest of suitable habitat, competition with barred owls, and habitat loss due to wildfire were identified as current threats. Complex interactions are likely among the various factors. The status of the northern spotted owl population, and increased risk

to northern spotted owl populations due to uncertainties surrounding barred owls were reported as not sufficient to reclassify the species to endangered at this time. Similarly, the reports did not identify cause for changing the basic conservation strategy in the NWFP.

Conservation Efforts on Non-federal Lands

In the report from the Interagency Scientific Committee (Thomas et al. 1990), the draft recovery plan (USFWS 1992b), and the report from the Forest Ecosystem Management Assessment Team (Thomas and Raphael 1993), it was noted that limited Federal ownership in some areas constrained the ability to form a network of old-forest reserves to meet the conservation needs of the spotted owl. In these areas in particular, non-Federal lands would be important to the range-wide goal of achieving conservation and recovery of the spotted owl. The Service's primary expectations for private lands are for their contributions to demographic support (pair or cluster protection) to Federal lands, or their connectivity with Federal lands. In addition, timber harvest within each state is governed by rules that provide protection of spotted owls or their habitat to varying degrees.

There are 17 current or completed Habitat Conservation Plans (HCPs) that have incidental take permits issued for spotted owls—eight in Washington, three in Oregon, and four in California. The HCPs range in size from 40 acres to more than 1.6 million acres, although not all acres are included in the mitigation for spotted owls. In total, the HCPs cover approximately 2.9 million acres (9.1 percent) of the 32 million acres of non-Federal forest lands in the range of the spotted owl. The period of time that the HCPs will be in place ranges from 5 to 100 years; however, most of the HCPs are of fairly long duration. While each HCP is unique, there are several general approaches to mitigation of incidental take:

- Reserves of various sizes, some associated with adjacent Federal reserves
- Forest harvest that maintains or develops suitable habitat
- Forest management that maintains or develops dispersal habitat
- Deferral of harvest near specific sites

Washington. In 1996, the State Forest Practices Board adopted rules (Washington Forest Practices Board 1996) that would contribute to conserving the spotted owl and its habitat on non-Federal lands. Adoption of the rules was based in part on recommendations from a Science Advisory Group that identified important non-Federal lands and recommended roles for those lands in spotted owl conservation (Hanson et al. 1993, Buchanan et al. 1994). The 1996 rule package was developed by a stakeholder policy group and then reviewed and approved by the Forest Practices Board (Buchanan and Swedeen 2005). Spotted owl-related HCPs in Washington generally were intended to provide demographic or connectivity support (USFWS 1992b).

Oregon. The Oregon Forest Practices Act provides for protection of 70-acre core areas around sites occupied by an adult pair of spotted owls capable of breeding (as determined by recent protocol surveys), but it does not provide for protection of spotted owl habitat beyond these areas (Oregon Department of Forestry 2007). In general, no large-scale spotted owl habitat protection strategy or mechanism currently exists for non-Federal lands in Oregon. The three spotted owl-related HCPs currently in effect cover more than 300,000 acres of non-Federal lands. These HCPs are intended to provide some nesting habitat and connectivity over the next few decades.

California. The California State Forest Practice Rules, which govern timber harvest on private lands, require surveys for spotted owls in suitable habitat and to provide protection around activity centers (California Department of Forestry and Fire Protection 2007). Under the Forest Practice Rules, no timber harvest plan can be approved if it is likely to result in incidental take of federally listed species, unless the take is authorized by a Federal incidental take permit (California Department of Forestry and Fire Protection 2007). The California Department of Fish and Game initially reviewed all timber harvest plans to ensure that take was not likely to occur; the Service took over that review function in 2000. Several large industrial owners operate under spotted owl management plans that have been reviewed by the Service and that specify basic measures for spotted owl protection. Four HCPs authorizing take of spotted owls have been approved; these HCPs cover more than 669,000 acres of non-Federal lands. Implementation of these plans is intended to provide for spotted owl demographic and connectivity support to NWFP lands.

Current Condition of the Spotted Owl

The current condition of the species incorporates the effects of all past human activities and natural events that led to the present-day status of the species and its habitat (USFWS and USDC NMFS 1998).

Range-wide Habitat and Population Trends

Habitat Baseline. The 1992 Draft Spotted Owl Recovery Plan estimated approximately 8.3 million acres of spotted owl habitat remained range-wide (USDI 1992b). However, reliable habitat baseline information for non-Federal lands is not available (Courtney et al. 2004). The Service has used information provided by the Forest Service, Bureau of Land Management, and National Park Service to update the habitat baseline conditions on Federal lands for spotted owls on several occasions since the spotted owl was listed in 1990. The estimate of 7.4 million acres used for the NWFP in 1994 (USDA and USDI 1994a) was believed to be representative of the general amount of spotted owl habitat on these lands. This baseline has been used to track relative changes over time in subsequent analyses, including those presented here.

In 2005 a new map depicting suitable spotted owl habitat throughout the range of the spotted owl was produced as a result of the NWFP's effectiveness monitoring program (Lint 2005). However, the spatial resolution of this new habitat map currently makes it non-habitat for tracking habitat effects at the scale of individual projects. The Service is evaluating the map for future use in tracking habitat trends. Additionally, there continues to be no reliable estimates of spotted owl habitat on non-Federal lands; consequently, consulted-on acres can be tracked, but not evaluated in the context of change with respect to a reference condition on non-Federal lands. The production of the monitoring program habitat map does, however, provide an opportunity for future evaluations of trends in non-Federal habitat.

NWFP Lands Analysis 1994 – 2001. In 2001, the Service conducted an assessment of habitat baseline conditions, the first since implementation of the NWFP (USFWS 2001). This range-wide evaluation of habitat, compared to the FSEIS, was necessary to determine if the rate of potential change to spotted owl habitat was consistent with the change anticipated in the NWFP. In particular, the Service considered habitat effects that were documented through the section 7 consultation process since 1994. In general, the analytical framework of these consultations focused on the reserve and connectivity goals established by the NWFP land-use allocations (USDA and USDI 1994a), with effects expressed in terms of changes in suitable spotted owl habitat within those land-use allocations. The Service determined that actions and effects were consistent with the expectations for implementation of the NWFP from 1994 to June, 2001 (USFWS 2001).

Range-wide Analysis from 1994 to August 2, 2007. This section updates the information considered in USFWS (2001), relying particularly on information in documents the Service produced pursuant to section 7 of the Act and information provided by NWFP agencies on habitat loss resulting from natural events (e.g., fires, windthrow, insect and disease). To track impacts to spotted owl habitat, the Service designed the Consultation Effects Tracking System database which records impacts to spotted owls and their habitat at a variety of spatial and temporal scales. Data are entered into the database under various categories including, land management agency, land-use allocation, physiographic province, and type of habitat affected.

In 1994, about 7.4 million acres of suitable northern spotted owl habitat were estimated to exist on Federal lands managed under the NWFP. As of August 2, 2007, the Service had consulted on the proposed removal of approximately 202,368 acres[3] (Table) or 2.73 percent of 7.4 million acres (Table) of northern spotted owl suitable habitat on Federal lands. Of the total Federal acres consulted on for removal, approximately 179,633 acres or 2.42 percent of 7.4 million acres of northern spotted owl habitat were removed as a result of timber harvest. These changes in suitable spotted owl habitat are consistent with the expectations for implementation of the NWFP (USDA and USDI 1994a).

[3] Due to the query type and combination of data categories in the NWFP and Section 7 Consultation Effects Tracker system, the NWFP subtotal for removed/downgraded in Table is 11,497 acres greater than the NWFP land use allocation removed/downgraded totals (Reserves and Non-reserves) in

April 13, 2004 marked the start of the second decade of the NWFP. Decade specific baselines and summaries of effects by State, physiographic province and land use function from proposed management activities and natural events are not provided here, but can be calculated using the Service's Consultation Effects Tracking system.

Habitat loss from Federal lands due to management activities has varied among the individual provinces with most of the impacts concentrated within the Non-Reserve relative to the Reserve land-use allocations (Table). When habitat loss is evaluated as a proportion of the affected acres range-wide, the most pronounced losses have occurred within Oregon (83.24%), especially within its Klamath (48.81%) and Western Cascades (24.35%) Provinces (Table), followed by much smaller habitat losses in Washington (7.87%) and California (8.89%) (Table). When habitat loss is evaluated as a proportion of provincial baselines, the Oregon Klamath Mountains (22.27%), Oregon Eastern Cascades (7.20%), and the California Cascades (5.45%) all have proportional losses greater than the range-wide mean (4.85%)(Table).

From 1994 through August 2, 2007, habitat lost due to natural events was estimated at approximately 167,894 acres (range-wide)(Table). About two-thirds of this loss was attributed to the Biscuit Fire that burned over 500,000 acres in southwest Oregon (Rogue River basin) and northern California in 2002. This fire resulted in a loss of approximately 113,451 acres of spotted owl habitat, including habitat within five LSRs (Table). Approximately 18,630 acres of spotted owl habitat were lost due to the B&B Complex and Davis Fires in the Oregon Eastern Cascades Province (Table).

Because there is no comprehensive spotted owl habitat baseline for non-Federal lands, there is little available information regarding spotted owl habitat trends on non-Federal lands. Yet, we do know that internal Service consultations conducted since 1992, have documented the eventual loss of 419,412 acres (Table) of habitat on non-Federal lands. Most of these losses have yet to be realized because they are part of large-scale, long-term HCPs. Combining effects on Federal and non-Federal lands, the Service had consulted on the proposed removal of approximately 622,021 acres of spotted owl habitat range-wide, resulting from all management activities, from 1994 to August 2, 2007 (Table).

Other Habitat Trend Assessments. In 2005, the Washington Department of Wildlife released the report, "An Assessment of Spotted Owl Habitat on Non-Federal Lands in Washington between 1996 and 2004" (Pierce et al. 2005). This study estimates the amount of spotted owl habitat in 2004 on lands affected by state and private forest practices. The study area is a subset of the total Washington forest practice lands, and statistically-based estimates of existing habitat and habitat loss due to fire and timber harvest are provided. In the 3.2-million acre study area, Pierce et al. (2005) estimated there was 816,000 acres of suitable spotted owl habitat in 2004, or about 25 percent of their study area. Based on their results, Pierce et al. (2005) estimated there were less than 2.8 million acres of spotted owl habitat in Washington on all ownerships in 2004. Most of the suitable owl habitat in 2004 (56%) occurred on Federal lands, and lesser amounts were present on state-local lands (21%), private lands (22%) and tribal lands (1%). Most of the harvested spotted owl habitat was on private (77%) and state-local (15%) lands. A total of 172,000 acres of timber harvest occurred in the 3.2 million-acre study area, including harvest of 56,400 acres of suitable spotted owl habitat. This represented a loss of about 6 percent of the owl habitat in the study area distributed across all ownerships (Pierce et al. 2005). Approximately 77 percent of the harvested habitat occurred on private lands and about 15 percent occurred on State lands. Pierce et al. (2005) also evaluated suitable habitat levels in 450 spotted owl management circles (based on the provincial annual median spotted owl home range). Across their study area, they found that owl circles averaged about 26 percent suitable habitat in the circle across all landscapes. Values in the study ranged from an average of 7 percent in southwest Washington to an average of 31 percent in the east Cascades, suggesting that many owl territories in Washington are significantly below the 40 percent suitable habitat threshold used by the State as a viability indicator for spotted owl territories (Pierce 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 dbh, single and multi-storied canopies) on Federal lands in the NWFP area between 1994 and 2003. The increase occurred primarily in the lower end of the diameter range for older forest. The net area in the greater than 30 inch dbh size class increased by only an estimated 102,000 to 127,000 acres. The estimates were based on change-detection layers for losses due to harvest and fire 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 on a subpopulation of 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 often associated with northern spotted owl habitat, the significance of these acres to northern spotted owl conservation remains unknown.

Spotted Owl Numbers, Distribution, and Reproduction Trends. There are no estimates of the size of the spotted owl population prior to settlement by Europeans. Spotted owls are believed to have inhabited most old-growth forests or stands throughout the Pacific Northwest, including northwestern California, prior to beginning of modern settlement in the mid-1800s (USFWS 1989). According to the final rule listing the spotted owl as threatened (USFWS 1990a), approximately 90 percent of the roughly 2,000 known spotted owl breeding pairs were located on Federally managed lands, 1.4 percent on State lands, and 6.2 percent on private lands; the percent of spotted owls on private lands in northern California was slightly higher (Forsman et al. 1984, USFWS 1989, Thomas et al. 1990).

The current range of the spotted owl extends from southwest British Columbia through the Cascade Mountains, coastal ranges, and intervening forested lands in Washington, Oregon, and California, as far south as Marin County (USFWS 1990a). The range of the spotted owl is partitioned into 12 physiographic provinces (Figure 1) based on recognized landscape subdivisions exhibiting different physical and environmental features (Thomas et al. 1993).

The spotted owl has become rare in certain areas, such as British Columbia, southwestern Washington, and the northern coastal ranges of Oregon.

As of July 1, 1994, there were 5,431 known site-centers of spotted owl pairs or resident singles: 851 sites (16 percent) in Washington, 2,893 sites (53 percent) in Oregon, and 1,687 sites (31 percent) in California (USFWS 1995). The actual number of currently occupied spotted owl locations across the range is unknown because many areas remain unsurveyed (USFWS 1992b, Thomas et al. 1993). In addition, historical sites may no longer be occupied because spotted owls have been displaced by barred owls, timber harvest, or severe fires, and it is possible that some new sites have been established due to reduced timber harvest on Federal lands since 1994. The totals in USFWS (1995) represent the cumulative number of locations recorded in the three states, not population estimates.

Because the existing survey coverage and effort are insufficient to produce reliable range-wide estimates of population size, demographic data are used to evaluate trends in spotted owl populations. Analysis of demographic data can provide an estimate of the finite rate of population change (λ), which provides information on the direction and magnitude of population change. A λ of 1.0 indicates a stationary population, meaning the population is neither increasing nor decreasing. A λ of less than 1.0 indicates a decreasing population, and a λ of greater than 1.0 indicates a growing population. Demographic data, derived from studies initiated as early as 1985, have been analyzed periodically (Anderson and Burnham 1992, Burnham et al. 1994: Forsman et al. 1996, Anthony et al. 2006) to estimate trends in the populations of the spotted owl.

In January 2004, two meta-analyses modeled rates of population change for up to 18 years using the re-parameterized Jolly-Seber method (λ_{RJS}). One meta-analysis modeled all 13 long-term study areas excluding the Marin study area, while the other modeled the eight study areas that are part of the effectiveness monitoring program of the NWFP (Anthony et al. 2006). Data were analyzed separately for individual study areas, as well as across all study areas in a meta-analysis.

Point estimates of λ_{RJS} ranged from 0.896 to 1.005 for the 13 long-term study areas, and in all study areas but one—the Tyee study area—these estimates were less than 1.0 (Anthony et al. 2006). There was strong evidence that populations in the Wenatchee, Cle Elum, Warm Springs, and Simpson study areas decreased during the period of study. There also was evidence that populations in the Rainier, Olympic, Oregon Coast Range, and HJ Andrews study areas were decreasing. The precision of the λ_{RJS} estimates for Rainier and Olympic study areas was poor and not sufficient to detect a statistically significant difference from 1.00; however, the estimate of λ_{RJS} for the Rainier study area (0.896) was the lowest of all of the areas. Populations in the Tyee, Klamath, South Oregon Cascades, Northwest California, and Hoopa study areas appeared to be stationary during the study, but there was some evidence that the spotted owl population in the Northwest California study area was decreasing (λ_{RJS} = 0.959 to 1.011).

The weighted mean λ_{RJS} for all of the study areas was 0.963 (standard error [SE] = 0.009, 95 percent confidence interval [CI] = 0.945 to 0.981), suggesting that populations over all of the study areas decreased by about 3.7 percent per year from 1985 to 2003. The mean λ_{RJS} for the eight demographic monitoring areas that are part of the effectiveness monitoring program of the NWFP was 0.976 (SE = 0.007, 95 percent CI = 0.962 to 0.990), and the mean λ_{RJS} for the other five study areas was 0.942 (SE = 0.016, 95 percent CI = 0.910 to 0.974), yielding average declines of 2.4 and 5.8 percent per year, respectively. These data suggest that demographic rates for spotted owl populations on Federal lands were better than elsewhere; however, both the interspersion of non-Federal land in study areas, and the likelihood that spotted owls use habitat on multiple ownerships in some demography study landscapes, confound this comparison.

The number of populations that declined and the rate at which they have declined are noteworthy, particularly the precipitous declines in the Wenatchee, Cle Elum, and Rainier study areas in Washington and the Warm Springs study area in Oregon. Estimates of population declines in these areas ranged from 40 to 60 percent during the study period of 1990 to 2003 (Anthony et al. 2006). Decreases in apparent adult survival rates were an important factor contributing to decreasing population trends. Survival rates decreased over time in five of the 14 study areas: four study areas in Washington, which showed the sharpest declines, and one study area in the California Klamath Province of northwest California (Anthony et al. 2006). In Oregon, there were no time trends in apparent survival for four of six study areas, and remaining areas had weak, non-linear trends. In California, three study areas showed no trend and one showed a significant linear decrease (Anthony et al. 2006). Like the trends in annual rate of population change, trends in the rate of adult survival showed clear decreases in some areas but not in others.

Loehle et al. (2005a) sampled a small portion of the range of the species and questioned the accuracy of lambda estimates computed in Anthony et al. (2005, subsequently published as Anthony et al. 2006), suggesting that the estimates were biased low by 3 to 4 percentage points. Loehle et al. (2005a) contended the lambda estimates in Anthony et al. (2006) did not accurately account for spotted owl emigration. Therefore, more of the spotted owl demography study areas would have a lambda closer to 1.0, a stationary population. Loehle et al. (2005b) then published an erratum acknowledging that the more recent analysis methods used in Anthony et al. (2006) did not cause them concern regarding potentially miscalculated permanent emigration rates. Subsequently, Franklin et al. (2006) published a comment indicating the Loehle et al. (2005a) survival estimates were inappropriate for comparison because they introduced a positive bias to the measure of population change, were not valid for evaluating bias, and their study areas were too different from the demography study areas to allow for comparison.

British Columbia has a small population of spotted owls. This population is relatively isolated from populations in Washington and appears to be declining sharply; spotted owls are absent from large areas of apparently suitable habitat (Chutter et al. 2004). Breeding populations have been estimated at fewer than 33 pairs and may be declining by as much as 35 percent per year (Chutter et al. 2004). The amount of interaction between spotted owls in Canada and the United States is unknown (Chutter et al. 2004). The Canadian population has now reached the point at which it is vulnerable to random, naturally occurring demographic events that could cause further declines and perhaps extirpation. Chutter et al. (2004) suggest that immediate action is required to improve the likelihood of recovering that population in British Columbia.

Table 5. Changes to northern spotted owl suitable[1] habitat acres from activities addressed in section 7 consultations (both formal and informal) and other causes, range-wide from 1994 to August 2, 2007.

Northwest Forest Plan (NWFP) Group /Ownership		Consulted On Habitat Changes[2]		Other Habitat Changes[3]	
		Removed/ Downgraded	Maintained	Removed/ Downgraded	Maintained
Federal - Northwest Forest Plan	Bureau of Land Management	85452	29113	760	0
	Forest Service	97875	452977	29832	5481
	National Park Service	3866	3316	3	0
	Multi-agency[4]	15175	23314	0	0
	NWFP Subtotal	202368	508720	30595	5481
Other Management and Conservation Plans (OMCP)	Bureau of Indian Affairs and Tribes	109370	28349	2398	0
	Habitat Conservation Plans	295889	14430	0	0
	OMCP Subtotal	405259	42779	2398	0
Other Federal Agencies & Lands[5]		241	466	28	70
Other Public & Private Lands[6]		14153	880	30240	20949
TOTAL Changes		622021	552845	63261	26500

[1] Nesting, roosting, foraging habitat. In California, suitable habitat is divided into two components; nesting – roosting (NR) habitat, and foraging (F) habitat. The NR component most closely resembles NRF habitat in Oregon and Washington. Due to differences in reporting methods, effects to suitable habitat compiled in this, and all subsequent tables include effects for nesting, roosting, and foraging (NRF) for 1994-6/26/2001. After 6/26/2001, suitable habitat includes NRF for Washington and Oregon but only nesting and roosting (NR) for California.

[2] Includes both effects reported by USFWS (2001) and subsequent effects compiled in the Spotted Owl Consultation Effects Tracker (web application and database).

[3] Includes effects to NRF habitat (as documented through technical assistance) resulting from wildfires (not from suppression efforts), insect and disease outbreaks, and other natural causes, private timber harvest, and land exchanges not associated with consultation.

[4] The 'Multi-agency' grouping is used to lump a variety of NWFP mixed agency or admin unit consultations that were reported together prior to 6/26/2001, and cannot be split out.

[5] Includes lands that are owned or managed by other federal agencies not included in the NWFP.

[6] Includes lands not covered by Habitat Conservation Plans that are owned or managed by states, counties, municipalities, and private entities. Effects that occurred on private lands from right-of-way permits across Forest Service and BLM lands are included here.

Table 6. Acres of northern spotted owl suitable (NRF[1]) habitat loss on Federal lands from 1994 to August 2, 2007, from proposed management activities and natural events: baseline and summary of effects by State, physiographic province and land use function.

Physiographic Province[4]		Evaluation Baseline[2]			Habitat Removed/Downgraded[3]				% Provincial Baseline Affected	% of Range-wide Effects
		Reserves[5]	Non-reserves[6]	Total	Reserves[5]	Non-reserves[6]	Habitat loss to natural events[7]	Total		
WA	Olympic Peninsula	548483	11734	560217	867	24	299	1190	0.21	0.33
	Eastern Cascades	506340	200509	706849	3783	5014	5754	14551	2.06	4.06
	Western Cascades	864683	247797	1112480	1681	10804	0	12485	1.12	3.48
	Western Lowlands	0	0	0	0	0	0	0	0.00	0.00
OR	Coast Range	422387	94190	516577	479	3684	66	4229	0.82	1.18
	Klamath Mountians	448509	337789	786298	1998	71442	101676[8]	175116	22.27	48.81
	Eastern Cascades	247624	196035	443659	1243	11152	19547[9]	31942	7.20	8.90
	Western Cascades	1012426	1033337	2015763	3581	59208	24583	87372	4.33	24.35
	Willamette Valley	593	5065	5658	0	0	0	0	0.00	0.00

CA	Coast Range	47566	3928	51494	405	69	100	574	1.11	0.16
	Cascades	61852	26385	88237	0	4808	0	4808	5.45	1.34
	Klamath	734103	345763	1079866	1470	9159	15869	26498	2.45	7.39
Total		4894566	2502532	7397098	15507	175364	167894	358765	4.85	100.00

[1] Nesting, roosting, foraging habitat. In California, suitable habitat is divided into two components; nesting – roosting (NR) habitat, and foraging (F) habitat. The NR component most closely resembles NRF habitat in Oregon and Washington. Due to differences in reporting methods, effects to suitable habitat compiled in this, and all subsequent tables include effects for nesting, roosting, and foraging (NRF) for 1994-6/26/2001. After 6/26/2001, suitable habitat includes NRF for Washington and Oregon but only nesting and roosting (NR) for California.

[2] 1994 FSEIS baseline (USDA and USDI 1994b).

[3] Includes consulted-on effects reported by USFWS (2001) and subsequent effects compiled in the Northern Spotted Owl Consultation Effects Tracking System database.

[4] Defined by the NWFP as the twelve physiographic provinces, as presented in Figure 3&4-1 on page 3&4-16 of the FSEIS.

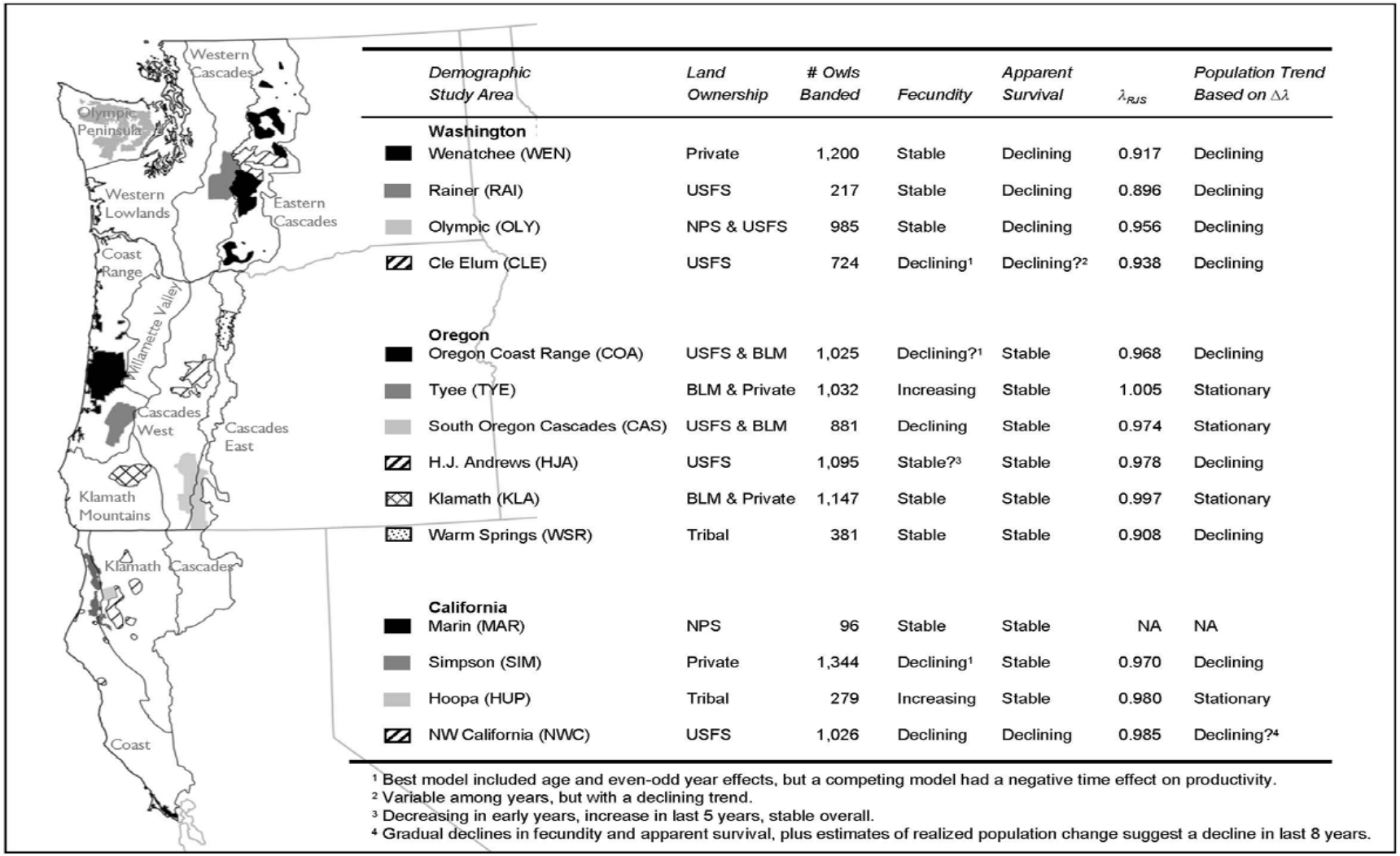
[5] Land-use allocations intended to provide large blocks of habitat to support clusters of breeding pairs

[6] Land-use allocations intended to provide habitat to support movement of spotted owls among reserves.

[7] Acres for all physiographic provinces, except the Oregon Klamath Mountains and Oregon Eastern Cascades, are from the Scientific Evaluation of the Status of the Northern Spotted Owl (Courtney et al. 2004).

[8] Acres are from the biological assessment entitled: Fiscal year 2006-2008 programmatic consultation: re-initiation on activities that may affect listed species in the Rogue-River/South Coast Basin, Medford BLM, and Rogue-Siskiyou National Forest.

[9] Acres are from the Scientific Evaluation of the Status of the Northern Spotted Owl (Courtney et al. 2004) and data in the Northern Spotted Owl Consultation Effects Tracking Database.



Demographic Study Area	Land Ownership	# Owls Banded	Fecundity	Apparent Survival	λ_{RJS}	Population Trend Based on $\Delta\lambda$
Washington						
Wenatchee (WEN)	Private	1,200	Stable	Declining	0.917	Declining
Rainer (RAI)	USFS	217	Stable	Declining	0.896	Declining
Olympic (OLY)	NPS & USFS	985	Stable	Declining	0.956	Declining
Cle Elum (CLE)	USFS	724	Declining[1]	Declining?[2]	0.938	Declining
Oregon						
Oregon Coast Range (COA)	USFS & BLM	1,025	Declining?[1]	Stable	0.968	Declining
Tyee (TYE)	BLM & Private	1,032	Increasing	Stable	1.005	Stationary
South Oregon Cascades (CAS)	USFS & BLM	881	Declining	Stable	0.974	Stationary
H.J. Andrews (HJA)	USFS	1,095	Stable?[3]	Stable	0.978	Declining
Klamath (KLA)	BLM & Private	1,147	Stable	Stable	0.997	Stationary
Warm Springs (WSR)	Tribal	381	Stable	Stable	0.908	Declining
California						
Marin (MAR)	NPS	96	Stable	Stable	NA	NA
Simpson (SIM)	Private	1,344	Declining[1]	Stable	0.970	Declining
Hoopa (HUP)	Tribal	279	Increasing	Stable	0.980	Stationary
NW California (NWC)	USFS	1,026	Declining	Declining	0.985	Declining?[4]

[1] Best model included age and even-odd year effects, but a competing model had a negative time effect on productivity.
[2] Variable among years, but with a declining trend.
[3] Decreasing in early years, increase in last 5 years, stable overall.
[4] Gradual declines in fecundity and apparent survival, plus estimates of realized population change suggest a decline in last 8 years.

Figure 1. Physiographic provinces, northern spotted owl demographic study areas, and demographic trends (Anthony et al. 2004).

Status of Northern Spotted Owl Critical Habitat

Legal Status

On January 15, 1992, the Service designated critical habitat for the spotted owl within 190 critical habitat units (CHUs) which encompass nearly 6.9 million acres across Washington (2.2 million acres), Oregon (3.3 million acres), and California (1.4 million acres) (USFWS 1992b). Only Federal lands were designated as critical habitat in the final rule (USFWS 1992b). The spotted owl critical habitat final rule states: "Section 7 analysis of activities affecting owl critical habitat should consider provinces, subprovinces, and individual CHUs, as well as the entire range of the subspecies (page 1823)." The rule goes on to assert the basis for an adverse modification opinion should be evaluated at the provincial scale (page 1823). On June 12, 2007, the Service issued a proposal to revise the existing designation of critical habitat for the spotted owl (USFWS 2007d).

We have estimated the minimum number of spotted owl sites each CHU should be able to support, based on the provincial home range size of approximately 3,000 acres and the amount of capable lands within the CHU. Capable lands are currently suitable spotted owl habitat or are capable of becoming suitable habitat in the future. Non-capable lands are areas such as open water, rock talus slopes, or soils that are not capable of producing large trees. Since there is some overlap of spotted owl home ranges, some home ranges straddle CHU boundaries, and suitable habitat is not homogenous across the landscape, more than the minimum number of owl sites may occur within a CHU.

Primary Constituent Elements

Primary constituent elements (PCEs) are the physical and biological features of critical habitat essential to a species' conservation. PCEs identified in the spotted owl critical habitat final rule include those physical and biological features that support nesting, roosting, foraging, and dispersal (USFWS 1992b). Features that support nesting and roosting habitat typically include a moderate to high canopy (60 to 90 percent); a multi-layered, multi-species canopy with large [> 30 inches diameter at breast height] overstory trees; a high incidence of large trees with various deformities (e.g., large cavities, broken tops, mistletoe infections, and other evidence of decadence); large snags; large accumulations of fallen trees and other woody debris on the ground; and sufficient open space below the canopy for owls to fly (Thomas et al. 1990). Foraging habitat generally consists of attributes similar to those in nesting and roosting habitat, but may not always support successfully nesting pairs (USFWS 1992b). Dispersal habitat, at minimum, consists of stands with adequate tree size and canopy closure to provide protection from avian predators and at least minimal foraging opportunities: there may be variations over the owl's range (e.g., drier sites in the east Cascades or northern California) (USFWS 1992b).

Conservation Role of Critical Habitat

Spotted owl critical habitat was designated based on the identification of large blocks of suitable habitat that are well distributed across the range of the spotted owl. Critical habitat units were intended to identify a network of habitats that provided the functions considered important to maintaining stable, self-sustaining, and interconnected populations over the range of the spotted owl, with each CHU having a local, provincial, and a range-wide role in spotted owl conservation. Most CHUs were expected to provide suitable habitat for population support, some were designated primarily for connectivity, and others were designated to provide for both population support and connectivity. Approximately 70 percent of extant suitable habitat in CHUs overlaps with Northwest Forest Plan (NWFP) Late-Successional Reserves on a range-wide basis and will therefore be managed to protect and enhance habitat characteristics.

Current Condition of Critical Habitat

Range-wide

In 1994, the FSEIS for the NWFP established that 3,141,987 acres of NRF habitat existed within spotted owl CHUs on federally administered public lands. To assess changes to the baseline condition since implementation of the NWFP, the Service relies on information in section 7 consultations and available information on natural events. Hereafter, effects to critical habitat refer to NRF habitat within spotted owl critical habitat.

Across the range of the spotted owl between 1994 and August 2, 2007, the Service has consulted on the removal and/or downgrading of 51,784 acres (1.65 %) of critical habitat due to management-related activities. The majority of these effects, 33,196 acres (64.10%), have been concentrated in the Oregon Western Cascades and Oregon Klamath Mountains Provinces. In addition, natural events (including fire and insect outbreaks) have resulted in the removal or downgrading of approximately 39,078 acres (1.24 %) of critical habitat extant in 1994. In general, fires have had more of an impact to spotted owl critical habitat in the interior provinces of Washington and California and the southern and interior provinces of Oregon than the coastal provinces.

Data indicate that affected suitable critical habitat acres have not been evenly distributed among the physiographic province (% of Total Effects. The majority of the effects (approximately 57.08 % totaling 51,865 acres) to suitable spotted owl critical habitat have occurred in the Oregon Klamath Mountains and Oregon Western Cascades physiographic provinces. Besides providing large blocks of suitable habitat to support population clusters and intra-provincial connectivity, these provinces also provide important inter-provincial links. The Oregon Klamath Mountains province provides a link between the Oregon Coast Range and Oregon Western Cascades provinces and south into the northern California provinces. The northern portion of the Western Oregon Cascades province provides the link to the Washington Cascades across the Columbia Gorge area of concern while the southern portion of this province shares the three linkage areas within the I-5 area of concern which connect this province with the Oregon Coast Range and Oregon Klamath Mountains provinces (USFWS 2001).

Consultation data also indicates that the percent reduction of suitable critical habitat within each physiographic province has not been evenly distributed (% Provincial Baseline Affected. Although there is not as much of a spread as the total effects, two physiographic provinces have greater than 4 percent of critical habitat removed or downgraded since 1994. Oregon Klamath Mountains has had 9.51 percent of the provincial base line affected, and Oregon Eastern Cascade has had 7.81 percent of the provincial base line affected. Of the remaining ten provinces, one (Oregon Willamette Valley) had no designated critical habitat, one (Washington Western Lowlands) had no suitable habitat within critical habitat, two had no effects to critical habitat (Washington Western Cascades and California Coast), and six provinces (Washington Olympic Peninsula, Washington Eastern Cascades, Oregon Coast Range, Oregon Western Cascades, California Cascades, and California Klamath) had less than 4 percent of the critical habitat removed or downgraded since 1994.

Provinces with the Majority of Impacts Range-wide or to Their Baseline

Oregon Klamath Mountains. The Oregon Klamath Mountains Province contains 16 CHUs and provides the link between the Oregon Western Cascades and Oregon Coast Ranges Province south into California (Tweten 1992).

Between 1994 and August 2, 2007, this province has had more critical habitat removed and/or downgraded than any other province: 28,677 acres or approximately 9 percent of its provincial baseline. Of these acres, 17,453 can be attributed to fire while the remaining 11,224 acres are associated with consulted-on activities. Consulted-on effects have been distributed across 12 CHUs. The majority of fire effects in this province can be attributed to the Biscuit Fire. This fire removed and/or downgraded approximately 23, 46, and 37 percent of the suitable habitat within OR-68, OR-69, and OR-70, respectively. These units were identified for their important contributions to inter- and intra-provincial connectivity and to provide essential NRF and dispersal habitat in areas where habitat is lacking (Tweten 1992).

Oregon Cascades West. This province is located in the geographic center of the spotted owl's range and contains more critical habitat (over 894,000 acres) than any other province. It provides links with the Washington Cascades, Oregon Coast Range, Oregon Klamath Mountains, Oregon Eastern Cascades Provinces, and connectivity with the California physiographic provinces (Tweten 1992).

Between 1994 and August 2, 2007, approximately 23,188 acres (2.59 percent of this province's baseline) have been removed and/or downgraded. Consulted-on effects have been widely dispersed within 27 of the 29 CHUs in this province. In general, this has resulted in relatively small impacts to individual units. Fire has had limited effects to spotted owl critical habitat in this province: 1,216 acres or less than 0.5 percent of the provincial baseline have been removed and/or downgraded by fire.

Oregon Eastern Cascades. The Oregon Eastern Cascades Province provides the easterly extension of the spotted owl's range in Oregon and contains all or portions of 10 CHUs.

Between 1994 and August 2, 2007, 10,833 acres or 7.81 percent of its provincial baseline have been removed and/or downgraded . The majority of these acres, approximately 6,878, are a result of several fires during 2002 and 2003. The impacts of these fires were concentrated in the central portion of this province where approximately 20 percent of the extant suitable habitat in OR-3 and OR-4 and over 36 percent of the suitable habitat in OR-7 were removed and/or downgraded. OR-3 and OR-4 were designated to maintain suitable habitat and support dispersal along the eastern slope of the Oregon Cascades (Tweten 1992). OR-7 provides a north-south link within the province and an inter-provincial link with the Oregon Cascades West Province. Consulted-on effects have occurred in 7 of the 10 CHUs in this province.

Summary

This evaluation of critical habitat indicates that there have been effects to individual CHU since 1994. However, these effects have not prevented the CHU network from providing for spotted owl recovery across the species' range. The Service reached this conclusion based on the following reasons: (1) in 2001 the Service evaluated critical habitat and concluded that "effects to critical habitat do not impair its ability to provide for conservation across the range of the (spotted) owl" (USFWS 2001), and (2) only an additional 1.69 percent of designated critical habitat has been affected range-wide since the 2001 range wide update, including consulted on management activities, fire and insect/disease.

The NWFP*'s* network of LSRs overlap designated critical habitat by about 70 percent along with owl habitat in other LUAs and in the Matrix contributing to connectivity (and some population support). Although the NWFP was designed using the ISC principles and incorporated recommendations from the owl recovery team (USFWS 1992b), it did not substitute for the network of designated critical habitat. The assessment of critical habitat condition and function for this BO was analyzed independent of the contribution that the LSR network provides to spotted owl conservation.

Baseline

Table 7 shows the status of northern spotted owl habitat and the estimated number of nest sites within the Willamette National Forest. Nest sites are based on either survey data or predicted sites from a USFWS occupancy template (USFWS, 2007e). Known sites are pairs or resident singles from historic surveys with some updates from recent surveys. According to the protocol for surveying (March 17, 1992), a historical site is only considered unoccupied if three years of surveys show no response from spotted owls. There is also an assumption that historic sites have a high likelihood of continued occupancy (Lint pers. comm. 2006).

The USFWS occupancy template methodology (USFWS, 2007e) is intended to facilitate a reasonable basis for estimating potentially occupied spotted owl habitat on a given landscape along with estimating the number of northern spotted owls that are likely to occur within the area affected by a proposed Federal action. The template relies on known spotted owl locations derived from spotted owl surveys as the foundation for the template. To estimate likely occupied habitat, outside of known home ranges, spotted owl density estimates and spotted owl habitat usage from the demography studies on the HJ Andrews study area were utilized to identify areas that could support a nesting pair. The known sites and the template sites then become the foundation upon which to conduct an effects analysis (see the Effects Analysis section).

For this consultation, the Analysis Area is a 2.4 mile buffer around all project units that may change habitat conditions for the spotted owl. The analysis area is within the H.J. Andrews northern spotted owl demographic study area and monitoring of owl populations have occurred since 1987 (Anthony et al. 2006). There are nineteen known activity centers within the Analysis Area. Occupancy modeling by USFWS predicted no new home ranges undetected by surveys so all the effects analysis are based on survey data. Steve Ackers (H.J. Andrews NSO monitoring project leader) was consulted about the activity center location for MSNO 2836 due to recent changes in the nest site for the pair. Seven spotted owl home ranges overlap project units. Table 8 shows these home ranges and the current pre-treatment habitat status for these owls within the action area.

The action area is defined in the implementing regulations for section 7 at 50 CFR 402 as, “all areas to be affected directly or indirectly by Federal action and not merely the immediate area involved in the action.” For this consultation, the action area is the footprint of the proposed timber sale, road construction, and rock quarry development plus all federal and non-federal lands within one mile. A one mile radius of the project footprint is being used since blasting can create noise above ambient levels out to about one mile.

The action area consists of the following land use allocations on Forest Service land: Adaptive Management Area and eight 100-acre LSRs. A portion of the action area is found within Critical Habitat Units OR-16. Other land ownerships in this area include private, COE and state.

The habitat condition of private ground within the affected home ranges as shown in Table 8 is almost entirely non habitat for owl sites 0104, 2034, and 2836. For owl sites 0856 and 2443 the habitat condition is approximately 70% and 80% non habitat respectively with the remaining acres likely to be harvested into non habitat in the foreseeable future, given current private timber ground harvest practices. The project analysis assumes that private lands are all non habitat for spotted owls. Owl sites 0029 and 2422 have no private ground within their designated home ranges.

No activity that would remove or downgrade northern spotted owl habitat in an Area of Concern (AOC) is proposed in this project or addressed by this assessment.

Table 7. Status of the current northern spotted owl and its habitat on the Willamette NF.

		Total Acres	Protected[1]		Unprotected[2]	
			Total Acres	% of Total[1]	Total Acres	% of Total[2]
Acres within Boundary[3]		1,799,323	854,411	47%	835,963	46%
Acres of Ownership[4]		1,685,602	852,518	51%	832,515	49%
Suitable Habitat - Capable Acres[5]		1,418,739	684,237	48%	734,158	52%
Suitable Habitat - Current Acres		817,158	443,274	54%	373,683	46%
Northern Spotted Owl Suitable Habitat within 1.2 mile of Known or Predicted Spotted Owl Sites		**Number of Sites**	**Protected**	**% of Total**	**Unprotected**	**% of Total**
Northern spotted owl Sites	Known sites	524	387	74%	137	26%
	Predicted sites	189	136	72%	53	28%
	Total	**713**	**523**	**73%**	**190**	**27%**
Spotted owl sites > 40% suitable	Known sites	424	315	74%	109	26%
	Predicted sites	111	86	77%	25	23%
	Total	**535**	**401**	**75%**	**134**	**25%**
Spotted owl sites 30-40% suitable	Known sites	60	40	67%	20	33%
	Predicted sites	19	9	47%	10	53%
	Total	**79**	**49**	**62%**	**30**	**38%**
Spotted owl sites < 30% suitable	Known sites	40	32	80%	8	20%
	Predicted sites	59	41	69%	18	31%
	Total	**99**	**73**	**74%**	**26**	**26%**

[1] Acres in this column are comprised of: Late Successional Reserves (LSR) and associated Riparian Reserves, 100-acre LSRs, Congressionally Withdrawn Areas.

[2] Acres in this column are comprised of: Matrix, Adaptive Management Areas, and Administratively Withdrawn Areas including associated Riparian Reserves. Administratively Withdrawn Areas are included in the unprotected column because technically these areas are not designed to provide spotted owl habitat but rather to serve some other function such as “recreation and visual areas, back country, and other areas where management emphasis precludes scheduled timber harvest” (USDA, and USDI 1994a, p. A-4). The administrative land and resource management plan may protect and/or reduce the likelihood that spotted owl habitat located within Administratively Withdrawn Areas would be modified.

[3] Acres include both private and federal lands. Acres are derived from corporate GIS data.

[4] Federal land only.

[5] Acres that are either currently suitable spotted owl habitat or have the potential to become suitable in the future. Suitable habitat is defined as nesting, roosting, and foraging habitat.

[6] Known sites represent pairs or resident singles 1990-2006. Predicted sites are those which represent occupancy based on habitat utilization using demographic study data – provided by the FWS.

[7] Known or predicted sites with greater than or equal to 1182 acres of suitable habitat within a 1.2 mile radius.

[8] Known or predicted sites that have between 886 and 1182 acres of suitable habitat within a 1.2 mile radius.

[9] Known or predicted sites with less than 886 acres of suitable habitat within a 1.2 mile radius.

Table 8. Current condition of Northern Spotted Owl Known Sites within the Action Area (in acres).

MSNO	NSO Habitat	Matrix	Adaptive Management Area	Late Successional Reserve	NonFS land*	Off Forest*	Grand Total Acres	Suitable Habitat % of Total
Current NSO Habitat within 200 meter Nest Patch								
0029	suitable		7	24			31	100%
0029 Total Acres		7		24			31	
0104	suitable			31			31	100%
0104 Total Acres				31			31	
0856	suitable			12			12	39%
	non-habitat		4	3			7	
	private				8		8	
	off forest					4	4	
0856 Total Acres		4		15	8	4	31	
2034	suitable		1	24			25	82%
	dispersal						0	
	non-habitat		5	1			6	
2034 Total Acres		5		26			31	
2422	suitable		8	19			27	85%
	dispersal		3				3	
	non-habitat		1				1	
2422 Total Acres		12		19			31	
2443	suitable		27	1			28	92%
	non-habitat		3				3	
2443 Total Acres		29		2			31	
2836	suitable			25			25	80%
	dispersal		2				2	
	non-habitat		4				4	
2836 Total Acres		6		25			31	
Grand Total Acres		63		142	8	4	217	
Current NSO Habitat within 0.5 mile Core Area								
0029	suitable		308	102			411	82%
	dispersal		52	0			52	
	non-habitat		41				40	
0029 Total Acres			401	102			503	
0104	suitable		92	112			203	40%
	dispersal		77				77	
	non-habitat		222	0			223	
0104 Total Acres			391	112			503	

MSNO	NSO Habitat	Matrix	Adaptive Management Area	Late Successional Reserve	NonFS land*	Off Forest*	Grand Total Acres	Suitable Habitat % of Total
0856	suitable		44	68	1		113	22%
	non-habitat		79	3	10		93	
	private		2		218		220	
	(blank)		0		0	77	77	
0856 Total Acres			125	71	229	77	503	
2034	suitable		145	99			244	49%
	dispersal		155	0			155	
	non-habitat		101	3			104	
2034 Total Acres			401	102			503	
2422	suitable		217	96			313	62%
	dispersal		160	1			161	
	non-habitat		27	2			28	
2422 Total Acres			404	99			503	
2443	suitable		108	71	0		179	36%
	dispersal		28	26			54	
	non-habitat		53	2	0		55	
	private		0	1	214		215	
2443 Total Acres			189	100	214		503	
2836	suitable		157	99			256	51%
	dispersal		166	1			167	
	non-habitat		79	1			80	
2836 Total Acres			402	101			503	
Grand Total Acres			2,313	687	443	77	3,520	
Current NSO Habitat within 1.2 mile Home Range								
0029	suitable		1,211	288			1,498	52%
	dispersal		664	74			738	
	nonhabitat		652	6			659	
0029 Total Acres			2,527	369			2,895	
0104	suitable		634	141	1		776	27%
	dispersal		747	91			839	
	nonhabitat		1,010	1			1,011	
	other agency				223		223	
	private				46		46	
0104 Total Acres			2,391	233	271		2,895	
0856	suitable		506	95	5		606	21%
	dispersal	2	438		9		449	
	nonhabitat	2	553	4	26		585	
	private		8		672		680	
	off-forest					575	575	
0856 Total Acres		3	1,505	99	713	575	2,895	

MSNO	NSO Habitat	Matrix	Adaptive Management Area	Late Successional Reserve	NonFS land*	Off Forest*	Grand Total Acres	Suitable Habitat % of Total
2034	suitable		928	99			1,028	35%
	dispersal		1,089				1,090	
	nonhabitat		732	3			735	
	private		2		41		43	
2034 Total Acres			2,752	102	41		2,895	
2422	suitable		1,388	388			1,775	61%
	dispersal		711	30			741	
	nonhabitat		371	8			378	
2422 Total Acres			2,469	426			2,895	
2443	suitable		384	75			458	16%
	dispersal		743	31			773	
	nonhabitat		322	2	3		327	
	private		1	1	1,335		1,336	
2443 Total Acres			1,449	108	1,338		2,895	
2836	suitable		1,002	157			1,160	40%
	dispersal		1,100	84			1,184	
	nonhabitat		547	3			549	
	private				2		2	
2836 Total Acres			2,649	244	2		2,895	
Grand Total Acres		3	15,743	1,581	2,365	575	20,267	

* Note that Non-FS land is within proclaimed Forest boundary. Off-Forest is outside the proclaimed Forest boundary.

Status of Spotted Owl Critical Habitat

The Standards and Guidelines for the Northwest Forest Plan (USDA & USDI 1994a: A-3) state:

> "The Fish and Wildlife Service may review and revise its critical habitat designation for the northern spotted owl, based upon the provisions of these standards and guidelines. In the interim, the combination of, and standards and guidelines for, Late-Successional Reserves, Managed Late-Successional Areas, Riparian Reserves, and matrix, should allow critical habitat to perform the biological function for which it was designated. Any site-specific considerations of critical habitat in the matrix are considered [to be] minimal and will be evaluated through watershed analysis and addressed in area-specific plans, as appropriate."

In its biological opinion of the Northwest Forest Plan (USFWS 1994:21), the Fish and Wildlife Service used four "measures of comparison" to evaluate whether or not the Late-successional Reserves and Managed Late-successional Areas, and other protective measures, would "adequately perform the biological function identified for critical habitat." These were:

1. the gross acreage provided,
2. the degree of overlap between the two designations,
3. the distribution of reserve units to maintain a well distributed population of owls on Federal lands, and
4. the ability of the two designations to provide for dispersal between adjacent areas.

Critical Habitat Units in the Action Area

The designated function of the Critical Habitat Unit (CHU) OR-16 that is affected by the proposed activities is detailed in Table 9.

Table 9. Designated functions of Critical Habitat Units that overlaps the action area.

OR-16	This critical habitat unit (CHU) was designated to maintain and provide essential NRF habitat. Unit OR-16 is located in an area of minimal north-south CHU connectivity within the Oregon Western Cascades Physiographic Province and links units OR-14 and OR-15 in the north to units OR-18 and OR-17 to the south. Unit OR-16 includes the H J Andrews Experimental Forest which contains the Central Cascades Study Area and some of the largest blocks of suitable habitat in this province. Unit OR-16 provides a major north-south link within the Western Cascades Physiographic Province with the northern portion incorporating the Santiam Pass area of concern which helps maintain the range-wide distribution of nesting habitat for the spotted owl. About 23% of this CHU overlaps with LSRs RO215 and RO217.

The current status of the CHU OR-16 within the Willamette National Forest that is affected by the proposed activities is shown in Table 10.

Table 10. Status of Critical Habitat Unit (CHU) OR-16, Willamette National Forest ownership.

NSO Habitat	Acres	% of Total	% of Capable*
suitable	52,806	55%	62%
dispersal	14,207	15%	17%
non-habitat	28,258	30%	
Total Acres	95,270		
Total Capable Acres in CHU OR-16 in WNF ownership = 85,084			

The current status of the CHU OR-16 that overlaps the analysis area is shown in Table 11.

Table 11. Critical Habitat Unit (CHU) OR-16 within the Bridge Thin project analysis area

NSO Habitat	Acres	% of Total	% of Capable*
suitable	8,664	54%	60%
dispersal	3,371	21%	23%
non-habitat	4,019	25%	
Total Acres	16,054		
Total Capable Acres in CHU OR-16 in WNF ownership intersecting the analysis area = 14,523			

The known owl sites within CHU OR-16 are shown in Table 12. There are five owl sites within the action area with home ranges that overlap CHU OR-16. Two of these sites MSNOs 0104 and 2034 are below optimal suitable acre levels; the remaining three owl sites MSNOs 0029, 2422, and 2836 are not below optimal suitable habitat acre levels as shown in Table 8.

Table 12. Known northern spotted owl sites within the entire CHU OR-16 and owl sites that overlaps the analysis area.

Known sites within the entire CHU	Known sites within CHU that overlaps analysis area	Predicted sites	Total Sites
57	12	0	57

Late Successional Reserves (LSR)

LSRs RO217, RO218 and 100-acre LSRs occur within the action area. None of the Bridge Thin proposed activities are in these LSRs so there would be no habitat effects.

There is an expectation that owl populations would be self-sustaining where the land area (assumed to be habitat-capable land area) in individual LSRs is at least 60 percent owl habitat (Lint et al.1999). Both of the LSRs that occur within the action area are above 60 percent suitable habitat.

IV. EFFECTS OF THE PROPOSED ACTION

Direct and Indirect Effects of Habitat Modification

The removal of suitable habitat has an indirect effect on northern spotted owl populations by reducing the amount of potential nesting and foraging habitat. These effects on a local owl population are greater when the amount of suitable habitat remaining post-harvest is limited in the area. Loss of nesting structure may reduce the number of breeding pairs if other nesting habitat is limited. Loss of foraging habitat could reduce the amount of food available to nearby adult and juvenile owls, which could affect their survival if other foraging options are limited.

Some habitat modification activities reduce the quality of suitable or dispersal habitat while retaining the structural characteristics of the affected stand that still allow it to support its original function. This generally includes a reduction in canopy cover to approximately >60 percent in suitable habitat and >40 percent in dispersal habitat, when other habitat elements (including snags, down wood, tree-height class-diversity, and older hardwoods) are retained, post-harvest, at levels that provide for the original function of the stand. The administrative unit biologist is responsible for ensuring prescriptive activities account for these structural elements and making correct effects determinations for each site-specific action. Since the functionality of the habitat is retained, the impacts on the ability of spotted owls to nest, forage or move across the landscape are anticipated to be insignificant.

In all cases, timber harvest within a spotted owl home range during the critical breeding season may adversely affect the reproductive capability of individual nesting owls within the disruption distance (see Table 1, page 3).

Modification of unoccupied suitable habitat is expected to have less of an impact on spotted owls because no individual spotted owls would be directly affected by the treatments and because the function of these stands would be retained, thus limiting any indirect effects.

There may also be short and/or long-term beneficial effects associated with habitat modification, particularly thinning in reserves, when they are designed to encourage faster development of late-successional characteristics. Thinning within non-matrix lands is implemented to increase growth rates and crowns by reducing competition for the retained trees, to make currently unsuitable nest trees and trees of marginal habitat quality become suitable nest trees sooner than without treatment. These thinning treatments also encourage currently suitable trees to maintain full crowns and branch development, and to create holes and gaps in the stand that will increase stand complexity and improve habitat by creating greater stand diversity for northern spotted owls and their prey base. In some cases, a short term adverse affect to the owl by light to moderate thinning may result in a long term benefit by providing structural diversity and limiting the amount of times active management (e.g., thinning) occurs in these stands.

Treatments of dispersal habitat that result in non habitat would not occur within 200 meters or 0.5 miles of known owl activity centers. Table 13 and Table 14 show proposed treatments within 0.5 miles and 1.2 miles of activity centers within the action area that would maintain dispersal habitat conditions (light/moderate thin) and remove (heavy thin).dispersal habitat in the short term.

Table 13. Treatment within 0.5 miles of activity centers within the action area.

MSNO	treatment	suitable	dispersal	non-habitat	Grand Total
2443	Light/Moderate Thin	0	20	0	20
2836	Light/Moderate Thin	0	158	0	158
Grand Total		0	178	0	178

Table 14. Treatment within 1.2 miles of activity centers within the action area

MSNO	treatment	suitable	dispersal	non-habitat	private	Grand Total
0029	Heavy Thin	0	13	0	0	13
	Light/Moderate Thin	0	79	0	0	79
0104	Heavy Thin	0	129	0	0	129
	Light/Moderate Thin	0	223	16	0	223
0856	Light/Moderate Thin	0	147	2	0	147
2034	Light/Moderate Thin	0	56	0	0	56
2422	Light/Moderate Thin	0	99	0	0	99
2443	Light/Moderate Thin	0	335	0	0	335
2836	Heavy Thin	0	96	0	0	96
	Light/Moderate Thin	0	412	0	0	412
	Fuels ReductionLt/Mod Thin	0	6	0	0	6
Grand Total		0	1594	18	0	1594

Post-treatment habitat acres are shown in Table 15 for owl home ranges in the action area. **The Bridge Thin Project does not propose to remove any suitable spotted owl habitat.** In addition, treatments of dispersal habitat that result in non habitat would not occur within 200 meters or 0.5 miles of known owl activity centers.

Table 15. Habitat in Spotted Owl Home Ranges (1.2 miles) within the Action Area after proposed treatment

MSNO	Habitat after treatment	Matrix land	Adaptive Management Area	Late Successional Reserve	NonFS land	Off-Forest	Grand Total	Suitable Habitat % of Total
0029	suitable		1,210	288			1,498	52%
	dispersal		651	74			725	
	non-habitat		666	7			672	
0029 Total			2,527	369			2,895	
0104	suitable		634	141	1		776	27%
	dispersal		619	91	0		710	
	non-habitat		1,138	1	0		1,140	
	other agency		0		223		223	
	private		0		46		46	
0104 Total			2,391	233	271		2,895	
0856	suitable		506	95	5		606	21%
	dispersal	2	438		9		449	
	off-forest					575	575	
	non-habitat	2	553	4	26		585	
	private		8		672		680	
0856 Total		3	1,505	99	713	575	2,895	
2034	suitable		928	99			1,028	35%
	dispersal		1,089	0	0		1,090	
	non-habitat		732	3	0		735	
	private		2		41		43	
2034 Total			2,752	102	41		2,895	
2422	suitable		1,388	388			1,775	61%
	dispersal		711	30			741	
	non-habitat		371	8			378	
2422 Total			2,469	426			2,895	
2443	suitable		384	75	0		458	16%
	dispersal		742	31			773	
	non-habitat		322	2	3		327	
	private		1	1	1,335		1,336	
2443 Total			1,448	108	1,338		2,894	
2836	suitable		1,002	157			1,160	40%
	dispersal		1,005	84			1,088	
	non-habitat		642	3			645	
	private		0		2		2	
2836 Total			2,649	244	2		2,895	
Grand Total		3	15,742	1,581	2,365	575	20,266	
* Within proclaimed Forest boundary								

Effects to Suitable and Dispersal Habitat in Non Critical Habitat

The effect of habitat changes are evaluated at three scales: a) nest patch area within 200 meters of activity center; b) core nesting area-0.5 miles of activity center; and c) nesting home range-1.2 miles of activity center. **The Bridge Thin project does not propose to remove or downgrade suitable spotted owl habitat**. The pretreatment habitat conditions for the owl territories within the action area are given in Table 8. The post-treatment habitat conditions for these owl territories are given in Table 15.

U. S. Fish and Wildlife Service recommends that spotted owl nest territories should average at least 50% suitable habitat in the core nest area and at least 40% suitable in the nest territory to avoid significant impact to the functionality of the home range and reproduction success of the pair to contribute to the population.

Rock Quarry Operation The existing rock quarry (unit 41) would have blasting, crushing and rock hauling occurring. This area is currently non habitat and would remain as such for the foreseeable future. The rock quarry operation will have **no effect on spotted owls.**

Road Reconstruction Roads would be cleared of vegetation, restored to grade and surfaced as needed for log or rock hauling. Road reconstruction would occur inside and outside of a CHU. No habitat would be modified therefore road reconstruction would have **no effect on spotted owls.**

Heavy Thin Big Game Forage in dispersal habitat within units (40, 42, 43, 44, 45 and 68) would enhance big game forage production on 227 acres. The post canopy closure of these seven stands could be as low as 30 percent but are expected to recover quickly (7-10 years) to the 40 percent threshold that would provide for owl dispersal, given the fast growing age of the trees. The 227 acres of Heavy Thin falls within three owl home ranges MSNO (0029, 0104, and 2836). As shown in Table 13 and Table 14, MSNO 0104 is currently below recommended levels of suitable habitat within the 0.5 mile nest core and 1.2 mile home range with suitable acres at 40% and 27% respectively. The removal of 129 acres of dispersal habitat within the home range of MSNO 0104 is **not likely to adversely affect spotted owls.** Two seasons of operation are expected for the heavy thinning.

Unit 80 (10 acres) proposes to create a big game forage area by reducing canopy closure to as low as 30 percent and maintaining the open under story through hand removal of unwanted vegetation and repeated under burning. The stand is currently functioning as dispersal habitat and is not within any known spotted owl home ranges. The over story trees are expected to achieve large diameters very quickly as there would be less competition from other trees. This legacy building feature of large trees is a positive for owls however, the multi-storied canopy and under story structure would be lacking with this park-like objective at least for the first several decades. Dispersal habitat is not limiting within or between spotted owl home ranges in the action area and therefore the unit 80 big game enhancement project is **not likely to adversely affect spotted owls.**

Light to Moderate Thinning is proposed within 1774 acres of dispersal habitat. Functionality of habitat will be maintained because the post treatment stands will have a canopy of at least 40 percent, which will provide cover and perch sites for dispersing owls; retention of snags, especially large diameter snags; retention of down wood across all condition classes: and retention of hardwoods. These are all elements positively associated with dispersal habitat and spotted owl use. The 1357 acres of light to moderate thinning in dispersal habitat falls within seven owl home ranges as shown in Table 13 and Table 14. Seven hundred and sixty one acres are proposed for light to moderate thinning within MSNOs 0104, 0856, 2034 and 2443 which are currently below recommended levels of suitable habitat within the 0.5 mile nest cores and 1.2 mile home ranges. With a 40% post harvest canopy closure maintained, light to moderate thinning of dispersal habitat within these four habitat deficient home ranges, are **not likely to adversely affect spotted owls.** Two seasons of operation are expected for the light to moderate thinning

Regeneration Savanna Restoration in dispersal habitat within units 84, 85, 86 and 89 would treat 18 acres of non suitable and 38 acres of dispersal habitat by changing a small portion of the McKenzie River / Elk Creek 6th field watershed from the current coniferous forest to its pre-settlement condition of open savanna with scattered Douglas-fir, and Oregon white oak, with a variably dense grass understory. The current overstocked condition in the Savanna Restoration project area is a result of fire suppression. The regeneration of 38 acres of dispersal habitat for oak savanna restoration would result in a post treatment canopy closure of less than 40 percent for the foreseeable future. This restoration activity is not within any known owl home ranges. Furthermore, dispersal habitat is not limiting within or between spotted owl home ranges in the action area and therefore is **not likely to adversely affect spotted owls.**

Helicopter Yarding It is assumed that a type I helicopter will be used to yard logs from the unit to the log landings. Helicopter yarding is planned for units 1,2,4,5,6,13-18,26,29-31,56,57,59,63,84, 85 and 88. No habitat will be modified with the helicopter use and therefore will have **no effect on spotted owls.**

Log and Rock Haul Log trucks would transport logs from the unit to the mill and rock trucks would transport rock to reconstruction sites. No hauling would occur within 35 yards of a known nest site. Spotted owls rarely nest at or immediately adjacent to road or edges (Kerns et al. 1992, Perkins 2000), further reducing the likelihood that hazard trees, culvert replacement and road realignments may affect nesting spotted owls. Log and rock haul associated with this project is **not likely to adversely affect spotted owls.**

Fuel Reduction/Light to Moderate Thinning in Suitable Habitat

Suitable Habitat: Functionality of suitable habitat will be maintained because the post treatment stand will have a canopy of at least 60 percent, a relatively high canopy closure; retention of snags, especially large diameter snags; retention of down wood across all condition classes: and retention of hardwoods. These are all elements positively associated with habitat function that facilitate high prey densities and therefore spotted owl use.

The Bridge Thin project proposes 38 acres (units 101 and 103) of light to moderate thinning for fuels reduction in suitable habitat. Small diameter <7” material could be mechanically removed. On site shredding/chipping of material could occur as well as piling of fuels and pile burning. Ladder fuels would be reduced and could allow the stand to be protected from future loss by catastrophic wildfire. This fuels treatment ***may affect, but is not likely to adversely affect*** the spotted owl because such actions would not change the ability of the suitable habitat to function.

Fuel Reduction/Light to Moderate Thinning in Dispersal Habitat: One hundred and forty two acres of fuel reduction thinning is planned in dispersal habitat. Small diameter <7" material could be mechanically removed with on site shredding/chipping of material as well as piling of fuels and pile burning. This fuel reduction treatment would not change the ability of the stands to function as dispersal habitat. Functionality of habitat will be maintained because post treatment the stand will have a canopy of at least 40 percent, which will provide cover and perch sites for dispersing owls; retention of snags, especially large diameter snags; retention of down wood across all condition classes: and retention of hardwoods. These are all elements positively associated with dispersal habitat function and spotted owl use and therefore, these treatments are **not likely to adversely affect spotted owls**.

Post Harvest Burning Treatment of harvest generated fuels can include grapple piling, hand piling and under burning. All harvest units are further than 0.25 miles from known activity centers except for unit 60. A seasonal restriction during the critical breeding season will be in place for unit 60 to avoid disruption to spotted owls and therefore, post-harvest burning associated with this project is **not likely to adversely affect spotted owls**.

Firewood Cutting Firewood would be cut from decks placed during timber sale operations. Firewood cutting will occur once harvest is complete or the following season if timing does not permit. No chainsaw activity will occur within 65 yards of known owl activity centers but could occur within 0.25 miles and therefore is **not likely to adversely affect spotted owls**.

Effects to Suitable and Dispersal Habitat in non Critical Habitat

Table 16 shows the projected changes in northern spotted owl suitable and dispersal habitat in each treatment unit based on the proposed activities.

Table 16. Proposed projects in non CHU northern spotted owl suitable and dispersal habitat.

Activity	NSO Habitat and Dispersal		Acres
	PreTreatment	PostTreatment	
Heavy Thin for Big Game Forage	Dispersal	Non habitat	237
Regeneration for Oak Savanna restoration	Dispersal Non habitat	Non habitat Non Habitat	38 18
Light/Mod Thin	Dispersal	Dispersal	1774
Light/Mod Thin for fuels reduction	Suitable	Suitable	38
Light/Mod Thin for fuels reduction	Dispersal	Dispersal	140

Dispersal ability of habitat after treatment:

There are 56 acres of potential future dispersal habitat removed with the savanna restoration, by maintaining an open (less than 20%) canopy closure to restore historic savanna conditions. The 10 acres of long term forage (unit 80) would maintain a stand with dominant conifers in a park like setting but not adequate canopy closure to meet preferred habitat requirements. No known spotted owl home ranges overlap these treatments. The six big game enhancement units (227 acres) will in the short term (7-10 years) reduce canopy closures to as low as 30 percent, however these fast growing trees are expected quickly attain the 40% canopy closure threshold within a few years with the benefit of a larger tree diameter given less competition from adjacent trees.

The loss of dispersal habitat from harvest activities is not expected to produce a measurable reduction in dispersal activities or prevent dispersal between known home ranges; no landscape level barriers to spotted owls dispersal would be created (Standard D).

Effects Summary

Proposed activities within non critical habitat for the Bridge Thin project are: rock quarry development, road reconstruction, regeneration for savanna restoration, helicopter yarding, log and rock haul, fuels reduction, post-harvest burning and firewood cutting which **are not likely to adversely affect spotted owls.**

Heavy Thin for Big Game Forage in Units 40, 42, 43, 44, 45 and 68 will remove 129 acres of dispersal habitat within the home range of MSNO 0104 which is below recommended habitat levels. The removal of dispersal habitat within the home range of MSNO 0104 is **not likely to adversely affect spotted owls.**

Light to moderate thinning will treat 1357 acres of dispersal habitat within four owl sites, MSNOs 0104, 0856, 2034 and 2443, which are currently below recommended levels of suitable habitat within the 0.5 mile nest cores and 1.2 mile home ranges. With a 40% post harvest canopy closure maintained, light to moderate thinning of dispersal habitat within these four habitat deficient home ranges, are **not likely to adversely affect spotted owls.**

Critical Habitat

Critical habitat is designated to provide for the conservation and eventual recovery of the species. The primary constituent elements (PCE) of spotted owl critical habitat are those physical and biological habitat features which support nesting, roosting, foraging, and dispersal. Any activity occurring within designated critical habitat that would impact any primary constituent element, or would appreciably slow or preclude the development of any primary constituent element, at the stand scale, may affect spotted owl critical habitat. Effects to critical habitat that are discountable, insignificant or entirely beneficial, at the stand scale are unlikely to adversely affect critical habitat. Effects that exceed this level, at the stand scale, are likely to adversely affect critical habitat.

There can also be short and/or long-term potential beneficial effects to critical habitat associated with habitat modification, particularly thinning designed to encourage faster development of late-successional characteristics. Thinning within non-matrix lands is implemented to increase growth rates and crowns by reducing competition for the retained trees, to make currently non-habitat nest trees and trees of marginal habitat quality become suitable nest trees sooner than without treatment. Table 17 shows acres of proposed treatment units in critical habitat.

Table 17. Acres of Proposed Treatment in Critical Habitat Unit OR-16.

Sale Unit	Activity	NSO Habitat		Total Unit Acres	Acres of unit in CHU	MSNO
		PreTreatment	PostTreatment			
46	Light/Moderate Thin	dispersal	dispersal	41	16	0104, 2836
47	Light/Moderate Thin	dispersal	dispersal	32	32	0104
48	Light/Moderate Thin	dispersal	dispersal	17	17	0104,2422,0029
57	Light/Moderate Thin	dispersal	dispersal	15	8	2034,2836
61	Light/Moderate Thin	dispersal	dispersal	16	7	2836
63	Light/Moderate Thin	dispersal	dispersal	29	29	0029,2422
60	Light/Moderate Thin	dispersal	dispersal	24	12	2836
62	Light/Moderate Thin	dispersal	dispersal	19	19	2836
64	Light/Moderate Thin	dispersal	dispersal	42	42	2422,2836
65	Light/Moderate Thin	dispersal	dispersal	10	10	2422,2836
66	Light/Moderate Thin	dispersal	dispersal	11	11	2422,2836
Total					**203**	

Specific Effects for Suitable and Dispersal Habitat in Critical Habitat

A "*may affect, not likely to adversely affect*" determination is warranted when the effects of the proposed action on the primary constituent elements of spotted owl critical habitat at the stand scale are expected to be discountable (extremely unlikely to occur), insignificant (not measurable, detectable or able to be evaluated), or completely beneficial as identified in the Endangered Species Consultation Handbook (USFWS and NMFS 1998, USFWS 2006a).

The effect of habitat changes are evaluated at three scales: a) nest patch area within 200 meters of activity center; b) core nesting area-0.5 miles of activity center; and c) nesting home range-1.2 miles of activity center. **The Bridge Thin project does not propose to treat suitable spotted owl habitat within critical habitat**. The pretreatment habitat conditions for the owl territories within the action area are given in Table 8. The post-treatment habitat conditions for these owl territories are given in Table 15

U. S. Fish and Wildlife Service recommends that spotted owl nest territories should average at least 50% suitable habitat in the core nest area and at least 40% suitable in the nest territory to avoid significant impact to the functionality of the home range and reproduction success of the pair to contribute to the population. Table 17 shows the projected changes in northern spotted dispersal habitat in each treatment unit within critical habitat unit OR-16 based on the proposed activities

Rock Quarry Operation This project has no planned rock quarry operation within critical habitat.

Road Reconstruction Road reconstruction would clear vegetation, restore grade and road surface as needed for log or rock hauling. Road reconstruction would occur inside of CHU. No habitat would be modified therefore road reconstruction would have **no effect on spotted owls.**

Heavy Thinning for Big game enhancement This project does not plan heavy thinning activities for big game enhancement within critical habitat.

Light to moderate thinning This project proposes to thin 203 acres of dispersal habitat within critical habitat. Functionality of habitat will be maintained because post treatment the stand will have a canopy of at least 40 percent, which will provide cover and perch sites for dispersing owls; retention of snags, especially large diameter snags; retention of down wood across all condition classes: and retention of hardwoods. These are all elements positively associated with dispersal habitat.

The five owl territories with home ranges within critical habitat are: MSNOs 0029, 0104, 2034, 2422 and 2836 as shown in Tables 17. Adequate levels of suitable habitat occur within the nest patches of each of these territories. Two owl sites MSNOs 0104 and 2034 are currently below the 50% level with 40% and 49% respectively for the core nesting area. These two territories are currently below the 40% suitable level for the general nesting home range percentages of 27% and 35% respectively. The acres of suitable habitat will not change post-treatment for any of the spotted owl home ranges within critical habitat (Table 15). Sixty five acres and eight acres of light to moderate thinning in dispersal habitat are proposed in the general home ranges of MSNO 0104 and 2034, respectively, in critical habitat. The light to moderate thinning will maintain a post treatment canopy of greater than 40%. Therefore, 73 acres of light to moderate thinning in dispersal habitat **may affect but is not likely to adversely affect northern spotted owls** in MSN0 territories 0104 and 2034. Two seasons of operation are expected for the light to moderate thinning in critical habitat.

Savanna Restoration: The savanna restoration units do not occur within critical habitat.

Helicopters: It is assumed that a type I helicopter will be used to yard logs from the unit to the log landings. Two helicopter units (57 and 63) are located in a CHU. No habitat will be modified with the helicopter use and therefore will have **no effect on spotted owls.**

Log and Rock Haul: Log trucks would transport logs from the unit to the mill and rock trucks would transport rock to reconstruction sites. Log and rock haul associated with this project will not modify habitat and therefore will have **no effect on spotted owls.**

Fuels Reduction Fuels reduction by light to moderate thinning is not planned in critical habitat.

Firewood Cutting Firewood would be cut from decks placed during timber sale operations. Firewood cutting will occur once harvest is complete or the following season if timing does not permit. Firewood cutting will not result in a modification of habitat and therefore will have **no effect on spotted owls**

Dispersal ability of Critical Habitat after treatment:

Light/moderate thinning would occur in 203 acres of dispersal habitat. Dispersal capacity will be maintained by canopy closure prescriptions above 40%, as well as snag, down wood and hardwood retention. There are no known dispersal barriers between owl home ranges and no landscape level barriers to spotted owls dispersal will be created (Standard E). Additionally all proposed projects are outside any area of concern.

Effects call to Critical Habitat Unit OR-16

The Bridge Thin project proposes to treat 203 acres of dispersal habitat but will maintain the 40% canopy closure thresholds, along with preferred dispersal habitat elements including snags, down wood and hardwoods. Critical Habitat Unit OR-16 continues to function well with some of the largest blocks of suitable habitat in the province and contains 57 known owl sites. The thinning of these stands is intended to encourage faster development of late-successional characteristics by increasing tree growth rates. Therefore, the Bridge Thin project ***may effect but is not likely to affect*** Critical Habitat Unit OR-16.

Disturbance

Direct and Indirect Effects of Associated Disturbance to Northern Spotted Owls

Proposed actions that would generate noise above local ambient levels might disturb spotted owls and interfere with essential nesting, roosting, or foraging behaviors. Disturbance from

proposed activities conducted within the disruption distance during the breeding period, as shown in Table 1 from an active nest, may affect, and are likely to adversely affect nesting northern spotted owls. Noise-producing activities projected for implementation during the critical breeding period (or the entire breeding period for Type I helicopters) could result in the incidental taking of spotted owls.

In the Central Cascades, 86 percent of owl young fledge (*i.e.,* leave the nest tree) by June 30 (Turner, personal comm. 1999). Based on observations (Forsman et al. 1984) that most young owls are capable of short, clumsy flights between trees within one week after fledging, it is likely that two weeks would allow sufficient development of owlets to achieve sustained flight. Therefore, the spotted owl critical period in the Willamette Province is considered to be March 1 through July 15. After July 15, it is presumed that most fledgling spotted owls are capable of sustained flight and can move away from harmful disturbances. For this reason, disturbance from the proposed actions within disruption distances of an active nest during the latter portion of the breeding period (between July 16 and September 30) may affect, but are not likely to adversely affect spotted owls, because while adverse effects are possible, they are not reasonably certain to occur.

However, disturbances associated with the use of ICS Type I helicopters[4] are considered to be of greater impact than ICS Type II – IV helicopters, due to the intensity of the noise and wind disturbance associated with rotor wash. Thus, activities requiring the use of large helicopters within disruption distances of an active nest may affect, and are likely to adversely affect nesting spotted owls during the entire breeding period (March 1 – September 30). See Table 1 for a complete listing of Disruption Distances.

Use of chainsaws within the disruption distance during the critical breeding season (March 1 – July 15) may disrupt northern spotted owl behavior and affect their ability to reproduce (USFWS 2003, 2006).

As shown in Table 1, the disruption distance for the northern spotted owl during the critical breeding period is 35 yards for use of heavy equipment, which in this case includes drilling, rock crushing, and hauling of rock. Blasting has a disruption distance of 1 mile.

In a white paper, the USFWS (2003) analyzed the research on spotted owl disturbance factors. The document states, "...we estimated these sound-only levels to be: 40 dB for the ambient sound level; 44 dB for the detect threshold; 57 dB for the alert threshold; 70 dB for the disturbance threshold; and 92 for the injury threshold."

The Willamette Province Level One Team has interpreted this information and assigned a threshold for disturbance effects calls (Table). When the sound levels reach the disturbance threshold of 70 decibels, the effects determination is *May Affect, Not Likely to Adversely Affect* Northern Spotted Owls. When the sound level reaches 92 decibels and above, the effects determination is *May Affect, Likely to Adversely Affect* Northern Spotted Owls. If sound levels are below 70 decibels, no effect is anticipated. These effects determinations are reflected in the disturbance/disruption distance charts shown in the current Willamette Province Batched Biological Assessment for Disturbance (USDA and USDI 2006) and in Table 18.

[4] Incident Command System definitions: A Type I helicopter seats at least 16 people and has a minimum capacity of 5,000 lbs. Both a CH-47 (Chinook) and UH-60 (Blackhawk) are Type I helicopters. A Type II helicopter seats at least 10 people and has a minimum capacity of 2,500 lbs. Both an UH1-H and a Bell 212 are Type II helicopters. A Type III helicopter seats at least 5 people and has a minimum capacity of 1,200 lbs. Both a 206 and a Hughes 500 are Type III helicopters. A Type IV helicopter seats at least 3 people and has a minimum capacity of 600 lbs.
Kmax helicopters are considered Type I helicopters according to the ICS definition but are considered Type II for the purposes of disturbance. Sound readings from Kmax helicopter logging on the Olympic NF registered 86 decibels at 150 yards (Piper 2006). The threshold for disruption is 92 decibels.

Table 18. Effects Determination to Northern Spotted Owls by Decibel Level.

Decibel Measurement	Effect Determination
92	May Affect, Likely to Adversely Affect
70-91	May Affect, Not Likely to Adversely Affect
Below 70	No Effect

Underground drilling into rocks is expected to result in a sound level of approximately 90 dB which may affect the northern spotted owl. The effects of blasting carry further, but can vary widely depending on the actual blasting charge and surrounding terrain. Decibel levels at 0.25 mile distance may range from 90-150 dB and are of shorter duration. Rock crushing may have a noise level between 60-90 dB, depending on distance.

Proposed actions within suitable habitat with no history of an owl nest site or activity center have the potential to occur within the disruption distance of an active nest site during the breeding season. Based on density studies from the western Cascades Physiographic Province demographic study, the nest density of northern spotted owls is 0.0104 territories per km^2 or 1 territory per 2,377.15 acres (Anthony and Forsman 1997). Assuming that 50 percent of pairs breed/nest in a given year, these studies posit one spotted owl nesting pair per 4,754.3 acres. Therefore, since the proposed projects and their associated activities are scattered throughout the action area and the disturbance "foot print" of the project is only a small percent of the area associated with a potential nesting pair, without additional site specific information, it is not reasonably certain that disturbance will adversely affect a nesting pair of spotted owls. Therefore, disturbance ***may affect but is not likely to adversely*** affect spotted owls outside of occupied sites.

Disturbance from proposed actions conducted outside of the breeding period (between October 1 and February 28) or more than the disturbance distances from a nest site during any time of the year would have ***no effect*** on northern spotted owls.

Projects that may affect spotted owls due to disruption or disturbance

Rock Quarry Operation

Table 19 summarizes disturbance-related activities that are proposed. For blasting, Table 1 shows a disruption/disturbance distance of 1 mile. A known owl activity center 0104 is just within one mile from the rock pit source. One season of blasting operations is expected but there will be a seasonal restriction for project-related blasting during the critical breeding period. Therefore, this activity ***may effect but is not likely to adversely affect*** spotted owls. The disruption distances for rock crushing, pile driving, and heavy equipment are 120, 60, and 35 yards, respectively. The disturbance distance for these three activities is 0.25 miles. These mechanical activities of rock source development at the project rock pit are expected to have ***no effect*** on northern spotted owls given location of rock quarry to known spotted owl sites.

Road Reconstruction

The disruption and disturbance distances (Table 1) for the northern spotted owl for heavy equipment used in road reconstruction are 35 yards and 0.25 miles, respectively. The disruption and disturbance distances for chain saws that might be used to fall hazard trees or cut downed trees along the road ways during reconstruction are 65 yards and 0.25 miles, respectively. All known owl activity centers are more than 65 yards from road reconstruction areas so no disruptions to nesting northern spotted owls are expected. One season of

operation is expected. Noise from road reconstruction may affect owls by disturbance, but, due to the distance from known nesting sites, this action ***may affect*** **but is** ***not likely to adversely affect*** northern spotted owls.

Timber Falling, Harvesting and Cable Yarding

The project design does not seasonally restrict timber harvest, including tree falling and ground based-logging. No activities are proposed during the critical breeding period within 35 yards of activity centers for heavy equipment or 65 yards of activity centers for chainsaws. Therefore, timber falling and cable yarding are **not likely to adversely affect** spotted owls.

Savanna Restoration

All savanna restoration units will have some amount of helicopter logging associated with them. There is a no seasonal restriction being recommended because there are no known owl activity centers in the vicinity of the project. The type of helicopter used is at the purchaser's discretion. Therefore in this analysis it is assumed that a Type I helicopter will be used to log these units.

Additionally, prescribed burning of this oak savanna will likely occur separately, at a different time than harvest activities. Depending on the fuels prescription, this unit may be burned during the critical breeding season. Since the disruption distance for burning during the critical breeding season is 0.25 miles (Table 1), this activity is well outside disturbance and disruption distances of known owl sites.

All other associated activities are outside the disturbance and disturbance distances for northern spotted owls. Therefore, these activities will have **no effect** to spotted owls due to disturbance. The savanna project could occur over one to three years depending on packaging of the sale units and burning conditions.

Helicopter Yarding

The disturbance distance for Type 1 helicopter-yarding is 0.5 miles (Table 1). Yarding with Type 1 helicopters between 0.25 miles and 0.5 miles of known owl activity centers during the breeding season **may affect but is not likely to adversely affect** spotted owls**.** There are six units (13, 14, 17, 56, 57 and 59) between 0.25 miles and 0.5 miles of known owl activity centers that are planned for helicopter yarding. However, there will be no helicopter activity within the disruption distance (0.25 mile) of any known site during the critical breeding period. All other helicopter yarding units are more than 0.5 miles from any known nest activity center.

Log and Rock Haul

Log haul along roads regularly used by the public is not expected to increase noise above ambient levels and should have no effect on northern spotted owls. Log haul along reconstructed roads will increase noise levels at about the same level as heavy equipment (Table 1). The risk of disturbances and disruptions to owl nest sites is similar to that discussed above for heavy equipment during road reconstruction. No other impacts to owls from log hauling are expected. Therefore, log hauling ***may affect, but is not likely to adversely affect*** northern spotted owls. Log haul could be expected to occur over three seasons depending on the timing of harvest and the decking of logs.

No hauling would occur within 35 yards of a known nest site. Spotted owls rarely nest at or immediately adjacent to road or edges (Kerns et al. 1992, Perkins 2000), further reducing the likelihood that hazard trees, culvert replacement and road realignments may affect nesting spotted owls

Fuels reduction

Small diameter <7" material could be mechanically removed with on site shredding/chipping of material as well as piling of fuels and pile burning. This fuel reduction treatment would not change the ability of the stands to function as either suitable or dispersal habitat. There are no known spotted owl activity centers within 0.25 miles of these fuel reduction units therefore, these treatments are expected to have **no effect on spotted owls**.

Prescribed Burning

The disruption and disturbance distance from burning is 0.25 miles during the critical and latter breeding periods, respectively (Table 1). Prescribed burning to treat harvest generated fuels could occur on Unit 60 which is within 0.25 miles of a known activity center.. A seasonal restriction will be in place on Unit 60 for the critical breeding season and therefore, the prescribed burning of Unit 60 ***is not likely to adversely affect*** northern spotted owls. In addition, burning may involve limited chainsaw work to clear brush and woody debris. All other timber harvest units where slash may be burned post-treatment are greater than 0.25 miles from any northern spotted owl activity center so **no effects** are expected to the species from burning logging-generated slash in these harvest units. Prescribed burning could occur over two seasons if weather is not favorable.

Firewood Cutting

Firewood would be cut from decks placed during timber sale operations. Firewood cutting will occur once harvest is complete or the following season if timing does not permit. No chainsaw activity will occur within 65 yards of known owl activity centers but could occur within 0.25 miles and therefore is ***not likely to adversely affect spotted owls***

A summary of disturbance determinations by activities as discussed above are summarized below in Table 19.

Table 19. Summary of Disturbance-Related Effects Determinations to Northern Spotted Owls by Activity.

Activity	MSNOs affected	Number of Seasons affected	Effect Determination
Rock Quarry Operations	0104 , 2836	1 Seasonal restriction during critical breeding	May Affect, Not Likely to Adversely Affect.
Road Reconstruction	0029,0104,0856,2034,2422, 2443,2836	1	May Affect, Not Likely to Adversely Affect
Heavy Thin of Dispersal for Big Game forage Enhancement	0029, 0104, 2836	2	May Affect, Not Likely to Adversely Affect
Light/Moderate Thinning of Dispersal	0029,0104,0856,2034, 2422, 2433,2836	2	May Affect, Not Likely to Adversely Affect
Regeneration Harvest of Dispersal for Oak Sananna Restoration	None	3	No Effect
Helicopter Yarding between 0.25 and 0.5 miles	2836,2443	1	May Affect, Not Likely to Adversely Affect
Log Haul	0029,0104,0856,2034,2422, 2443,2836	3	May Affect, Not Likely to Adversely Affect
Fuels reduction Lt/Mod Thin	None within 0.25 miles	1	No Effect
Post Harvest Burning	2836 (unit 60 within 0.25 miles)	2 Unit 60 will have seasonal restriction during critical breeding season	May Affect, Not Likely to Adversely Affect
Firewood Cutting	None within 65yds	3	May Affect, Not Likely to Adversely Affect

V. CUMULATIVE EFFECTS

Cumulative effects include the effects of future State, local or private actions that are reasonably certain to occur in the action area considered in this biological assessment. Future Federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 7 of the ESA.

While the U.S. Fish and Wildlife Service, BLM and U.S. Forest Service do not have the authority under the ESA to affect private actions, cumulative effects analysis of foreseeable State and private actions provide the federal agencies greater insight toward understanding the current environmental baseline and likely trends. This insight is necessary to provide the federal agencies with a broader context in which to fully evaluate the impact of the Federal action.

Habitat for spotted owls has not been comprehensively classified or surveyed on state or private lands. Most lands, including the larger state and private timber company holdings, have been harvested within the past 50 years, and are now in shrub, pole, or large pole condition classes. Some mature forested stands exist on county, state, or private land, but these stands represent a small proportion of non-federal land ownership. The mature stands provide limited amounts of suitable habitat for listed forest species. Mature and large pole stands are presently being logged at an accelerated rate due to present economic conditions. This trend is expected to continue into the foreseeable future.

The majority of late successional/old-growth forests on state and private land in Washington, Oregon, and Northern California are used for timber production (Thomas *et al.* 1990; USDA and USDI 1994b). Historically, non-federal landowners have practiced even-aged management (clear cutting) of timber over extensive acreage. Given current market conditions, it is reasonable to assume that these past management practices are likely to continue, thereby reducing the amount of suitable habitat for spotted owls on non-federal lands over time. Before the spotted owl was listed as a threatened species under the ESA, Thomas *et al.* (1990) estimated that most non-federal spotted owl habitat in Oregon would be eliminated within 10 years. Although the trend to harvest continues, not all non-federal owl habitat was harvested during the 1990s. Hence, harvest activities on non-federal lands can be expected to continue to impact spotted owls located within adjacent Federal lands through the continued reduction and fragmentation of habitat.

It is generally recognized that Federal lands will make significant contributions to the recovery of spotted owls through implementation of the NWFP. However, non-federal lands are important where Federal lands are absent or where suitable habitat on Federal lands is believed insufficient to maintain local populations or, in the case of the spotted owl, provide demographic support across and between physiographic provinces (Thomas *et al.* 1990). While contributions on all non-federal land may not be critical across the range of these species, contributions in certain regions may provide demographic support to Late-successional Reserves which are not yet fully functional and providing necessary connectivity between Late-successional Reserves.

VI. CITATIONS

AFRC (American Forest Resource Council). 2004. Estimating timber harvest activity in selected Spotted Owl demographic areas, 1993-2003. Prepared by: Mason, Bruce and Girard, Inc.

Anderson, D.R. and K.P. Burnham. 1992. Demographic analysis of northern spotted owl populations. Pages 66-75 *in* Draft final recovery plan for the northern spotted owl: Appendix C. U.S. Fish and Wildlife Service, Portland, Oregon.

Anthony, R., S. Ackers, R. Claremont, D. McCoskey, N. Nielsen-Pincus, T. Plawman, and A. Smoluk. 2006. The demography of northern spotted owls (*Strix occidentalis caurina*) on the Willamette National Forest; Annual Research Report-Unpublished. Oregon State University. 43 pp.

Anthony, R.G., and E.D. Forsman. 1997. The ecology of northern spotted owls on the Willamette National Forest, Oregon: habitat use and demography. Annual Progress Report. Oregon Coop. Fish and Wildlife Research Unit, Oregon State Univ., Corvallis, OR.

Anthony, R.G., and L.S. Andrews. 2004. Summary Report – Winter habitat use by spotted owls on USDI Bureau of Land Management Medford District Lands within the boundaries of the Timbered Rock Fire. Unpublished report, OCWRU, OSU, Corvallis, Oregon. 29pages.

Anthony, R.G., E.D. Forsman, A.B. Franklin, D.R. Anderson, K.P. Burnham, G.C. White, C.J. Schwarz, J. Nichols, J.E. Hines, G.S. Olson, S.H. Ackers, S. Andrews, B.L. Biswell, P.C. Carlson, L.V. Diller, K.M. Dugger, K.E. Fehring, T.L. Fleming, R.P. Gerhardt, S.A. Gremel, R.J. Gutiérrez, P.J. Happe, D.R. Herter, J.M. Higley, R.B. Horn, L.L. Irwin, P.J. Loschl, J.A. Reid, and S.G. Sovern. 2004. Status and trends in demography of northern spotted owls, 1985-2003. Final Report to the Interagency Regional Monitoring Program, Portland, Oregon. September 2004. 179pp.

Anthony, R.G., E.D. Forsman, A.B. Franklin, D.R. Anderson, K.P. Burnham, G.C. White, C.J. Schwarz, J. Nichols, J.E. Hines, G.S. Olson, S.H. Ackers, S. Andrews, B.L. Biswell, P.C. Carlson, L.V. Diller, K.M. Dugger, K.E. Fehring, T.L. Fleming, R.P. Gerhardt, S.A. Gremel, R.J. Gutiérrez, P.J. Happe, D.R. Herter, J.M. Higley, R.B. Horn, L.L. Irwin, P.J. Loschl, J.A. Reid, and S.G. Sovern. 2006. Status and trends in demography of northern spotted owls, 1985-2003. Wildlife Monograph 163: 1-48.

Anthony, R.G., Forsman, E.D., Franklin, A.B., Anderson, D.R., Burnham, K.P., White, G.C., Schwarz, C.J., Nichols, J.D., Hines, J.E., Olson, G.S., Ackers, S.H., Andrews, L.S., Biswell, B.L., Carlson, P.C., Diller, L.V., Dugger, K.M., Fehring, K.E., Fleming, T.L., Gerhardt, R.P.,Gremel, S.A., Gutiérrez, R.J., Happe, P.J., Herter, D.R., Higley, J.M., Horn, R.B., Irwin, L.L., Loschl, P.J., Reid, J.A., and Sovern, S.G. 2005. Status and trends in demography of northern spotted owls, 1985–2003. Wildl. Monogr. In press.

Barrowclough, G. F. and R. J. Gutiérrez. 1990. Genetic variation and differentiation in the spotted owl. Auk 107:737-744.

Barrowclough, G.F., J.G. Groth, and R.J. Gutiérrez. 2005. Genetic structure, introgression and a narrow hybrid zone between northern and California spotted owls (*Strix occidentalis*). Molecular Ecology 14:1109–1120.

Barrowclough, G.F., R.J. Gutiérrez, and J.G. Groth. 1999. Phylogeography of spotted owl (Strix occidentalis) populations based on mitochondrial DNA sequences; gene flow, genetic structure, and a novel biogeographic pattern. Evolution 53(3):919-931.
Barrows, C. W., and K. Barrows. 1978. Roost characteristics and behavioral thermoregulation in the spotted owl. Western Birds 9:1-8.
Bart, J. 1995. Amount of suitable habitat and viability of northern spotted owls. Conservation Biology 9 (4):943-946.
Bart, J., and E.D. Forsman. 1992. Dependence of northern spotted owls Strix occidentalis caurina on old-growth forests in the western USA. Biological Conservation 62:95-100.
Bigley, R. and J. Franklin. 2004. Habitat trends. In: Courtney, S.P., J.A. Blakesley, R.E. Bigley, M.L. Cody, J.P. Dumbacher, R.C. Fleischer, A.B. Franklin, J.F. Franklin, R.J. Gutiérrez, J.M. Marzluff, L. Sztukowski. 2004. Scientific evaluation of the status of the northern spotted owl. Sustainable Ecosystems Institute. Portland, Oregon. September 2004.
Bingham, B.B., and B.R. Noon. 1997. Mitigation of habitat “take”: Application to habitat conservation planning. Conservation Biology 11 (1):127-138.
Bond, M.L., R.J. Gutierrez, A.B. Franklin, W.S. LaHaye, C.A. May, and M.E. Seamans. 2002. Short-term effects of wildfires on spotted owl survival, site fidelity, mate fidelity, and reproductive success. Wildlife Society Bulletin 30(4):1022-1028.
Buchanan, J., E. Hanson, D. Hays, and L. Young. 1994. An evaluation of the Washington Forest Practices Board Wildlife Committee preferred alternative for a spotted owl protection rule. Washington Forest Practices Board Spotted Owl Scientific Advisory Group. Olympia, Washington.
Buchanan, J.B. 2004. In my opinion: Managing habitat for dispersing northern spotted owl – are the current management strategies adequate? Wildlife Society Bulletin 32(4):1333-1345.
Buchanan, J.B. and P. Swedeen. 2005. Final briefing report to the Washington State Forest Practices Board regarding spotted owl status and forest practices rules. Washington Department of Fish and Wildlife, Olympia. 84 pp.
Buchanan, J.B., L.L. Irwin, and E.L. McCutchen. 1995. Within-stand nest site selection by spotted owls in the eastern Washington Cascades. Journal of Wildlife Management 59:301-310.
Burnham, K.P., D.R. Anderson, and G.C. White. 1994. Estimation of vital rates of the northern spotted owl. Colorado Cooperative Fish and Wildlife Research Unit, Colorado State University, Fort Collins, Colorado, USA.
Caffrey, C. 2003. Determining impacts of west Nile Virus on crows and other birds. American Birds (103rd Count) 57:14-21.
Caffrey, C. and C.C. Peterson. 2003. west Nile Virus may not be a conservation issue in northeastern United States. American Birds (103rd Count) 57:14-21.
California Department of Forestry and Fire Protection. 2007. California Forest Practices Rules: 2001. Title 14, California Code of Regulations, Chapters 4, 4.5, and 10. Sacramento, California.
Campbell, N. A. 1990. Biology. The Benjamin/Cummings Publishing Company, Inc. Redwood City, California.

Carey, A.B., J.A. Reid, and S.P. Horton. 1990. Spotted owl home range and habitat use in southern Oregon coast ranges. Journal of Wildlife Management 54:11–17.

Carsia, R. V., and S. Harvey. 2000. Adrenals. Chapter 19 *in* G. C. Whittow, editor. Sturkie's Avian Physiology. Academic Press, San Diego, CA.

Chi, T., A. Henke, J. Smith, and C. Brinegar. 2004. Spotted owl mitochondrial DNA haplotyping. San Jose State University. Unpublished results submitted to U.S. Fish and Wildlife Service.

Chutter, M.J., I. Blackburn, D. Bonin, J. Buchanan, B. Costanzo, D. Cunnington, A. Harestad, T. Hayes, D. Heppner, L. Kiss, J. Surgenor, W. Wall, L. Waterhouse, and L. Williams. 2004. Recovery strategy for the northern spotted owl (*Strix occidentalis caurina*) in British Columbia. British Columbia Ministry of Environment, Victoria. 74 pp.

Courtney, S.P. and R.J. Gutiérrez. 2004. Scientific evaluation of the status of the northern spotted owl – threats. In: Courtney, S.P., J.A. Blakesley, R.E. Bigley, M.L. Cody, J.P. Dumbacher, R.C. Fleischer, A.B. Franklin, J.F. Franklin, R.J. Gutiérrez, J.M. Marzluff, L. Sztukowski. 2004. Scientific evaluation of the status of the northern spotted owl. Sustainable Ecosystems Institute. Portland, Oregon. September 2004.

Courtney, S.P., J.A. Blakesley, R.E. Bigley, M.L. Cody, J.P. Dumbacher, R.C. Fleischer, A.B. Franklin, J.F. Franklin, R.J. Gutiérrez, J.M. Marzluff, and L. Sztukowski. 2004. Scientific evaluation of the status of the northern spotted owl. Sustainable Ecosystems Institute. Portland, Oregon. September 2004.

Crozier, M.L., M.E. Seaman, R.J. Gutierrez, P.J. Loschl, R. B. Horn, S.G. Sovern, and E.D. Forsman. 2006. Does the presence of barred owls suppress the calling behavior of spotted owls? The Condor 108:760-769.

Delaney, D. K., T. G. Grubb, P. Beier, L. L. Pater, and M. H. Reiser. 1999. Effects of helicopter noise on Mexican spotted owls. Journal of Wildlife Management 63:60-76.

Deubel, V., L. Fiette, P. Gounon, M.T. Drouet, H. Khun, M. Huerre, C. Banet, M. Malkinson, and P. Despres. 2001. Variations in biological features of west Nile viruses. Annals of the New York Academy of Sciences 951:195-206.

Diller, L.V. and D.M. Thome. 1999. Population density of northern spotted owls in managed young-growth forests in coastal northern California. Journal of Raptor Research 33: 275–286.

Dugger, K.M., F. Wagner, R.G. Anthony, and G.S. Olson. 2005. The relationship between habitat characteristics and demographic performance of northern spotted owls in southern Oregon. The Condor 107:863-878.

Dunbar, D.L., B.P. Booth, E.D. Forsman, A.E. Hetherington, and D.J. Wilson. 1991. Status of the spotted owl, Strix occidentalis, and barred owl, Strix varia, in southwestern British Columbia. Canadian Field Naturalist 105:464-468.

Fitzgerald, S.D., J.S. Patterson, M. Kiupel, H.A. Simmons, S.D. Grimes, C.F. Sarver, R.M. Fulton, B.A. Fulton, B.A. Steficek, T.M. Cooley, J.P. Massey, and J.G. Sikarskie. 2003. Clinical and pathological features of west Nile Virus infection in native North American owls (family Strigidae). Avian Diseases 47:602-610.

Folliard, L. 1993. Nest site characteristics of northern spotted owls in managed forest of northwest California. M.S. Thesis. Univ. Idaho, Moscow, ID.

Forsman, E.D. 1975. A preliminary investigation of the spotted owl in Oregon. M.S. thesis, Oregon State University, Corvallis. 127 pp.
Forsman, E.D. 1981. Molt of the spotted owl. Auk 98:735-742
Forsman, E.D., E.C. Meslow, and H.M. Wight. 1984. Distribution and biology of the spotted owl in Oregon. Wildlife Monographs 87:1-64.
Forsman, E.D., I.A. Otto, S.G. Sovern, M. Taylor, D.W. Hays, H. Allen, S.L. Roberts, and D.E. Seaman. 2001. Spatial and temporal variation in diets of spotted owls in Washington. Journal of Raptor Research 35(2):141-150.
Forsman, E.D., R. G. Anthony, J. A. Reid, P. J. Loschl, S. G. Sovern, M. Taylor, B. L. Biswell, A. Ellingson, E. C. Meslow, G. S. Miller, K. A. Swindle, J. A. Thrailkill, F. F. Wagner, and D. E. Seaman. 2002. Natal and breeding dispersal of northern spotted owls. Wildlife Monographs, No. 149. 35 pages.
Forsman, E.D., R.G. Anthony, E.C. Meslow, and C.J. Zabel. 2004. Diets and foraging behavior of northern spotted owls in Oregon. Journal of Raptor Research 38(3):214-230.
Forsman, E.D., S. DeStefano, M.G. Raphael, and R.J. Gutierrez, (editors). 1996. Demography of the northern spotted owl. Studies in Avian Biology No. 17. Cooper Ornithology Society.
Franklin, A.B. 1992. Population regulation in northern spotted owls: theoretical implications for management. Pp 815-827 in D. R. McCullough and R. H. Barrett (eds.)., Wildlife 2001: populations. Elsevier Applied Sciences, London, England.
Franklin, A.B., D.R. Anderson, R.J. Gutiérrez, and K.P. Burnham. 2000. Climate, habitat quality, and fitness in northern spotted owl populations in northwestern California. Ecological Monographs, 70(4): 539-590.
Franklin, A.B., J.D. Nichols, R.G. Anthony, K.P. Burnham, G.C. White, E.D. Forsman, and D.R. Anderson. 2006. Comment on “Are survival rates for northern spotted owls biased?” Canada Journal or Zoology. 84:1375-1379.
Franklin,A.B., K.P. Burnham, G.C. White, R.J. Anthony, E.D. Forsman, C. Schwarz, J.D. Nichols, and J. Hines. 1999. Range-wide Status and Trends in Northern spotted owl Populations. Colorado Cooperative Fish and Wildlife Research Unit. U.S. Geological Survey - Biological Resources Division.
Gaines, W.L., R.A. Strand, and S.D. Piper. 1997. Effects of the Hatchery Complex Fires on northern spotted owls in the eastern Washington Cascades. Pages 123-129 in Dr. J.M. Greenlee, ed. Proceedings of the First Conference on Fire Effects on Rare and Endangered Species and Habitats, November 13-16, 1995. International Association of Wildland Fire. Coeur d’Alene, ID.
Garmendia, A.E., H.J. Van Kruiningen, R.A. French, J.F. Anderson, T.G. Andreadis, A. Kumar, and A.B. west. 2000. Recovery and identification of west Nile virus from a hawk in winter. Journal of Clinical Microbiology 38:3110-3111.
Glenn, E.M, M.C. Hansen, and R.G. Anthony. 2004. Spotted owl home-range and habitat use in young forests of western Oregon. Journal of Wildlife Management 68(1):33-50.
Goheen, E.M., E.M. Hansen, A. Kanaskie, M.G. Williams, N. Oserbauer, and W. Sutton. 2002. Sudden oak death caused by Phytophthora ramorum in Oregon. Plant Disease 86:441.

Gremel, S. 2005. Factors controlling distribution and demography of northern spotted owls in a reserved landscape. M.S. thesis, University of Washington, Seattle. 49 pp.
Gutierrez, R. J., A. B. Franklin, and W. S. LaHaye. 1995. Spotted Owl (Strix occidentalis). In The Birds of North America, no. 179. (A. Poole and E Gill, Eds.). Academy of Natural Sciences, Philadelphia, and American Ornithologists' Union, Washington, D.C.
Gutiérrez, R. J., M. Cody, S. Courtney, and D. Kennedy. 2004. Assessment of the potential threat of the northern barred owl. In: Courtney, S.P., J.A. Blakesley, R.E. Bigley, M.L. Cody, J.P. Dumbacher, R.C. Fleischer, A.B. Franklin, J.F. Franklin, R.J. Gutiérrez, J.M. Marzluff, L. Sztukowski. 2004. Scientific evaluation of the status of the northern spotted owl. Sustainable Ecosystems Institute. Portland, Oregon. September 2004.
Gutiérrez, R.J. 1989. Hematozoa from the spotted owl. Journal of Wildlife Diseases 24:614–618.
Gutiérrez, R.J. 1996. Biology and distribution of the northern spotted owl. Pages 2-5 in E.D. Forsman, S. DeStefano, M.G. Raphael, and R.J. Guiterrez (Eds): Studies in Avian Biology No. 17.
Haig, S.M., R.S. Wagner, E.D. Forsman, and T.D. Mullins. 2001. Geographic variation and genetic structure in spotted owls. Conservation Genetics 2(1): 25-40.
Haig, S.M., T.D. Mullins, E.D. Forsman, P. Trail, and L. Wennerberg. 2004. Genetic identification of Spotted Owls, Barred Owls, and their hybrids: evolutionary and legal implications. Conservation Biology.
Hamer, T. E. 1988. Home range size of the northern barred owl and northern spotted owl in western Washington. M.S. Thesis. western Washington University, Bellingham, WA.
Hamer, T. E., E. D. Forsman, A. D. Fuchs, and M. L. Walters. 1994. Hybridization between barred and spotted owls. Auk 111(2):487-492.
Hamer, T.E., D.L. Hays, C.M. Senger, and E.D. Forsman. 2001. Diets of northern barred owls and northern spotted owls in an area of sympatry. Journal of Raptor Research 35(3):221-227.
Hamer, T.E., S.G. Seim, and K.R. Dixon. 1989. Northern spotted owl and northern barred owl habitat use and home range size in Washington: preliminary report. Washington Department of Wildlife, Olympia, Washington.
Hanson, E., D. Hays, L. Hicks, L. Young. and J. Buchanan. 1993. Spotted Owl Habitat in Washington: A Report to the Washington Forest Practices Board. Washington Forest Practices Board, Spotted owl Advisory Group. Final Report: December 20, 1993. Olympia, Washington. 116 pages.
Harestad, A., J. Hobbs, and I. Blackburn. 2004. Précis of the Northern spotted owl in British Columbia. Pages. 12-14 in Zimmerman, K., K. Welstead, E. Williams, J. Turner, (editors). Northern spotted owl Workshop Proceedings. Forrex Series (online No. 14), Vancouver, British Columbia, Canada.
Henke, A.L., T.Y. Chi, J. Smith, C. Brinegar. Unpublished Draft. Microsatellite Analysis of Northern and California Spotted Owls in California. Conservation Genetics Laboratory, Department of Biological Sciences, San Jose State University, San Jose, California.

Hershey, K.T., E.C. Meslow, and F.L. Ramsey. 1998. Characteristics of forests at spotted owl nest sites in the Pacific Northwest. Journal of Wildlife Management 62(4):1398-1410.
Herter, D.R., and L.L. Hicks. 2000. Barred owl and spotted owl populations and habitat in the central Cascade Range of Washington. Journal of Raptor Research 34(4): 279-286.
Herter, D.R., L.L. Hicks, H.C. Stabins, J.J. Millspaugh, A.J. Stabins, and L.D. Melampy. 2002. Roost site characteristics of northern spotted owls in the nonbreeding season in central Washington. Forest Science 48(2):437-446.
Hicks, L.L., D.R. Herter, and R. Early. 2001. Northern spotted owl demographic monitoring and modeling – 5 year summary report. Plum Creek Cascades Habitat Conservation Plan, May 21, 2002.
Hoberg, E.P., G.S. Miller, E. Wallner-Pendleton, and O.R. Hedstrom. 1989. Helminth parasites of northern spotted owls (*Strix occidentalis caurina*). Journal of Wildlife Diseases 25:246–251.
Irwin, L.L., D.F. Rock, and G.P. Miller. 2000. Stand structures used by northern spotted owls in managed forests. J. Raptor Res. 34(3):175-186.
Iverson, W.F. 1993. Is the barred owl displacing the spotted owl in western Washington? M.S. Thesis, western Washington University, Bellingham, Washington.
Iverson, W.F. 2004. Reproductive success of Spotted Owls sympatric with Barred Owls in western Washington. Journal of Raptor Research 38(1):88-91.
Johnson, D.H. 1992. Spotted owls, great horned owls, and forest fragmentation in the central Oregon Cascades. M.S. Thesis, Oregon State University, Corvallis, OR.
Johnson, K. N., J. F. Franklin, J. W. Thomas, and J. Gordon. 1991. Alternatives for management of late successional forests of the Pacific Northwest. A report to the Agriculture and Merchant and Marine Fisheries Committees of the U.S. House of Representative. Scientific Panel on Late Successional Forest Ecosystems, Washington, D.C
Kelly, E.G. and E.D. Forsman. 2004. Recent records of hybridization between barred owls (Strix varia) and northern spotted owls (S. occidentalis caurina). Auk 121:806-810.
Kelly, E.G., E.D. Forsman, and R.G. Anthony. 2003. Are barred owls displacing spotted owls? Condor 105:45
Kerns, S.J., and D. Allwardt. 1992. Proximity of human activity to northern spotted owl nesting pairs on lands of the Pacific Lumber Company. Unpublished document. 15 pages
King, G.M., K.R. Bevis, M.A. Rowe, E.E. Hanson. 1997. Spotted owls use of habitat impacted by 1994 fires on the Yakama Indian Reservation: three years post fire.
Knight, R.L., and S.K. Skagen. 1998. Effects of recreational disturbance on birds of prey: a review. Pages 355-359 in R.L. Glinski et al., editors. Proceedings of the Southwest Raptor Management Symposium and Workshop, National Wildlife Federation, Washington, D.C.

Komar, N., N.A. Panella, J.E. Burns, S.W. Dusza, T.M. Mascarenhas, and T.O. Talbot. 2001. Serologic evidence for west Nile virus infection in birds in the New York City vicinity during an outbreak in 1999. Emerging Infectious Diseases 7(4):621-5.
LaHaye, W.S., R.J. Guiterrez, and J.R. Dunk. 2001. Natal dispersion of the spotted owl in southern California: dispersal profile of an insular population. Condor 103:691-700.
Laidig, K.J., and D.S. Dobkin. 1995. Spatial overlap and habitat association of Barred Owls and Great Horned Owls in southern New Jersey. Journal of Raptor Research 29:151–157.
Leskiw, T., and R.J. Gutiérrez. 1998. Possible predation of a Spotted Owl by a Barred Owl. Western Birds 29:225–226.
Lint, J. (tech. coord.). 2005. Northwest Forest Plan—the first 10 years (1994–2003): status and trends of northern spotted owl populations and habitat. Gen. Tech. Rep. PNW-GTR-648. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 176 pages.
Lint, J., B. Noon, R. Anthony, E. Forsman, M. Raphael, M. Collopy, E. Starkey. 1999. Northern spotted owl effectiveness monitoring plan for the Northwest Forest Plan. Gen. Tech. Rep. PNW-GTR-440. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 43 p.
Livezey, K.B. 2005. Iverson (2004) on spotted owls and barred owls: comments on methods and conclusions. Journal of Raptor Research 39(1):102-103.
Loehle, C., L. Irwin, D. Rock, and S. Rock. 2005a. Are survival rates for northern spotted owls biased? Canadian Journal of Zoology 83:1386-1390.
Loehle, C., L. Irwin, D. Rock, and S. Rock. 2005b. Erratum: Are survival rates for northern spotted owls biased? Canadian Journal of Zoology 84: 141.
Marra, P.P., S. Griffing, C. Caffrey, A.M. Kilpatrick, R. McLean, C. Brand, E. Saito, A.P. Dupuis, L. Kramer, and R. Novak. 2004. West Nile Virus and wildlife. BioScience 54(5):393-402.
McGarigal, K., R.G. Anthony, and F.B. Issacs. 1991. Interactions of humans and bald eagles on the Columbia River estuary. Wildlife Monographs 115:1-47.
McLean, R.G., S.R. Ubico, S.E. Docherty, W.R. Hansen, L. Sileo, and T.S. McNamara. 2001. West Nile Virus and transmission and ecology in birds. Annals of the New York Academy of Sciences 951:54-57.
Meiman, S., R. Anthony, E. Glenn, T. Bayless, A. Ellingson, M.C. Hansen, and C. Smith. 2003. Effects of commercial thinning on home-range and habitat-use patterns of a male northern spotted owl: a case study. Wildlife Society Bulletin. 2003, 31(4) 1254-1262.
Meyer, J.S., L.L. Irwin, and M.S. Boyce. 1998. Influence of habitat abundance and fragmentation on northern spotted owls in western Oregon. Wildlife Monographs 139: 1-51.
Miller, G.S. 1989. Dispersal of juvenile spotted owls in western Oregon. M.S. Thesis. Oregon State University, Corvallis, Oregon.
Miller, G.S., R.J. Small, and E.C. Meslow. 1997. Habitat selection by spotted owls during natal dispersal in western Oregon. J. Wildl. Manage. 61(1):140-150.

Miller, G.S., S.K. Nelson, and W.C. Wright. 1985. Two-year-old female spotted owl breeds successfully. Western Birds 16:69-73.
Moen, C.A., A.B. Franklin, and R.J. Gutiérrez. 1991. Age determination of subadult northern spotted owls in northwest California. Wildlife Society Bulletin 19:489-493.
Moeur, M., T.A. Spies, M. Henstrom, J.R. Martin, J. Alegria, J. Browning, J. Cissel, W.B. Cohen, T.E. Demeo, S. Healey, R. Warbington. 2005. Northwest Forest Plan–The first 10 years (1994-2003): status and trend of late-successional and old-growth forest. Gen. Tech. Rep. PNW-GTR-646. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 142 p.
Noon, B.R. and J.A. Blakesley. 2006. Conservation of the northern spotted owl under the Northwest Forest Plan. Conservation Biology 20:288–296.
North, M.P., G.Steger, R.Denton, G.Eberlein, T. Munton, and K. Johnson. 2000. Association of weather and nest-site structure with reproductive success in California spotted owls. Journal of Wildlife Management 64(3):797-807.
Olson, G.S., E. Glenn, R.G. Anthony, E.D. Forsman, J.A. Reid, P.J. Loschl, and W.J. Ripple. 2004. Modeling demographic performance of northern spotted owls relative to forest habitat in Oregon. Journal of Wildlife Management.
Olson, G.S., R.G. Anthony, E.D. Forsman, S.H. Ackers, P.J. Loschl, J.A. Reid, K.M Dugger, E.M. Glenn, and W.J. Ripple. 2005. Modeling of site occupancy dynamics for northern spotted owls, with emphasis on the effects of barred owls. Journal of Wildlife Management 69(3):918-932.
Oregon Department of Forestry. 2007. Forest Practices Administrative Rules and Forest Practices Act. Salem, Oregon.
Parmesan, C. and G. Yohe. 2003. A globally coherent fingerprint of climate change impacts across natural systems. Nature 421:37-42.
Pearson, R.R., and K.B. Livezey. 2003. Distribution, numbers, and site characteristics of spotted owls and barred owls in the Cascade Mountains of Washington. Journal of Raptor Research 37(4):265-276.
Perkins, J.P. 2000. Land cover at northern spotted owl nest and non-nest sites, eastcentral coast ranges, Oregon. M.S. thesis. Department of Forest Resources, Oregon State University, Corvallis, OR.
Pierce, D.J., J.B. Buchanan, B.L. Cosentino, and S. Snyder. 2005. An assessment of spotted owl habitat on non-federal lands in Washington between 1996 and 2004. Wildlife Department of Wildlife Research Report.
Pious, M. 1995. Home range and habitat use of spotted owls in managed Redwood/Douglas fir forests, California. Louisiana-Pacific Corporation, Forestry Department, Calpella, CA.
Piper, Susan. 2006. Personal communication with Piper, Forest Wildlife Biologist, Olympic National Forest. May 8, 2006 and spreadsheet of K-max sound records in email to Alan Dyck, Mt Hood Forest Wildlife Biologist, June 4, 2006. Spreadsheet on file at the Willamette NF, Eugene, OR.
Rizzo, D.M., M. Garbeloto, J.M. Davidson, G.W. Slaughter, and S.T. Koike. 2002. Phytophthora ramorum as the cause of extensive mortality of Quercus spp. and Lithocarpus densiflorus in California. Plant Disease 86:205-214.

Rosenberg, D.K. and K.S. McKelvey. 1999. Estimation of habitat selection for central-place foraging animals. J. Wildlife Management 63(3):1028-1038
Rosenberg, D.K., K.A. Swindle, and R.G. Anthony. 2003. Influence of prey abundance on northern spotted owl reproductive success in western Oregon. Canadian Journal of Zoology 81:1715-1725.
Sapolsky, R. M., L. M. Romero, and A. U. Munck. 2000. How do glucocorticoids influence stress responses? Integrating permissive, suppressive, stimulatory, and preparative actions. Endocrine Reviews 21:55-89.
Schmidt, K. 2003. Northern spotted owl monitoring and inventory, Redwood National and State Parks, 2002 annual report. Redwood National and State Parks, Orick, California.
Schmidt, K. 2006. Northern spotted owl monitoring and inventory, Redwood National and State Parks, 2005 annual report. Redwood National and State Parks, Orick, California.
Singleton, P., S. Graham, W. Gaines, and J. Lehmkuhl. 2005. The ecology of barred owls in fire-prone forests. USDA PNW December 2005 Progress Report; Wenatchee, Washington.
Sisco, C.L. 1990. Seasonal home range and habitat ecology of spotted owls in northwestern California. M.S. Thesis. Humboldt State University, Arcata, California.
Solis, D.M., and R.J. Gutiérrez. 1990. Summer habitat ecology of northern spotted owls in northwestern California. The Condor 92:739-748.
Sovern, S.G., E.D. Forsman, B.L. Biswell, D.N. Rolph, and M. Taylor. 1994. Diurnal behavior of the spotted owl in Washington. Condor 96(1):200-202.
Spangle, S. 1992. Narratives for the final designation of critical habitat for the northern spotted owl in California. Unpublished report. U.S. Fish and Wildlife Service, Portland, Oregon.
Swarthout, E.C. and Steidl, R.J. 2001. Flush responses of Mexican spotted owls to recreationists. J. Wildl. Manage. 65(2):312-317.
Tehan, M. 1991. Narratives for the final designation of critical habitat for the northern spotted owl in Washington. Unpublished report. U.S. Fish and Wildlife Service, Portland, Oregon.
Tempel, D. J. and R. J. Gutiérrez. 2003. Fecal corticosterone levels in California spotted owls exposed to low-intensity chainsaw noise. Wildlife Society Bulletin 31:698-702.
Tempel, D. J. and R. J. Gutiérrez. 2004. Factors related to fecal corticosterone levels in California spotted owls: implications for assessing chronic stress. Conservation Biology 18:538-547.
Thomas, J.W., and M.G. Raphael (Eds.). 1993. Forest Ecosystem Management: An Ecological, Economic, and Social Assessment. Report of the Forest Ecosystem Management Assessment Team (FEMAT). July 1993. Portland, OR: USDA Forest Service and the USDI Bureau of Land Management.
Thomas, J.W., E.D. Forsman, J.B. Lint, E.C. Meslow, B.R. Noon, and J. Verner. 1990. A conservation strategy for the northern spotted owl. Report of the Interagency Scientific Committee to address the conservation of the northern spotted owl. Unpublished interagency document. 458 pages.

Thomas, J.W., J.F. Franklin, J. Gordon, and K.N. Johnson. 2006. The Northwest Forest Plan: origins, components, implementation experience, and suggestions for change. Conservation Biology 20:277–287.
Thomas, J.W., M.G. Raphael, R.G. Anthony, E.D. Forsman, A.G. Gunderson, R.S. Holthausen, B.G. Marcot, G.H. Reeves, J.R. Sedell, and D.M. Solis. 1993. Viability assessments and management considerations for species associated with late-successional and old-growth forests of the Pacific Northwest. USDA Forest Service, Portland, Oregon.
Turner, S. 1999. Letter on fledge data from the Central Cascades Study area. To Kit Hershey, U.S. Fish and Wildlife Service, Portland, Oregon.
Tweten, R. 1992. Narratives for the final designation of critical habitat for the northern spotted owl in Oregon. Unpublished report. U.S. Fish and Wildlife Service, Portland, Oregon.
U.S. Department of Agriculture & U.S. Department of Interior. 1994a. Final Supplemental Environmental Impact Statement on Management of Habitat for Late Successional and Old Growth Forests Related species within the Range of the Northern spotted owl. Forest Service, Bureau of Land Management. Portland, Oregon.
U.S. Department of Agriculture & U.S. Department of Interior. 1994b. Record of Decision for Amendments to Forest Service and Bureau of Land Management Planning Documents Within the Range of the Northern spotted owl, and Standards and Guidelines for Management of Habitat for Late-Successional and Old-Growth Forest Related Species Within the Range of the Northern spotted owl. USDA Forest Service, USDI Bureau of Land Management, Portland, Oregon.
U.S. Department of Agriculture & U.S. Department of Interior. 2004. Record of Decision to Remove or Modify the Survey and Manage Mitigation Measure Standards and Guidelines, USDA Forest Service and USDI Bureau of Land Management, March 2004.
USFWS (U.S. Fish and Wildlife Service) and USDC NMFS (U.S. Department of Comerce, National Marine Fisheries Service). 1998. Procedures for Conducting Consultation and Conference Activities under Section 7 of the Endangered Species Act.
USFWS (U.S. Fish and Wildlife Service), BLM (U.S. Bureau of Land Management) and FS (U.S. Forest Service). 2007. Methodology for estimating the number of northern spotted owls affected by proposed federal actions. Oregon Fish and Wildlife Office, Fish and Wildlife Service, Portland, OR.
USFWS (U.S. Fish and Wildlife Service). 1983a. Endangered and threatened species listing and recovery priority guidelines. Federal Register 48:43098–43105.
USFWS (U.S. Fish and Wildlife Service). 1983b. Endangered and threatened species listing and recovery priority guidelines: correction. Federal Register 48:51985.
USFWS (U.S. Fish and Wildlife Service). 1989. The northern spotted owl; a status review supplement. U.S. Fish and Wildlife Service.
USFWS (U.S. Fish and Wildlife Service). 1990a. Endangered and Threatened Wildlife and Plants; determination of threatened status for the northern spotted owl. Fed. Reg. Vol. 55. 123: 26114-26194. June 26, 1990.

USFWS (U.S. Fish and Wildlife Service). 1990b. The 1990 status review: northern spotted owl: *Strix occidentalis caurina*. Report to the U.S. Fish and Wildlife Service, Portland, Oregon. 95 pages.
USFWS (U.S. Fish and Wildlife Service). 1992a. Protocol for surveying proposed management activities that may impact northern spotted owls. Revised - March 7, 1992.
USFWS (U.S. Fish and Wildlife Service). 1992b. Endangered and Threatened Wildlife and Plants; determination of critical habitat for the northern spotted owl. Fed. Reg. Vol. 57. 10:1796-1838. January 15, 1992.
USFWS (U.S. Fish and Wildlife Service). 1992c. Draft final recovery plan for the northern spotted owl. U.S. Fish and Wildlife Service. 2 Volumes. Portland, Oregon.
USFWS (U.S. Fish and Wildlife Service). 1994. Final biological opinion for the preferred alternative of the Supplemental Environmental Impact Statement on Management of Habitat for Late-Successional and Old-Growth Forest Related Species Within the Range of the Northern spotted owl. Portland, Oregon, USA.
USFWS (U.S. Fish and Wildlife Service). 2001. A range wide baseline summary and evaluation of data collected through section 7 consultation for the northern spotted owl and its critical habitat: 1994-2001. Portland, Oregon. Unpublished document. 41 pages.
USFWS (U.S. Fish and Wildlife Service). 2003. Estimates of distances at which incidental take of murrelets and spotted owls due to harassment are anticipated from sound-generating, forest-management activities in Olympia National Forest. Lacey, WA.
USFWS (U.S. Fish and Wildlife Service). 2004. Northern Spotted Owl: Five Year Review Summary and Evaluation. U.S. Fish and Wildlife Service, Portland, Oregon. 73 pages
USFWS (U.S. Fish and Wildlife Service). 2006. Biological Opinion for Effects to Northern Spotted Owls (*Strix occidentalis caurina*) from the Willamette Planning Province Fiscal Year 2007-2008 activities that have the potential to adversely affect, due to habitat modification and disturbance, on U. S. Department of the Interior, Bureau of Land Management, Eugene District and Salem District, and the U. S. Department of Agriculture; Mt Hood National Forest, Willamette National Forest, and the Columbia River Gorge National Scenic Area. FWS Reference Number 1-7-06-F-0179. Portland, Oregon.
USFWS (U.S. Fish and Wildlife Service). 2007a. Draft: What are the Effects of Habitat Thinning on Northern Spotted Owls? Literature Summarized through 2005. Portland, OR. 17pp.
USFWS (U.S. Fish and Wildlife Service). 2007b. 2007 Observations of Smoke Effects on Northern Spotted Owls Compiled by J. Thrailkill, Oregon Fish and Wildlife Service Office, Portland, Oregon. 5pp.
USFWS (U.S. Fish and Wildlife Service). 2007c. 2007 Draft Recovery Plan for the Northern Spotted Owl, *Strix occidentalis caurina*: Merged Options 1 and 2. Portland, Oregon. 160 pp.
USFWS (U.S. Fish and Wildlife Service). 2007d. Proposed Revised Designation of Critical Habitat for the Northern Spotted Owl (*Strix occidentalis caurina*); Proposed Rule. Fed. Reg. Vol. 72. 112:32450-32516. June 2007.

USFWS (U.S. Fish and Wildlife Service). 2007e. In preparation. Habitat model for predicting northern spotted owl activity centers. Oregon State Office. Portland.
Wagner, F.F., E.C. Meslow, G.M. Bennett, C.J. Larson, S.M. Small, and S. DeStefano. 1996. Demography of northern spotted owls in the southern Cascades and Siskiyou, Mountains, Oregon. Pages: 67-76 In: Forsman, E.D., S. DeStefano, M.G. Raphael, and R.J. Gutierrez, (editors). 1996. Demography of the northern spotted owl. Studies in Avian Biology No. 17. Cooper Ornithology Society
Ward, J. W. Jr. 1990. Spotted owl reproduction, diet and prey abundance in northwest California. M.S. Thesis. Humboldt State University, Arcata.
Ward, J. W. Jr., R.J. Gutiérrez, and B.R. Noon. 1998. Habitat selection by northern spotted owls: the consequences of prey selection and distribution. Condor 100:79-92.Weathers, W.W., P.J. Hodumand, and J.A. Blakesley. 2001. Thermal ecology and ecological energetics of California spotted owls. The Condor 103:678-690.
Washington Forest Practices Board. 1996. Permanent rules for the northern spotted owl. Washington Department of Natural Resources, Olympia, Washington.
Wasser, S. K., K. Bevis, G. King, and E. Hanson. 1997. Noninvasive physiological measures of disturbance in the northern spotted owl. Conservation Biology 11:1019-1022.
Weathers, W.W., Hodum, P.J., and J.A. Blakesley. 2001. Thermal ecology and ecological energetics of California spotted owls. The Condor 103: 678-690.
Weidemeier, D.J. and S.P. Horton. 2000. Trends in spotted owl and barred owl detections in the Olympic Experimental State Forest from 1991 to 1999. (Paper file reads: Detection rates and occupancy trends of spotted and barred owls in the Olympic Experimental State Forest). Northwestern Naturalist 81(3):63.
White, C. M., and T. L. Thurow. 1985. Reproduction of ferruginous hawks exposed to controlled disturbance. The Condor 87:14-22.
Zabel C.J., S.E. Salmons, and M. Brown. 1996. Demography of northern spotted owls in southwestern Oregon. Studies in Avian Biology 17:77-82.
Zabel, C. J., J.R. Dunk, H.B. Stauffer, L.M. Roberts, B.S. Mulder, and A. Wright. 2003. Northern spotted owl habitat models for research and management application in California (USA). Ecological Applications 13(4): 1027-1040.
Zabel, C. J., K.M. McKelvey, and J.P. Ward, Jr. 1995. Influence of primary prey on home-range size and habitat-use patterns of northern spotted owls (Strix occidentalis caurina). Canadian Journal of Zoology 7.

Bridge Thin Wildlife Biological Evaluation

File Code:	2670 T, E, and S species	**Date:**	18 January 2008
Route To:	Project File		
Subject:	Terrestrial Fauna Biological Evaluation (BE) for: Bridge Thin Project		

SUMMARY OF DETERMINATIONS

Determinations:

The following summarizes effect or impact determinations to species currently listed as threatened, endangered, or sensitive (TES) that may have suitable habitat identified, and have either documented or suspected occurrence within the project area. **There are no recognized effects or impacts to TES species from No Action.**

Activities associated with the proposed project **may affect, but are not likely to adversely affect** the northern spotted owl. A full discussion of affects can be found in the Biological Assessment dated January 10, 2008 that was submitted to U S Fish and Wildlife Service.

Activities associated with the proposed project should have **no impact** on individuals of the following regionally listed sensitive species or their habitat:

- **Peregrine Falcon**
- **Wolverine**
- **Pacific Fringe-tailed Bat**
- **Crater Lake Tightcoil**

Cumulative effects of this project in conjunction with other reasonably foreseeable projects in and adjacent to the project area are not expected to jeopardize the continued existence of any TES species as a result of modification of their essential habitat; nor would they likely contribute to a trend towards Federal listing or cause a loss of viability to populations of species designated as R-6 Sensitive or as Management Indicator Species on the Willamette National Forest. Maintenance and/or recovery of late successional habitat serving as current or potential dispersal corridors surrounding the project area will ensure ongoing opportunities for occupancy and movement of terrestrial TES wildlife species that may occur in the vicinity of this project and are dependent on such habitat.

SUMMARY OF SEASONAL RESTRICTIONS/RECOMMENDATIONS

Implementing the following recommendations would ensure effects or impacts on listed species from proposed activities would be no greater than those addressed in this document, and also would mitigate those impacts.

<u>Spotted Owl</u>

- Impose seasonal restriction on activities associated with project that generate above-ambient noise levels during the spotted owl critical nesting period between March 1 and July 15.

<u>Pacific Fringe-tailed Bat</u>

- Protect decadent trees and snags >12”dbh (roosting habitat) within the project area to the greatest extent feasible while conducting restoration activities.

<u>Crater Lake Tightcoil</u>

- Ensure that measures identified to prevent habitat disturbance within 10 meters of perennially wet areas are implemented during project activities.

Introduction

This document addresses potential effects to proposed, threatened, endangered or sensitive (TES) fauna listed in the Region 6 Regional Forester's Federally Listed or Proposed, and Sensitive Species Lists (dated July 21, 2004) with documented or suspected occurrences on the Willamette National Forest from activities associated with a habitat restoration project. Biological evaluations of the potential effects to threatened, endangered and sensitive fish and flora are in separate documents prepared by this project's Fish Biologist and Botanist. This evaluation, required by the Interagency Cooperative Regulations (Federal Register, January 4, 1978), ensures compliance with the provisions of the Endangered Species Act (ESA) of 1973, P.L. 93-205 (87Stat. 884), as amended. A review of potential effects to non-TES wildlife species from this project proposal is presented in a separate Wildlife Specialist Report.

Project Location and Description

The McKenzie River Ranger Districts proposes to harvest timber on approximately 2256 acres of the Bridge Thin Project Area, which would yield an approximate net estimate of 35.6 million board feet (MMBF) of wood products. This proposal, represented in Alternative B in this EA, would include heavy thinning on 1458 acres, moderate thinning on 398 acres, oak savanna restoration on 51 acres, wildlife forage thinning on 190 acres and fuels treatment on 178 acres. The timber sales from this proposal would likely occur over a four year time span, beginning in fiscal year 2009.

The project is located on the McKenzie River Ranger District, Willamette National Forest, Lane County, Oregon. The legal location of the project is WM T15S R4,5 E, and T16S R4,5E. The Willamette National Forest Land and Resource Management Plan shows land allocation in the project area as: 5a- special interest area, 7- Old growth Groves, 9c- Wildlife marten Area, 9d- Special Wildlife Habitat Area, 11a-Scenic Modification Middleground, 11c- Scenic Partial Retention Middleground, 11e-Scenic Retention Middleground, 11f- Scenic Retention Foreground, 14a-General Forest, 16a-Late Successional Reserve, and 17-Adaptive Management Area.

Alternatives:

The Bridge Thin Project will be analyzed in an Environmental Assessment that reviews three alternatives – a No Action alternative and two Action Alternatives. The Action Alternatives involve activities described above.

Action Alternative: The influence of proposed activities on terrestrial wildlife is considered in the context of whether or not suitable habitat may be modified or if a species may be present at or near sites where physical disturbance may occur, or be sensitive to and thereby influenced by anthropogenic activities occurring during implementation of this project. Habitat disturbance that may affect some terrestrial wildlife species could occur as a result of this project. That potential is addressed later in this report.

No Action Alternative: There is no rationale to suggest the No Action alternative would affect or impact any terrestrial wildlife species based on their ecological requirements and current habitat conditions in the project area. Considering the No Action Alternative would have no effect/impact on terrestrial wildlife species is based on the following assumption - taking no action would not affect current habitat or wildlife species that may be present as either evolves without human management. The dynamic nature of habitat suitability that may be subject to an unknown frequency and variety of stochastic events is considered beyond the scope of this evaluation. Only potential effects or impacts of the Action Alternative will be discussed further in this document.

WATERSHED ANALYSIS / ADDITIONAL DOCUMENT SUPPORT

Proposed activities respond positively to recommendations made to address vegetation and wildlife in the Quartz Creek and Minor Tributaries Watershed Analysis.

MANAGEMENT DIRECTION COMPLIANCE

The alternative selected for management of the Willamette National Forest includes a strategy that provides Management Requirements (MRs) exceeding the minimum MRs established for Management Indicator Species (MIS) as presented in the Willamette Forest Plan FEIS Appendices - Volume 1 (USDA 1990, pp B-79 through 82). Maintenance of the MRs ensures the viability of MIS and the species they represent. The MRs have been further enhanced for most MIS species (i.e. those species dependent on old growth and mature conifer habitat, and dead and defective tree habitat) under the Forest Plan S&Gs as amended by the Northwest Forest Plan.

Proposed action associated with this project complies with current forest Standards and Guidelines (S&Gs) pertaining to MIS and other rare and uncommon species management. This proposal also complies with other S&Gs established in the Willamette National Forest Land and Resource Management Plan (1990) as amended by the Northwest Forest Plan Records of Decision (ROD) (1994, 2001, and 2004).

TES SPECIES – REVIEW AND ASSESSMENT

The Biological Evaluation (BE) is a 6-step process that identifies known or suspected threatened, endangered, and sensitive (TES) or Proposed wildlife species that may be associated with a project area, and evaluates impacts the project may have to those species. The six steps are as follows:

1. Prefield review of existing information.
2. Field reconnaissance of the project area to document evidence of a species or habitat.
3. Assessment of whether known or suspected populations of TES or Proposed species will be affected by the project.
4. Analysis of the significance of the project's effects on local and entire populations of TES or Proposed species.
5. If step 4 cannot be completed due to lack of information, a biological investigation is done.*
6. Conferencing or informal/formal consultation with the U.S. Fish & Wildlife Service (USFWS) is initiated at appropriate stage as outlined in FSM 2673.2-1, or is otherwise arranged through formal channels.

* Step 5 pertains only to listed species and will not be indicated except when applicable.

A summary of ecological requirements for Federally listed[1] or proposed[2] species, and animal species on the Regional Forester's Sensitive Species List[3] for species with documented or suspected occurrence in the the Willamette National Forest is displayed in Table 1.

A summary of the BE process showing **effects determinations**[4] for Federally listed or proposed species, and **impact determinations**[5] for animal species on the Regional Forester's Sensitive Species List for species with known or potential occurrence in the project area is displayed in Table 2.

1 Species listed based on the USDA Forest Service Pacific Northwest Region Federally Listed or Proposed Species list (updated 7/21/04) having documented or suspected occurrence on the Willamette National Forest.

2 When a species is proposed for listing under the Endangered Species Act of 1973 (with amendments), a notice is published in the Federal Register, a daily publication of the Federal Government. The Federal Register is available on the internet at the following site: http://www.access.gpo.gov/nara/nara005.html

3 Species listed based on the USDA Forest Service Regional Forester's Sensitive Animal List (updated 7/21/04) (USDA 2004a,b) having documented or suspected occurrence on the Willamette National Forest.

4 The criteria for effects determinations can be found in the *Endangered Species Act Consultation Handbook: Procedures for Conducting Section 7 Consultations and Conferences* (USFS and NMFS 1998).

5 Impact determinations are required for all species listed under the Regional Forester's Sensitive Species List (Forest Service Manual 2670.32, 2670.5). Direct, indirect, and cumulative effects should be considered. For a discussion of cumulative effects analysis, see the document *Considering Cumulative Effects under the National Environmental Policy Act* (Council on Environmental Quality 1997).

Table 1. Summary of Ecological Requirements for Animal Species on the Regional Forester's Federally Listed and Sensitive Species Lists for species with documented or suspected occurrence on the Willamette National Forest (July 21, 2004).

Species	**Habitat**
Northern Spotted Owl ***Strix occidentalis*** ***Status: Federally Threatened***	Occur primarily in the interior of older timber stands with structure required for food, cover, nest sites, and protection from weather and predation. Reproductive habitat = forest w/ canopy closure 60 – 80%; multi-layered, multi-species canopy dominated by large overstory trees (> 30"dbh); abundant large trees w/deformities (e.g. large cavities, broken tops, dwarf-mistletoe infections, decadence); abundant large snags/down logs; and sufficient open flying space below the canopy. Foraging habitat = forest w/ > 2 canopy layers; overstory trees > 21" DBH; abundant snags/down wood; and a 60-80% canopy closure. Dispersal habitat = forest w/ > 11" DBH trees and > 40% canopy closure. Numerous sightings and occupied territories recorded on the McKenzie River RD.
Northern Bald Eagle ***Haliaeetus leucocephalus*** ***Status: Federally Threatened***	Use scattered old-growth conifer trees in proximity to open water near rivers, lakes, and reservoirs with plentiful prey. Feed primarily on fish, but will also eat waterfowl and carrion. On the McKenzie River RD, they currently nest at Blue River Reservoir, and activity observed at Clear Lake and Lost Lake.
Least Bittern ***Ixobrychus exilis***	Freshwater or brackish marshes with tall vegetation. Stalks through the weeds to find prey. Eats small fish, frogs, insects, small mammals, and sometimes bird eggs and chicks. Nests are small platform of sticks and live or dead vegetation, placed in cattails, bulrushes, or bushes 8-14" above water. Sightings of individuals at Fern Ridge and Salem. No confirmed sightings on the McKenzie River RD.
Bufflehead ***Bucephala albeola***	Summers on wooded lakes and rivers, winters on lakes and coastal waters. Nesting normally occurs near lakes in tree cavities 5-50 feet high. Dives underwater and eats small mollusks, fish, snail, and crustaceans. Also eats aquatic insects. Winter sightings common along reservoirs, and nesting activity suspected at sites associated with numerous high elevation lakes on the McKenzie River RD.
Harlequin Duck ***Histrionicus histrionicus***	During nesting (April-June) adults require fast-flowing water with midstream loafing sites nearby, dense shrub or timber/shrub mosaic vegetation on the bank, and an absence of human disturbance. Nest on ground under the shelter of vegetation, rocks, or large woody debris in close proximity to water. Broods prefer low gradient streams with adequate macro invertebrate abundance. Breeding and foraging known to occur along portions of the Main stem and South fork of the McKenzie River .

American Peregrine Falcon ***Falcon peregrinus anatum***	Preferred nesting sites are sheer cliffs 75 ft. or more in height having horizontal ledges or small caves. Foraging is associated with a variety of open and forested habitats, however is most closely associated with riparian settings. Numerous potential nest sites and occupied territories occur on the McKenzie River RD.
Yellow Rail ***Coturnicops noveboracensis***	Feeds in shallow water, eating snails, insects, and some seeds and grasses. Summers on wet meadows, marshes; winters on grasslands, fields, and coastal marshes. No documented occurrence in potential habitat on McKenzie River RD.
Black Swift ***Cypseloides niger***	Found near wet cliffs in mountainous regions. Feeds on-the-wing eating flying insects. Nests in small colonies on ledges or mountain crevices associated with waterfalls. There are historical summer records in the Santiam Pass area, Linn County, which suggests breeding in that area.
Baird's Shrew ***Sorex bairdii permiliensis***	Poorly understood but generally considered a non-riparian associate. In 1986 two specimens were trapped from an open Douglas-fir forested area with numerous rotting logs in Polk Co. It has also been trapped on McKenzie River RD in the Mill Creek area and in the Blue River watershed.
Pacific Shrew ***Sorex pacificus cascadensis***	Poorly understood, but considered a riparian associate generally found in moist areas along class III-IV streams with abundant vegetation and down material. Occasionally found in adjacent conifer forest with moist abundant decaying logs and brush. Nests made of grasses, mosses, lichens, or leaves. Feed on slugs, snails, insects, and sometimes vegetation. No known locations on McKenzie River RD.
Pacific Fisher ***Martes pennanti***	Considered a riparian associate but found in a wide variety of densely forested habitats at low to mid-elevations. Diet consists of small and medium-sized forest mammals (porcupines, snowshoe hares, tree squirrels, mice, and voles most common). Also eat carrion, and will seasonally eat birds, bird eggs, amphibians, fish, and insects. Use ground burrows, tree cavities, witches brooms or other clumped growth, or occasionally bird or small mammal nests as resting sites. Tree cavities are used by most maternal females with young and ground burrows are used mostly in winter. Data suggests they do better in areas with minimized fragmentation of old growth, second-growth, and riparian area and in areas with abundant down and standing woody material important. A few sightings recorded on the McKenzie River RD.
California Wolverine ***Gulo gulo***	Found primarily in wilderness or remote country where human activity is limited. High elevation areas appear to be preferred in summer, which may effectively separate wolverines and intensive human disturbance in most areas. In winter wolverines may move to lower elevations that are snowbound and/or have very limited human activity. They are capable of foraging widely (30-40 km) on a daily basis, and do not significantly use young, dense stands of timber or clearcuts. The majority of activity occurs in large expanses of scattered mature timber, with some use of ecotonal areas such as small timber pockets, and rocky, broken areas of timbered benches. Heavy use of openings w/ good winter populations of big game, a principal source of carrion which makes up much of the wolverine's diet. They also feed on marmots, snowshoe hares, various rodents, insects, insect larvae, eggs, and berries. Several unconfirmed observations mostly in wilderness areas.
Pacific Fringe-tailed Bat ***Myotis thysanodes vespertinu***	Occurs in Oregon, however habitat use is poorly documented. Three captured in 1971 were associated with young coniferous forest. They are known to use caves, mines, rock crevices, and buildings as both day and night roosts. Nothing is known about habits in winter. Diet of moths, leafhoppers, lacewings, daddy-loglegs, crickets, flies, true bugs, and spiders. Occurrence has been documented on McKenzie River RD.

Oregon Slender Salamander ***Batrachoseps wrighti***	Live in forested areas, especially old-growth Douglas-fir and younger stands with abundant downed large logs. They lay their eggs under thick bark, inside a crevice in a log, or in talus. Juveniles and adults live under thick bark, inside partially decayed logs, or in debris piles around the bases of large snags. They also occur in moist talus w/ abundant woody debris. Sightings have been documented at lower elevation sites on McKenzie River RD.
Cascade Torrent Salamander ***Rhyacotriton cascadae***	Live in very cold, clear springs, seeps, headwater streams, and waterfall splash zones. Forage in moist forests adjacent to these areas. Eggs are laid in rock crevices in seeps. Larve and adults live in gravel or under small cobbles in silt-free, very shallow water that is flowing or seeping. Adults may be found under debris on streambanks or in streamside forests and talus during rainy periods. Documented in the Blue River landscape area.
Foothill Yellow-legged Frog ***Rana boylii***	Live in sections of low-gradient streams with exposed bedrock or rock and gravel substrates. Attach eggs to the bottom of quiet scour-pools or riffles in gentle-gradient streams, often where there is only slight flow from the main river. Hatchlings cling to egg masses initially and then to rocks. Nearest known sightings are on private lands adjacent to the Sweet Home RD to the north.
Oregon Spotted Frog ***Rana pretiosa***	Favor lakes and slow moving streams associated w/a permanent water source w/ a soft and muddy bottom. A marsh specialist w/strong preference/requirement for warmer waters; more aquatic than other ranids; often found in water or water's edge floating on the surface or resting on aquatic vegetation. Diet is invertebrates caught above and below the surface. Early breeders: egg masses are typically deposited on top of one another in a communal fashion, not attached to vegetation, and deposited in warmer shallow water, making them susceptible to mortality due to freezing or drying. Documented populations on the McKenzie River RD in the Mink Lake basin area of the Three Sisters Wilderness.
Northwestern Pond turtle ***Clemmys marmorata marmorata***	Inhabit marshes, sloughs, moderately deep ponds, slow moving portions of creeks and rivers. Observed in altered habitats including reservoirs, abandoned gravel pits, stock ponds, and sewage treatment plants. Occur from sea level to about 1,830 meters. Require basking sites, such as partially submerged logs, vegetation mats, rocks and mud banks, and may even climb a short way onto tree branches that dip into the water. They use uplands for egg laying, overwintering, and dispersal. They may move up to 500 meters and possibly more for overwintering where they burrow into leaf litter or soil. Nest distances from the water course ranges from 3 meters to over 402 meters. Sparse vegetation, usually short grasses or forbs characterize most nesting areas. Documented sites along McKenzie River on private ground.
Mardon Skipper ***Polites mardon***	A small, tawny-orange butterfly currently known to exist at seven, small, geographically disjunct areas in Washington, Oregon, and California. In the southern Washington Cascades, the mardon skipper is found in open, fescue grasslands within Ponderosa pine savanna/woodland habitat at elevations ranging from 1900' to 5100'. South Cascade sites vary in size from small, ½ acre or less meadows, to large grassland complexes, and site conditions range from dry, open ridgetops, to areas associated with wetlands or riparian habitats. Within these environments a variety of nectar source plants are important. The short, open stature of native fescue bunchgrass stands allows mardon skippers to access nectar and oviposition plants. There are no known populations of this species on the Willamette NF.

Crater Lake Tightcoil ***Pristiloma arcticum crateris***	Species may be found sparsely distributed throughout Oregon Cascades above 2000' elevation associated with perennially wet environment in mature conifer forests and meadows among vegetation or under rocks and woody debris. Suitable locations within 10 meters of open water generally in areas under snow for extended periods during winter. One documented site on Middle Fork RD along with a few sites on Mt Hood, Deschutes, Umpqua, Winema, and Rouge River National Forests. No documented sites on the McKenzie River RD.

Table 2. Biological Evaluation process for Willamette TES (or Proposed) fauna associated with potential effects from the Bridge Thin Project Action Alternative.

	STEP 1	**STEP 2**	**STEP 3**	**STEP 4**	**STEP 6**
	Prefield Review	*Field Reconn.*	*Risk Assessment*	*Analysis of Significance*	*USFWS Review*
SPECIES	**Habitat Present (B,R,F,D)***	**Occupancy Status**	**Conflicts? Action Alt**	**Effects / Impacts Action Alt**	**Consul-tation? BA[1]/BO[2]**
Northern Spotted Owl ***Strix occidentalis caurina***	B,R,F,D	Occupied	Potential Conflict	NLAA	1/10/2008/ 02/07/2008
Northern Bald Eagle ***Haliaeetus leucocephalus***	B,R,F,D			NE	NA
Least Bittern ***Ixobrychus exilis***	No			NI	
Bufflehead ***Bucephala albeola***	No			NI	
Harlequin Duck ***Histrionicus histrionicus***	B,R,F,D			NI	
American Peregrine Falcon ***Falcon peregrinus anatum***	F,D	Occupied	No Conflict	NI	
Yellow Rail ***Coturnicops noveboracensis***	No			NI	
Black Swift ***Cypseloides niger***	No			NI	
Baird's Shrew ***Sorex bairdii permiliensis***	No			NI	
Pacific Shrew ***Sorex pacificus cascadensis***	No			NI	
Wolverine ***Gulo gulo***	F,D	Unknown	No Conflict	NI	
Fisher ***Martes pennanti***	No			NI	
Pacific Fringe-tailed Bat ***M. thysanodes vespertinu***	R,F	Unknown	No Conflict	NI	
OR Slender Salamander ***Batrachoseps wrighti***	B,R,F,D			NI	
Cascade Torrent Salamander ***Rhyacotriton cascadae***	No			NI	
Foothill Yellow-legged Frog ***Rana boylii***	No			NI	
Oregon Spotted Frog ***Rana pretiosa***	No			NI	
Northwestern Pond Turtle ***C. marmorata marmorata***	No			NI	
Mardon Skipper ***Polites mardon***	No			NI	
Crater Lake Tightcoil ***Pristiloma arcticum crateris***	B,R,F,D	Unknown	No Conflict	NI	

* B = breeding (nesting/denning) habitat R = roosting/cover habitat F = foraging habitat D = dispersal habitat

[1] Date of Biological Assessment (BA) Consultation initiated with USFWS

[2] Date Biological Opinion (BO) or Concurrence issued from USFWS

NA = not applicable

NE = **No Effect**

BE = **Beneficial Effect**

NLAA[a] = May Affect, **N**ot **L**ikely to **A**dversely **A**ffect

LAA[b] = **May** Affect, **L**ikely to **A**dversely **A**ffect
NI = **N**o **I**mpact.
NLCT = May impact individuals or their habitat, but the action will **N**ot **L**ikely **C**ontribute to a **T**rend towards Federal Listing or loss of viability to the population or species.
MCT[c] = May impact individuals or their habitat, with a consequence that the action **M**ay **C**ontribute to a **T**rend towards Federal Listing or a loss of viability to the population or species.
BI = **B**eneficial **I**mpact

a A **NLAA** determination requires *informal consultation* with the U.S. Fish and Wildlife Service.
b For *listed* species, a **LAA** determination requires *formal consultation* with the U.S. Fish and Wildlife Service. For *proposed* species, a LAA determination requires *conferencing* with the U.S. Fish and Wildlife Service (WO Amendment 2600-91-3, Forest Service Manual 2671.45, March 31, 1991).
c A **MCT** determination may require that an Environmental Impact Statement be written.

AFFECTED WILDLIFE – Discussion/Determinations/Recommendations

A discussion of the affects of the proposed project on TES species follows. **If it was determined that suitable habitat for a species does not occur in the proposed project area** (Table 2), **it is concluded that the proposed action would have no potential to effect or impact those listed TES species**, and the species will not be discussed further in this document. **A No Action proposal is expected to have no effect on federally listed threatened, endangered, or proposed species, and is also expected to have no impact on sensitive species identified by the Regional Forester.** References used to support discussion, determinations, and recommendations are listed at the end of this document (Appendix 1).

1) Northern Spotted Owl (*Strix occidentalis caurina*)
Status: Federal: Threatened
State: Threatened
FS R-6: Sensitive, Identified as Management Indicator Species (MIS)

Determination: "may affect, not likely to adversely affect" northern spotted owls, "not likely to adversely affect" designated critical habitat. A full discussion of affects can be found in the Biological Assessment dated January 10, 2008 that was submitted to U S Fish and Wildlife Service.

Status Background: It has been reported that in some regards the northern spotted owl is the most studied raptor in the world (Blakesley 2004), yet prior to the early 1970's little was known about this species in the Pacific Northwest. Knowledge and interest quickly accumulated throughout the 1970's and in 1977 management guidelines for spotted owls on public land in Oregon were established. Driven by concerns over habitat loss, the USFWS conducted their first status review of the species in 1982. In 1987 a petition was submitted to list the spotted owl as endangered under the Federal ESA. The USFWS considered listing the species unwarranted at the time, however that decision was later reversed and the owl was officially listed as threatened under the Federal ESA in 1990.

Since that time a DRAFT Recovery Plan was released (USDI 1992), and the Northwest Forest Plan was implemented (1994) and subsequently amended (USDA et al. 2001, 2004) in efforts to most appropriately manage Federal land within the range of the northern spotted owl with the welfare of this and other late-successional species in mind.

Habitat and Ecology: The northern spotted owl is a species strongly associated with old-growth forests containing a component of large diameter Douglas-fir. These forest stands commonly provide a variety

of structural features such as large diameter trees having central cavities, dense canopies with a high level of vertical and horizontal diversity, and an abundance of snags and down logs (Thomas et al. 1990). Stands with all these characteristics provide the best suitable (nesting, roosting, foraging) habitat for spotted owls. However, all of the above characteristics may not need be present for spotted owls to make use of an area as nesting, roosting or foraging habitat. The owl's affinity to old-growth forest types may result from adaptation and niche partitioning of this species to foraging on prey commonly present in such stands under lack of predation pressure and interspecies competition typical of more open areas (USDI 1992). Nevertheless, spotted owls have been known to forage short distances into harvested openings from a forested edge if a prey is available (Carey 2004).

Dispersal-only habitat for the northern spotted owl generally consists of mid seral stage stands between 40 and 80 years of age with canopy closures of 40 percent or greater and trees with a mean dbh of 11 inches or greater. Older stands lacking structural development that supports nesting may be considered dispersal habitat, however on some occassions may provide roosting or foraging opportunities for the species. Spotted owls generally use dispersal habitat to move between blocks of suitable habitat or, for juveniles, to disperse from natal territories (Forsman et al. 2002, USDI 2004a).

The reader is referred to the following documents for a more comprehensive and account of the biology, ecology, and status of the northern spotted owl: A Conservation Strategy for the Northern Spotted Owl (Thomas et al. 1990); Recovery Plan for the Northern Spotted Owl - (USDI 1992); Northern Spotted Owl Five-year Review Summary and Evaluation (USDI 2004a); Status and trends in demography of northern spotted owls, 1985 – 2003 (Anthony et al. 2004); Scientific evaluation of the status of the northern spotted owl - SEI Report (Courtney et al. 2004).

Pre-field Review: This project is consistent with current standards established for projects that could affect the northern spotted owl. These standards were established for the Willamette Province and are listed in both the Programmatic Biological Assessment (BA) (USDA et al. 2007) and the subsequent USFWS Letter of Concurrence (LOC) (USDI 2007) for projects which may disturb bald eagles and northern spotted owls during FY 2007 and 2008.

Effects not specifically discussed in this document pertaining to new threats to the spotted owl (USDI 2004a, Anthony et al. 2004, Courtney et al. 2004) such as wildfire, west Nile virus, and barred owls are of a cumulative nature considered beyond the scope of this individual project. Such threats are addressed in the FY 2006 – 2007 Disturbance BA and LOC, which provide a thorough analysis of new information pertaining to potential threats to this species.

Field Reconnaissance: There are seven northern spotted owl home ranges in the project area. No project units are within Late Successional Reserves. There are eleven units totaling 203 acres in designated Critical Habitat Unit OR-16. Post treatment stand conditions will maintain an average 40% canopy cover and functionality of dispersal habitat in the CHU.

No suitable breeding habitat is proposed for removal with the Bridge Thin project. Noise-generating activities from harvest and prescribed burning with this project that may disturb spotted owls during the critical breeding season (March 1 – July 15) will be restricted from occurring.

Risk Assessment:
Project Effects: There are no recognized direct or indirect effects to suitable spotted owl habitat from activities associated with this project as proposed. Effects to individual spotted owls that may be present in adjacent suitable habitat are limited to some potential for disturbance from noise-generating activities during the non-critical portion of the breeding season.

Cumulative Effects: The changing trend in timber management occurring within the past decade, and projected for the future, should positively influence occupancy of suitable habitat for northern spotted owls as previously harvested stands within these watersheds redevelop, and as more emphasis is placed on recruitment of key structural components missing from harvested stands as well as retention of key structural components present in unharvested stands and restoration/maintenance of special habitats as key components of biodiversity at a landscape level.

Current Standards and Guidelines governing management of the surrounding landscape provide direction that should provide for long-term maintenance of amount and distribution of suitable spotted owl habitat. Because of the location of harvest and non-harvest allocations, it is unlikely that cumulative effects would influence the ability of local populations to persist, or become established, by eliminating demographic linkages beyond the species dispersal capabilities.

Analysis of Significance: The Bridge Thin project does not propose any activity that would remove suitable spotted owl habitat. However this project does propose stand treatment activities that would remove dispersal habitat within all seven known spotted owl home ranges. It is determined that implementing the Action Alternative **may affect, but is not likely to adversely affect northern spotted owls or its designated critical habitat.**

Communication with U.S. Fish and Wildlife Service: Informal consultation for effects from proposed activities was submitted in a BA dated 1/10/2008. The USFWS issued their LOC for effects to spotted owls from this project on 02/07/2008 (FWS *reference*: 1-7-05-I-0025).

Recommendations: Impose seasonal restriction on project activities in close proximity to known location of spotted owls that could generate above-ambient noise levels during the spotted owl critical nesting period between March 1 and July 15.

2) Harlequin Duck (*Histrionicus histrionicus*)
Status Federal: Sensitive)
State: Sensitive

Determination: "no impact" to Harlequin Ducks or their habitat.

Status Background: The majority of documented harlequin duck use on the McKenzie River Ranger District occurs in the McKenzie River floodplain and its class 1 tributaries. Surveys have been conducted on the McKenzie River yearly since 1992. Nest are extremely difficult to find without the use of radio telemetry. No nests have been documented in the project area.

Habitat: During nesting (April-June) adults require fast-flowing water with midstream loafing sites nearby, dense shrub or timber/shrub mosaic vegetation on the bank, and an absence of human disturbance. Nests are typically found on the ground under the shelter of vegetation, rocks, or large woody debris in close proximity to water. Broods prefer low gradient streams with adequate macro invertebrate abundance.

Pre-field Habitat quality for harlequin ducks in this area is expected to continue to be high. There are no threats to water quality in the Mckenzie River or its tributaries. Human disturbance in riparian habitat (primarily in recreation sites) may cause the loss of nest sites. Disturbance from rafters on the River may cause disturbance to females with their young.
review:

Field reconnaissance: Breeding and foraging habitat are known to occur along portions of the Main stem and South fork of the McKenzie River.

Risk Assessment:
Project Effects: No suitable harlequin duck nesting habitat will be modified by this project. Due to the location and timing of proposed activities there should be no direct or indirect effects to harleuin ducks from disturbance that would influence breeding, foraging, or dispersal behavior.

Cumulative Effects:
Current Standards and Guidelines governing management of the landscape in watersheds surrounding the project area provide direction that should provide for long-term maintenance of amount and distribution of suitable habitat for *Harlequin ducks*. Riparian buffers will ensure protection to potential nest sites.

Analysis of Significance: The Bridge Thin Project does not propose any activity that would modify suitable harlequin duck nesting habitat, and activities that could result in disturbance to harlequin ducks by influencing either breeding or foraging behavior are not expected to occur due to spatial and temporal factors. It is therefore determined this projct should have **no impact on harlequin ducks and their habitat.**

Communication with U.S. Fish and Wildlife Service: Not required.

Recommendations: None warranted.

2) American Peregrine Falcon (*Falco peregrinus anatum*)
Status Federal: None (Delisted 8/99)
State: Endangered
FS R-6: Sensitive, Identified as Management Indicator Species (MIS)

Determination: "no impact" to peregrine falcons or their habitat.

Status Background: Following a global population depression and the near total disappearance of the American peregrine falcon (*Falco peregrinus anatum*) from habitat throughout much of the United States, largely as a result of environmental contamination (Cade et al. 1988, USFWS 2003), the peregrine was listed as endangered in 1970 under the Endangered Species Conservation Act of 1969 (precursor to the ESA) and subsequently listed under the ESA in 1973. After meeting a variety of objectives listed in regional recovery plans, the peregrine was removed from the ESA list of endangered

species on August 25, 1999. Since that time monitoring results suggest that population growth has continued throughout the lower 48 states (USFWS 2003).

Habitat: In the Pacific states, preferred peregrine falcon nesting sites are sheer cliffs 150 ft. or more in height with horizontal ledges (USFWS 1982). On the Willamette National Forest, cliffs with potential for nesting by peregrine falcons include those that are at least 75 feet high, have horizontal ledges, ledges with overhangs or cave-like openings, have sheer faces inaccessible to ground predators and within .5 miles of riparian habitat (USDA 2000). Peregrine falcons feed almost exclusively on birds, many of which may be associated with riparian zones, large bodies of water or an abundance of snag habitat. Peregrine falcons feed on small birds that are present in drier, open areas, particularly where hardwood shrubs and trees are abundant. Some avian prey species select for closed coniferous forest. Peregrine falcons can forage widely for prey and will hunt over closed coniferous forest canopies as well as in open areas and over hardwood patches - wherever prey is abundant (Cade et al. 1988).

Pre-field review: There is no high quality suitable peregrine nesting habitat within or immediately adjacent to the project area. The Bridge Thin project area is within 4 miles of a known peregrine nest site, and is includes part of the tertiary management zone for that site (OE-82).

As a result of annual site monitoring, adult and young peregrines from the nearby nest site are known to forage for avian prey in and near the project area. Young peregrines may linger in the project area while dispersing from a nest site. Proposed habitat restoration activities would not modify or disturb any suitable peregrine nesting habitat. All proposed activities would occur late at a sufficient distance from nesting habitat such that any disturbance potential would be avoided (Pagel 1992,USDA2002).

Field reconnaissance: The peregrine nest site nearest to the project area has been monitored annually throughout the breeding season since its discovery in year 2000. The site has been occupied annually since that time, and has successfully fledged young during half of these years. Protocol surveys of potential peregrine nesting habitat near the Bridge Thin area have not been conducted for several years.

Formal breeding bird surveys have not been conducted within the planning area. The complete range of avian prey species that may currently occur in habitat throughout the project area is unknown, but expected to be typical for habitat associated with this area (O'Neil et al. 2001).

Risk Assessment:
Project Effects: No suitable peregrine nesting habitat will be modified by this project. Due to the location and timing of proposed activities there should be no direct or indirect effects to peregrines from disturbance that would influence breeding, foraging, or dispersal behavior.

Removal of trees and prescribed burning may modify or disturb habitat suitable for use by some potential peregrine prey species. Tree cutting and prescribed burning would typically occur outside the breeding seasons for most prey species that could be utilizing affected habitat. Modification or disturbance activities are considered relatively insignificant considering the overall amount of foraging habitat within management zones established for the known peregrine nest sites (approximately 26,000 acres). Any short-term (0-5 year) negative effects from proposed activities on potential peregrine prey species are considered offset by meadow and forest/meadow ecotone restoration, which increases habitat suitability for a variety of potential peregrine prey species.

Cumulative Effects: This project reflects an overall focus on habitat management that has occurred within the past decade, and projected for the future, that should positively influence occupancy of

suitable nesting habitat and successful utilization of foraging habitat for peregrines as more emphasis is placed on recruitment of key structural components missing from harvested stands, retention of key structural components present in unharvested stands, and restoration and maintenance of special habitats as key components of biodiversity at a landscape level.

Analysis of Significance: The Bridge Thin Project does not propose any activity that would modify suitable peregrine falcon nesting habitat, and activities that could result in disturbance to peregrines by influencing either breeding or foraging behavior are not expected to occur due to spatial and temporal factors. It is therefore determined this projct should have **no impact on peregrine falcons and their habitat.**

Communication with U.S. Fish and Wildlife Service: Not required.

Recommendations: None warranted.

Wolverine (*Gulo gulo*)
Status: Federal: None
State: Threatened
FS R-6: Sensitive

Determination: "no impact" to wolverine or its habitat.

Status Background: The Bridge Thin Project is recognized historic and current range for the wolverine (*Gulo gulo (luscus)*) which was petitioned for federal listing under the Endangered Species Act (ESA) in July 2000. On October 21, 2003 the U.S. Fish and Wildlife Service (FWS) issued a 90-day Finding for a Petition To List as Endangered or Threatened Wolverine in the Contiguous United States. In that finding it was determined that the petition did "not provide substantial information indicating that listing may be warranted". An earlier (1994) petition to list the wolverine was found to be "not warranted" by FWS.

Taxonomy can lead to confusion when assessing the status of this species and its historic or current potential occurrence in these watersheds. Sighting records frequently include the name "California Wolverine". However, the validity of such a nominal subspecies has been questioned or is not recognized throughout much of the published literature devoted to addressing this species (Banci 1994, Johnson and O'Neil 2001, NatureServe 2005, Verts and Carraway 1998). Therefore further references to wolverine in this document are intended to be interpreted as *Gulo gulo*.

Records show that the wolverine has been listed on the Regional Forester's Sensitive Animal List for at least the past fifteen years. The wolverine was one of the original species classified as threatened by the Oregon Fish and Wildlife Commission in 1975. The status of the species was reviewed in 1988 (Marshall 1988) and as a result of that review wolverine are currently listed as threatened under the Oregon Endangered Species Act.

Habitat and Ecology: A large block of literature has been published in the past decade pertaining to the biology, ecology, and management of wolverine (Banci 1994, Claar et al. 1999, Copeland 1996, Heinemeyer et al. 2001, O'Neil et al. 2001, Verts and Carraway 1998). This is not meant to suggest that all aspects of the ecological relationships between this species and its environment are well understood. On the contrary, some relationships such as responses to human disturbance are just

beginning to be understood based on a scientific rather than anecdotal context (Joslin and Youmans 1999; Rowland et al. 2003). The following is a gross summary of wolverine ecology considered pertinent to the presence of this species in the vicinity of the project area. The reader is strongly encouraged to reference the literature for a more thorough understanding of this species.

The wolverine has been referenced as the largest-bodied terrestrial mustleid (Banci 1994) with a body weight three to four times greater than the fisher despite having a similar overall body length. Its robust appearance allows adults to be described as resembling a small bear.

O'Neil et al. (2001) list the wolverine in Oregon as associated with 26 forest structural conditions, 11 habitat types, 17 habitat elements, and as serving 5 key ecological functions within the identified associations. Overall data do not support any statistical association between the species and a particular vegetative community – a fact reflected by O'Neil in attaching a low confidence to all associations listed for structural conditions and habitat types. Forested habitats used by wolverines appear to vary geographically and seasonally in areas where they have been studied (Claar et al. 1999). Habitat preferences have been linked to areas based on the availability of food and low human occurrence. The most specific habitat need of wolverines may be for female denning habitat secure from human disturbance (Copeland 1996) throughout the breeding season, which can range from November through April (Banci 1994).

Current definition and subsequent identification of suitable wolverine habitat has evolved largely from Copeland's (1996) study of a wolverine population in central Idaho. Because of a widely published concern regarding the sensitivity of wolverines to human disturbance at natal den sites (Banci 1994, Claar et al. 1999, Copeland 1996, Krebs and Lewis 1999, Lyon et al. 1994, Youmans 1999a), there seems to be scientific consensus that identification of female denning habitat is key to managing for this species where it is likely (or known) to occur. Following that logic the Willamette National Forest created a GIS layer in 1998 based on criteria provided by the Regional Office in an effort to identify potential denning habitat. Habitat generally described as areas having a northerly aspect for higher elevation cirque landscape features with a large boulder/talus component and a relatively open canopy was mapped across the Forest.

Wolverine are generally described as opportunistic omnivores in summer and primarily scavengers in winter while they utilize extremely large home ranges in proportion to their body size. Adult wolverine home range sizes average 148mi^2 for females and 610mi^2 for males (Copeland 1996). They are capable of foraging widely (30-40 km) on a daily basis, and do not significantly use young, dense stands of timber or clearcuts (Banci 1994). Virtually all studies that have investigated food habitats for the species have shown wolverine to be closely associated with a dependency upon the availability of large mammal carrion to balance its energy budget during critical periods of its lifecycle.

Pre-field Review: Habitat conditions during the reference era in watersheds surrounding the project area favored the likelihood of occupancy by wolverine as it is located well within the historic range for this species, and would have been relatively free from human disturbance – especially during the breeding season. Then, as now, population densities would be expected to have been low given our current understanding of wolverine ecology.

The USDA Forest Service Fiscal Year 1958 Annual Wildlife Statistical Report for the Willamette National Forest lists the wolverine as having occasional abundance and a stationary population trend. Suitable denning habitat existed within a wolverine's daily movement range at numerous locations surrounding the project area, and if wolverine were indeed present during that time the species would

likely have occupied habitat in the area. Then, as now, the function of habitat associated with this project would have been to support year-round foraging and dispersal activities.

Maj and Garton (1994) mapped observation records for wolverine from 1961 through 1982, which show a cluster of sightings located within easy dispersal range of the project area. They also mapped records from 1983 through 1993, which show a sharp decline for sightings in the same location. Occurrence and breeding status data presented by O'Neil et al. (2001) show that wolverine both occurs and breeds in Oregon. A review of reported wolverine sightings on the Willamette National Forest conducted in May 2001 revealed 33 records of sightings between 1965 and 1999 on or adjacent to the Forest boundary, including sightings in watersheds where this project is located. There is no current verification this species occupies habitat in the area, and late-winter aerial surveys around denning habitat conducted from 1998 through 2001 have not detected the presence of wolverine within any adjacent watershed.

An issue regarding the reliability of current and historical presence of species such as the wolverine based on anecdotal records considered to be unverifiable has been raised (Aubry and Lewis 2003; McKelvey et al. 2002; McKelvey et al. 2000). The issue is associated with using such observational data combined with verifiable records to arrive at conservation actions and management recommendations. While some investigators believe combining such occurrence records results in scientific and legal vulnerability, others apparently do not (Rowland et al. 2003). Based on historic and current information, this analysis assumes the potential for wolverine to utilize habitat associated with this project for one or more of its biological requirements.

Field Reconnaissance: The Bridge Thin project is located adjacent prominent landscape features providing a westerly extension of upper elevation habitat connected to a vast remote area of the Western Oregon Cascades. Rocky outcrops associated with some potential habitat are visible from various locations within the project area. Most potential denning habitat is considered to be relatively free of human disturbance from winter recreation activities throughout much of the breeding season. However, winter activities such as cross country skiing and snowmobiling can be expected to occur periodically in surrounding areas. Although currently small in scale, these types of winter recreation do have potential to disturb wolverine – particularly a female that may be utilizing nearby denning habitat. This project or surrounding areas are open to a variety of human recreation activities throughout the remainder of the year. Activities such as hiking, horse back riding, and pleasure driving are considered to have less potential to disturb any wolverine that may be simply foraging or dispersing through nearby habitat.

The project area is recognized for its importance in providing habitat supporting local big game populations. Deer and elk are frequently observed during field visits to the project area. Improved forage habitat for big game would be created under this project's Action Alternative. Refer to this project's wildlife report for a further discussion of potential effects to big game habitat.

Habitat directly associated with the Bridge Thin Project is considered to be suitable as foraging and dispersal habitat for wolverine.

Risk Assessment:

Project Effects: This project proposes no activities that would result in modification or disturbance of potential natal denning habitat. Project activities that are proposed should not compromise foraging or dispersal opportunities for any individual to any estimable extent. For these reasons there are no recognized direct or indirect effects to this species associated with the project proposal.

Cumulative Effects: If security of natal denning habitat from human disturbance is critical for the persistence of wolverine in an area, the ability of this species to occupy otherwise suitable habitat in this area has likely been compromised by activities not associated with this project. Road building has allowed a variety of motorized and non-motorized winter recreation to extend into many areas surrounding the project area that were not historically readily accessible. Cumulative effects associated with human disturbance in the form of winter recreation have negatively influenced suitability of areas to support denning activity. Past, present, and ongoing winter activities in areas such as the East Fork McKenzie River , Castle Rock and MacDuff Mountain are examples of areas where suitability has been compromised.

If access to areas where wolverine may depend on larger mammals as a food source during critical times of the year is another factor influencing the persistence of this species in an area, wolverine have likely benefited from past harvest activity that has resulted in a wider distribution of forage habitat for big game. During the past decade however, harvest practices have changed and this positive contribution is waning rapidly as forage units regenerate into hiding cover. In addition, some former areas of natural forage habitat (such as the meadows associated with this proposal) are shrinking as forested stands expand in response to fire suppression.

The cumulative effect of this project on natural forage habitat as it pertains directly to big game and indirectly to wolverine will be positive, but immeasurable on a landscape scale.

Analysis of Significance: This project does not propose any activity that would modify or otherwise disturb potential wolverine denning habitat. Considering the wide-ranging nature of daily movements associated with wolverine foraging and/or dispersal behavior along with the low likelihood of occurrence and timing of restoration activities, this project should not result in disturbance to the species. It is therefore determined this project should have **no impact to wolverines or their habitat.**

Communication with U.S. Fish and Wildlife Service: Not required.

Recommendations: None warranted.

4) Pacific Fringe-tailed Bat (*Myotis thysanodes vespertinu*)
Status: Federal: None
State: None
FS R-6: Sensitive

Determination: "no impact" to individuals or habitat for Pacific Fringe-tailed bats

Habitat: The Pacific fringe-tailed bat was added to the Regional Forester's sensitive animal list in November 2000 based on the Natural Heritage Ranking for the species. This species is one of the three named sub-species of fringed myotis (*Myotis thysanodes*), which is among the bat species whose specific habitat needs are addressed under a Northwest Forest Plan standard and Guideline (2001 ROD pp 37-38).

This bat is considered a riparian associate species that has been associated with mixed-conifer forests having relatively dry moisture regimes in the Coast Range and southern Cascade Range of Oregon (NatureServe 2005, O'Neil et al. 2001). Other scattered locations occur in the Washington Cascades and into California and the desert Southwest. They may occur from near sea level to above 4000' in Oregon and utilize a wide range of habitats – from forested to non-forested (Hayes 2003, Verts and Carraway 1998). Foraging behavior specific to this species is poorly documented, however they have been described as aerial foragers and hovering gleaners (O'Neil et al. 2001). Maternity sites, hibernacula, and most documented individual roost sites for fringed myotis occur in rock crevices, caves, or anthropogenic structures. However Weller and Zabel (2001) recently published data that show a significant amount of individual roosting occurring in trees/snags when this species occurs in or near forested habitat. Structures associated with live trees or snags have since been recognized as the primary roost structures for this species when it occurs in/near forested habitat and features associated with caves, mines, bridges or buildings may serve as primary roost structures in non-forested habitat (Hayes 2003). Knowledge of roosting behavior is almost exclusively based on data obtained during the breeding season for this species which likely extends from May through August (O'Neil et al. 2001).

Pre-field Review: Despite an overall lack of survey data and poorly documented habitat requirements and life-history accounts for this species, its presence has been documented on the McKenzie River Ranger District (Ormsbee pers com., Verts and Carraway 1998). The potential exists that at least single individuals may utilize available forage and roost habitat throughout the summer and early fall in or adjacent to areas where proposed habitat restoration activities would occur.

Field Reconnaissance: Formal bat surveys within the project area have not been conducted. There are no caves, mines, or abandoned wooden bridges and buildings that would serve as suitable hibernacula nor are there known roost sites associated with other structures within 250 feet that would be affected by proposed activities. Some snags and decadent trees occurring adjacent to proposed treatment areas contain features suitable for roost use by bats – including *Myotis thysanodes*.

The current composition of habitat throughout the project area consisting of a mixture of forested and open (meadow) habitat creates a moderate amount of edge habitat, increasing the potential that individuals may use the area for foraging and either day or night roosting. Bats are known to use edge habitat more frequently than forest or open habitat, which is likely a function of avoiding dense clutter associated with forest habitat and areas where prey abundance may be reduced in open habitat (Hayes 2003).

Risk Assessment:
Measures can be taken to protect snags or decadent trees adjacent to the project area that may provide roosting habitat. Prescribed burning associated with portions of these meadows during late fall should not affect foraging opportunities for this species. Project activities should not compromise roosting or foraging opportunities for any individuals to any estimable extent, and therefore should not result in any direct effect to Pacific fringe-tailed bats. Indirect effects to this species may occur if larger trees are affected by prescribed burning such that they are modified and eventually develop into roosting habitat.

Cumulative Effects: Current Standards and Guidelines governing management of the landscape in watersheds surrounding the project area provide direction that should provide for long-term maintenance of amount and distribution of suitable habitat for *Myotis thysanodes*. Because of the range and location of land allocations in this area, it is unlikely that cumulative effects would influence the ability of local populations to persist, or become established, by eliminating demographic linkages beyond the species

dispersal capabilities. The cumulative effect of this project on roosting or forage habitat as it pertains directly to this species would be immeasurable on a landscape scale.

Analysis of Significance: There is no known threat to hibernacula or maternity roosts from activities proposed under the Bridge Thin Project. Suitable roosting habitat adjacent to the project areas should not be affected by this proposal, and activities that could result in disturbance to this species by influencing either roosting or foraging behavior are not expected to occur. It is therefore determined this projct should have **no impact on Pacific fringe-tailed bats and their habitat.**

Communication with U.S. Fish and Wildlife Service: Not required.

Recommendations: Protect decadent trees and snags >12"dbh (roosting habitat) adjacent to the project area to the greatest extent feasible while conducting project activities.

5) Crater Lake Tightcoil (*Pristiloma arcticum crateris*)
Status: Federal: None
State: ODFW none / Natural Heritage S1
FS R-6: Sensitive / Survey and Manage Species

Determination: "no impact" to individuals or habitat for Crater Lake Tightcoil.

Status Background: The Crater Lake tightcoil had been listed as a Survey and Manage species since the 1994 Northwest Forest Plan ROD (USDA, USDI 1994). Under the 2001 ROD (USDA, USDI 2001) it was classified as a Category B species. The species was changed to a Category A species following the 2002 Annual Species Review where it remains considered rare, and for which pre-disturbance surveys are practical if habitat is present. It was added to the Regional Forester's sensitive animal list in July 2004.

The species is endemic to Oregon, and known to occur above 2000 feet elevation throughout the Oregon Cascades from the Mt Hood National Forest south to the Winema National Forest. As of August 2005 specimens had been confirmed at approximately 160 sites from very limited locations across this range (Duncan 2004, NatureServe 2005).

Habitat and Ecology: *Pristiloma arcticum crateris* "may be found in perennially moist situations in mature conifer forests and meadows among rushes, mosses and other surface vegetation or under rocks and woody debris within 10 m. of open water in wetlands, springs, seeps and streams, generally in areas which remain under snow for long periods in the winter. Essential habitat componenst include uncompacted soil, litter, logs, and other woody debris in a perennially wet environment."(Duncan 2004).

This species is among many organisms functioning as primary and secondary consumers that contribute to soil building and dissemination of spores and microbes. Having very limited dispersal capabilities on their own, they may be assisted in dispersal by other vectors capable of transporting mud that may contain eggs or adults across distances into suitable habitat (Duncan et al. 2004). An example of such dispersal could be individuals in mud transported on the hoof of a deer or elk.

Loss or degradation of suitable wetland habitat has been identified as the major threat to this species.

Pre-field Review: Prior to 2005 the presence of the Crater Lake Tightcoil had not been documented on the Willamette National Forest. However in May 2005 a specimen that has since been confirmed to be *Pristiloma arcticum crateris* was collected on the Middle Fork Range District from a site in the North Fork of Middle Fork Willamette River Watershed to the southwest of this project area.

Based on habitat described in an established survey protocol for this species (Duncan et al. 2003) it is considered that suitable habitat for Crater Lake Tightcoil exists within portions of the project area.
Field Reconnaissance: Based on the three evaluation criteria to determine the need to conduct a survey, surveys for Crater Lake Tightcoil are not considered to be required for this project. This consideration is made because each of the three criteria necessary to trigger a survey would not be met for the following reason: perennially wet habitat associated with creeks in portions of the project area will be protected by a 10 meter buffer against all disturbance activities including prescribed burning. For this reason the persistence of the species if present in the project area should not be compromised.

Risk Assessment:
Project Effects: Because measures will be taken to protect suitable habitat for this species against disturbance or modification from effects associated with proposed activities, there are no recognized direct or indirect effects to this species or its habitat from the project.

Cumulative Effects: Because measures will be taken to protect suitable habitat for this species against disturbance or modification from effects associated with proposed activities, there are no recognized cumulative effects to this species or its habitat from the project.

Analysis of Significance: Suitable habitat for the Crater Lake Tightcoil exists in portions of the Bridge Thin Project area, however measures will be taken to protect this habitat where it occurs against disturbance or modification from effects associated with proposed activities, therefore there should be **no impact to Crater Lake Tightcoil or its habitat** from this proposal.

Communication with U.S. Fish and Wildlife Service: Not required.

Recommendations: Ensure that measures identified to prevent habitat disturbance within 10 meters of perennially wet areas are implemented during prescribed burning activities.

This document was prepared by: /s/ Shane D Kamrath Date: 1/18/08

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Appendix 1: Literature referenced during this biological evaluation to arrive at determinations regarding potential effects/impacts from proposed projects and activities.

Anthony, R., R.L. Knight, G.T. Allen, B.R. McClelland, and J.I. Hodges. 1982. Habitat use by nesting and roosting bald eagles in the Pacific Northwest. Trans. of the 47th N. Amer. Wildl. and Nat. Res. Conf., Washington, DC.

Anthony, R.G., M.A. O'connell, M.M. Pollock, and J.G. Hallett. 2003. Associations of mammals with riparian ecosystems in Pacific Northwest forests. pp. 510-563 *in:* C.J. Zabel and R.G. Anthony, eds. Mammal community dynamics: management and conservation in the coniferous forests of Western North America. Cambridge University Press. 2003.

Anthony, R.G., E.D. Forsman, A.B. Franklin, D.R. Anderson, K.P. Burnham, G.C. White, C.J. Schwarz, J. Nichols, J.E. Hines, G.S. Olson, S.H. Ackers, S. Andrews, B.L. Biswell, P.C. Carlson, L.V. Diller, K.M. Dugger, K.E. Fehring, T.L. Fleming, R.P. Gerhardt, S.A. Gremel, R.J. Gutierrez, P.J. Happe, D.R. Herter, J.M. Higley, R.B. Horn, L.L. Irwin, P.J. Loschl, J.A. Reid, S.G. Sovern. 2004. Status and trends in demography of northern spotted owls, 1985 – 2003. September 2004.

Aubry, K.B. and P.A. Hall. 1991. Terrestrial amphibian communities in the southern Washington Cascade Range. pp. 326-338 *in:* Ruggiero, Leonard F.; Aubry, Keith B.; Carey, Andrew B.; Huff, Mark H., tech. coords. Wildlife and vegetation of unmanaged Douglas-fir forests. USDA Forest Service, Pacific Northwest Research Station, Portland, Oregon, General Technical Report PNW-GTR-285, May 1991.

Aubry, K.B. and J.C. Lewis. 2003. Extirpation and reintroduction of fishers (*Martes pennanti*) in Oregon: implications for their conservation in the Pacific states. Biological Conservation 114 (2003) 79-90.

Banci, V. 1994. Wolverine. Pages 99-127. *in* L.R. Ruggiero, K.B. Aubry, S.W. Buskirk, L.J. Lyon and W.J. Zielinski, eds. The scientific basis for conserving forest carnivores: American marten, fisher, lynx and wolverine in western United States. USDA Forest Service Gen. Tech. Rep. RM-254. 184 pp.

Blakesley, J. 2004. Chapter five: habitat associations. *in* Courtney, S.P., J.A. Blakesley, R.E. Bigley, M.L. Cody, J.P. Dumbacher, R.C. Fleischer, A.B. Franklin, J.F. Franklin, R.J. Gutierrez, J.M. Marzluff, L. Sztukowski. 2004. Scientific evaluation of the status of the northern spotted owl (SEI Report). Sustainable Ecosystems Institute, Portland OR. September 2004.

Blaustein, A.R., J.J. Beatty, D.H. Olson, and R.M. Storm. 1995. The biology of amphibians and reptiles in old-growth forests in the Pacific Northwest. USDA Forest Service, Pacific Northwest Research Station, Portland, Oregon, General Technical Report PNW-GTR-337, March 1995.

Bruner, Howard J. 1997. Habitat use and productivity of harlequin ducks in the central Cascade range of Oregon. Master's Thesis. Oregon State University, Corvallis, OR. 44 pp.

Cade, T.J., J.H. Enderson, C.G. Thelander, and C.M. White. 1988. Peregrine falcon populations: their management and recovery. The Peregrine Fund, Inc. Boise, Idaho, USA. 1988. 949pp.

Cary, A.B. 2004. Appendix 5: relationship of prey and forest management. *in* Courtney, S.P., J.A. Blakesley, R.E. Bigley, M.L. Cody, J.P. Dumbacher, R.C. Fleischer, A.B. Franklin, J.F. Franklin, R.J. Gutierrez, J.M. Marzluff, L. Sztukowski. 2004. Scientific evaluation of the status of the northern spotted owl (SEI Report). Sustainable Ecosystems Institute, Portland OR. September 2004.

Chappell, C.B., R.C. Crawford, C. Barrett, J. Kagan, D.H. Johnson, M. O'Mealy, G.A. Green, H.L. Ferguson, W.D. Edge, E.L. Greda, and T.A. O'Neil. 2001. Wildlife habitats: descriptions, status, trends, and system dynamics. *in* D. H. Johnson and T.A. O'Neil (Manag. Dirs.) *Wildlife-Habitat Relationships in Oregon and Washington*. Oregon State University Press, Corvallis, OR, USA. 2001. 736 pp.

Claar, J.J., N. Anderson, D. Boyd, M. Cherry, B. Conard, R. Hompesch, S. Miller, G. Olson, H. Ihsle Pac, J. Waller, T. Wittenger, H. Youmans. 1999. Carnivores. Pages 7.1-7.63 *in* Joslin, G. and H. Youmans, coordinators. Effects of recreation on Rocky Mountain wildlife: A Review for Montana. Committee on Effects of Recreation on Wildlife. Montana Chapter of The Wildlife Society. 307 pp.

Copeland, J.P. 1996. Biology of the wolverine in central Idaho. M.S. thesis, Univ Idaho, Moscow. 138 pp.

Corkran, C.C. and C.R. Thoms. 1996. Amphibians of Oregon, Washington and British Columbia. Lone Pine Publishing, Redmond, Washington. 175 pp.

Courtney, S.P., J.A. Blakesley, R.E. Bigley, M.L. Cody, J.P. Dumbacher, R.C. Fleischer, A.B. Franklin, J.F. Franklin, R.J. Gutierrez, J.M. Marzluff, L. Sztukowski. 2004. Scientific evaluation of the status of the northern spotted owl (SEI Report). Sustainable Ecosystems Institute, Portland OR. September 2004.

Csuti, B., A.J. Kimerling, T.A. O'Neil, M.M. Shaughnessy, E.P. Gaines, and M.M.P. Huso. 1997. Atlas of Oregon Wildlife (Distribution, Habitat, and Natural History), Oregon State University Press, Corvallis, Oregon.

Duncan, N., T. Burke, S. Dowlan, and P. Hohenlohe. 2003. Survey Protocol for Survey and Manage Terrestrial Mollusk Species From the Northwest Forest Plan. Version 3.0. 2003.

Duncan, N. 2004. Conservation Assessment for *Pristiloma arcticum crateris*, Crater Lake Tightcoil – originally issued as management recommendations, October 1999, Darryl Gowan and Thomas E. Burke, Authors. reconfigured September 2004 by Nancy Duncan.

Forsman, Eric D., R.G. Anthony, J.A. Reid, P.J. Loschl, S.G. Sovern, M. Taylor, B.L. Biswell, A. Ellingson, E.C. Meslow, G.S. Miller, K.A. Swindle, J.A. Thrailkill, F.F. Wagner, D.E. Seaman. 2002. Natal and breeding dispersal of northern spotted owls. The Wildlife Society, Wildlife Monographs No. 149, October 2002.

Gilbert, F.F. and R. Allwine. 1991. Terrestrial amphibian communities in the Oregon Cascade Range. pp. 319-325 *in:* Ruggiero, Leonard F.; Aubry, Keith B.; Carey, Andrew B.; Huff, Mark H., tech. coords. Wildlife and vegetation of unmanaged Douglas-fir forests. USDA Forest Service, Pacific

Northwest Research Station, Portland, Oregon, General Technical Report PNW-GTR-285, May 1991.

Hammond, P.C. 2003. Report on possible occurrences of the Fender's blue butterfly and the Mardon skipper on National Forest lands in western Oregon. Philomath, OR. May 26, 2003.

Hayes, J.P. 2003. Habitat ecology and conservation of bats in western coniferous forests. pp. 81-119 *in:* C.J. Zabel and R.G. Anthony, eds. Mammal community dynamics: management and conservation in the coniferous forests of Western North America. Cambridge University Press. 2003.

Hayes, M.P. 1994. The spotted frog (*Rana pretiosa*) in western Oregon. Department of Biology, Portland State University. Unpublished Report 30 pp.

Heinemeyer, K.S., B.C. Aber and D.F. Doak. 2001. Aerial surveys for wolverine presence and potential winter recreation impacts to predicted wolverine denning habitats in the southwestern Yellowstone Ecosystem. Unpubl. Report. University of California, Santa Cruz Department of Environmental Studies. 33 pp.

Hornocker, M.G., and H.S. Hash. 1981. Ecology of the Wolverine in Northwestern Montana. Can. J. Zool. 59:1286-1301.

Johnson, David H. and T.A. O'Neil (Manag. Dirs.). 2001. Wildlife-habitat relationships in Oregon and Washington. Oregon State University Press, Corvallis, Oregon.

Joslin, G. and H. Youmans, coordinators. 1999. Effects of recreation on Rocky Mountain wildlife: A Review for Montana. Committee on Effects of Recreation on Wildlife. Montana Chapter of The Wildlife Society. 307 pp

Krebs, J.A. and D. Lewis. 1999. Wolverine ecology and habitat use in the North Columbia Mountains: progress report. Columbia Basin Fish and Wildlife Compensation Program. Nelson, British Columbia.

Leonard, W.P., H.A. Brown, L.L.C. Brown, K.R. McAllister, and R.M. Storm. 1993. Amphibians of Washington and Oregon. Seattle Audubon Society. Seattle Washington, 168 pp.

Lint, J.B. (technical coordinator). 2005. Northwest forest plan – the first ten years (1994-2003): Status and trend of northern spotted owl populations and habitat. Gen. Tech. Rep. PNW-GTR-[In Press]. Portland, OR: USDA Forest Service, Pacific Northwest Research Station.

Lyon, J.L., K.B. Aubry, W.J. Zielinski, S.W. Buskirk, and L.F. Ruggiero. 1994. The scientific basis for conserving forest carnivores: considerations for management. Pages 128-137. *in* L.R. Ruggiero, K.B. Aubry, S.W. Buskirk, L.J. Lyon and W.J. Zielinski, eds. The scientific basis for conserving forest carnivores: American marten, fisher, lynx and wolverine in western United States. USDA Forest Service Gen. Tech. Rep. RM-254. 184 pp.

Maj, M. and E.O. Garton. 1994. Fisher, lynx, wolverine: summary of distrubution information. Appendix B (7pp.) *in* L.R. Ruggiero, K.B. Aubry, S.W. Buskirk, L.J. Lyon and W.J. Zielinski, eds.

The scientific basis for conserving forest carnivores: American marten, fisher, lynx and wolverine in western United States. USDA Forest Service Gen. Tech. Rep. RM-254. 184 pp.

Marshall, David B. 1988. Status of the wolverine in Oregon. Unpublished Report. Oregon Department of Fish and Wildlife, Portland, OR. Unpublished Report. 18 pp.

McKelvey, K.S., K.B. Aubry, and Y.K. Ortega. 2000. History and distribution of lynx in the contiguous United States. Pages 207-264. *in* Ruggiero, L. F., K. B. Aubry, S. W. Buskirk, G. M. Koehler, C. J. Krebs, K. S. McKelvey, and J. R. Squires. 2000*a*. Ecology and conservation of lynx in the United States. Univ. Press of Colorado. Boulder, CO. 480 pp.

McKelvey, K.S., K.B. Aubry, and P.T. Rivera. 2002. Historical biogeography of the wolverine in the United States. *in* Proceedings: Defenders of Wildlife's Carnivores 2002, From Mountains to the Sea: A Conference on Carnivore Biology and Conservation, Session 2: Wolverines in the Contiguous United States. November 17-20, 2002. Monterey, CA.

NatureServe. 2005. NatureServe Explorer: An online encyclopedia of life [web application]. Version 4.5. NatureServe, Arlington, Virginia. Available http://www.natureserve.org/explorer. Copyright © 2005 NatureServe, 1101 Wilson Boulevard, 15th Floor, Arlington Virginia 22209, U.S.A. All Rights Reserved.

O'Neil, Thomas A., David H. Johnson, Charley Barrett, Maria Trevithick, Kelly A. Bettinger, Chris Kiilsgaard, Madeleine Vander Heyden, Eva L. Greda, Derek Stinson, Bruce G. Marcot, Patrick J. Doran, Susan Tank, and Laurie Wunder. *Matrixes for Wildlife-Habitat Relationship in Oregon and Washington*. Northwest Habitat Institute. 2001. *in* D. H. Johnson and T.A. O'Neil (Manag. Dirs.) *Wildlife-Habitat Relationships in Oregon and Washington*. Oregon State University Press, Corvallis, OR, USA. 2001. 736 pp.

Ormsbee, P. 1999. Personal Communication. Forest wildlife ecologist, Regional bat specialist, Willamette National Forest, February 9, 1999.

Pagel, J.E. (Ed.). 1992. Protocol for observing known and potential peregrine falcon eyries in the Pacific Northwest *in* Proceedings- Symposium on peregrine falcons in the Pacific Northwest, 16-17 Jan. 1991. Rogue River National Forest, 125 pp.

Perlmeter, S. 1996. The bat project: Report of activities for 1996. Willamette National Forest, 23 pp.

Potter, A., J. Fleckenstein, S. Richardson, and D. Hays. 1999. Washington state status report for the mardon skipper. Washington Department of Fish and Wildlife, Olympia. 39pp.

Potter, A., J. Fleckenstein, J. Feen. 2002. Mardon skipper range and distrubution in Washington in relation to state and federal highways with a habitat description and survey method guidelines – Final Report to Washington Department of Transportation. A report to Washington Dept. of Transportation, Olympia, WA under Washington Dept. of Fish and Wildlife agreement number 39012270. June 30, 2002.

Powell, R.A. and W.J. Zielinski. 1994. Fisher. Pages 38-73. *in* L.R. Ruggiero, K.B. Aubry, S.W. Buskirk, L.J. Lyon and W.J. Zielinski, eds. The scientific basis for conserving forest carnivores:

American marten, fisher, lynx and wolverine in western United States. USDA Forest Service Gen. Tech. Rep. RM-254. 184 pp.

Pyle, R.M. 2002. The butterfies of Cascadia: a field guide to all the species of Washington, Oregon, and surrounding territories. Seattle Audubon Society. Seattle, WA. 2002.

Rowland, M.M., M.J. Wisdom, D.H. Johnson, B.C. Wales, J.P. Copeland, and F.B. Edelmann. 2003. Evaluation of landscape models for wolverines in the interior Northwest, United States of America. Journal of Mammalogy, 84(1):92-105, 2003.

Seitz, R. 2005. Personal Communication. Wildlife Biologist, McKenzie River Ranger District, Willamette National Forest. 6/27/2005 and 7/19/2005.

Thomas, J.W., E.D. Forsman, J.B. Lint, [and others]. 1990. A conservation strategy for the northern spotted owl: a report of the Interagency Scientific Committee to address the conservation of the northern spotted owl. Portland, OR: USDA Forest Service; USDI Bureau of Land Management, Fish and Wildlife Service, and National Park Service. 427pp.

USDA Forest Service. 1990. Willamette National Forest Land and Resource Management Plan, 1990.

USDA Forest Service. 1994a. South Fork McKenzie River Watershed Analysis. Willamette National Forest, Blue River (McKenzie River) Ranger District. December 1994.

USDA Forest Service. 1995. North Fork of the Middle Fork Willamette River Watershed Analysis. Willamette National Forest, Oakridge (Middle Fork) Ranger District. September 1995.

USDA Forest Service. 2000. INTERIM FINAL (draft) Peregrine Falcon (*Falco peregrinus anatum*) Nest Site and Habitat Management Plan with Site Specific Appendix. Willamette National Forest. April 17, 2000.

USDA Forest Service. 2002. Environmental assessment: peregrine falcon forest plan amendment-DRAFT. Willamette National Forest – Oregon. August 2002.

USDA Forest Service, Pacific Northwest Region. 2004a. Regional Forester's Sensitive Animal List. July 21, 2004.

USDA Forest Service Pacific Northwest Region. 2004b. Federally Listed or Proposed Species and Proposed or Designated Critical Habitat List. July 21, 2004.

USDA Forest Service. 1994. Record of Decision for Amendments to Forest Service and Bureau of Land Management Planning Documents Within the Range of the Northern Spotted Owl, and Standards and Guidelines for Management of Habitat for Late-Successional and Old-Growth Forest Related Species Within the Range of the Northern Spotted Owl, USDA Forest Service and USDI Bureau of Land Management, 1994.

USDA Forest Service, USDI Bureau of Land Management. 2001. Record of Decision and Standards and Guidelines for Amendments to the Survey and Manage, Protection Buffer, and other Mitigation Measures Standards and Guidelines. January 2001.

USDA Forest Service, USDI Bureau of Land Management. 2004. Record of Decision to Remove or Modify the Survey and Manage Mitigation Measure Standards and Guidelines in Forest Service and Bureau of Land Management Planning Documents Within the Range of the Northern Spotted Owl. March 2004.

USDA Forest Service, USDI Bureau of Land Management, Columbia River Gorge NSA, USDI Fish and Wildlife Service. 2005. Biological Assessment of Activities with the Potential to Disturb Northern Spotted Owls or Bald Eagles: Willamette Planning Province – FY2006-2007. July 28, 2005.

USDI Fish and Wildlife Service. 2005. Letter of Concurrence regarding informal consultation on FY 2006-2007 projects within the Willamette Planning Province which may disturb bald eagles and northern spotted owls. (FWS *reference*: 1-7-05-I-0666) USFWS, 10/14/05.

USDI Fish and Wildlife Service. 2004a. Northern spotted owl, five-year review summary and evaluation. Fish and Wildlife Service, Portland, OR. 72pp.

USDI Fish and Wildlife Service. 2004b. 50 CFR Part 17. endangered and threatened wildlife and plants; review of species that are candidates or proposed for listing as endangered or threatened; annual notice of findings on resubmitted petitions; annual description of progress on listing actions; notice of review; proposed rule. Federal Register Vol.69, No.86 24876-24909, May 4, 2004.

USDI Fish and Wildlife Service, and National Marine Fisheries Service. 1998. Endangered Species Consultation Handbook: Procedures for conducting consultation and conference activities under Section 7 of the Endangered Species Act. March 1998.

USDI. 1982. Pacific Coast Recovery Plan For The American Peregrine Falcon. The Pacific Coast American Peregrine Falcon Recovery Team, USFWS Denver, Colorado. August 1982. 87pp.

USDI. 1986. Recovery Plan for the Pacific Bald Eagle. Portland, OR. 160 pp.

USDI. 1992. Recovery Plan for the Northern Spotted Owl – Draft. Portland, OR: U.S. Department of the Interior. 662pp.

USFWS. 2003. Monitoring plan for the American peregrine falcon, a species recovered under the Endangered Species Act. U.S. Fish and Wildlife Service, divisions of Endangered Species and Migratory Birds and State Programs, Pacific Region, Portland, OR. 53pp.

Verts, B.J. and Leslie N. Carraway. 1998. Land mammals of Oregon. University of California Press, Berkeley and Los Angeles, California.

Waldien, D.L. 1996. Bat communities of Western Oregon: Landscape relationships of roost structures and activity areas of *Myotis evotis* (Long-eared myotis). Annual Report. Unpublished. 38 pp.

Weller, T.J. and C.J. Zabel. 2001. Characteristics of fringed myotis day roosts in northern California. Journal of Wildlife Management 65(3):489-497.

Youmans, H. 1999a. Project Planning. Appendix C (12pp.) *in* Joslin, G. and H. Youmans, coordinators. Effects of recreation on Rocky Mountain wildlife: A Review for Montana. Committee on Effects of Recreation on Wildlife. Montana Chapter of The Wildlife Society. 307 pp

Bridge Thin Wildlife Specialist Report

File Code:	2600 Wildlife	**Date:**	11 January 2008
Route To:	Files		
Subject:	Terrestrial Wildlife Specialist's Report for: Bridge Thin Project		
To:	Files		

SUMMARY OF DETERMINATIONS

For reasons addressed later in this document **it is considered that activities proposed by the Bridge Thin Project should not result in any adverse impacts to other rare and uncommon species, MIS, or other terrestrial wildlife species, and long-term effects should be positive as a result of increased overall biodiversity. Taking No Action would have no effect on these species while allowing growth of timber stands to continue.**

Cumulative effects of this project in conjunction with other reasonably foreseeable projects in and adjacent to this area are not expected to influence the ability of other rare and uncommon species under the Northwest Forest Plan or as Management Indicator Species on the Willamette National Forest to persist or become established in habitat associated with the project area. Maintenance and/or recovery of late successional habitat serving as current or potential dispersal corridors surrounding the project area will ensure ongoing opportunities for occupancy and movement of terrestrial wildlife species that may occur in the vicinity of this project and are dependent on such habitat.

SUMMARY OF SEASONAL RESTRICTIONS/RECOMMENDATIONS

Implementing the following recommendations would ensure effects or impacts on listed species from proposed activities would be no greater than those addressed in this document, and also would mitigate those impacts.

- Ensure that measures identified in the proposal to avoid habitat disturbance within 10 meters of perennially wet areas are implemented. This measure would provide refugia in a limited amount of the project area for a variety of wildlife species that may be present and associate with habitat exposed to activities while being implemented.
- Protect decadent trees and snags >12"dbh when feasible while conducting project activities.

INTRODUCTION

This report serves to document potential impacts to terrestrial wildlife considered as other rare and uncommon species and Management Indicator Species (USDA 1990) plus other wildlife and associated habitat that may occur in or near a project area from activities associated with this project. A separate biological analysis/evaluation (BA/BE) addresses effects to threatened, endangered and sensitive (TES) fauna species.

PROJECT LOCATION AND DESCRIPTION

The McKenzie River Ranger Districts proposes to harvest timber on approximately 2256 acres of the Bridge Thin Project Area, which would yield an approximate net estimate of 35.6 million board feet (MMBF) of wood products. This proposal, represented in Alternative B in this EA, would include heavy thinning on 1458 acres, moderate thinning on 398 acres, oak savanna restoration on 51 acres, wildlife forage thinning on 190 acres and fuels treatment on 178 acres. The timber sales from this proposal would likely occur over a four year time span, beginning in fiscal year 2009.

The project is located on the McKenzie River Ranger District, Willamette National Forest, Lane County, Oregon. The legal location of the project is WM T15S R4,5 E, and T16S R4,5E. The Willamette

National Forest Land and Resource Management Plan shows land allocation in the project area as: 5a-special interest area, 7- Old growth Groves, 9c- Wildlife marten Area, 9d- Special Wildlife Habitat Area, 11a-Scenic Modification Middleground, 11c- Scenic Partial Retention Middleground, 11e-Scenic Retention Middleground, 11f- Scenic Retention Foreground, 14a-General Forest, 16a-Late Successional Reserve, and 17-Adaptive Management Area.

Forested habitat surrounding the project areas is most closely associated with the Westside Lowland Conifer Hardwood Habitat type described by Chappell et al. (2001).

Alternatives:
The Bridge Thin Project will be analyzed in an Environmental Assessment that reviews three alternatives – a No Action alternative and two Action Alternatives. The Action Alternatives involve activities described above.

Action Alternative: The influence of proposed activities on terrestrial wildlife is considered in the context of whether or not suitable habitat may be modified or if a species may be present at or near sites where physical disturbance may occur, or be sensitive to and thereby influenced by anthropogenic activities occurring during implementation of this project. Habitat disturbance that may affect some terrestrial wildlife species could occur as a result of this project. That potential is addressed later in this report.

No Action Alternative: There is no rationale to suggest the No Action alternative would affect or impact any terrestrial wildlife species based on their ecological requirements and current habitat conditions in the project area. Considering the No Action Alternative would have no effect/impact on terrestrial wildlife species is based on the following assumption - taking no action would not affect current habitat or wildlife species that may be present as either evolves without human management. The dynamic nature of habitat suitability that may be subject to an unknown frequency and variety of stochastic events is considered beyond the scope of this evaluation. Only potential effects or impacts of the Action Alternative will be discussed further in this document.

WATERSHED ANALYSIS / ADDITIONAL DOCUMENT SUPPORT

Proposed activities respond positively to recommendations made to address vegetation and wildlife in the Quartz Creek and Minor Tributaries Watershed Analysis.

MANAGEMENT DIRECTION COMPLIANCE

The alternative selected for management of the Willamette National Forest includes a strategy that provides Management Requirements (MRs) exceeding the minimum MRs established for Management Indicator Species (MIS) as presented in the Willamette Forest Plan FEIS Appendices - Volume 1 (USDA 1990, pp B-79 through 82). Maintenance of the MRs ensures the viability of MIS and the species they represent. The MRs have been further enhanced for most MIS species (i.e. those species dependent on old growth and mature conifer habitat, and dead and defective tree habitat) under the Forest Plan S&Gs as amended by the Northwest Forest Plan.

Proposed action associated with this project complies with current forest Standards and Guidelines (S&Gs) pertaining to MIS and other rare and uncommon species management. This proposal also complies with other S&Gs established in the Willamette National Forest Land and Resource Management Plan (1990) as amended by the Northwest Forest Plan Records of Decision (ROD) (1994, 2001, and 2004).

ADJACENT ACTIVITIES / CUMULATIVE EFFECTS

Many years of fire suppression have contained fires to a size of mostly less than one acre, resulting in light to moderate burn intensities. The fire suppression has also allowed conifer encroachment to occurring near the oak savannah habitat in this area.

GENERAL WILDLIFE OVERVIEW

As previously stated, forested habitat surrounding the project areas is most closely associated with the Westside Lowland Conifer Hardwood Habitat type described by Chappell et al. (2001). Within this habitat type, plant associations relevant to the project area vary considerably.

Westside Lowland Conifer Hardwood Habitat

Where it occurs in Washington and Oregon, 233 wildlife species have been identified as associated with the Westside Lowland Conifer Hardwood Habitat type described by Chappell et al. (2001).
These species includes birds, mammals, amphibians, and reptiles.

Historic sighting records and current inventory data have documented the presence of many species within or near the project area. Effects from project activities will enhance overall biodiversity in the area

Project Effects to General Wildlife: Proposed activities would generally occur outside the breeding season for most species and/or at a time when many may have migrated from the area or become seasonally inactive (Csuti et al. 1997, Marshall et al. 2003, O'Neil et al. 2001, NatureServe 2005). The timing of activities would mitigate potential short-term (< 5 years) negative effects from habitat modification such as temporary loss of some potential nesting habitat, or disturbance such as temporary displacement of individuals or their prey from thinning or prescribed burning activities. Habitat altering activities proposed by this project should not affect other terrestrial wildlife species such that their ability to persist in the vicinity of the project area or throughout their ranges would be compromised.

Project effects to associated species are essentially unquantifiable on an individual basis relative to the amount of habitat modified or disturbed against the amount available throughout the surrounding Westside Lowland Conifer Hardwood Habitat type and the affected plant associations within it. Project effects would result in a positive yet marginal overall contribution, with respect to restoring historic habitat and biodiversity, to cumulative effects that have occurred from past actions affecting the project area.

Recommendation Pertaining to General Wildlife: Ensure that measures identified in the proposal to avoid habitat disturbance within 10 meters of perennially wet areas are implemented. This measure would provide refugia in a limited amount of the project area for a variety of wildlife species that may be present and associate with habitat exposed to activities while being implemented.

SNAGS AND DOWN WOOD

The significance of the ecological role of snags and down wood in influencing ecosystem diversity and productivity is well addressed in the Willamette National Forest Land and Resource Management Plan (1990) and elsewhere (Brown et al. 2003). The significance of this relationship in coniferous forests of the Pacific Northwest is further emphasized by management S&Gs under the Northwest Forest Plan ROD (1994, 2001) and elsewhere throughout published literature (Hagar et al. 1996, Hallett et al. 2001, Laudenslayer et al. 2002, Lewis 1998, Muir et al. 2002, Rose et al. 2001).

Under the Willamette Forest Plan as amended by the ROD, snag habitat shall be managed at levels capable of providing for at least 40% or greater potential populations of cavity-nesting species. Current science has tested the validity of the potential population approach to species management, yet it remains the basis for S&Gs involving snag management. Strong support for identifying more appropriate amounts of snag and down wood habitat is being given to new approaches in addressing these habitat components. One such approach devoted to identifying appropriate levels of snag and down wood in selected habitat types is DecAID - the decayed wood advisor for managing snags, partially dead trees, and down wood for biodiversity in forests of Washington and Oregon (Mellen et al. 2006). DecAID has been created to help managers decide how much dead wood to provide for this part of a species habitat needs, and is designed to apply to salvage as well as green tree projects. The benefit of DecAID applied to projects involving removal (harvest) of green trees is in evaluating affected habitat types during the planning process to determine if current dead wood levels are consistent with reference conditions, and to aid in identifying dead wood management goals for projects that affect dead wood habitat throughout dominant habitat types. Snag and dead wood habitat levels were compared to DecAID recommendations as well as Forest Plan S&Gs based on population potential.

Interpretation and/or application of advice obtained from DecAID pertaining to how the Bridge Thin Project may affect dead wood habitat is based on referencing information available in DecAID for the Westside Lowland Conifer-Hardwood habitat type, in the Western Oregon Cascades, with a Small/Medium Tree Vegetation Condition (WLCH_OCA_S). The Bridge Thin Project is predominantly within this habitat type. All stands proposed for commercial thinning harvest are within this habitat type, and the Bridge Thin Project planning area (20,657 acres) is considered an appropriate sized area of similar habitat to consider when evaluating current and future levels of dead wood (Mellen et al. 2006).

Snags:

Estimates for current snag size and distribution are displayed in Table A, and were made based on estimates from a combination of stand exam data, knowledge of previous snag creation activity and field reconnaissance. Snag levels for this project were compared against those listed in DecAID for Westside Lowland Conifer-Hardwood habitat type, in the Western Oregon Cascades, with a Small/Medium Tree Vegetation Condition (WLCH_OCA_S). Current snag levels throughout the planning area are above average values of the 50% tolerance range representative for snags in unharvested areas in this habitat type and condition.

Table A Current Condition (Alternative A- No Action) and Estimated levels of Snag Habitat for Alternatives B and C in Comparison with DecAID

Snag Size	Current Snag/Acre	DecAID- WLCH_OCA_S	
		Un-harvested inventory plots (unthinned managed stands)	All inventory plots (previously thinned and unthinned managed stands)
≥10" dbh	≈≥13 snags/acre	66th percentile	85th percentile
≥20" dbh	≈≥6 snags/acre	67th percentile	83rd percentile

The majority of large standing snags are Douglas-fir. The majority of smaller snags throughout the area is also Douglas-fir, and is a result of mortality from growth competition. Snag distribution across the project area can be considered patchy and variable, and would be affected equally under either Action Alternative.

Down wood:

Down wood estimates for current size and distribution were made based on reasoned estimates using inventory and stand exams from unthinned managed stands throughout the planning area. Tree mortality largely associated with self-thinning competition, cull logs from previous harvest activity, localized breakout from snow loading, and in one area wildfire has resulted in down wood levels as shown in Table B .

Smaller logs are generally in decay class I and II, while larger logs are in decay class II and III. Many of the largest pieces of down wood (cull logs from initial harvest activity) exist in decay class III. Plot data and field reconnaissance indicate existing down wood occurs in a patchy rather than even distribution across the planning area.

Table B Current Condition (Alternative A- No Action) and Estimated levels of Down Wood for Alternatives B an C in Comparison with DecAID

Down wood Size	Stand Type	Tons/Acre
≥6" diameter	Previously thinned managed stands	22.7 tons/ac
≥20" diameter	Previously thinned managed stands	18.4 tons/acre
≥6" diameter	unthinned managed stands	38.1 tons/acre
≥20" diameter	unthinned managed stands	24.8 tons/acre

In addition to dead wood levels associated with down logs, it is estimated that decaying wood habitat associated with stumps ≥20" diameter would cover less than 1% of areas treated under either Action Alternative. The amount is considered to be equal under either of these alternatives. Use of stumps throughout a range of decay classes has been documented for a wide variety of organisms (O'Neil et al. 2001, NatureServe 2006, Rose et al. 2001, Zabel and Anthony 2003). This type of dead wood provides a valuable, long-lasting habitat component that supplements the potential to maintain native biodiversity throughout the project area.

Down wood levels for this project were compared against those listed in DecAID for Westside Lowland Conifer-Hardwood habitat type, in the Western Oregon Cascades, with a Small/Medium Tree Vegetation Condition (WLCH_OCA_S). A review of DecAID data discloses current down wood levels throughout the planning area are above average values (within the 50% tolerance range) representative for dead wood in both harvested and unharvested areas within this habitat type and condition. How down wood levels in the Bridge Thin Project planning area compare to DecAID data is displayed in Table C.

Table C – Current Conditions (Alternative A – No Action) and Estimated Levels of Down Wood for Alternative B and C and in Comparison with DecAID

Down Wood Size	DecAID- WLCH_OCA_S	
	Un-harvested inventory plots (unthinned managed stands)	All inventory plots (previously thinned and unthinned managed stands)
≥6" dbh	71st percentile	67th percentile
≥20" dbh	82nd percentile	78th percentile

Normal processes that influence these changes (dynamics) are highly variable in their ability to affect change (Rose et al. 2001). Natural fire interval for this area has been estimated at 50-200 years (USDA 1995). Insects and pathogens continually contribute to successional development, however traditionally this occurs at a small scale in this area relative to the overall landscape. The area is not prone to flooding or landslides which may also affect changes on a small scale. Windthrow is yet another normal process that has occurred, and will continue to occur unpredictably, to influence stand dynamics in this area on a small scale. Because the overall condition of the project area is largely influenced by previous management activities that have simplified stand and landscape structure and diversity, additional stand management may be seen as a method to assist in restoring some landscape conditions such as stand dynamics associated with creating more normal levels of snags and down wood. Snag creation in the 1990s through year 2006 have already contributed in this regard as an average of one snags/acre were created across approximately 12% of the project area.

A number of events throughout the watershed, as well as within the project area, have occurred to increase dead wood levels across the landscape. District fire records reveal that from 1970 to 2007, 46 small wildfires averaging less than one acre each have contributed to additional levels of dead wood in a patchy distribution throughout much of the WLCH habitat in four townships in the watershed immediately surrounding the project area. Any tree mortality associated with fires > 40 years ago is likely to currently function as down wood habitat. Mortality from fires within the past 40 years (n=46) is likely currently functioning as snag habitat. Fire intensity has ranged from mild to moderate under burning . No salvage has occurred associated with any of these events.

In addition to dead wood levels increasing related to effects from wildfire, effects from insects, disease, and other natural events have further increased this habitat component across the landscape surrounding the Bridge Thin Project area. Annual aerial insect and disease detection surveys from 1986 through 2006 have documented several sites across the watershed (including locations within the planning area) where snag habitat is increasing in a patchy distribution from effects of these mortality agents (USDA 2005).

Reference information extrapolated from DecAID suggests current size, abundance, and distribution of snags and down wood exceeds average historic levels (50% tolerance) across the project area considering habitat type and vegetation condition. It should be noted that with respect to snags or down wood, the objective of the Bridge Thin Project is more directed at managing for an average historic dead wood habitat condition rather than focusing on specific dead wood requirements for individual wildlife species.

Direct and Indirect Effects
Effects of Alternatives A, B and C – Snags and Down Wood

Some loss of existing snag habitat would occur under either Action Alternative, due to safety issues. Some existing snags in proximity to harvest activities would present a serious safety risk to workers involved with implementing the silvicultural prescription. Snag loss would be greatest among sizes <10" dbh, intermediate for snags ≥10" - <20" dbh, and lowest among snags ≥20" dbh. All felled snags would be left as down wood. Depending on decay class and burning conditions, some felled snags may be fully or partially consumed during subsequent fuels reduction and prescribed underburning in selected areas.

Under the silvicultural prescriptions for this project green trees would be harvested from specified areas by variable density thinning. Following these prescriptions would result in a minimum range of 34-72 trees per acre being retained, some of which may have defects that would provide a dead wood habitat component distributed throughout the project area. The silvicultural prescription for Riparian reserves calls for protection and retention of habitat features such as hardwoods and the largest conifers some of which possess decadent features providing an arboreal dead wood habitat component. The prescription would create 2 snags per acre to mitigate any snag loss.

Implementing the fuels treatment prescription under either Action Alternative should not affect current snag levels. On these acres, less than 10% live tree mortality estimated from under burning translates to approximately 3-7 snags/acre created in an area that involves approximately 40% of all acres thinned, and less than 1% of the planning area. However it is also reasonable to assume some level of partial or full mortality associated with trees immediately adjacent to pile burning activity. Any such mortality would add to an existing patchy distribution of snag habitat throughout the planning area.

Within stand variability throughout the planning area influences current snag distribution. This variability will also influence the location of replacement snags, which would be provided for in a patchy rather than even distribution across the area. This prescription is common to each Action Alternative and will assure compliance with Northwest Forest Plan guidance to maintain 40% of potential populations of cavity nesting species (USDA, USDI 1994 page C-42).

Post treatment snag sizes and quantities would also be consistent within the range of average levels recently provided from plot data from unharvested stands in a Western hemlock vegetation series such as those influencing habitat throughout the project area (McCain 2006). These data are presented in terms of tolerance levels and tolerance intervals described in DecAID. They reveal that 50% of individuals in all populations of species using snags in a Douglas Fir and Western hemlock series types can be expected to occur where a range of 4-7 snags per acre ≥ 20" dbh exist. Although these data apply to unharvested tree condition class stands, snag habitat throughout the Bridge Thin project area would fall within this range.

Based on current stand structure, composition, and habitat type there is generally sufficient site-specific potential to support application of the Northwest Forest Plan Standard and Guideline (ROD page C-40) to leave an average of 240 linear feet of logs per acre greater than or equal to 20 inches in diameter or material of the largest diameter class available across areas treated by the Bridge Thin Project under either Action Alternative.

Cumulative Effects: - **Snags and Down Wood**

The cumulative effects analysis area was the Bridge Thin project area. As mentioned above the project area (20,657 acres) is considered an appropriate sized area of similar habitat to consider when evaluating current and future levels of dead wood (Mellen et al. 2006)

Past management actions related to timber harvest activity are generally responsible for the current condition of dead wood habitat throughout the planning area. These actions have affected the overall amount and distribution of dead wood habitat by reducing the amount of old-growth habitat and increasing the amount of mid-late seral habitat. There are no foreseeable actions that would affect dead wood habitat in this area. Current science and the changing trend in timber management that has occurred within the past decade, and projected for the future, should positively influence management of decaying wood as previously harvested stands redevelop, and more emphasis is placed on retention of key structural components in unharvested stands.

Data analysis reveals the amount and distribution of snag and down wood habitat would essentially remain unchanged or experience a slight increase under either Action Alternative. Commercial thinning as proposed under either Action Alternative for the Bridge Thin Project is therefore likely to have little or no cumulative effect on dead wood habitat throughout the planning area. The action alternatives would provide other ecological benefits by allowing trees to grow larger and faster, and to develop other desirable tree habitat characteristics such as large limbs and crowns.

Dead wood habitat should exist in a sufficient amount and distribution to support the local wildlife community, including MIS such as pileated woodpecker, marten, and cavity nesters such that their ability to persist or become established would not be limited by this habitat component important to most members of the wildlife community in this area.

Conclusion – Snags and Down Wood

Under either Action Alternative the Bridge Thin Project proposes commercial thinning in approximately 55% of mid-seral (stem exclusion) habitat throughout the planning area. This relates to approximately 18% of the entire planning area. Proposed openings associated with compaction areas under Alternative B are generally lacking in snags and down wood. There is essentially no difference between Action Alternatives and their effect on dead wood.

The silvicultural prescription calls for protection of existing snags and down logs. However some amount of loss or disturbance of snags and down wood is inevitable as a result of safety and logging feasibility issues. Measures are identified to address this loss or disturbance. Effects analysis reveals that proposed activities in conjunction with mitigation measures would result in a stable or slight increase in dead wood levels associated with areas treated. Direct and indirect effects would be limited to an undeterminable number of snags and logs that may be unavoidably affected or created within harvest units.

DecAID relies on data from unharvested plots to assist managers in setting objectives aimed at mimicking natural conditions. Considering the current condition of snag and down wood habitat along with the information presented above, it is expected that dead wood levels throughout the planning area

should remain above average in the natural range considered for similar habitat following thinning, prescribed fuels reduction, and underburning.

The Bridge Thin Project would result in maintenance and promotion of dead wood habitat throughout a managed forest that typifies the planning area at levels that would ensure its ongoing central role in the ecological processes affecting this type of forested habitat (Rose et al. 2001). The project would comply with S&Gs pertaining to snag and down wood management.

Project Effects to Snags and Down Wood:
Data analysis reveals the amount and distribution of snag and down wood habitat would essentially remain unchanged or experience a slight increase under either Action Alternative. Commercial thinning as proposed under either Action Alternative for the Bridge Thin Project is therefore likely to have little or no cumulative effect on dead wood habitat throughout the planning area. The action alternatives would provide other ecological benefits by allowing trees to grow larger and faster, and to develop other desirable tree habitat characteristics such as large limbs and crowns.

Recommendations pertaining to snags and down wood:
Protect decadent trees and snags >12"dbh adjacent to the project area to the greatest extent feasible while conducting restoration activities.

OTHER RARE OR UNCOMMON WILDLIFE SPECIES

Species listed below in Table 2 were compiled from the 2001 and 2003 Annual Species Reviews and incorporate those vertebrate species whose known or suspected range includes the Willamette National Forest according to the following documents: Survey Protocol for the Great Gray Owl within the range of the Northwest Forest Plan v3.0, January 12, 2004 and Survey Protocol for the Red Tree Vole v2.1, October2002.

Table 2: Other Rare or Uncommon Wildlife Species Known on the Willamette National Forest.

Species	Survey Triggers			Survey Results			Site Management
	Within Range of the Species?	Project Contains Suitable habitat?	Project may negatively affect species/habitat?	Surveys Required?	Survey Date (month/year)	Sites Known or Found?	
Vertebrates							
Great Gray Owl (*Strix nebulosa*)	Yes	No	No	No	NA[1]	NA	NA
Red Tree Vole (*Arborimus longicaudus*)	Yes[2]	Yes	Yes	Yes	7/2007	Yes	Yes

[1] N/A = Not Applicable

Red tree vole (*Arborimus longicaudus*):
This project is within the Northern Mesic Zone where the red tree vole is uncommon, and pre-disturbance surveys are considered practical. Surveys for red tree voles were conducted in suitable habitat and located one site in unit 82, with a 10 acre buffer being established to protect the site.

Other ROD Species/Habitat:

Cavity-nesting birds - White-headed woodpecker, black-backed woodpecker, pygmy nuthatch, and flammulated owl: The white-headed woodpecker, black-backed woodpecker, pygmy nuthatch, and flammulated owl will not be sufficiently aided by applying mitigation measures for riparian habitat protection or other elements of the Northwest Forest Plan (USDA, USDI 2001 and 2004). These four

species occur primarily on the periphery of the range of the northern spotted owl on the east slope of the Cascade Range in Washington and Oregon however, they are not likely to occur in the project area.

To ensure the distribution and numbers of all four species do not decline on BLM Districts and National Forests within the range of the northern spotted owl, adequate numbers of large snags and green-tree replacements for future snags in appropriate forest types within the range of these four species will be maintained in sufficient numbers to maintain 100 percent of potential population levels of these four species (USDA, USDI 2001 and 2004).

A discussion of how proposed activities may impact this habitat component is conducted in the Snags and Down Wood section of this document.

The influence of this project on these species is considered either neutral or beneficial. Proposed activities would generally occur outside the breeding season, and the likelihood that they occur in the project area is considered low. Beneficial influences are associated with a potential to improve foraging habitat and overall biodiversity that may attract their presence in the area.

Bat roosts – caves, mines, and abandoned wooden bridges and buildings: There are no caves, mines, abandoned wooden bridges or buildings within the project area that would need to be protected from activities associated with this project.

Project Effects and Cumulative Effects to Other Rare or Uncommon Species, and Other ROD Species: Activities proposed by this project include measures that maintain and protect habitat components important to support potential use by other rare or uncommon species, and other ROD Species. Implementing project activities as proposed should have no direct or indirect effect on these species such that their ability to persist within the project area or throughout their ranges

Current S&Gs governing management of this area provide direction that should ensure the long-term maintenance of amount and distribution of suitable habitat for this group of species. With respect to restoring historic habitat and biodiversity that may benefit these species, project effects may result in a positive yet marginal overall contribution to cumulative effects that have occurred from past actions within the project area.

Ensure that perennially wet habitat associated with springs in portions of Bridge Thin area are protected by a 10-meter buffer against disturbance from proposed activities including prescribed burning.

Recognize previous recommendations made in this report pertaining to snags and other dead wood habitat.

MANAGEMENT INDICATOR SPECIES (USDA 1990)

Background and Effects Summary: The Willamette Forest Plan has identified a number of terrestrial wildlife species with habitat needs that are representative of other wildlife species with similar habitat requirements for survival and reproduction. These management indicator species (MIS) include spotted owl, bald eagle, peregrine falcon, cavity excavators, pileated woodpecker, deer, elk, and marten. Spotted owls, bald eagles, and peregrine falcons are addressed in a separate Biological Assessment and Biological Evaluation. The other MIS have potential to occur in or near the project area and are

addressed below. Activity associated with the proposed action is consistent with, or exceeds Willamette Forest Plan Standards and Guidelines as they pertain to MIS management.

Habitat for terrestrial MIS modified by activities associated with the proposed Bridge Thin Project would be limited to foraging use by these species. Activities could result in disturbance to MIS that may be present in or adjacent to proposed treatment sites. However, any modification or disturbance that may occur associated with this project is not of a scale that would threaten the viability of any MIS to persist within the project area or throughout the range of these species.

Pileated Woodpecker:
Current, as well as historic, composition and structure associated with habitat type and plant associations surrounding the project area favor nesting and foraging use by pileated woodpeckers (Csuti et al. 1997, Marshall et al. 2003, NatureServe 2005, O'Neil et al. 2001).

Effects from proposed activities previously addressed in this report pertaining to snags and down wood as habitat important to cavity nesting birds, are also relevant to how this restoration project may affect this MIS.

Currently the Oregon Natural Heritage Program (ONHP), The Nature Conservancy (TNC), and the Oregon Department of Fish and Wildlife (ODFW) show the status of the pileated woodpecker to be secure, which suggests the changing trend in timber management that has occurred within the past decade, and projected for the future, may positively influence occupancy of suitable habitat by this species as previously harvested stands redevelop, and more emphasis is placed on retention of key structural components in unharvested stands (USDA 1985, USDA 1994).

Marten:
Marten occupy a narrow range of habitat types found in or near coniferous forests. More specifically, they associate closely with late-successional stands of mesic conifers – especially those with complex physical structures near the ground such as large low snags and down wood (Chapin et al. 1997, NatureServe 2005, Ruggiero et al. 1994, Verts and Carraway 1998, Zielinski et al. 2001). Current habitat surrounding the planning possesses such characteristics. Marten are known to occur within the project watersheds, and despite lack of documented presence in the immediate vicinity it should be assumed the species is likely a member of the local faunal community.

In the General Wildlife Overview section of this report the marten was identified as a species closely associated with habitat in and adjacent to this project area. Effects identified pertinent to general wildlife, as well as to snags and down wood, apply to this MIS. Because marten prefer a more interior setting, large snags or down logs that could function as denning habitat would not be affected by this project. Foraging habitat for marten would likely improve as a result of beneficial habitat changes for prey species known to be favored by marten such as voles, rabbits, squirrels, and mountain beaver (Csuti et al. 1997).

Currently the ONHP, TNC, and the ODFW show the status of this species to be secure or not immediately imperiled, which suggests species viability may be assured as long as adequate protection measures such as Standards and Guidelines governing activities proposed by this type of project continue to be implemented. The changing trend in timber management that has occurred within the past decade, and projected for the future, may positively influence occupancy of suitable habitat for

marten as previously harvested stands redevelop, and more emphasis is placed on recruitment of key structural components missing from harvested stands and retention of key structural components present in unharvested stands.

Cavity Excavators:

The significance of snags as one component characterizing both old-growth and younger timber stands, and the dependence of primary cavity excavators on this component as MIS that provide nesting and denning habitat for numerous additional species of birds and mammals (secondary cavity nesters) is thoroughly addressed in the Willamette National Forest Land and Resource Management Plan (1990). The significance of this relationship is further emphasized by management S&Gs under the Northwest Forest Plan ROD (1994, 2001, 2004) and elsewhere throughout published literature (Hagar et al. 1996, Hallett et al. 2001, Lewis 1998, Muir et al. 2002, Olson et al. 2001, Rose et al. 2001).

All species of primary cavity excavators used as ecological indicators in the Willamette Forest Plan (USDA 1990) have current and/or future potential to occupy habitat surrounding the project area based on recognized associations with the Westside Lowland Conifer Hardwood Forest Habitat type (O'Neil et al. 2001).

Effects from proposed activities previously addressed in this report pertaining to snags as habitat important to cavity nesting birds, are also relevant to how this project may affect this group of MIS cavity excavators. This project does propose modification of current nesting habitat and could result in disturbance during the breeding season for this group of species. The number of small snags identified as a safety hazard to work areas that may be felled or that could be affected by thinning and prescribed burning is considered inconsequential relative to this type of habitat component in the surrounding landscape where fire is recognized as the major natural disturbance (Chappell et al. 2001).

Activities proposed by this project include measures that maintain and protect habitat components important to support use by the group of cavity excavators listed as MIS. Implementing project activities as proposed should have no direct or indirect effect on these species such that their ability to persist within the project area or throughout their range. Current Standards and Guidelines governing management of this area provide direction that promotes long-term maintenance of amount and distribution of suitable habitat for this group of species. With respect to restoring historic habitat and biodiversity that may benefit these species or their prey, project effects should result in a positive yet marginal overall contribution to cumulative effects that have occurred from past actions affecting the project area.

Elk/Deer (Big Game):

Current Condition – Big Game Habitat

The Bridge Thin planning area has three designated Elk Emphasis Areas: Florence, Taylor, and Minor Tributaries (See Elk Emphasis Area Map in Appendix D). The areas are designated as High, Moderate and Low Emphasis Areas respectively. These areas are managed for elk habitat under guidance from the Willamette Forest Plan Standards and guidelines (FW-137) with the assumption that providing high quality elk habitat would adequately address the needs for black-tailed deer.

A Model to Evaluate Elk Habitat in Western Oregon (Wisdom, 1986) is used to estimate habitat effectiveness (HE), which is defined as the proportion of achievement relative to an optimum condition. The management intent is to maintain effectiveness within a range of values with the optimum value being 1.0. HE incorporates and qualifies four key habitat attributes; size and spacing of forage (HEs), quality of forage (HEf), cover areas (HEc), and open road density through elk habitat (HEr). Each habitat variable is calculated individually and allows for a comparison by variable or as a whole (HEI). The elk model considers past and ongoing activities.

Table C displays the current condition of habitat values for patch size and spacing (HEs), open road density (HEr), cover quality (HEc), forage quality (HEf), and overall habitat quality (HEI) that existed for big game habitat when watershed analyses were conducted for these areas.

Table C HEI Analysis for Big Game Habitat in the Bridge Thin Project Area

BGEA Name	BGEA Emphasis Level	Results for Each Model Variable Indices				
		HEs	HEr	HEc	HEf	Overall HEI
Florence	High	0.71	0.41*	0.50	0.33*	0.47*
Taylor	Moderate	0.37*	0.57	0.33*	0.45	0.42
Minor Tribs	Low	0.49	0.56	0.73	0.53	0.56

* Values are below recommended minimum threshold levels
Willamette NF Land Management Plan S&G Target Level:
High Level BGEA Individual Index: >0.5 Overall index: >0.6
Moderate Level GBEA Individual Index: >0.4 Overall Index: >0.5
Low Level GBEA Individual Index: >0.2 Overall index: increase any variable <0.2

Summary of Existing Elk Model Variables for the BridgeTthin Project Analysis Area:

Size and Spacing of Forage: The size and spacing habitat effectiveness rating (HEs) for forage and cover in two elk emphasis areas indicates that the existing distribution of cover and forage is very good and that management goals for size and spacing are currently being met for Florence (0.71) and Minor Tribs (0.49). The size and spacing for Taylor (0.37) is currently below Forest Plan recommendations.

Road Density: Road densities in two areas are currently adequate with HEr values of Taylor (0.57) and Minor Tribs (0.56). Road densities in the Florence (0.41) area is currently below Forest standards.

Cover: The habitat effectiveness value for cover (HEc) in the Florence (0.50) area and the Minor tribs (0.73) area are currently meeting the Forest Plan standards. The Taylor (0.33) emphasis area is currently below Forest Plan standards.

Forage: The forage quality habitat effectiveness rating (HEf) for Taylor (0.45) and minor Tribs (0.53) are currently meeting Forest Plan standards. The Florence (0.33) area is currently below Forest Plan standards for forage quantity and quality.

Habitat Effectiveness Index (HEI): The overall ratings of (HEI) indicate that two emphasis areas are currently above Forest plan standards: Taylor (0.42) and Minor Tribs (0.56). The overall HEI rating for Florence (0.47) is currently below Forest Plan standards.

Forage, Hiding, Thermal and Optimal Thermal Habitat, and Road Densities

Past harvest activities have shaped the landscape in terms of the juxtaposition and types of elk habitat. Since the 1940s, over 2800 acres have been managed with timber harvesting. Harvest treatments were primarily regeneration, including clearcuts and shelterwoods. These harvested units once provided a wealth of quality forage for elk but have since grown into hiding and thermal cover. No specific data are available for the local elk/deer population within the three BGEAs for this project. Current ODFW biological data are not sufficient to provide an accurate estimate of the black-tailed deer population in western Oregon (ODFW 2002). Recent ODFW elk population estimates show that state management unit in the vicinity of the project area (McKenzie) have elk herds with population numbers near their current management objectives (Bill Castillo pers com; ODFW 2005).

Maintaining a balance between cover and forage areas is a key component of elk habitat management in the Wisdom model. Using tightly controlled experimental conditions, Cook et al (1998) found that thermal cover did not enhance elk survival and production, was not required by elk where food was not limiting, and could not compensate for inadequate forage conditions. Further research has shown that high summer and fall forage quality is critical to elk reproduction, survival, and population growthand stability (Cook et al. 2004). The increased importance of available forage abundance and quality compared to thermal cover has also been supported by nutritional and physiological studies of black-tailed deer (Parker et al. 1999).

The Wisdom model was developed to evaluate landscape areas where quality forage areas were provided primarily by clear cutting and associated post-harvest burning and fertilization. With the dramatic decline in regeneration timber harvest under the Northwest Forest Plan, there has been a corresponding decline in high-quality elk forage habitat. This trend, coupled with recent studies, has increased the importance of providing foraging habitat for elk on the Forest. A drawback of the Wisdom model is that forage is evaluated based on the average value of defined forage areas and does not consider the amount of forage provided. Areas that do not provide meaningful forage are not considered in the forage effectiveness calculations. Consequently, providing substantial acres of temporarily

improved elk and deer forage conditions by commercial thinning may result in a lower forage score in the Wisdom model if these acres lower the average value for forage areas in the landscape. Published research support the idea that increasing the amount of available forage by commercial thinning should improve the overall habitat conditions for elk and deer within the analysis area regardless of the average forage value derived from the Wisdom model.

Direct and Indirect Effects

Effects of Alternative A – No Action

Current trends of elk habitat development would continue to occur naturally over time with Alternative A. Existing elk foraging habitat is expected to continue growing into hiding cover and then to thermal cover. Thermal cover would continue to grow toward optimal thermal cover. There would be no change to the current elk effectiveness ratings.

In ten years, forage availability would be expected to decrease in this area as current openings succeed into hiding cover. In the absence of additional harvest or wildfire, no new foraging areas would be created. The current optimal and thermal cover would not significantly change.

In 50 years, approximately 30% of the existing thermal cover would shift into optimal thermal cover. Hiding cover would succeed into thermal cover. Road density and big game security would not change. Overall habitat quality may decrease from the loss of forage.

Effects of Alternatives B and C

The proposed thinning (approx 2256 acres) and prescribed burning (approx 1000 acres) for the Bridge Thin project would change the function of big game habitat from thermal cover to: either lower quality thermal cover, or hiding cover or foraging. Alternatives B and C propose 227 acres of wildlife thinning, intended to improve big game forage in the heart of the high emphasis Florence area where forage quality are currently lacking. In addition unit 80 (10 acres) in Alternative B only would propose a forage area intended for repeated underburning and manual forage enhancement to maintain a beneficial forage production area. The proposed oak savanna treatments would restore approximately 56 acres of historic open oak savanna habitat with a dominated grassy forage understory. The remaining acres for the Bridge Thin project would provide a limited short-term (<5-6 years) benefit to forage from light to moderate thinning until the tree canopies close in as a result of tree crowns responding to reduced competition for sunlight. Road densities would not measurably change with the Elk Model with 0.2 miles of additional roads being closed with this project.

Cumulative Effects

Analysis for cumulative effects is based on an area comprised of the three BGEAs Emphasis Areas where management activities would occur. The BGEAs Emphasis Areas were used for the scope of analysis because of the determined ratings for elk habitat that is described for the BGEAs Emphasis Areas in the Willamette National Forest.

Past management activities initially resulted in an abundance of forage habitat with the many acres of regeneration harvesting that occurred. The more recent lack of harvest has allowed these forests to grow into hiding and thermal cover to create the current condition represented by the no action alternative in the Table 3. The overall impact of the proposed action is that thermal cover in the treated stands would be changed to lower quality thermal cover, or hiding cover or forage. There are no foreseeable actions that would modify habitat in these BGEAs.

Conclusion – Big Game Habitat

Proposed activities would increase habitat quality for elk and deer in all three BGEA emphasis areas. Open road densities would not measurably change. Forage quality would definitely increase on 233 acres in Alternative B and 223 acres in Alternative C. Beneficial effects to big game forage from thinning and prescribed burning proposed by this project are not significant in scale and are not expected to be reflected in individual or overall habitat effectiveness values in the elk model given the majority of acres in a thermal cover classification. A limited number of animals would benefit from the small-size openings that would be created by the project, so there would be little potential for any noticeable population response as a result of the proposed actions. Project effects to big game are essentially unquantifiable on an individual basis relative to the amount of habitat modified or disturbed against the amount available to these species on a daily basis in the affected BGEAs. Direct and indirect effects are largely limited to potential temporary displacement of individuals occurring in habitat during implementation of proposed activities. Short and long-term effects to forage habitat will be beneficially evident within the project area. In the context of the BGEAs, and adjacent 5th field watersheds, project effects would result in a minor positive contribution to cumulative effects that have already occurred from past management actions surrounding the project area. Given what is currently known about local deer and elk populations, the future viability of these species should be assured as long as habitat restoration opportunities continue to be implemented – especially when conducted at an appropriate scale.

MIS summary:
Although proposed activities would modify some suitable habitat, and likely disturb some individual terrestrial MIS that may be present, they should not threaten the capability of any local population of these species to persist or become established in the project area. Any project effect considered negative in this regard would be short-term and minimal compared to the amount of habitat available in the surrounding landscape. Cumulative effects to MIS from proposed activities would be small in scale yet generally beneficial, as they contribute to long-term improvements in the overall diversity of habitat in the Bridge Thin area.

Current available data or reports on the status of the above MIS, and additional information on the status and management of these MIS may be found on the following websites:
http://oregonstate.edu/ornhic/ORNHP.html
http://www.heritage.tnc.org/nhp/us/or/
http://www.dfw.state.or.us/ODFWhtml/InfoCntrWild/InfoCntrWild.html

Recommendations Pertaining To MIS: For cavity excavators (including pileated woodpecker and secondary cavity nesters) and marten - recognize previous recommendations made in this report pertaining to snags and other dead wood habitat.

For Elk/Deer: Consider additional activities that improve forage habitat throughout summer and winter range within Florence, Taylor, Cougar and Minor Tributaries BGEAs.

MIGRATORY LAND BIRDS

Land bird species exhibit a dramatic response to the height, seral stage, canopy structure, and spatial distribution associated with forest habitat where greater numbers of birds are associated with more complex heterogeneous forested landscapes (Altman 1999). The current amount of forested and open ecotonal habitat characteristic throughout the project area should be attractive for use by a variety of avian species (Gilbert and Allwine 1991). However effects from past management practices – specifically fire suppression – have resulted in simplification of habitat throughout this area as forest encroachment progresses on meadow habitat.

Effects to Migratory Land Birds: Proposed activities would generally occur outside the breeding season for these species and/or at a time when many may have migrated from the area (Csuti et al. 1997, Marshall et al. 2003, O'Neil et al. 2001, NatureServe 2005). The timing of activities would mitigate potential short-term (< 5 years) negative effects from habitat modification such as temporary loss of some potential nesting habitat, or disturbance such as temporary displacement of individuals or their prey from thinning and prescribed burning activities. The number of individuals and/or species potentially affected by proposed activities is unknown and considered unquantifiable without reliable survey data. Habitat changes proposed by this project should not affect this group of species such that their ability to persist in the vicinity of the project area or throughout their ranges would be compromised.

Altman and Hagar (2007) identify 93 bird species in the Pacific Northwest that regularly breed in conifer forests less than 60 years of age. Over half of these species are experiencing population declines. Thinning generally does not change habitat conditions so dramatically that bird species can do longer use the stand, but often temporarily increase or decrease bird abundance depending on species. Altman and Hagar (2007) summarize studies showing 21 species of migratory birds whose range overlaps the project area increasing in abundance following forest thinning treatments. Seventeen migratory bird species did not changed in abundance or had mixed responses in forests that were thinned, while 7 species generally decreased in abundance, at least temporarily, after thinning. Silvicultural treatments that promote understory shrub development, trees species diversity, deciduous trees, and the growth of larger trees; maintain or create snags and downed logs; and create gaps in the stand generally improve avian biodiversity in the stand. Thinning has not been shown to have long term negative effects on any sensitive bird species or species of special concern.

Given these considerations, both short and long-term suitability of open forest, meadow, and edge habitat in and near proposed treatment areas should improve for the majority of bird species that are likely to forage and nest in this area – albeit on a small scale compared to the surrounding landscape.

Project effects to Migratory Land Birds are of no measurable consequence on an individual basis relative to the amount of habitat modified or disturbed against the amount available throughout the surrounding Westside Lowland Conifer Hardwood Habitat type and the affected plant associations within it. Project effects would result in a positive yet marginal overall contribution, with respect to restoring historic habitat and biodiversity, to cumulative effects that have occurred from past actions affecting the project area.

Recommendations pertaining to Migratory Land Birds: Consider enlisting the expertise of a group such as the local chapter of the National Audubon Society in initiating an annual breeding bird survey route in habitat associated with this project's restoration activities in order to gain a better understanding species occurrence and habitat use in this area.

This document was prepared by: /s/ Shane D. Kamrath Date: 1/11/2008

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Appendix 1: Literature referenced during preparation of this report to arrive at determinations regarding potential influence of the proposal on terrestrial wildlife species and habitat.

Altman, B. 1999. Conservation stratey for landbirds in coniferous forests of western Oregon and Washington. Version 1.0. Prepared for: Oregon-Washington Partners in Flight. March 1999.

Castillo, W.J. 2005. Personal Communication. District Wildlife Biologist, South Willamette Watershed District, Oregon Department of Fish and Wildlife. March 9, 2005.

Chapin, T.G., D.J. Harrison, and D.M. Phillips. 1997. Seasonal habitat selection by marten in an untrapped forest preserve. Journal of Wildlife Management 61(3): 707-717.

Chappell, C.B., R.C. Crawford, C. Barrett, J. Kagan, D.H. Johnson, M. O'Mealy, G.A. Green, H.L. Ferguson, W.D. Edge, E.L. Greda, and T.A. O'Neil. 2001. Wildlife habitats: descriptions, status, trends, and system dynamics. *in* D. H. Johnson and T.A. O'Neil (Manag. Dirs.) *Wildlife-Habitat Relationships in Oregon and Washington*. Oregon State University Press, Corvallis, OR, USA. 2001. 736 pp

Cook, J.G., L.L. Irwin, L.D. Bryant, R.A. Riggs, and J.W. Thomas. 1998. Relations of forest cover and condition of elk: a test of the thermal cover hypothesis in summer and winter. Wildlife Monographs, No. 141, October 1998.

Cook, J.G. 2002. Nutrition and Food. Chapter 5, pp. 259-350. *in*: Toweill, D.E. and J.W. Thomas, editors. North American Elk: Ecology and Management. Smithsonian Institution Press. 2002.

Cook, J. G., B. K. Johnson, R.C. Cook, R. A. Riggs, T. Delcurto, L. D. Bryant, and L. L. Irwin. 2004. Effects of summer-autumn nutrition and parturition date on reproduction and survival of elk. Wildlife Monographs 155.

Csuti, B., A.J. Kimerling, T.A. O'Neil, M.M. Shaughnessy, E.P. Gaines, and M.M.P. Huso. 1997. Atlas of Oregon Wildlife (Distribution, Habitat, and Natural History), Oregon State University Press, Corvallis, Oregon.

Duncan, N., T. Burke, S. Dowlan, and P. Hohenlohe. 2003. Survey Protocol for Survey and Manage Terrestrial Mollusk Species From the Northwest Forest Plan. Version 3.0. 2003.

Gilbert, F.F. and R. Allwine. 1991. Spring bird communities in the Oregon Cascade Range. pp. 319-325 *in*: Ruggiero, Leonard F.; Aubry, Keith B.; Carey, Andrew B.; Huff, Mark H., tech. coords. Wildlife and vegetation of unmanaged Douglas-fir forests. USDA Forest Service, Pacific Northwest Research Station, Portland, Oregon, General Technical Report PNW-GTR-285, May 1991.

Hallett, J.G., T. Lopez, M.A. O'Connell, M.A. Borysewicz. 2001. Decay dynamics and avian use of artificially created snags. Northwest Science 75:378-386.

Johnsgard, P.A. 1988. North American Owls – biology and natural history. Smithsonian Institution Press. 295 pp.

Johnson, David H. and T.A. O'Neil (Manag. Dirs.). 2001. Wildlife-habitat relationships in Oregon and Washington. Oregon State University Press, Corvallis, Oregon.

Laudenslayer, W.F.Jr., P.J. Shea, B.E. Valentine, C.P. Weatherspoon, T.E. Lisle, technical coordinators. 2002. Proceedings of the symposium on the ecology and management of dead wood in western forests. 1999 November 2-4; Reno, NV. Gen. Tech. Rep. PSW-GTR-181. Albany, CA: Pacific Southwest Research Station, USDA Forest Service; 949pp.

Lewis, J.C. 1998. Creating snags and wildlife trees in commercial forest landscapes. Western Journal of Applied Forestry, Vol. 13, no. 3 pp. 97-101.

Logan, S.E., M.A. Hemstrom, and W. Pavlat. 1987. Plant association and management guide – Willamette National Forest. USDA Forest Service. R6-Ecol 257-A-86. May 1987.

Lyon, LJ., K.B. Aubry, W.J. Zielinski, S.W. Buskirk, and L.F. Ruggiero. 1994. The scientific basis for conserving forest carnivores: considerations for management. Pages 128-137. *in* L.R. Ruggiero, K.B. Aubry, S.W. Buskirk, L.J. Lyon and W.J. Zielinski, eds. The scientific basis for conserving forest carnivores: American marten, fisher, lynx and wolverine in western United States. USDA Forest Service Gen. Tech. Rep. RM-254. 184 pp.

Lyon, L.J. and A.G. Christensen. 2002. Elk and Land Management. Chapter 13, pp. 556-581. *in*: Toweill, D.E. and J.W. Thomas, editors. North American Elk: Ecology and Management. Smithsonian Institution Press. 2002.

Marshall, D.B., M.G. Hunter, and A.L. Contreras, Eds. 2003. Birds of Oregon: A General Reference. Oregon State University Press, Corvallis, OR. 768pp.

McCain, C. and N. Diaz. 2002. Field guide to the forested plant associations of the Westside Central Cascades of Northwest Oregon: Willamette N.F., USFS; Mt. Hood N.F., USFS; Salem District, BLM; Eugene District, BLM. USDA Forest Service Pacific Northwest Region. Technical Paper R6-NR-ECOL-TP-02-02. June, 2002.

Mellen, Kim, Bruce G. Marcot, Janet L. Ohmann, Karen Waddell, Susan A. Livingston, Elizabeth A. Willhite, Bruce B. Hostetler, Catherine Ogden, and Tina Dreisbach. 2003. DecAID, the decayed wood advisor for managing snags, partially dead trees, and down wood for biodiversity in forests of Washington and Oregon. Version 1.10. USDA Forest Service, Pacific Northwest Region and Pacific Northwest Research Station; USDI Fish and Wildlife Service, Oregon State Office; Portland, Oregon. http://wwwnotes.fs.fed.us:81/pnw/DecAID/DecAID.nsf

NatureServe. 2005. NatureServe Explorer: An online encyclopedia of life [web application]. Version 4.5. NatureServe, Arlington, Virginia. Available http://www.natureserve.org/explorer. Copyright © 2005 NatureServe, 1101 Wilson Boulevard, 15th Floor, Arlington Virginia 22209, U.S.A. All Rights Reserved.

Olson, D.H., J.C. Hagar, A.B. Carey, J.H. Cissel, and F.J. Swanson. 2001. Wildlife of westside and high montane forests. pp. 187-212. *in* D. H. Johnson and T.A. O'Neil (Manag. Dirs.) *Wildlife-Habitat Relationships in Oregon and Washington*. Oregon State University Press, Corvallis, OR, USA. 2001. 736 pp.

O'Neil, Thomas A., David H. Johnson, Charley Barrett, Maria Trevithick, Kelly A. Bettinger, Chris Kiilsgaard, Madeleine Vander Heyden, Eva L. Greda, Derek Stinson, Bruce G. Marcot, Patrick J. Doran, Susan Tank, and Laurie Wunder. *Matrixes for Wildlife-Habitat Relationship in Oregon and Washington*. Northwest Habitat Institute. 2001. *in* D. H. Johnson and T.A. O'Neil (Manag. Dirs.)

Wildlife-Habitat Relationships in Oregon and Washington. Oregon State University Press, Corvallis, OR, USA. 2001. 736 pp.

Oregon Department of Fish and Wildlife. 2002. Draft black-tailed deer work group report 2002 (7/12/02). Oregon Department of Fish and Wildlife, P.O. Box 59, 2501 S.W. First Avenue, Portland, Oregon 97201.

Oregon Department of Fish and Wildlife. 2003. Oregon's elk management plan: February 2003. Oregon Department of Fish and Wildlife, P.O. Box 59, 2501 S.W. First Avenue, Portland, Oregon 97201.

Oregon Department of Fish and Wildlife. 2005. DRAFT Review of Oregon's mule deer and elk management objectives February 2005. Proposals developed by district working groups for public review. Oregon Department of Fish and Wildlife, 3406 Cherry Avenue NE, Salem, Oregon 97303.

Parker, K. L., M. P. Gillingham, T. A. Hanley, and C. T. Robbins. 1999. Energy and protein balance of free-ranging black-tailed deer in a natural forest environment. Wildlife Monographs 143.

Quintana-Coyer, D.L., R.P. Gerhardt, M.D. Broyles, J.A. Dillon, C.A. Friesen, S.A.Godwin, and S.D. Kamrath. 2004. Survey protocol for the Great Gray Owl within the range of the Northwest Forest Plan. Version 3.0, January 12, 2004. Prepared for the USDA Forest Service and USDI Bureau of Land Management.

Rose, C.L., B.G. Marcot, T.K. Mellen, J.L. Ohmann, K.L. Waddell, D.L. Lindley, B. Schreiber. 2001. Decaying wood in Pacific Northwest forests: concepts and tools for habitat management. pp. 580-623. *in* D. H. Johnson and T.A. O'Neil (Manag. Dirs.) *Wildlife-Habitat Relationships in Oregon and Washington*. Oregon State University Press, Corvallis, OR, USA. 2001. 736 pp.

Ruggiero, L.F., K.B. Aubry, A.B. Carey, and M.H. Huff (technical coordinators). 1991. Wildlife and vegetation of unmanaged Douglas-fir forests. U.S. Forest Service General Technical Report PNW-GTR-285, Portland , OR.

Ruggiero, L.F., K.B. Aubry, S.W. Buskirk, L.J. Lyon, and W.J. Zielinski (technical editors). 1994. The scientific basis for conserving forest carnivores: American marten, fisher, lynx, and wolverine in the western United States. USDA Forest Service General Technical Report RM-254. September 1994.

U.S. Fish and Wildlife Service. 2002. Birds of conservation concern 2002. Division of Migratory Bird Management, Arlington, Virginia. 99 pp. [Online version available at http://migratorybirds.fws.gov/reports/bcc2002.pdf

USDA Forest Service. 1985. Publication No. R6-F&WL-192-1985. Management of Wildlife and Fish Habitats in Forests of Western Oregon and Washington.

USDA Forest Service. 1990. Willamette National Forest Land and Resource Management Plan, 1990.

USDA Forest Service. 1994a. South Fork McKenzie River Watershed Analysis. Willamette National Forest, Blue River (McKenzie River) Ranger District. December 1994.

USDA Forest Service. 1995. North Fork of the Middle Fork Willamette River Watershed Analysis. Willamette National Forest, Oakridge (Middle Fork) Ranger District. September 1995.

USDA Forest Service, Willamette National Forest; USDI Salem District BLM; USDI Fish and Wildlife Service OSO. 1998. Mid-Willamette late-successional reserve assessment. August 24, 1998.

USDA Forest Service. 2005. Forest health protection aerial survey data. Forest Health Protection, USDA Forest Service, Pacific Northwest Region. http://www.fs.fed.us/r6/nr/fid/as/

USDA Forest Service, USDI Bureau of Land Management. 1994. Record of Decision for Amendments to Forest Service and Bureau of Land Management Planning Documents Within the Range of the Northern Spotted Owl, and Standards and Guidelines for Management of Habitat for Late-Successional and Old-Growth Forest Related Species Within the Range of the Northern Spotted Owl, USDA Forest Service and USDI Bureau of Land Management, 1994.

USDA Forest Service, USDI Bureau of Land Management. 2001. Record of Decision and Standards and Guidelines for Amendments to the Survey and Manage, Protection Buffer, and other Mitigation Measures Standards and Guidelines. January 2001.

USDA Forest Service, USDI Bureau of Land Management. 2004. Record of Decision to Remove or Modify the Survey and Manage Mitigation Measure Standards and Guidelines in Forest Service and Bureau of Land Management Planning Documents Within the Range of the Northern Spotted Owl. March 2004.

Verts, B.J. and Leslie N. Carraway. 1998. Land mammals of Oregon. University of California Press, Berkeley and Los Angeles, California.

Wisdom, M., L.R. Bright, C.G. Carey, W.W. Hines, R.J. Pedersen, D.A. Smithey, J.W. Thomas, and G.W. Witmer. 1986. A model to evaluate elk habitat in western Oregon. USDA Forest Service, Pacific Northwest Region Report R6-F&WL-216-1986. March 1986.

Zabel, C.J. and R.G. Anthony. 2003. Mammal community dynamics – management and conservation in the coniferous forests of Western North America. Cambridge University Press. 709pp.

Zielinski, William J., K.M. Slauson, C.R. Carroll, C.J. Kent, D.G. Kundrna. 2001. Status of American martens in coastal forests of the Pacific states. Journal of Mammalogy, 82(2):478-490.