United States Department of the Interior

FISH AND WILDLIFE SERVICE

Washington Fish and Wildlife Office
Central Washington Field Office
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July 12, 2010

MEMORANDUM

To: Vicki Gempko, Natural Resource Manager
National Park Service, North Cascades National Park Complex
Stehekin, Washington

From: Ken S. Berg, Manager
Central Washington Field Office
Wenatchee, Washington

Jessica K. Gonzales for

Subject: Consultation on the Stehekin River Corridor Implementation Plan
USFWS Reference Number: 13260-2010-F-0036
Cross Reference: 13260-2010-B-0002, 13260-2010-I-0037

This correspondence transmits the U.S. Fish and Wildlife Service's (Service) Biological Opinion (BO) based upon our review of the proposed Stehekin River Corridor Implementation Plan (Project) in Chelan County, Washington. The Biological Assessment (BA) for this Project and additional information requested by the Service's Central Washington Field Office (CWFO) on December 11, 2009, were received by the Service on February 23, 2010. A complete record for this consultation is on file in the CWFO.

The attached Biological Opinion (BO) describes the effects of the Project on the northern spotted owl (*Strix occidentalis caurina*). The Service concludes in the attached BO that the implementation of the Project is not likely to jeopardize the continued existence of the northern spotted owl. The attached BO completes consultation on the Stehekin River Corridor Implementation Plan.

The Service appreciates the efforts of the National Park Service to minimize Project effects to the northern spotted owl. If you have further questions about this BO or your responsibilities under the Endangered Species Act, please contact Gregg Kurz of the CWFO in Wenatchee at 509-665-3508, extension 22, or via e-mail at gregg_kurz@fws.gov.

U.S. FISH AND WILDLIFE SERVICE
BIOLOGICAL OPINION

for the

Stehekin River Corridor Implementation Plan

U.S. Department of Interior
National Park Service
North Cascades National Park

USFWS Reference Number: 13260-2010-F-0036
Cross Reference: 13260-2010-B-0002

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Since the 1995 there have been several large flood events in the Stehekin Valley, and compared to the previous 50 years, these events are becoming more common. The NPS, North Cascades National Park Complex (NOCA), has proposed a Stehekin River Corridor Implementation Plan (SRCIP) with five primary elements including: (1) rerouting a portion of the valley road out of the floodplain; (2) streambank erosion protection measures; (3) management of large woody debris; (4) recreation facilities development; and (5) identification of public lands for exchange.

One substantial project element, road reroute, will occur near a northern spotted owl (*Strix occidentalis caurina*) nest which was active intermittently between 1998 and 2007. During recent years (2008 and 2009) no spotted owls have been detected and a pair of barred owls occupied the nest. However, in 2010, a resident male was detected in protocol surveys. The Project's construction activities would occur in the summers of 2011 and 2012. The Project will result in approximately 24.5 acres of overall disturbance within northern spotted owl habitat, including 12.8 acres of habitat removal from the permanent removal of vegetation within the road prism and the short-term impacts associated with construction (e.g., noise, human presence, staging areas for equipment). Disturbance effects are anticipated to be discountable.

Based on the analysis presented in this Biological Opinion, Project effects are minor in terms of habitat impacts. Since effects at the Project scale appear to be minor, effects at the province or rangewide scales may not be measurable. As a result, the Service does not anticipate that the proposed action will jeopardize the continued existence of the spotted owl.

INTRODUCTION

The Project area is located along the lower nine miles of the Stehekin River valley, near the head of Lake Chelan, Washington, in a dry forest area. Most of the land is overseen by the National Park Service (NPS), and the remainder is small private parcels.

Since the 1995 there have been several large flood events in the Stehekin Valley, and compared to the previous 50 years, these events are becoming more common. The NPS, North Cascades National Park Complex (NOCA), has proposed a Stehekin River Corridor Implementation Plan (SRCIP) with five primary elements including: (1) rerouting a portion of the valley road out of the floodplain; (2) streambank erosion protection measures; (3) management of large woody debris; (4) recreation facilities development; and (5) identification of public lands for exchange.

One substantial project element, road reroute, will occur near a northern spotted owl (*Strix occidentalis caurina*) nest (the McGregor activity center) which was active intermittently between 1998 and 2007. During recent years (2008 and 2009) no spotted owls have been detected and a pair of barred owls occupied the nest. However, in 2010, a resident male was detected in protocol surveys. The Project's construction activities would occur in the summers of 2011 and 2012.

The U.S. Fish and Wildlife Service's (USFWS or Service) objective of the following Biological Opinion (BO) is to determine whether the proposed Project is likely to "jeopardize the continued existence of" the spotted owl. The standard for determining jeopardy is described in Section 7(a)(2) of the Endangered Species Act of 1973 (Act), as amended (16 U.S.C. 1531 *et seq.*) and further defined in 50 C.F.R. 402.14.

Jeopardy Determination

In accordance with policy and regulation, the jeopardy analysis in this BO relies on four components: (1) the *Status of the Species*, which evaluates the spotted owl's rangewide condition, the factors responsible for that condition, and its survival and recovery needs; (2) the *Environmental Baseline*, which evaluates the condition of the spotted owl in the action area, the factors responsible for that condition, and the relationship of the action area to the survival and recovery of the spotted owl; (3) the *Effects of the Action*, which determines the direct and indirect impacts of the proposed Federal action and the effects of any interrelated or interdependent activities on the spotted owl; and (4) *Cumulative Effects*, which evaluates the effects of future, non-Federal activities in the action area on the spotted owl.

In accordance with policy and regulation, the jeopardy determination is made by evaluating the effects of the proposed Federal action in the context of the spotted owl's current status, taking into account cumulative effects, to determine if implementation of the proposed action is likely to cause an appreciable reduction in the likelihood of both the survival and recovery of the spotted owl in the wild.

The jeopardy analysis in this BO places an emphasis on consideration of the rangewide survival and recovery needs of the spotted owl and the role of the action area in the survival and recovery

of the spotted owl as the context for evaluating the significance of the effects of the proposed Federal action, taken together with cumulative effects, for purposes of making the jeopardy determination.

This BO is based upon information provided in the final Project Biological Assessment (BA) (USDI 2008); published literature and unpublished reports; the final rule for listing the spotted owl (USDI 1990a); final designation of critical habitat (USDI 1992a and 2008a); the 1992 draft (USDI 1992b), 2007 draft (USDI 2007) and final (USDI 2008b) Recovery Plans for the spotted owl; and the 5-year review for the spotted owl (Courtney *et al.* 2004); as listed in the literature cited section. A complete record of this consultation is on file in the Service's Central Washington Field Office in Wenatchee, Washington.

CONSULTATION HISTORY

The following chronology documents the key points of the consultation process that culminated in the following BO for the spotted owl and informal consultation for other listed species:

1. June 1990: The Service issued its final rule for listing the spotted owl as a threatened species (USDI 1990a). The primary reason for listing included widespread habitat loss and an inadequacy of regulatory mechanisms to protect the species.

2. Throughout 2008: The NPS began informal discussions with Marc Whistler and David Morgan, USFWS, about the Project. Most of the conversations with Marc were about impacts to terrestrial species, and most of the conversations with David were about fish and geomorphology.

3. March 2009: Additional conversations with Marc took place in March 2009 to briefly discuss the consultation process, provide an explanation of the preferred alternative, discuss the timing for completion of the BO, and to identify David as the Service point of contact for the project. David was the Service representative on the SRCIP Technical Advisory Committee during the planning process which began in early 2008 and continued into late 2009.

4. November 2009: The NPS submitted a BA for the Project. The Service responded with a request for more information about effects to owl habitat.

5. February 2010: The NPS sent supplemental information, which was date-stamped and entered into the Service's document management system, beginning the official timeline for completion of the BO (estimated as July 8, 2010; USFWS reference: 13260-2010-F-0036).

6. March 10, 2010: The Service responded to the NPS request for formal consultation and replied that the information provided was determined to be sufficient to complete consultation. In addition, the Service concurred with the NPS determination of "may affect, not likely to adversely affect" the bull trout (*Salvelinus confluentus*), Canada lynx (*Lynx canadensis*), gray wolf (*Canis lupus*), and grizzly bear (*Ursus arctos*) (USFWS reference: 13260-2010-I-0037).

BIOLOGICAL OPINION

1.0 PROJECT DESCRIPTION

The Project purpose is to develop sustainable management strategies and actions for the Stehekin River corridor. The plan's primary objectives seek to:

1. Allow for natural processes associated with the Stehekin River to function, largely unimpeded by human influence;
2. Maintain park facilities (including the road system, campgrounds, and administrative areas);
3. Help ensure the persistence of visitor services provided by the Stehekin community, including those services and facilities found on private lands.

The following sections summarize specific elements of the proposed action, including: (1) rerouting a portion of the valley road out of the floodplain; (2) riverbank erosion protection measures; (3) management of large woody debris; (4) recreation facilities development; and (5) public lands identified for exchange.

Rerouting a portion of the valley road out of the floodplain

The reroute would be approximately 1.89 miles long, and would abandon a stretch of road located on an active floodplain, which required repeated bank protection and several short reroutes since 1995. Prior efforts were ultimately unsuccessful as the river continued to migrate. The new roadway would be 12-14 feet wide and would tie in to the existing alignment of the Stehekin Valley Road down valley of McGregor Meadows and up valley of the Lower Field. Nearly all of the new disturbance from the roadway would be outside of the channel migration zone (CMZ) and would therefore be protected from flooding. There would be approximately 24.5 acres of overall disturbance within northern spotted owl habitat, including 12.8 acres of habitat removal from the removal of vegetation within the road prism. Between milepost 6.5 and milepost 7.5, the existing alignment of the Stehekin Valley Road would be obliterated and revegetated to trail width to serve as a portion of the Lower Valley Trail (see Recreation Facilities for description).

The vegetation in this area consists of a mixed coniferous forest type dominated by Douglas-fir (*Pseudotsuga menziesii*) and Ponderosa Pine (*Pinus ponderosa*) with some Big leaf maple (*Acer macrophyllum*) and Pacific dogwood (*Cornus nuttallii*). There are approximately six seasonal drainages (non-fish bearing) that would be crossed with culverts along the proposed alignment.

Construction is scheduled to begin summer 2011 and is expected to be complete in 2012 (may extend into 2013).

Riverbank erosion protection measures

This element includes work at seven locations.

1. Weaver Point: at this campground on the lakeshore just below the river mouth, the docks will be moved away from 200' of eroding shoreline, which will be stabilized by augmenting large wood already in the area, and riparian plantings.
2. Stehekin River Resort Access Road: this riverbank just above the river mouth was treated with unauthorized riprap years ago and it is failing. That material would be replaced with bioengineering and an engineered log jam or two new rock barbs with large wood incorporated into the design. The bank barb component would be implemented as part of the Raft Takeout project, described below.
3. Buckner Pasture: this riverbank located about two miles above the lake is rapidly eroding the lower pasture of the historic Buckner Orchard. Riparian vegetation would be planted along about 500 feet of bank to reduce erosion and restore a portion of the riparian zone. Small log structures and bioengineering may also be used to slow erosion.
4. Frog Island: this riverbank is near road mile 3.8, where reroutes are impossible due to the steep adjacent terrain and rock cliffs. One or two rock barbs and cabled logs along the bank will be installed to protect the road, and native riparian cuttings will be added to approximately 100 ft of bank.
5. Wilson Creek: the road at mile 5.3 traverses the toe of the Wilson Creek debris cone. Wilson Creek is prone to periodic massive deposition on the road bed and into the culvert. No reroutes are possible given the location of the road along the edge of the river bank and the profile of the cone. The road would be moved approximately 10 feet into the hill slope. No large diameter trees would be removed. Three new culverts (24-36 inches in diameter) would be added to the one existing culvert to reduce damage from heavy rains and flooding caused by Wilson Creek. Two rock barbs will be installed at the toe of the slope to slow erosion. The bank above and between the barbs would be stabilized by incorporating large woody debris and layering native vegetation.
6. Lower Field: the river is eroding the bank near road mile 7.3, and the road would be obliterated and revegetated to trail standards, and incorporated into the Lower Valley Trail, described below. Approximately 500 feet of bank for a width of 30 feet would be planted with native shrubs and trees including Big leaf maple, cottonwood (*Populus deltoids*), alder (*Alnus sp.*), and red osier dogwood (*Cornus sericea*). Douglas fir, ocean spray (*Holodiscus discolor*), wild rose (*Rosa acicularis*), and snowberry (*Symphoricarpos albus*) would be planted further from the water to add diversity and to match vegetation to soil moisture conditions. Large woody debris and bioengineering along the bank slope would be used to slow erosion.
7. Slope Stabilization near River Mile 8: previously the NPS armored the river bank along 800 feet of the Stehekin Valley Road in this area with six bank barbs. Historic features preclude a road reroute in this area. In addition to maintaining existing barbs and bioengineering, the slope would be stabilized by constructing a rock wall at the toe and laying back the over-steepened slope.

Management of large woody debris (LWD)

The proposed action would allow for minimal manipulation of LWD (the minimum needed) to protect public facilities, including roads, water quality, public safety and regular access to private property. Also, LWD could be taken from the tops of logjams in the lower section of the Stehekin River that is influenced by Chelan Public Utility District (CPUD) lake level manipulation (river mouth to Boulder Creek). Wood removed would be used for NPS erosion management and riparian restoration projects and would remain within the CMZ. Logs would only be taken from above the ordinary high water mark, and would not be removed if the stability of the jam could be affected.

Recreation facilities development

This element includes work at two locations.

1. Lower Valley Trail: several sections of new trail would be built to connect several existing trails within the lower Stehekin Valley. The trail would be maintained for horses and hikers; bicycles and motor vehicles would be prohibited. Approximately 1.2 miles of the Lower Valley Trail would be constructed within northern spotted owl habitat.
2. Stehekin River Raft Takeout: a new raft takeout (approximately 20 x 40 ft) and an access road (approximately 300 ft) in length would be constructed upstream of the Stehekin River Resort between the bank barbs described above.

Public lands identified for exchange

In order to facilitate natural river migration, the NPS has a list of public lands that may be suitable for exchange with private landowners. Although initial review of park-owned (fee) lands resulted in approximately 76 acres that were preliminarily identified as possibly being suitable for exchange consideration, further resource analysis and field reconnaissance resulted in the reduction of this acreage to the approximately 24 acres that are proposed as being available for exchange. Criteria used to evaluate the parcels available for exchange includes:

1. Proximity to CMZ
2. Presence of wetlands (riparian / shoreline)
3. Presence of threatened, endangered or sensitive species or important habitats
4. Consequences for habitat fragmentation (is there other development in the surrounding area?)
5. Presence of National Register Eligible Cultural Resources

Of these project elements, only the road reroute is anticipated to have habitat- or disturbance-based effects to the spotted owl and is analyzed in this BO. Effects of the other project elements were described in informal consultation for the bull trout, Canada lynx, gray wolf, and grizzly bear (USFWS reference: 13260-2010-I-0037) and will not be analyzed further in this BO.

1.1 Conservation Measures

When used in the context of the Act, conservation measures are actions that are included by the Federal agency as an integral part of the proposed action. Because conservation measures are pledged in the Project description by the action agency, their implementation is required under the terms of the consultation (USDI and USDC 1998, page 4-19). Conservation measures would be implemented for the protection of spotted owls. These measures include:

- Align the road to avoid as many large diameter trees (≥30" dbh) and those with nesting features (conifers with upper canopy crotch or mistletoe broom) as possible.
- Complete spotted owl surveys to protocol March 1 - June 30 in 2010 and 2011. Surveys would be completed prior to the start of construction.

If spotted owls are detected during the 2011 surveys, the following measures would be implemented:

- Construction or other disturbance activities would not occur within 0.7 mile radius of the nest site during the breeding season (March 1 – September 6). This applies to known all nest sites if the current year nest site location is not known.

If spotted owls are detected during the 2010 survey but not detected in 2011:

- In 2011, construction would begin on or after July 1 (following the 2011 surveys)
- In 2012, surveys to protocol would be completed (March 1 – June 30). If spotted owls are detected, construction and disturbance activities within 0.7 miles of the nest site would not begin until after the breeding season (September 6). If spotted owls are not detected during the surveys, construction would begin once surveys are complete (July1).

If spotted owls are not detected during surveys in 2010 or 2011:

- Construction would begin July 1, 2011.
- Construction would begin in 2012 without restriction
- Monitoring by NPS biologist would continue throughout the breeding season (March 1– September 6) for the remainder of the project. If a spotted owl is detected during monitoring, construction and disturbance activities would stop within a 0.7 mile radius of the nest site until September 6.

In addition to these Conservation Measures, Best Management Practices (BMP's) such as temporary erosion and sediment control, including silt fencing, would be used. Revegetation of disturbed areas would protect soils from erosion and reduce the potential for erosion and long-term impacts to stream habitat. In addition, moving the Stehekin Valley Road away from the river would have long-term beneficial effects on allowing additional area for natural river processes within the 100-year floodplain and channel migration zone, which could improve local habitat for fish.

1.2 Definition of the Action Area

The action area is defined as all areas to be affected directly or indirectly by the Federal action, including interrelated and interdependent actions, and not merely the immediate area involved in the action (50 C.F.R. 402.02). Subsequent analyses of the environmental baseline, effects of the

action, cumulative effects, and levels of incidental take are based upon the action area as determined by the Service.

For the purposes of this analysis, the Service defines the action area as the lower Stehekin Valley between Lake Chelan and river mile 9, near the Courtney Ranch. However, the effects of the action are analyzed at multiple scales to put the effects into a meaningful context. For the spotted owl, effects of the action are analyzed primarily at the scale of action area, but also at the province and rangewide scales.

2.0 STATUS OF THE SPECIES FOR THE SPOTTED OWL

2.1 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 (USDI FWS 1990a, p. 26114). The U.S. Fish and Wildlife Service recovery priority number for the spotted owl is 6C (USDI FWS 2004, pp. 55), on a scale of 1C (highest) to 18 (lowest). This number reflects a high degree of threat, a low potential for recovery, and the owl's taxonomic status as a subspecies (USDI FWS 1983b, pp. 51895). The "C" reflects conflict with development, construction, or other economic activity (USDI FWS 1983a, pp. 43104). 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 (USDI FWS 2004, pp. 55).

2.2 Life History

2.2.1 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, pp.741-742; Barrowclough et al. 1999, pp. 928; Haig et al. 2004, pp. 1354) morphological (Gutiérrez et al. 1995, pp. 2), and biogeographic information (Barrowclough and Gutiérrez 1990, pp.741-742). 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, pp.2). Recent studies analyzing mitochondrial DNA sequences (Haig et al. 2004, pp. 1354, Chi et al. 2004, pp. 3; Barrowclough et al. 2005, pp. 1117) and microsatellites (Henke et al., unpubl. data, pp. 15) 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 Nevada's, appears to be stable (Barrowclough et al. 2005, pp. 1116).

2.2.2 Physical Description

The northern spotted owl is a medium-sized owl and is the largest of the three subspecies of spotted owls (Gutiérrez 1996, pp. 2). 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 USDI 2008b, pp. 43). 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 (Moen et al. 1991, page 493). The northern spotted owl superficially resembles the barred owl, a species with which it occasionally hybridizes (Kelly and Forsman 2004, pp. 807). Hybrids exhibit physical and vocal characteristics of both species (Hamer et al. 1994, pp. 488).

2.2.3 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 (USDI 1990a, pp. 26115). 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 (USDI 1992b, pp. 31). 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
- Three provinces in California: California Coast, California Klamath, California Cascades

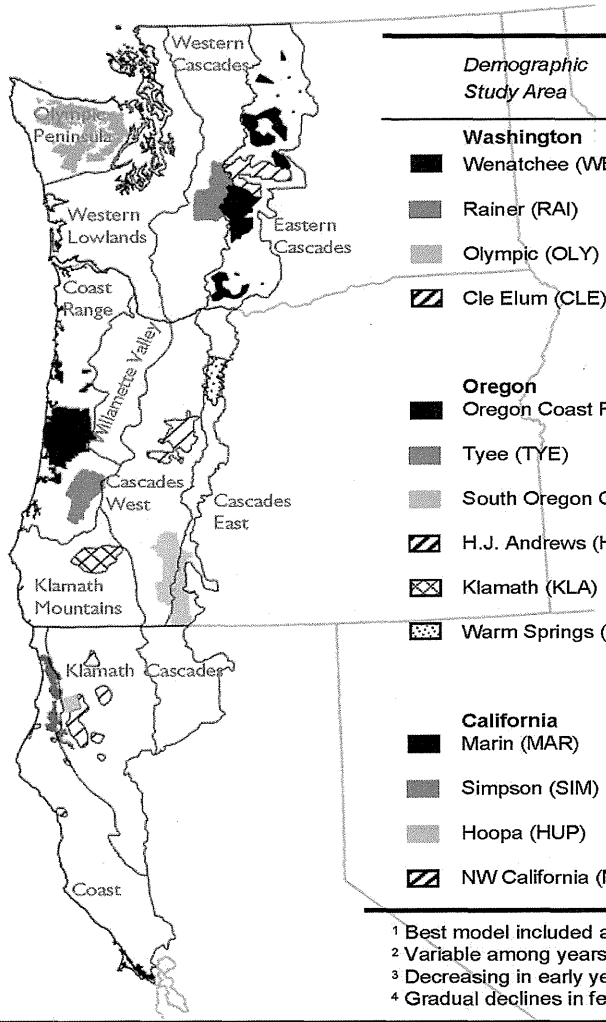
The spotted owl is extirpated or uncommon in certain areas such as southwestern Washington and British Columbia. Timber harvest activities have eliminated, reduced or fragmented spotted owl habitat sufficiently to decrease overall population densities across its range, particularly within the coastal provinces where habitat reduction has been concentrated (USDI 1992a, pp. 1799).

2.2.4 Behavior

Spotted owls are territorial. However, home ranges of adjacent pairs overlap (Forsman et al. 1984, pp. 22; Solis and Gutiérrez 1990, pp. 746) 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, pp. 4). 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, pp. 822). Little is known about floaters other than that they exist and typically do not respond to calls as vigorously as territorial birds (Gutiérrez 1996, pp. 4).

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, pp. 10).

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



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.

2.2.5 Habitat Relationships

2.2.5.1 Home Range. Home-range sizes vary geographically, generally increasing from south to north, which is likely a response to differences in habitat quality (USDI 1990a, pp. 26117). 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, pp. IX-15) vary by province and range from 2,955 acres in the Oregon Cascades (Thomas et al. 1990, pp. 194) to 14,211 acres on the Olympic Peninsula (USDI 1994a, pp. 3). Zabel et al. (1995, pp. 436) 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, pp. 22; Solis and Gutiérrez 1990, pp. 746), 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, pp. 133-135). 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, pp. 134). 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, pp. 21-22; Sisco 1990, pp. iii).

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 nesting success (Bart 1995, pp. 944) and abundance (Bart and Forsman 1992, pp. 98-99).

Shortly after their listing in 1990, the Service developed guidance for protecting spotted owl habitat in proximity to the nest tree or activity center (more recently summarized by Bart 1995). This guidance describes various "thresholds" or amounts of suitable habitat within prescribed distances from the nest tree or activity center. The Service uses this guidance to evaluate the existing habitat condition, the effects of the proposed action, and the potential for incidental take of spotted owls (see the Incidental Take Statement). Removing habitat below threshold values increases the likelihood of site abandonment, reduced fecundity, and other significant impairments of normal behavioral patterns.

To be considered "at threshold" in the Washington Eastern Cascades, suitable habitat must comprise (1) 100 acres of the best habitat nearest the nest tree or activity center, (2) 500 acres within a 0.7 mile radius of the activity center, and (3) 2,663 acres within a 1.82 mile radius of the activity center (i.e., 40 percent of the home range). The "100 acres of best habitat" is also known as the 100-acre core; although the Service initially described a 70-acre core, this area was expanded to a 100-acre core with the adoption of the NWFP. Even if no longer occupied by spotted owls, the ROD (USDA and USDI 1994a) specified that the 100-acre core should be maintained as an "unmapped LSR" (ROD, page C-10 and C-39), and managed consistent with LSR objectives. This standard and guideline was developed for areas outside of "reserve" LUA's (e.g., Congressionally Reserved, Administratively Withdrawn, LSR, MLSA, and Riparian Reserves); "unmapped LSRs" may benefit other late-successional species or provide a "stepping stone" for spotted owls moving across the landscape.

2.2.5.2 Habitat Use. Forsman et al. (1984, pp.15-16) 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, pp. 27; Forsman et al. 1984, pp. 15-16).

Roost sites selected by spotted owls have more complex vegetation structure than forests generally available to them (Barrows and Barrows 1978, pp.3; Forsman et al. 1984, pp.29-30; Solis and Gutiérrez 1990, pp.742-743). 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, pp.30; Hershey et al. 1998, pp.1402). 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, pp. 40; Buchanan et al. 1995, pp.1402; Hershey et al. 1998 pp. 1404).

Foraging habitat is the most variable of all habitats used by territorial spotted owls (USDI 1992b, pp. 20). Descriptions of foraging habitat have ranged from complex structure (Solis and Gutiérrez 1990, pp. 742-744) to forests with lower canopy closure and smaller trees than forests containing nests or roosts (Gutiérrez 1996, pp.5).

2.2.5.3 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, pp. 19). Nesting spotted owls consistently occupy stands with a high degree of canopy closure that may provide thermoregulatory benefits (Weathers et al. 2001, pp. 686) and protection from predators.

Foraging habitat for spotted owls provides a food supply for survival and reproduction. Foraging activity is positively associated with tree height diversity (North et al. 2000, pp. 524), canopy closure (Irwin et al. 2000, pp. 180; Courtney et al. 2004, pp. 5-15), snag volume, density of snags greater than 20 in (50 cm) dbh (North et al. 2000, pp. 524; Irwin et al. 2000, pp. 179-180; Courtney et al. 2004, pp. 5-15), density of trees greater than or equal to 31 in (80 cm) dbh (North et al. 2000, pp. 524), volume of woody debris (Irwin et al. 2000, pp. 179-180), and young forests with some structural characteristics of old forests (Carey et al. 1992, pp. 245-247; Irwin et al. 2000, pp. 178-179). Northern spotted owls select old forests for foraging in greater proportion

than their availability at the landscape scale (Carey et al. 1992, pp. 236-237; Carey and Peeler 1995, pp. 235; Forsman et al. 2005, pp. 372-373), but will forage in younger stands with high prey densities and access to prey (Carey et al. 1992, pp. 247; Rosenberg and Anthony 1992, pp. 165; Thome et al. 1999, pp. 56-57).

Dispersal habitat is essential to maintaining stable populations by filling territorial vacancies when resident spotted owls die or leave their territories, and to providing adequate gene flow across the range of the species. 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. Dispersal habitat may include younger and less diverse forest stands than foraging habitat, such as even-aged, pole-sized stands, but such stands should contain some roosting structures and foraging habitat to allow for temporary resting and feeding for dispersing juveniles (USDI 1992a, pp. 1798). Forsman et al. (2002, pp. 22) found that spotted owls could disperse through highly fragmented forest landscapes. However, the stand-level and landscape-level attributes of forests needed to facilitate successful dispersal have not been thoroughly evaluated (Buchanan 2004, pp. 1341).

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, pp. 158; Diller and Thome 1999, pp. 275). 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, pp. 304). 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, pp. 41).

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, pp. 437).

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, pp. 24-25; Carey et al. 1990 pp. 14-15; Forsman et al. 2005, pp. 372-373). Glenn et al. (2004, pp. 46-47) 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, pp. 62) 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, pp. 436) 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, pp. 1038; Franklin et al. 2000, pp. 573-579; Meyer et al. 1998, pp. 43). In Oregon Klamath and Western Oregon Cascade provinces, Dugger et al. (2005, pp. 876) 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, pp. 873-874). 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, pp. 876) 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, pp. 1050-1051) 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, pp. 1049-1050) 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.

2.2.6 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 (Gutiérrez et al. 1995, pp. 5). 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, pp. 93; Franklin 1992, pp. 821; Forsman et al. 2002, pp. 17). 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 (Forsman et al. 1984, pp. 32-34, Anthony et al. 2006, pp. 28), and re-nesting after a failed nesting attempt is rare (Gutiérrez 1996, pp. 4). 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, pp. 4).

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, pp. 32). 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 (Forsman et al. 1984, pp. 38). 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, pp. 38). Telemetry and genetic studies indicate that close inbreeding between siblings or parents and their offspring is rare (Haig et al. 2001, pp. 35, Forsman et al. 2002, pp. 18).

2.2.7 Dispersal Biology

Natal dispersal of spotted owls typically occurs in September and October with a few individuals dispersing in November and December (Forsman et al. 2002, pp. 13). Natal dispersal occurs in stages, with juveniles settling in temporary home ranges between bouts of dispersal (Forsman et al. 2002, pp. 13-14; Miller et al. 1997, pp. 143). The median natal dispersal distance is about 10 miles for males and 15.5 miles for females (Forsman et al. 2002, pp. 16). Dispersing juvenile spotted owls experience high mortality rates, exceeding 70 percent in some studies (Miller 1989, pp. 32-41). Known or suspected causes of mortality during dispersal include starvation, predation, and accidents (Miller 1989, pp. 41-44; Forsman et al. 2002, pp. 18-19). Parasitic infection may contribute to these causes of mortality, but the relationship between parasite loads and survival is poorly understood (Hoberg et al. 1989, pp. 247; Gutiérrez 1989, pp. 616-617, Forsman et al. 2002, pp. 18-19). 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, pp. 697-698).

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, pp. 22). 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, pp. 22). 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, pp. 35).

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, pp. 20-21). Breeding dispersal distances were shorter than natal dispersal distances and also are apparently random in direction (Forsman et al. 2002, pp. 21-22).

2.2.8 Food Habits

Spotted owls are mostly nocturnal, although they also forage opportunistically during the day (Forsman et al. 1984, pp. 51; 2004, pp. 222-223; Sovern et al. 1994, pp. 202). 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, pp. 40-41) in Washington (Hamer et al. 2001, pp. 224) and Oregon, while dusky-footed wood rats (*Neotoma fuscipes*) are a major part of the diet in the Oregon Klamath, California Klamath, and California Coastal provinces (Forsman et al. 1984, pp. 40-42; 2004, pp. 218; Ward et al. 1998, pp. 84). 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, pp. 40-43; 2004, pp. 218; Ward et al. 1998; pp. 84; Hamer et al. 2001, pp.224).

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, pp. 4-27). For example, Rosenberg et al. (2003, pp. 1720) showed a strong correlation between annual reproductive success of spotted owls (number of young per territory) and abundance of deer mice (*Peromyscus maniculatus*) (r^2 = 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, pp. 1723). Ward (1990, pp. 55) 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. 2001, pp. 148; 2004, pp. 218-219).

2.2.9 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 (Gutiérrez 1996, pp. 5). 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, pp. 576).

Annual variation in population parameters for spotted owls has been linked to environmental influences at various life history stages (Franklin et al. 2000, pp. 581). 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, pp. 805), 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, pp. 1). Annual variation in breeding may be related to weather (i.e., temperature and precipitation) (Wagner et al. 1996, pp. 74 and Zabel et al. 1996, pp.81 *In*: Forsman et al. 1996) and fluctuation in prey abundance (Zabel et al. 1996, pp.437-438).

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, pp. 581-582). Specifically, weather could have increased negative effects on spotted owl fitness for those owls occurring in relatively lower quality habitat (Franklin et al. 2000, pp. 581-582). 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, pp. 583). Olson et al. (2005, pp. 930-931) 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.

2.3 Threats

2.3.1 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" (USDI 1990a, pp. 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 (USDI 1992a, pp. 33-41). These threats were characterized for each province as severe, moderate, low or unknown (USDI 1992a, pp. 33-41) (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 rangewide 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, pp 11-8 to 11-9). However, great horned owls (*Bubo virginianus*), an effective predator on spotted owls, are closely associated with fragmented forests, openings, and clearcuts (Johnson 1992, pp. 84; Laidig and Dobkin 1995, pp. 155). As mature forests are harvested, great horned owls may colonize fragmented forests, thereby increasing spotted owl vulnerability to predation.

2.3.2 New Threats

The Service conducted a 5-year review of the spotted owl in 1994 (USDI 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, pp. 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 rangewide habitat base over a 10-year period)." (Courtney and Gutiérrez 2004, pp. 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, pp. 11-8).

2.3.2.1 Barred Owls (Strix varia). With its recent expansion to as far south as Marin County, California (Gutiérrez et al. 2004, pp. 7-12-7-13), 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, pp.226) or habitat (Hamer et al. 1989, pp.55; Dunbar et al. 1991, pp. 467; Herter and Hicks 2000, pp. 285; Pearson and Livezey 2003, pp. 274). In addition, barred owls physically attack spotted owls (Pearson and Livezey 2003, pp. 274), and circumstantial evidence strongly indicated that a barred owl killed a spotted owl (Leskiw and Gutiérrez 1998, pp. 226). 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, pp. 46; Pearson and Livezey 2003, pp. 267; Olson et al. 2005, pp. 921). 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 et al 1989, pp. 34; Iverson 1993, pp.39). However, recent studies conducted in the Pacific Northwest show that barred owls frequently use mature and old-growth forests (Pearson and Livezey 2003, pp. 270; Schmidt 2006, pp. 13). 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, pp. 1).

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, pp. 226). 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, pp. 225-226).

The presence of barred owls has been reported to reduce spotted owl detectability, site occupancy, reproduction, and survival. Olson et al. (2005, pp. 924) 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, pp. 51). Pearson and Livezey (2003, pp. 271) 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, p. 11) 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, pp. 928) 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, pp. 1048) 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, pp. 89) was unfounded because of small sample sizes (Livezey 2005, pp. 102). 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 USDI 2008b, pp. 65). Anthony et al. (2006, pp. 32) 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, pp. 807). 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, pp. 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, pp. 739-740; Olson et al. 2005, pp. 930-931). 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, pp. 7-38).

2.3.2.2 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, pp. 1025) 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, pp. 1026). In a preliminary study conducted by Anthony and Andrews (2004, pp. 8) in the Oregon Klamath 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, pp. 125). 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 (Gaines et al. 1997, pp. 126). 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. 1998, pp. 2-3). 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 (USDI 1990a, pp. 26183). New information suggests fire may be more of a threat than previously thought. In particular, the rate of habitat loss due to fire has been expected with over 102,000 acres of late-successional forest lost on Federal lands from 1993-2004 (Moeur et al 2005, pp. 110). Currently, the overall total amount of habitat loss from wildfires has been relatively small, estimated at approximately 1.2 percent on federal lands (Lint 2005, pp. v). 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, pp. 12-11). 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, pp. 77).

2.3.2.3 West Nile Virus. WNV has killed millions of wild birds in North America since it arrived in 1999 (Caffrey 2003, pp. 12; Marra et al. 2004, pp. 393). 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, pp. 3111). One captive spotted owl in Ontario, Canada, is known to have contracted WNV and died (Gancz et al 2004, pp. 2137), but there are no documented cases of the virus in wild spotted owls.

Health officials expect that WNV eventually will spread throughout the range of the spotted owl (Blakesley *et al.* 2004, pp. 8-31), but it is unknown how the virus will ultimately affect spotted owl populations. Susceptibility to infection and the mortality rates of infected individuals vary among bird species (Blakesley *et al.* 2004, pp. 8-33), but most owls appear to be quite susceptible. For example, eastern screech-owls breeding in Ohio that were exposed to WNV experienced 100 percent mortality (T. Grubb pers. comm. in Blakesley *et al.* 2004, pp. 8-33). Barred owls, in contrast, showed lower susceptibility (B. Hunter pers. comm. in Blakesley *et al.* 2004, pp. 8-34).

Blakesley et al. (2004, pp. 8-35) offer two possible scenarios for the likely outcome of spotted owl populations being infected by WNV. One scenario is that a rangewide reduction in spotted owl population viability is unlikely because the risk of contracting WNV varies between regions. An alternative scenario 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. WNV remains a potential threat of uncertain magnitude and effect (Blakesley et al. 2004, pp. 8-34).

2.3.2.4 Sudden Oak Death. Sudden oak death was recently identified as a potential threat to the spotted owl (Courtney and Guttierez. 2004, pp. 11-8). 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, pp. 733). 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, pp. 441). 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 and Guttierez. 2004, pp. 11-8).

2.3.2.5 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 significantly reduced genetic variation in Washington, Oregon, or California (Barrowclough et al. 1999, pp. 922; Haig et al. 2001, pp. 36). 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 et al. 2004, pp. 13). 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, pp. 11-9). 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.

2.3.2.6 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, pp. 9-15). 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, pp. 37-42) 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, pp. 685), subtle changes in climate have the potential to affect this. However, the specific impacts to the species are unknown.

2.3.2.7 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, pp. 355-358). 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 close proximity to recreational hikers can cause Mexican spotted owls (*S. o. lucida*) to flush from their roosts (Swarthout and Steidl 2001, pp. 314) and helicopter overflights can reduce prey delivery rates to nests (Delaney et al. 1999, pp. 70). Additional effects from disturbance, including altered foraging behavior and decreases in nest attendance and reproductive success, have been reported for other raptors (White and Thurow 1985, pp. 14; Andersen et al. 1989, pp. 296; McGarigal et al. 1991, pp. 5).
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, pp. 925). 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 and Harvey 2000, pp.517-518; Saplosky et al. 2000, pp. 1). In avian species, the secretion of corticosterone is the primary non-specific stress response (Carsia and Harvey 2000, p. 517). The quantity of this hormone in feces can be used as a measure of physiological stress (Wasser et al.1997, pp. 1019). 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, pp. 698; Tempel & Gutiérrez 2004, pp. 538). However, prolonged activities, such as those associated with timber harvest, may increase fecal corticosterone levels depending on their proximity to spotted owl core areas (Wasser et al. 1997, pp.1021; Tempel & Gutiérrez 2004, pp. 544).

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.

2.4 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:

2.4.1 Habitat-specific Needs

1. Large blocks of suitable habitat to support clusters or local population centers of spotted owls (e.g., 15 to 20 breeding pairs) throughout the owl's range;

2. Suitable habitat conditions and spacing between local spotted owl populations throughout its range to facilitate survival and movement;

3. Suitable habitat distributed across a variety of ecological conditions within the spotted owl's range to reduce risk of local or widespread extirpation;

4. 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

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

2.4.2 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.

2.4.3 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 (USDI 1992a), the Draft Recovery Plan (USDI 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.

2.4.4 Federal Contribution to Recovery

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 included land use allocations which would provide for population clusters of spotted owls (*i.e.,* demographic support) and maintain connectivity between population clusters. Certain land use allocations in the plan contribute to supporting population clusters: 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 were 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, USDI 1994b)) 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, pp. 279-280): 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 (USDI FWS 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, pp. II-31, USDA and USDI 1994b, pp. 3&4-229). Based on the results of the first decade of monitoring, Lint (2005, pp. 18) 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, pp. 18; Noon and Blakesley 2006, pp. 288). Bigley and Franklin (2004, pp. 6-34) 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, pp. 6-34).

Under the NWFP, the agencies anticipated a decline of spotted owl populations during the first decade of implementation. Recent reports (Anthony et al. 2006, pp. 33-34) 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, 9-12, Lint 2005, pp. 87). Even with the population decline, Courtney et al (2004, pp. 9-15) 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 (USDI 2004, pp. 54). 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 May, 2008, the Service published the 2008 Final Recovery Plan for the Northern Spotted Owl (USDI 2008b). The recovery plan identifies that competition with barred owls, ongoing loss of suitable habitat as a result of timber harvest and catastrophic fire, and loss of amount and distribution of suitable habitat as a result of past activities and disturbances are the most important rangewide threats to the spotted owl (USDI 2008b, pp. 57-67). To address these threats, the present recovery strategy has the following three essential elements: barred owl control, dry-forest landscape management strategy, and managed owl conservation areas (MOCAs) (USDI 2008b, pp. 12-15). The recovery plan lists recovery actions that address research of the competition between spotted and barred owls, experimental control of barred owls to better understand the impact the species is having on spotted owls, and, if recommended

by research, management of barred owls (USDI 2008b, pp. 15). The foundation of the plan for managing forest habitat in the non-fire-prone western Provinces of Washington and Oregon is the MOCA network on Federal lands, which are intended to support stable and well-distributed populations of spotted owls over time and allow for movement of spotted owls across the network (USDI 2008b, pp. 13). On the fire-dominated east side of the Cascade Mountains in Washington and Oregon, and the California Cascades, the dry-forest habitat management strategy is intended to maintain spotted owl habitat in an environment of frequent natural disturbances (USDI 2008b, pp. 14). Additionally, the recovery plan identifies Conservation Support Areas (CSAs) in Washington, the west side of the Cascades in Oregon, and in California. These CSAs are located on private, State, and Federal lands and are expected to support the MOCA network and the dry-forest landscape management approach (USDI 2008b, pp. 14). In addition, the recovery plan recommends a research and monitoring program be implemented to track progress toward recovery, inform changes in recovery strategy by a process of adaptive management, and ultimately determine when delisting is appropriate (USDI 2008b, pp. 15). The three primary elements of this program include 1) the monitoring of spotted owl population trends, 2) an inventory of spotted owl distribution, and 3) a comprehensive program of barred owl research and monitoring (USDI 2008b, pp. 15). The recovery plan estimates that recovery of the spotted owl could be achieved in approximately 30 years (USDI 2008b, pp. VIII).

2.4.5 Conservation Efforts on Non-Federal Lands

In the report from the Interagency Scientific Committee (Thomas et al. 1990, pp. 3), the draft recovery plan (USDI 1992b, pp. 272), and the report from the Forest Ecosystem Management Assessment Team (Thomas and Raphael 1993, pp. IV-189), 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 rangewide goal of achieving conservation and recovery of the spotted owl. The U.S. Fish and Wildlife 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 (USDI 2008b, pp. 55). 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, pp. 11-15; Buchanan et al. 1994, pp. ii). 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, pp. 9). Spotted owl-related HCPs in Washington generally were intended to provide demographic or connectivity support (USDI 1992b, pp. 272).

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, pp. 64). 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 (USDI 2008b, pp. 56).

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, pp. 85-87). 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, pp. 85-87). The California Department of Fish and Game initially reviewed all timber harvest plans to ensure that take was not likely to occur; the U.S. Fish and Wildlife Service took over that review function in 2000. Several large industrial owners operate under spotted owl management plans that have been reviewed by the U.S. Fish and Wildlife 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 (USDI 2008b, pp. 56).

2.5 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 (USDI and USDC 1998).

2.5.1 Range-wide Habitat and Population Trends

2.5.1.1 *Habitat Baseline.* The 1992 Draft Spotted Owl Recovery Plan estimated approximately 8.3 million acres of spotted owl habitat remained range-wide (USDI 1992b, pg. 37). However, reliable habitat baseline information for non-Federal lands is not available (Courtney et al. 2004, pg. 6-5). 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, pg. G-34) 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, pgs. 21-82). However, the spatial resolution of this new habitat map currently makes it unsuitable for tracking habitat effects at the scale of individual projects. The Service is evaluating the map for future use in tracking range-wide 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.

2.5.1.2 *NWFP Lands Analysis 1994 – 2001.* In 2001, the Service conducted an assessment of habitat baseline conditions, the first since implementation of the NWFP (USDI FWS 2001, pg. 1). 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, pg. 6), 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 (USDI 2001, pg. 32).

2.5.1.3 *Range-wide Analysis 1994 – May 19, 2010.* This section updates the information considered in USDI FWS (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, wind storms, insect and disease outbreaks). To track impacts to spotted owl habitat, the Service developed the Consultation Effects Tracking System database in which we record impacts to spotted owls and their habitat. 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 May 19, 2010, the Service had consulted on the proposed removal of approximately 237,551 acres (Table 1) or 3.2 percent of 7.4 million acres of northern spotted owl suitable habitat on Federal lands. Of the total Federal acres consulted on for removal, approximately 192,712 acres, or 2.6 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 FS and USDI BLM 1994a).
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.

Due to ongoing technical difficulties with the Service's Consultation Effects Tracking system, the range-wide summary of acres of federal NWFP lands that were consulted on and removed and downgraded presented in Table 1 does not match the province-specific summary of acres of habitat on federal NWFP lands that were consulted on and removed and downgraded in reserves and non-reserves (Table 2). Table 2 reports approximately 11,500 acres less of total habitat removal. Despite this discrepancy, we include Table 2 because it is useful for providing an approximate breakdown of habitat impacts by physiographic province and state. We are currently re-programming our Consultation Effects Tracking system, with support from the U.S. Geological Survey, and we expect to resolve this technical problem during this process.

Habitat removal from Federal lands due to management activities has varied among the individual provinces with most of the impacts concentrated within the Non-Reserve land-use allocations (about 83% of total removal) (Table 2). When habitat removal is evaluated as a proportion of the affected acres range-wide, the majority of total habitat removal has occurred within Oregon (84%), especially within its Klamath Mountains (50%) and Cascades (East and West) (33%) Provinces (Table 2), followed by much smaller habitat losses in Washington (8 %) and California (8%) (Table 2). When habitat loss is evaluated as a proportion of provincial baselines, the Oregon Klamath Mountains (25%), Cascades East (8%), and the California Cascades (5.45%) all have proportional losses greater than the range-wide mean (5.33%) (Table 2).

From 1994 through April 8, 2009, habitat lost due to natural events was estimated at approximately 167,894 acres rangewide (Table 2). 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 2 – footnote 8). Approximately 18,630 acres of spotted owl habitat were lost due to the B&B Complex and Davis Fires in the East Cascades Province of Oregon (Table 2– footnote 9).

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 419,432 (Table 1) acres 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 632,860 acres of spotted owl habitat rangewide, resulting from all management activities, as of April 8, 2008 (Table 1).

Table 1. Changes to NRF[1] habitat acres from activities addressed in section 7 consultations (both formal and informal) and other causes rangewide from 1994 to May 19, 2010.

Northwest Forest Plan (NWFP) Group / Ownership		Consulted On Habitat Changes[2]		Other Habitat Changes[3]	
		Removed/ Downgraded	Degraded	Removed/ Downgraded	Degraded
Federal - Northwest Forest Plan	Bureau of Land Management	100930	56166	760	0
	Forest Service	117324	472795	36911	5481
	National Park Service	3916	5286	3	0
	Multi-agency[4]	15381	23314	130220	0
	NWFP Subtotal	237551	557561	167894	5481
Other Management and Conservation Plans (OMCP)	Bureau of Indian Affairs and Tribes	110123	28398	2398	0
	Habitat Conservation Plans	295889	14430	0	0
	OMCP Subtotal	406012	42828	2398	0
Other Federal Agencies & Lands[5]		241	241	466	28
Other Public & Private Lands[6]		14173	14473	880	30240
TOTAL Changes		632860	658277	601735	200560

[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 USDI FWS (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 the acres of habitat loss to natural events that can not be split out by administrative unit.

[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 FS lands are included here.

Table 2: Acres of suitable (NRF[1]) habitat loss on Federal lands from 1994 to May 19, 2010 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]				% of 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	0.31
	Eastern Cascades	506340	200509	706849	3946	5748	5754	15448	2.19	3.96
	Western Cascades	864683	247797	1112480	1681	10924	0	12605	1.13	3.23
	Western Lowlands	0	0	0	0	0	0	0	0	0.00
OR	Coast Range	422387	94190	516577	734	3938	66	4738	0.92	1.21
	Klamath Mountains	448509	337789	786298	23402	71989	101676[8]	197067	25.06	50.38
	Cascades East	247624	196035	443659	2343	13448	19547[9]	35338	7.97	9.06
	Cascades West	1012426	1033337	2045763	4020	66397	24583	95000	4.64	24.28
	Willamette Valley	593	5065	5658	0	0	0	0	0.00	0.00
CA	Coast	47566	3928	51494	455	65	100	620	1.2	0.16
	Cascades	61852	26385	88237	0	4809	0	4809	5.45	1.23
	Klamath	734103	345763	1079866	1545	9719	15869	27133	2.51	6.94
Total		4894566	4894566	2502532	7397098	38993	187061	167894	393948	5.33

[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 FS and USDI BLM 1994b).

[3] Includes consulted-on effects reported by USDI FWS (2001) and subsequent effects compiled in the NSO 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 Cascades East, are from the Scientific Evaluation of the Status of the 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 Spotted owl (Courtney et al. 2004) and data in the NSO Consultation Effects Tracking Database. NSO Consultation Effects Tracking Database

2.5.1.4 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, pp. 88) 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 and others (2005, pp. 98) 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, pp. 91). Approximately 77 percent of the harvested habitat occurred on private lands and about 15 percent occurred on State lands. Pierce and others (2005, pp. 80) 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, pp. 90).

Moeur et al. 2005 (pp. 110) 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 Northwest Forest Plan 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 (Moeur et al. 2005, pp. 100). The estimates were based on change-detection layers for losses due to harvest and fire and re-measured inventory plot data for increases due to in-growth. 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.

2.5.1.5 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 (USDI 1989, pp. 2-17). According to the final rule listing the spotted owl as threatened (USDI 1990a, pp. 26118), 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 (USDI 1989, pp. 4-11; Thomas et al. 1990, pp.64).

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 (USDI 1990a, pp. 26115). 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 (USDI 1992b, pp. 31). 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 (USDI 1995, pp. 9495). By June 2004, the number of territorial spotted owl sites in Washington recognized by the Washington Department of Fish and Wildlife was 1,044 (Buchanan and Swedeen 2005, pp. 37). The actual number of currently occupied spotted owl locations across the range is unknown because many areas remain unsurveyed (USDI 2008b, pp. 44). In addition, many historical sites are no longer 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 USDI (1995, pp. 9495) 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 rangewide 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 (Table 3), while the other modeled the eight study areas that are part of the effectiveness monitoring program of the NWFP (Anthony et al. 2006, pp. 2). Data were analyzed separately for individual study areas, as well as across all study areas in a meta-analysis.

Table 3. Spotted owl demographic study areas (adapted from Anthony *et al.* 2006, pp. 29).

Area	Fecundity	Survival	λ_{RJS}	Population Change
Wenatchee	Declining	Declining	0.917	Declining
Cle Elum	Declining	Declining?	0.938	Declining
Rainier	Stable	Declining	0.896	Declining
Olympic	Stable	Declining	0.956	Declining
Coast Ranges	Declining?	Stable	0.968	Declining
HJ Andrews	Stable?	Stable	0.978	Declining
Warm Springs	Stable	Stable	0.908	Declining
Tyee	Increasing	Stable	1.005	Stationary
Klamath	Stable	Stable	0.997	Stationary
S. Cascades	Declining	Stable	0.974	Stationary
NW California	Declining	Declining	0.985	Declining?
Hoopa	Increasing	Stable	0.98	Stationary
Simpson	Declining	Stable	0.97	Declining
Marin	Stable	Stable	NA	NA

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, pp. 29). 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. Anthony *et al.* (2006, pp. 31) explains that the indication populations were declining was based on the fact that the 95 percent confidence intervals around the estimate of the mean lambda did not overlap 1.0 (stable) or barely included 1.0.

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, pp. 31). 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, pp. 30). 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, pp. 30). 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.

There are few spotted owls remaining in British Columbia. Chutter et al. (2004, pp. *v*) suggested immediate action was required to improve the likelihood of recovering the spotted owl population in British Columbia. So, in 2007, personnel in British Columbia captured and brought into captivity the remaining 16 known wild spotted owls (USDI 2008b, pp. 48). Prior to initiating the captive-breeding program, the population of spotted owls in Canada was declining by as much as 10.4 percent per year (Chutter et al. 2004, pp. *v*). The amount of previous interaction between spotted owls in Canada and the United States is unknown.

3.0 ENVIRONMENTAL BASELINE

3.1 Introduction

The environmental baseline is an account of the effects of past and ongoing human actions and natural factors leading to the current status of the species, its habitat, and ecosystem at the scale of the action area (USDI and USDC 1998 p. 4-22). The environmental baseline represents the current condition of species and designated critical habitat, and provides the context for the analysis of potential effects of the proposed action.

For wide-ranging, highly mobile species like the spotted owl, the action-area scale is not the only scale relevant to the evaluation of how baseline conditions might influence the consequences of project effects. Baseline conditions at larger scales, particularly the watershed and physiographic province, provide important information about trends in habitat quantity, quality, and distribution, as well as non-habitat factors that may be influencing spotted owl numbers, reproduction, and distribution across the landscape. The watershed baseline provides insights about the condition of the local population of spotted owls affected in the action area. The physiographic province scale describes the condition of the broader metapopulation with which the affected local population interacts. Baseline conditions of the spotted owl metapopulation presumably influence the numbers, distribution, and reproduction of the local population in the action area.

The following sub-sections present baseline information starting at the broad scale of the physiographic provinces affected and zooming in to the watershed and action area scales. In conjunction with the Status of the Species, this nested hierarchy of baseline conditions provides

the context for subsequent analysis of Project effects at multiple scales en route to determining the potential for the Project to jeopardize the continued existence of the spotted owl or to destroy or adversely modify critical habitat.

3.2 Washington Eastern Cascades Province Baseline

This section describes the implementation of the conservation strategy for the spotted owl at the scale of the Washington Eastern Cascades province (WECP). The Service uses this background to determine how representative baseline conditions in the action area are relative to baseline conditions at the broader provincial scale, and how the action area is currently contributing to the provincial conservation strategy. This background also provides insights about how resilient the broader metapopulation of spotted owls may be to adverse effects to the local population in the action area.

The 5.7 million acre WECP is located along the eastern edge of the Cascade Mountains in Washington, spanning the entire state from Canada south to the Columbia River and the border with Oregon. The range of the spotted owl within the WECP has a mixture of federal, state, tribal, and private ownership. The Forest Service, Yakama Indian Nation, and State of Washington are owners and managers of most of the spotted owl suitable habitat and known activity centers within the province. The province is generally characterized by high topographic relief compared to other provinces, especially the extensively glaciated northern portion. The province is dominated by mixed-conifer and ponderosa pine forests in the low- to mid-elevation areas, and true fir/hemlock forests at higher elevations.

The Service's current recovery strategy includes two primary components; (1) maintain large clusters of spotted owl pairs, with smaller clusters supporting these large clusters, and (2) maintain dispersal habitat between clusters by limiting the distance between clusters and providing "stepping stones" and corridors of suitable habitat linking larger habitat blocks (Thomas et al. 1990, USDI 1990a, FEMAT 1993). These strategic objectives guided the final recovery plan for the spotted owl, revision of spotted owl critical habitat (based on the recovery plan), and the design of the reserve network in the NWFP. In the WECP, four large clusters (i.e., groups of at least 20 pairs) have been identified. Populations of this size have a high probability of being self-sustaining for 100 years, and are expected to produce "extra" owls that can disperse into other smaller reserves where populations are less stable. Other smaller clusters (i.e., numbering less than 20 pair) exist to support these four large clusters. These clusters are located within three large Late-successional Reserves on federal lands managed under the NWFP (Chiwawa, Swauk, and Manastash LSRs) and on Yakama Nation Lands.

The designation of critical habitat in the province was designed to provide for intra-provincial connectivity and inter-provincial connectivity with Washington Western Cascades to the west, the Yakama Indian Nation to the south, and Canadian populations of spotted owls to the north (Tehan 1991). Within the province, the three largest CHU's were anticipated to support three large clusters of spotted owls on federal lands described above. Smaller units had other roles such as supporting smaller clusters of owls, acting as "stepping stones" to support dispersal, or providing roosting/foraging opportunities.

Effects to spotted owl habitat in the province result primarily from natural disturbance and forest management projects. The primary agents of natural disturbance in forested areas of the province are fires, insect outbreaks, and tree diseases. Preliminary data suggest that over 36,000 acres of suitable habitat for the spotted owl have been removed due to wildfire since 1994 (Appendix A). During the same period, about 15,448 acres have been removed or downgraded due to management actions (through May 2010; USFWS effects tracking data). Information about effects to spotted owl habitat from insect and disease is limited. The risk of these disturbances has recently been assessed by the OWNF in their forest health assessment (USDA 2004). In general, insect and disease disturbances exist across the OWNF. Some loss of suitable habitat and the PCEs of designated critical habitat are occurring on the Naches, Wenatchee River, and Methow Valley Ranger Districts. Patchy mortality is a natural process and can increase stand heterogeneity, which may benefit the spotted owl in some cases by producing the snags and large woody debris required by prey species (see Lehmkuhl et al. 2006a and b).

Regarding effects to critical habitat, the Services best estimate is that about 12,000 acres of critical habitat, or 3.8 percent of the provincial baseline, were removed or downgraded from 1994 to September 2008. The majority of effects were concentrated in the northern half of the province and resulted primarily from the Tyee, Needles, North 25 Mile, and Maple fires. The largest of these fires, the Tyee, removed or downgraded approximately 3,600 acres of suitable habitat. The Maple Fire removed or downgraded an additional 300 acres of suitable habitat. The Needles and North 25 Mile Fires removed or downgraded approximately 2,974 acres of suitable habitat from two different units (see Appendix A). Collectively, the units impacted by these fires are important for the rangewide distribution of the spotted owl, because they are located on the eastern and northeastern edge of the species range (Tehan 1991). Although some units in the original critical habitat network sustained substantive effects, the Service believed the province-wide network continued to fulfill the conservation functions for which it was designated.

These estimates of natural disturbance effects represent the best available information, but they remain preliminary. These estimates cannot be finalized and entered into the Service's rangewide effects-tracking database until they have been reviewed and agreed upon by the NWFP Level 1 team. Many factors, especially lack of comprehensive surveys of spotted owl presence across the province, also complicate estimation of the effects of wildfire and fire suppression activities on spotted owls. The summary provided in Appendix A gives our best estimates for effects to spotted owls and their habitat in the vicinity of known activity centers detected using protocol surveys.

Since 1994, authorized removal of suitable habitat from NWFP reserves in the WECP was less than 1 percent of the starting habitat total. Wildfires, especially during the summer of 1994, removed large areas of habitat from a subset of reserves, including the Chiwawa. Up to 20 known spotted owl activity centers may have been removed due to fire and fire-suppression effects since 1994. Despite these losses, the large-cluster LSRs continue to have relatively high proportions of suitable habitat, particularly in the Manastash, which has 65 percent of its area in suitable habitat (USDA 1997).
Given the relatively modest scale of disturbance and management effects to spotted owl habitat, it is surprising that from1996 through 2006, the number of spotted owls in the four large clusters declined between 32 and 62 percent, and only 1 cluster currently has more than 20 pairs. All

four demography study areas in Washington (Wenatchee [WEN], Cle Elum [CLE], Rainier [RAI], and Olympic [OLY]) and the Warm Springs Reservation study site in the northeast Oregon Cascades, are all locations where precipitous declines in spotted owl populations have been observed (4.4 to 10.4 percent per year). Spotted owl population trends in the WECP are declining at about 6.2 percent annually (Anthony et al. 2006). Consequently, formerly large clusters in the province may no longer be fulfilling their expected roles of ensuring long-term persistence of spotted owls and providing recruits to other areas.

Connectivity among clusters may still be adequate, based on the distribution of habitat. Although suitable spotted owl habitat in the Matrix has been reduced by over 10 percent, again primarily due to wildfire effects, the distribution of suitable and dispersal habitat across all land allocations does not exceed typical dispersal distances and does not contain conspicuous gaps. The concentration of spotted owl habitat removal in fire areas suggests reduced local connectivity, but dispersal opportunities remain either through unburned patches of habitat or outside fire perimeters.

One reason spotted owl demographic performance in the WECP may not be matching expectations based on habitat condition is the presence of barred owls. Barred owls first arrived in the WECP over 25 years ago. Barred owls are potential competitors with spotted owls for prey and nest sites. The barred owl has rapidly expanded its distribution within the range of the spotted owl and negative inter-specific interactions with the spotted owl have been documented (reviewed in Courtney et al. 2004). However, competitive interactions between barred and spotted owls are not well studied (Courtney et al. 2004). Most published studies about barred owls in the Pacific Northwest have been ancillary to studies being conducted on spotted owls. This has led to a great deal of uncertainty about the barred owl's pattern of range expansion, its interaction and the consequences of those interactions with spotted owls, and the contribution of barred owls to the decline of spotted owls both in terms of direct effects (e.g., competition, predation, social harassment, hybridization) or interactions among barred owl effects and the effects of other factors (e.g., ongoing habitat loss, lag effects associated with previous habitat loss, or weather).

Preliminary results from one study of barred owl habitat selection and use in the WECP have provided insights into some aspects of the interspecific interaction. Along a moisture gradient extending from mesic to dry forests, barred owls prefer the more mesic end of the gradient, and in more mesic forests have established adjoining territories that nearly saturate suitable spotted owl habitat (Peter Singleton, USFS, pers. comm. 2008). Barred owl territories are only about 200 to 300 ha in size, roughly one-tenth the size of spotted owl territories in the WECP, and barred owls appear to defend these territories vigorously (Singleton, pers. comm. 2008). Barred owls appear to prefer flat or gentle slopes (broad valley bottoms) with mature, closed canopy forests that include a deciduous component. Toward the drier end of the moisture gradient, barred owls appear to prefer the moistest inclusions within a matrix of dry forest types. Existing and historic spotted owl sites in this study area were associated with closed canopy, mature ponderosa pine or Douglas fir forest on steeper slopes at mid-slope locations (Singleton, pers. comm. 2008). Though these results are preliminary, they suggest that barred owl competition with spotted owls may be more intense in more mesic forests, and that some opportunities for niche partitioning may be present in drier forest types.

Experimental studies that will clarify the nature of competitive interactions between these species are currently underway or are being designed. Results of these experiments should help to predict the likely consequences of interactions between these species. Pending the outcome of these studies, the best available science indicates the presence of barred owls has a negative effect on spotted owl numbers, distribution, and reproduction in the WECP, but the magnitude of this negative effect is unknown.

North Cascades National Park Complex (i.e., including the North Cascades National Park, Lake Chelan National Recreation Area, and the Ross Lake National Recreation Area), spans both the Washington Western Cascades Province and the WECP. The Park includes most of the area that was originally designated as a mapped category 2 Habitat Conservation Area (HCA), designed to support less than 20 spotted owl pairs (Thomas et al. 1990). This HCA (W-34) has a total area of 101,000 acres of potential habitat and was expected to have the capacity to support 11 pairs of spotted owls in the future (Thomas et al. 1990). Within the WECP, Thomas et al. (1990) estimated that about 900 acres of suitable spotted owl habitat may develop in the North Cascades National Park as forests mature after logging that occurred from the 1930s to 1960s. However, recent vegetation analyses by National Park staff indicate that the estimated total area of spotted owl suitable habitat in the WECP is much larger, about 28,295 acres (Kuntz and Christophersen 1996). The management objectives for National Parks emphasize maintenance of ecological processes, and therefore are generally considered compatible with maintaining spotted owl populations (Thomas et al. 1990). Fire, as an ecological process, may reduce the future amount of suitable habitat for spotted owls in localized patches of the North Cascades National Park, but the overall amount of suitable habitat in the Park is generally expected to increase as second-growth forests mature. Surveys conducted from 1993 to 1996 identified 11 spotted owl activity centers in the North Cascades National Park Complex, 4 of which were detected in the WECP. However, the spotted owl population in the Park is thought to be declining, perhaps due to competition with more abundant barred owls; 42 barred owl activity centers have been detected in the Park (Kuntz and Christophersen 1996). More recent survey information on National Park Service lands in the WECP are limited. Given the 35 to 62% decline of spotted owls on the OWNF between 1996 and 2006, very few owls may currently exist in the North Cascades National Park Complex.

Overall, the Service is concerned about the long-term persistence of spotted owls within the WECP. Continuing population declines suggest the combined effects of historic and ongoing habitat removal due to human activities, habitat removal by wildfire and other natural disturbances, changes in habitat suitability due to fire suppression (e.g., Irwin et al. 2004), and interactions with barred owls are reducing survival and reproduction, and may be contributing to range contraction in the province. The final recovery plan proposes a new conservation strategy for the province based on managing the entire landscape to meet spotted owl conservation objectives. This strategy acknowledges that in fire-prone landscapes, spotted owl habitat is likely to be spatially dynamic, and recommends a three-part landscape management strategy: (1) identify existing high-quality spotted owl habitat, (2) strategically place fuel-reduction treatments, and (3) manage for sustainable ecosystem processes and functions (USDI 2008b). Most of the important decisions about how to implement this strategy remain to be made. During the transition period, the Service believes all remaining spotted owls within the WECP

are vital to the conservation of the species until populations stabilize and recover to abundance levels with a higher likelihood of long-term persistence.

3.3 Environmental Baseline at the Watershed Scale

We consider this scale to be roughly equivalent to the population of spotted owls likely to be affected by the proposed Project.

The spotted owl is an uncommon resident in the North Cascades. Approximately 60 percent of the suitable spotted owl habitat in the Park has been surveyed for spotted owls. Past efforts to assess the status of spotted owls within the Park began in the early 1980's when random calling surveys were initiated by the Washington Department of Fish and Wildlife. Only a few of the random survey transects actually entered Park boundaries and no spotted owls were detected in the Park from these surveys (Kuntz and Christophersen 1996). In 1987, Park biologists conducted a calling survey in the Ross Lake basin and found no spotted owls (Kuntz and Christophersen 1996). Other surveys conducted by Park biologists were done in conjunction with environmental assessments of Park operations (USDI 1989). No spotted owls were detected from these surveys. Biologists from the National Council of the Paper Industry for Air and Stream Improvement, Incorporated (NCASI), helped complete reconnaissance-level surveys in the Stehekin Valley while conducting spotted owl investigations on USFS lands adjacent to the Park and discovered 2 nest sites. Since the mid-1980's, park biologists and NCASI have visited these nest sites found in the Stehekin Valley to monitor productivity and survivorship. NCASI banded adults and juveniles at these nest sites and on adjacent USFS lands (Kuntz and Christophersen 1996).

The most recent analysis of the population of spotted owls in the Park was completed by Kuntz and Christophersen (1996). They identified 11 spotted owl activity centers during 1993-1996. Approximately 60 percent of the suitable spotted owl habitat identified in the Park was surveyed during this period. They documented pair occupancy at six of these sites, and single spotted owls at five other sites. Half of the documented pairs are located in the Stehekin Valley (Kuntz and Christophersen 1996). Activity sites range in elevation from 1,040 feet to 2,880 feet. Occupancy at sites with pairs ranged from was 0.33-0.75 (mean = 0.52). Mean annual fecundity was 0.30 female young per paired adult female. During the same 4 years, they identified 42 barred owl sites, 18 of which were pairs and 24 of which were singles. They reported "[i]t appears spotted owl populations in the North Cascades are continuing to decline. Competition with barred owls for suitable habitat may be influencing the spotted owl's distribution and abundance" [in the North Cascades National Park] (Kuntz and Christophersen 1996; pg. 4). Since 1996, one additional spotted owl activity site containing a breeding pair was documented in the Park (USDI 2005).

Throughout the 4 year study, spotted owl activity sites found during current and previous inventory field seasons were monitored to determine owl occupancy and productivity. These data provided information on nest site fidelity, pair fidelity, and survival rates. As many activity sites as possible were sampled each year. However, when all activity sites could not be visited in a given year, sites where pair activity had been identified in previous years were given priority. An average of 8.5 activity sites were monitored each year. Three of six spotted owl pairs

successfully fledged at least 1 young during the 4-year period. A total of 7 young fledged during the 4-year period. Young fledged in all years except 1995. Mean annual productivity equaled 1.25 young per successful pair (Kuntz and Christophersen 1996).

3.4 Environmental Baseline at the Action Area Scale

In this sub-section, we focus on the specific spotted owl activity centers that may be affected by the Project. One active site, known as the McGregor Meadow site, is within the project area. Located approximately 500 feet from the Stehekin Valley Road on the south side of the Stehekin Valley, this site was discovered in July 1998 during a cavity nesting bird survey. Later, this discovery was confirmed when an adult pair and three juveniles were observed. Three birds were banded in August 1998. Table 4 provides a status summary for this site.

Table 4. Status summary for the McGregor Meadow Spotted Owl Activity Site.

Year	Occupancy	Reproduction
1998	Pair	2 young
1999	Pair	Unknown
2000	Single	Unknown
2001	Unknown	Unknown
2002	Unknown	Unknown
2003	No Survey	No Survey
2004	Single	Unknown
2005	Pair	2 young
2006	Pair	1 young
2007	Pair	Failed
2008	Unoccupied*	n/a
2009	Unoccupied*	n/a

****Note:*** In 2008 and 2009, no northern spotted owls were detected, however, a pair of barred owls was found.

In 2010, a single resident male was discovered at the McGregor activity center during survey efforts (R. Kuntz, pers. comm. 2010). Although protocol surveys are not complete for 2010, information gathered since the BA was completed suggests no reproduction is likely to occur.

3.5 Factors Affecting the Species Environment in the Action Area

This section describes all federal, state, tribal, local, and private actions already affecting the species that will occur contemporaneously with the proposed action.

3.5.1 Consulted-Upon Effects

The 1995 NPS Forest Fuel Reduction/Firewood Management Plan called for thinning sections of the forest in the Stehekin Valley through manual thinning and prescribed burns. In 1995 it was estimated that 2,500 acres of suitable habitat were available for owls from Lower Field down the valley to Lake Chelan (see USFWS Biological Opinion, August 23, 1995). NPS actions in the lower valley, as defined in the Forest Fuel Reduction Plan, will reduce the suitable habitat by 299 acres. No other projects affecting owls have occurred in the action area.

3.5.2 Presence and Effect of Barred Owls

During surveys in 2008 and 2009, no northern spotted owls were detected at the McGregor Meadows Spotted Owl Activity Site, although a pair of barred owls was found. However, a resident male was discovered at the McGregor activity center during surveys in 2010. Courtney *et al.* (2004) reported that the competitive interaction between barred owls and spotted owls is unclear and that relatively little data has been specifically collected regarding this issue. The opinion of the scientific panel convened for the 5-year review for the spotted owl was divided; while all panelists thought this was a major threat, some felt that the scientific case for the effects of barred owls remained inconclusive and others were more certain.

Because the information on detections of barred owls has been collected incidental to spotted owl surveys, the data are neither consistently collected nor consistently reported, and are usually reported in the literature either as a ratio of barred owls to spotted owls or as numbers of barred owls detected over time. Consequently, there is a great deal of uncertainty about the barred owl's pattern of range expansion, its interaction and the consequences of those interactions with spotted owls, and the contribution of barred owls to the decline of spotted owls both in terms of direct effects (e.g., competition, predation, social harassment, hybridization) or indirect contributing effects (e.g., additional pressure on spotted owls in combination with habitat loss and/or lag effects associated with previous habitat loss; weather; or other factors). However, it is apparent that barred owls have greatly and rapidly expanded their distribution within the range of the spotted owl and that they have demonstrated negative inter-specific interactions with the spotted owl (Courtney *et al.* 2004).

Given this uncertainty, Courtney *et al.* (2004) proposed nine hypotheses regarding the potential consequences of the barred owl invading the range of the spotted owl. They range from complete replacement of the spotted owl by barred owls across their range to varying degrees of range, habitat, or niche partitioning. Although these hypotheses were categorized as "clearly plausible," "plausible," or "not plausible or not clear," no management recommendations were provided.

3.5.3 Summary

The Service concludes that only recent, minor consulted-upon effects and natural disturbances have occurred in or near the action area. At the watershed and WECP scales, moderate degrees of effect have occurred. While historic timber harvest has occurred across the entire WECP, habitat removal from wildland fire in the central and northern sub-provinces has been extensive. Habitat degradation from insect and disease mortality appears to be increasing across the WECP, and "outbreak" levels exist most notably in the northern and southern sub-provinces. Spotted owl populations in the northern part of their range are in precipitous decline, and non-habitat factors may be significant. The barred owl may be a greater threat than previously thought, but the potential effects are poorly understood and may be confounded by lag effects of habitat removal and other factors. Due to the documented decline in spotted owl populations and the uncertainty in identifying the effects of the proximate cause, a conservative approach is taken in analyzing the proposed action.

4.0 EFFECTS OF THE ACTION

The Service regulations for implementing the Act define "effects of the action" as "the direct and indirect effects of an action on the species together with the effects of other activities that are interrelated or interdependent with that action, that will be added to the environmental baseline" (50 C.F.R. §402.02). "Indirect effects" are those that are caused by the proposed action and are later in time, but are still reasonably certain to occur. Any adverse effect requires the Service to conduct a jeopardy/adverse modification analysis (Section 7[a][2] of the Act).

4.1 Factors to be Considered

The Service evaluates the degree of effect resulting from the proposed action by considering the proximity, distribution, timing, type, duration, frequency, intensity, and severity of the action (USDI and USDC 1998; pages 4-23, 24). The standard to be analyzed is whether the proposed action will "jeopardize the continued existence" of the spotted owl. "Jeopardy" is defined as an appreciable reduction in the likelihood of survival and recovery by reducing its reproduction, numbers, or distribution (USDI and USDC 1998; page xvi).

4.2 Analyses for Effects of the Action

The Service has identified all Project elements as having the potential to affect suitable and dispersal habitat. These effects are anticipated to occur primarily through the construction of a new roadway 12-14 feet wide and 1.89 miles long. Nearly all of the new disturbance from the roadway (13.3 acres) would be outside of the CMZ and would therefore be protected from flooding. There would be approximately 24.5 acres of overall disturbance within the McGregor activity center, including 12.8 acres of habitat removal from constructing the new road alignment. Short-term impacts associated with construction include noise and human presence within the new road prism and staging areas for equipment.

4.2.1 Direct and Indirect Effects

The proposed reroute project is within the activity area of a pair of northern spotted owls that have periodically nested since first detected in 1998. Although this nest site was found to be occupied by barred owls during the 2008 and 2009 nesting seasons, it is possible that northern spotted owls, which have occupied this site for 10 years, producing at least five young, could return at some future time. In 2010, a resident male was detected at this nest site during survey efforts, which may suggest a step toward re-occupancy.

The U.S. Fish and Wildlife Service estimates that spotted owls require an average of 6,657 acres of suitable habitat per nesting pair (USDI 2005). Suitable habitat surrounding the 2006 nest site (based on a 1.82 mile radius buffer) is comprised of only 978 acres, approximately 15% of the amount required at nest sites in Washington (NPS data). Within the core area of the nest site (0.7 mile radius buffer), only 176 acres of suitable habitat exist. This amounts to only 17.8% of the buffered area. As a result of the removal of 12.8 acres of habitat, the proposed action would adversely affect northern spotted owls.

As described in the Status of the Species (section 2.0), effects of habitat modification can disrupt normal behavior patterns including feeding, breeding, and sheltering. Potential effects include (1) reductions in canopy closure that can increase susceptibility to predators and competitors ill-suited for movements within a closed canopy; and (2) reductions in stand complexity (e.g., density and/or multi-layered canopy), snags, and coarse woody debris that can influence prey populations.

Disturbance effects can cause an adverse affect if they disrupt normal behavior patterns and/or create a likelihood of injury. However, disturbance effects can be managed through the application of seasonal timing restrictions to minimize effects during critical periods (e.g., the nesting season). The proposed action will implement seasonal restrictions to minimize effects during the nesting season for the spotted owl (March 1 through September 6), so disturbance is anticipated to be discountable.

4.2.2 Interrelated and Interdependent Actions

"Interrelated and Interdependent Actions" are defined in the Service's consultation handbook (USDI and USDC 1998; page xv). In brief, they are actions that would not occur but for the proposed Project and are a connected action and effect.

Interrelated and interdependent actions are not anticipated. The Service is unaware of other efforts in and around the action area that would affect spotted owls.

4.3 Species Response to the Proposed Action

Habitat removal and alteration resulting from Project implementation will reduce nesting, roosting, foraging, and dispersal opportunities and change their distribution in the action area. While this resident male may be locally displaced, habitat-based impacts of this small scale to non-breeding spotted owls generally do not result in take. Direct "harm" or "harassment" (e.g., capture, injury, mortality) is also not anticipated to result from Project activities. Like habitat removal and alteration, disturbance can modify the normal behavior of the spotted owls and displace them from areas they normally use for nesting, roosting, foraging, and dispersal. However, design criteria/conservation measures will reduce the likelihood of disturbance to discountable levels. The combined effect of habitat and disturbance may be additive.

Changes in the distribution and abundance of suitable and dispersal habitat will occur over the life of the project (2011-2012). As the Project is implemented, the spotted owl is anticipated to respond to the changes in habitat conditions and disturbance, likely through a modification of its normal behavioral activities and patterns. This may include changing dispersal routes, foraging locations, behavior, and timing; and may result in increased contact with and exposure to predators and competitors such as the northern goshawk, great-horned owl, and barred owl. Whatever habitat or niche portioning may have been present before Project implementation may be altered if spotted owls modify their behavior in response to the proposed action. This may subject spotted owls to increased risk of predation, competition, and harassment by these other species during Project implementation. The extent of increased susceptibility to predation and competition is speculative, although northern goshawk, great-horned owl, and barred owls are

known to occur within the action area. While it is reasonable to assume that this potential effect exists, the Service has no predictive ability to quantify this further.

4.4 Summary

The Project will result in adverse effects to northern spotted owls due to the removal of suitable habitat for the spotted owl. There would be approximately 24.5 acres of overall disturbance and habitat removal within the McGregor activity center, but impacts are relatively small in scale and disturbance would be restricted to the period of construction. Nonetheless, removal of suitable habitat may influence future habitat use and dispersal behaviors. Disturbance effects are anticipated to be discountable, due in part to seasonal timing restrictions.

5.0 CUMULATIVE EFFECTS

Cumulative effects include the effects of future State, tribal, local, or private actions that are reasonably certain to occur in the action area considered in this BO. 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 Act. All future permitted actions (e.g., through a USFS special use permit) would require consultation following the implementing regulations of Section 7 of the Act.

Climate change, and the related warming of global climate, has been well documented in the scientific literature. The abundance and distribution of species, including the spotted owl, are dynamic relative to a variety of factors including climate. As climate changes, the abundance and distribution of species are expected to change. Many of the current future climate predictions for the Pacific Northwest suggest the spotted owl and its habitat will be affected by climate change through several pathways, including but not limited to changes in fire regime; patterns of rain and snowfall; wildlife diseases; and abundance and distribution of native and nonnative species of fish, wildlife, and plants.

6.0 CONCLUSION

The Service has reviewed the status of the species for the spotted owl, the environmental baseline, the effects of the proposed action, and the cumulative effects. Based on this review, it is the Service's biological opinion that these actions are not likely to jeopardize the continued existence of the spotted owl. The basis for these conclusions are summarized as follows:

1. The change in the rangewide status of the spotted owl due to consulted-upon effects is within expectations of the overall conservation strategy. Approximately 96 percent of effects have occurred outside of LSR and other NWFP reserve allocations (Table 2), and only about 1.5 percent of the amount of extant critical habitat has been consulted-upon for removal or downgrading since the 1994 FSEIS baseline (Table 3) was established.

2. Natural events (e.g., wildland fire, insect and disease disturbances) have impacted some spotted owl suitable habitat and individual CHU's, but rangewide the conservation framework (LSR/MLSA and CHU networks) continues to function as designated.

3. Consulted-upon effects in the Washington Eastern Cascades physiographic province have been minor, but wildland fires since 1994 have been extensive. Although the provincial CHU and LSR/MLSA networks have been degraded, primarily by wildland fire, they remain intact although the resiliency of some areas has been reduced.

4. The proposed action will result in relatively minor amounts of habitat effects. Because protocol surveys indicate the action area is not currently used by reproductive owls, and no direct "harm" or "harassment" (e.g., capture, injury, mortality) is anticipated, incidental take will not occur. Project implementation and the proposed action will not impact the overall conservation needs of the species.

5. The proposed action will likely modify the normal behavioral patterns of the spotted owl, and may increase their susceptibility to predation and competition. The severity of these effects is speculative and currently cannot be quantified. Seasonal timing restrictions will minimize the proximity, distribution, timing, type, duration, frequency, intensity, and severity of this effect.

Based on the analysis presented in this BO, Project effects are minor in terms of habitat impacts and disturbance is anticipated to be discountable. Since effects at the Project scale appear to be minor, effects at the province or rangewide scales may not be measurable. As a result, the Service does not anticipate that the proposed action will jeopardize the continued existence of the spotted owl.

7.0 REASONABLE AND PRUDENT ALTERNATIVES

Regulations implementing Section 7 of the Act (50 C.F.R. §402.02 *et seq.*) define reasonable and prudent alternatives as alternative actions, identified during formal consultation, that: (1) can be implemented in a manner consistent with the intended purpose of the action; (2) can be implemented consistent with the scope of the action agency's legal authority and jurisdiction; (3) are economically and technologically feasible; and (4) would, the Service believes, avoid the likelihood of jeopardizing the continued existence of listed species or resulting in the destruction or adverse modification of critical habitat.

Because the proposed action is not likely to jeopardize the continued existence of the spotted owl, no reasonable and prudent alternatives are required.

INCIDENTAL TAKE STATEMENT

Section 9 of the Act, and Federal regulations pursuant to Section 4(d) of the Act, prohibit the take of endangered and threatened species, respectively without special exemption. Take is defined as harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. Harm is further defined by the Service to include significant habitat modification or degradation that results in death or injury to listed species by significantly impairing behavioral patterns, including breeding, feeding, or sheltering. Harass is defined by the Service as intentional or negligent actions or omissions that create the likelihood of injury to listed species by annoying it to such an extent as to significantly disrupt normal behavior patterns which include, but are not limited to, breeding, feeding or sheltering. Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Under the terms of Section 7(b)(4) and Section 7(o)(2), taking that is incidental to and not intended as part of the agency action is not considered to be prohibited taking under the Act provided that such taking is in compliance with this Incidental Take Statement.

The measures described below are non-discretionary, and must be undertaken by the USFS so that they become binding conditions of any grant or permit issued to the applicant, as appropriate, for the exemption in section 7(o)(2) to apply. The USFS has a continuing duty to regulate the activity covered by this incidental take statement. If the USFS fails to assume and implement the terms and conditions of the incidental take statement through enforceable terms that are added to the permit or grant document, the protective coverage of section 7(o)(2) may lapse. In order to monitor the impact of incidental take, the USFS must report the progress of the action and its impact on the species to the Service as specified in this Incidental Take Statement [(50 C.F.R. §402.14(i)(3)].

AMOUNT OR EXTENT OF TAKE

As described in the BO, the Service does not anticipate incidental take will occur, so an exemption for incidental take is not required. As a result, no reasonable and prudent measures or terms and conditions are appropriate.

REPORTING REQUIREMENTS

In order to monitor the impacts of implementation of the reasonable and prudent measure, the NPS shall prepare a report describing the progress of the proposed Project, including implementation of the associated terms and conditions and impacts to the spotted owl (50 CFR §402.14[I][3]). The report, which shall be submitted to the Central Washington Field Office on or before February 1 of each year, shall list and describe:

1. Annual survey results and reproductive status of affected spotted owls;
2. Any observed adverse effects resulting from Project activities, including type, location, and frequency of the event, especially any interaction between spotted owls and their predators and competitors;

3. The details regarding any newly discovered nesting or territorial spotted owl nest sites or activity centers.

Upon locating a dead, injured, or sick endangered or threatened species specimen, prompt notification must be made to the nearest Service Law Enforcement Office (Special Agent Corky Roberts, Richland, Washington; telephone 509.546.8344) and the Central Washington Field Office (Wenatchee, Washington; telephone 509.665.3508). Care should be taken in handling sick or injured specimens to ensure effective treatment and care or the handling of dead specimens to preserve biological material in the best possible state for later analysis of cause of death. In conjunction with the care of sick or injured endangered species or preservation of biological materials from a dead animal, the finder has the responsibility to carry out instructions provided by Law Enforcement to ensure that evidence intrinsic to the specimen is not unnecessarily disturbed.

REINITIATION-CLOSING STATEMENT

This concludes formal consultation pursuant to the regulations implementing the Act, 50 C.F.R. §402.16. Reinitiation of formal consultation is required where discretionary Federal agency involvement or control over the action has been retained (or is authorized by law) and if: (1) the amount or extent of incidental take is exceeded; (2) new information reveals effects of the agency action that may affect listed species or critical habitat in a manner or to an extent not considered in this BO; (3) the agency action is subsequently modified in a manner that causes an effect to the listed species or critical habitat that was not considered in this BO; or (4) a new species is listed or critical habitat designated that may be affected by the action. If spotted owls are incidentally taken, any operations causing such take must cease pending reinitiation.

LITERATURE CITED

Andersen, D.E. O.J. Rongstad and W.R. Mytton. 1989. Response of nesting red-tailed hawks to helicopter overflights. Condor 91(2):296-299.

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. USDI Fish and Wildlife Service, Portland, Oregon.

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. 29 pages.

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. 2004a. Status and trends in demography of 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, L. 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 spotted owls, 1985-2003. Wildlife Monographs 163:1-48.

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

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.

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.

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 spotted owls. Conservation Biology 9 (4):943-946.

Bart, J., and E.D. Forsman. 1992. Dependence of 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.

Blakesley, J.A., W. LaHaye, J.M.M. Marzluff, B.R. Noon, and S. Courtney. 2004. Scientific evaluation of the status of the northern spotted owl – demography. Chapter 8 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.

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.B. 2004. Managing habitat for dispersing northern spotted owls - are the current management strategies adequate? Wildlife Society Bulletin 32:1333–1345.

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., 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.

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.

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.

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. and K.C. Peeler. 1995. Spotted owls: resource and space use in mosaic landscapes. Journal of Raptor Research 29(4):223-239.

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.

Carey, A.B., S.P. Horton, and B.L. Biswell. 1992. Northern Spotted Owls: Influence of Prey Base and Landscape Character. Ecological Monographs: Vol. 62, No. 2, pp. 223-250.

Carsia. R.V.. and Harvey. S. 2000. Adrenals. In: Sturkie's Avian Physiology. 5th edition. Whittow. G.C.. ed.. Chap. 19. pp. 489-587. Academic Press.

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.B. Buchanan, D. Cunnington, A. Harestad, L. Kiss, L. Waterhouse, and L. Williams. 2004. National recovery strategy for the Spotted owl. Recovery of Nationally Endangered Wildlife Committee, Ottawa, Ontario, Canada.

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, L. Sztukowski. 2004. Scientific evaluation of the status of the spotted owl. Sustainable Ecosystems Institute. Portland, Oregon. September 2004.

Delaney, D. K., T.G. Grubb, P. Beier, L.L. Pater and M.H. Reiser. 1999. Effects of helicopter noise on Mexican spotted owls. J. Wildl. Manage. 63(1):60-76.

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 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.

FEMAT (Forest Ecosystem Management Assessment Team). 1993. Forest ecosystem management: An ecological, economic, and social assessment. Portland, Oregon. U.S. Forest Service, and 5 cooperating agencies.

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

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., Meslow, E.C., and H.M. Wight. 1984. Distribution and biology of the spotted owl in Oregon. Wildlife Monographs 87:1-64.

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.

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., Anthony, R. G., Reid, J. A., Loschl, P. J., Sovern, S. G., Taylor, M., Biswell, B. L., Ellingson, A., Meslow, E. C., Miller, G. S., Swindle, K. A., Thrailkill, J. A., Wagner, F. F., and D. E. Seaman. 2002. Natal and breeding dispersal of 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 spotted owls in Oregon. Journal of Raptor Research 38(3):214-230.

Forsman, E.D., T.J. Kaminski, J.C. Lewis, K.J. Maurice, S.G. Sovern, C. Ferland, and E.M. Glenn. 2005. Home range and habitat use of northern spotted owls on the Olympic Peninsula, Washington. Journal of Raptor Research 39(4):365-377.

Franklin, A.B. 1992. Population regulation in 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., K.P. Burnham, G.C. White, R.J. Anthony, E.D. Forsman, C. Sanchez, J.D. Nicols and J. Hines. 1999. Rangewide status and trends in spotted owl populations. Colorado Coop. Fish and Wildl. Res. Unit, Fort Collins, Colorado and Oregon Coop. Fish and Wildl. Res. Unit, Corvallis, OR. Unpublished report.

Franklin, A.B., Anderson, D.R., Gutiérrez, R.J., and K.P. Burnham. 2000. Climate, habitat quality, and fitness in spotted owl populations in northwestern California. Ecological Monographs, 70(4): 539-590.

Gaines, W.L., R.A. Strand, and S.D. Piper. 1997. Effects of the Hatchery Complex Fires on 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.

Gancz, A., I.K. Barker, R. Lindsay, A. Dibernardo, K. McKeever, and B. Hunter. 2004. West Nile Virus outbreak in North American owls, Ontario, 2002. Emerging Infectious Diseases 10:2135-2142.

Garmendia, A.E., Van Kruiningen, H.J., French, R.A., Anderson, J.F., Andreadis, T.G., Kumar, A. 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.

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 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.

Gutiérrez, R. J., A. B. Franklin, and W. S. LaHaye. 1995. Spotted owl (*Strix occidentalis*) *in*: A. Poole and F. Gill, editors. The birds of North America, No. 179. The Academy of Natural Sciences and The American Ornithologists' Union, Washington, D.C. 28 pp.

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.

Haig, S.M., Wagner, R.S., Forsman, E.D., 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: legal implications of hybrid identity. Conservation Biology 18:1347-1357.

Hamer, T.E., S.G. Seim, and K.R. Dixon. 1989. Spotted owl and northern barred owl habitat use and home range size in Washington: preliminary report. Washington Department of Wildlife, Olympia, Washington.

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 spotted owls in an area of sympatry. Journal of Raptor Research 35(3):221-227.

Hanson, E., Hays, D., Hicks, L. Young. L., 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 Spotted owl in British Columbia. Pages. 12-14 *in* Zimmerman, K., K. Welstead, E. Williams, J. Turner, (editors). 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 spotted owls in the non-breeding season in central Washington. Forest Science 48(2):437-446.

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 spotted owls in managed forests. J. Raptor Res. 34(3):175-186.

Irwin, L. I., T. L. Fleming, and J. Beebe. 2004. Are spotted owl populations sustainable in fire-prone forests? Journal of Sustainable Forestry 18(4):1-28

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, Oregon.

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., E.D. Forsman, and R.G. Anthony. 2003. Are barred owls replacing spotted owls? Condor 105:45-53.

Kelly, E.G. and E.D. Forsman. 2004. Recent records of hybridization between barred owls (*Strix varia*) and spotted owls (*S. occidentalis caurina*). Auk 121:806-810.

King, G.M., K.R. Bevis, M.A. Rowe, E.E. Hanson. 1998. Spotted owls use of habitat impacted by 1994 fires on the Yakama Indian Reservation: three years post fire. Unpub. report.

Knight, R.L. and S.K. Skagen. 1988. Effects of recreational disturbance on birds of prey: a review. In Proceedings of the Southwest Rap/tor Management Symposium and Workshop, eds., L. Glinski, et al., 355-359. Washington, D.C.: National Wildlife Federation.

Kuntz, R. C. II and R. G. Christophersen. 1996. A survey of Northern Spotted Owls in North Cascades National Park Service Complex. Technical Report NPS/CCSONOCA/NRTR-96/05.

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. The 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.

Lehmkuhl, J.F., Kistler, K.D., Begley, J.S., and J. Boulanger. 2006a. Demography of northern flying squirrels informs ecosystem management of western interior forests. Ecological Applications 16(2):584-600.

Lehmkuhl, J.F., Kistler, K.D., Begley, J.S. 2006b. Bushy-tailed woodrat abundance in dry forests of eastern Washington. Journal of Mammalogy 87(2):371-379.

Leskiw, T., and R.J. Gutiérrez. 1998. Possible predation of a Spotted Owl by a Barred Owl. Western Birds 29:225–226.

Lint, J., technical coordinator. 2005. Northwest Forest Plan – the first 10 years (1994-2003): status and trends of spotted owl populations and habitat. PNW-GTR-648, USDA Forest Service, Pacific Northwest Research Station, Portland, Oregon.

Livezey, K.B. 2005. Iverson (2004) on spotted owls and barred owls: comments on methods and conclusions. *Journal of Raptor Research.*

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. Isaacs. 1991. Interactions of humans and Bald Eagles on the Columbia River estuary. Wildlife Monographs 115. 47 pp.

Meyer, J.S., Irwin, L.L., and M.S. Boyce. 1998. Influence of habitat abundance and fragmentation on 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., S.K. Nelson, and W.C. Wright. 1985. Two-year-old female spotted owl breeds successfully. Western Birds 16:69-73.

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.

Moen, C.A., A.B. Franklin, and R.J. Gutiérrez. 1991. Age determination of subadult spotted owls in northwest California. Wildlife Society Bulletin 19:489-493

Moeur, Melinda; Spies, Thomas A.; Hemstrom, Miles; Martin, Jon R.; Alegria, James; Browning, Julie; Cissel, John; Cohen, Warren B.; Demeo, Thomas E.; Healey, Sean; Warbington, Ralph. 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.M. Glenn, R.G. Anthony, E.D. Forsman, J.A. Reid, P.J. Loschl, and W.J. Ripple. 2004. Modeling demographic performance of spotted owls relative to forest habitat in Oregon. Journal of Wildlife Management 68(4):1039-1053.

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 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.

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.

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 R.G. Anthony. 1992. Characteristics of northern flying squirrel populations in young second- and old-growth forests in western Oregon. Can. J. Zool. 70:161-166.

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. 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 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.

Swarthout, E.C.H. and R. J. Steidl. 2001. Flush responses of Mexican spotted owls to recreationists. Journal of Wildlife Management 65(2):312-317.

Tehan, M. 1991. Narratives for the final designation of critical habitat for the spotted owl in Washington. Unpublished report. USDI Fish and Wildlife Service, Portland, Oregon.

Temple, D.J., and R. J Gutiérrez. 2003. Fecal corticosterone levels in California spotted owls exposed to low-intensity chainsaw sound. Wildlife Society Bulletin 31(3):698-702.

Temple, 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., E.D. Forsman, J.B. Lint, E.C. Meslow, B.R. Noon, and J. Verner. 1990. A conservation strategy for the spotted owl. Report of the Interagency Scientific Committee to address the conservation of the spotted owl. Unpublished interagency document. 458 pages.

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., 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.

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.

Thome, D.M., C.J. Zabel, and L.V. Diller. 1999. Forest stand characteristics and reproduction of spotted owls in managed north-coastal California Forests. Journal of Wildlife Management 63:44-59.

USDA (U.S. Department of Agriculture) and USDI (U.S. Department of Interior). 1994a. Record of decision for amendments to Forest Service and Bureau of Land Management planning documents within the range of the spotted owl; standards and guidelines for management of habitat for late-successional and old-growth forest related species within the range of the spotted owl. Forest Service and Bureau of Land Management. Portland, Oregon.

USDA (U.S. Department of Agriculture) and USDI (U.S. Department of Interior). 1994b. Final supplemental environmental impact statement on management of habitat for late-successional and old-growth forest related species within the range of the spotted owl. Forest Service and Bureau of Land Management. Portland, Oregon. 2 vols. and appendices.

USDA (U.S. Department of Agriculture). 1997. Forest-wide assessment for late-successional reserves and managed late-successional areas. Forest Service, Wenatchee National Forest. 174 pp.

USDI (U.S. Department of Interior). 1983a. Endangered and threatened species listing and recovery priority guidelines. Federal Register 48:43098–43105.

USDI (U.S. Department of Interior). 1983b. Endangered and threatened species listing and recovery priority guidelines: correction. Federal Register 48:51985.

USDI (U.S. Department of Interior). 1989. The spotted owl; a status review supplement. Fish and Wildlife Service, Portland, Oregon.

USDI (U.S. Department of Interior). 1990a. Endangered and Threatened Wildlife and Plants; determination of threatened status for the spotted owl. Fish and Wildlife Service. Fed. Reg. Vol. 55. 123: 26114-26194. June 26, 1990.

USDI (U.S. Department of Interior). 1992a. Endangered and Threatened Wildlife and Plants; determination of critical habitat for the spotted owl. Fish and Wildlife Service. Fed. Reg. Vol. 57. 10:1796-1838. January 15, 1992.

USDI (U.S. Department of Interior). 1992b. Draft final recovery plan for the spotted owl. Fish and Wildlife Service. 2 Volumes. Portland, Oregon.

USDI (U.S. Department of Interior). 1994a. Letter from D.C. Frederick (USFWS) to J. Belcher (Washington Department of Natural Resources) dated February 1, 1994, regarding correction to spotted owl home-range data for the Olympic Peninsula. USFWS, Olympia, Washington.

USDI Fish and Wildlife Service. 1995. Endangered and threatened wildlife and plants; proposed special rule for the conservation of the northern spotted owl on non-federal lands. Federal Register 60:9483–9527.

USDI (U.S. Department of the Interior). 2001. A rangewide baseline summary and evaluation of data collected through section 7 consultation for the spotted owl and its critical habitat: 1994-2001. Fish and Wildlife Service. Portland, Oregon. Unpublished document. 41pp.

USDI (U.S. Department of the Interior). 2004. Spotted owl: Five Year Review Summary and Evaluation. Fish and Wildlife Service, Portland, Oregon. 73 pages.

USDI (U.S. Fish and Wildlife Service). 2007. Draft Recovery Plan for the Spotted owl, *Strix occidentalis caurina.* U.S. Fish and Wildlife Service, Portland, Oregon. 170 pp.

USDI (U.S. Department of Interior). 2008a. Endangered and Threatened Wildlife and Plants; revised determination of critical habitat for the spotted owl. Fish and Wildlife Service. Fed. Reg. Vol. 73. 157:47326-47374. August 13, 2008.

USDI (U.S. Fish and Wildlife Service). 2008b. Final recovery plan for the northern spotted owl, Strix occidentalis caurina. U.S. Fish and Wildlife Service, Portland, Oregon. xii + 142 pp.

USDI (National Park Service). 2009. Biological Assessment: Stehekin River Corridor Implementation Plan. Unpublished report. North Cascades National Park.

USDI (U.S. Department of Interior) and USDC (U.S. Department of Commerce). 1998. Consultation Handbook: Procedures for Conducting Consultation and Conference Activities under Section 7 of the Endangered Species Act. Fish and Wildlife Service and National Marine Fisheries Service.

Wagner, F.F., E.C. Meslow, G.M. Bennett, C.J. Larson, S.M. Small, and S. DeStefano. 1996. Demography of 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 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, California.

Ward, J. W. Jr., R.J. Gutiérrez, and B.R. Noon. 1998. Habitat selection by 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., P.J. Hodum and J.A. Blakesley. 2001. Thermal ecology and ecological energetics of the California spotted owl. The Condor 103(4):678.

White, C.M. and T.L. Thurow. 1985. Reproduction of ferruginous hawks exposed to controlled disturbance. Condor 87:14-22.

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 spotted owls (*Strix occidentalis caurina*). Canadian Journal of Zoology 73:433-439.

Zabel C.J., S.E. Salmons, and M. Brown. 1996. Demography of 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. Spotted owl habitat models for research and management application in California (USA). Ecological Applications 13(4): 1027-1040.

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APPENDIX A

Summary of Estimated Wildfire Effects on Spotted Owl Habitat in the Washington Eastern Cascades Physiographic Province, 1994 to 2007.

Year	#	Fire	Unit	Total Acres	NRF Rmvd	CHU Rmvd	CHU	AC Rmvd	READ	Comments
1994	1	Tyee/Rat/Rd. Mtn	WNF	186800	9512	6080	6, 9, 11	17	0	jb analysis
1998	2	North 25	Chelan	8845	3500	1260	4	1	0	jb
			TOTAL	**195645**	**13012**	**7340**		**18**	**0**	
2001	3	Icicle Complex	Leav	7850	1569	41	10	0	1	jk
2001	4	Rex Creek	Chelan	56000	1873	0	n/a	0	1	cm
2001	5	South Libby	MVRD	3800	380	0	n/a	0	0	jk: assumed 10% of area is NRF
2001	6	Tommy Creek	Entiat	640	100	30	5	0	0	jk
2001	7	Rattlesnake	Naches	20	2	0	n/a	0	0	jk: assumed 10% of area is NRF
2001	8	Spruce-Dome	Naches	2600	260	130	17	0	0	jk: assumed 10% of area is NRF; about half in CHU
2001	9	Merritt Lake	Lake	20	2	0	n/a	0	0	jk: assumed 10% of area is NRF
2001	10	Dog Creek	Naches	450	45	0	n/a	0	0	jk: assumed 10% of area is NRF
			TOTAL	**71380**	**4231**	**201**		**0**	**2**	
2002	11	Deer Point	Chelan	43000	2098	0	n/a	0	1	cm
2002	12	Power Creek	Leav	10	0	0	n/a	0	0	jk
2002	13	Deer Mountain	Chelan	1500	0	0	n/a	0	0	jk
2002	14	Malcom	Cle Elum	10	2	2	13	0	0	jk: assumed 20% of area is NRF
2002	15	Cat Face	Lake	10	0	0	n/a	0	0	jk
			TOTAL	**44530**	**2100**	**2**		**0**	**1**	
2003	16	Crystal Creek	Leav	1284	195	0	n/a	0	1	jk
2003	17	Square Lake	Leav	1097	607	0	n/a	0	0	jk
2003	18	Farewell	MVRD	81400	1343	0	n/a	0	1	jk: about 1/3 of area is w/in NWFP; assumed 5% of area was NRF
2003	19	Needles	MVRD	21300	6500	2500	2	1	0	cm: much of home range of Driveway Butte STOC burned
2003	20	Maple	Lake	2409	1385	630	6	0	1	cm
			TOTAL	**107490**	**10030**	**3130**		**1**	**3**	

Year	#	Fire	Unit	Total Acres	NRF Rmvd	CHU Rmvd	CHU	AC Rmvd	READ	Comments
2004	21	Pot Peak Complex	Chelan	46000	4600	1150	4	1	1	jk: assumed 10% of area is NRF; about 1/2 of CHU was burned, much of 25-mile STOC home range burned
2004	22	Rattlesnake	Naches	600	30	0	n/a	0	0	jk: assumed 5% of area is NRF
2004	23	Icicle	Leav	778	416	355	10	0	1	jk
2004	24	Trinity	Lake	45	0	0	6	0	0	jk
2004	25	Dirtyface	Lake	295	50	0	n/a	0	0	jk
2004	26	Sunshine	MVRD	50	5	0	n/a	0	0	assumed 10% of area is NRF
2004	27	Reecer	Cle	100	18	0	n/a	0	0	jk
2004	28	Fisher	Leav	16500	1314	0	n/a	0	1	jk
			TOTAL	**64368**	**6433**	**1505**		**1**	**3**	
2005	29	Pearrygin Lake	MVRD	550		0	n/a	0	0	jk
2005	30	Dirtyface	Lake	1150	303	5	6	0	1	jk: BA coming over winter; weed issues
2005	31	Squaw Creek	MVRD	1200		0	n/a	0	0	
			TOTAL	**2900**	**303**	**5**		**0**	**1**	
2006	32	Tripod Complex	MVRD	175000			n/a		1	outside NWFP area
2006	33	Tatoosh Complex	MVRD	2550			n/a		0	
2006	34	Flick Creek	Chelan	5160					0	
2006	35	Tinpan	Entiat	5750					0	
2006	36	Cedar Creek	MVRD	1661					0	
2006	37	Polallie Ridge	Cle	500					0	
				190621	**0**	**0**		**0**	**1**	
2007		Easton Ridge	Cle	400	4				0	40 acres on USFS; assumed 10% was NRF
		Grand Totals		**676934**	**36109**	**12183**		**20**	**11**	

NRF and CHU removed is a combination of fire and fire-suppression effects

NRF and CHU acres overlap unless otherwise stated; CHU acres = NRF only
READ = Service resource advisors/BAER/monitoring (1=present, 0=absent