United States Department of the Interior

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In Reply Refer To:
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JAN 15 2009

Deborah Harmon, Senior Environmental Planner
North Region Environmental Services
California Department of Transportation
1656 Union Street
P.O. Box 3700
Eureka, California 95502

Dear Ms. Harmon:

Subject: Formal Consultation on Realignment of U.S. Highway 101 at Richardson Grove State Park, Humboldt County, California

This document transmits the U.S. Fish and Wildlife Service's (Service) biological opinion based on our review of a proposed road realignment project along U.S. Highway 101 (Highway 101) at Richardson Grove State Park, Humboldt County, California, and its effects on the federally threatened marbled murrelet (*Brachyramphus marmoratus*) and northern spotted owl (*Strix occidentalis caurina*). The California Department of Transportation (Caltrans) obtained federal funding from the Federal Highway Administration (FHWA) and is lead federal agency for the proposed project, based on the delegation of consultation authority to Caltrans by FHWA. This biological opinion has been prepared in accordance with consultation procedures contained in section 7(a)(2) of the Endangered Species Act (Act) of 1973, as amended (16 U.S.C. 1531 *et seq.*). Your request for formal consultation, dated September 12, 2008, was received on September 19, 2008. This biological opinion is based on information provided to the Service by Caltrans and other sources of information. Documents related to this consultation are on file in this office.

Consultation History

Streamlined Consultation Process

On June 7, 2007, FHWA and Caltrans signed a Memorandum of Understanding, in which FHWA assigned, and Caltrans assumed, all responsibilities for consultation and coordination with resource agencies for most projects determined to be Categorical Exclusions under the National Environmental Policy Act. On December 1, 2007, the Service and Caltrans signed a standard agreement, in effect through September 30, 2010, by which both parties agree to assist and expedite timely involvement of Service staff in the development of Caltrans' transportation projects. This agreement includes a commitment by the Service to complete formal consultation and issue a biological opinion on a project within 120 days of receipt of sufficient information.

Other Service Conclusions

Caltrans determined that the proposed project may modify, but is not likely to adversely modify critical habitat for the marbled murrelet. For a complete project description refer to the biological assessment and the description of the proposed action in the following biological opinion. The following discussion deals only with aspects of the proposed action that apply specifically to critical habitat for the marbled murrelet.

On May 24, 1996, the Service designated 3,887,800 acres of land as critical habitat for the marbled murrelet in Washington, Oregon, and California; 693,200 acres (17.8 percent) of this land occur in northern California (Service 1996). Marbled murrelet critical habitat is designated on 175,500 acres of State lands in northern California. Richardson Grove State Park is 1,598 acres in size, all of which are included in the 10,602-acre marbled murrelet critical habitat unit CA-06-a, located in southern Humboldt and northern Mendocino Counties. The remaining 9,004 acres within this critical habitat unit are Late Successional Reserves occurring on lands owned and managed by the Bureau of Land Management. Critical habitat unit CA-06-a comprises approximately 6 percent of designated critical habitat for the marbled murrelet on State lands in northern California. Richardson Grove State Park comprises approximately 0.9 percent of designated critical habitat for the marbled murrelet on State lands in northern California. For critical habitat of the marbled murrelet, the Service identified the following features essential to the conservation of the species (primary constituent elements): individual trees with potential nesting platforms, and (2) forested areas within 0.5 miles of individual trees with potential nesting platforms, and with a canopy height of at least one-half the site-potential tree height.

The Service concurs with your determination that the proposed action may modify, but is not likely to adversely modify designated critical habitat for the marbled murrelet. Our concurrence is based on the following factors:

1. The removal of as many as 31 second-growth redwood and Douglas-fir trees would amount to approximately 0.6 percent of the estimated potential (current and future) old-growth habitat available to nesting marbled murrelets within 0.5 mile of proposed vegetation-removal activities. We think that it is unlikely that

removal of this small percentage of vegetation would substantially alter the canopy characteristics of the forest in Richardson Grove State Park.

2. Because the trees that are proposed to be removed are not large or old enough to contain suitable nesting platforms, their removal would not result in the loss of any current marbled murrelet nesting habitat.

3. Caltrans proposes measures to avoid and minimize impacts to old-growth redwood tree roots during paving activities. These measures are described in detail in the Minimization Measures section (measures 4-8), and are intended (in part) for 25 old-growth redwood trees with a dbh greater than 40 inches.

BIOLOGICAL OPINION

Description of the Action

Project Description

Caltrans proposes to realign sections of Highway 101 at six locations between post miles (PM) 1.1 and 2.2 at Richardson Grove State Park. The project would involve ground disturbance, areas of cut and fill, culvert work, potential temporary stream diversion, a seasonal construction window, placement a 300-foot long retaining wall, disposal/barrow sites, equipment staging areas, paving, utility relocation, permanent right-of-way acquisition, temporary construction easements, subsurface drainage easements, and removal of tress and other vegetation. Work activities are scheduled to occur in 2009-10, 2010-11, or 2011-12.

The proposed purpose and need of this work is to modify the roadway through realignment and widening to accommodate STAA (Surface Transportation Assistance Act of 1982) trucks. STAA trucks are longer than California legal trucks and have a larger turning radius. Consequently, they require more gradual curves to avoid off-tracking. Off-tracking is a result of a turning movement where the rear tires follow a shorter tracking path than the front tires. Off-tracking may cause the vehicle to scrape trees, knock down signs, encroach onto shoulders, or cross into the opposing/adjacent lane of traffic to accommodate the roadway.

The following activities are proposed to occur over the course of 13 consecutive months in years 2009-10, according to the following schedule: tree and shrub removal (September 30, 2009 through March 1, 2010); excavation of slopes and construction of the retaining wall (February 1, 2010 through July 1, 2010); cut and fill (February 1, 2010 through September 30, 2010); culvert work (June 1, 2010 through October 15, 2010) and; paving (September 1, 2010 through October 30, 2010). It is possible that work activities could be delayed by one or two years, in which cases the aforementioned activities would occur during the same monthly timeframes, but one or two years later.

Approximately 80 trees and a number of understory shrubs (mostly huckleberry and sword fern, would be removed from areas of cut and fill for this project. Numbers and species of trees to be removed include: 38 tanoak, 22 Douglas-fir, 9 redwood, 5 big leaf maple, 5 live-oak, and 1 madrone. The majority of the disturbed areas would be replanted in kind. The mean (± standard deviation) dbh of the Douglas-fir trees to be removed is 14.3 ± 6 inches, and the trees range in size from 5 inches to 24 inches dbh. The mean dbh of the redwood trees to be removed is 10.5 ± 5 inches, and the trees range in size from 4 inches to 19 inches dbh. Vegetation removal would occur on approximately 0.25 acre of land.

Caltrans would construct a 300-foot long retaining wall on the hillside above the western roadway shoulder between PM 2.1 and PM 2.2, immediately north of and outside the northern boundary of Richardson Grove State Park. No more than 37 trees would be removed from this location, including 12 Douglas-fir trees, 21 tanoak trees, three live-oak trees, and one madrone tree. Approximately 900 cubic yards of hillside slope would be cut, encompassing an area of approximately 5,000 square feet (0.11 acre). The wall would be retained with soldier piles, which would be installed with a soldier pile auger.

Caltrans would cut approximately 2,200 cubic yards of earthen material from a slope located on the west side of the highway between PM 2.05 and PM 2.10, at the northern boundary of Richardson Grove State Park. Twenty-two trees would be removed from this location, including six Douglas-fir trees, five redwood trees, eight tanoak trees, two live-oak trees, and one big leaf maple tree.

Caltrans would cut approximately 30 cubic yards and fill approximately 40 cubic yards on the eastern shoulder of the highway between PM 1.65 and PM 1.75. Five tanoak trees would be removed from this area.

Caltrans would add approximately 200 cubic yards of earthen fill material between PM 1.56 and 1.61. Five trees would be removed, including three redwoods, one big leaf maple, and one unidentified 7-inch DBH tree.

Caltrans would cut approximately 300 cubic yards of earthen material from a slope located on the west side of the highway between PM 1.35 and PM 1.36. Thirteen trees would be removed from an area measuring approximately 1,650 square feet, including 4 Douglas-fir trees, one redwood, four tanoaks, three big leaf maples, and one unidentified 13-inch DBH tree.

Caltrans proposes to repair or replace four 18-inch culverts and one 24-inch culvert at five locations within the proposed project area. In addition, Caltrans proposes to modify a berm at another location, to improve drainage. No trees would be removed during culvert-repair/replacement activities.

To minimize traffic delays during peak travel hours, Caltrans may conduct some work at night, as well as during the day. For night work, lighting would be directed downward toward the work area to avoid disturbance to foraging northern spotted owls. Contractor stockpiling, equipment storage, and staging areas would be located on the paved roadway and gravel shoulders, and the contractor(s) could arrange additional staging and storage areas on nearby parkland or private property. Excess material would be transported for off-site disposal. Some of the excess material from the slope cuts could be used for fill material within the project area. The following equipment would likely be used: loader, excavator, small crane, backhoe, grader, soldier pile auger, light plant, chainsaw, compressor, jackhammer, rock wheel, pavement saw, grinder, paver, cement truck, 10-wheel dump truck, and belly dump. Pile-driving equipment would not be used.

Conservation Measures

When used in the context of the Act, "conservation measures" represent actions proposed by the Federal agency that are intended to further the recovery of and/or to minimize or compensate for project effects on the species under review. Because conservation measures are pledged in the project description by the action agency, their implementation is required under the terms of the consultation (Service and USDC National Marine Fisheries Service 1998).

Common ravens (*Corvus corax*), American crows (*Corvus brachyrhynchos*), and Steller's jays (*Cyanocitta stelleri*) are known to take marbled murrelet eggs and chicks at nests. These species often scavenge human garbage, discarded food, and spilled food around picnic tables and other outdoor locations, and studies have shown that corvid density is especially elevated in and near campgrounds (Liebezeit and George 2002). Campgrounds, parks, and other outdoor public-use sites are often placed in remote areas or in the remnant fragments of pristine habitat (e.g. old-growth forest) that are often inhabited by threatened and endangered species. Because corvids are often attracted to areas of human use, maintaining campgrounds in these locations may increase the potential impacts of corvids on the species of concern (specifically, marbled murrelts) (Liebezeit and George 2002). To discourage corvid presence near parking, picnic and camping areas at Richardson Grove State Park, Caltrans proposes to provide Richardson Grove State Park with 13 corvid-proof garbage containers to replace current garbage containers.

Caltrans has proposed to implement a revegetation plan for the roadway realignment project along Highway 101 at Richardson Grove State Park. Specifically, Caltrans proposes to replant, in kind with native species, approximately 0.25 acre of disturbed cut and fill areas. In addition, Caltrans proposes restorative planting (with native plant species) of 0.57 acre of a former (now defunct) section of Highway 101 in Richardson Grove State Park. This measure is proposed to enhance foraging habitat for northern spotted owls.

Recovery Measure

Surveying potential breeding habitat to identify potential nesting areas is identified as a recovery action in the marbled murrelet recovery plan (Service 1997). However, focused inland nesting surveys for marbled murrelets have not been conducted at Richardson Grove State Park. To aid in the recovery of the marbled murrelet, Caltrans will conduct surveys for marbled murrelets in areas that contain potential marbled murrelet nesting habitat within Richardson Grove State Park, and will follow the Pacific Seabird Group's *Methods for Surveying Marbled Murrelets in Forests: A Revised Protocol for Land Management and Research*. Caltrans will contact the Arcata Fish and Wildlife Office prior to conducting inland surveys for marbled murrelets at Richardson Grove State Park, for review of the study design and to ensure that a qualified individual conducts the surveys. After the surveys have been completed, Caltrans will send a report to the Arcata Fish and Wildlife Office that summarizes the results of the surveys.

Minimization Measures

Caltrans will implement the following measures to avoid and minimize adverse effects to marbled murrelets and northern spotted owls:

1. Before activities associated with vegetation removal and road construction (including culvert installation and wall construction) begin, a Caltrans qualified biologist approved by the Service will conduct a training session for all personnel. At a minimum, the training will include a description of the marbled murrelet and northern spotted owl and their habitats, a description of the format of the biological opinion, the general measures that are being implemented to conserve the marbled murrelet and northern spotted owl as they relate to the project, and the boundaries within which the project may be accomplished. Brochures, books and briefings may be used in the training session, provided that a qualified person is on hand to answer any questions.

2. Caltrans will designate a person(s) to monitor on-site compliance with all minimization measures, and who will have the authority to halt any action that might result in impacts that exceed the levels anticipated by the Caltrans and the Service during review of the proposed action. If work is stopped, the Service will be notified immediately by the Caltrans project biologist or on-site monitor. A person designated to monitor on-site compliance with all minimization measures will be present on-site during all project activities.

3. During project activities, all trash that may attract predators will be properly contained, removed from the work site and disposed of regularly daily. Following construction, all trash and construction debris will be removed from work areas.

4. All excavation work within a setback equal to 3 times the diameter of any redwood tree with a dbh greater than 36 inches will be done by hand to minimize disturbance or damage to roots.

5. During required excavations for roadway structural sections, no roots greater than 3 inches in diameter will be severed or damaged.

6. Smaller roots less than 3 inches in diameter that must be cut will be cut cleanly with a sharp instrument to promote healing.

7. The structural section for the new pavement will use cement treated permeable base (CTPB) to minimize structural section thickness, provide greater porosity, minimize compaction of roots, and minimize thermal exposure to roots from hot mix asphalt (HMA) paving.

8. In areas where new embankment is to be constructed, the following measures will be followed to protect roots and promote air circulation: a) the existing vegetation needing to be removed will be cut flush with the ground, and stumps will be left in place; b) any duff layer will be hand-raked off the area within the clearing limits; c) a 0.75-foot thick

layer of class 1, type A permeable material will be placed and compacted as the first lift of the fill, and a layer of filter fabric will then be applied prior to placing any remaining fill required for the embankment; and d) in locations where fill will be placed next to the trunk of a redwood tree with a diameter of 36 inches or greater, a brow log will be used to maintain the soil next to the trunk of the tree and to ensure air circulation.

Action Area

Road-construction related activities will occur along approximately 1.1 mile of Highway 101 at and near Richardson Grove State Park. Based upon sound levels expected to occur as a result of the action, and presumed ambient sound conditions at the project location, the Service estimates that the action may result in harassment of marbled murrelets and northern spotted owls that may nest within 825 feet (0.15 mile) of project activities. This comprises an area encompassing approximately 229 acres.

Time-frame of Biological Opinion
This biological opinion is valid from the date of issuance through January 31, 2013, or until work is completed, whichever comes first.

Status of the Species : Marbled Murrelet

Legal Status
The marbled murrelet was federally listed as a threatened species in Washington, Oregon and California on September 28, 1992 (Service 1992). The final recovery plan was released in 1997 (Service 1997). The species is State-listed as endangered in California and as threatened in Oregon and Washington (Service 1997).

In 2004, the Service completed a 5-year status review of the marbled murrelet. As part of the status review process the Service contracted the task of compiling all new and relevant information available on the species. The contractor produced a report summarizing information relevant to the status of the species (McShane et al. 2004). Based on this report, the Service concluded that the California, Oregon and Washington distinct population segment of the marbled murrelet should remain listed as a threatened species. The Service also determined that the California, Oregon, and Washington distinct population segment of the marbled murrelet does not meet the criteria set forth in the Service's 1996 distinct population segment policy (61 FR 4722) (Service 2004). Currently, the marbled murrelet remains listed and retains its' protected status as a threatened species under the Act until the original 1992 listing decision is revised through formal rule-making procedures.

Life History
Marbled murrelets are long-lived seabirds that spend most of their life in the marine environment, but use old-growth forests for nesting. Accounts of the taxonomy, ecology, and reproductive characteristics of the marbled murrelet are found in the following publications: Ecology and Conservation of the Marbled Murrelet (Ralph et al. 1995a), the Final Recovery Plan Marbled Murrelet *(Brachyramphus marmoratus)* Washington, Oregon, and California Populations (Recovery Plan) (Service 1997), the Final Supplemental Environmental Impact

Statement on Management of Habitat for Late-successional and Old-growth Forest Related Species Within the Range of the Northern Spotted Owl (USDA Forest Service and USDI Bureau of Land Management 1994), the Status of the Marbled Murrelet in North America: with Special Emphasis on Populations in California, Oregon, and Washington (Marshall 1988), Marbled Murrelet (*Brachyramphus marmoratus)* (Nelson 1997), and in the Evaluation Report in the 5-Year Status Review (McShane et al. 2004). Information from these sources is incorporated by reference and summarized as follows.

Current and Historical Range
The breeding range of the marbled murrelet extends along the Pacific coast from Alaska to Monterey Bay in central California. Some wintering birds occur as far south as northern Baja California, Mexico. However, only the Washington, Oregon, and California population segment is federally-listed as threatened (Service 1992). Limited information is available on their historic distribution and numbers; however, most summaries give indications that the distribution of marbled murrelet populations was significantly reduced as habitat was removed throughout its' range. Populations declined as a result. In some areas, only small numbers of marbled murrelets persist or have been locally extirpated, risking maintenance of the species' distribution. These areas are identified as "areas of concern" (Service 1997). They include distribution gaps in central California, northwestern Oregon, and southwestern Washington, where very little suitable habitat remains, and what habitat does remain occurs in small, fragmented patches.

Marine Environment
The breeding and winter range of the marbled murrelet in the listed range occur within the oceanographic system known as the California Current. The California Current is subject to high interannual frequency of anomalous conditions such as an El Niño which can affect prey availability (McShane et al. 2004).

Courtship, foraging, loafing, molting, and preening occur in near-shore marine waters. Beginning in early spring, courtship continues throughout summer with some observations even noted during the winter period (Speckman 1996, Nelson 1997). Observations of courtship occurring in the winter suggest that pair bonds are maintained throughout the year (Speckman 1996, Nelson 1997). Courtship involves bill posturing, swimming together, synchronous diving, vocalizations, and chasing in flights just above the surface of the water. Copulation occurs both inland in the trees and at sea (Nelson 1997).

Marbled murrelets forage at all times of the day, but most actively in the morning and late afternoon (Strachan et al. 1995). They typically forage in pairs, but have been observed to forage alone or in groups of three or more (Carter and Sealy 1990, Strachan et al. 1995, Speckman et al. 2003). Strachan et al. (1995) believe pairing influences foraging success and cooperative foraging techniques may be employed. For example, pairs consistently dive together during foraging and often synchronize their dives by swimming towards each other before diving (Carter and Sealy 1990) and resurfacing together on most dives. Strachan et al. (1995) speculate pairs may keep in visual contact underwater. Paired foraging is common throughout the year, even during the incubation period, suggesting that breeding marbled murrelets may temporarily pair up with other foraging individuals or non-mates (Strachan et al. 1995, Speckman et al. 2003).

Marbled murrelets go through two molts each year. The timing of molts varies temporally throughout their range likely due to prey availability, stress, and reproductive success (Nelson 1997). Adult or after hatch-year marbled murrelets have two primary plumage types: alternate plumage during the breeding season and basic plumage during the winter. The pre-alternate molt occurs from late February to mid-May. This is an incomplete molt during which the birds lose their body feathers but retain their ability to fly (Carter and Stein 1995, Nelson 1997). A complete pre-basic molt occurs from mid-July through December (Carter and Stein 1995, Nelson 1997). During the pre-basic molt, marbled murrelets lose all flight feathers somewhat synchronously and are flightless for up to 2 months (Nelson 1997).

Little is known about marine-habitat preference outside of the breeding season, but use during the early spring and fall is thought to be similar to that preferred during the breeding season (Nelson 1997). Adults and subadults may move away from breeding areas prior to molting and must select areas with predictable prey resources during the flightless period (Carter and Stein 1995, Nelson 1997). During the non-breeding season, marbled murrelets disperse and can be found farther from shore (Strachan et al. 1995). During the winter there may be a general shift from exposed outer coasts into more protected waters (Nelson 1997). For example, many marbled murrelets breeding on the exposed outer coast of Vancouver Island appear to congregate in the more sheltered waters within the Puget Sound and the Strait of Georgia in fall and winter (Burger 1995). However, in many areas, marbled murrelets remain associated with their inland nesting habitat during the winter months (Carter and Erickson 1992). In central California, a radio telemetry study of marbled murrelet movement during the late summer and fall months revealed that most birds remained near their nesting areas immediately following molt, but then began to disperse distances greater than 100 miles to wintering areas (Peery et al. 2003b).

Terrestrial Environment

Marbled murrelets generally nest in old-growth forests, characterized by large trees, multiple canopy layers, and moderate to high canopy closure. Marbled murrelet nests have been located at a variety of elevations from sea level to 5,020 feet (Burger 2002). However, most nests have been found below 3,500 feet. In California, nest stands are typically composed of low elevation conifers, which include coastal redwood and Douglas-fir. These forests are located close enough to the marine environment for the birds to fly to and from nest sites. The furthest known inland occupied site is in Washington, about 52 miles from the coast. However, marbled murrelets have been detected up to 70 miles from the coast in the southern Cascade Mountains (Evans Mack et al. 2003).

Radar and audio-visual studies have shown marbled murrelet habitat use is positively associated with the presence and abundance of mature and old-growth forests, large core areas of old-growth, low amounts of edge and fragmentation, proximity to the marine environment, total watershed area, and increasing forest age and height (McShane et al. 2004). In California and southern Oregon, areas with abundant numbers of marbled murrelets were farther from roads, occurred more often in parks protected from logging, and were less likely to occupy old-growth habitat if it was greater than 3 miles from other nesting marbled murrelets (Meyer et al. 2002). Meyer et al. (2002) also found at least a few years passed before birds abandoned fragmented forests.

Marbled murrelets do not form dense colonies, which is atypical for most seabirds. Limited evidence suggests they may form loose colonies or clusters of nests in some cases (Ralph et al. 1995b). The marbled murrelets reliance on cryptic coloration to avoid detection would suggest they utilize a wide spacing of nests in order to prevent predators from forming a search image (Ralph et al. 1995b). However, active nests have been seen within 98 feet in Oregon (Nelson and Wilson 2002). Estimates of marbled murrelet nest densities vary depending upon the method of data collection. For example, nest densities estimated using radar range from 0.003 to 0.042 mean nests per hectare, while nest densities estimated from tree climbing efforts range from 0.11 to 1.42 mean nests per hectare (Nelson 2005).

Of particular importance to recovery options is evidence that breeding marbled murrelets displaced by the loss of nesting habitat apparently do not pack in higher densities into remaining habitat (McShane et al. 2004). Thus, currently unoccupied habitat with suitable nesting structure may be important to displaced marbled murrelets and first-time breeders.

There are few data available regarding marbled murrelet nest site fidelity because of the difficulty in locating nest sites and observing bands on birds attending nests. However, marbled murrelets have been detected in the same nesting stands for many years suggesting marbled murrelets have a high fidelity to nesting areas (Nelson 1997). Use of the same nest platform in successive years and multiple nests in the same tree has been documented, although it is not clear whether the repeated use involved the same birds (Divoky and Horton 1995, Nelson and Peck 1995, Nelson 1997, Hébert et al. 2003a).

It is unknown whether juveniles disperse from natal breeding habitat or return to their natal breeding habitat after reaching breeding age. Divoky and Horton (1995) predicted that juvenile dispersal is likely to be high because marbled murrelets are non-colonial and nest in widely dispersed nest sites. Conversely, Swartzman et al. (1997 cited in McShane et al. 2004) suggested juvenile dispersal is likely to be low, as it is for other alcid species.

When tending active nests during the breeding season, breeding pairs forage within commuting distance of the nest site. Daily movements between nest sites and foraging areas for breeding marbled murrelets averaged 10 miles in Prince William Sound, Alaska (McShane et al. 2004), 24 miles in Desolation Sound, British Columbia, and 48 miles in southeast Alaska (Hull et al. 2001). In California, Hébert et al. (2003b) found the mean extent of north-south distance traveled by breeding adults to be about 46 miles.

Known predators of adult marbled murrelets in the forest environment include the peregrine falcon (*Falco peregrinus*), sharp-shinned hawk (*Accipiter striatus*), common raven, northern goshawk (*Accipiter gentilis*), and bald eagle (*Haliaeetus leucocephalus*). Common ravens and Steller's jays are known to take both eggs and chicks at the nest, while sharp-shinned hawks have been found to take chicks. Suspected nest predators include great horned owls (*Bubo virginianus*), barred owls (*Strix varia*), Cooper's hawks (*Accipiter cooperi*), northwestern crows (*Corvus caurinus*), American crows, and gray jays (*Perisoreus canadensis*) (Nelson and Hamer 1995a, Nelson 1997). Predation by squirrels and mice has been documented at artificial nests and cannot be discounted as potential predators on eggs and chicks (Luginbuhl et al. 2001, Raphael et al. 2002, Bradley and Marzluff 2003).

Reproductive Biology
Life history information is limited for the marbled murrelet (Service 1997). However, marbled murrelets probably do not reach sexual maturity until at least their second year, and most birds probably do not lay eggs until they are at least 3 years old (Service 1997). Marbled murrelets are estimated to live an average of 10 years (Beissinger 1995). Marbled murrelets produce one egg per nest and usually only nest once a year, however re-nesting is documented (Hébert et al. 2003a). Nests are not built, but rather the egg is placed in a small depression or cup made in moss or other debris on the limb (Service 1997). In California, egg-laying and incubation span a long period, beginning around March 24 and ending August 15, with the nestling period beginning April 23 and ending September 13 (Hamer et al. 2002).

Incubation lasts about 30 days, and chicks fledge after about 28 days after hatching. Both sexes incubate the egg in alternating 24-hour shifts. The chick is fed up to eight times daily, and is usually fed only one fish at a time. Adults fly from the ocean to inland nest sites at all times of the day, but most often at dusk and dawn (Nelson and Hamer 1995b). New information from a radio-telemetry study in northern California indicates that inland flights at dusk are exclusively made by breeding birds, whereas inland flights at dawn are made by both breeding and non-breeding birds (B. Accord pers. comm.). The young are semiprecocial, capable of walking but not leaving the nest. Fledglings apparently fly directly from the nest to the ocean, but are sometimes found on the ground, indicating that they were unable to sustain flight to reach the ocean (Service 1997).

<u>Threats</u>
Marbled murrelets remain subject to a variety of threats both in the terrestrial and marine environment including the loss of nesting habitat, predation, noise and visual disturbance, gill-net fishing operations, oil spills and marine pollution, trends in prey availability from oceanographic conditions and overfishing, and disease (Service 1997, McShane et al. 2004).

Habitat loss
Marbled murrelets prefer late-successional and old-growth forests for nesting. Loss of this type of habitat due to timber harvest was the primary reason for listing the species (Service 1992). Loss of nesting habitat exacerbated by poor reproductive success in remaining habitat are the primary factors responsible for a decline in the marbled murrelet population, compared to the historical population level in the early 1800's (Service 1997).

Predation
Predation of eggs and chicks is a major cause of nest failure (Nelson and Hamer 1995a). Even small increases in predation can have deleterious effects to population viability, due to the marbled murrelet's low reproductive rate (Nelson and Hamer 1995a). Poor reproductive success is likely caused by high predation rates. In particular, human activities which increase the number of predators or risk of predation near nesting areas should be discouraged (Service 1997).

Predation rates are influenced largely by habitat patch size, habitat quality, nest location relative to edge of nest stand, and proximity of nesting habitat to areas of human activity, where many of the corvid species are in high abundance. The quality of nesting habitat decreases as patch size decreases because the amount of forest edge increases in relation to the amount of interior forest habitat. As the amount of forest edge increases, the probability that nests would be located near an edge also increases. Nests placed near the edge of a stand are more likely subject to predation (Ralph et al. 1995b). Nelson and Hamer (1995a) found successful nests were farther from edges and were better concealed than unsuccessful nests. Furthermore, independent of patch size, the quality of nesting habitat decreases when in close proximity to human activity. Forest stands within 0.6 mile of human activity centers, such as campgrounds, can experience increased nest predation because human food sources attract corvids (Marzluff et al. 2000). The probability of predation on simulated marbled murrelet nests decreased from 95 percent to 50 percent when visitors and their food were not allowed into an area of the Olympic National Park (Marzluff and Neatherlin in review).

Disturbance

Marbled murrelets may be sensitive to human-caused disturbance in the terrestrial environment due to their secretive nature and their vulnerability to predation. There are few data concerning the marbled murrelet's vulnerability to disturbance effects, however research on a variety of other species, including other seabirds, indicates an animal's response to disturbance follows the same pattern as its response to encountering predators. Anti-predator behavior has a cost to other fitness enhancing activities, such as feeding and parental care (Frid and Dill 2002).

Anecdotal researcher observations indicate that marbled murrelets typically exhibit a limited, temporary behavioral response to noise disturbance at nest sites and are able to adapt to auditory stimuli (Singer et al. 1995 cited in McShane et al. 2004, Long and Ralph 1998). Responses by marbled murrelet adults and chicks to calls from corvids and other potential predators include no response, alert posturing, and aggressive attack. Adults may temporarily leave a nest (McShane et al. 2004). However, the most typical behavior of chicks and adults in response to the presence of a potential predator is to flatten against a tree branch and remain motionless (Nelson and Hamer 1995a, McShane et al. 2004). In addition, there may be physiological responses researchers cannot account for with visual observations. Corticosterone studies have not been conducted on marbled murrelets, but studies on other avian species indicate chronic high levels of this stress hormone may have negative consequences on reproduction or physical condition (Wasser et al. 1997, McShane et al. 2004).

Though largely inconclusive, Hébert et al. (2003a) examined the effects of operating chainsaw noise during incubation and chick rearing periods on nesting adult marbled murrelets and chicks. Adult marbled murrelets and chicks both spent less time motionless and resting and more time exhibiting "raised head" and "bill up" behaviors during the disturbance trial than pre- and post-trial. The relevance of these behaviors is unknown; however, a species that relies on being cryptic and motionless to avoid predation at the nest may risk being detected by a predator if it moves more often.

Gill-net fishing
Marbled murrelets can become entangled in gill-nets and drown. Marbled murrelets can also be killed by hooking with fishing lures and entanglement with fishing lines (Carter et al. 1995). There is little information available on marbled murrelet mortality from net fishing prior to the 1990s, although it was known to occur (Carter et al. 1995). In the mid-1990s, a series of fisheries restrictions and changes were implemented to address mortality of all species of seabirds, resulting in a lower mortality rate of marbled murrelets (McShane et al. 2004). Fishing effort has also decreased since the 1980s because of lower catches, fewer fishing vessels, and greater restrictions (McShane et al. 2004); although a regrowth in gill net fishing is likely to occur if salmon stocks increase.

Oil spills and marine contaminants
Marbled murrelets are highly vulnerable to oiling. Oil spills which have occurred near murrelet concentrations have had catastrophic effects on marbled murrelet populations (Service 1996). Marbled murrelets exposed to oil floating on the water's surface likely die within days of exposure. Though the number of oil spills has generally declined since passage of the U.S. Oil Pollution Act in 1990, marbled murrelet and seabird mortality remains a significant conservation issue (McShane et al. 2004).

The primary consequence from the exposure of marbled murrelets to contaminants is reproductive impairment. Reproduction can be impacted by food web bioaccumulation of organochlorine pollutants and heavy metals discharged into areas where marbled murrelets feed and prey species concentrate (Fry 1995). However, marbled murrelet exposure is likely a rare event because marbled murrelets have widely dispersed foraging areas and they feed extensively on transient juvenile and subadult midwater fish species that are expected to have low pollutant loads (McShane et al. 2004). The greatest exposure risk to marbled murrelets may occur at regular feeding areas near major pollutant sources, such as those found in Puget Sound (McShane et al. 2004).

Reduced prey availability
Many fish populations have been depleted due to overfishing, reduction in the amount or quality of spawning habitat, and pollution. Other than anchovies and herring, primary marbled murrelet prey species have little commercial fishery value.
Oceanographic variation can also influence prey availability. While the effects to marbled murrelets from events such as the warm phase of the Pacific Decadal Oscillation or El Niño have not been well documented, El Niño events are thought to reduce overall prey availability and several studies have found that El Niño events can influence the behavior of marbled murrelets (McShane et al. 2004). Even though changes in prey availability may be due to natural and cyclic oceanographic variation, these changes may exacerbate other threats to marbled murrelets in the marine environment.

Disease
The emergence of fungal, parasitic, bacterial, and viral diseases and biotoxins has affected populations of seabirds in recent years. West Nile virus disease has been reported in California which is known to be lethal to seabirds, but little is known about its potential impact on marbled murrelets (McShane et al. 2004). No diseases have been documented to have caused marbled

murrelet mortality; however, four marbled murrelets may have died from domoic acid toxicosis in central California in 1999 (Burkett et al. 1999).

Genetics

Loss of genetic variation among populations was identified as a potential threat to the marbled murrelet (McShane et al. 2004). Friesen et al. (2007) concluded that marbled murrelets are comprised of three genetic units: (1) western and central Aleutian Islands; (2) eastern Aleutian Islands to northern California; and (3) central California. All three populations are important to maintaining the species genetic resources and/or local adaptations and its long-term viability. Murrelets in the western and central Aleutian Islands and central California occupy the periphery of the species range and are genetically distinct.

Conservation Needs

Recovery objectives for the marbled murrelet include the following (Service 1997): (1) stabilize and then increase population size, changing the current downward trend to an upward trend throughout the listed range; (2) provide conditions in the future that allow for a reasonable likelihood of continued existence of viable populations; and (3) gather the necessary information to develop specific delisting criteria. Stabilizing and increasing habitat quality and quantity on land and at sea are the primary means for stopping the current population decline and encouraging future population growth (Service 1997).

In order to achieve the recovery objectives, the following short-term conservation actions are needed (Service 1997): (1) maintain all occupied nesting habitat on Federal lands administered under the NWFP (USDA Forest Service and USDI Bureau of Land Management 1994); (2) on non-Federal lands, maintain as much occupied habitat as possible and use the Habitat Conservation Plan (HCP) process to avoid or reduce the loss of this habitat; (3) maintain potential and suitable habitat in large contiguous blocks; (4) maintain and enhance buffer habitat surrounding occupied habitat; (5) decrease adult and juvenile mortality; and (6) minimize nest disturbances to increase reproductive success.

In order to achieve the recovery objectives, the following long-term conservation actions are needed (Service 1997): (1) increase the amount and quality of suitable nesting habitat; (2) decrease fragmentation by increasing the size of suitable stands; (3) protect “recruitment” nesting habitat to buffer and enlarge existing stands, reduce fragmentation, and provide replacement habitat for current suitable nesting habitat lost to disturbance events; (4) increase speed of development of new habitat; and (5) improve and develop north/south and east/west distribution of nesting habitat.

Six marbled murrelet conservation zones occur throughout the listed range. They are as follows: Puget Sound (Zone 1); Western Washington Coast Range (Zone 2); Oregon Coast Range (Zone 3); Siskiyou Coast Range (Zone 4); Mendocino (Zone 5); and Santa Cruz Mountains (Zone 6). Specific conservation management plans need to be developed for each zone (Service 1997). Zones 1 to 4 must be managed to produce and maintain well distributed, viable populations to address the long-term survival and recovery of the marbled murrelet.

Conservation Strategy

The conservation strategy is to conserve as much of the remaining suitable or occupied habitat on Federal land (i.e., the NWFP) and on key non-Federal lands. These habitats would provide a system of long-term habitat reserves which are needed to stabilize and eventually recover the declining population. This approach assumes that marbled murrelet populations have not already declined below an extinction threshold from which recover is not possible (USDA Forest Service and USDI Bureau of Land Management 1994). It also assumes that marbled murrelet populations will respond positively to a long-term reversal in the trend of habitat loss (Raphael et al. 2002). Our ability to predict extinction thresholds for the marbled murrelet is still quite crude (National Research Council 1995). In addition, our ability to estimate the size and trend in the marbled murrelet population is limited (Becker et al. 1997).

The NWFP is a conservative approach to managing marbled murrelet habitat, and it accommodates our inability to identify an extinction threshold. The biological opinion on the NWFP concluded that it "…should provide for the survival of a marbled murrelet population that is well distributed on Federal lands throughout the planning area" (Service 1994). The NWFP is designed to enable Federal lands to bear most of the burden for recovering and maintaining late-successional species such as the marbled murrelet. The NWFP protects approximately 90 percent of suitable marbled murrelet habitat on Federal lands (Service 1997); it prohibits removal of occupied marbled murrelet habitat on Federal lands, including the Matrix where intensive timber harvest is otherwise allowed.

Non-Federal land makes an important contribution to marbled murrelet recovery where gaps occur in the distribution of suitable habitat (USDA Forest Service and USDI Bureau of Land Management 1994, Service 1997). Removal of some occupied marbled murrelet habitat on non-Federal land is likely and potentially permissible, assuming sufficient high quality habitat is protected throughout the listed range to maintain well distributed, viable subpopulations. On non-Federal lands in California, the California Forest Practice Rules and California Endangered Species Act protect occupied marbled murrelet habitat and a 300-foot buffer around the occupied habitat during the breeding season. Non-Federal landowners who propose to harvest occupied habitat may incidentally take the marbled murrelet in known or likely occupied habitat, in accordance with section 7 or section 10 of the Act. The Service applies recommendations of the Recovery Plan when authorizing incidental take of marbled murrelets. These recommendations include the following (Service 1997): minimize the loss of occupied marbled murrelet habitat by evaluating and ranking various types of occupied habitat, and balance short-term risks with long-term tradeoffs.

Section 7 consultation on several HCPs and on tribal lands has authorized incidental take of the marbled murrelet. Each of these approved actions retained the highest quality marbled murrelet habitat as part of a management strategy that was consistent with the Recovery Plan.

Current Condition

The current condition of the species incorporates the effects of all past human and natural activities or events that have led to the present-day status of the species (USDI Fish and Wildlife and USDC National Marine Fisheries Service 1998).

Marine environment
In the California Current, seabirds in general, have done poorly during the most recent El Niño. Response of the marbled murrelet to the El Niño is unknown, but it is likely that consistent with other seabird species, fewer marbled murrelets breed during an El Niño, and foraging effort is increased as birds have to disperse more widely in search of decreased prey (McShane et al. 2004).

During the 1990s, oil tanker and shipping traffic into west coast ports grew, increasing the amount of oil that could be spilled. However, fewer spills have occurred since the U.S. Oil Pollution Act was instated in 1990, and a moratorium on oil development offshore of northern California, Oregon and Washington was enacted in 1992. Though marbled murrelets continue to be killed by oil spills, the overall threat has been reduced since the early 1990s (McShane et al. 2004).

In the mid 1990s, a series of fisheries restrictions and changes were implemented to address mortality of all species of seabirds, resulting in a lower mortality rate of marbled murrelets. Fishing effort has also decreased since the 1980s because of lower catches, fewer fishing vessels, and greater restrictions; although a regrowth in gill net fishing is likely to occur if salmon stocks increase. In most areas, the threat from gill net fishing has been reduced or eliminated since 1992. However, threats to adult and juvenile marbled murrelets are still present in Washington Zones 1 and 2 (McShane et al. 2004). In central California gill-net fishing is currently prohibited in waters less than 60 fathoms deep. This restriction protects the diving zone used by marbled murrelets, thus eliminating the threat of entanglement.

The Service considers disturbance in the marine environment to be a concern for marbled murrelets, particularly in areas of high human activity.

Terrestrial Environment
Habitat Amount. The precise amount of suitable marbled murrelet habitat within the listed range is unknown at this time. However, based on recent agency estimates and the Service's internal files, the best estimate of potentially suitable habitat for the marbled murrelet within the listed range is approximately 2.2 million acres of which approximately 155,000 acres or 7 percent are classified as remnant habitat (Service 2003). Approximately 93 percent of the suitable habitat occurs on Federal land. Suitable habitat is distributed among the three States as follows: Washington, approximately 1 million acres; Oregon, approximately 800,000 acres; and California, approximately 400,000 acres (Service 2003). Though our ability to quantify suitable habitat has improved recently, the current estimates likely overestimate the amount in many areas because of the lack of detail on the presence of nesting structure. In fact, northern spotted owl habitat was used as a surrogate for marbled murrelet habitat in some areas. Marbled murrelet habitat quality depends on its proximity to marine waters, landscape context, and stand size. This information is needed to refine estimates of total suitable habitat. Quality habitat must meet basic nesting requirements, provide refuge from predators, and be relatively stable against catastrophic disturbances. It is not possible at this time to estimate the amount of high quality habitat which contributes to long-term nesting success.

The NWFP protects marbled murrelet habitat on Federal land by prohibiting timber harvest of occupied murrelet habitat, regardless of the land allocation (USDA Forest Service and USDI Bureau of Land Management 1994). In addition, the system of Federal reserves protects currently suitable marbled murrelet habitat and allows currently unsuitable habitat to develop into larger blocks of suitable habitat. Currently there are approximately 56,000 acres of old-growth redwood forest remaining in California, representing about 2.5 percent of the original old-growth redwood forest. More detailed descriptions of suitable marbled murrelet habitat throughout its listed range are given in Nelson (1997) and Service (1997) and are incorporated herein by reference.

Occupied habitat is defined as that portion of potentially suitable habitat which is occupied by nesting marbled murrelets (Evans Mack et al. 2003), or expected to be occupied, based on survey history in the area and the application of an occupancy index to unsurveyed areas. At least 483,919 acres of potentially occupied marbled murrelet habitat exist within the listed range of the species (Table 1); data are not available for Washington. Marbled murrelets may not occupy a large portion of potentially suitable habitat, due to the absence of nesting structure or its spatial configuration. As a result, the 2.2 million acres of suitable habitat likely overestimates the amount of actual occupied marbled murrelet habitat (Service 2003). For example, about 100,000 acres of late-seral forests occur on the Siskiyou and Rogue River National Forests and the Medford District of the Bureau of Land Management. Survey results in the area closest to the coast suggest that marbled murrelets actually occupy approximately 26 percent of the suitable habitat, based on existing survey data and assumptions about areas not adequately surveyed. Where published data were lacking, the Service solicited professional judgments from agency biologists and considers these simple estimates as the best available information (Service 2003).

Approximately 68,000 acres of occupied marbled murrelet habitat occur in the California portion of Zone 4 (Table 1). The agencies were unable to separate habitat estimates for Zones 3 and 4 in Oregon. In general, much of the habitat varies in quality. In California, high quality habitat occurs primarily in unmanaged redwood forests which are found close to the coast. Lower quality habitat occurs inland in managed Douglas-fir forests. In California, the estimated 360,000 acres of potentially suitable habitat far exceeds the estimated 68,000 acres of occupied habitat (Service 2003). This discrepancy exists largely as a result of our incomplete understanding of the inland distribution of the marbled murrelet. For example, most habitats previously thought to be suitable on Forest Service lands in California are likely not occupied (Hunter at al. 1998). Comparisons or analyses using the larger amount of suitable habitat may underestimate the potential impacts of a proposed action and, therefore, should not be used to analyze the impacts of a proposed action.

The Service estimates that marbled murrelets likely occupy approximately 430 acres of habitat in Zone 5 and 7,250 acres of habitat in Zone 6. Most suitable habitat in these Zones was historically harvested; suitable habitat which remains is of lower quality and found in scattered, small patches in State and County Parks and on private lands.

Habitat Trend. Historically, the amount of suitable habitat has declined throughout the range of the marbled murrelet, due primarily to commercial timber harvest. Some habitat loss is attributed to natural disturbance, such as fire and windthrow. Timber harvest has eliminated most suitable habitat on private lands within Washington, Oregon, and California (Service 1997). In the early to mid-1800s, Western Washington and Oregon contained 14 to 20 million acres of old-growth forest, compared to about 3.4 million acres in 1991. This loss of habitat represents a reduction of 82 percent (Service 1997). About 1.3 million to 3.2 million acres of old-growth Douglas-fir/mixed conifer and 2.7 million acres of old-growth redwood forests occurred in northwestern California during the early to mid-1800s (Service and USDC National Marine Fisheries Service 1999).

Between 1992 and 2003, the loss of suitable marbled murrelet habitat totaled 22,398 acres over the 3-state area, of which 5,364 acres resulted from timber harvest and 17,034 acres resulted from natural events (McShane et al. 2004). Habitat loss and fragmentation is expected to continue in the near future, but at an uncertain rate (McShane et al. 2004). Gains in suitable nesting habitat are expected to occur on Federal lands over the next 40-50 years, but due to the extensive historic habitat loss and the slow replacement rate of marbled murrelets and their habitat, the species is potentially facing a severe reduction in numbers in the coming 20 to 100 years (Beissinger 2002).

Habitat Distribution. Breeding populations of marbled murrelets are not currently distributed continuously throughout the forested portions of Washington, Oregon, and California. A gap of 100 miles in the north/south distribution of suitable habitat exists in southwestern Washington and northwestern Oregon, and a north/south gap of 300 miles exists in central California in the southernmost portion of the species' range. These gaps consist of areas of second-growth and remnant older forests where marbled murrelets occur in low numbers. The inland distribution is greatest in Washington at about 50 miles from the marine environment; it narrows down in Oregon; and it declines to as close as 10 to15 miles from the coast in California.

Habitat Quality. Overall, the quality of existing marbled murrelet habitat has diminished, compared to conditions which existed prior to logging (Service 1997). Total habitat area is greatly reduced, and remaining habitat is often fragmented and located further from the marine environment. In California, a large amount of remaining habitat occurs on National, State, and County Park lands which are subject to a high degree of recreation and its associated effects on marbled murrelet populations.

Habitat quality varies on a range-wide basis. Some excellent old-growth habitat remains on Federal lands in each of the three states. However, habitat quality has declined throughout the marbled murrelet's range, compared to historic times. Habitat occurs in smaller patch sizes, consists of smaller trees, and contains more roads and clearcut openings. Predation has likely increased at the local level, due to increased numbers of predators which find food sources associated with human recreational activities. At a landscape level, the abundance of avian predators has probably increased. Ongoing research should shed more light on specific factors which affect marbled murrelet nest predation and stand size preferences. The best available information strongly suggests forest fragmentation may adversely affect the reproductive success of marbled murrelets (Service 1997).

Population

Population Numbers. The size of the listed population of the marbled murrelet in Washington, Oregon and California was initially estimated at 18,550-32,000 birds (Ralph et al. 1995b). Two largely divergent population estimates in Oregon account for the wide range in the estimated population size.

Monitoring to determine a trend in marbled murrelet populations began in 2000 and has continued annually since, as part of effectiveness monitoring for the NWFP (Bentivoglio et al. 2002, Huff ed. in press) (Table 2). A separate population monitoring effort is conducted each year in Zone 6, which is not part of the NWFP area. The population point estimates (years, in parentheses) for Zones 1-5 from the effectiveness monitoring are as follows: 18,571 birds (2000); 22,180 birds (2001); 23,673 birds (2002); 22,217 birds (2003); 20,578 birds (2004); 20,223 birds (2005); 18,622 birds (2006) (excluding Zone 5); and 17,354 birds (2007) (Table 2). The Effectiveness Monitoring Team has evaluated trend for zones 1-5 with all data (2000-2007) and without the 2000 data. The latter analysis was done because aspects of the survey protocol were not fully implemented in 2000, which could bias estimates for that year. For 2001-2007, the downward trend is statistically significant (*P*-value of 0.015), with an overall decline of 27 percent over this period. This trend is based on an annual rate of decline of 4.5 percent with a 95 percent CI of 8.0 percent to -1.0 percent annual decline. For 2000-2007, the average annual rate of decline of 2.2 percent is not statistically distinguishable from no trend (*P*=0.19). At the individual Zone scale, trend data are inconclusive for zones 1-5, using a significance level of 0.05. Zones 1, 3, and 4 have estimated rates of change consistent with the likely decline observed for the entire 5-zone area.

Four of the six Zones must be functional to effectively recover and maintain a well-distributed, viable marbled murrelet population, both in the short- and long-term (Service 1997

Population Trend. Since 1995, four demographic modeling efforts have provided information on predicting population trends, and in one case, extinction probabilities of marbled murrelets into the future: Population Trends of the Marbled Murrelet Projected from Demographic Analyses (Beissinger 1995); Population Trends of the Marbled Murrelet Projected from Demographic Analyses (Beissinger and Nur 1997 in Service 1997); a subsequent analysis by Beissinger and Peery in 2003: and the Evaluation Report for the 5-Year Status Review of the Marbled Murrelet in Washington, Oregon, and California by McShane et al. (2004).

These efforts employed a Leslie Matrix modeling structure using estimates for demographic parameters such as survival and fecundity. Estimates of survival were derived from life history analyses of similar species. Estimates of fecundity (i.e., number of female young produced per adult female) were generated from estimates of nest success, either from radio-telemetry studies or from juvenile-to-adult ratios obtained in the marine environment. Table 3 lists the four latest murrelet Leslie Matrix models and the values for common demographic parameters used in each.

In 1995, juvenile-to-adult ratios for murrelets ranged between 0.01 and 0.14, while fecundity was estimated at less than 0.2, a value well below the level of productivity needed to sustain stable populations (Beissinger 1995). Fecundity would have to range from 0.2 to 0.46 to sustain stable populations. Marbled murrelet populations in California, Oregon, and Washington may be declining at a rate of 4 to 7 percent per year, and perhaps as much as 12 percent per year (Beissinger and Nur 1997 in Service 1997).

In 2003, juvenile-to-adult ratios were once again reviewed, based on 8 additional years of survey data collected at-sea (Beissinger and Peery 2003). Juvenile-to-adult ratios varied from 0.038 to 0.089, depending on Zone. Fecundity estimates were developed for four Zones, but unlike the analysis in 1995, fecundity estimates were compared to reproductive histories of individual birds, based on recent radio-telemetry studies. Using a stage-based Leslie matrix model with a range of values for adult survival, fecundity derived from juvenile-to-adult ratios was too low to maintain stable populations in most zones. Rates of population decline ranged from 2.0 to 15.8 percent per year, depending upon the recovery zone and the values used for survival. A comparison of fecundity values derived from juvenile-to-adult ratios, to fecundity values from individual reproductive histories resulted in good agreement between the estimates. Both techniques support the assertion that fecundity is currently too low to maintain viable populations of marbled murrelets in the listed range (Beissinger and Peery 2003).

In 2004, radio telemetry data were used to estimate nest success (McShane et al. 2004). Using a stochastic Leslie Matrix model for each Zone with estimates for immigration, a range of values for survival, and what was considered higher estimates of nest success from radio telemetry data rather than juvenile-to-adult ratio data, McShane et al. (2004) found all zone populations were declining at a mean annual rate of between 2.1 and 6.2 percent per decade (McShane et al. 2004). McShane et al. (2004) predict the highest rate of decline for Zone 6 and the lowest rate of decline for Zone 2.

In summary, all sources concluded that the listed population apparently exhibits a long-term downward trend.

Population Distribution. The historic distribution of the marbled murrelet within its listed range was probably relatively continuous in near-shore waters and in coniferous forests near the coast from the Canadian border south to Monterey County, California (Service 1997). Current breeding populations are discontinuous and generally concentrated at-sea in areas adjacent to remaining late successional coniferous forests near the coast (Nelson 1997). At-sea observations of marbled murrelets are rare between the Olympic Peninsula in Washington and Tillamook County, Oregon, a gap of approximately 100 miles.

Off the California coast, marbled murrelets are concentrated in two areas at-sea that correspond to the three largest remaining blocks of older, coastal forest. The two at-sea concentration areas are located in Humboldt and Del Norte counties in northern California and San Mateo and Santa Cruz counties in central California. These forest blocks are separated by areas of little or no habitat, which correspond to locations at-sea where few marbled murrelets occur. A 300-mile gap occurs in the southern portion of the marbled murrelet’s breeding range, between populations in Humboldt and Del Norte counties in the north and populations in San Mateo and Santa Cruz counties to the south. Marbled murrelets likely occurred in this gap prior to extensive logging of redwood forests (Service 1997).

Threats in the terrestrial environment

Habitat loss

McShane et al. (2004) found that the annual rate of habitat loss has slowed since the marbled murrelet was Federally listed as threatened; however, habitat loss remains a threat to the species due to the continued permitted loss of habitat, and in particular occupied sites.

Predation

Losses of eggs and chicks to avian predators have been determined to be the most important cause of nest failure (Nelson and Hamer 1995a, McShane et al. 2004). Furthermore, McShane et al. (2004) conclude that since listing, threats from predation have actually increased. The abundance of several corvid species has increased dramatically in western North America as a result of forest fragmentation, increased agriculture, and urbanization (McShane et al. 2004). As predator abundance has increased, predation on murrelet chicks and eggs has also increased resulting in decreased reproductive success. This trend is likely to continue as forest fragmentation, agriculture, and urbanization continues to dominate the landscape.

Disturbance

Although detecting effects of sub-lethal noise disturbance at the population level in marbled murrelets is difficult, the potential for effects of noise disturbance on marbled murrelet fitness and reproductive success remains a concern and should not be discounted (McShane et al. 2004). As such, the Service has concluded in recent biological opinions that the potential for injury associated with visual and auditory disturbance to marbled murrelets in the terrestrial environment includes flushing from the nest, aborted feeding, and postponed feedings. These responses by individual marbled murrelets to disturbance stimuli may reduce productivity of the nesting pair, as well as the entire population (Service 1997).

Disease

Though little is known about the potential impact of diseases and biotoxins on marbled murrelets, there is a possibility that marbled murrelets will be negatively affected in the near future because of the cumulative effects of stressors such as oceanic temperature changes, overfishing, and habitat loss (McShane et al. 2004).

Status of the Species: Northern Spotted Owl

Legal Status

The northern 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 (Service 1990a). The Service recovery priority number for the northern spotted owl is 6C, on a scale of 1C (highest) to 18 (lowest) (Service 1983a, 1983b, 2004a). This number reflects a high degree of threat, a low potential for recovery, and the owl's taxonomic status as a subspecies. The "C" reflects conflict with development, construction, or other economic activity. The northern 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 (Service 2004a).

Life History

Taxonomy

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

Physical Description

The northern spotted owl is a medium-sized owl and is the largest of the three subspecies of northern spotted owls (Gutiérrez et al. 1995). It is approximately 46 to 48 centimeters (18 inches to 19 inches) long and the sexes are dimorphic, with males averaging about 13 percent smaller than females. The mean mass of 971 males taken during 1,108 captures was 580.4 grams (1.28 pounds) (out of a range 430.0 to 690.0 grams) (0.95 pound to 1.52 pounds), and the mean mass of 874 females taken during 1,016 captures was 664.5 grams (1.46 pounds) (out of a range 490.0 to 885.0 grams) (1.1 pounds to 1.95 pounds) (P. Loschl and E. Forsman, pers. comm., cited in Service 2008). The northern spotted owl is dark brown with a barred tail and white spots on its head and breast, and it has dark brown eyes surrounded by prominent facial disks. Four age classes can be distinguished on the basis of plumage characteristics (Forsman 1981, Moen et al. 1991). The northern spotted owl superficially resembles the barred owl, a species with which it occasionally hybridizes (Kelly and Forsman 2004). Hybrids exhibit physical and vocal characteristics of both species (Hamer et al. 1994).

Current and Historical Range

The current range of the northern 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 (Service 1990a). The range of the northern spotted owl is partitioned into 12 physiographic provinces (see Figure 1) based on recognized landscape subdivisions exhibiting different physical and environmental features (Thomas et al. 1993). These provinces are distributed across the species' range as follows:

- Four provinces in Washington: Eastern Washington Cascades, Olympic Peninsula, Western Washington Cascades, Western Washington Lowlands

- Five provinces in Oregon: Oregon Coast Range, Willamette Valley, Western Oregon Cascades, Eastern Oregon Cascades, Oregon Klamath

- Three provinces in California: California Coast, California Klamath, California Cascades

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

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

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

Habitat Relationships
<u>Home Range</u>. Home-range sizes vary geographically, generally increasing from south to north, which is likely a response to differences in habitat quality (Service 1990a). Estimates of median size of their annual home range (the area traversed by an individual or pair during their normal activities (Thomas and Raphael 1993)) vary by province and range from 2,955 acres in the Oregon Cascades (Thomas et al. 1990) to 14,211 acres on the Olympic Peninsula (Service 1994a). Zabel et al. (1995) showed that these provincial home ranges are larger where flying squirrels (*Glaucomys sabrinus*) are the predominant prey and smaller where wood rats (*Neotoma* spp.) are the predominant prey. Home ranges of adjacent pairs overlap (Forsman et al. 1984, Solis and Gutiérrez 1990), suggesting that the defended area is smaller than the area used for foraging. Within the home range there is a smaller area of concentrated use during the breeding season (~20 percent of the home range), often referred to as the core area (Bingham and Noon 1997). Northern 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). Northern spotted owls use smaller home ranges during the breeding season and often dramatically increase their home range size during fall and winter (Forsman et al. 1984, Sisco 1990).

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

<u>Habitat Use</u>. Forsman et al. (1984) reported that northern spotted owls have been observed in the following forest types: Douglas-fir, 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. The upper elevation limit at which northern spotted owls occur corresponds to the transition to subalpine forest, which is characterized by relatively simple structure and severe winter weather (Forsman 1975, Forsman et al. 1984).

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

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

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

<u>Habitat Selection.</u> Northern 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 northern spotted owls to fly (Thomas et al. 1990). Forested stands with high canopy closure also provide thermal cover (Weathers et al. 2001) and protection from predators.

While northern spotted owls nest almost exclusively in trees, foraging habitat generally has attributes similar to those of nesting and roosting habitat, but such habitat may not always support successfully nesting pairs (Service 1992a). 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 (Service 1992a). Although Forsman et al. (2002) found that northern spotted owls could disperse through highly fragmented forest landscapes, the stand-level and landscape-level attributes of forests needed to facilitate successful dispersal have not been thoroughly evaluated (Buchanan 2004).

Northern 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 northern spotted owls also occur in younger forest stands, particularly in areas where hardwoods provide a multi-layered structure at an early age (Thomas et al. 1990, Diller and Thome 1999). In mixed conifer forests in the eastern Cascades in Washington, 27 percent of nest sites were in old-growth forests, 57 percent were in the understory reinitiation phase of stand development, and 17 percent were in the stem exclusion phase (Buchanan et al. 1995). In the western Cascades of Oregon, 50 percent of northern spotted owl nests were in late-seral/old-growth stands (greater than 80 years old), and none were found in stands of less than 40 years old (Irwin et al. 2000).

In the Western Washington Cascades, northern 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. Northern spotted owls also used young forest (trees of 20 to 50 centimeters (7.9 inches to 19.7 inches) dbh with greater than 60 percent canopy closure) less often than expected based on this habitat's availability (Herter et al. 2002).

In the Coast Ranges, Western Oregon Cascades and the Olympic Peninsula, radio-marked northern spotted owls selected for old-growth and mature forests for foraging and roosting and used young forests less than predicted based on availability (Forsman et al. 1984, Carey et al. 1990, 1992, Thomas et al. 1990). Glenn et al. (2004) studied northern spotted owls in young forests in western Oregon and found little preference among age classes of young forest.

Habitat use is influenced by prey availability. Ward (1990) found that northern spotted owls foraged in areas with lower variance in prey densities (that is, where the occurrence of prey was more predictable) within older forests and near ecotones of old forest and brush seral stages. Zabel et al. (1995) showed that northern spotted owl home ranges are larger where flying squirrels are the predominant prey and smaller where wood rats 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 northern spotted owls more than large, homogeneous expanses of older forests (Zabel et al. 2003, Franklin et al. 2000, Meyer et al. 1998). In Oregon Klamath and Western Oregon Cascade provinces, Dugger et al. (2005) found that apparent survival and reproduction was positively associated with the proportion of older forest near the territory center (within 730 meters) (2,395 feet). Survival decreased dramatically when the amount of non-habitat (non-forest areas, sapling stands, etc.) exceeded approximately 50 percent of the home range (Dugger et al. 2005). The authors concluded that they found no support for either a positive or negative direct effect of intermediate-aged forest—that is, all forest stages between sapling and mature, with total canopy cover greater than 40 percent—on either the survival or reproduction of northern spotted owls. It is unknown how these results were affected by the low habitat fitness potential in their study area, which Dugger et al. (2005) stated was generally much lower than those in Franklin et al. (2000) and Olson et al. (2004), and the low reproductive rate and survival in their study area, which they reported were generally lower than those studied by Anthony et al. (2006). Olson et al. (2004) found that reproductive rates fluctuated biennially and were positively related to the amount of edge between late-seral and mid-seral forests and other habitat classes in the central Oregon Coast Range. Olson et al. (2004) concluded that their results indicate that while mid-seral and late-seral forests are important to northern spotted owls, a mixture of these forest types with younger forest and non-forest may be best for northern spotted owl survival and reproduction in their study area.

Reproductive Biology

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

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

Dispersal Biology

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

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

Mountains and the Washington Cascades, and between the Olympic Mountains and the Oregon Coast Range (Haig et al. 2001).

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

Food Habits

Northern spotted owls are mostly nocturnal, although they also forage opportunistically during the day (Forsman et al. 1984, Sovern et al. 1994). The composition of the northern spotted owl's diet varies geographically and by forest type. Generally, flying squirrels are the most prominent prey for northern spotted owls in Douglas-fir and western hemlock forests (Forsman et al. 1984) in Washington and Oregon, while dusky-footed wood rats (*N. fuscipes*) are a major part of the diet in the Oregon Klamath, California Klamath, and California Coastal provinces (Forsman et al. 1984, 2001, 2004, Ward et al. 1998, Hamer et al. 2001). Depending on location, other important prey include deer mice (*Peromyscus maniculatus*), tree voles (*Arborimus longicaudus, A. pomo*), red-backed voles (*Clethrionomys* spp.), gophers (*Thomomys* spp.), snowshoe hare (*Lepus americanus*), bushy-tailed wood rats (*N. cinerea*), birds, and insects, although these species comprise a small portion of the northern spotted owl diet (Forsman et al. 1984, 2004, Ward et al. 1998, Hamer et al. 2001).

Other prey species such as the red tree vole (*Arborimus longicaudus),* red-backed voles (*Clethrionomys gapperi),* mice, rabbits and hares, birds, and insects) may be seasonally or locally important (reviewed by Courtney et al. 2004). For example, Rosenberg et al. (2003) showed a strong correlation between annual reproductive success of northern spotted owls (number of young per territory) and abundance of deer mice (r2 = 0.68), despite the fact they only made up 1.6±0.5 percent of the biomass consumed. However, it is unclear if the causative factor behind this correlation was prey abundance or a synergistic response to weather (Rosenberg et al. 2003). Ward (1990) also noted that mice were more abundant in areas selected for foraging by owls. Nonetheless, northern 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 northern spotted owl diet should not be underestimated (Forsman et al. 1984, 2001, 2004).

Population Dynamics

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

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

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

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

Threats

Reasons for Listing

The northern spotted owl was listed as threatened throughout its range "due to loss and adverse modification of suitable habitat as a result of timber harvesting and exacerbated by catastrophic events such as fire, volcanic eruption, and wind storms" (Service 1990a: 26114). More specifically, threats to the northern 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 (Service 1992a). These threats were characterized for each province as severe, moderate, low or unknown (Service 1992a) (The range of the northern 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 northern spotted owl throughout its range, isolation of populations was identified as a severe or moderate threat in 11 provinces, and a decline in population was a severe or moderate threat in 10 provinces. Together, these three factors represented the greatest concerns about range-wide conservation of the northern 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 northern 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 northern 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 northern spotted owls (Courtney et al. 2004). However, great horned owls, an effective predator on northern spotted owls, are closely associated with fragmented forests, openings, and clearcuts (Johnson 1992, Laidig and Dobkin 1995). As mature forests are harvested, great horned owls may colonize fragmented forests, thereby increasing northern spotted owl vulnerability to predation.

New Threats
The Service conducted a 5-year review of the northern spotted owl in 1994 (Service 2004b), for which the Service prepared a scientific evaluation of the status of the northern spotted owl (Courtney et al. 2004). An analysis was conducted assessing how the threats described in 1990 might have changed by 2004. Some of the key threats identified in 2004 are:

- "Although we are certain that current harvest effects are reduced, and that past harvest is also probably having a reduced effect now as compared to 1990, we are still unable to fully evaluate the current levels of threat posed by harvest because of the potential for lag effects…In their questionnaire responses…6 of 8 panel member identified past habitat loss due to timber harvest as a current threat, but only 4 viewed current harvest as a present threat" (Courtney and Gutiérrez 2004:11-7)

- "Currently the primary source of habitat loss is catastrophic wildfire, although the total amount of habitat affected by wildfires has been small (a total of 2.3 percent of the range-wide habitat base over a 10-year period)." (Courtney and Gutiérrez 2004:11-8)
- "Although the panel had strong differences of opinion on the conclusiveness of some of the evidence suggesting [barred owl] displacement of [northern spotted owls], and the mechanisms by which this might be occurring, there was no disagreement that [barred owls] represented an operational threat. In the questionnaire, all 8 panel members identified [barred owls] as a current threat, and also expressed concern about future trends in [barred owl] populations." (Courtney and Gutiérrez 2004:11-8)

<u>Barred Owls</u>. With its recent expansion to as far south as Marin County, California (Gutiérrez et al. 2004), the barred owl's range now completely overlaps that of the northern spotted owl. Barred owls may be competing with northern spotted owls for prey (Hamer et al. 2001) or habitat (Hamer et al. 1989, Dunbar et al. 1991, Herter and Hicks 2000, Pearson and Livezey 2003). In addition, barred owls physically attack northern spotted owls (Pearson and Livezey 2003), and circumstantial evidence strongly indicated that a barred owl killed a northern spotted owl (Leskiw and Gutiérrez 1998). Evidence that barred owls are causing negative effects on northern spotted owls is largely indirect, based primarily on retrospective examination of long-term data collected on northern spotted owls (Kelly et al. 2003, Pearson and Livezey 2003, Olson et al. 2005). It is widely believed, but not conclusively confirmed, that the two species of owls

are competing for resources. However, given that the presence of barred owls has been identified as a negative effect while using methods designed to detect a different species (northern 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 northern spotted owls, based on studies conducted on the west slope of the Cascades in Washington (Hamer 1988, Iverson 1993). However, recent studies conducted in the Pacific Northwest show that barred owls frequently use mature and old-growth forests (Pearson and Livezey 2003, Gremel 2005, Schmidt 2006). In the fire prone forests of eastern Washington, a telemetry study conducted on barred owls showed that barred owl home ranges were located on lower slopes or valley bottoms, in closed canopy, mature, Douglas-fir forest, while northern spotted owl sites were located on mid-elevation areas with southern or western exposure, characterized by closed canopy, mature, ponderosa pine or Douglas-fir forest (Singleton et al. 2005).

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

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

Olson et al. (2004) found that the presence of barred owls had a significant negative effect on the reproduction of northern 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 northern spotted owls in one study (Iverson 2004) was unfounded because of small sample sizes (Livezey 2005). It is likely that all of the above analyses underestimated the effects of barred owls on the reproduction of northern spotted owls because northern spotted owls often cannot be relocated after they are displaced by barred owls (E. Forsman, pers. comm., cited in Service 2008). Anthony et al. (2006) found significant evidence for negative effects of barred owls on apparent survival of northern 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 northern spotted owls throughout their range, only 47 hybrids were detected (Kelly and Forsman 2004). Consequently, hybridization with the barred owl is considered to be "an interesting biological phenomenon that is probably inconsequential, compared with the real threat—direct competition between the two species for food and space" (Kelly and Forsman 2004:808).

The preponderance of evidence suggests that barred owls are exacerbating the northern spotted owl population decline, particularly in Washington, portions of Oregon, and the northern coast of California (Gutiérrez et al. 2004, Olson et al. 2005). There is no evidence that the increasing trend in barred owls has stabilized in any portion of the northern spotted owl's range in the western United States, and "there are no grounds for optimistic views suggesting that barred owl impacts on northern spotted owls have been already fully realized" (Gutiérrez et al. 2004:7-38).

Wildfire. Studies indicate that the effects of wildfire on northern spotted owls and their habitat are variable, depending on fire intensity, severity and size. Within the fire-adapted forests of the northern spotted owl's range, northern spotted owls likely have adapted to withstand fires of variable sizes and severities. Bond et al. (2002) examined the demography of the three northern spotted owl subspecies after wildfires, in which wildfire burned through northern spotted owl nest and roost sites in varying degrees of severity. Post-fire demography parameters for the three subspecies were similar or better than long-term demographic parameters for each of the three subspecies in those same areas (Bond et al. 2002). In a preliminary study conducted by Anthony and Andrews (2004) in the Oregon Klamath Province, their sample of northern 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 northern spotted owl activity centers (Gaines et al. 1997).

Northern 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 northern spotted owls was assumed to have occurred at one site, and northern spotted owls were present at only one of the six sites 1 year after the fire. In 1994, two wildfires burned in the Yakama Indian Reservation in Washington's eastern Cascades, affecting the home ranges of two radio-tagged northern spotted owls (King et al. 1998). Although the amount of home ranges burned was not quantified, northern spotted owls were observed using areas that burned at low and medium intensities. No direct mortality of northern spotted owls was observed, even though thick smoke covered several northern spotted owl site-centers for a week. It appears that, at least in the short term, northern 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 northern spotted owl habitat use.

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

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

Health officials expect that WNV will eventually spread throughout the range of the northern spotted owl (Courtney et al. 2004), but it is unknown how WNV will ultimately affect northern spotted owl populations. Susceptibility to infection and mortality rates of infected individuals vary among bird species, even within groups (Courtney et al. 2004). Owls appear to be quite susceptible. For example, breeding Eastern screech owls (*Megascops asio*) in Ohio experienced 100 percent mortality (T. Grubb, pers. comm., cited in Courtney et al. 2004). Barred owls, in contrast, showed lower susceptibility (B. Hunter, pers. comm., cited in Courtney et al. 2004). Some level of innate resistance may occur (Fitzgerald et al. 2003), which could explain observations in several species of markedly lower mortality in the second year of exposure to WNV (Caffrey and Peterson 2003). Wild birds also develop resistance to WNV through immune responses (Deubel et al. 2001). The effects of WNV on bird populations at a regional scale have not been large, even for susceptible species (Caffrey and Peterson 2003), perhaps due to the short-term and patchy distribution of mortality (K. McGowan, pers. comm., cited in Courtney et al. 2004) or annual changes in vector abundance and distribution.

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

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

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

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

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

Disturbance-Related Effects. The effects of noise on northern spotted owls are largely unknown, and whether noise is a concern has been a controversial issue. The effect of noise on birds is extremely difficult to determine due to the inability of most studies to quantify one or more of the following variables: 1) timing of the disturbance in relation to nesting chronology; 2) type, frequency, and proximity of human disturbance; 3) clutch size; 4) health of individual birds; 5) food supply; and 6) outcome of previous interactions between birds and humans (Knight and Skagan 1988). Additional factors that confound the issue of disturbance include the individual bird's tolerance level, ambient sound levels, physical parameters of sound and how it reacts with topographic characteristics and vegetation, and differences in how species perceive noise.

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

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

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

Conservation Needs of the Spotted Owl

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

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

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

3. Suitable habitat distributed across a variety of ecological conditions within the northern 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 northern 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.

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 northern spotted owls and, for WNV, research into methods that may reduce the likelihood or severity of outbreaks in northern spotted owl populations.

Conservation Strategy
Since 1990, various efforts have addressed the conservation needs of the northern 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 (Service 1992a), the Draft Recovery Plan (Service 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 FS and USDI BLM 1994a). Each conservation strategy was based upon the reserve design principles first articulated in the ISC's report, which are summarized as follows.

- Species that are well distributed across their range are less prone to extinction than species confined to small portions of their range.

- Large blocks of habitat, containing multiple pairs of the species, are superior to small blocks of habitat with only one to a few pairs.
- Blocks of habitat that are close together are better than blocks far apart.

- Habitat that occurs in contiguous blocks is better than habitat that is more fragmented.

- Habitat between blocks is more effective as dispersal habitat if it resembles suitable habitat.

Federal Contribution to Recovery

Since it was signed on April 13, 1994, the NWFP has guided the management of Federal forest lands within the range of the northern spotted owl (USDA FS and USDI BLM 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 northern 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 northern 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 FS and USDI BLM 1994a, Service 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): 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 (Service 1992b) was based on the ISC report.

The Forest Ecosystem Management Assessment Team predicted, based on expert opinion, the northern spotted owl population would decline in the Matrix land use allocation over time, while the population would stabilize and eventually increase within LSRs as habitat conditions improved over the next 50 to 100 years (Thomas and Raphael 1993, USDA FS and USDI BLM 1994a, 1994b). Based on the results of the first decade of monitoring, Lint (2005) could not determine whether implementation of the NWFP would reverse the northern spotted owl's declining population trend because not enough time had passed to provide the necessary measure of certainty. However, the results from the first decade of monitoring do not provide any reason to depart from the objective of habitat maintenance and restoration as described in the NWFP (Lint 2005, Noon and Blakesley 2006). Bigley and Franklin (2004) suggested that more fuels treatments are needed in east-side forests to preclude large-scale losses of habitat to stand-replacing wildfires. Other stressors that occur in suitable habitat, such as the range expansion of the barred owl (already in action) and infection with WNV (which may or may not occur) may complicate the conservation of the northern spotted owl. Recent reports about the status of the northern spotted owl offer few management recommendations to deal with these emerging threats. The arrangement, distribution, and resilience of the NWFP land use allocation system may prove to be the most appropriate strategy in responding to these unexpected challenges (Bigley and Franklin 2004).

Under the NWFP, the agencies anticipated a decline of northern spotted owl populations during the first decade of implementation. Recent reports (Courtney et al. 2004, Anthony et al. 2006) identified greater than expected northern 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 northern spotted owls at the meta-population scale. However, at the territory scale, there is evidence of negative effects to northern spotted owl fitness due to reduced habitat quantity and quality. Also, there is no evidence to suggest that dispersal habitat is currently limiting (Courtney et al. 2004, Lint 2005). Even with the population decline, Courtney et al (2004) noted that there is little reason to doubt the effectiveness of the core principles underpinning the NWFP conservation strategy.

The current scientific information, including information showing northern spotted owl population declines, indicates that the northern spotted owl continues to meet the definition of a threatened species (Service 2004b). 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 (Service 2008). 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 range-wide threats to the northern spotted owl (Service 2008). 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) (Service 2008). 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 northern spotted owls, and, if recommended by research, management of barred owls (USDI 2008). 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 northern spotted owls over time and allow for movement of northern spotted owls across the network (Service 2008). 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 northern spotted owl habitat in an environment of frequent natural disturbances (Service 2008). 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 (Service 2008). 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 (Service 2008). The three primary elements of this program include 1) the monitoring of northern spotted owl population trends, 2) an inventory of northern spotted owl distribution, and 3) a comprehensive program of barred owl research and monitoring (Service 2008). The recovery plan estimates that recovery of the northern spotted owl could be achieved in approximately 30 years (Service 2008).

Conservation Efforts on Non-Federal Lands
In the report from the Interagency Scientific Committee (Thomas et al. 1990), the draft recovery plan (Service 1992b), and the report from the Forest Ecosystem Management Assessment Team (Thomas and Raphael 1993), it was noted that limited Federal ownership in some areas constrained the ability to form a network of old-forest reserves to meet the conservation needs of the northern spotted owl. In these areas in particular, non-Federal lands would be important to the range-wide goal of achieving conservation and recovery of the northern spotted owl. The Service's primary expectations for private lands are for their contributions to demographic support (pair or cluster protection) to Federal lands, or their connectivity with Federal lands. In addition, timber harvest within each state is governed by rules that provide protection of northern 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 northern spotted owls—eight in Washington, three in Oregon, and four in California. The HCPs range in size from 40 acres to more than 1.6 million acres, although not all acres are included in the mitigation for northern 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 northern 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 northern 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 northern spotted owl conservation (Hanson et al. 1993, Buchanan et al. 1994). The 1996 rule package was developed by a stakeholder policy group and then reviewed and approved by the Forest Practices Board (Buchanan and Swedeen 2005). Northern spotted owl-related HCPs in Washington generally were intended to provide demographic or connectivity support (Service 1992b).

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

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

Current Condition of the Spotted Owl

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

Range-wide Habitat and Population Trends

Habitat Baseline. The 1992 Draft Spotted Owl Recovery Plan estimated approximately 8.3 million acres of northern spotted owl habitat remained range-wide (USDI 1992b). However, reliable habitat baseline information for non-Federal lands is not available (Courtney et al. 2004). The Service has used information provided by the Forest Service, Bureau of Land Management, and National Park Service to update the habitat baseline conditions on Federal lands for northern spotted owls on several occasions since the northern spotted owl was listed in 1990. The estimate of 7.4 million acres used for the NWFP in 1994 (USDA and USDI 1994a) was believed to be representative of the general amount of northern 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 northern spotted owl habitat throughout the range of the northern spotted owl was produced as a result of the NWFP's effectiveness monitoring program (Lint 2005). However, the spatial resolution of this new habitat map currently makes it unsuitable for tracking habitat effects at the scale of individual projects. The Service is evaluating the map for future use in tracking habitat trends. Additionally, there continues to be no reliable estimates of northern spotted owl habitat on non-Federal lands; consequently, consulted-on acres can be tracked, but not evaluated in the context of change with respect to a reference condition on non-Federal lands. The production of the monitoring program habitat map does, however, provide an opportunity for future evaluations of trends in non-Federal habitat.

NWFP Lands Analysis 1994 – 2001. In 2001, the Service conducted an assessment of habitat baseline conditions, the first since implementation of the NWFP (Service 2001). This range-wide evaluation of habitat, compared to the FSEIS, was necessary to determine if the rate of potential change to northern 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 FS and USDI BLM 1994a), with effects expressed in terms of changes in suitable northern 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 (Service 2001).

Range-wide Analysis 1994 – July 24, 2008. This section updates the information considered in Service (2001), relying particularly on information in documents the Service produced pursuant to section 7 of the Act and information provided by NWFP agencies on habitat loss resulting from natural events (e.g., fires, windthrow, insect and disease). To track impacts to northern spotted owl habitat, the Service designed the Consultation Effects Tracking System database which records impacts to northern spotted owls and their habitat at a variety of spatial and temporal scales. Data are entered into the database under various categories including, land management agency, land-use allocation, physiographic province, and type of habitat affected.

In 1994, about 7.4 million acres of suitable northern spotted owl habitat were estimated to exist on Federal lands managed under the NWFP. As of October 16, 2008, the Service had consulted on the proposed removal of approximately 204,769 acres (Table 4) or 2.8 percent of 7.4 million acres (Table 5) of northern spotted owl suitable habitat on Federal lands. Of the total Federal acres consulted on for removal, approximately 185,583 acres or 2.5 percent of 7.4 million acres of northern spotted owl habitat were removed as a result of timber harvest. These changes in suitable northern 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 acres of habitat on federal NWFP lands that were consulted on and removed and downgraded in reserves and non-reserves in Table 5 do not match those acres of federal NWFP lands that were consulted on and removed and downgraded in Table 4. Until the technical difficulties are resolved, we continue to include Table 5 because it is useful for providing an approximate breakdown of habitat impacts by physiographic province and state.

Habitat loss from Federal lands due to management activities has varied among the individual provinces with most of the impacts concentrated within the Non-Reserve relative to the Reserve land-use allocations (Table 5). When habitat loss is evaluated as a proportion of the affected acres range-wide, the most pronounced losses have occurred within Oregon (83 percent), especially within its Klamath Mountains (49 percent) and Cascades (East and West) (34 percent) Provinces (Table 5), followed by much smaller habitat losses in Washington (8 percent) and California (9 percent) (Table 5). When habitat loss is evaluated as a proportion of provincial baselines, the Oregon Klamath Mountains (22.3 percent), Cascades East (7.4 percent), and the California Cascades (5.5 percent) all have proportional losses greater than the range-wide mean (4.9 percent) (Table 5).

From 1994 through July 24, 2008, habitat lost due to natural events was estimated at approximately 167,894 acres range-wide (Table 5). 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 northern spotted owl habitat, including habitat within five LSRs (Table 5[8]). Approximately 18,630 acres of northern spotted owl habitat were lost due to the B&B Complex and Davis Fires in the East Cascades Province of Oregon (Table 5[9]).

Because there is no comprehensive northern spotted owl habitat baseline for non-Federal lands, there is little available information regarding northern 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 acres of habitat on non-Federal lands (Table 4). 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 624,442 acres of northern spotted owl habitat range-wide, resulting from all management activities, as of October 16, 2008 (Table 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 northern spotted owl habitat in 2004 on lands affected by state and private forest practices. The study area is a subset of the total Washington forest practice lands, and statistically-based estimates of existing habitat and habitat loss due to fire and timber harvest are provided. In the 3.2-million acre study area, Pierce et al. (2005) estimated there was 816,000 acres of suitable northern spotted owl habitat in 2004, or about 25 percent of their study area. Based on their results, Pierce and others (2005) estimated there were less than 2.8 million acres of northern spotted owl habitat in Washington on all ownerships in 2004. Most of the suitable owl habitat in 2004 (56 percent) occurred on Federal lands, and lesser amounts were present on state-local lands (21 percent), private lands (22 percent) and tribal lands (1 percent). Most of the harvested northern spotted owl habitat was on private (77 percent) and state-local (15 percent) 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 northern spotted owl habitat. This represented a loss of about 6 percent of the owl habitat in the study area distributed across all ownerships (Pierce et al. 2005). Approximately 77 percent of the harvested habitat occurred on private lands and about 15 percent occurred on State lands.

Pierce and others (2005) also evaluated suitable habitat levels in 450 northern spotted owl management circles (based on the provincial annual median northern 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 northern spotted owl territories (Pierce et al. 2005).

Moeur et al. 2005 estimated an increase of approximately 1.25 to 1.5 million acres of medium and large older forest (greater than 20 inches dbh, single and multi-storied canopies) on Federal lands in the 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. The estimates were based on change-detection layers for losses due to harvest and fire and remeasured inventory plot data for increases due to ingrowth. Transition into and out of medium and large older forest over the 10-year period was extrapolated from inventory plot data on a subpopulation of Forest Service land types and applied to all Federal lands. Because size class and general canopy layer descriptions do not necessarily account for the complex forest structure often associated with northern spotted owl habitat, the significance of these acres to northern spotted owl conservation remains unknown.

Spotted Owl Numbers, Distribution, and Reproduction Trends. There are no estimates of the size of the northern spotted owl population prior to settlement by Europeans. Northern 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 (Service 1989). According to the final rule listing the northern spotted owl as threatened (Service 1990a), approximately 90 percent of the roughly 2,000 known northern 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 northern spotted owls on private lands in northern California was slightly higher (Forsman et al. 1984, Service 1989, Thomas et al. 1990).

The current range of the northern 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 (Service 1990a). The range of the northern spotted owl is partitioned into 12 physiographic provinces (Figure 1) based on recognized landscape subdivisions exhibiting different physical and environmental features (Thomas et al. 1993). The northern 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 northern 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 (Service 1995). By June 2004, the number of territorial northern spotted owl sites recognized by Washington Department of Fish and Wildlife was 1,044 (Buchanan and Swedeen 2005. The actual number of currently occupied northern spotted owl locations across the range is unknown because many areas remain unsurveyed (Service 1992a, Thomas et al. 1993). In addition, many historical sites are no longer occupied because northern 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 Service (1995) represent the cumulative number of locations recorded in the three states, not population estimates.

Because the existing survey coverage and effort are insufficient to produce reliable range-wide estimates of population size, demographic data are used to evaluate trends in northern 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 northern spotted owl.

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

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

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

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

There are few northern spotted owls remaining in British Columbia. Chutter et al. (2004) suggested immediate action was required to improve the likelihood of recovering the northern spotted owl population in British Columbia. So, in 2007, personnel in British Columbia captured and brought into captivity the remaining 16 known wild northern spotted owls. Prior to initiating the captive-breeding program, the population of northern spotted owls in Canada was declining by as much as 35 percent per year (Chutter et al. 2004). The amount of previous interaction between northern spotted owls in Canada and the United States is unknown (Chutter et al. 2004).

Environmental Baseline (In the Action Area): Marbled Murrelet

Regulations implementing the Act (50 CFR §402.02) define the environmental baseline as the past and present impacts of all Federal, State, or private actions and other human activities in the action area, the anticipated impacts of all proposed Federal projects in the action area that have already undergone formal or early section 7 consultation, and the impact of State or private actions which are contemporaneous with the consultation process. As stated earlier, the action area for this consultation includes 16 acres within 0.15 mile of the proposed action.

Conservation Needs of the Marbled Murrelet in the Action Area

The primary conservation need of the marbled murrelet in California State Parks, as identified in the recovery plan, is to minimize nest disturbances to increase reproductive success (Service 1997). The recovery plan recommends considering the need to maintain high quality marbled murrelet habitat when planning recreational projects in the California State Parks. Recreational facilities may present threats to marbled murrelets through loss of habitat, nest disturbance, and increased predation from corvids (Service 1997).

Current Condition in the Action Area

Habitat

Richardson Grove State Park is approximately 1,598 acres in size. For the purpose of this consultation, the Service assumes that marbled murrelets could occupy all old-growth forest stands in Richardson Grove State Park. Based upon cursory reviews of aerial imagery (i.e., Google Earth imagery) of Richardson Grove State Park, and a vegetation map in California Department of Parks and Recreation (2001), we estimate that 32 percent of Richardson Grove State Park (approximately 512 acres) is comprised of old-growth habitat. As stated earlier in this biological opinion, the action area consists of approximately 229 acres that occur within 0.25 mile of the proposed action. Accordingly, we estimate that approximately 73 acres of old-growth habitat suitable for nesting by marbled murrelets occurs within the action area.

Marbled Murrelets: Numbers, Distribution, and Reproduction

Richardson Grove State Park is located in marbled murrelet conservation Zone 4. Since 2000, monitoring to determine marbled murrelet population trends has occurred annually in Zone 4 as part of the effectiveness monitoring for the NWFP (Huff et al. 2003). For sampling purposes, Zone 4 was divided into two strata. The northern strata includes the area from Coos Bay, Oregon to Big Lagoon, California and the southern strata the area from Big Lagoon south to Shelter Cove, California. The southern strata occurs offshore of lands owned and managed by the State of California.

Long et al. (2007) did not detect a decline in numbers of marbled murrelets in Zone 4, based on results from at-sea surveys during 2000-07. However, they cited Miller et al. (2006), and stated that a power analysis based on the first four years of data estimated that eleven years of sampling are needed to detect a 5 percent annual decrease in population in Zone 4 with 80 percent power. Long et al. (2007) estimated a population of 208 marbled murrelets in the southern stratum of Zone 4 (i.e., southern Humboldt County region) in 2007, with a 95 percent CI of 145 to 528 birds. No juvenile marbled murrelets were identified during at-sea surveys in 2005-07 in the southern Humboldt County region, which includes the area offshore of the Headwaters Forest and Richardson Grove State Park (Long et al. 2007). Data are not available regarding reproductive success of marbled murrelets nesting in Richardson Grove State Park.

Environmental Baseline (In the Action Area): Northern Spotted Owl

Conservation Needs of the Northern Spotted Owl in the Action Area

The primary conservation need of the northern spotted owl in California State Parks, as identified in the recovery plan, is to function as Conservation Support Areas (CSAs) to improve habitat to support nearby Managed Owl Conservation Areas (MOCAs) (Service 2008). CSAs may function to provide demographic support to core northern spotted owl populations in the MOCA network or dry-forest landscape management areas, facilitate dispersal of juvenile northern spotted owls among MOCAs, or serve both of these functions (Service 2008).

Current Condition in the Action Area

Habitat

Richardson Grove State Park is approximately 1,598 acres in size. For the purpose of this consultation, the Service assumes that northern spotted owls could occupy all old-growth forest stands in Richardson Grove State Park. Based upon cursory reviews of aerial imagery (i.e., Google Earth imagery) of Richardson Grove State Park, and a vegetation map in California Department of Parks and Recreation (2001), we estimate that 32 percent of Richardson Grove State Park (approximately 512 acres) is comprised of old-growth habitat. As stated earlier in this biological opinion, the action area consists of approximately 229 acres that occur within 0.25 mile of the proposed action. Accordingly, we estimate that approximately 73 acres of old-growth habitat suitable for nesting by northern spotted owls occurs within the action area.

Northern Spotted Owls: Numbers, Distribution, and Reproduction

The nearest known northern spotted owl activity center (breeding pair in year 2001) occurs approximately 0.8 mile northeast of the action area, and at least six occurrences of northern spotted owls occur within 2.5 miles of the action area (California Department of Fish and Game 2008). Data are not available regarding the reproductive status of northern spotted owls in Richardson Grove State Park.

Barred Owls:

We are aware of the following three observations of barred owls near the action area: a barred owl (sex unknown) observed 0.8 mile northeast of the action area in year 2000; a female barred owl observed in action area in year 2001; and a male barred owl observed in the action area in year 2004.

Effects of the Action

This section presents an analysis of the direct and indirect effects of the action, including interrelated and interdependent actions, on the marbled murrelet and northern spotted owl. These effects are then evaluated with respect to the conservation needs of the marbled murrelet and northern spotted owl within the action area and within the larger conservation strategy established in the recovery plans. Marbled murrelet and northern spotted owl occupancy of suitable habitat has been assumed based on availability of nesting habitat in the action area.

Likelihood of the Presence of Marbled Murrelets and Northern Spotted Owls

Based on the presence of old-growth habitat in the action area, the Service assumes that all stands with trees providing nesting opportunities have the potential to be occupied by marbled murrelets and northern spotted owls.

Effects of the Action: Marbled Murrelet

Habitat Modification

No marbled murrelet nesting habitat will be removed or degraded by the action. None of the trees that are proposed to be removed are potential nest trees, nor do they provide cover for potential nesting platforms. All of the trees that are proposed to be removed will be felled to avoid impacts to potential nest trees and trees adjacent to potential nest trees. Since all potential nest trees, potential nesting platforms, and trees providing protective cover around nesting platforms will be retained, impacts due to the proposed action do not reach the level of habitat degradation.

Disturbance

Scientific Basis for Evaluating Potential Effects on the Marbled Murrelet

Disturbance is defined as noise in excess of ambient levels in or near suitable nesting habitat or as the reaction of nesting birds to human presence or activity, resulting in disruption of essential breeding behavior. Disturbance during the marbled murrelet breeding season may potentially disrupt the species' essential breeding behaviors by: 1) causing abandonment of the breeding effort by failure to initiate nesting or to complete incubation; 2) disrupting nesting activity such as feeding young; and 3) causing premature dispersal of juveniles.

Activities that require use of heavy equipment, chainsaws, helicopters, and large vehicles introduce noise, visual, and air disturbances into the environment. The effects of auditory and visual disturbances on birds are extremely difficult to determine (Knight and Skagen 1988). Confounding factors include the tolerance level of individual birds, type and frequency of human activity, ambient sound levels, how sound reacts with topography and vegetation, and differences in how species perceive noise and human presence. Regardless of these difficulties, research conducted on a variety of bird species does suggest that the effects of human disturbance can have a negative impact on reproductive success (Carney and Sydeman 1999, Frid and Dill 2002, Marzluff and Neatherlin 2006). Disturbance can affect productivity in a number of ways, including interference of courtship (Bednarz and Hayden 1988), nest abandonment (White and Thurow 1985), egg and hatchling mortality, due to exposure and predation (Drent 1972; Swensen 1979), and altered parental care (Fyfe and Olendorrf 1976; Bortolotti et al. 1984).

Though largely inconclusive, Hébert and Golightly (2003) examined the effects of operating chainsaw noise during incubation and chick rearing periods on nesting adult marbled murrelets and chicks. Adult marbled murrelets and chicks both spent less time motionless and resting and more time exhibiting "raised head" and "bill up" behaviors during the disturbance trial than pre- and post-trial. The relevance of these behaviors is unknown; however, a species that relies on being cryptic and motionless to avoid predation at the nest may risk being detected by a predator if it moves more often.

Data on timing of various aspects of the breeding season indicate that marbled murrelets in California have the longest breeding period with the listed range. Incubation commences as early as March 24 and ends as late as August 13; the nestling period may begin April 23 and end September 9 (Hamer and Nelson 1995). In California, we have defined the marbled murrelet breeding season as the period from March 24 through September 15. Data from marbled murrelet populations throughout North America show that approximately 84 percent of marbled murrelet young fledge from their nests by August 18 (Hamer and Nelson 1995). The latest fledging date was a record of a fledgling found on September 21 in Oregon (Hamer and Nelson 1995).

Effects of the Action - Disturbance
Three primary construction-related activities are proposed to occur in or near Richardson Grove State Park during all or most of the breeding season of the marbled murrelet, including: 1) excavation of slopes and construction of the retaining wall (February 1, 2010 through July 1, 2010); 2) cut and fill (February 1, 2010 through September 30, 2010); and 3) culvert work (June 1, 2010 through October 15, 2010). Paving (September 1, 2010 through October 30, 2010) would occur during the final two weeks of the marbled murrelet breeding season.

Injury or Mortality
No marbled murrelet nesting habitat will be removed or degraded as a result of the action along Highway 101 at Richardson Grove State Park, between PM 1.1 and PM 2.2. Consequently, the likelihood that the action will result in direct mortality of marbled murrelets, particularly to young or the loss of eggs, is discountable.

Summary of Project Effects on Numbers, Distribution, and Reproduction
No suitable marbled murrelet nesting habitat will be removed or degraded. The proposed project may result in noise disturbance (i.e., harassment) to breeding marbled murrelets during one breeding season. We have no evidence that marbled murrelets nest in Richardson Grove State Park; however, we estimate that at least one nesting pair of marbled murrelets associated with 250 acres of suitable nesting habitat may be subjected to disturbance during the breeding season.

In the short-term, conservation needs of the marbled murrelet include the protection of occupied habitat, minimizing disturbance, and reducing predation at nest sites. The proposed project may result in limited short-term harassment of marbled murrelets that nest in 250 acres of suitable habitat. Over the long-term, the conservation needs of the marbled murrelet focus on the retention or development of suitable habitat to stop population decline and increase population growth.

Effects of the Action - Northern Spotted Owl

Habitat Modification
No northern spotted owl nesting habitat will be removed or degraded by the action. None of the trees that are proposed to be removed are potential nest trees. All of the trees that are proposed to be removed will be felled to avoid impacts to potential nest trees and trees adjacent to potential nest trees. Since all potential nest trees will be retained, impacts due to the action do not reach the level of habitat degradation.

Disturbance
Scientific Basis for Evaluating Potential Effects on the Northern Spotted Owl
Disturbance is defined as noise in excess of ambient levels in or near suitable nesting habitat or as the reaction of nesting birds to human presence or activity, resulting in disruption of essential breeding behavior. Disturbance during the northern spotted owl breeding season may potentially disrupt the species' essential breeding behaviors by: 1) causing abandonment of the breeding effort by failure to initiate nesting or to complete incubation; 2) disrupting nesting activity such as feeding young; and 3) causing premature dispersal of juveniles.

Effects of the Action - Disturbance
Three primary construction-related activities are proposed to occur in or near Richardson Grove State Park during all or most of the breeding season of the northern spotted owl, including: 1) excavation of slopes and construction of the retaining wall (February 1, 2010 through July 1, 2010); 2) cut and fill (February 1, 2010 through September 30, 2010); and 3) culvert work (June 1, 2010 through October 15, 2010). Paving (September 1, 2010 through October 30, 2010) would occur outside the breeding season of the northern spotted owl.

Injury or Mortality
No northern spotted owl nesting habitat will be removed or degraded as a result of the action along Highway 101 at Richardson Grove State Park, between PM 1.1 and PM 2.2. Consequently, the likelihood that the action will result in direct mortality of northern spotted owls, particularly to young or the loss of eggs, is discountable.

Summary of Project Effects on Numbers, Distribution, and Reproduction
No suitable northern spotted owl habitat will be removed or degraded. The proposed project may result in disturbance to breeding northern spotted owls during one breeding season. We have no evidence that northern spotted owls nest in Richardson Grove State Park; however, we estimate that at least one nesting pair of northern spotted owls associated with 250 acres of suitable nesting habitat may have be subjected to disturbance during the breeding season.

In the short-term, conservation needs of the northern spotted owl are the protection of occupied habitat, minimizing disturbance, and reducing predation at nest sites. The proposed project may result in limited short-term harassment of northern spotted owls that may nest in 250 acres of suitable habitat. Over the long-term, the conservation needs of the northern spotted owl focus on the retention or development of suitable habitat to stop population decline and increase population growth.

Cumulative Effects: Marbled Murrelet and Northern Spotted Owl

Cumulative effects include the effects of future State, tribal, local or private actions that are reasonably certain to occur within the action area considered in this biological opinion. 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. Non-federal actions that are reasonably certain to occur within the action area include vehicular traffic along Highway 101, and pedestrian utilization of trails within Richardson Grove State Park. Because only a few marbled murrelets and/or northern spotted owls are likely to be within the action area, we expect that any harassment from noises created by vehicular traffic and hikers would not substantially affect the survival and recovery of marbled murrelets and northern spotted owls. Hikers utilizing trails within the action area could be a source of discarded food and trash, which could attract corvids, which could subsequently prey upon marbled murrelet adults, chicks and eggs. However, although some hikers could discard trash and food, the majority of litter and unattended and/or discarded food likely occurs within State Park campgrounds that occur outside of the action area. Therefore, the Service expects that the attraction of corvids to litter within the action area is less likely than in campgrounds, and would not substantially affect the survival and recovery of marbled murrelets. The Service is interested in future collaboration with personnel from Richardson Grove State Park, to educate hikers and campers about the threat that corvids pose to marbled murrelets, and how the careless disposition of garbage and food attracts corvids to areas adjacent to and within marbled murrelet nesting habitat.

Conclusion

Marbled Murrelet and Northern Spotted Owl

After reviewing the current status of both the marbled murrelet and the northern spotted owl, the environmental baseline, the effects of the action, and the cumulative effects, it is the Service's biological opinion that implementation of the emergency road and slope repair activities along Highway 101 at between PM 1.1 and PM 2.2 likely will not jeopardize the continued existence of the marbled murrelet or northern spotted owl.

The Service reached the non-jeopardy conclusion based on the following factors:

1. The proposed action will not remove or degrade suitable marbled murrelet or northern spotted owl nesting habitats.

2. It is not known whether marbled murrelets or northern spotted owls nest within the action area. However, any nesting marbled murrelets and northern spotted owls occurring within the estimated 250 acres of suitable habitat in the action area may be subject to possible harassment during the breeding season when the proposed action occurs. This is a relatively-short term one-time disturbance that we expect will not have a long-term influence on the breeding performance of marbled murrelets or northern spotted owls at this location.

INCIDENTAL TAKE STATEMENT

Introduction

Section 9 of the Act and Federal regulation pursuant to section 4(d) of the Act prohibit the taking 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 attempt to engage in any such conduct. Harm is further defined (50 CFR 17.3) by the Service to include significant habitat modification or degradation that results in death or injury to listed species by significantly impairing behavioral patterns such as breeding, feeding, or sheltering. Harass is defined by the

Service (50 CFR 17.3) as actions that create the likelihood of injury to a 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.

Amount or Extent of Take

The minimization measures developed in cooperation with the Service were designed to minimize incidental take of marbled murrelets and northern spotted owls that might otherwise have resulted from road realignment and vegetation removal activities along Highway 101 between PM 1.1 and PM 2.2. Although quantification of take of marbled murrelets and northern spotted owls is difficult, we conclude that zero marbled murrelets and zero northern spotted owls will be injured or killed by the road realignment and vegetation removal activities. We further conclude that two marbled murrelets (i.e., one nesting pair) and two northern spotted owls (i.e., one nesting pair) may be harassed by the road realignment and vegetation removal activities.

Effect of the Take

In the accompanying biological opinion, the Service has determined that this level of take will not likely result in jeopardy to the marbled murrelet or northern spotted owl.

REASONABLE AND PRUDENT MEASURES

The Service believes the following reasonable and prudent measures are necessary and appropriate to minimize incidental take of marbled murrelets and northern spotted owls.

1. Biologists must be approved by the Service before they conduct the worker-awareness training program(s).

2. Caltrans must use well-defined procedures to minimize adverse effects to marbled murrelets and northern spotted owls.

3. Caltrans must ensure that the level of incidental take that occurs during project implementation is commensurate with the analysis contained herein.

TERMS AND CONDITIONS

In order to be exempt from the prohibitions of section 9 of the Act, Caltrans must comply with the following terms and conditions, which implement the reasonable and prudent measures, described above, and outline required reporting/monitoring requirements. These terms and conditions are non-discretionary.

1. The following term and condition implements reasonable and prudent measure 1:

Caltrans will contact our office with the name(s) and qualifications of the Caltrans biologist(s) or hired environmental consultant(s) to be approved to conduct the worker-awareness training program(s).

2. The following term and conditions implement reasonable and prudent measure 2:

   a. As part of the worker awareness training, the Caltrans biologist(s) will include descriptions of the vocalizations (calls) of marbled murrelets, northern spotted owls, and barred owls. The descriptions will include audio recordings, and timing (i.e., within year and time of day) when the various calls might be expected to be heard. The Caltrans biologist(s) will ensure that the person(s) designated to monitor on-site compliance with all minimization measures is (are) able to identify these species by their calls.

   b. If a marbled murrelet or northern spotted owl is heard or seen (e.g., by the Caltrans biologist and/or on-site monitor) during the course of any of the project activities, Caltrans will contact our office immediately so we can review the project activities to determine if additional protective measures are needed.

3. The following term and condition implements reasonable and prudent measure 3:

   The person(s) designated to monitor on-site compliance with all minimization measures will contact the Service-approved Caltrans biologist to ensure that worker awareness programs, as outlined in minimization measure #1, above, are conducted for new personnel before they join construction activities.

The reasonable and prudent measures with their implementing terms and conditions are designed to minimize the impact of incidental take that might otherwise result from the proposed action. If, during the course of the action this level of incidental take is exceeded, such incidental take would represent new information requiring re-initiation of consultation and review of the reasonable and prudent measures provided. Caltrans must immediately provide an explanation of the causes of the taking and review with the Service the need for possible modification of the reasonable and prudent measures.

MONITORING REQUIREMENTS

In order to monitor the impacts of incidental take, Caltrans must report the progress of the action and its impacts on the species to the Service, as specified below.

Caltrans must provide a written annual report to the Service by January 31 of each year this biological opinion is in effect, in accordance with 50 CFR 13.45 and 18.27. The report must describe the work completed during the previous calendar year, and avoidance and minimization measures implemented during the previous year. The report must also include the number of marbled murrelets and northern spotted owls heard or seen (detected) during project activities, and include the date, time, and specific location of any detections. The report must contain a discussion of the activities conducted, any problems encountered in implementing terms and conditions or minimization measures, and any recommendations for improving the protective measures.

REPORTING REQUIREMENTS

Any dead or injured marbled murrelet or northern spotted owl must be reported to the Service's Law Enforcement Division (916-979-2987) or the Arcata Fish and Wildlife Office as soon as possible, and turned over to the Law Enforcement Division or a game warden or biologist of the California Department of Fish and Game for care or analysis. The Service is to be notified in writing within three working days of the accidental death of, or injury to, a marbled murrelet or northern spotted owl or of the finding of any dead or injured marbled murrelet or northern spotted owl during implementation of the proposed action. Notification must include the date, time, and location of the incident or discovery of a dead or injured marbled murrelet or northern spotted owl, as well as any pertinent information on circumstances surrounding the incident or discovery. The Service contact for this written information is the Field Supervisor for the Arcata Fish and Wildlife Office at (707) 822-7201.

COORINATION OF INCIDENTAL TAKE WITH OTHER LAWS, REGULATIONS, AND POLICIES

The incidental take statement provided in this biological opinion satisfies the requirements of the Act. The Service will not refer the incidental take of any migratory bird or bald eagle for prosecution under the Migratory Bird Treaty Act of 1918, as amended (16 U.S.C. §§ 668-668d), if such take is in compliance with the terms and conditions, including the amount and/or number specified herein.

CONSERVATION RECOMMENDATIONS

Sections 2(c) and 7(a)(1) of the Act direct Federal agencies to utilize their authorities to further the purposes of the Act by carrying out conservation programs for the benefit of endangered and threatened species and the ecosystems upon which they depend. Conservation recommendations are discretionary agency activities to minimize or avoid adverse effects of a proposed action on listed species or critical habitat, to help implement recovery plans, or to develop information.

The Service has identified the following conservation recommendations that could be implemented by Caltrans:

1. Coordinate with the Service and California Department of Parks and Recreation to survey for and monitor nesting activities of marbled murrelets and northern spotted owls on other lands owned and managed by the Department of Parks and Recreation (e.g., Humboldt Redwood State Parks).

2. Coordinate with the Service and California Department of Parks and Recreation to reduce litter (that could attract corvids) by installing additional predator-proof trash containers at

Richardson Grove State Park, and/or other campground and picnic areas on lands owned and managed by the Department of Parks and Recreation.

3. Coordinate with the Service, California Department of Parks and Recreation, and California Department of Fish and Game to conduct public outreach at various State Parks (e.g., through the use of informational signs), to inform the public of measures that can be taken (e.g., proper disposal of trash in campgrounds) by the public to minimize predation of marbled murrelets by corvids.

4. Coordinate with the Service, California Department of Fish and Game, and California Department of Parks and Recreation to conduct research in State Parks into techniques which may reduce and/or control populations of jays and other corvids, to reduce predation of marbled murrelet nests.

5. Coordinate with the California Department of Parks and Recreation to develop a vegetation map of Richardson Grove State Park, which quantifies and describes the locations of the various vegetation communities that occur there.

6. Coordinate with the Service, California Department of Fish and Game, California Department of Parks and Recreation, and others to conduct near-shore at-sea boat surveys for marbled murrelets in northern California. For example, Caltrans could serve as a non-Federal entity that provides (in part) the 25 percent match (in kind support and/or direct funding) for the Service's section 6 "traditional" funds, which could help fund at-sea surveys for marbled murrelets.

In order for the Service to be kept informed of actions minimizing or avoiding adverse effects or benefiting listed, proposed, or candidate species or their habitats, the Service requests notification of the implementation of any conservation recommendations.

This concludes formal consultation on the road and slope repair activities along Highway 101 between PM 1.1 and PM 2.2. If you have any questions regarding this biological opinion, please contact Bill McIver of my staff at (707) 822-7201.

Sincerely,

Acting for

Michael M. Long
Field Supervisor

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TABLES

Table 1. Estimated acreage of potentially occupied marbled murrelet nesting habitat at various landscape scales within the species' listed range (USDI Fish and Wildlife Service 2003).

Landscape scale[1]	Acres
Washington	
MMCZ1	No estimate available
MMCZ2	No estimate available
TOTAL	No estimate available
Oregon	
MMCZ3 and 4	408,621
TOTAL	408,621
California	
MMCZ4(CA)	67,618[2]
MMCZ5	430
MMCZ6	7,250
TOTAL	75,298
2 State (Oregon and California)	
OR	408,621
CA	75,298
TOTAL	**483,919**

1 MMCZ = Marbled Murrelet Conservation Zone.
Recently adjusted to include Richardson Grove State Park acres: 8,672 from USDI Fish and Wildlife Service and USDC National Marine Fisheries Service 1999.

Table 2. Marbled murrelet population point estimates and associated 95 percent confidence intervals (CI) by Zone within the listed range.

	2000 Population Point Estimate	95 % CI	**2001** Population Point Estimate	95 % CI	**2002** Population Point Estimate	95 % CI	**2003** Population Point Estimate	95 % CI
Zone 1[1]	5,637	2,998 – 8,537	8,936	5,536 – 12,583	9,717	6,075 – 14,027	5,473	5,740 – 11,708
Zone 2[1]	1,252	727 – 2,228	1,738	575 – 3,888	2,619	565 – 3,784	3,071	1,959 – 5,039
Zone 3[1]	6,724	3,955 – 9,941	7,538	5,341 – 9,292	6,271	3,957 – 10,060	7,781	3,895 – 7,550
Zone 4[1]	4,880	3,535 – 9,299	3,851	2,919 – 6,532	4,816	3,608 – 6,247	4,169	3,437 – 6,710
Zone 5[1]	79	11 – 259	117	14 - 259	250	30 - 412	84	0 - 88
Zone 6[2]	NA		661	556 - 786	683	561 - 832	699	567-860
Listed Range	NA		22,841	NA	24,354	NA	22,916	NA
Zones 1-5	18,571		22,180	18,349-28,997	23,673	18,063-26,372	22,217	15,953-25,203

[1] Data for Zones 1 through 5 from Northwest Forest Plan Effectiveness Monitoring Program.

[2] Data for Zone 6 from Z. Peery, pers. comm. 2007. No surveys in 2004, 2005, and 2006.

Table 2 (continued). Marbled murrelet population point estimates and associated 95 percent confidence intervals (CI) by Zone within the listed range.

	2004 Population Point Estimate	95% CI	**2005** Population Point Estimate	95% CI	**2006** Population Point Estimate	95% CI	**2007** Population Point Estimate	95% CI
Zone 1[1]	5,473	2,959 – 7,438	7,956	4,784-11,589	5,899	4,013-8,208	6,985	4.105-10,382
Zone 2[1]	3,071	1,742 – 4,596	2,492	1,629-3,642	2,381	1,672-3.430	2,525	1,271-3,811
Zone 3[1]	7,781	5,885 – 9,763	5,843	3,618-7,309	6,375	4,569-7,429	3,996	2,714-5,929
Zone 4[1]	4,169	3,084 – 9,167	3,642	2,680-5,955	3,968	3,168-5,467	3,791	2,687-7,342
Zone 5[1]	84	18-204	289	117-453	---	---	57	26-105
Zone 6[2]	---	---	---	---	---	---	378	238 -518
Listed Range	NA	NA	NA	NA	NA	NA	17,372	NA
Zones 1-5	20,578	15,959-24,487	20,223	15,681-21,563	18,622[3]	NA	17,354	12,800-21,909

[1] Data for Zones 1 through 5 Northwest Forest Plan Effectiveness Monitoring.

[2] Data for Zone 6 from Z. Peery, pers. comm. 2007. No surveys in 2004, 2005, and 2006.

[3] Does not include Zone 5.

Table 3. The estimated values for demographic parameters used in four population models for the murrelet.

Demographic Parameter	Beissinger 1995	Beissinger and Nur 1997–cited in USDI[1] 1997	Beissinger and Peery 2003	McShane et al. 2004
Juvenile to Adult Ratio	0.10367	0.124 or 0.131	0.089	0.02 - 0.09
Annual Fecundity	0.11848	0.124 or 0.131	0.06-0.12	(See nest success)
Nest Success			0.16-0.43	0.38 - 0.54
Maturation	3	3	3	2 - 5
Estimated Adult Survivorship	85 - 90%	85 - 88%	82 - 90%	83 - 92%

[1]Fish and Wildlife Service

Table 4. Changes to NRF[1] habitat acres from activities addressed in section 7 consultations (both formal and informal) and other causes range-wide from 1994 to October 16, 2008.

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	85960	46147	760	0
	Forest Service	99623	455241	34234	5481
	National Park Service	3866	4855	3	0
	Multi-agency[4]	15320	23314	132897	0
	NWFP Subtotal	204769	529557	167894	5481
Other Management and Conservation Plans (OMCP)	Bureau of Indian Affairs and Tribes	109370	28349	2398	0
	Habitat Conservation Plans	295889	14430	0	0
	OMCP Subtotal	405259	42779	2398	0
Other Federal Agencies & Lands[5]		241	466	28	70
Other Public & Private Lands[6]		14173	880	30240	20949
TOTAL Changes		624442	573682	200560	26500

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

[2] Includes both effects reported by Service (2001) and subsequent effects compiled in the Northern 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 5. Acres of suitable (NRF[1]) habitat loss on Federal lands from 1994 to October 16, 2008, from proposed management activities and natural events: baseline and summary of effects by State, physiographic province and land use function.

Physiographic Province[4]		Evaluation Baseline[2]	Habitat Removed/Downgraded[3]				% Provincial Baseline Affected	% Range-wide Affected
		Total	Reserves[5]	Non-Reserves[6]	Habitat Loss to Natural Events	Total		
WA	Olympic Peninsula	560217	867	24	299	1190	0.21	0.33
	Eastern Cascades	706849	3807	5528	5754	15089	2.13	4.18
	Western Cascades	1112480	1681	10804	0	12485	1.12	3.46
	Western Lowlands	0	0	0	0	0	0	0
OR	Coast Range	516577	394	3769	66	4229	0.82	1.17
	Klamath Mountains	785589	2030	71479	101676[8]	175185	22.3	48.51
	Cascades East	443659	1381	11938	19547[9]	32866	7.41	9.10
	Cascades West	2046472	3581	60092	24583	88256	4.31	24.44
	Willamette Valley	5658	0	0	0	0	0	0
CA	Coast	51494	405	69	100	574	1.11	0.16
	Cascades	88237	0	4808	0	4808	5.45	1.33
	Klamath	1079866	1492	9123	15869	26484	2.45	7.33
Total		7397098	15638	177634	167894	361166	4.88	NA

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 Service (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 northern 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 Northern Spotted Owl (Courtney et al. 2004).

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

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

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

Figure 1. Physiographic provinces, northern spotted owl demographic study areas, and demographic trends (Anthony et al. 2006).