United States Department of the Interior

FISH AND WILDLIFE SERVICE

Western Washington Fish and Wildlife Office
510 Desmond Dr. SE, Suite 102
Lacey, Washington 98503

In Reply Refer To:
1-3-05-FP-0439

Memorandum

To: Superintendent, Mount Rainier National Park */s/1/27/06 Pamela Repp*
Ashford, Washington

From: Manager, Western Washington Fish and Wildlife Office
Lacey, Washington

Subject: Biological Opinion for the Hazard Tree Management Plan

This transmits the Biological Opinion (Opinion) of the U.S. Fish and Wildlife Service based on our review of the Hazard Tree Management Plan Biological Assessment (BA), Mount Rainier National Park (Park). A detailed description of the proposed action and its potential effects to listed species is provided in the attached Opinion. The Park determined that the proposed action "may affect, but is not likely to adversely affect" the northern spotted owl (*Strix occidentalis caurina*) and "may affect, and is likely to adversely affect" the marbled murrelet (*Brachyramphus marmoratus*). The Park also determined that the proposed action would have no effect on the gray wolf (*Canis lupus*), grizzly bear (*Ursus arctos*), Canada lynx (*Lynx canadensis*), bull trout (*Salvelinus confluentus*) or the bald eagle (*Haliaeetus leucocephalus*). The attached Opinion evaluates the potential effects of the proposed action on the threatened northern spotted owl and marbled murrelet.

Your request for consultation, dated May 12, 2005, and BA, was received May 13, 2005. We received amendments to the BA on July 1, July 26, and August 31, 2005. This consultation is in accordance with section 7(a)(2) of the Endangered Species Act of 1973, as amended (16 U.S.C. 1531 *et seq*.).

The attached Opinion is based on information provided in the BA and discussions with Park staff. A complete administrative record of this consultation is on file at the U.S. Fish and Wildlife Service's Western Washington Fish and Wildlife Office in Lacey, Washington.

TAKE PRIDE IN AMERICA

If you have any questions about the attached Opinion, or your responsibilities under the Endangered Species Act, please contact Mark Hodgkins (360) 753-9532 or Marc Whisler (360) 753-4410), of my staff.

Attachment

cc:
NPS, Mount Rainier National Park, Ashford, WA (R. Andrascik)
RO, Ecological Services, Portland, OR (L. Salata)

BIOLOGICAL OPINION

for the

Mount Rainier National Park
Hazard Tree Management Plan

U.S. Fish and Wildlife Service
Western Washington Fish and Wildlife Office
Lacey, Washington
January 2006

Prepared by Mark Hodgkins
(FWS: 1-3-05-FP-0439)

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Ken S. Berg, Manager

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INTRODUCTION

This document presents the U.S. Fish and Wildlife Service's (Service) Biological Opinion (Opinion) based on our review of the National Park Service (NPS) Biological Assessment (BA) for programmatic activities affecting the threatened northern spotted owl (*Strix occidentalis caurina*) (spotted owl) and the threatened marbled murrelet (*Brachyramphus marmoratus*) (murrelet) within the Mount Rainier National Park (Park) in Washington. This document has been prepared in accordance with section 7(a)(2) of the Endangered Species Act of 1973, as amended (16 U.S.C. 1531 *et. seq*.) (Act).

Scope of Consultation

This document is a single-program consultation for the Park's hazard tree management activities that are expected to occur during a 10-year period on NPS lands. This consultation covers certain activities that the Park determined "may affect, but are not likely to adversely affect" the spotted owl, and "may affect, and are likely to adversely affect" murrelets. This consultation does not cover downed tree management or effects to any other federally listed species. Only Park actions are covered under this consultation. Activities conducted on NPS lands by any other agency or group, or their contractors, permittees, licensees, lessees, grantees, or agents are not covered by this consultation.

Non-Federal activities over which the Park has no control, such as unauthorized activities, illegal actions, and emergency situations (natural disasters or other calamities) are not addressed in this consultation. Emergency situations involving an act of nature, casualties, national defense, or security emergencies, including response activities that must be taken to prevent imminent loss of human life or property, will be consulted on separately, using the emergency consultation procedures (50 CFR § 402.05).

This consultation also does not include activities associated with annual spring road opening (March to June) such as downed tree removal and emergency hazard tree removal. The Park estimates that 50 downed logs and up to 5 standing trees will require removal along roads during spring opening each year. The Park reports that it is unlikely that any standing hazard tree requiring felling during spring opening will occur in suitable murrelet habitat or within spotted owl activity centers. Over the past 11 years, no standing hazard trees were felled during spring opening (Richard Lechleitner, Mount Rainier National Park, pers. comm. October 25, 2005). Nonetheless, before crews treat any emergency hazard trees for any other reason during the breeding season, they will consult with the Park's Ecology Ecologist to determine if the tree (a) occurs within suitable murrelet habitat and whether the tree contains suitable nest platforms, or (b) occurs within spotted owl nesting habitat and whether it lies within a 0.7 mile (mi) radius activity circle, or the 100-acre core area. If any of these conditions exist, the Park will conduct emergency consultation with this office.

CONSULTATION HISTORY

The following chronology documents the consultation process that culminated in this Opinion.

Personnel of the Western Washington Fish and Wildlife Office (WWFWO) of the Service met and communicated with personnel of the Park on several occasions to coordinate efforts and clarify consultation requirements for the proposed action.

1. February 11, 2005: The Park met with the WWFWO to discuss the Hazard Tree Management Plan (Plan) and the probable effect determinations for listed species. The Park anticipated a "no effect" determination for the grizzly bear (*Ursus arctos*), Canada lynx (*Lynx canadensis*), gray wolf (*Canis lupus*), and bald eagle (*Haliaeetus leucocephalus*). The Park also anticipated a "may affect, not likely to adversely affect" determination for the murrelet and spotted owl. The Service advised the Park that we will likely not concur with a "may affect, not likely to adversely affect" determination for murrelets and suggested a "may affect, likely to adversely affect" determination.

2. May 12, 2005: The Service received from the Park the preliminary Hazard Tree Management Plan, Programmatic BA, and cover letter, to initiate section 7 formal consultation.

3. June 3, 2005: Marc Whisler and Mark Hodgkins (WWFWO) telephoned Jim Schaberl, Park Wildlife Ecologist, to discuss details of the BA.

4. June 8, 2005: Mark Hodgkins (WWFWO) telephoned Roger Andrascik, Chief of Natural and Cultural Resources, Mount Rainier National Park, to discuss details of the BA, specifically, effect determinations, and inconsistencies within the document.

5. Mark Hodgkins (WWFWO) and Rich Lechleitner, Maintenance Worker, Mount Rainier National Park, had several telephone conversations (June 22, July 13, August 25) and Email correspondences (July 8, 26; August 19, 29; September 2, 13; November 23, 2005) to discuss the BA, specifically, clarifications and additional information needs.

6. The Service received BA revisions from the Park on July 26, and September 5, 2005.

This Opinion on the proposed action is based on information provided in the BA (National Park Service 2005a, as amended pursuant to discussions and revisions as noted in the Consultation History). A complete administrative record of this consultation is on file at the Service's WWFWO in Lacey, Washington.

BIOLGICAL OPINION

DESCRIPTION OF THE PROPOSED ACTION

In national parks, the identification and management of hazard trees is an important component of preserving park resources used by visitors. Hazard trees are defined as standing trees, alive or dead, or tree parts, at substantial risk of failure, which may strike a permanent or transitory object of value (or "target," e.g., humans, picnic areas, parking pads, campsites, power lines, fences, roads, mineral claims, or other structures, resulting in injury or damage) (Harvey and Hessburg 1992). Hazards increase with increasing tree defects, potential for failure, potential for damage, and importance or value of the target (Harvey and Hessburg 1992).

The Park proposes to continue its hazard tree management program to protect visitors and employees, facilities, and property. The Park will continue to systematically evaluate hazard trees using methodology used by the surrounding U.S. Forest Service as described by Harvey and Hessburg (1992). The Park will treat hazard trees within all 22 developed areas (including administrative areas, campgrounds, picnic areas, entrances, and points of interest), some back-country areas (including trailside campsites and administrative or historic structures in the wilderness area), and along Park roads as needed.

The Park surveyed for hazard trees in developed and back-county areas. No hazard tree surveys occurred along maintained trails in the back-country. The Park also did not survey roadsides for hazard tree status due to the extensive amount of roads and the low potential for a hazard striking a target. However, the Park did survey high-use areas such as pullouts and overlooks.

Hazard tree treatments require individual interdisciplinary analysis and documentation. The Park will review treatments to insure they meet certain criteria outlined within the Park Hazard Tree Management Plan (National Park Service 2005b). This Plan includes the description, assessment, and routine monitoring of potential hazard trees based on documentation of defects or other conditions that contribute to tree failure.

Park staff have identified a maximum of 1,565 hazard trees requiring treatment within both developed and back-country areas in the next 10 years. Of these, surveys found 848 trees over 20 in diameter at breast height (dbh). The Park has determined that 551 hazard trees occur within 0.7 mi of a spotted owl activity center while 150 hazard trees are considered suitable murrelet habitat. Within the next 2 years, 271 of these hazard trees require treatment, the majority of which occur in developed areas. Overall, the Park will treat about 200 trees each year. Treatment methods include (in order of priority) removing the target, if feasible, followed by topping, limbing, and total hazard tree removal. The Park will not use blasting to remove hazard trees.

Authority

The proposed action falls under the NPS Organic Act, the National Park Management Policies of 2001, and the NPS Natural Resources Management Guideline of 2001. Under the Federal Tort

Claims Act of 1946 (28 USC 2671-8- and 1346(b)), the NPS can be held liable for failure or negligence with respect to visitor protection, and hence the aforementioned authorities.

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 to the species under review. The Park incorporated the following conservation measures into the proposed action to minimize adverse impacts to listed species. The Park will:

1. Insure the Hazard Tree Management Coordinator will annually create a list of potential hazard trees with recommended treatments types. An interdisciplinary team will review this list to ensure the proposed treatments conform to the conservation measures, and does not result in take of listed species.
2. Follow a NPS-established hierarchy of hazard tree treatment choices to minimize impacts to NPS resources. Treatments range from moving the potential target, closing the site, removing unstable portions of the hazard tree, with the final choice of felling the hazard tree.
3. Require additional interdisciplinary analysis and individual documentation of special recommended hazard-tree treatments that include:
    a. Removal of more than 10 percent of the total number of trees from a specific location, such as a campground.
    b. Removal of known nesting sites of rare species.
    c. Removal of "specimen" trees or trees with a dbh of 40 inches (in) or more.
4. Ensure removal of known nesting sites of federally listed threatened and endangered bird species will not occur regardless of time of year.
5. Generally complete hazard tree treatment during the late fall, after September 30 (after closure of visitor facilities) to minimize potential effects to murrelets and spotted owls.
6. Leave felled trees on site, when practicable, to provide large woody debris.
7. Consult with U.S. Forest Service Wenatchee National Forest pathologist (or equivalent expert) in the event of discovering large numbers of hazard trees with advanced ratings to verify the ratings.
8. Use the minimum (smallest, quietist) mechanized tool necessary to treat hazard trees to minimize potential disturbance to wildlife.
9. Ensure the presence of a Hazard Tree Management Coordinator, as a Contracting Officer's Technical Representative, during contracted felling operations to insure that the properly identified trees are removed in a manner consistent with requirements of the contract and the conservation measures.

Action Area Defined

The Park is located approximately 65 mi southeast of Seattle, Washington, in Pierce and Lewis Counties and contains 235,625 acres. The action area for the Park's Plan is defined as lands within the Park's boundary that occur within all 24 developed areas and include administrative areas, campgrounds, picnic areas, entrances, points of interest, and 12 wilderness campsites. The action area also includes a 300-ft buffer area around each developed area and wilderness

campsite to accommodate the distance a large hazard tree will fall into the surrounding stand if felled from the edge of the developed area (R. Lechleitner, pers. comm. August 19, 2005). Finally, the action area includes 147 mi of paved road adjacent to which the Park estimates about 100 hazard trees occur that need treatment (which also includes a 300-ft buffer).

The action area ranges in elevation from 1,780 ft to 4,930 ft. The Park contains three ecological zones. The alpine zone lies above tree line (approximately 7,000 ft) and comprises 19 percent of the Park. This zone consists of snow, ice, rock, and alpine plant communities. The subalpine zone ranges from 5,000 ft to 7,000 ft and covers 23 percent of the Park. The subalpine zone is characterized by scattered stands of subalpine fir (*Abies lasiocarpa*) and grass meadows. The forest zone lies at elevations below 5,000 ft and occupies approximately 58 percent of the Park. Western hemlock (*Tsuga heterophylla*), Pacific silver fir (*Abies amabilis*), Douglas-fir (*Pseudotsuga menziesii*), and western red cedar (*Thuja plicata*) dominates this zone.

CONCURRENCE FOR THE SPOTTED OWL

The Service concurs with the Park's determination that the proposed action as described in the BA, "may affect, but is not likely to adversely affect" the spotted owl. The rationale for our concurrence is discussed below.

Effects of Habitat Removal on the Spotted Owl

In the Washington Cascades, the spotted owl median annual home range (home range) is estimated at 6,657 acres. For the purposes of habitat analyses, a circle is used to approximate the spotted owl home range. In the Washington Cascades, a 1.82-mi-radius circle is used to identify the home range. The Service uses a 0.7-mi-radius circle (960 acres) to delineate the area most heavily used by spotted owls during the nesting season (activity center). Further, the Service uses a 100-acre area around nest trees to delineate the core nesting area (core area).

The Park conducts spotted owl surveys every year and have done so for many years. The Park has precise location information on spotted owl home ranges, activity centers, core areas, and nest sites. The Park currently contains 27 spotted owl home ranges which Park personnel monitor yearly.

The Park identified four developed areas, four back-country campsites, and portions of Park roads that lie within spotted owl activity centers. Two additional back-country campsites occur outside spotted owl activity centers, but within home ranges. Hazard trees will be removed from all these areas and along Park roads (Table 1). None of these developed areas or back country sites occur within core areas as the Park found no spotted owl nests in any developed area or back-country campsites scheduled for hazard tree treatment. All hazard trees within developed areas and back-country campsites are greater than 65 yards from any core area. Nine core areas overlap Park roads.

Table 1. Hazard tree removal within developed areas, back-country campsites, and along Park roads that are within spotted owl activity centers or home ranges

Developed Areas/Roads	Number of hazard trees to be treated	Within 0.7-mi activity center	Within home range but outside activity center
Grove of the Patriarchs	5	X	
Steven's Canyon Entrance	5	X	
Ohanapecosh Administrative Area	5	X	
Ohanapecosh Campground	410	X	
East Side Roads	50		
West Side Roads	50		
Paradise River back-country campsite	6	X	
Pyramid Creek back-country campsite	4	X	
North Puyallup back-country campsite	4	X	
South Puyallup back-country campsite	4		X
South Mowich back-country campsite	4	X	
Deer Creek back-country campsite	4		X
Totals	551	8	2

Developed Areas

The Grove of the Patriarchs and Steven's Canyon Entrance will lose 5 hazard trees each over the 10-year life of the proposed action. The Grove of the Patriarchs and Steven's Canyon Entrance occur in the same spotted owl activity center (but outside the core area). Therefore, the combined total of 10 hazard trees will be removed from one spotted owl activity center.

The removal of these hazard trees would not likely adversely affect spotted owls for the following reasons:

1. Hazard tree removal would occur within the activity center but outside the core area; therefore, we do not expect removal of nest trees.

2. The habitat within these developed areas is degraded and experiences high, continuous human activity; we expect spotted owls to use this habitat only occasionally for roosting and foraging.

3. Conservation measures developed by the Park will maintain at least 75 percent of activity centers and 55 percent of home ranges in a suitable spotted owl habitat condition. The effect of the loss of 10 trees is minor compared to the minimum of 720 acres of suitable habitat within an activity center or 3,661 acres of suitable habitat within a home range.

4. Hazard tree removal would result in only a minor loss of prey or roosting habitat within the activity center—this loss would not preclude its use by spotted owls for roosting or foraging.

The Park will treat 5 hazard trees in the Ohanapecosh Administrative Area and 410 hazard trees in the Ohanapecosh Campground. The administrative area and Ohanapecosh campground occur in the same spotted owl activity center, thus the Park will treat a total of 415 hazard trees within a single owl activity center, but outside the core area.

The removal of these hazard trees are not likely to adversely affect spotted owls for the following reasons:

1. Hazard tree removal would occur within the activity center but outside the core area; therefore, the removal of nest trees is not expected.

2. The Ohanapecosh Campground is 68 acres in size and contains an estimated 4,760 trees. The loss of 8.6 percent of the trees within the developed area over 10 years will incrementally degrade the habitat but will not preclude its use by spotted owls for foraging and roosting.

3. The habitat within these developed areas is already degraded and experiences high, continuous human activity; this habitat is likely used only occasionally for roosting and foraging.

4. The effects of the loss of 415 trees is minor compared to the minimum of 720 acres of suitable habitat within an activity center or 3,661 acres of suitable habitat within a home range.

5. Hazard tree removal would result in only a minor loss of prey or roosting habitat within the activity center—this loss would not preclude its use by spotted owls for roosting or foraging.

<u>Back-country Campsites</u>

Six back-country campsites lie within spotted owl activity centers or home ranges and contain up to 6 hazard trees each for a total of 26 trees that need treatment over the life of the proposed action. The removal of hazard trees from outside activity centers, but within home ranges would result in only a minor loss of prey habitat—the majority of roosting and foraging activity occurs within the activity center. The removal of hazard trees from activity centers is not likely to adversely affect spotted owls for the following reasons:

1. Hazard tree removal within activity centers is not expected to result in the removal of nest trees.

2. The effects of the loss of up to six trees per back-country campsite is minor compared to the minimum of 720 acres of suitable habitat within an activity center or 3,661 acres of suitable habitat within a home range.

3. Hazard tree removal would result in only a minor loss of prey and roosting habitat within the activity centers—this loss would not preclude the areas use by spotted owls for roosting or foraging.

Park Roads

Approximately 100 hazard trees will be treated (Table 1) along 147 miles of roads within the Park (80 miles on the east side and 67 miles on the west side [R. Lechleitner, *in litt.* November 23, 2005]). Currently, 18 spotted owl activity centers overlap Park roads. Of these 18 activity centers, nine 100-acre core areas overlap Park roads (R. Lechleitner, *in litt.* September 13, 2005). If we consider the maximum potential dispersal of 100 trees over 147 mi, we arrive at about 0.7 hazard tree per mi (or 1 tree every 1.4 mi). The removal of 100 hazard trees along Park roads would not appreciably affect spotted owls for the following reasons:

1. Some roads are at elevations above that which supports spotted owl habitat. Removal of hazard trees at this elevation would reduce the potential number of hazard trees that would be removed within spotted owl core areas or activity centers.
2. We do not expect any nest trees would be felled as a hazard tree. The proposed action's conservation measures require additional consultation with this Service office in the event that a proposed hazard tree is a known nest tree.
3. It is assumed that hazard trees are so dispersed that no more than one hazard tree is likely to be treated per core area or activity center. The effects of the loss of a single tree is minor compared to 100 acres of suitable habitat within a core area and a minimum of 720 acres of suitable habitat within an activity center.
4. The removal of a single hazard tree along a road within a core area or activity center would not preclude the stand's use by spotted owls for nesting, roosting, or foraging because the remainder of the habitat is of high quality and quantity; sufficient to support a productive site.

Potential for Disturbance to Spotted Owls

All hazard tree removal will occur outside the spotted owl breeding season; therefore, we do not expect sound or visual disturbance to breeding spotted owls. Fellers will begin hazard tree removal after September 30 of any project year and complete tree felling before March 15. In the rare event that a hazard tree will require treatment during the breeding season, the Park will conduct emergency consultation with this office as this action would be outside the scope of this consultation.

Potential for Increased Competition from Barred Owls

Herter et al. (2004) report barred owl detections within the Rainier Demographic Study Area, which includes the Park. Also, they suspect that barred owls in Washington may now be reaching saturation levels, or occupying all suitable habitats throughout the state. Therefore, barred owls are also likely generally present in suitable habitat throughout the Park. The proposed action would neither improve nor degrade conditions that would promote or deter the expansion of the barred owl population within the Park or surrounding area.

STATUS OF THE SPECIES: MARBLED MURRELET

Legal Status

The marbled murrelet (murrelet) was federally listed as a threatened species in Washington, Oregon, and northern California effective September 28, 1992 (U.S. Fish and Wildlife Service 1992). The final rule designating critical habitat for the murrelet (61 FR 26256) became effective on June 24, 1996. The species' decline has largely been caused by extensive removal of late-successional and old-growth coastal forests which serve as nesting habitat for murrelets. Additional listing factors included high nest-site predation rates and human-induced mortality in the marine environment from gillnets and oil spills.

The Service recently determined the California, Oregon, and Washington distinct population segment of the murrelet does not meet the criteria set forth in the Service's 1996 Distinct Population Segment policy (61 FR 4722) (U.S. Fish and Wildlife Service 2004). However, the murrelet retains its listing and protected status as a threatened species under the Act until the original 1992 listing decision is revised through formal rule-making procedures, involving public notice and comment.

The Marbled Murrelet Recovery Plan (U.S. Fish and Wildlife Service 1997a) (Recovery Plan), identified six Conservation Zones throughout the listed range of the species: Puget Sound (Conservation Zone 1), Western Washington Coast Range (Conservation Zone 2), Oregon Coast Range (Conservation Zone 3), Siskiyou Coast Range (Conservation Zone 4), Mendocino (Conservation Zone 5), and Santa Cruz Mountains (Conservation Zone 6).

As specified in the Recovery Plan and provided by the consultation procedures (U.S. Fish and Wildlife Service and National Marine Fisheries Service 1998) pursuant to the Act, jeopardy/non-jeopardy conclusions for the murrelet will be made for each affected recovery unit (Conservation Zone) rather than exclusively at the species' listed range. However, the Service's determination will include consideration of the long-term viability of the overall population and metapopulations in all Conservation Zones. Accordingly, the following discussion and analysis for this action will focus on Conservation Zone 1.

<u>Conservation Zone 1</u>

Conservation Zone 1 includes all the waters of Puget Sound and most waters of the Strait of Juan de Fuca south of the U.S.-Canadian border and extends inland 50 mi from the Puget Sound, including the north Cascade Mountains and the northern and eastern sections of the Olympic Peninsula. Forest lands in the Puget Trough have been predominately replaced by urban development and the remaining suitable habitat in Conservation Zone 1 is typically a considerable distance from the marine environment, lending special importance to nesting habitat close to Puget Sound (U.S. Fish and Wildlife Service 1997a).

Life History

Murrelets are long-lived seabirds that spend most of their life in the marine environment, but use old-growth forests for nesting. Detailed discussions of the biology and status of the murrelet are presented in the final rule listing the murrelet as threatened (U.S. Fish and Wildlife Service 1992), the Recovery Plan, Ecology and Conservation of the Marbled Murrelet (Ralph et al. 1995), the final rule designating murrelet critical habitat (61 FR 26256, U.S. Fish and Wildlife Service 1996a), and the Evaluation Report for the 5-Year Status Review of the Marbled Murrelet in Washington, Oregon, and California (McShane et al. 2004).

Physical Description

The murrelet is taxonomically classified in the family Alcidae (Alicids), a family of Pacific seabirds possessing the ability to dive using wing-propulsion. The plumage of this relatively small (9.5-10 inches) seabird is identical between males and females, but the plumage of adults changes during the winter and breeding periods providing some distinction between adults and juveniles. Breeding adults have light, mottled brown under-parts below sooty-brown upperparts contrasted with dark bars. Adults in winter plumage have white under-parts extending to below the nape and white scapulars with brown and grey mixed upperparts. The plumage of fledged young is similar to the adult winter plumage (U.S. Fish and Wildlife Service 1997a).

Distribution

The range of the murrelet, defined by breeding and wintering areas, extends from the northern terminus of Bristol Bay, Alaska, to the southern terminus of Monterey Bay in central California. The listed portion of the species' range extends from the Canadian border south to central California. Murrelet abundance and distribution has been significantly reduced in portions of the listed range, and the species has been extirpated from some locations. The areas of greatest concern due to small numbers and fragmented distribution include portions of central California, northwestern Oregon, and southwestern Washington (U.S. Fish and Wildlife Service 1997a).

Reproduction

Murrelet breeding is asynchronous and spread over a prolonged season. In Washington, the murrelet breeding season occurs between April 1 and September 15. Egg laying and incubation occur from late April to early August and chick rearing occurs between late May and late August, with all chicks fledging by early September (Hamer *in litt.* 2003).

Murrelets lay a single-egg clutch (Nelson 1997), which may be replaced if egg failure occurs early (Hebert et al. 2003; McFarlane Tranquilla et al. 2003). However, there is no evidence a second egg is laid after successfully fledging a first chick. Adults typically incubate for a 24-hour period, then exchange duties with their mate at dawn. Hatchlings appear to be brooded by an adult for 1-2 days and are then left alone at the nest for the remainder of the rearing period, except during feedings. Both parents feed the chick, which receives 1-8 meals per day (Nelson 1997). Most meals are delivered early in the morning, while about a third are delivered at dusk and a few meals are sometimes scattered throughout the day (Nelson and Hamer 1995a). Chicks

fledge 27-40 days after hatching. The initial flight of a fledgling appears to occur at dusk and parental care is thought to cease after fledging (Nelson 1997).

Murrelets in the Marine Environment

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).

Vocalization

Murrelets are known to vocalize between 480 Hertz and 4.9 kilohertz and have at least 5 distinct call types (Suzanne Sanborn, pers. comm. 2005). Murrelets tend to be more vocal at sea compared to other alcids (Nelson 1997). Individuals of a pair vocalize after surfacing apart from each other, after a disturbance, and during attempts to reunite after being separated (Strachan et al. 1995; Ralph unpublished data, and Miller pers. comm. cited in Strachan et al. 1995).

Loafing

When murrelets are not foraging or attending a nest, they loaf on the water, which includes resting, preening, and other activities during which they appear to drift with the current, or move without direction (Strachan et al. 1995). Strachan et al. (1995) noted that vocalizations occurred during loafing periods, especially during the mid-morning and late afternoon.

Molting

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 (after hatch-year) murrelets have two primary plumage types: alternate (breeding) plumage and basic (winter) plumage. 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, murrelets lose all flight feathers somewhat synchronously and are flightless for up to 2 months (Nelson 1997). In Washington, there is some indication that the pre-basic molt occurs from mid-July through the end of August (Chris Thompson, WDFW, pers. comm. 2003).

Flocking

Strachan et al. (1995) defines a flock as three or more birds in close proximity which maintain that formation when moving. Various observers throughout the range of the murrelet report flocks of highly variable sizes. In the southern portion of the murrelet's range (California,

Oregon, and Washington), flocks rarely contain more than 10 birds. Larger flocks usually occur during the later part of the breeding season and may contain juvenile and subadult birds (Strachan et al. 1995).

Aggregations of foraging murrelets are probably related to concentrations of prey. In Washington, murrelets are not generally found in interspecific feeding flocks (Strachan et al. 1995). Strong et al. (cited in Strachan et al. 1995) observed that murrelets avoid large feeding flocks of other species and presumed that the small size of murrelets may make them vulnerable to kleptoparasitism or predation in mixed species flocks. Strachan et al. (1995) point out that if murrelets are foraging cooperatively, the confusion of a large flock of birds could reduce foraging efficiency.

Foraging Behavior

Murrelets forage at all times of the day, but most actively in the morning and late afternoon (Strachan et al. 1995). Murrelets 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 murrelets may temporarily pair up with other foraging individuals (non-mates) (Strachan et al. 1995; Speckman et al. 2003).

Murrelets generally forage within 1.25 mi of shore (Strachan et al. 1995), but are also known to forage in freshwater lakes (Nelson 1997). Traditional feeding areas (nurseries) are used consistently on a daily and yearly basis (Carter and Sealy 1990). Activity patterns and foraging locations are influenced by biological and physical processes that concentrate prey, such as weather, climate, time of day, season, light intensity, up-wellings, tidal rips, narrow passages between islands, shallow banks, and kelp (*Nereocystis* spp.) beds (Ainley et al. 1995; Burger 1995; Strong et al. 1995; Speckman 1996; Nelson 1997).

Juveniles are found closer to shore than adults (rarely greater than 0.625 mi offshore) (Beissinger 1995) and forage without the assistance of adults (Strachan et al. 1995). Kuletz and Piatt (1999) found that in Alaska, juvenile murrelets congregated in kelp beds. Kelp beds are often associated with productive waters and may provide protection from avian predators (Kuletz and Piatt 1999). McAllister (unpublished data–cited in Strachan et al. 1995) found that juveniles were more common within 328 feet of shorelines, particularly, where bull kelp was present.

Murrelets forage most frequently in nearshore water generally less than 98 ft (30 m) deep (Strachan et al. 1995, Burger 2000). The most common foraging depths are not known. However, murrelets are known to feed on small schools of fish within the upper 16.4 ft (5 m) of marine waters (Mahon et al. 1992). An alcid the size of a murrelet is expected to have a maximum diving depth of about 154 ft (47 m) (Mathews and Burger 1998), although the deepest record of a marbled murrelet was from one captured at 89 ft (27 m) in a gill net off of California

(Carter and Erickson 1992). Jodice and Collopy (1999) reported most diving in Oregon occurred in water less than 33 ft (10 m) deep.

The duration of dives appears to depend upon age (adults vs. juveniles), water depth, and prey depth. Reported dive durations are highly variable for murrelets, ranging from 7 to 42 seconds, with an average of 14 seconds reported from observations in California (Strachan et al. 1995). Carter and Sealy (1990) reported that dive durations in British Columbia averaged 27.8 seconds and Thorensen (1989) reported dive durations in Washington ranged from 15 to 115 seconds.

Adults and subadults often 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, murrelets disperse and can be found farther from shore (Strachan et al. 1995). 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). During the winter there may be a general shift from exposed outer coasts into more protected waters (Nelson 1997), for example many 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, murrelets remain associated with the inland nesting habitat during the winter months (Carter and Erickson 1992) and throughout the listed range, murrelets do not appear to disperse long distances, indicating they are year-round residents (McShane et al. 2004).

Prey Species

Throughout their range, murrelets are opportunistic feeders and utilize prey of diverse sizes and species. They feed primarily on fish and invertebrates in near-shore marine waters although they have also been detected on rivers and inland lakes (Carter and Sealy 1986; U.S. Fish and Wildlife Service 1992). In general, small schooling fish and large pelagic crustaceans are the main prey items. Pacific sand lance *(Ammodytes hexapterus)*, northern anchovy *(Engraulis mordax)*, immature Pacific herring *(Clupea harengus)*, capelin *(Mallotus villosus)*, and surf smelt (Osmeridae) are the most common fish species taken and are eaten year round. Squid (*Loligo* spp.), euphausiids, mysid shrimp, and large pelagic amphipods are the main invertebrate prey and are primarily eaten during the non-breeding season, thus are not a significant part of a nestling's diet.

Murrelets usually carry a single fish to their chicks and appear to select a relatively large (relative to body size), energy-rich fish such as larger sand lance, immature herring, anchovy, smelt, and occasionally salmon smolts (Burkett 1995; Nelson 1997). This forces breeding adults to exercise more specific foraging strategies when feeding chicks. Freshwater prey appears to be important to some individuals during several weeks in summer and may facilitate more frequent chick feedings, especially for those that nest far inland (Hobson 1990). As a result, the distribution and abundance of prey suitable for feeding chicks may greatly influence the overall foraging behavior and location(s) during the nesting season. The availability of abundant forage fish during the nestling period may significantly affect the energy demand on adults by influencing both foraging time and number of trips inland required to feed nestlings (U.S. Fish and Wildlife Service 1992).

Predators

At sea predators include bald eagles (*Haliaeetus leucocephalus*), peregrine falcons (*Falco peregrinus*), western gulls (*Larus occidentalis*), and northern fur seals (*Callorhinus ursinus*) (McShane et al. 2004). California sea lions (*Zalophus californianus*), northern sea lions (*Eumetopias jubatus*), and large fish may also be occasional predators (Burger 2002).

Murrelets in the Terrestrial Environment

Murrelets are dependent upon old-growth forests, or forests with an older tree component, for nesting habitat (Hamer and Nelson 1995; Ralph et al. 1995; McShane et al. 2004). Sites occupied by murrelets tend to have a higher proportion of mature forest age-classes than do unoccupied sites (Raphael et al. 1995). Specifically, murrelets prefer high and broad platforms for landing and take-off, and surfaces which will support a nest cup (Hamer and Nelson 1995). The physical condition of a tree appears to be the important factor in determining the tree's suitability for nesting (Ralph et al. 1995); therefore, presence of old-growth in an area does not assure the stand contains sufficient structures (i.e. platforms) for nesting. In Washington, murrelet nests have been found in conifers, specifically, western hemlock, Sitka spruce, Douglas fir, and western red cedar (Hamer and Meekins 1999; Hamer and Nelson 1995). Nests have been found in trees as small as 2.6 ft in diameter at breast height on limbs at least 65 ft from the ground and 0.36 ft in diameter (Hamer and Meekins 1999).

Murrelet populations may be limited by the availability of suitable nesting habitat. In the Ecology and Conservation of the Marbled Murrelet, Ralph et al. 1995 surmised in the book's summary that the suitable nesting habitat remaining in Washington, Oregon, and California was saturated with murrelets based on (1) at-sea concentrations of murrelets near suitable nesting habitat during the breeding season, (2) winter visitation to nesting sites, and (3) the limitation of nest sites available in areas with large amounts of habitat removal. Murrelets have been observed visiting nesting habitat during the non-breeding periods in Washington, Oregon, and California (Nelson 1997, Naslund 1993) which may indicate adults are defending nesting sites and/or stands (Ralph et al. 1995). Other studies provide further insight to the habitat associations of breeding murrelets, concluding breeding murrelets displaced by the loss of nesting habitat do not pack in higher densities into remaining habitat (McShane et al. 2004). Thus, murrelets may currently be occupying nesting habitat at or near carrying capacity in highly fragmented areas and/or in areas where a significant portion of the historic nesting habitat has been removed.

Therefore, unoccupied stands containing nesting structures could be important to displaced breeders and first-time breeding adults. Even if nesting habitat is at carrying capacity, there will be years when currently occupied stands become unoccupied as a result of temporary disappearance of inhabitants due to death or to irregular breeding (Ralph et al. 1995). Therefore, unoccupied stands will not necessarily indicate that habitat is not limiting or that these stands are not murrelet habitat (Ralph et al. 1995) and important to the species persistence.

Radar and audio-visual studies have shown 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 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 isolated (> 5km) from other nesting murrelets (Meyer et al. 2002). Meyer et al. (2002) also found at least a few years passed before birds abandoned fragmented forests.

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. 1995). The murrelets reliance on cryptic coloration to avoid detection will suggest they utilize a wide spacing of nests in order to prevent predators from forming a search image (Ralph et al. 1995). However, active nests have been seen within 100 m of one another in the North Cascades in Washington and within 30 m in Oregon (Kim Nelson, OSU, pers comm. 2005). Estimates of 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).

There are little data available regarding murrelet nest site fidelity because of the difficulty in locating nest sites and observing bands on birds attending nests. However, murrelets have been detected in the same nesting stands for many years (at least 20 years in California and 15 in Washington), suggesting 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 have been documented, although it is not clear whether the repeated use involved the same birds (Hebert and Golightly 2003; Manley 2000; Nelson 1997; Nelson and Peck 1995; Divoky and Horton 1995). The limited observed fidelity to the same nest depression in consecutive years appears to be lower than for other alcids, but this may be an adaptive behavior in response to high predation rates (Divoky and Horton 1995). Researchers have suggested annual use of specific or adjacent nesting platforms may be more common in areas where predation is limited or the number of suitable nest sites are few because large, old-growth trees are rare (Nelson and Peck 1995; Singer et al. 1995; Manley 1999).

Ralph et al. (1995) speculated the annual use of nest sites or stands by breeding murrelets may be influenced by the nesting success of previous rearing attempts. Although murrelet nesting behavior in response to failed nest attempts is unknown, nest failures could lead to prospecting for new nest sites or mates. Other alcids have shown an increased likelihood to relocate to a new nest in response to breeding failure (Divoky and Horton 1995). However, murrelets likely remain in the same stand over time as long as the stand is not significantly modified (Ralph et al. 1995).

It is unknown whether juveniles disperse from natal breeding habitat (natal dispersal) or return to their natal breeding habitat after reaching breeding age (natal philopatry). Divoky and Horton (1995) predicted that juvenile dispersal is likely to be high because 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. Therefore, the presence of unoccupied suitable nesting habitat on the landscape may be important for first-time nesters if they disperse away from their natal breeding habitat.

Murrelets generally select nests within 37 mi (60 kilometers (km)) of the coast (Miller and Ralph 1995). However, in Washington, occupied habitat has been documented 52 mi (84 km) from the coast and murrelets have been detected up to 70 mi (113 km) from the coast in the southern Cascade Mountains (Evans Mack et al. 2003).

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

Murrelet nests have been located at a variety of elevations from sea level to 5,020 ft (Burger 2002). However, most nests have been found below 3,500 ft. In Conservation Zone 1, murrelets have exhibited occupied behaviors up to 4,400 feet elevation and have been detected in stands up to 4,900 ft in the north Cascade Mountains (Peter McBride, WDNR, pers. comm. 2005). On the Olympic Peninsula, survey efforts for nesting murrelets have encountered occupied stands up to 4,000 ft within Conservation Zone 1 and up to 3,500 ft within Conservation Zone 2. Surveys of murrelet habitat at higher elevations on the Olympic Peninsula have not been conducted. However, recent radio-telemetry work detected a murrelet nest at 3,600 ft elevation on the Olympic Peninsula in Conservation Zone 1 (Martin Raphael, USFS, *in litt.* 2005).

Population Status in the Coterminous United States

Population Abundance

Research on murrelet populations in the early 1990s estimated murrelet abundance in Washington, Oregon, and California at 18,550 to 32,000 (Ralph et al. 1995). However, consistent population survey protocols were not established for murrelets in the coterminous United States until the late 1990s following the development of the marine component of the Effectiveness Monitoring (EM) Program for the NWFP (Bentivoglio et al. 2002). As a consequence, sampling procedures have differed and thus the survey data collected prior to the EM Program is unsuitable for estimating population trends for the murrelet (McShane et al. 2004).

The development of the EM Program unified the various at-sea monitoring efforts within the five Conservation Zones encompassed by the NWFP. These efforts along with efforts in Conservation Zone 6 have resulted in annual estimates of murrelet abundance for each Conservation Zone (Bentivoglio 2002, Huff et al. 2003, Lance 2004, Peery et al. 2002), with the annual listed population estimated to be 18,097 in 2000; 22,200 in 2001; 23,700 in 2002; and 22,300 in 2003.

Population Trend

Estimated population trends within each Conservation Zone or for the entire coterminous population are not yet available from the marine survey data. Trend information will eventually be provided through the analysis of marine survey data from the EM Program (Bentivoglio et al. 2002) and from survey data in Zone 6 once a sufficient number of survey years have been completed. Depending on the desired minimum power (80 or 95 percent) to detect annual decreases, at least 8 to 10 years of surveys are required for an overall population estimate and 7 to 16 years are required for population estimates for Conservation Zones 1 and 2 (Huff et al. 2003).

In the interim, demographic modeling has aided attempts to analyze and predict population trends and extinction probabilities of murrelets. Incorporating important population parameters and species distribution data (Beissinger 1995; Beissinger and Nur 1997–cited in U.S. Fish and Wildlife Service 1997a; Cam et al. 2003; McShane et al. 2004), demographic models can provide useful insights into potential population responses from exposure to environmental pressures and perturbations. However, weak assumptions or inaccurate estimates of population parameters such as survivorship rates, breeding success, and juvenile-to-adult ratios, can limit the use of models. Thus, a cautious approach is warranted when forecasting long-term population trends using demographic models.

Most of the published demographic models used to estimate murrelet population trends employ Leslie Matrix modeling (McShane et al. 2004). Two other more complex, unpublished models (Akcakaya 1997 and Swartzman et al. 1997–cited in McShane et al. 2004) evaluate the effect of nest habitat loss on murrelets in Zone 4 (McShane et al. 2004). McShane et al. (2004) developed a stochastic Leslie Matrix model (termed "Zone Model") to project population trends in each murrelet Conservation Zone. The Zone Model was developed to integrate available demographic information for a comparative depiction of current expectations of future population trends and probability of extinction in each Zone (McShane et al. 2004). Table 2 lists the four latest murrelet Leslie Matrix models and the values for common demographic parameters used in each.

Table 2. The estimated values for demographic parameters used in four population models for the murrelet

Demographic Parameter	Beissinger 1995	Beissinger and Nur 1997–cited in U.S.* 1997a	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%

*Fish and Wildlife Service

Regardless of model preference, the overall results of modeling efforts are in agreement, indicating murrelet abundance is declining (McShane 2004:6-27). The rates of decline are highly sensitive to the assumed adult survival rate used for calculation (Beissinger and Peery 2003). The most recent modeling effort using the "Zone Model" (McShane et al. 2004) suggests the murrelet zonal sub-populations are declining at a rate of 3.0 to 6.2 percent per year.

Estimates of breeding success are best determined from nest site data, but difficulties in finding nests has led to the use of other methods, such as juvenile to adult ratios and radio-telemetry estimations, each of which have biases. The nest success data presented in Table 2 under McShane et al. (2004) was derived primarily from radio telemetry studies; however the nests sampled in these studies were not representative of large areas and specifically did not include Washington or Oregon. In general, telemetry estimates are preferred over juvenile to adult ratios for estimating breeding success due to fewer biases (McShane et al. 2004), but telemetry data are not currently available for Washington or Oregon. Therefore, it is reasonable to expect that juvenile to adult ratios derived from at-sea survey efforts best represent murrelet reproductive success in Washington, Oregon, and California.

Beissinger and Peery (2003) performed a comparative analysis using data from 24 bird species to predict the juvenile to adult ratio for murrelets should be 0.27 (confidence intervals ranged from 0.15 to 0.65). Demographic models suggest murrelet population stability requires a minimum of 0.18 – 0.28 chicks per pair per year (Beissinger and Nur 1997–cited in U.S. Fish and Wildlife Service 1997a). The lower confidence intervals for both the predicted juvenile to adult ratio (0.15) and the stable population juvenile to adult ratio (0.18) are greater than the juvenile to adult ratios observed for any of the Conservation Zones (0.02 – 0.09 chicks per pair, Beissinger and Nur 1997–cited in U.S. Fish and Wildlife Service 1997a; Beissinger and Peery 2003). Therefore, the juvenile to adult ratios observed in the Conservation Zones are lower than predicted ratios and are too low to obtain a stable population in any Conservation Zone, which indicates murrelet population are declining in all Conservation Zones and will continue to decline until reproductive success improves.

Based upon (1) the outcome of demographic modeling, (2) the observed juvenile to adult ratios, and (3) adult survivorship rates, the number of murrelets in Washington, Oregon, and California are too low to sustain a murrelet population and the rate of decline for murrelets throughout the listed range is estimated to be between 2.0 to 15.8 percent (Beissinger and Nur 1997–cited in U.S. Fish and Wildlife Service 1997a; McShane et al. 2004).

<u>Murrelets in Washington (Conservation Zones 1 and 2)</u>

Historically, murrelets in Conservation Zones 1 and 2, were "common" (Rathbun 1915 and Miller et al. 1935–cited in U.S. Fish and Wildlife Service 1997a), "abundant" (Edson 1908 and Rhoades 1893–cited in U.S. Fish and Wildlife Service 1997a), or "numerous" (Miller et al. 1935–cited in McShane et al. 2004).

Conservation Zone 1, encompassing the Puget Sound in northwest Washington, contains one of the larger murrelet populations in the species' listed range, and supports an estimated 41 percent of the murrelets in the coterminous United States (Huff et al. 2003). The 2003 population

estimate (with 95 percent confidence intervals) for Conservation Zone 1 is 8,500 (6,000 – 11,300) and Conservation Zone 2 is 3,400 (2,000 – 4,900) (Huff et al. 2003). In Conservation Zone 2, a higher density of murrelets occurs in the northern portion of the Zone (Huff et al. 2003) where the majority of available nesting habitat occurs. In Conservation Zone 1, higher densities of murrelets occur in the Straits of Juan de Fuca, the San Juan Islands, and the Hood Canal (Huff et al. 2003), which are in proximity to nesting habitat on the Olympic Peninsula and the North Cascade Mountains.

Although population numbers in Conservation Zones 1 and 2 are likely declining, the precise rate of decline is unknown. The juvenile to adult ratio derived from at-sea survey efforts in Conservation Zone 1 is 0.09. Juvenile to adult ratio is not collected in Conservation Zone 2; however, the juvenile to adult ratio for Conservation Zone 3 is 0.08. Therefore, it is reasonable to infer that a juvenile to adult ratio for Conservation Zone 2 is likely between 0.08 and 0.09. These low juvenile to adult ratios infer there is insufficient juvenile recruitment to sustain a murrelet population in Conservation Zones 1 and 2. Beissinger and Peery (2003) estimated the rate of decline for Conservation Zone 1 to be between 2.0 to 12.6 percent and between 2.8 to13.4 percent in Conservation Zone 3. It is likely that the rate of decline in Conservation Zone 2 is similar to that of Conservation Zones 1 and 3.

Juvenile to adult ratios in Washington may be skewed by murrelets coming and going to British Columbia. At-sea surveys are timed to occur when the least number of murrelets from British Columbia are expected to be present. However, recent radio-telemetry information indicates (1) murrelets nesting in British Columbia forage in Washington waters during the breeding season (Martin Raphael, USFS, *in litt.* 2005) and could be counted during at-sea surveys; and (2) adult murrelets foraging in Washington during the early breeding season moved to British Columbia in mid-June and mid-July (Bloxton and Raphael 2004) and will not have been counted during the at-sea surveys. The movements of juvenile murrelets in Washington and southern British Columbia are unclear. Therefore, until further information is obtained to define the impact of exchange of murrelets between British Columbia and Washington, the Service will continue to rely on the at-sea derived juvenile to adult ratios to evaluate the population status in Conservation Zones 1 and 2.

Habitat Abundance

Estimates on the amount of available suitable nesting habitat vary as much as the methods used for estimating murrelet habitat. McShane et al. (2004) estimates murrelet habitat in Washington State at 1,022,695 acres, representing approximately 48 percent of the estimated 2,223,048 acres of remaining suitable habitat in the listed range. McShane et al. (2004) caution about making direct comparisons between current and past estimates due to the evolving definition of suitable habitat and methods used to quantify habitat. As part of the ongoing pursuit to improve habitat estimates, information was collected and analyzed by the Service in 2005 resulting in an estimated 751,831 acres of suitable nesting habitat in Conservation Zone 1 and 585,821 acres in Conservation Zone 2 (Table 3).

Table 3. Estimated acres of suitable nesting habitat for the murrelet on Federal and non-Federal lands in Conservation Zones 1 and 2

Conservation Zone	Estimated acres of suitable murrelet habitat by land management category *				
	Federal	State	Private*	Tribal	Total
Puget Sound (Zone 1)	650,937	98,036	2,338	520	751,831
Western Washington Coast Range (Zone 2)	485,574	82,349	9,184	8,714	585,821
Totals	1,136,511	180,385	11,522	9,234	1,337,652

*Estimated acres of private land represent "occupied" habitat based on surveys submitted to WDFW. Additional suitable nesting habitat not surveyed or considered to be "unoccupied" is not included in this estimate.

Estimated acreages of suitable habitat on Federal lands in Table 3 are based on modeling and aerial photo interpretation and likely overestimate the actual acres of suitable murrelet habitat because (1) most acreages are based on models predicting spotted owl nesting habitat which include forested lands that do not have structures suitable for murrelet nesting; and (2) neither modeling or aerial photo interpretation can distinguish microhabitat features, such as nesting platforms or the presence of moss, that are necessary for murrelet nesting. The amount of high quality murrelet nesting habitat available in Washington, defined by the Service as large, old, contiguously forested areas not subject to human influences, such as timber harvest or urbanization, is expected to be a small subset of the estimated acreages in Table 3. Murrelets nesting in high quality nesting habitat are assumed to have a higher nesting success rate than murrelets nesting in fragmented habitat near humans.

Conservation Zone 1

The majority of suitable murrelet habitat in Conservation Zone 1 occurs in northwest Washington and is found on Forest Service and National Park Service lands, and to a lesser extent on State lands. The majority of the historic habitat along the eastern and southern shores of the Puget Sound has been replaced by urban development resulting in the remaining suitable habitat being farther inland from the marine environment than what occurred historically (U.S. Fish and Wildlife Service 1997a).

Conservation Zone 2

Murrelet nesting habitat north of Gray's Harbor in Conservation Zone 2 occurs largely on State, Forest Service, National Park Service, and Tribal lands, and to a lesser extent, on private lands. Alternatively, the majority of habitat in the southern portion of Conservation Zone 2 occurs primarily on State lands, with a small amount on privately-owned lands.

Threats

Murrelets remain subject to a variety of anthropogenic threats within the upland and marine environment. They also face threats from low population numbers, low immigration rates, high predation rates, and disease.

Threats in the Marine Environment

Threats to murrelets in the marine environment include declines in prey availability; mortality associated with exposure to oil spills, gill net, and other fisheries; contaminants suspended in marine waters; and visual or sound disturbance from recreational or commercial watercrafts (U.S. Fish and Wildlife Service 1992, 1997a; Ralph et al. 1995; McShane et al. 2004).

Prey Availability

Many fish populations have been depleted due to overfishing, reduction in the amount or quality of spawning habitat, and pollution. Primary murrelet prey species have little commercial fishery value and, in general, there is little geographic overlap between murrelet distribution and areas of commercial harvest (McShane et al. 2004). However, there are several fisheries for herring and surf smelt in Puget Sound and for anchovy in Grays Harbor, Willapa Bay, and along the outer coast (Bargmann 1998). The extent of the effects of these fisheries on murrelets is unknown, but is presumed to be minor.

In addition to fishing pressure, oceanographic variation can influence prey availability. While the effects to murrelets from events such as 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 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 murrelets in the marine environment.

Oil Spills

Murrelet mortality from oil pollution is a conservation issue in Washington (U.S. Fish and Wildlife Service 1997a). Most oil spills and chronic oil pollution that can affect murrelets occurs in areas of high shipping traffic, such as the Strait of Juan de Fuca and Puget Sound. There have been at least 47 oil spills of 10,000 gallons or more in Washington since 1964 (WDOE 2004). However, the number of oil spills has generally declined since passage of the U.S. Oil Pollution Act in 1990. The estimated annual mortality of murrelets from oil spills in Washington has decreased from 3 - 41 birds per year (1977 to 1992) to 1 - 2 birds per year (1993 to 2003) (McShane et al. 2004).

Since the murrelet was listed, the amount of oil tanker and shipping traffic has continued to increase (U.S. Fish and Wildlife Service 1997a; Burger 2002). Large commercial ships, including oil tankers, cargo ships, fish processing ships, and cruise ships, enter Washington waters more than 7,000 times each year, bound for ports in Puget Sound, British Columbia, Grays Harbor, and the Columbia River (WDOE 2004). Additionally, 4,500 tank-barge transits, 160,000 ferry transits, and military vessel traffic occurs in these same waters each year (WDOE 2004). Individually these vessels may carry up to 33 million gallons of crude oil or refined petroleum products, but collectively, they carry about 15.1 billion gallons across Puget Sound waters each year (WDOE 2004). These numbers are expected to increase as the human population and commerce continues to grow. Currently there are State and Federal requirements for tug escorts of laden oil tankers transiting the waters of Puget Sound east of Dungeness Spit.

However, the Federal requirements do not apply to double-hulled tankers and will no longer be in effect once the single-hull tanker phase-out is complete (WDOE 2005). Washington State is considering revising their tug escort requirements (WDOE 2005); however, the current tug escort requirements remain in place until the Washington State Legislature officially makes a change.

The U.S. Coast Guard rated the Dungeness area in the Strait of Juan de Fuca as being in the top five high-risk areas of the United States for being impacted by oil spills (U.S. Fish and Wildlife Service 2005). Therefore, even though the threat from oil spills appears to have been reduced since the murrelet was listed, the risk of a catastrophic oil spill remains, and could severely impact adult and/or juvenile murrelets in Conservation Zones 1 and 2.

Gillnets

Murrelet mortality from gillnet fishing has been considered a conservation issue in Washington (U.S. Fish and Wildlife Service 1997a; Melvin et al. 1999). 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 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 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. In most areas, the threat from gill net fishing has been reduced or eliminated since 1992, but threats to adult and juvenile murrelets are still present in Washington nearshore zones (McShane et al. 2004).

Marine Contaminants

The primary consequence from the exposure of murrelets to contaminants is reproductive impairment. Reproduction can be impacted by food web bioaccumulation of organochlorine pollutants and heavy metals discharged into marine areas where murrelets feed and prey species concentrate (Fry 1995). However, murrelet exposure is likely a rare event because 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 murrelets may occur at the regularly feeding areas near major pollutant sources, such as those found in Puget Sound (McShane et al. 2004).

Disturbance

In coastal and offshore marine environments, vehicular disturbance (e.g., boats, airplanes, personal watercraft) is known to elicit behavioral responses in murrelets of all age classes (Kuletz 1996; Speckman 1996; Nelson 1997). Aircraft flying at low altitudes and boating activity, in particular motorized watercraft, are know to cause murrelets to dive and are thought to especially affect adults holding fish (Nelson 1997). It is unclear to what extent this kind of disturbance affects the distribution and movements of murrelets. However, it is unlikely this

type of disturbance has decreased since 1992 because the shipping traffic and recreational boat use in the Puget Sound and Strait of Juan de Fuca has continued to increase.

Marine projects that include seismic exploration, pile driving, detonation of explosives and other activities that generate percussive sounds can expose murrelets to elevated underwater sound pressure levels (SPLs). High underwater SPLs can have adverse physiological and neurological effects on a wide variety of vertebrate species (Cudahy and Ellison 2002; USDD Department of Navy 2002; Fothergill et al. 2001; Popper 2003; Steevens et al. 1999; Yelverton and Richmond 1981; Yelverton et al. 1973). High underwater SPLs are known to injure and/or kill fish by causing barotraumas (pathologies associated with high sound levels including hemorrhage and rupture of internal organs), as well as causing temporary stunning and alterations in behavior (Hastings and Popper 2005; Popper 2003; Turnpenny and Nedwell 1994; Turnpenny et al. 1994). During monitoring of seabird response to pile driving in Hood Canal, Washington, a pigeon guillemot (*Cepphus columba*) was observed having difficulty getting airborne after being exposed to underwater sound from impact pile driving (Entranco and Hamer Environmental 2005). In controlled experiments using underwater explosives, rapid change in SPLs caused internal hemorrhaging and mortality in submerged mallard ducks (*Anas platyrhnchos*) (Yelverton et al. 1973). Risk of injury appears related to the effect of rapid pressure changes, especially on gas filled spaces in the bodies of exposed organisms (Turnpenny et al. 1994). In studies on ducks (*Anas spp.*) and a variety of mammals all species exposed to underwater blasts had injuries to gas filled organs including eardrums (Yelverton and Richmond 1981). These studies indicate that similar effects can be expected across taxa.

Physical injury may not result in immediate mortality. If an animal is injured, death may occur several hours or days later, or injuries may be sublethal. Sublethal injuries can interfere with the ability of an organism to carry out essential life functions such as feeding and predator avoidance. Diving birds are able to detect and alter their behavior based on sound in the underwater environment (Ross et al. 2001) and elevated underwater SPLs may cause murrelets to alter normal behaviors, such as foraging. Disturbance related to elevated underwater SPLs may reduce foraging efficiency resulting in increased energetic costs to all murrelet age classes in the marine environment and may result in fewer deliveries or lower quality food being delivered to nestlings.

Threats in the Terrestrial Environment

Habitat

Extensive harvest of late-successional and old-growth forests was the primary reason for listing the murrelet as threatened. Due primarily to extensive timber cutting over the past 150 years, at least 82 percent of the old-growth forests existing in western Washington and Oregon prior to the 1840s have been harvested (Booth 1991; Teensma et al. 1991; Ripple 1994; Perry 1995). About 10 percent of pre-settlement old-growth forests remain in western Washington (Norse 1990; Booth 1991). Although the NWFP has reduced the rate of habitat loss on Federal lands, the threat of continued loss of suitable nesting habitat remains on Federal and non-Federal lands through timber harvest and natural events such as wildfire, insect outbreaks, and windthrow.

Natural disturbance has the potential to affect the amount and quality of murrelet nesting habitat. Wildfire and windthrow result in immediate loss of habitat and can also influence the quality of adjacent habitat. Global warming, combined with long-term fire suppression on Federal lands, may result in higher incidences of stand-replacing fires in the future (McShane et al. 2004). As forest fragmentation increases, the threat of habitat loss due to windthrow is likely to increase. In addition, insects and disease can kill complete stands of habitat and can contribute to hazardous forest fire conditions.

Between 1992 and 2003, the loss of suitable 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 murrelets and their habitat, the species is potentially facing a severe reduction in numbers in the coming 20 to 100 years (U.S. Forest Service and U.S. Fish and Wildlife Service 1994b; Beissinger 2002).

In addition to direct habitat removal, forest management practices can fragment murrelet habitat, which reduces the amount and heterogeneous nature of the habitat, reduces the forest patch sizes, reduces the amount of interior or core habitat, increases the amount of edge, isolates remaining habitat patches, and creates "sink" habitats (McShane et al. 2004). There are no estimates available for the amount of suitable habitat that has been fragmented or degraded since 1992. However, the ecological consequences of these habitat changes to murrelets can include effects on population viability and size, local or regional extinctions, displacement, fewer nesting attempts, failure to breed, reduced fecundity, reduced nest abundance, lower nest success, increased predation and parasitism rates, crowding in remaining patches, and reductions in adult survival (Raphael et al. 2002).

Predation

Predation is expected to be the principal factor limiting murrelet reproductive success and nest site selection (Ralph et al. 1995; Nelson and Hamer 1995b). Murrelets are believed to be highly vulnerable to nest predation compared to other alcids and forest nesting birds (Nelson and Hamer 1995b; U.S. Fish and Wildlife Service 1997a). Murrelets have no protection at nest sites other than the ability to remain hidden. Nelson and Hamer (1995b) hypothesized that small increases in murrelet predation will have deleterious effects on murrelet population viability due to their low reproductive rate (one egg clutches).

Known predators of adult murrelets in the forest environment include the peregrine falcon (*Falco peregrinus*), sharp-shinned hawk (*Accipiter striatus*), common raven (*Corvus corax*), northern goshawk (*Accipiter gentilis*), and bald eagle (*Haliaeetus leucocephalus*). Common ravens and Stellar's jays (*Cyanocitta stelleri*) are known to take both eggs and chicks at the nest, while sharp-shinned hawks have been found to take chicks. Common ravens account for the majority of egg depredation, as they appear to be the only predator capable of flushing incubating or brooding adults from a nest (Nelson and Hamer 1995b). Suspected nest predators include great horned owls (*Bubo virginianus*), barred owls (*Strix varia*), Cooper's hawks (*Accipiter cooperi*),

northwestern crows (*Corvus caurinus*), American crows (*Corvus brachyrhynchos*), and gray jays (*Perisoreus canadensis*) (Nelson and Hamer 1995b; Nelson 1997; Manley 1999). 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).

Losses of eggs and chicks to avian predators have been determined to be the most important cause of nest failure (Nelson and Hamer 1995b; McShane et al. 2004). The risk of predation by avian predators appears to be highest in complex structured landscapes in proximity to edges and human activity, where many of the corvid species are in high abundance. Predation rates are influenced mainly by habitat stand size, habitat quality, nest placement (on the edge of a stand vs. the interior of a stand), and proximity of the stand to human activity centers. The quality of murrelet nest habitat decreases in smaller stands because forest edge increases in relation to the amount of interior forest, while forest stands near human activity centers (less than 1 kilometer), regardless of size, are often exposed to a higher density of corvids due to their attraction to human food sources (Marzluff et al. 2000). The loss of nest contents to avian predators increases in some forested areas with habitat fragmentation and an increase in the ratio of forest edge to interior habitat (Nelson and Hamer 1995b; McShane et al. 2004). For example, Nelson and Hamer (1995b) found successful nests were farther from edges (greater than 55 m) and were better concealed than unsuccessful nests.

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). It is reasonable to infer that as predator abundance has increased, predation on murrelet chicks and eggs has also increased, and murrelet reproductive success has decreased. It is also reasonable to assume that this trend will not be interrupted or reversed in the near future, as forest fragmentation, agriculture, and urbanization continue to occur.

Other Threats

Murrelets are subject to additional threats from diseases and genetic-related influences as a result of low population numbers and low immigration rates. To date, inbreeding (mating between close genetic relatives) and/or hybridizing (breeding with a different species or subspecies) have not been identified as threats to murrelet populations. However, as abundance declines, a corresponding decrease in the resilience of the population to disease, inbreeding or hybridization, and other perturbations may occur. Additionally, murrelets are considered to have low recolonization potential because their low immigration rate makes the species slow to recover from local disturbances (McShane et al. 2004).

The emergence of fungal, parasitic, bacterial, and viral diseases 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. While the amount of negative impact this disease may bring is unknown, researchers agree that it is only a matter time before West Nile virus reaches the Washington seabird population (McShane et al. 2004). Effects for murrelets from West Nile virus and other diseases are expected to increase in the near future due to an accumulation of stressors such as oceanic temperature changes, overfishing, and habitat loss (McShane et al. 2004).

Murrelets may be sensitive to human-caused disturbance due to their secretive nature and their vulnerability to predation. There are little data concerning the murrelet's vulnerability to disturbance effects, except anecdotal researcher observations that indicate murrelets typically exhibit a limited, temporary behavioral response (if any) to noise disturbance at nest sites and are able to adapt to auditory stimuli (Singer et al. 1995 cited in McShane et al. 2005; Long and Ralph 1998; Golightly et al. 2002). In general, responses to auditory stimuli at nests sites have been modifications of posture and on-nest behaviors (Long and Ralph 1998). While the unique breeding biology of the murrelet is not conducive to comparison of the reproductive success of other species, studies on other alcid and seabird species have revealed detrimental effects of disturbance to breeding success and the maintenance of viable populations (Cairns 1980; Pierce and Simons 1986; Piatt et al. 1990; Beale and Monaghan 2004).

Research on a variety of other species, including other seabirds, indicate an animal's response to disturbance follows the same pattern as its response to encountering predators and anti-predator behavior has a cost to other fitness enhancing activities, such as feeding and parental care (Frid and Dill 2002). Some authors indicate disturbance stimuli can directly affect the behavior of individuals and indirectly affect fitness and population dynamics through increased energetic costs (Frid and Dill 2002; Carney and Sydeman 1999). Responses by murrelet adults and chicks to calls from corvids and other potential predators include no response, alert posturing, aggressive attack, and temporarily leaving a nest (adults only) (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 1995; McShane et al. 2004). Therefore, researcher's anecdotal observations of little or no physical response by murrelets are consistent with the behavior they will exhibit in response to a predator. In addition, there may have been physiological responses researchers cannot account for with visual observations. Corticosterone studies have not been conducted on 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; Marra and Holberton 1998 cited in McShane et al. 2004).

Although detecting effects of sub-lethal noise disturbance at the population level is hindered by the breeding biology of the murrelet, the effect of noise disturbance on murrelet fitness and reproductive success should not be completely discounted (McShane et al. 2004). In recently completed analyses, the Service concluded the potential for injury associated with disturbance (visual and sound) to murrelets in the terrestrial environment includes flushing from the nest, aborted feeding, and postponed feedings (U.S. Fish and Wildlife Service 2003). These responses by individual murrelets to disturbance stimuli can reduce productivity of the nesting pair, as well as the entire population (U.S. Fish and Wildlife Service 1997a).

Conservation Needs

The Recovery Plan outlines the conservation strategy for the species. In the short-term, specific actions necessary to stabilize the population include maintaining occupied habitat, maintaining large blocks of suitable habitat, maintaining and enhancing buffer habitat, decreasing risks of nesting habitat loss due to fire and windthrow, reducing predation, and minimizing disturbance.

Long-term conservation needs include increasing productivity (abundance, the ratio of juveniles to adults, and nest success) and population size; increasing the amount (stand size and number of stands), quality, and distribution of suitable nesting habitat; protecting and improving the quality of the marine environment; and reducing or eliminating threats to survivorship by reducing predation in the terrestrial environment and anthropogenic sources of mortality at sea. The Service (U.S. Fish and Wildlife Service 1997a) estimates recovery of the murrelet will require at least 50 years.

The Recovery Plan states that four of the six Conservation Zones must be functional to effectively recover the murrelet in the short- and long-term; that is, to maintain viable populations that are well-distributed. Based on the new population estimates, it appears three of the six Conservation Zones contain relatively large numbers of murrelets (Zones 1, 3, and 4). Conservation Zones 1 and 4 contain the largest number of murrelets compared to the other four Zones. This alone will seem to indicate a better condition there, but areas of concern remain. For example, the population in Conservation Zone 4 was impacted when oil spills killed an estimated 10 percent of the population (Bentivoglio et al. 2002; Ford et al. 2002), small oil spills continue to occur in Conservation Zone 1, and the juvenile-to-adult ratios in both of these Conservation Zones continue to be too low to establish stable or increasing populations (Beissinger and Peery 2003).

Murrelets in Conservation Zones 3, 5, and 6 have suffered variously from past oil spills which killed a large number of murrelets (Zone 3) (Ford et al. 2001), extremely small population sizes (Zones 5 and 6), and alarmingly low reproductive rates (Zone 6) (Peery et al. 2002). These factors have brought the status of the species to a point where recovery in Conservation Zones 5 and 6 may be precluded (Beissinger 2002). The poor status of murrelet populations in the southern Conservation Zones emphasizes the importance of supporting murrelet populations in Conservation Zones 1 and 2 in order to preserve the opportunity to achieve murrelet recovery objectives.

Conservation Strategy

Marine Environment

Protection of marine habitat is also a component of the recovery strategy. The main threat to murrelets in the marine environment is the loss of individuals through death or injury, generally associated with oil spills and gill-net entanglements. The recovery strategy recommends managing all waters within 1.2 mi of shore within the Puget Sound and Strait of Juan de Fuca, and along the Pacific Coast from Cape Flattery to Willapa Bay in such a way as to reduce or eliminate murrelet mortality (U.S. Fish and Wildlife Service 1997a). Management strategies could include exclusion of vessels, stricter hull requirements, exclusion of net fisheries or modification of fishing gear.

In Washington State, the Washington Fish and Game Commission requires the use of alternative gear (i.e., visual alerts within the upper 7 ft of a multifilament net), prohibits nocturnal and dawn fishing for all non-treaty gill-net fisheries, and closes areas to gill-net fishing in order to reduce by-catch of murrelets.

The Olympic Coast National Marine Sanctuary was established in 1994 along the outer Washington coast from Cape Flattery south to approximately the Copalis River and extending between 25 mi and 40 mi offshore. Oil exploration and development are prohibited within this Sanctuary (USDC 1993).

Terrestrial Habitat Management

The loss of nesting habitat (old-growth/mature forest) has generally been identified as the primary cause of the murrelet population decline and disappearance across portions of its range (Ralph et al. 1995). Logging, urbanization, and agricultural development have all contributed to the loss of habitat, especially at lower elevations.

The recovery strategy for the murrelet (U.S. Fish and Wildlife Service 1997a) relies heavily on the NWFP to achieve recovery on Federal lands in Washington, Oregon, and California. However, the Recovery Plan also addresses the role of non-Federal lands in recovery, including Habitat Conservation Plans, state forest practices, and Tribal lands. The importance of non-Federal lands in the survival and recovery of murrelets is particularly high in Conservation Zones, where Federal lands within 50 mi of the coastline are lacking, such as the southern half of Conservation Zone 2.

Lands considered essential for the recovery of the murrelet within Conservation Zones 1 and 2 are: (1) any suitable habitat in a Late-Successional Reserve (LSR); (2) all suitable habitat located in the Olympic Adaptive Management Area; (3) large areas of suitable nesting habitat outside of LSRs on Federal lands, such as habitat located in the Olympic National Park; (4) suitable habitat on State lands within 40 mi of the coast; and (4) habitat within occupied murrelet sites on private lands (U.S. Fish and Wildlife Service 1997a).

Northwest Forest Plan

When the U.S. Forest Service (USFS) and Bureau of Land Management incorporated the NWFP as the management framework for public lands, a long-term habitat management strategy for murrelets (U.S. Forest Service and U.S. Fish and Wildlife Service 1994a,b) was established. The NWFP instituted pre-project surveys of murrelet habitat in areas planned for timber harvest and the protection of existing habitat at sites determined through surveys to be occupied by murrelets.

In the short-term, all known-occupied sites of murrelets occurring on USFS or Bureau of Land Management lands under the NWFP are to be managed as LSRs. In the long-term, unsuitable or marginally suitable habitat occurring in LSRs will be managed, overall, to develop late-successional forest conditions, thereby providing a larger long-term habitat base into which murrelets may eventually expand. Thus, the NWFP approach offers both short-term and long-term benefits to the murrelet.

Over 80 percent of murrelet habitat on Federal lands in Washington occurs within land management allocations that protect the habitat from removal or significant degradation. Scientists predicted implementation of the NWFP will result in an 80 percent likelihood of

achieving a well-distributed murrelet population on Federal lands over the next 100 years (U.S. Forest Service and U.S. Fish and Wildlife Service 1994b). Although the NWFP offers protection of known-occupied murrelet sites, concerns over the lingering effects of the historic widespread removal of suitable habitat will remain until the habitat recovers to late-successional characteristics. This habitat recovery may require over 100 years.

Habitat Conservation Plans

Four Habitat Conservation Plans (HCP) addressing murrelets in Washington have been completed for private/corporate forest land managers within the range of the murrelet: West Fork Timber Corporation (Murray Pacific Corporation 1993, 1995, U.S. Fish and Wildlife Service 1995) (Mineral Tree Farm HCP); Plum Creek Timber Company (Plum Creek Timber Company 1996, 1999, U.S. 1996b,1999) (Cascades HCP; I-90 HCP); Port Blakely Tree Farms, L.P. (Port Blakely Tree Farms 1996, U.S. Fish and Wildlife Service 1996c) (R.B. Eddy Tree Farm HCP); and Simpson Timber Company (Simpson Timber Company 2000; U.S. Fish and Wildlife Service 2000a) (Olympic Tree Farm HCP). Habitat Conservation Plans have also been completed for the Washington Department of Natural Resources (WDNR 1997; U.S. Fish and Wildlife Service1997b) (WDNR HCP) and two municipal watersheds, City of Tacoma (Tacoma Public Utilities 2001, U.S. Fish and Wildlife Service 2001) (Green River HCP) and City of Seattle (City of Seattle 2001; U.S. Fish and Wildlife Service 2000b) (Cedar River HCP). The HCPs which address murrelets cover approximately 500,000 acres of non-Federal (private/corporate) lands, over 100,000 acres of municipal watershed, and over 1.6 million acres of State-managed lands. However, only a portion of these lands contain suitable murrelet habitat.

The WDNR HCP addresses murrelets in Conservation Zones 1 and 2. All of the others address murrelets in Conservation Zone 1. Most of the murrelet HCPs in Washington employ a consistent approach for murrelets by requiring the majority of habitat to be surveyed prior to timber management. Only poor-quality marginal habitat (with a low likelihood of occupancy) is released for harvest without survey. All known occupied habitat is protected to varying degrees, but a “safe-harbor-like” approach is used to address stands which may be retained as, or develop into, suitable habitat and become occupied in the future. This approach will allow harvest of habitat in the future, which is not currently nesting habitat.

Washington State Forest Practices Regulations

Under Washington Forest Practices Rules, which apply to all non-Federal lands not covered by an HCP (WFPB 2001), surveys for murrelets are required prior to the harvest of stands that meets certain platform numbers and stand size criteria. These criteria vary depending on the location of the stand. For stands found to be occupied or known to be previously occupied, the WDNR makes a decision to issue the permit based upon a significance determination. If a determination of significance is made, preparation of a State Environmental Policy Act Environmental Impact Statement is required prior to proceeding. If a determination of non-significance or mitigated determination of non-significance is reached, the action can proceed without further environmental assessment.

Tribal Management

The management strategy of the Bureau of Indian Affairs for the murrelet focuses on working with Tribal governments on a government-to-government basis to develop management strategies for reservation lands and trust resources. The Bureau of Indian Affairs' management strategy typically focus on avoiding harm to murrelets when feasible, to facilitate the trust responsibilities of the United States. However, other factors must be considered. Strategies must foster Tribal self-determination, and must balance the needs of the species and the environmental, economic, and other objectives of Indian Tribes within the range of the murrelet (Renwald *in litt*. 1993 cited in U.S. Fish and Wildlife Service 1997). For example, one of the Bureau of Indian Affairs' main goals for murrelet protection includes assisting Tribes in managing habitat consistent with tribal priorities, reserved Indian rights, and legislative mandates.

Summary

Demographic modeling results indicate murrelet populations are declining within each Conservation Zone and throughout the listed range. The juvenile to adult ratios observed at sea in the Conservation Zones are too low to obtain a stable population in any Conservation Zone, which indicates murrelet abundance in all Conservation Zones will continue to decline until reproductive success improves. In other words, there is insufficient recruitment of juveniles to sustain a murrelet population in the listed range.

Some of the threats to the murrelet population may have been reduced as a result of the species' listing under the Act, such as the passage of the Oil Pollution Act and implementation of the NWFP. However, no threats have been reversed since listing and in some areas threats, such as predation and West Nile Virus, may be increasing or emerging. Threats continue to contribute to murrelet population declines through adult and juvenile mortality and reduced reproduction.

Therefore, given the current status of the species and background risks facing the species, it is reasonable to assume that murrelet populations in Conservation Zones 1 and 2 and throughout the listed range have little resilience to deleterious population-level effects and are at high risk of extirpation.

ENVIRONMENTAL BASELINE

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. Also included in the environmental baseline are the expected impacts of all proposed Federal projects in the action area that have undergone section 7 consultation, and the impacts of State and private actions that are contemporaneous with the consultation in progress. The environmental baseline for this Opinion includes the effects of a variety of human activities and natural phenomena that may effect the survival and recovery of murrelets in the action area. Such phenomena and activities have contributed to the current status of murrelets in the action area.

Murrelet Habitat in the Park

Approximately 25,300 acres of forested area within the Park is defined as suitable murrelet nesting habitat (Myers 2003) which constitutes 2 percent of Conservation Zone 1. This habitat is distributed along the western boundary of the Park as valleys running east and west separated by high elevation ridges. Of the 25,300 acres, 8,780 acres of relatively contiguous occupied habitat lie within the watersheds of the Carbon, Mowich, and Puyallup Rivers within the Park's boundary.

Although other watersheds including eastern portions of the Park occur below 3,800 ft, extensive surveys have never detected murrelets in the area. The Ohanapecosh, Muddy Fork, and Stevens Creek portions of the Cowlitz watershed, as well as the White River on the eastern side of the Park, lie more than 50 mi from ocean foraging habitat.

The management objectives for the Park are considered compatible with maintaining suitable habitat for murrelets. The Park Service policy states that "Natural resources will be managed to preserve fundamental physical and biological processes, as well as individual species, features, and plant and animal communities. The NPS will not attempt to solely preserve individual species (except threatened or endangered species) or individual natural processes; rather, it will try to maintain all the components and processes of naturally evolving ecosystems, including the natural abundance, diversity, and genetic and ecological integrity of the plant and animal species native to those ecosystems" (National Park Service 2001).

With the exception of a relatively small number of roads, visitor centers, and administrative sites, murrelet habitat at the landscape level within the action area remains unchanged from conditions that existed before the Park was established in 1899.

Distribution, Reproduction, and Population Trends in the Action Area

The action area occurs entirely within Conservation Zone 1 as defined in the Marbled Murrelet Recovery Plan (U.S. Fish and Wildlife Service 1997a). Further, most of the murrelet population in Washington occurs in Conservation Zone 1 (Fish and Wildlife Service 1997a; Bentivoglio et al. 2002; Jodice et al. 2002; Huff 2003). Conservation Zone 1 extends south from the U.S.–Canadian border along the east shore of Puget Sound to the southern end of Puget Sound, and then follows the north shore of the Olympic Peninsula westward to Koitlah Point, just northeast of Cape Flattery. Conservation Zone 1 includes all of Puget Sound and most waters of the Strait of Juan de Fuca and extends inland 50 mi from eastern Puget Sound and includes the northern and eastern section of the Olympic Peninsula.

As a result of the development of the marine component of the Environmental Monitoring (EM) Program for the NWFP (Bentivoglio 2002), sampling procedures have been unified within the five Conservation Zones contained within NWFP lands. These efforts, along with a coordinated effort in Conservation Zone 6 to implement the same sampling protocol, have resulted in annual estimates of murrelet abundance for each Conservation Zone (Bentivoglio 2002; Huff et al. 2003; McShane et al. 2004) with the annual overall population estimated at 18,097 (2000), 22,200 (2001), 23,700 (2002), and 22,300 (2003). Using the most recent population estimates

from Huff et al. (2003), Conservation Zone 1 has an estimated murrelet population size of 8,600 murrelets.

Surveys have been conducted since 1994 according to Pacific Seabird Group protocols in all major Park watersheds. Murrelet presence is documented within four river corridors: the Carbon, Mowich, Puyallup, and Nisqually Rivers. However, occupied behavior detections have been documented at all of these locations except the Nisqually River. No ground surveys have ever detected murrelets in that watershed (Myers 2003). Because of the occupied behavior detections, it is assumed that murrelets are nesting within the Carbon, Mowich, and Puyallup River corridors below 3,800 ft. No active nests have been located within the Park. It is unknown how many murrelets might occupy this habitat as murrelets do not occupy all habitats uniformly and research has not been conducted in this area that will provide a direct calculation of murrelet numbers per acre.

EFFECTS OF THE PROPOSED ACTION ON MURRELETS

This section evaluates the overall effects of the proposed action with respect to the conservation needs of the murrelet within the action area. In accordance with the Service's Endangered Species Consultation Handbook (U.S. Fish and Wildlife Service and National Marine Fisheries Service 1998), a "jeopardy analysis" of impacts to a species as the result of a specific project can be made at the "recovery unit" scale rather than over the entire species' listed range. For the murrelet, the individual recovery unit is the Conservation Zone (U.S. Fish and Wildlife Service 1997a). In this analysis, we will address Conservation Zone 1. This section does not evaluate the effects of any emergency consultation that will result from the need to remove hazard trees within suitable murrelet habitat during the breeding season.

Direct Effects to the Murrelet

Direct Injury or Mortality

We expect no direct injury or mortality to murrelets as a result of the proposed action. Direct injury or mortality could only occur if murrelets were present during hazard tree treatment. The Park will treat all hazard trees outside the murrelet breeding season.

Habitat Modification Effects

The proposed action will result in the loss of murrelet habitat components, namely, individual large trees and snags. Some of these hazard trees are potential nest trees or large trees adjacent to potential nest trees that provide protection such as cover and shade. The Park identified 150 hazard trees over 20 in dbh within suitable murrelet habitat. Identified hazard trees occur in four developed areas (a Park entrance, two campgrounds, and a picnic area), two back-country campsites, and along west side Park roads. These hazard trees require some form of treatment over the next 10 years. Treatment methods will vary and range from moving any target that a hazard tree may strike if left to fall on its own, to complete hazard tree removal. Because

treatment methods will vary, the removal of all 150 hazard trees represents the worst-case scenario (Table 5).

Table 5. Distribution of hazard trees within murrelet habitat

Park Area	Number of hazard trees >20 in dbh to be treated
Carbon River Entrance	10
Ipsut Creek Campground	25
Cougar Rock Campground	40
Cougar Rock Picnic Area	20
West Side Roads	50
South Mowich back-country campsite	4
Carbon River back-country campsite	1
Total hazard trees	150

Murrelets appear to require specific conditions for nesting. Therefore, a potential nest tree does not imply a nest tree, just that it has the structural elements (e.g., large limbs, mistletoe brooms) which provide for nesting. The BA uses the description of suitable nest trees by Ralph et al. (1995), namely that they are typically greater than 200 years old and at least 20 in dbh, although trees in productive ground may develop these characteristics at an earlier age (faster rate) and younger trees may also develop platforms through mistletoe infestations or in reaction to damage from wind or ice.

Hazard tree removal as a result of the proposed action will incrementally reduce nesting opportunities within the action area. Felling trees with suitable nest platforms will make those structures unavailable to nesting murrelets now and in the future.

Evidence suggests that murrelets exhibit fidelity to nesting areas. We assume that some murrelet breeding pairs could have fidelity to trees planned for hazard tree treatment and removal. Accordingly, we reviewed available literature on nesting fidelity in an attempt to predict how returning murrelets will respond to the loss of nesting habitat in the breeding seasons following hazard tree removal. Specifically, we needed to determine whether the proposed action would significantly disrupt or impair essential reproductive behavior.

Several authors report nest site fidelity in murrelets, which is consistent with that of other adult alcids where birds return to previously occupied, but recently destroyed nest sites for two or more years (Divoky and Horton 1995:86; Nettleship and Birkhead 1985 in Nelson 1997). Murrelets are known to return to the same forest stands in successive years (Nelson and Peck 1995). According to Divoky and Horton (1996), murrelets have been recorded in the same forest stands for a minimum of 20 years in northern California, 18 years in central California, 7 years in Oregon and 3 years in Washington. Murrelets sometimes use the same nest platform or tree in subsequent years, just not necessarily the same pair or individual (N = 7 nests) (Nelson and Peck 1995). There are more than 15 records of murrelets returning to the same tree, 6 of these to the

same platform. However, individual nest cups are not reused in consecutive years (Nelson 1997).

Nest site fidelity has adaptive benefits. A long-lived species can increase breeding success and lifetime fitness. It can reduce potential reproductive effort by increasing the chances of breeding with the previous years' mate, eliminate or reduce the need to locate a suitable nest site, and allow the development of familiarity with the surrounding environment (Divoky and Horton 1995). Site fidelity also has important implications in how murrelets respond to habitat loss and the reestablishment of breeding areas when habitat has been altered (Divoky and Horton 1995).

Evidence suggests the fidelity murrelets show to a previously used breeding area or site should be related to the rate and magnitude of habitat destruction (Divoky and Horton 1995). Since only individual potential nest trees will be removed as hazard trees (low rate and magnitude), the quality of the stand will be negligibly affected. We therefore expect a corresponding negligible change in fidelity to the immediate area; murrelets will respond to hazard tree removal by re-nesting in different trees within the affected stand, as long as alternate habitat of equal quality is available adjacent to the affected nest site.

The ability for breeding murrelets to prospect for new nest sites is well documented. Prospecting involves pairs and individuals flying near and landing on tree limbs in the early spring and midsummer. Non-breeding birds and subadults may also participate in this activity during the midsummer. Birds also visit nesting areas during the winter and may select nest sites during this time (several authors in Nelson, 1997). We expect the murrelets that nest within the Park to also prospect and thus have familiarity with the area around their nest site, including potential alternative nest sites. We, therefore, do not expect permanent murrelet displacement from the action area as a result of the proposed action.

We must also analyze whether relocating nest territories would delay breeding, because a significant delay could disrupt essential breeding behavior. Divoky and Horton (1995:86) describe the "ease and rapidity with which displaced murrelets seek out new breeding areas." They cite the frequency at which murrelets normally change nesting sites as evidence to this trait, and that they may be able to readily move at least short distances to new nest sites. Further, there is evidence that murrelets visit remnants of newly harvested stands before disappearing from the area (Folliard pers. comm. in Divoky and Horton 1995:86), indicating that murrelets might not immediately abandon a disturbed nest stand. The loss of a single suitable nest tree represents a condition far less impacted than a harvested stand. Therefore, we do not expect murrelets to significantly delay breeding due to the removal of hazard trees that may be nesting trees.

Using the above-described murrelet response framework, we do not expect murrelet habitat-use patterns would change at the scale of the action area. Therefore, we do not expect the loss of up to 150 potential nest trees outside of the breeding season to result in a long-term abandonment of nesting stands, and that any nesting displacement or temporary delay would not result in a loss of reproduction within the Park as the displaced murrelets would be expected to nest in adjacent suitable trees.

Sound and Visual Disturbance-Related Effects

The proposed action will not expose murrelets to sound or visual disturbance because it will occur outside the murrelet breeding season. Fellers will begin hazard tree removal after September 30 of any project year.

Indirect Effects to the Murrelet

Indirect effects are defined as those effects that are caused by, or will result from, the proposed action at a later time, but still reasonably certain to occur (50 CFR 402.02). Murrelets nesting in stands which remain after treatment may experience lower nest success because of edge and fragmentation effects which could contribute to increased predation, windthrow, and less favorable micro-climatic conditions (U.S. Fish and Wildlife Service 1996a). These are considered indirect effects to murrelets and are discussed below.

Increased Risk of Predation

Areas of human recreation attract some corvids (members of the Corvidae family) due to an abundance of discarded and dropped food. A study by Neatherlin and Marzluff (2002) found crows (common crows–*Corvus brachyrhynchos*—and Northwestern crows–*Corvus caurinus*), common ravens (*Corvus corax*), and Steller's jays (*Cyanocitta stelleri*), exploited anthropogenic food sources when nesting within 1 km of human settlement and recreation, and the benefits to crows that nested near humans (within 1 km) was "extreme—annual reproduction doubled and annual survivorship was 97.8 percent." Nesters more than 5 km from human settlement and recreation had poor reproduction—about half the annual survivorship.

Large corvids (crows and ravens) appeared greatly influenced by proximity to human recreation, and thus an anthropogenic food source (Neatherlin and Marzluff 2002). Crows and ravens reduced their home range sizes and increased their reproduction and abundance. Recent studies on the Olympic Peninsula found that proximity to anthropogenic food sources benefited American crows with potential negative consequences for other nesting birds (Neatherlin 2002). Neatherlin and Marzluff (2002) found that corvids were responsible for approximately one-third of the documented predation events on artificial murrelet nests. They found a strong correlation between crow abundance and rate of nest predation at sites less than 1 km from human settlement and recreation. Thus, crows appear to be the greatest nest predator to nests within this distance. In contrast, some corvids were not so influenced by anthropogenic food sources. Steller's jay nesting success and relative abundance did not appear to change with their proximity to human settlement and recreation (Neatherlin and Marzluff 2002).

Many of the suitable murrelet trees targeted for treatment during the proposed action occur at the edge of stands that are adjacent to high human-use areas. The close proximity to visitors and nearby traffic detracts from the quality of these platform trees and thus already puts any murrelets that may use those trees at risk of predation. The individual removal of up to 150 hazard trees is not expected to appreciably increase the amount of forest edge and thus will not appreciably increase the risk of predation to resident murrelets given the nature of areas to be treated.

Back-country campsites are small, about 1 acre each, or less. One back-country site within suitable murrelet habitat will have one hazard tree removed while another will have four hazard trees removed. Hazard tree removal from these small sites will not appreciably increase the forest edge, and thus will not appreciably increase the risk of predation of resident murrelets. Corvids are likely regular visitors to back-country campsites and have been for decades. Therefore, the potential increase in nest predation as a result of proposed action would be insignificant.

Windthrow Effects

Stand density, tree height, tree structure, and tree species composition are important factors in tree stability, as is support offered by adjacent trees (Harris 1989). Edge trees have longer crowns extending down their exposed side, favoring growth and stability, and are more resistant to windthrow (Oliver and Larson 1990). Trees in the lower crown classes are more susceptible to windthrow when exposed after thinning or partial cutting because they rely on surrounding trees for protection (Harris 1989; Oliver and Larson 1990).

Increased windthrow as a result of individual tree removal could result in adverse effects to murrelets by downing and/or damaging suitable nest trees or downing trees adjacent to nest trees that provide cover to a nest tree, or downing trees that strike nesting murrelets. However, developed areas from which fellers will remove hazard trees already have forest edges; the small contribution of the removal of a few scattered trees per developed site will not appreciably increase the amount of forest edge. Therefore, the increased threat of windthrow to nesting murrelets as a result of the proposed action will be insignificant.

Microclimate Changes

New forest edges often influence the microclimate within the adjacent forest which could affect nesting murrelets. When trees are felled, an opening in the canopy is created which can cause changes in the microclimate in the surrounding stand. Air temperature, humidity, soil temperature, soil moisture, solar radiation, and wind speed within a stand can be altered by clearings (Chen et al. 1992). Along clearcut edges, the amounts of windthrow and dead wood are more abundant because of exposure to strong winds and environmental stress.

Wind "significantly influences other physical (e.g., evapotranspiration) and biological (seed dispersal) processes and it drives air circulation, which controls the balance between energy (heat) and materials (e.g., vapor) between the edge and interior forest" (Chen et al. 1995). Chen et al. (1995) found that wind speed's distance of influence may range from 1,082 ft to 1,673 ft into an old-growth Douglas-fir forest, and based upon their data and other studies, the maximum distance of influence of wind blowing into the forest was probably greater than 5 or 6 tree heights.

The existing forest stands in developed areas and along roads currently have edges and openings, and are already subject to wind effects. The removal of dispersed trees adjacent to existing forest edges will not significantly increase the amount or nature of the forest edge. Therefore,

we expect the proposed action to have such a small effect on the existing microclimatic as to be insignificant.

Effects of Interdependent and Interrelated Actions

Interdependent actions are those that have no independent utility apart from the action under consultation. There are no known interdependent actions associated with the proposed action. Interrelated actions are those that are part of a larger action and depend upon the larger action for their justification. We know of no interrelated actions associated with the proposed action.

Summary of the Effects of the Programmatic Action

There are many potential pathways that hazard tree removal within the Park may result in adverse affects to murrelets. These include direct effects through injury (when an occupied nest tree is felled or a felled tree lands on a nest tree), habitat modification, and sound and visual disturbance, or through indirect effects such as increased risk of predation, windthrow, or changes in the microclimate. For the proposed action, the Park has eliminated risks of sound and visual disturbance and direct injury through seasonal timing restrictions of hazard tree treatment that avoids the breeding season.

The remaining pathways of potential adverse effects to murrelets include habitat modification, increased risk of predation, windthrow effects, and microclimate effects for which the Park cannot mitigate. Indirect effects, such as increase in predation, windthrow effects, and microclimate effects, taken individually and collectively, will result in effects considered insignificant. Only habitat modification raises to the level of an adverse affect to the murrelet. However, the loss of 150 individual hazard trees will not change the action area's or the Park's ability to support successful murrelet reproduction.

CUMULATIVE EFFECTS

Cumulative effects are those impacts of future State and private actions that are reasonably certain to occur within the area of the action subject to consultation. Future Federal actions will be subject to the consultation requirements established in section 7 of the Act and, therefore, are not considered cumulative to the proposed action. No State or private lands exist within the action area; therefore, we expect no cumulative effects associated with non-Federal activities.

INTEGRATON AND SYNTHESIS

The Service expects adverse effects to murrelets in the form of incremental habitat removal. We do not expect adverse effects to murrelets in the form of injury, mortality, or sound and visual disturbance. We also do not expect the proposed action to result in any other adverse indirect effects to murrelets, including increases in predation, or adjacent stand windthrow and microclimate changes.

The Marbled Murrelet Recovery Plan outlined a conservation strategy that includes short-term actions and long-term conservation needs for the survival and recovery of the species. Relative to the proposed action, the conservation measures against which we measure the potential for the murrelet's survival and recovery include maintaining and increasing the distribution and quality of suitable nesting habitat while minimizing disturbance and reducing predation.

In the Status of the Species and Environmental Baseline sections of this Opinion, we established that murrelet abundance and distribution have been significantly reduced throughout its range. Population trends cannot be derived from current survey data, but have been estimated to be declining in all six Conservation Zones (McShane et al. 2004:6-27). The estimated population decline across all conservation zones ranges from 2.0 to 15.8 percent annually (Beissinger and Nur 1997 *in* U.S. Fish and Wildlife Service 1997a; McShane et al. 2004).

The proposed action will occur only within Conservation Zone 1. Compared to other zones, Conservation Zone 1 appears to contain one of the larger murrelet populations in the species' listed range (Huff et al. 2003). Conservation Zone 1 also has an estimated population decline that is lower than other Conservation Zones that ranges from 2.0 and 12.6 percent (Beissinger and Peery 2003).

Much of the land within Conservation Zone 1 has been replaced by urban development (U.S. Fish and Wildlife Service 1997a). Opportunities for increasing or protecting suitable additional murrelet habitat are limited, which increases the importance of the remaining habitat. The Park contains a large amount of minimally fragmented, low-elevational mature forest stands in Conservation Zone 1—approximately 25,300 acres of suitable murrelet nesting habitat. Also, the Park will likely keep these forests intact due to NPS mandates. Therefore, the Park in general and the quality of its suitable murrelet habitat in particular are important to the survival and recovery of the murrelet.

The Service expects the proposed action will result in adverse effects to murrelets in the form of habitat removal. The potential removal of 150 hazard trees within the developed areas, back-country campsites, and along roads will likely result in the loss of suitable habitat for murrelets nesting within the Park. However, loss of an incremental amount of suitable nesting habitat would not necessarily mean an incremental reduction in reproduction in the action area. Since data suggests that murrelets exhibit high fidelity to nesting areas, we do not expect the proposed habitat loss to result in long-term abandonment of nesting stands. Rather, we expect murrelets to respond to the proposed action by resuming nesting within adjacent trees and without significant delay.

Following the Recovery Plan, to maintain murrelet habitat quality within Conservation Zone 1, disturbance to adult and nestling murrelets must be minimized to avoid flushing adults off nests and exposing them and their nestlings and eggs to predation. The proposed action meets this conservation strategy because hazard tree removal will occur outside the nesting season.

The Recovery Plan also contains a conservation strategy for reducing predation. Individual hazard tree removal from developed areas and back-country campsites will not appreciably increase forest edge; developed sites already have existing forest edges and individual hazard

tree removal will not appreciably increase forest edges. Because we do not expect an appreciable amount of increase in forest edge, we also do not expect an increase in predation. These hazard tree sites have likely been used by humans for decades and corvids are likely regular visitors to these areas. The proposed action may not reduce murrelet predation, but at least is will not appreciably increase the risk of predation.

We also do not expect an appreciable amount of increase in windthrow effect or microclimate changes to the adjacent forest stands because of the negligible increase in forest edges. Finally, we know of no interrelated or interdependent actions and we expect no cumulative effects associated with non-Federal activities.

CONCLUSION

Under section 7(a)(2) of the Act, Federal agencies must ensure that activities are not likely to jeopardize the continued existence of any listed species. Regulations implementing this section of the Act define "jeopardize the continued existence of" as "to engage in an action that reasonably will be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species."

In determining whether an action is likely to jeopardize the survival and recovery of a species, the Service analyzes (1) the direct and indirect effects of the proposed action; and (2) the effects of other activities that are interrelated or interdependent with the proposed action, in the context of the environmental baseline and expected cumulative effects. All actions are evaluated against, and added to, the environmental baseline.

After reviewing the current status of the murrelet, the environmental baseline for the action area, the effects of the proposed action, and the cumulative effects, it is the biological opinion of the Service that the project, as proposed, is not likely to jeopardize the continued existence of the murrelet for the following reasons:

1. The proposed action will reduce suitable habitat in Conservation Zone 1 by up to 150 potential suitable nest trees. This habitat loss represents an insignificant reduction in available nest trees, nesting habitat, and overstory canopy cover.

2. Although the proposed action may adversely affect murrelets due to the incremental loss of potential nest trees, this habitat will generally occur as individual trees dispersed throughout the Park's developed areas. Murrelets will continue to have access to large blocks of high quality nesting habitat after implementation of the proposed action.

3. Since only individual potential nest trees will be removed, we expect a negligible change in the nesting suitability of the immediate stand.

4. We do not expect habitat loss to result in abandonment of nesting stands. Murrelets exhibit fidelity to nesting areas. We therefore expect a corresponding negligible change

in fidelity to the immediate area. Murrelets will respond to hazard tree removal by re-nesting in different trees within the affected stand.

5. We do not expect murrelets to significantly delay breeding due to the removal of hazard trees that may be nest trees.

6. No murrelet mortality or disturbance-related impacts will occur as a result of the proposed action—hazard tree treatment will occur entirely outside the breeding season.

7. The proposed action will not contribute to increased nest predation.

INCIDENTAL TAKE STATEMENT

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 Service expects an unquantifiable number of murrelets could be adversely affected as a result of the loss of 150 potential nest trees. This level of adverse affect assumes a worst-case scenario in that all hazard trees scheduled for treatment are assumed to be nest trees and scheduled to be felled. However, the Service does not expect the level of adverse affects to result in harm to murrelets as a result of the proposed action. We expect murrelets to respond to the proposed action by resuming nesting within adjacent trees and without significant delay.

The Service also does not expect harassment to murrelets as a result of the proposed action. Since hazard tree treatment would occur outside the nesting season when murrelets are not in the Park, we expect no harassment of murrelets associated with sight and sound disturbance. We also do not expect injury to murrelets for the same reasons. Therefore, the Service does not expect the proposed action will incidentally take any murrelets.

EFFECTS OF THE TAKE

In the accompanying Biological Opinion, the Service has determined that the proposed action will not jeopardize the continued existence of the murrelet because there would be no loss of individuals, reproduction, or distribution of murrelets in the action area.

REASONABLE AND PRUDENT MEASURES

Pursuant to 50 CFR 402.14 (i)(1)(ii), reasonable and prudent measures (RPMs) are those measures the Service considers necessary to minimize incidental take. We expect no take as a result of the proposed action, therefore no reasonable and prudent measures are necessary.

Reporting Requirements

Any dead or injured federally listed species found in the action area shall be reported within 24 hours to a special agent of the Service, Division of Law Enforcement, at (360) 753-7764, or to the Service's Western Washington Fish and Wildlife Office at (360) 753-9440. The Service requires notification in writing within 3 working days of the accidental death of, or injury to, federally listed species, or the finding of any dead or injured federally listed species, during implementation of the proposed action. Notification must include the date, time, and location of the incident or discovery of a dead or injured federally listed species, as well as any pertinent information on circumstances surrounding the incident or discovery. The Service contact for this written information is the Manager for the Western Washington Fish and Wildlife Office.

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. Regulations in 50 CFR § 402.02 define conservation recommendations as Service suggestions regarding discretionary agency activities to minimize or avoid adverse effects of a proposed action to listed species or critical habitat, to help implement recovery plans, or develop information. The Service offers to the Park two conservation recommendations.

<u>Felled Tree Use</u>

If the hazard tree is within a riparian corridor but at a distance from the floodplain that is greater than the height of the tree, the felled tree should be left on site. If the tree to be felled is within a distance equal to or less than the height of the tree from the active floodplain, the tree should be felled toward the aquatic habitat and left on site unless leaving the tree will pose additional danger to human health such as to cause injury, pose a high risk to downstream facilities or prevent the intended use of the facility from occurring.

Outreach Efforts

Continue to design future projects that reduce incidental take of murrelets, and impacts to other listed species and their habitat. This will include incorporating into the public-outreach program messages concerning dropping/leaving food, food wrappers, trash, and garbage on the trail, the subsequent attraction of corvids, and the consequential risk of predation on murrelet eggs and nestlings. This will be in addition to existing outreach messages that discourage visitors from feeding animals.

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

REINITIATION

This concludes formal consultation on the Plan outlined in the BA and cover letter. As provided in 50 CFR 402.16, reinitiation of formal consultation is required where discretionary Federal agency involvement or control over the actions has been retained (or is authorized by law) and if: (1) the amount or extent of incidental take is exceeded; (2) new information reveals effects of the agency actions that may affect listed species or critical habitat in a manner or to an extent not considered in this Opinion; (3) the agency action is subsequently modified in a manner that causes an effect to listed species or critical habitat not considered in this opinion; or (4) a new species is listed or critical habitat designated that may be affected by the actions. In instances where the amount or extent of incidental take is exceeded, any operations causing such take must cease pending reinitiation.

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