Marbled Murrelet
(Brachyramphus marmoratus)

5-Year Review

U.S. Fish and Wildlife Service
Washington Fish and Wildlife Office
Lacey, WA

June 12, 2009
FINAL

5-YEAR REVIEW

Species reviewed: Marbled murrelet (*Brachyramphus marmoratus*)

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1.0 GENERAL INFORMATION

1.1 Reviewers

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1.2 Methodology used to complete the review:

This 5-year review was conducted internally within the U.S. Fish and Wildlife Service (Service) through a multi-office team effort. Team members included Field and Regional Office biologists; No part of this review was contracted out. We relied heavily on the previous 2004 5-year review and McShane et al. (2004) for our baseline information and only provided updated information were it was available. Nearly all the information cited in this review has been peer reviewed separately through various publications.

1.3 Background:

1.3.1 FR Notice citation announcing initiation of this review: 73 FR 57314

1.3.2 Listing history

Original Listing
FR notice: 57 FR 45328
Date listed: October 1, 1992
Entity listed: Washington, Oregon, and California Distinct Population Segment
Classification: Threatened

1.3.3 Associated rulemakings: Critical Habitat Designation (61 FR 26256)

We originally designated critical habitat for the marbled murrelet (murrelet) in Washington, Oregon, and California on May 24, 1996 (61 FR 26256). At that time, we designated 3,887,800 acres of Federal and non-Federal lands, consisting of 78 percent Federal land; 21 percent city, county, or state land; and 1 percent private land. Primary constituent elements (PCEs) were described as (1) trees with potential nesting platforms and, (2) forested areas within 1/2 mile of potential nest trees with a canopy height of at least 1/2 of the site potential tree height. In June of 2008, the Service proposed to revise critical habitat for the murrelet by removing approximately 254,070 ac (102,820 ha) in northern California and Oregon from the 1996 designation, based on new information indicating that these areas do not meet the definition of critical habitat. This action, if adopted in its entirety, would result in a revised designation of approximately 3,633,800 ac (1,470,550 ha) as critical habitat for the murrelet. At this time, this proposed rule has not been finalized and critical habitat for the murrelet remains unchanged from the 1996 designation. In the 1996 murrelet critical habitat designation, critical habitat on Federal lands, including Forest Service lands, is only within Northwest Forest Plan (NWFP) Late Successional Reserves. The 1996 critical habitat rule did not designate matrix lands.

1.3.4 Review History:

In September 1, 2004, a 5-yr review was completed with no change in status. Under the DPS analysis portion, a determination was made that the population did not satisfy the criteria for designation as a DPS under the Service's 1996 DPS Policy.

1.3.5 Species' Recovery Priority Number at start of this 5-year review: 2

1.3.6 Current Recovery Plan or Outline

Name of plan or outline: Recovery plan for the threatened marbled murrelet (*Brachyramphus marmoratus*) in Washington, Oregon and California.

Date issued: September 24, 1997

Dates of previous revisions, if applicable: N/A

2.0 REVIEW ANALYSIS

2.1 Application of the 1996 Distinct Population Segment (DPS) policy

2.1.1 Is the species under review a vertebrate?

Yes.

2.1.2 Is the species under review listed as a DPS?

Yes.

2.1.3 Was the DPS listed prior to 1996?

Yes. It was listed in 1992.

2.1.3.1 Prior to this 5-year review, was the DPS classification reviewed to ensure it meets the 1996 policy standards?

Yes, in the September 2004 5-year review. However, that DPS analysis compared management and regulatory differences between the United States and Canada at the *current* levels of legal protection in the two countries rather than comparing the management/regulatory levels that would exist *if the species were not listed* in the United States. We now believe that the 2004 analysis was fundamentally flawed for this reason. The purpose of a 5-year review under section 4(c)(2) of the Act is to determine whether a change in listing status is warranted. Nothing in the Act suggests that the criteria governing a 5-year review differ from those that apply in an initial listing determination. Hence, the logical way to approach such a review is to apply the listing criteria to the species in the same manner as the Service does when it makes an initial listing determination. At the time of an initial listing determination, a species does not yet have the Act's protection, so an analysis for *discreteness* based on an international border would compare any regulatory mechanisms on the foreign side of the border with any *non-Act* regulatory mechanisms that exist in the United States.

____ ***No****, go to section 2.1.3.2.*

2.1.3.2 Does the DPS listing meet the discreteness and significance elements of the 1996 DPS policy?

Yes (see below).

2.1.4 Is there relevant new information for this species regarding the application of the DPS policy?

Yes. Our analysis considers new information regarding regulatory protections in Canada (as compared to non-Endangered Species Act regulatory protections in the coterminous U.S.) as well

as updated population and habitat estimates for a comparison of conservation status and management of habitat across the international border.

Given the updated information, is the listed entity consistent with the DPS policy with regards to the Discreteness and Significance elements?

Yes, the currently listed entity is consistent with the DPS policy.

A) Is the currently listed murrelet population discrete according to the 1996 DPS Policy?

Yes, the murrelet population is discrete according to the 1996 DPS Policy.

Discreteness: A population segment of a vertebrate species may be considered discrete if it satisfies either one of the following conditions:

- It is markedly separated from other populations of the same taxon as a consequence of physical, physiological, ecological, or behavioral factors. Quantitative measures of genetic or morphological discontinuity may provide evidence of this separation. [*Biological Issues*]
- It is delimited by international governmental boundaries within which differences in control of exploitation, management of habitat, conservation status, or regulatory mechanisms exist that are significant in light of section 4(a)(1)(D) of the Endangered Species Act of 1973 (Act; 50 CFR 1431 et seq.) . [*International Border Issues*]

(1) ***Biological Issues:*** We have no evidence of marked genetic or morphological discontinuity between populations at the United States - Canadian border.

(2) ***International Border Issues****:* If the species were not listed, there would be differences in management of habitat, conservation status, and regulatory mechanisms across the international border that are significant in light of section 4(a)(1)(D) of the Act.

(2)(a) Control of exploitation. Both countries similarly prohibit direct exploitation of murrelets therefore there are not substantive differences in the control of exploitation across the international border.

(2)(b) *Management of Habitat*. The management of habitat is different across the United States-Canada border (assuming removal of Act protections) because the two countries would rely on regulatory mechanisms that are not equally protective of the murrelet or its habitat (see *Regulatory Mechanisms* below).

(2)(c) *Conservation Status.* There is a difference in conservation status between the United States and Canada. If the murrelet were not listed under the Act, no Federal protections would be afforded it under the Act. In Canada, under SARA, the species would remain classified as "threatened," that is, "a wildlife species that is likely to become an endangered species if nothing is done to reverse the factors leading to its extirpation or extinction." SARA's

prohibition of harm to the species and its residence would mean the species would have significantly greater legal protection on the Canadian side of the border. As stated earlier, the murrelet is listed as threatened in Oregon and Washington, and endangered in California under the individual State endangered species acts, but these statutes provide relatively little protection to the species. Hence, there would be a significant difference in conservation status from a legal standpoint.

There is also a significant difference in conservation status from a population standpoint. The continental United States has a substantially smaller population of murrelets (approximately 18,000; Falxa et al.. 2009, Peery et al. 2008), than does Canada (approximately 66,000; Burger 2002). In addition, based on at-sea surveys of juvenile to adult ratios, the productivity of murrelets in Washington, Oregon, and California (Cresent Coastal Research, 2008, p. 13; Beissinger and Peery 2007, p. 299; Raphael et al. 2007a, p. 16; Long et al. 2008, pp. 18-19) is considerably lower than in British Columbia.(Bellefleur and others, 2005 as cited in Piatt et al. 2007, p.18). British Columbia reports higher productivity values from anywhere outside of Kachemak Bay in Alaska. This difference in conservation status is likely to be exacerbated when one compares status across the border assuming the loss of the Act's protections in the United States.

In addition, estimates of loss of old-growth forests in the United States' Pacific Northwest since pre-industrial times (National Research Council 2000), compared to the amount of forests within the range of the murrelet in British Columbia that have become unsuitable due to anthropogenic causes (e.g., industrial logging and urbanization) (Demarchi and Button 2001a, b as adapted by Burger 2002), show a higher percentage of murrelet habitat has been lost historically in Washington, Oregon, and California than in Canada.

Finally, there are differences in the amount of nesting habitat remaining for marbled murrelets between the U.S. and Canada. There are approximately 1.5 to 2 million hectares (3.7 to 4.94 million acres) of nesting habitat remaining in British Columbia (Piatt et al. 2007, p. 118), while there are only 890,000 to 1.6 million hectares (2.2 to 3.95 million acres) of suitable nesting habitat remaining in the contiguous U.S. (Raphael, et al 2006). Furthermore, the contiguous U.S. estimate is likely an overestimate because some administrative units used northern spotted owl habitat as a surrogate for murrelet habitat, and owl habitat includes younger forest than typical murrelet habitat.

In conclusion, the conservation status of the marbled murrelet is significantly different across the international border. Murrelet population numbers are lower in the U.S. (less then one-third of the Canadian population), productivity is lower, the loss of old-growth forests has been more severe, and the amount of remaining habitat is lower. This difference in conservation status is likely to be exacerbated when one compares status across the border assuming the loss of the Act's protections in the United States.

(2)(d) *Regulatory Mechanisms.* Compared with protection in Canada, there would be significantly less regulatory protection for the murrelet in Washington, Oregon, and California if the species were delisted.

Regulatory Mechanisms in Canada: In 2003, Canada implemented its Federal endangered species legislation, the Species At Risk Act (SARA). Under SARA the murrelet is classified as a "threatened" species (Statutes of Canada (S.C.) Chapter (ch). 29, Schedule 1, Part 3 (2002)). SARA defines a "threatened" species as "a wildlife species that is likely to become an endangered species if nothing is done to reverse the factors leading to its extirpation or extinction" (S.C. ch. 29 § 2). It is illegal to kill, harm, harass, capture, or take an individual of a wildlife species that is listed as an extirpated species, an endangered species or a threatened species, or to possess, collect, buy, sell, or trade an individual of a wildlife species that is listed as an extirpated species, an endangered species or a threatened species, or any part or derivative of such an individual (S.C. ch. 29 § 32). SARA also prohibits any person from damaging or destroying the residence of a listed species, or from destroying any part of its critical habitat (S.C. ch. 29 §§ 33, 58). For many of the species listed under SARA, the prohibitions on harm to individuals and destruction of residences are limited to Federal lands, but this limitation is inapplicable to migratory birds protected under the Migratory Birds Convention Act, including the murrelet (S.C. ch. 29, § 34). Hence, SARA protects murrelets from harm and destruction of their residences, not only on Federal lands, but also on provincial and private lands, where most of the remaining habitat for the species occurs. (Because critical habitat has not yet been designated for the marbled murrelet, SARA's provisions protecting critical habitat are not yet effective.) SARA defines the "residence" of a species to mean "a dwelling-place, such as a den, nest or other similar area or place, that is occupied or habitually occupied by one or more individuals during all or part of their life cycles, including breeding, rearing, staging, wintering, feeding or hibernating"(S.C. ch. 29, § 2). Hence, to receive SARA's protection, a "residence" need not be continuously occupied by the species. Thus, SARA protects the marbled murrelet, not only from direct killing, but also from indirect harm through destruction of its residence. Moreover, SARA mandates development and implementation of a recovery strategy and action plans (S.C. ch. 29, §§ 37, 47).

Violations of SARA are punishable by a fine of up to $250,000 for an individual, or $1,000,000 for a corporation, or imprisonment for up to 5 years, or both (SARA 2002, p.54-55; S.C. ch. 29 § 97). SARA provides that each day of a continuing violation constitutes a separate offense, and makes corporate officers and employers vicariously liable for actions of their agents and employees (S.C. ch. 29 §§ 97-99).

The murrelet is also protected under Canada's Federal Migratory Birds Convention Act, 1994 (MBCA) (S.C. ch 22), which is their domestic legislation similar to our Migratory Bird Treaty Act of 1918 (MBTA). The MBCA and its implementing regulations prohibit the hunting of migratory nongame birds and the possession or sale of "migratory birds, their nests, or eggs" (S.C. ch. 22 §§ 5, 12).

Although British Columbia has no stand-alone endangered species act, the provincial Wildlife Act protects virtually all vertebrate animals from direct harm, except as allowed by regulation (e.g., hunting or trapping). Legal designation as endangered or threatened under this act increases the penalties for harming a species, and also enables the protection of habitat in a Critical Wildlife Management Area (British Columbia Wildlife Act 1996). The marbled murrelet is not listed under this act as an endangered or threatened species.

The marbled murrelet is designated as a "species at risk" and as an "identified wildlife species" under British Columbia's Forest and Range Practices Act (FRPA) (2002). Under this act, guidelines for murrelet management are contained in the Identified Wildlife Management Strategy (IWMS). Under the IWMS, murrelet habitat in British Columbia is divided into six conservation regions. Within each of these regions, a recommended maximum decline in population and habitat by 2032 has been identified. In four of the six regions, a limit of a 31 percent decline in population and habitat has been recommended. The other two regions have a zero to 10 and 15 percent recommended maximum decline. Management of habitat is implemented through several mechanisms, including wildlife habitat areas (WHAs) and strategic land use plans. The required size and characteristics of the WHAs (essentially protected suitable habitat) have been identified, yet "the amount of habitat to be established as WHAs remains constrained by existing policy," such as the 1 percent timber supply impact cap on the timber harvesting land base (British Columbia Ministry of Environment 1999).

Under a directive issued pursuant to the FRPA, timber licensees on provincial lands must conserve all murrelet nesting habitat in the non-contributing land base (areas not economically viable to harvest) plus a small area in the timber harvesting land base (B.C. Forest Practices Board (BCFPB) 2008, p. 1). British Columbia has set a general objective under the FRPA to conserve sufficient habitat for the survival of all species at risk, without unduly reducing the timber supply (BCFPB 2008, p.6). In 2004, British Columbia designated the murrelet as a species at risk, and issued a notice requiring the primary licensee on the southern coast to prepare a Forest Stewardship Plan (FSP) consistent with the murrelet conservation objective. The licensee met this requirement by preparing a strategy that avoids road-building and timber harvest in some murrelet nesting habitat. The BCFPB has determined that the effect of the FSP requirement will be to conserve 23,500 hectares, or 67 percent, of remaining suitable murrelet habitat on the southern coast of the province (BCFPB 2008, p.13).

Murrelet habitat is also protected in British Columbia in several provincial and national parks. These designations, along with WHAs, protect about 490,000 hectares of murrelet habitat, or about 25 percent of the total available in British Columbia in 2002 (Burger 2008, p. 6).

In accordance with SARA, the federally-led Canadian Marbled Murrelet Recovery Team has developed a draft murrelet recovery strategy, which has been approved by the Province, but has not been posted on the SARA public registry. One of the three action plans identified by the Recovery Team has been drafted but has not yet been approved (Burger in litt. 2009, p. 4). Given that the murrelet is a migratory bird and therefore comes under Federal jurisdiction across all lands, including Provincial lands, the recovery and action plans will apply to the murrelet over its entire range in Canada (Bertram pers. comm. 2006). It is unclear, however, how the recovery and action plan elements (which are awaiting approval or are still being drafted) will interact with the IWMS, therefore it is unclear how management of murrelet habitat in Canada will occur into the future.

Regulatory Mechanisms in Washington, Oregon, and California Without the Protections of the Act: If the murrelet were not federally listed in Washington, Oregon, and California, prohibitions under section 9 of the Act would no longer apply. Thus, there would be no Federal prohibitions against take through habitat destruction, or harassment of the murrelet. In addition,

absent protection of the Act, Federal agencies would have no duty under section 7 of the Act to consult with the Service on the effects of their actions on the species, to avoid jeopardizing the species, or to avoid adversely modifying previously identified critical habitat.

The murrelet would continue to receive some protection under the MBTA (16 U.S.C. § 703), which makes it unlawful to take migratory birds, including the marbled murrelet. However, the MBTA's definition of "take" includes direct pursuit, killing and capturing, but does not include harm through habitat destruction, nor harassment (16 U.S.C. § 715n). The Ninth Circuit has held that MBTA does not protect migratory birds from habitat destruction such as logging of old growth forest (Seattle Audubon Society v. Evans, 952 F.2d 297 (9th Cir. 1991)). SARA, by contrast, protects the murrelet from not only direct killing, but also harm, harassment, and destruction of the species' "residence". Moreover, the MBTA's sanctions for violations are significantly lighter than SARA's, imposing only misdemeanor penalties of six months imprisonment and $15,000 in fines (16 U.S.C. § 707), compared with the felony-level sanctions under SARA.

The murrelet receives some protection under State laws in Washington, Oregon, and California, but these laws are less protective than SARA. Washington law prohibits "maliciously" killing or harassing murrelets or destroying their nests, but does not prohibit indirect harm through habitat modification (Revised Code of Washington (RCW) § 77.15.120; and Washington Administrative Code (WAC) § 232-12-011). Violation of this law is a gross misdemeanor, punishable by no more than one year of imprisonment or a fine of no more than $5000. This law is less protective than SARA because, by limiting its reach to "malicious" conduct, it does not govern as broad a range of conduct as does SARA's strict liability standard, and because the penalties it imposes are substantially lighter. Washington forest practice regulations limit, but do not entirely prohibit, timber harvest that would constitute "take" under the Act (WAC §§ 222-10-042, 222-16-080). Washington law (WAC 232-12-297) requires that recovery plans be written for species listed as endangered or threatened by the Washington Fish and Wildlife Commission; however, currently there is no State recovery plan for the murrelet. In order to delist the species, Washington Department of Fish and Wildlife would have to develop criteria for reclassifying to species of concern and delisting and then show the species has met these criteria.

In Washington, the State Forest Practices Rules (FPR) (Wash. Admin. Code Title 222) specifically establish marbled murrelet suitable habitat definitions, survey requirements, and review processes for forest practices that may impact murrelet habitat. The FPR provide protection to occupied (as defined by FPR) murrelet sites during the nesting season on private forest lands where the landowner owns more than 500 acres of land that are less than 50 miles from marine waters. For those lands that are presumed to have at least a 30 percent probability of occupancy, landowners are subject to survey requirements and those areas where occupancy is found are protected. The FPR provide for protection of marbled murrelets through minimization of take and jeopardy pursuant to the Washington Endangered Species Act and the Federal Endangered Species Act. However, the definitions of suitable habitat, inland distance, and occupied site are negotiated definitions; therefore not all of the lands the Service considers to have features essential for conservation of murrelet are considered to be suitable habitat under FPR, are not subject to the specific murrelet FPR, and therefore some suitable habitat may be harvested without review. In addition, landowners have the option to go through the State

Environmental Policy Act process and get approval to harvest, however this has not occurred to date. Current FPR protect occupied (as defined by State) habitat and a 300-foot managed buffer around occupied habitat. However, there are no reasonable assurances that the maximum site size and managed buffers are adequate to protect and maintain maintain complex-structured forest isolated from human development such that the risk of predation, windthrow, and changes in microclimate are reduced.

Oregon has listed the murrelet as a threatened species under State law (Oregon Administrative Regulations (OAR) 635-100-0125(3)(i)), but the Oregon Endangered Species Act (Oregon ESA) is weaker than SARA. It includes no take prohibition (ORS 496.182). In fact, the statute expressly exempts private landowners from any obligation to protect listed species (ORS 496.192(1)). The Oregon ESA provides some protection on state lands, but less than SARA provides on public lands in Canada. Under the Oregon ESA, each state agency is permitted to make its own determination as to how to balance the needs of listed species with the "social and economic impacts" that conservation would have on the state (ORS 496.182(8)(a)(B)). A state agency is permitted to take an action that would jeopardize a state-listed species, provided the agency determines that the public benefits of the action outweigh the harm to the species (ORS 496.182(4)(a)) Moreover, state lands comprise a relatively small proportion of occupied murrelet habitat in Oregon; the majority of known occupied habitat is on Federal land. Finally, the murrelet could lose any state protection in Oregon if it is delisted under the Federal Act, because the Oregon ESA provides that the state may delist a species if it has been determined not to qualify for listing under the Federal Act (ORS 496.176(6)(c)).

In Oregon, the Oregon Forest Practices Act (ORS 527.610 to 527.992 and OAR Chapter 629, Divisions 600 to 665) lists protection measures specific to private and State-owned forested lands in Oregon. These measures include specific rules for resource protection, including some threatened and endangered species such as the northern spotted owl, but the rules do not address protection of marbled murrelet habitat (OAR 629-665).

The marbled murrelet is listed as endangered under California law (Cal. Code Regs., tit. 14, § 670.5(a)(5)(R)). The California Endangered Species Act (CESA) (Cal. Fish and Game Code sections 2080, et seq.) prohibits "take" of endangered species (Cal. Fish and Game Code § 2080). "Take" is defined by California Fish and Game Code section 86. This definition includes capturing or killing or attempting to capture or kill, but not harming or harassing, which is prohibited under the Federal Act and SARA. Therefore, some actions that would be prohibited under SARA would not be prohibited under CESA. Activities that may disrupt a bird's behavior such that it constitutes "harm" or "harassment" under SARA would not constitute "take" under CESA if the disruption does not result in mortality of the bird through nest abandonment or other means. Damaging or destroying a bird's residence is prohibited under SARA even without evidence that the bird died, while CESA would require at least circumstantial evidence showing that the bird died as a result of the action. Nothing in California state law requires recovery planning. Recovery actions can be voluntarily undertaken, however, pursuant to authorities such as the Natural Community Conservation Planning Act (Cal. Fish and Game Code sections 2800 et seq.)

In California, the California Forest Practice Rules (CFPR) were established to regulate timber harvest on non-Federal lands within the State of California. The CFPRs are implemented through the California Department of Forestry and Fire Protection (CALFIRE) individual Timber Harvest Plans (THP) and Nonindustrial Timber Management Plans (NTMP) review and approval processes. With the exception of plans that are exempted from the preparation and submission requirements under the CFPRs, all commercial timber harvest must go through this process (CALFIRE 2009).

The CFPRs do not contain a definition of suitable marbled murrelet nesting habitat. Consequently, each plan has a decision on habitat suitability on a stand by stand basis, and they may or may not disclose the presence of marbled murrelet habitat. Under the CFPR's Special Conditions section 898.2, CALFIRE is required to disapprove a plan if implementation of the plan would result in take or jeopardy in violation of the Federal Endangered Species Act (CALFIRE 2009). When recommendations to avoid unauthorized take of marbled murrelets are provided they are typically included in THPs or NTMPs. However because only a small percentage of these plans have been reviewed, suitable marbled murrelet habitat and possibly even occupied nesting habitat likely has been lost due to this lack of oversight. In summary, the practical application of the CFPRs are only partially effective at protecting suitable habitat pursuant to the Federal Act due to the lack of a detailed description of habitat suitability within the CFPRs and the lack of adequate resource agency staff to review THPs and NTMPs that may contain suitable marbled murrelet nesting habitat.

The adoption of the NWFP by the Forest Service and the Bureau of Land Management has greatly reduced the annual rate of habitat loss on Federal land in the United States since 1994. Nonetheless, estimated potential total loss of suitable murrelet habitat since listing of the species is about 10 percent of the current estimate of suitable habitat (USFWS 2004, p.16). If the murrelet were delisted, the NWFP could be amended to reduce protection for the species. The murrelet would still derive some incidental benefit from continued protection of the reserve system under the NWFP, although conservation benefits would not likely extend to all areas currently protected for the murrelet. In addition, even if the NWFP were not amended, delisting would relieve the Forest Service and the BLM of any obligation to consult with the Service on site-specific actions that may adversely affect the murrelet. These agencies would also be relieved of their duty under section 7(a)(1) of the Endangered Species Act (Act; 50 CFR 1531 et seq) to carry out programs for the conservation of the species. The British Columbia murrelet conservation assessment by comparison, states a central recovery goal is to down-list the species from Threatened to Special Concern, by creating conditions that will limit the decline of the British Columbia population and its nesting habitat to less than 30 percent over three generations (30 years) (Bertram et al. 2003, p.5), roughly the same habitat loss in arithmetical terms as that experienced during the period 1992 to 2003 in the United States.

Absent listing under the ESA, state laws would not necessarily protect murrelets on Federal lands. Other Federal laws governing management of Federal lands could preempt state law to the extent there is an irreconcilable conflict (National Audubon Society v. Davis, 307 F.3d 835, 854 (9th Cir. 2002)).

There appears to be a difference in management of marine habitat between Canada and the United States as well. In the United States there is a ban on exploitation of forage fishes and regulated take of protected species under the Magnuson-Stevens Fishery Conservation and Management Act. For regulation purposes, the National Marine Fisheries Service considers forage species to include the prey species important to murrelets; however, some important prey species (such as Pacific herring) are commercially fished. In British Columbia, there are no restrictions on exploitation of forage species (Piatt et al. 2007, p. 94). In the United States, murrelets are protected from commercial fisheries in California and Oregon through state laws. However in Washington State, protections afforded the commercial fishery are tied specifically to section 7 of the Act, and are implemented through interagency consultation with National Oceanic and Atmospheric Administration (NOAA) and Bureau of Indian Affairs. Without the Act, murrelets in Washington do not appear to be protected from bycatch. In British Columbia, there have been limited direct efforts to reduce bycatch (Piatt et al. 2007, p. 92) although the MBCA does afford them some protections. SARA's take prohibitions, however, are applicable in the marine environment, and hence commercial fishing operations that harm murrelets by ensnaring them in nets would violate the statute.

As described above, the differences in regulatory mechanisms that would exist on each side of the border would be significant in light of section 4(a)(1)(D) of the Act and would result in differences in management of habitat. The loss of Federal protective measures afforded by the Act is likely to place the species at greater risk of extirpation in the coterminus United States.

B) Is the currently listed murrelet population significant according to the 1996 DPS Policy?

Yes, the murrelet population is significant according to the 1996 DPS Policy.

Significance: Under the DPS Policy, if a population segment is considered discrete, its significance can be assessed. The DPS Policy states that a species' population can be considered significant based on considerations that may include, but are not limited to:

- Persistence of the discrete population segment in an ecological setting unusual or unique for the taxon;
- Evidence that loss of the discrete population segment would result in a significant gap in the range of a taxon;
- Evidence that the discrete population segment represents the only surviving natural occurrence of a taxon that may be more abundant elsewhere as an introduced population outside its historic range; or
- Evidence that the discrete population segment differs markedly from other populations of the species in its genetic characteristics.

Loss of the DPS would result in a significant gap in the range of the murrelet. This gap is significant because the Washington, Oregon, and California area accounts for roughly 18 percent of the total coastal distribution of the species, encompassing 17 degrees of latitude. In addition, the Washington, Oregon, and California area is located at the southern-most extent of the range.

This DPS contains an ecologically distinct forest system, the coastal redwood zone. Citing Noss 1994, Fraser (1999, p. 50), declares that in order to maintain opportunities for speciation and future biodiversity, the conservation of peripheral and disjunct populations is critical. Recovery of species without the conservation of these peripheral populations may be impossible if these populations are eliminated or severely damaged (Fraser 1999, p.50).

Although there is no genetic distinction at the border, researchers have found significant genetic distinction throughout the range of the species. Friesen et al. (2005) reported significant differentiation of birds from peripheral sites (i.e., California and the Aleutian Islands), with the Aleutian and California populations each having one or more private control region haplotypes that occurred at high frequency. Friesen et al. (2007) results indicate that genetic variation changes clinally in this species, and provided additional resolution showing that murrelets in western and central Aleutian Islands and central California differ significantly from murrelets in the rest of the species' range. They concluded that murrelets appear to comprise three genetic units: (1) western and central Aleutian Islands; (2) eastern Aleutian Islands to northern California; and, (3) central California. Loss of any of these populations would result in the loss of a portion of the species' genetic resources and/or local adaptations, and may compromise its long-term viability (Piatt et al. 2007, p. 43).

Conclusion

We consider the Washington, Oregon, and California population of murrelets to be a valid distinct population segment under the 1996 DPS Policy. This population of murrelets is discrete based on differences in conservation status, management of habitat, and regulatory mechanisms between the United States and Canada that would result without the Federal protective measures afforded by the Endangered Species Act in the United States. The coterminus United States population of murrelets is also considered significant in accordance with the criteria of the DPS Policy, as the loss of this distinct population segment would result in a significant gap in the range of the taxon and the loss of unique genetic characteristics that are significant to the taxon.

2.2 Recovery Criteria

2.2.1 Does the species have a final, approved recovery plan[1] containing objective, measurable criteria?

__*X*__ ***Yes****, continue to section 2.2.2.*

2.2.2 Adequacy of recovery criteria.

2.2.2.1 Do the recovery criteria reflect the best available and most up-to date information on the biology of the species and its habitat? *Yes*

[1] Although the guidance generally directs the reviewer to consider criteria from final approved recovery plans, criteria in published draft recovery plans may be considered at the reviewer's discretion.

2.2.2.2 Are all of the 5 listing factors that are relevant to the species addressed in the recovery criteria? *No.*

2.2.3 Recovery Objectives and Delisting Criteria

The murrelet recovery plan was completed in 1997. The recovery plan has interim recovery objectives, recovery actions necessary to address the recovery objectives, and interim delisting criteria. The recovery plan was intended to be valid for 5 to 10 years only, with the anticipation that research conducted during that time would allow for better definitions of recovery tasks and specific delising criteria.

The interim objectives of this recovery plan are: (1) to stabilize and then increase population size, changing downward trend to an upward trend throughout listed range; (2) to provide conditions in the future that allow for a reasonable likelihood of continued existence of viable populations; and (3) to gather the necessary information to develop specific delisting criteria.

The following actions were identified as necessary to address the recovery objectives. These actions include: (1) establishing six Marbled Murrelet Conservation Zones (Conservation Zone) and develop landscape-level management strategies for each Conservation Zone; (2) identifying and protecting habitat areas within each Conservation Zone, including the marine environment, through implementation of the NWFP, designation as critical habitat, better use of existing laws, or other methods (e.g., HCPs), and developing management plans for these areas; (3) monitoring populations and habitat, and surveying potential breeding habitat to identify potential nesting areas (e.g., occupied sites); (4) implementing short-term actions to stabilize and increase the population that include maintaining potential suitable habitat in large contiguous blocks and buffer areas, maintaining habitat distribution and quality, decreasing risk of fire and windthrow, decreasing adult and juvenile mortality, reducing nest predation, increasing recruitment, and initiating research to determine impacts of disturbance in both marine and terrestrial environments; (5) implementing long-term actions to stop population decline and increase population growth by increasing the amount, quality and distribution of suitable nesting habitat, decreasing fragmentation, protecting "recruitment" habitat, providing replacement habitat through silvicultural techniques, and improving marine habitat quality; (6) initiating research to develop and refine survey and monitoring protocols, refine population estimates, examine limiting factors, evaluate disturbance effects, and obtain additional life history data; and, (7) establishing a Regional Coordination body for the marbled murrelet research efforts, including data storage and retrieval in databases and archives.

The recovery plan indicates delisting can be considered after research and monitoring provides the necessary information on present populations and life history requirements for the development of recovery criteria. These criteria should be reasonable, attainable, and adequate to maintain the species over the period of reduced habitat availability during the next 50 years and to insure viable populations over the long-term (greater than 200 years). The interim delisting criteria included in the recovery plan are: (1) trends in estimated population size, densities and productivity have been stable or increasing in four of the six Conservation Zones over a 10-year period, which should encompass at least one to two El Nino events and (2) management commitments, including protection and monitoring in marine and terrestrial

habitats, have been implemented to provide adequate protection of marbled murrelets in the six Conservation Zones for at least the near future (50 years).

The recovery objectives and delisting criteria have not been met, although each of the recovery actions, with the exception of establishing a Regional Coordination body, have been implemented to varying degrees. Research and monitoring has continued to be implemented since the analysis for the 2004 5-year review.

2.3 Updated Information and Current Species Status

2.3.1 Biology and Habitat

2.3.1.1 New information on the species' biology and life history:

Since the analysis for the 2004 5-year review, more information has become available regarding the biology, life history and habitat use of the murrelet.

Marine distribution and movements. McShane et al. (2004, pg. 2-12) observed that murrelet movements within and among seasons are poorly known, and included limited information on daily and seasonal movements, primarily from studies in Alaska and British Columbia. New information is available on movements and home range size during the breeding season, from research conducted in the listed range.

Daily flights to incubate an egg or feed a young were assumed to limit the distance murrelets can travel away from nesting habitat. In California, recent radio marked murrelets confirm that breeders forage more closely to nesting habitat once nesting is initiated than non-breeders (Peery et al. 2009, p. 120, and Hebert and Golightly 2008, p. 101). In northern California mean home range size was 655 kilometer squared (km^2) for non-nesters and 240 km^2 for nesters (Hebert and Golightly 2008, p. 101). Mean along shore movement was 69 km for nesting females and 78 km for nesting males (Standard Errors of 11 and 9 respectively, Hebert and Golightly 2008, p. 101). Mean offshore movement was within 1.4 km with a Standard Error of 0.1 km regardless of sex or nesting status (Hebert and Golightly 2008, p. 99).

In Washington, home range size during the breeding season was more variable. Here, average marine home range size was five times larger in 2005 (2,098 km^2) compared to 2004 (469 km^2) during the breeding season (Bloxton and Raphael 2008, p. 4). In 2004, the radio-tagged murrelets had relatively confined home ranges within a single part of the study area. However, in 2005, they used multiple core feeding areas, likely in response to poor oceanographic conditions (Bloxton and Raphael 2008, pp. 4-5). These numbers include both nesting and non-nesting individuals, and the 2005 mean home range size was considerably larger than observed in northern California by Hebert and Golightly (2008). No new information was available for Oregon.

New information is also available from Conservation Zone 6 on movements. In central California, nesting birds spent night time hours resting on the ocean an average of 5.1 km from the mouths of drainages used to reach nesting habitat, and commuted from these resting areas to

daytime foraging locations (Peery et al. 2009, p. 125). These at-sea resting areas associated with inshore nesting habitat appear important to breeding murrelets as they are constrained by the need to attend nest sites (Peery at el. 2009, p. 130). Non-breeders often spent the night near daytime foraging areas (Peery et al. 2009, p. 127).

Overall, there appear to be differences in home range size and use across the range. This may be tied to habitat use and forage availability.

Elevation. Murrelet nests have been located at a variety of elevations from sea level to 5,020 ft (Burger 2002, p. 109). However, most nests have been found below 3,500 ft as reported by McShane et al. (2004, p. 4-35). In more recent research in Conservation Zone 1, murrelets have exhibited "occupied" behaviors up to 4,400 ft elevation and have been detected in stands up to 4,900 ft in the north Cascade Mountains (Peter McBride, WDNR, *in litt*., 2005). On the Olympic Peninsula, audio-visual survey efforts for nesting murrelets have found occupied stands up to 4,000 ft within Conservation Zone 1 and up to 3,500 ft within Conservation Zone 2. Audio-visual surveys for murrelet nesting at higher elevations on the Olympic Peninsula have not been conducted. However, based on recent radio-telemetry work, nests have been found at 3,800 ft within Conservation Zone 2 (Bloxton and Raphael 2008, appendix A).

There has been no new information to suggest the existence of nest at higher elevations in Oregon or California.

2.3.1.2 Abundance, population trends (e.g. increasing, decreasing, stable), demographic features (e.g., age structure, sex ratio, family size, birth rate, age at mortality, mortality rate, etc.), or demographic trends:

Population Size

Conservation Zones 1 through 5: The best current data on murrelet population size and status for Conservation Zones 1 through 5 are the results from the effectiveness monitoring program of the NWFP, which has conducted annual at-sea population surveys during the breeding season since 2000 using a uniform survey protocol (Huff 2006; Miller et al. 2006; Raphael et al. 2007b). The 2004 5-year review included 2000-2002 results from that program which concluded no decline; results are now available through 2008 (Table 1). For 2008, the estimated population of murrelets in the 5-Conservation Zone area was 17,800 (± 3,200 at 95 percent confidence interval; Falxa et al. 2009). The 2007 and 2008 estimates represent the smallest population estimates since monitoring began, and, as described under Population Trends below, the monitoring survey results indicate a population decline since 2000.

At the Conservation Zone scale, murrelet at-sea density estimates from Conservation Zones 1-5 in 2008 ranged from 0.14 birds/km^2 in Conservation Zone 5 to 4.14/km^2 in Conservation Zone 4 (Table 3). At-sea densities followed the same general pattern as observed previously, with high densities in Oregon and northern California (Conservation Zones 3 and 4), and very low densities in Conservation Zone 5. Although its mean density is not high, Conservation Zone 1 has a large population because it encompasses a large area of coastal waters. Conservation Zone 2, the outer coast of Washington, had the lowest average density north of Conservation Zone 5; most birds in this Conservation Zone are located in waters off the Olympic Peninsula.

Table 1 Summary of 2000-2008 murrelet density and population size estimates in Conservation Zones 1 through 5 in the area of the Northwest Forest Plan.

Year	Density (birds/km^2)	Bootstrap Standard Error (birds/km^2)	Coefficient of Variation of Density (%)	Birds	Birds Lower 95% CL	Birds Upper 95% CL
2000	2.11	0.30	14.2	18,600	13,400	23,700
2001	2.52	0.27	10.5	22,200	17,600	26,800
2002	2.69	0.31	11.5	23,700	18,300	29,000
2003	2.53	0.24	9.5	22,200	18,000	26,400
2004	2.34	0.27	11.5	20,600	16,000	25,200
2005	2.30	0.25	10.8	20,200	16,000	24,500
2006	2.14	0.17	8.0	18,795	15,900	21,700
2007	1.98	0.26	13.4	17,400	12,800	21,900
2008	2.03	0.18	9.1	17,700	14,600	21,000

Conservation Zone 6: While the NWFP surveys did not include Conservation Zone 6, Peery et al. (2008) conducted at-sea population surveys for murrelets in Conservation Zone 6 offshore of breeding habitat between Half Moon Bay and Santa Cruz in 2007-2008, following a method used previously to survey Conservation Zone 6 during 1999-2003 (Peery et al. 2006a). Using distance sampling estimation techniques (same method as Conservation Zones 1-5), they estimated the 2007 Conservation Zone 6 population to be 367 birds (95% CL: 240-562) and the 2008 Conservation Zone 6 population to be 174 birds (95% CL: 91-256) (Table 2).

Table 2 Population estimates and 95 percent confidence intervals for Conservation Zone 6. Source: Peery et al. 2008. The 1999-2000 surveys used slightly different routes from later years, and estimates from those 2 years should not be compared directly with 2001-2008 data.

Survey Year	1999	2000	2001	2002	2003	2007	2008
Population Estimate	487	496	661	683	699	367	174
95% CI	333-713	338-728	556-786	561-832	567-860	240-562	91-256
Number of surveys	5	8	15	15	12	4	6

Listed Range:
Using the combined estimates from the Conservation Zone 1-5 surveys and the Conservation Zone 6 surveys for 2008, the estimated population size for the listed range in 2008 is about 18,000 birds (95 percent confidence interval of 14,700-21,200, figures rounded to nearest 100; Table 3). Based on McShane et al. (2004) using population estimates from 2002, the Service in the 2004 5-year review (USFWS 2004, p.18) estimated the population to be 24,400 birds (95 percent confidence interval of 18,800 to 29,800). The confidence intervals reported here for the population estimate for the listed range in 2002 differ from those reported in USFWS 2004; a calculation error has been corrected.

Table 3 Estimates of murrelet density and population size, with 95 percent confidence limits, during the 2008 breeding season in Conservation Zones 1 through 6. See text for details.

Conservation Zone	Density (birds/km^2)	Coefficient of Variation of Density (%)	Birds	Birds: Lower 95% CL	Birds: Upper 95% CL	Survey Area (km^2)
1	1.34	17.0	4,699	3,132	6,201	3,497
2	1.18	21.1	1,944	1,187	2,843	1,650
3	3.87	15.4	6,176	4,175	7,903	1,595
4	4.18	19.4	4,850	3,688	7,325	1,159
5	0.14	50.5	121	-	242	883
6	NA	NA	174	91	256	NA
Zones 1-6	NA	NA	17,965	14,722	21,208	NA

Population Trends

Declining murrelet populations have been predicted by demographic models (USFWS 1997, McShane et al. 2004), which estimated losses of about 3-to-7 percent per year. New information, based on population estimates conducted by standardized protocols for nearly a decade, provides, for the first time, direct data with which to evaluate population trends in the listed range.

Since 2000, yearly at-sea surveys provide population estimates for Conservation Zones 1 through 5 under the Effectiveness Monitoring Program of the NWFP (Miller et al. 2006; Falxa et al. 2008, 2009). In 2008, sufficient years of data had accrued to allow analyses for population trends. The population estimates from 2000 through 2008 were used to evaluate whether a declining trend exists (Falxa et al. 2009). Trends were evaluated for two periods: 1) 2000 through 2008, and 2) 2001 through 2008. The latter was evaluated because inspection of the data set (Figure 1) suggested that the 2000 estimate may have been unusually low, considering the pattern of estimates from subsequent years, or perhaps that a decline began around 2001-2002. The cause for the low estimate is not known; it may represent the true abundance that year, or it may simply represent natural or sampling variation. Departures from the protocol did occur in that first year under the new protocol, and may have contributed to the low number, but it is not known if those departures actually biased the estimate downwards. However, the area (parts of Washington) where protocol departures occurred in 2000 also had low estimates compared to subsequent years, and these low estimates contributed substantially to the low 5-Conservation Zone population estimate for 2000. The trend analysis for 2001-2008 provides an estimate of rate of decline without the influence of the 2000 data.

A significant population decline was detected for the combined 5-Conservation Zone area, both for the 2000-2008 and 2001-2008 periods (Tables 4 and 5). Based on the 2000-2008 data, the estimated decline was 490 birds per year (Standard Error of 241), or about 3,900 birds over the 9-year period (95% confidence limit: ±4,553 birds). For the analysis based on the shorter 2001-2008 period, the estimated loss was 870 birds per year (Standard Error of 129), or about 6,900 birds over the 8-year period (95% confidence limit: ±2,533 birds). Omitting the year 2000 population estimate from the shorter period (2001 to 2008) increases the estimated rate of decline and overall loss of birds. The 2000-2008 data represent a 2.4 percent annual decline, while the 2001-2008 data represent an annual decline of about 4.3 percent (Tables 2 and 3, Figure 1). The 2.4 and 4.3 percent values represent two estimates for the rate of decline based on the best available information. Using them this way, 2.4 and 4.3 percent decline rates represent overall declines of 19 and 34 percent, respectively, of the population in Conservation Zones 1 through 5 during the 2000-2008 period.

At the individual Conservation Zone scale, preliminary trend analyses did not detect statistically significant trends in any Conservation Zone for 2000-2008. For the 2001-2008 analysis, there was a significant decline in Conservation Zone 1 (Tables 4 and 5). Also, in Conservation Zone 3 the trend was not significant (P=0.07 for 2000-2008), but the pattern of declining population estimates is consistent with a decline. At the individual-Conservation Zone scale, the statistical power to detect decline rates of 2-to-4 percent per year was generally not high using 9 years of survey data (Miller et al. 2006; pg. 57). Therefore, the lack of a significant trend for individual Conservation Zones at this time is not conclusive evidence of population stability or instability for those Conservation Zones.

In Conservation Zone 6, the 2008 population estimate represented a decline of about 55 percent since 2007, and a 75 percent decline since 2003 (Peery et al. 2008), for an average decline of about 15 percent per year between 2003 and 2008. The 2007 and 2008 population estimates are the lowest estimate since surveys began in 1999, with the 95 percent confidence interval (CI) for 2008 not overlapping the 95 percent confidence intervals for the 2001-2003 period, and the confidence interval for the 2007 estimate barely or not overlapping 95 percent confidence intervals for 2001-2003 (Table 2; Figure 2). The authors concluded that the murrelet population in central California underwent a significant and rapid decline between 2003 and 2008 (Peery et al. 2008).

In the Service's analysis for the 2004 5-year review, trend results from the NWFP Effectiveness Monitoring program were stated to be from too short a time frame to evaluate for a trend but noted that other studies of more limited geographic scope reported either no evidence of population change, a possible decline, or an actual measured decline in the case of Oregon for 1992-1996 (USFWS 2004, pp. 5-6). As noted earlier, McShane et al. (2004, p. 3-58) evaluated future trends at the Conservation Zone scale using demographic models, and concluded that all Conservation Zone populations are in decline with mean annual rates of decline over 40 years between 2.1 and 6.2 percent, with modeling results generally consistent with earlier models that forecast declines of 4-7 percent. Conservation Zone decline rates were slightly higher, 2.8 to 6.2 percent, for a shorter future time period of 20 years (McShane et al. 2004, pg. 3-52).

Conclusions, Population Size and Trend: With declines documented separately for Conservation Zones 1 through 5 and Conservation Zone 6, we conclude that the listed population has declined significantly since 2002, the year of the estimate in the Service's previous 5-year review (McShane et al. 2004). For Conservation Zones 1 through 5 combined, population estimates from NWFP monitoring for 2000-2008 indicate an annual rate of decline in the range of 2.4 to 4.3 percent. For Conservation Zone 6, new data indicate an annual decline of about 15 percent between 2003 and 2008. Based on the tri-state estimate of about 24,400 birds used in the analysis for the 2004 5-year review (USFWS 2004, p. 18), the 2008 population estimate of about 18,000 birds represents a decline of about 26 percent across the listed range from that estimate. This is significant new information regarding population size and trend.

Table 4 Estimates of average annual change (slope) in terms of birds and the percentage of the mean number of birds over the 2000 to 2008 at-sea surveys along with standard errors (in numbers of birds) for the estimates of annual change. The *P*-value is for testing whether the annual change is zero or a negative value less than zero.

Conservation Zone	Mean # of birds	Estimate of Annual change			*P*-value for a decline
		Birds	% of mean	Std. Err.	
1	7,089	-295	-4.2%	216	0.1071
2	2,371	64	2.7%	85	0.7605
3	6,286	-211	-3.3%	129	0.0731
4	4,273	-47	-1.1%	66	0.2473
5	135	1	1.0%	12	0.5427
All	**20,154**	**-488**	**-2.4%**	**241**	**0.0412**

Table 5 Estimates of average annual change (slope) in terms of birds and the percentage of the mean number of birds over the 2001 to 2008 at-sea surveys along with standard errors for the estimates of annual change. See Table 3 for additional information.

Conservation Zone	Mean # Of birds	Estimate of Annual change			*P*-value for a decline
		Birds	% of mean	Std. Err.	
1	7,270	-577	-7.9%	183	0.0099
2	2,511	-29	-1.1%	86	0.3756
3	6,231	-254	-4.1%	163	0.0854
4	4,198	-3	-0.1%	78	0.4862
5	142	-4	-2.9%	15	0.3924
All	**20,351**	**-867**	**-4.3%**	**129**	**0.0003**

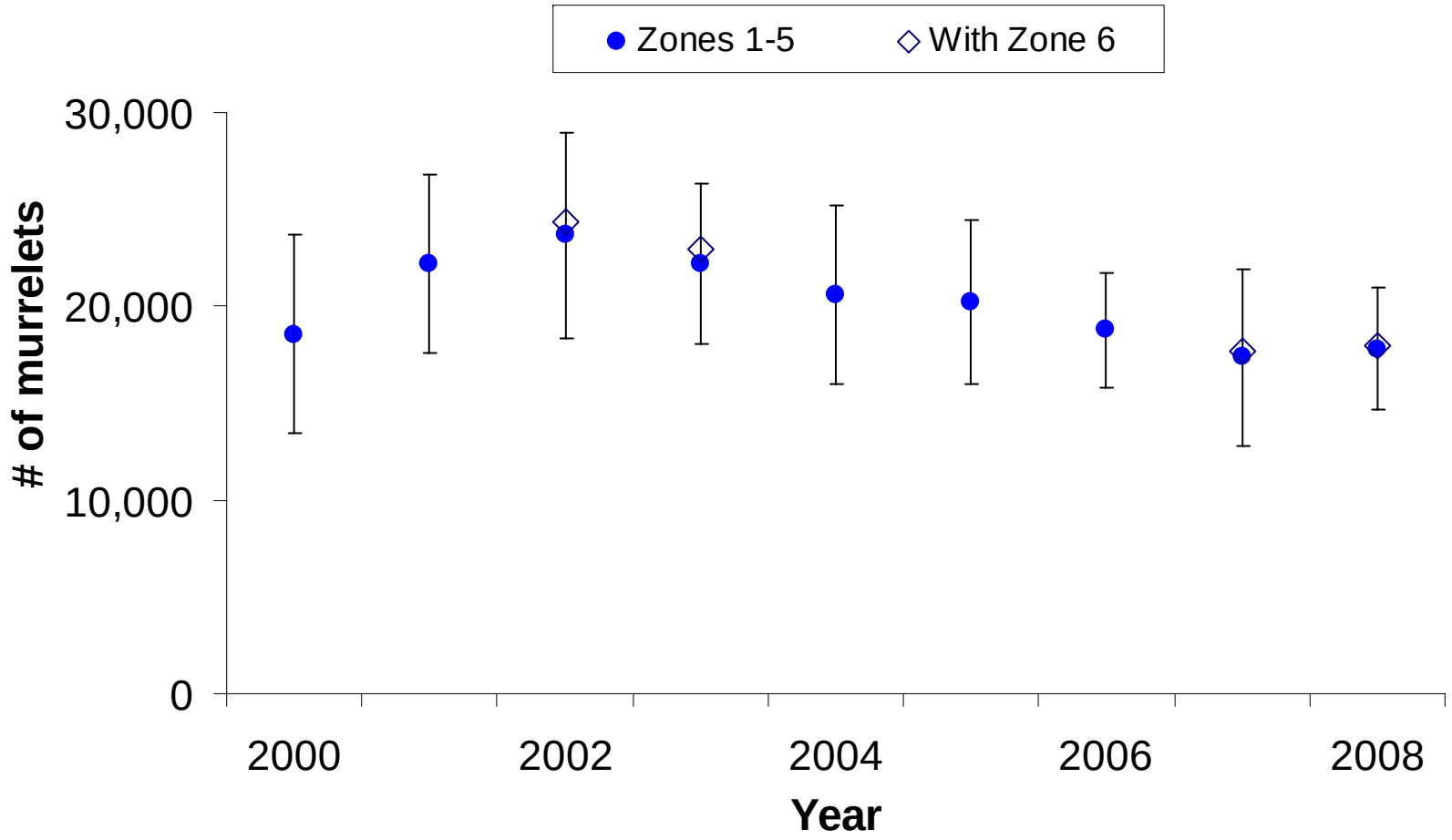

Figure 1 Annual population estimates and 95 percent confidence intervals, for Conservation Zones 1 - 5 combined, based on data from at-sea monitoring under the Effectiveness Monitoring Program of the Northwest Forest Plan. Population estimates with Conservation Zone 6 included are also shown for years when Conservation Zone 6 estimates were available. The shaded area represents the data that were included in the analysis for the 2004 5-year review (USFWS 2004).

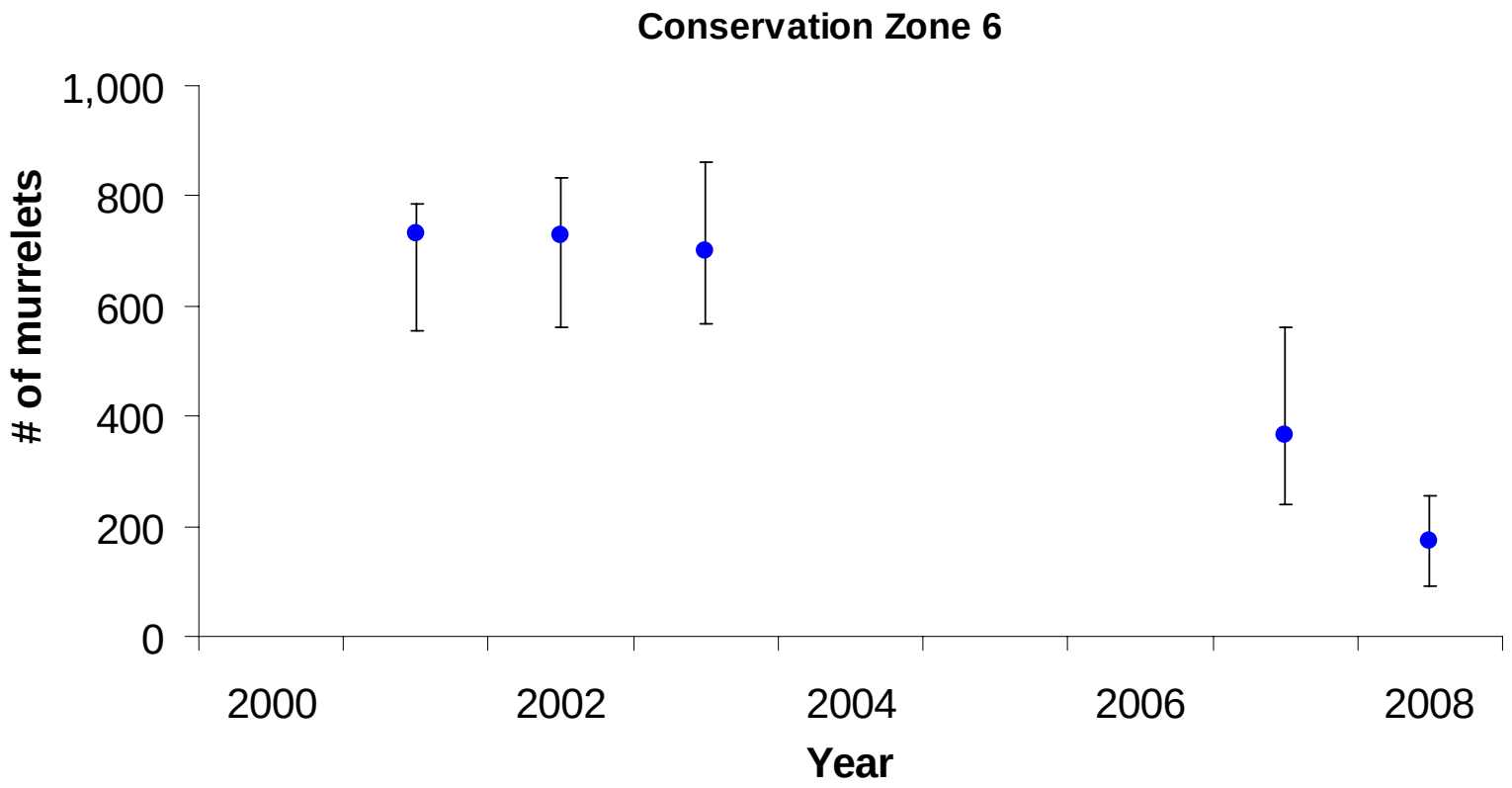

Figure 2 Annual population estimates and 95 percent confidence intervals, for Conservation Zone 6 only, based on data from at-sea monitoring by Peery et al. (2008). No surveys were conducted in 2004-2006. Data from 1999 and 2000 are not included here because methodology differences prevent direct comparison with data from 2001 and later.

Reproduction

McShane et al. (2004 p. 3-2) considered murrelet breeding success to be a function of nest predation, timing, foraging conditions, prey availability, and adult survival during the breeding season. Impacts to breeding success from predation are discussed under Factor C: predation. We have no new information on adult survival. The following discussion focuses on timing of nest initiation, new estimates of productivity from radio telemetry studies and adult:juvenile ratios gathered at-sea, and prey quantity and quality.

Hebert and Golightly (2006, pp.93-94) confirmed through radio telemetry that the nesting chronology of mid-March through mid-August was still appropriate for California. Although Hebert and Golightly's (2006, p.93) earliest nest initiation was April 22, they had captured murrelets in April that had fully developed brood patches, suggesting that nesting had already been attempted. Hebert and Golightly (2006, pp.89-90) also documented that egg laying occurred in the early morning and in all cases the male murrelet began the first incubation duties.

Three radio telemetry studies have documented low nest success. In central California, Peery et al. (2004, p.1094) estimated fecundity to be 0.027. This estimate is much lower than the 0.065 fecundity that McShane et al. (2004, p.3-53) used for modeling extinction within 20 years for Conservation Zone 6. In northern California, Hebert and Golightly (2006, p.95) documented a low hatching success of 22.2 percent. In Washington, Bloxton and Raphel (2008, pp.7 and 10) documented a high rate of nest failure with only two chicks fledging out of 40 nest initiations.

In central California, Peery et al. (2007, p.236) concluded that adult:juvenile ratios detected at sea may be an effective way of estimating productivity. A historic demography study estimated the adult:juvenile ratio at 0.297 in central California (Beissinger and Peery 2007, p. 299). Beissinger and Peery (2007, pp. 299 and 302) suggest that conserving murrelets in the long term will require improving the 1997-2003 ratio of 0.035 or 0.032 up to 0.2 to 0.3. Unadjusted and adjusted adult:juvenile ratios detected at sea, as an indirect index of breeding success, continue to suggest extremely low breeding success in northern California with ratios at 0.003 to 0.008 (Long et al. 2008, pp.18-19), and low breeding success in Oregon with ratios at 0.0254 – 0.0598 (Cresent Coastal Research, 2008, p.13). Adusted adult:juvenile ratios in the San Juan Islands in Washington have been below 0.15 every year since surveys began in 1995, with three of those years below 0.05 (Raphael et al. 2007a, p.16).

The historic decline of murrelet reproduction is likely caused by a shift to a reduced trophic level of available prey (Becker et al. 2007, p.267; Becker and Beissinger 2006, p.476). Becker and Beissinger (2006, pp.470 – 473) suggest that modern murrelets (1998-2002) eat at a lower trophic level than historic murrelets (1895-1911) and that the change in available prey is linked to fishing pressures. Becker et al. (2007, p.267) suggest that cooler ocean temperatures support increased availability of krill and juvenile rockfish and that this improves successful reproduction. However, Becker and Beissinger (2006, p.476) also note that even in years with cooler ocean temperatures and improved reproduction, modern murrelets are eating prey at a lower trophic level than historic murrelets.

Current research suggests that a combination of low food availability in some years and predation in others restricts successful reproduction in central California (Peery et al. 2004, pp. 1094 -1095). Peery et al. (2004 p. 1095) further assert that reduced quotas for fisheries targeting murrelet prey species may be needed to increase murrelet productivity.

A lack of high quality forage at the appropriate time of year may explain the low nest initiation rates and nesting success observed by Bloxton and Raphael (2008) and Peery et al. (2004, pp. 1094-1095) and the low juvenile-to-adult ratios observed in Conservation Zones 1 and 6. Adult murrelets typically feed larger fish (i.e. age-1+ herring) to chicks and feed on smaller fish themselves. Kuletz (2006) found that age-1 herring are the optimum prey resource for raising murrelet chicks in Alaska because a herring weighing about 23 grams delivers about 1.37 kJoule/fish. If chicks are fed smaller herring or other fish species, more of those fish need to be delivered per day to get a similar energy delivery. For example, the number of age-2 sand lance (12 grams, 68 kJoule/fish) required for a murrelet to reach fledging weight is double the number of age-1 herring needed to obtain an equivalent weight. Because of the difference in energy content between prey species, Kuletz (2006) found that murrelets delivering fish other than age-1 herring may have to increase prey deliveries by up to 4.2 times per day to deliver the kJoules necessary for a chick to reach fledging weight. This can result in a substantial increase in energy expenditure by the parents, both in capturing prey and delivering it to the chick. Increases in prey capture and delivery efforts by the adults results in reduced adult body condition by end of the breeding season, and increases the predation risks to adults and chicks as more trips inland are required (Kuletz 2006).

While increasing the number of trips inland may be possible, Ronconi and Burger (2008, p. 252) found that even though murrelets increased their foraging effort during years of low prey availability, they were not able to maintain normal levels of reproductive success. This may be because adults were unable or unwilling to adequately adjust chick provisioning rates, because of the predation risks associated with nest attendance during the day. Ronconi and Burger (2008, p. 256) conclude that murrelet life-history strategy likely follows a “fixed” investment hypothesis, whereby adults compromise reproductive investment (i.e. they do not initiate nesting or abandon the nest) to ensure their own survival when available forage is inadequate or not synchronized with breeding activities. Thus, changes in the marine environment that reduce prey quality and quantity during the pre- and breeding seasons resulting in lack of nest initiation or nest abandonment, may be a limiting factor to the lifetime reproductive output of murrelets (Becker et al. 2007, p. 274; Norris et al. 2007, pp. 879 and 881; Ronconi and Burger 2008, p. 256).

Since 2004, additional data on nest success from radio telemetry and adult:juvenile ratios as an index of breeding success continue to confirm that reproduction in Washington, Oregon , and California is too low to sustain populations. New information on one potential cause for the observed poor reproductive success is related to changes in the marine environment that have resulted in murrelets eating prey at a lower trophic level (lower quality), particularly during the breeding season. The trophic level shift is likely to have caused a decline in murrelet reproduction. Moreover, this shift together with predation, is likely to be largely responsible for current observations of poor reproductive success.

2.3.1.3 Genetics, genetic variation, or trends in genetic variation (e.g., loss of genetic variation, genetic drift, inbreeding, etc.):

New information since the analysis for the 2004 5-year review more clearly defines population structure and genetic viability.

Population Structure. A number of studies have examined the population structure of murrelets using genetic markers. These studies are relevant to the conservation status of the species because they can help identify populations that are demographically isolated or that contain unique genetic resources with adaptive advantages, which, if preserved, may help reduce extinction risk (reviewed by Friesen et al. (1996, p. 682). Below we review studies that have investigated murrelet population structure and report molecular methods, sample sizes, and significant conclusions.

Friesen et al. (1996) conducted the first large-scale genetics study of population structure in murrelets. They compared variation in the mitochondrial cytochrome b gene and 39 allozyme loci from 43 birds sampled between the western Aleutian Islands and Oregon and found low but significant population genetic structure. However, they could not determine the details of the structuring because of small sample sizes (Congdon et al. 2000, p. 975).

In an attempt to resolve the population structure of murrelets suggested by Friesen et al. (1996), Congdon et al. (2000), studied variation in nine nuclear introns in 120 birds from the western Aleutian Islands to southern British Columbia. Their study did not include any individuals from the contiguous United States. They found that murrelets from mainland Alaska and British Columbia were similar, but differed from those in the western and central Aleutian Islands. Furthermore, they determined that population genetic structure in murrelets was best explained by peripheral isolation in the Aleutian Islands, rather than by selection associated with different nesting habitats.

In a more recent and more comprehensive study, Friesen et al. (2005) compared variation in the mitochondrial control region, four nuclear introns, and three microsatellite loci among 194 murrelets from throughout their range (except Washington and Oregon). They reported significant differentiation of birds from peripheral sites (i.e., California and the Aleutian Islands), with the Aleutian and California populations each having one or more private control region haplotypes that occurred at high frequency. Furthermore, the two California populations together had private intron alleles, with three at high frequency. Significant isolation by distance was found, but there was little genetic structuring within the central portion of the species' range. Both Congdon et al. (2000) and Friesen et al. (2005) found evidence for a genetic cline (i.e., gradual change in the genetic makeup of populations across the geographic distribution of the species), and Friesen et al. (2005) argued for the recognition of five genetic management units: (1) western Aleutian Islands, (2) central Aleutian Islands, (3) mainland Alaska and British Columbia, (4) northern California, and (5) central California. However, these studies were limited in the number of sites and loci that were sampled.

In an update to their 2005 study, and in the most comprehensive rangewide analysis of population genetic structure for murrelets to date, Friesen et al. (2007; also reported in Piatt et al.

(2007)) examined 282 murrelets across the global range of the species. They assessed genetic variation at 9 intron and 15 microsatellite loci. Their results agreed with previous findings indicating that genetic variation changes clinally in this species, but provided additional resolution showing that murrelets in western and central Aleutian Islands and central California differ significantly from murrelets in the rest of the species' range. They concluded that murrelets appear to comprise three genetic units (rather than five): (1) western and central Aleutian Islands; (2) eastern Aleutian Islands to northern California; and, (3) central California. Loss of any of these population would result in the loss of a portion of the species' genetic resources and/or local adaptations, and may compromise its long-term viability (Piatt et al. 2007, p. 43).

With the current population structure largely resolved, Peery et al. (in press), attempted to examine whether murrelet population structure has changed over the last 100 years due to habitat fragmentation. To do this, they obtained genetic samples from 601 murrelets at-sea, in five regions, from southeast Alaska to central California and compared their genetic population structure (current population structure) to that of 192 murrelet specimens in museums (historical population structure). Modern samples were amplified and genotyped at up to 16 microsatellite loci, while historical samples were amplified at a subset of nine of these loci. They found that historically, populations from southeastern Alaska to central California constituted a single genetically undifferentiated population. They concluded that the population structuring demonstrated by Friesen et al. (2007) appears to have occurred over the last century as populations became increasingly isolated due to habitat fragmentation caused by extensive logging of old-growth habitat along the north coast of California (Peery et al. in press, pp.15-16). Thus, they concluded, that it is reasonable to expect that additional fragmentation could isolate remaining populations genetically and demographically, ultimately increasing the risk of local extinctions (Peery et al. in press, p.19).

Genetic Viability

Friesen et al. (2007) found no strong evidence for either inbreeding or low genetic variation within any sampling site. However, Peery et al. (in press, p. 13) found that the central California population has lost alleles at three of the nine microsatellite loci over the last century, and allelic richness declined by an average of 6.9 percent across loci. Comparatively, in northern populations analyzed by Peery et al. (in press, p. 13) (i.e., southeast Alaska to northern California), alleles were lost at only one locus and allelic richness declined by an average of 4.5 percent across loci.

Summary. The current information on murrelet genetics indicates that (1) there is clinal genetic variation in the species from the Aleutian Islands to central California; (2) murrelets appear to comprise three genetic units: (i) western and central Aleutian Islands, (ii) eastern Aleutian Islands to northern California, and (iii) central California; (3) the genetic discreteness of the central California population appears to be a relatively recent phenomenon tied to habitat fragmentation; and, (4) there is no strong evidence for inbreeding or low genetic variation, however the number of alleles and allelic diversity has declined at a greater rate in central California than in northern populations over the last century.

2.3.1.4 Taxonomic classification or changes in nomenclature:

As discussed in previous proposed rules for this species, the scientific name of the marbled murrelet (*Brachyramphus marmoratus marmoratus*) should be changed to *Brachyramphus marmoratu*s to reflect recent (1997) taxonomic information.

Two subspecies of the marbled murrelet were previously recognized—North American murrelet (*Brachyramphus marmoratus marmoratus*) and Asiatic murrelet (*B. marmoratus perdix*). New information suggests that the Asiatic murrelet is a distinct species (Friesen et al. 1994, 1996). The American Ornithologists' Union, in its "Forty-first Supplement to the Checklist of North American Birds," officially recognized the long-billed murrelet (*B. perdix*) and the marbled murrelet (*B. marmoratus*) as distinct species (American Ornithologists' Union 1997).

2.3.1.5 Spatial distribution, trends in spatial distribution (e.g. increasingly fragmented, increased numbers of corridors, etc.), or historic range (e.g. corrections to the historical range, change in distribution of the species' within its historic range, etc.):

Since the analysis for the 2004 5-year review, there is no new information regarding spatial distribution or changes in the historic range.

2.3.1.6 Habitat or ecosystem conditions (e.g., amount, distribution, and suitability of the habitat or ecosystem):

Since the analysis for the 2004 5-year review, new modeling by Raphael et al (2006) has revised the previous information on amount and distribution of habitat. Results from Raphael et al. (2006) also indicate that losses of potential nesting habitat in the 1994-2003 period may be greater than previously estimated, with losses ranging from about 61,000 to 279,000 acres in the 5-Conservation Zone area, with about 10 to 28 percent of habitat loss occurring on Federal lands, and about 72 to 90 percent on non-Federal lands (difference of about 7 percent of total baseline habitat). For further information, see section 2.3.2.1.

2.3.1.7 Other: None

2.3.2 Five-Factor Analysis (threats, conservation measures, and regulatory mechanisms)

2.3.2.1 Present or threatened destruction, modification or curtailment of its habitat or range:

In the following sections, we provide an analysis of the new information pertinent to the murrelet's terrestrial and marine environments. Within each section we update the existing information and discuss existing and new threats. In each of the sections, we discuss the aspects of climate change that will most likely affect the terrestrial and marine habitats of the murrelet. We present information that indicates that climate change is occurring globally, and discuss literature related to climate change that has been published for the Pacific Northwest (PNW) and the western United States (US).

The Intergovernmental Panel on Climate Change (IPCC) is a scientific body set up by the World Meteorological Organization and the United Nations Environment Program in 1988 to inform policymakers about the causes of climate change, its potential environmental and socio-economic consequences, and the adaptation and mitigation options to respond to it. The Service considers the IPCC an impartial and legitimate source of information on climate change. In 2007, the IPCC published its Fourth Assessment Report, which is considered the most comprehensive compendium of information on actual and projected global climate change currently available. Although the extent of warming likely to occur is not known with certainty at this time, the IPCC has concluded that warming of the climate is unequivocal and continued greenhouse gas emissions at or above current rates would cause further warming (IPCC 2007, p. 30).

In North America, the IPCC projects that the annual mean warming is likely to exceed the global mean warming, with the largest increases in the winter in northern regions as a result of less snowpack, and summer in southern regions (Christensen et al. 2007, p.887-890). The snow season length and snow depth are very likely to decrease in most of North America. Annual mean precipitation is very likely to increase over most of the area, with the increase occurring during the fall and winter, but summer months are projected to have decreased annual precipitation (Christensen et al. 2007, pp.887-890). The IPCC projects an increase in the frequency of extreme weather related events including high temperature, precipitation, and flooding (Christensen et al. 2007, p.891).

Other aspects of climate change currently affecting biological systems and predicted to continue in the future include documentation of significant species range shifts northward towards the poles, significant mean advancement of spring events (Parmesan and Yohe 2003, p.38-39), and significant upward elevational range shifts (Moritz et al. 2008, p.262).

Comprehensive reports on the projected impacts from climate change in Washington, Oregon and California have been prepared recently (Littell et al. 2009, State of Oregon 2008, State of California 2009). All reports are in general agreement with the projections as outlined in the IPCC 2007 report and provide further detail on how the projections may affect resources and areas specific to each state.

Terrestrial Environment

In this section we summarize new information regarding potential threats to the murrelet's terrestrial environment, specifically its terrestrial nesting habitat. New information includes information on the amount of potential nesting habitat, losses and gains in potential nesting habitat, losses authorized through Section 7 consultations under the Act, and other threats to the terrestrial environment, notably those associated with climate change.

Amount of potential nesting habitat

In the last 5-year review, the Service estimated that there were at the time about 2.2 million acres of suitable murrelet nesting habitat in the tri-state area, but noted that this was almost certainly an overestimate for those ownerships included in this estimate (USFWS 2004, pp.9-10). The estimate for Washington and California was believed to be fairly complete for most land ownerships, but the estimate did not include habitat on privately owned lands in Oregon, and did

not account for some private lands in Washington. The Service also determined that the rate of habitat loss had declined since listing, particularly on Federal lands due to implementation of the NWFP (USFWS 2004, pp.11 and 13).

New information on the amount of suitable murrelet nesting habitat is available from an analysis of murrelet habitat, which covered both Federal and non-Federal lands within the five Conservation Zones within the NWFP area (Raphael et al. 2006). These new habitat estimates are believed to represent an improvement over previous estimates (Huff et al. 2006, Executive Summary). The new estimates summarized here were derived by 2 different modeling approaches, and were developed for the baseline period of 1994-1996 (Raphael et al. 2006, p..99; the satellite imagery used was from this span of years). For one of those approaches, the Expert Niche Factor Analysis (ENFA, Raphael et al. 2006), two different habitat suitability (HS) threshold criteria were used to estimate suitable habitat. Habitat suitability was on a scale of 0-100, where 100 is the highest suitability; HS>60 provided a more generous (inclusive) portrayal of habitat, and HS>80 a more conservative one (Raphael et al. 2006, p.130). A separate habitat change analysis then calculated net losses (net gains were not observed) of nesting habitat between the baseline period and 2002-2003 (2002 for Oregon, Washington, 2003 for California; Raphael et al. 2006, pp. 100 and 129). To estimate the amount of habitat available in 2002-2003 requires subtracting the net losses from the baseline period. These are the numbers presented in Table 6.

The NWFP divided the murrelet nesting habitat into 2 inland habitat zones, with habitat zone 1 comprising the area near the coast, and habitat zone 2 the most inland potential habitat. The two modeling methods differ in the area covered, with the Expert Judgment model covering both habitat zones, and ENFA including only habitat zone 1. Expert Judgment model results for habitat zone 1 are reported separately in Table 6 to allow more direct comparison with ENFA results. Overall, in the NWFP habitat zone 2 accounted for about 23 percent of the total habitat estimated by the Expert Judgment model. While excluding habitat zone 2 likely underestimates the amount of habitat, the inclusion of the NWFP habitat zone 2 likely overestimates habitat. This is because extensive studies have demonstrated that the distribution of likely nesting birds is not as far inland in southern Oregon and northern California as thought in 1996, when the NWFP inland boundaries were drawn (FR 73(148), July 31, 2008, p. 44680).

For Federal lands, McShane et al. (2004) estimated about 2 million acres of suitable habitat in 2003, but acknowledged this likely represented an overestimate because some administrative units used northern spotted owl habitat as a surrogate for murrelet habitat, and owl habitat includes younger forest than typical murrelet habitat. Nonetheless, the 2004 estimate is relatively similar to the estimates from the Expert Judgment model and from ENFA using HS>60 (Table 6). The similarity of these 3 estimates from different approaches, each roughly 2 million acres, suggests that this is the best estimate of suitable potential nesting habitat on Federal lands as of 2002-2003. This estimate may be something of an overestimate, considering the much smaller estimate of 0.6 million acres based on a more stringent minimum habitat quality threshold (ENFA HS>80), and the potential overestimate in the 2004 number from McShane et al. (2004), as noted above. The authors of the modeling work, however believed that the HS>60 criterion yielded a reasonable estimate of potential murrelet nesting habitat (Raphael et al. 2006, p. 141).

For non-Federal lands, the nesting habitat estimates are more variable, with all three estimates from the Raphael et al. (2006) modeling effort substantially larger than the earlier estimate of 0.2 million acres rangewide (McShane et al. 2004; Table 6). The 2006 study noted that habitat on non-Federal lands was probably overestimated in some areas (Raphael et al. 2006, pg. 140), perhaps by mistakenly classifying larger second-growth forest as suitable habitat. Except for ENFA HS>80, the differences in the estimates for non-Federal lands are substantial between the 2004 and 2006 estimates. McShane et al. (2004) had less complete information for non-Federal lands than for Federal (USFWS 2004, pp. 9-10). Assuming that the ENFA>60 estimate is an overestimate, the true value for non-Federal lands is likely somewhere between the estimates of 0.5 to 1.5 million acres from the ENFA HS>80 and Expert Judgment models (Table 6). Further refinement of this estimate will require new information.

Table 6 Different estimates of the amount of suitable potential murrelet nest habitat (in millions of acres) within the listed range in 2002-2003 (Raphael et al. 2006 for first 3 estimates). See text for details.

Model, Criteria	All ownerships	Federal	Percent Federal	Non-Federal
ENFA, HS>60	3.74	1.88	50%	1.86
ENFA, HS>80	1.08	0.60	56%	0.48
Expert Judgment	3.81	2.33	61%	1.48
Expert Judgment, NWFP habitat zone 1 only	3.10	1.76	57%	1.33
McShane et al. 2004	2.22	2.02	91%	0.20
USFS & BLM 1994	2.5	NA	NA	NA

Habitat losses and gains.

Extensive harvest of late-successional and old-growth forest 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 (Teensma et al. 1991; Booth 1991; Ripple 1994; Perry 1995; USFWS 1997, p. 4)). About 10 percent of pre-settlement old-growth forests remain in western Washington (Norse 1990; Booth 1991). In California, old-growth coastal redwood forests had been reduced by about 85 to 96 percent at the time of listing (USFWS 1997, p. 4).

Although the NWFP has reduced the rate of habitat loss due to timber harvest on Federal lands, the threat of continued loss and degradation of suitable nesting habitat remains on Federal and non-Federal lands through timber harvest and natural events such as wildfire, insect outbreaks, and windthrow. In addition, insects and disease can kill complete stands of habitat and can contribute to hazardous forest fire conditions. As discussed below under climate change, global warming may increase the adverse effects of natural events on murrelets.

McShane et al. (2004) stated that windstorms periodically eliminate potential murrelet habitat, but that most damage is at a local scale; edges and fragmentation can increase the risk of windthrow (McShane et al. 2004, pg. 4-79). Where forest fragmentation increases, the threat of habitat loss due to windthrow is likely to increase. A significant windthrow event occurred in

southwest Washington and northwest Oregon in December 2007. The Washington Department of Fish and Wildlife estimate the amount of occupied murrelet habitat affected by the December 2007 and subsequent windstorms as approximately 2,000 acres. This includes only those areas where the agency has information from assessments of damaged stands and/or from completed salvage logging. Not included are damaged stands that the agency has not been apprised of, nor impacts to potentially suitable (versus known occupied) murrelet habitat (Gary Bell, WDFW, pers. comm. 2009). WDFW hopes to complete a more accurate accounting during 2009.

Estimates of previous habitat losses. The analysis for the 2004 5-year review estimated total losses of murrelet habitat within the listed range, due to all causes combined. Between 1992 and 2003, the estimated loss of suitable murrelet habitat totaled 22,398 acres in Washington, Oregon, and California combined, of which 5,364 acres resulted from timber harvest and 17,034 acres resulted from natural events (McShane et al. 2004, pg. 4-64). Those data primarily represented losses on Federal lands, and did not include data for most private or State lands within the murrelets' range.

New information on habitat losses is available from the analysis of Raphael et al. (2006), which used habitat models to estimate losses of potential murrelet habitat for the period from 1994-1996 to 2002-2003, and covered both Federal and non-Federal lands within the five Conservation Zones in the NWFP area. Results from that study indicate that losses of potential nesting habitat may be greater than previously estimated, with losses ranging from about 61,000 to 279,000 acres in the 5-Conservation Zone area, with about 10 to 28 percent of habitat loss occurring on Federal lands, and 72 to 90 percent on non-Federal lands (Table 7). The variation in the acreage estimates provided by Raphael et al. (2006) is dependent upon the habitat model used to evaluate habitat suitability. However, the earlier estimates were based on direct reports of losses by agencies, and the newer numbers are based on habitat modeling; therefore, direct comparisons should be made cautiously. McShane et al. (2004, p.4-66) had incomplete data on habitat losses for non-Federal lands, thus the higher losses from the 2006 modeling may in part represent a capturing of unreported losses. Further complicating comparisons is that the same models (Expert Judgment, ENFA>60) which estimated much greater habitat losses on non-Federal lands than did McShane et al. (2004) also estimated more baseline habitat on those lands. If those models incorrectly classified mature second-growth forest as baseline murrelet habitat on non-Federal lands, the error could also inflate losses, via harvest of second-growth which was incorrectly classified as suitable nesting habitat, and thus also counted among losses.

In addition to direct habitat removal, forest management practices can fragment murrelet habitat; this 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 forest 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).

Table 7 Different estimates of the losses of suitable murrelet nest habitat (in thousands of acres) within the listed range between 1994-1996 and 2002-2003 (Raphael et al. 2006) or 1992 and 2003 (McShane et al. 2004). Baseline numbers are based on Table 6.

Model, Criteria	All ownerships	Federal	Non-Federal	Percent of Baseline
ENFA, HS>60	278.8	30.0	248.8	7.5
ENFA, HS>80	60.5	5.5	55.0	5.7
Expert Judgment	195.2	55.5	139.7	5.1
McShane et al. 2004	22.4	See text	See text	

Habitat gains. Gains in suitable nesting habitat are expected to occur on Federal lands over the next 40 to 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 population numbers in the coming 20 to 100 years (USFS and USBLM 1994a; Beissinger 2002). As noted above, no net habitat gains were observed in the habitat analysis of Raphael et al. (2006). In the California coastal redwood forests, the potential for a gain in suitable habitat outside Parks and reserves is extremely limited because the majority of potential future habitat occurs on privately owned lands that are primarily managed for timber harvest. Furthermore, Federal forest land managed under the NWFP in California provide little conservation benefit for the murrelet through gains in habitat because the majority of occupied habitat occurs outside NWFP lands.

Habitat removal/degradation authorized through section 7 consultation. Since the analysis for the 2004 5-year review, the Service, in the tri-state area, has authorized incidental take associated with the removal of a total of 16,423 acres of potential or known nesting habitat, in addition to removal of 2,450 individual potential nest trees, and the degradation of 23,449 acres of potential or known nesting habitat.

In Washington, since the last review the Service has authorized incidental take associated with the removal of 2,445 potential nest trees and 11,101 acres of potential nesting habitat. In addition, the Service has authorized incidental take associated with the degradation of 11 acres of suitable nesting habitat. Within designated critical habitat units, the Service has authorized incidental take associated with the removal of 51 individual trees and 5 acres of suitable nesting habitat in Conservation Zone 1, and removal of 42 individual trees and 1 acre of suitable nesting habitat in Conservation Zone 2. The losses reported for critical habitat units are included in the numbers reported for the entire Conservation Zone.

In Oregon, the Service has authorized incidental take associated with the removal of 850 acres and the degradation of 715 acres of nesting habitat in Conservation Zone 3, and removal of 4,472 acres of nesting habitat and removal of 5 trees in Conservation Zone 4. The 715 acres consisted of 65 acres of intact habitat and 650 acres of stands with remnant trees. The Service also authorized incidental take associated with the degradation of 22,723 acres of nesting habitat in Conservation Zone 4, in Oregon and California. No removal or degradation of nesting habitat was authorized via incidental take within Conservation Zones 5 and 6.

Within designated critical habitat units since the last review, the Service has authorized incidental take associated with the removal of 80 acres and degradation of 21 acres of habitat in Conservation Zone 3, and the removal of 234 acres and the degradation of 6 acres of habitat in Conservation Zone 4. No removal or degradation of critical habitat was authorized via incidental take in Conservation Zones 5 and 6.

Climate Change:
Although the marine environment is the murrelet's principal habitat, terrestrial habitat serves a vital function seasonally for nesting and reproduction. The following section describes the effects or potential effects of climate change on murrelet's use of terrestrial habitat. In general, where climate models are informative, their projections for the forested habitat that murrelets occupy are largely unfavorable.

We discuss temperature, rainfall, and snowpack projections specific to the PNW as defined by Mote et al. (2003, 2008) and similarly by Millar et al. (2006, p.45), and Littell et al. (2009, p.3) to include Washington, Oregon, Idaho, western Montana and small portions of adjacent states. Fire, disease and insects, and tree mortality were examined across a much broader landscape in the western US. Changes in vegetation communities as a result of climate change were modeled for California (Lenihan et al. 2008, p.220) and the PNW (Millar et al. 2006, p.45).

During the next 20 to 40 years, the climate of the PNW is projected to change significantly with associated changes to forested ecosystems. Initially, the PNW is likely to see increased forest growth region-wide over the next few decades due to increased winter precipitation and longer growing seasons; however, forest growth is expected to decrease as temperatures increase and trees can no longer benefit from the increased winter precipitation and longer growing seasons (Littell et al. 2009, p.15). Additionally, the changing climate will likely alter forest ecosystems as a result of the frequency, intensity, duration and timing of disturbance factors such as fire, drought, introduced species, insect and pathogen outbreaks, hurricanes, windstorms, ice storms, landslides, and flooding (Kliejunas et al. 2008, p.25; Littell et al. 2009, p.14).

The climate in the PNW has already experienced a warming of 0.8° C during the 20th century (Mote et al. 2008, p.3). Using output from eight climate models the PNW is projected to warm further by 0.6 to 1.9° C by the 2020s, and 0.9 to 2.9° C by the 2040s (Mote et al. 2008, pp.5-6). Additionally, the majority of models project wetter winters and drier summers (Mote et al. 2008, p.7), and of greatest consequence, a reduction in regional snowpack, which supplies water for ecosystems during the dry summer (Mote et al. 2003). The small summertime precipitation increases projected by a minority of models do not change the fundamentally dry summers of the PNW and do not lessen the increased drying of the soil column brought by higher temperatures (Mote et al. 2003, p.8). Consequently, the potential for increased fire frequency and severity even in wet coastal ecosystems of the PNW is likely under climate change projections (Millar et al. 2006, p.49).

One of the largest projected effects on PNW forests is likely to come from an increase in fire frequency, duration and severity. In general, wet western forests have short dry summers and high fuel moisture levels that result in very low fire frequencies. However, high fuel accumulations and forest densities create the potential for fires of very high intensity and severity

when fuels are dry (Mote 2008, p.23). Westerling et al. (2006) looked at a much larger area in the western US including the PNW, and found that since the mid-1980s, wildfire frequency in western forests has nearly quadrupled compared to the average of the period 1970-1986. The total area burned is more than six and a half times the previous level and the average length of the fire season during 1987-2003 was 78 days longer compared to 1978-1986 (Westerling et al. 2006, p.941). Littell et al. (2009, p.2) project that the area burned by fire in the PNW will double by the 2040s and triple by the 2080s. Lenihan et al. (2008, p.225) predict under 3 simulations that by the end of the 21st century the total annual area burned in California will increase, ranging from 9 to 15 percent more than historical totals.

There is much uncertainty about how forest pathogens will respond to climate change; however, despite these uncertainties, a recent literature review contains some general predictions (Kliejunas et al. 2008, p.2). With global warming, some diseases may be able to occur farther north or at higher elevations, and there may be increasing invasions by non-native pathogens. Because temperatures are expected to increase more in winter than in other seasons, there may be greater overwinter success of pathogens and an increase in disease severity. Kliejunas et al. (2008, p.23) state "there is consensus that climate change will likely increase host stress and predispose them to disturbance factors such as insects, pathogens, and emerging diseases".

Van Mantgen et al. (2009) examined mortality rates in unmanaged old forests in the western US and British Columbia. Specifically in the PNW, mortality rates have doubled in the last 17 years (Van Mantgen et al. 2009, p.522). They suggest that regional warming and drought stress resulting from declining precipitation falling as snow, declining snowpack water content, earlier spring snowmelt, and lengthening of summer drought are likely contributors to the increases in tree mortality rates (Van Mantgen et al. 2009, p.523).

The response of vegetation distribution to scenarios of future climate change has been modeled for the PNW and California. Millar et al. (2006, p.45) projected that coastal maritime forests in the PNW would be displaced by temperate-subtropical mixed forests or interior conifer forests with an overall increase in broadleaf vegetation. Similarly, in California, extensive conversion of evergreen conifer forest (maritime temperate conifer forest such as redwood, closed-cone pine, ponderosa pine, and mixed conifer) to mixed evergreen forest (Douglas-fir-tanoak, tanoak-madrone-oak, and ponderosa pine-black oak) was simulated under all scenarios, with an average loss of 20 percent of conifer forest (Lenihan et al. 2008, p.227).

It is very likely that heat extremes and heavy precipitation events will become more frequent (Loehman and Anderson 2009, p.5). Extreme rainfall events are currently modeled on a 20-year return interval. The frequency of these events is expected to occur roughly twice as often as they currently do (Kharin et al. 2007 In Loehman and Anderson 2009, p.14).

Summary, threats to terrestrial environment. In the analysis for the 2004 5-year review, habitat loss and fragmentation were expected to continue in the near future, but at an uncertain rate (McShane et al. 2004). The new information does not suggest a change in the level of threat. The new results suggest that habitat losses in the past decade were likely greater than previously estimated, notably on non-Federal lands. The 2004 estimates were known to be underestimates, so to some extent the 2006 modeling results corroborate that fact. The size of those losses is not

well known, as different models provided widely varying estimates of losses, and the models have a number of sources of uncertainty (Raphael et al. 2006, p.137). However, the magnitude of the non-Federal losses reported by some models in Raphael et al. (2006) for non-Federal lands (as much as about 7 percent of total baseline habitat), suggests a need for investigation to better understand the status of habitat on non-Federal lands.

The new estimates of potential suitable murrelet nesting habitat are, for Federal lands, similar to the estimate in the Service's analysis for the 2004 5-year review. Considering the approximate nature of previous and current estimates, the new data do not indicate a change in status or threat level. For non-Federal lands, the recent habitat modeling work suggest that more habitat may be present than previously estimated. Considering that the previous numbers were known to be underestimates for non-Federal lands because of incomplete data for those lands, and the more recent modeling results likely overestimates, we conclude that the data available at this time does not indicate a significant change from previous estimates of suitable nesting habitat. However, improved data, especially for non-Federal lands, would be valuable to better assess the true amount and distribution of suitable nesting habitat.

Though considerable uncertainty exists with respect to any regional-scale impacts of climate change due to the differences in trajectories of climate change scenarios, modeling results underscore the potentially large impacts on the PNW and California ecosystems. From this review we can generalize that adverse consequences to forest ecosystems are predicted to increase as a result of climate change (Kliejunas et al. 2008, p.25), potentially negatively impacting habitat for many species including the murrelet.

Climate change is likely to further exacerbate some existing threats such as the projected potential for increased habitat loss from drought related fire, mortality, insects and disease, and increases in extreme flooding, landslides and windthrow events in the short-term (10 to 30 years). However, while it appears likely that the murrelet will be adversely affected, we lack adequate information to quantify the magnitude of effects to the species from the climate change projections described above.

Marine Environment

In this section we summarize new information regarding potential threats to the murrelet's marine environment. New information regarding the condition of the marine environment in the 3-state area includes harmful algal blooms, dead zones, prey availability and quality, and the potential exacerbation of these conditions from climate change.

California Current System. With the exception of Conservation Zone 1 (Puget Sound and Straits of Juan de Fuca), the listed range is entirely within the California Current System (CCS). The CCS extends about 190 mi (~300 km) offshore from southern British Columbia, Canada, to Baja California, Mexico, and is dominated by a southward surface current of colder water from the north Pacific (Miller et al. 1999, p.1; Dailey et al. 1993, pp.8-10). The system is characterized by upwelling, particularly in spring-summer. This is an oceanographic phenomenon involving wind-driven movement of dense, cooler, and usually nutrient-rich water towards the ocean surface, which replaces warmer and usually nutrient-depleted surface water (Smith 1983, pp.1-2433). Coastal upwelling replenishes nutrients near the surface where photosynthesis occurs,

resulting in increased productivity (Batchelder et al. 2002, p.37). This upwelling of cold productive water tends to be strongest towards the south (central Oregon to Monterey Bay), and may be key to maintaining cold productive marine conditions that are favorable to murrelets in the region south of Washington (McShane et al. 2004, p.5-4), which would have warmer sea temperatures in the absence of the California Current and upwelling.

The CCS is affected by inter-annual El Niño-Southern Oscillation (ENSO) and inter-decadal (Pacific Decadal Oscillation) climatic processes. ENSO is used to describe periodic changes, typically lasting 1-2 years, in air-sea interaction in the equatorial Pacific Ocean region. El Niño events (warm-water events) result in increased sea-surface temperatures, reduced flow of eastern boundary currents such as the CCS, and reduced coastal upwelling (Norton and McLain 1994, pp.16,019–16,030; Schwing et al. 2002, p.461). La Niña events (cold-water events) produce effects in the northeast Pacific Ocean that tend to be the reverse of those during El Niño events, resulting in colder, more-nutrient rich waters than usual, due to strong upwelling-favorable winds and cold waters near the surface due to a shallow thermocline (zone of rapid temperature in the water column that typically separates warm water above from cold water below) (Murphree and Reynolds 1995, p.52; Oedekoven et al. 2001, p.266). In addition to inter-annual climate events such as El Niño and La Niña, the mid-latitude Pacific Ocean experiences warm and cool phases that occur on decadal time scales (Mantua 2000, p.21). The term "Pacific Decadal Oscillation" was coined to describe long-term climate variability in the Pacific Ocean, in which there are observed warm and cool phases, or "regime shifts" (Mantua et al. 1997, pp.1069-1079; Mantua 2000, p.1). Recently, the North Pacific Gyre Oscillation concept was developed to help explain the basis for the changing PDO patterns in the northeast Pacific (Ceballos et al. 2009).

Straits of Juan de Fuca. The Strait of Juan de Fuca is where deep in-flowing oceanic waters mix with out-flowing Puget Sound and Georgia Basin surface waters. The incoming ocean water can fluctuate between high-density waters with low oxygen and high nutrient content, versus low-density waters with high oxygen and low nutrient content (Puget Sound Action Team (PSAT) 2007, p.116). The marine conditions in the Straits are in response to upwelling and downwelling patterns generated by coastal winds and changes in coastal circulation.

Puget Sound. Puget Sound is unique among North American estuaries, because of its geologically young, deep, narrow, fiord-like structure. The subtidal circulation of Puget Sound is largely driven by the differences in salinity between fresher waters within the Sound and the saltier waters in the Strait of Juan de Fuca. The Olympic and Cascade mountain ranges provide freshwater inputs; however, several shallow sills restrict the entry of deep oceanic water into Puget Sound, which reduces flushing of these inland marine and estuarine waters compared to the other urbanized estuaries of North America. This hydrologic isolation puts Puget Sound's acquatic organisms at higher risk because toxic chemicals, nutrients, and pathogens that enter Puget Sound remain in the system longer, resulting in increased exposure (PSAT 2007). Recently, The PSAT (2007) completed a comprehensive report of the conditions of Puget Sound. Some of the key findings from this report are here and other key findings are incorporated in the sections below.

- During the 20th century, the average air temperature in Puget Sound increased by 2.3° F, which is more than double the global average air temperature increase of 1.1° F.

- Fifty-two non-native species have been documented in Puget Sound; a large number of these were probably introduced via ship ballast. The European green crab, Chinese mitten crab, and zebra mussel are non-native species that could arrive at anytime and threaten Puget Sound's biological resources.
- Approximately 1 percent of Puget Sound sediments are highly degraded, 31 percent are of intermediate quality, and 68 percent are of high quality. The degraded sediments (as measured by toxicity, chemistry, and benthic infauna) are mainly associated with urban embayments that are often located near river deltas and other highly productive nearshore habitat of importance to Puget Sound species. Flame retardants [polybrominated diphenyl ethers (PBDEs)] occurred in 17 percent of sediment sites sampled in Hood Canal in 2004 and were detected in 16 percent of samples from l0 Puget Soundwide sediment sampling sites in 2005. The levels of polycyclic aromatic hydrocarbons (PAHs), such as creosote, have not changed significantly in Puget Sound sediments over the past decade, except in Bellingham Bay, Port Gardner, and Anderson Island, where levels have increased. Point Pully (in central Puget Sound) had a significant decrease in PAHs during this same period.
- PBDEs are now second to Polychlorinated biphenyls (PCBs) in order of importance in the Puget Sound food web. PBDEs levels in English sole from urban areas are almost l0 times higher than those levels measured in sole from the Georgia Basin. Pacific herring from Puget Sound have nearly three times the levels of PBDEs found in Georgia Basin herring. Harbor seals from Puget Sound have over twice the PBDEs found in seals near Vancouver, British Columbia. Scientists estimate that PBDE levels are doubling every four years in marine mammals, including harbor seals and orcas, and will surpass PCB levels in these species by 2020.

Harmful Algal Blooms and Biotoxins. Some algal species cause harm to animals and the environment through toxin production or excessive growth. These algal species are known as harmful algae and can include microalgae that live suspended in the water or macroalgae that live attached to plants or other substrates. Harmful algal blooms (HABs) are a natural phenomenon, but human activities are thought to contribute to the increased frequency of some HABs, for example increased nutrient loading is a factor that contributes to increased occurrence of high biomass HABs (Lopez et al. 2008, p.19). All coastal states in the United States have experienced HAB events and "it is generally believed that the frequency and distribution of HABs and their impacts have increased considerably in recent years" (Lopez et al. 2008, p.19).

The consequences of HABs can include the death of whales, sea lions, dolphins, manatees, sea turtles, birds, fish, and invertebrates from direct exposure to toxins; exposure to toxins via contaminanted food, water, or aerosols; damaged gills; starvation due to low or poor food quality (Lopez et al. 2008, pp.19 and 22); and by producing compounds that reduce feather waterproofing which can result in hypothermia (Jessup et al. 2009). HABs can also exacerbate impacts of other stressors and indirectly lead to mortalities. Ecosystems can be degraded through the formation of such large blooms that they alter habitat quality through overgrowth, shading, or oxygen depletion (see dead zone section below). In addition, HAB-inflicted mortalities can degrade habitat quality indirectly through altered food webs or hypoxic events caused by the decay of dead animals (Lopez et al. 200, p.22).

The types of HABs known to occur along the Pacific coast that can impact seabirds are *Heterosigma akashiwo,* macroalgae, *Alexandrium catenella,* and *Pseudo-nitzschia* (Lopez et al. 2008, p.28). Blooms of *Heterosigma akashiwo*, a raphidophyte known to kill fish have been documented in the Pacific Northwest annually since the 1960s and blooms of *Chanttonella*, another raphidophyte, have also killed fish along the Pacific coast. Macroalgal blooms along Washington's coast harm seagrasses, fish, and invertebrates due to hypoxia and potentially due to the production of bioactive compounds (Lopez et al. 2008, p.28).

The paralytic shellfish poisoning (PSP) suite of marine biotoxins are produced by the dinoflaggelate *Alexandrium catenella* and some other members of this genus (NWFSC HAB website). Unlike the diatoms, dinoflagellates (as their name implies) have at least one flagella or "tail" that permits them to move through the water. Because of this property, dinoflagellates move up and down through the water column, usually coming near the surface during the daylight hours and moving down during the night. These dinoflaggelates are taken up by filter feeders (i.e. shellfish), lobster, and crabs. Along the west coast of North America, the most common culprit involved in PSP outbreaks is *Alexandrium catenella*. Along the eastern coasts of Canada and the U.S., *A. tamarense* has been implicated in PSP events. However, *A. tamarense* has also been observed in waters off the west coast of Canada (British Columbia) and in northern Puget Sound in Washington State (NWFSC HAB website). Within Puget Sound, 18 of 29 sampling sites (62 percent) had at least some PSP impact in 2005 (PSAT 2007, p.197). As reported in McShane et al. (2004, p.3-67), 2 juvenile murrelets were killed by PSP in 1989. To our knowledge this source of mortality has not been documented again.

Pseudo-nitzschia blooms are recurrent along the entire Pacific coast. Recent research indicates that the seasonal fluctuation of the Juan de Fuca Eddy serves as an incubator for growth for this algae and other algae and when it gets disrupted, these algae are deposited along the Washington coastline (Lopez et al. 2008, p.28). In California, blooms of *Pseudo-nitzschia* are recurrent and have caused large numbers of seabird and marine mammal deaths annually since 1998 (Lopez et al. 2008, p.28).

Diatoms in the genus *Pseudo-nitzschia* produce domoic acid. Exposure to domoic acid can lead to permanent brain damage, reproductive failure, and death; commonly observed effects include seizures and head weaving. Domoic acid can also have significant chronic effects, such as epilepsy and behavioral changes due to repeated exposures at sublethal levels (Lopez et al. 2008, p.28). Shellfish and fish can accumulate this toxin without apparent ill effects, but transfer the toxin when consumed (NOAA 2009a). In 1991, along the beaches of Monterey Bay, CA, dead and dying seabirds were observed – many of the sick birds displayed unusual symptons suggesting a neurological toxin. Examination of the contents of the dead bird's stomachs revealed high levels of domoic acid. The birds had been eating anchovies that had been consuming the diatom *Pseudo-nitzschia australis* (NOAA 2009a). Prior to 2003, within Puget Sound domoic acid had not been detected at levels high enough to cause beach closures, although *Pseudo-nitzschia* and domoic acid had been documented in Hood Canal (Horner et al.1996 cited in PSAT 2007, p.220). However, in 2003, a short-lived *Pseudo-nitzschia* bloom occurred at Fort Flagler near Port Townsend resulting in domoic acid levels slightly above the U.S. Food and Drug Administration's (FDA's) action level and in October 2005, elevated levels

of domoic acid caused beach closures at four places in north Puget Sound (Sequim Bay, Port Townsend, Holmes Harbor, and Penn Cove) (PSAT 2007, p.220). In 2007, domoic acid levels in water samples from southern California were reported as some of the highest ever recorded in natural samples (Lopez et al. 2008, p.28).

Recently published data confirms murrelets are suspectible to domoic acid poisoning. During a *Pseudo-nitzschia* bloom in California in 1998, domoic acid poisoning was documented as the cause of death of 2 of 17 radio-tagged murrelets (Peery et al. 2006b, pp.83-84). In addition, Peery et al. (2006b, p.83) showed murrelet survival was reduced in years with a *Pseudo-nitzschia* bloom. McShane et al (2004) acknowledged that biotoxins will affect murrelets in the near future. If HABs continue to increase in scope and frequency as predicted, effects to murrelet populations will continue to occur and likely will increase.

Dead Zones. Ecosystems can be degraded through the formation of such large algal blooms that they alter habitat quality through overgrowth, shading, or oxygen depletion (hypoxia or anoxia) (Lopez et al. 2008, pp.21-22). Hypoxia or anoxia (low or no dissolved oxygen) can suffocate fish and bottom-dwelling organisms and can sometimes lead to hydrogen sulfide poisoning (Lopez et al. 2008, p.22; Grantham et al. 2004, p.750; Chan et al. 2008). In addition, HAB-inflicted mortalities can degrade habitat quality indirectly through altered food webs or hypoxic events caused by the decay of dead animals (Lopez et al. 2008, p.22).

Hypoxic and anoxic events along the Pacific Coast can also be caused by large-scale changes in ocean conditions on near-shore upwelling ecosystem dynamics. Upwelling is part of the California Current coastal ecosystem, but typically, northerly winds alternate throughout the summer with southerly winds. The wind shifts suppress upwelling, mix the water, and prevent nutrient overload. However, every summer since 2002 the Oregon Coast has experienced an hypoxic/anoxic event (also refered to as “dead zone”) (Grantham et al. 2004; Chan et al. 2008) due to changes in typical summer wind patterns along with upwelling of nutrient rich, but oxygen poor waters. While hypoxic conditions are known to be related to upwelling events, the hypoxic events off Oregons’s coast extend from the shallowest reaches (inshore of 30 meter isobath) to the nearshore stations (2 to 5 kilometers offshore), which is unusual. Further complicating matters, phytoplankton are two to three times more abundant, resulting in increased respiration (expiration of carbon dioxide) exacerbating the dissolved oxygen deficits (Grantham et al. 2004, pp.751-752). The severe hypoxic event in 2006, extended into Washington at least as far north as the Quinault River (http://www.Sciencedaily.com/releases/2006/07/060727090749.html) and affected crabs in pots at depths of about 45 to 90 feet.

In addition to unusual summer wind patterns, researchers are also interested in large phytoplankton blooms that occur in the late spring and early summer in the waters off Washington and Vancouver Island. The large blooms in the north might explain why waters off the Oregon coast that now well up at the coastal shelf break are unusually low in oxygen. The change in wind patterns and the response of the marine ecosystem may be an interlude in a natural cycle or may signal a more permanent shift in the regional climate and the health of the ecosystem (Chan et al 2008).

The Hood Canal is a 60-mile-long (100 km), highly productive estuary within Puget Sound that has a strong seawater density stratification and slow circulation (months to a year). These conditions are conducive to seasonal hypoxic events, which have been observed in records dating back to the 1930s. While this phenomenon, or even anoxia is not new in Hood Canal, research suggests that this problem has increased in severity, persistence, and spatial extent (Curl and Paulson 1991 cited in PSAT 2007, p. 107; Newton et al. 1995; 2002). The most severe low dissolved oxygen conditions occur in the southern end of the canal, at the point furthest from water exchange with the rest of Puget Sound. A comparison of oxygen data from 1930 through the 1960s with data from 1990 through 2000s shows that, in recent years, the area of low dissolved oxygen is growing and spreading northwards and periods of hypoxia are persisting longer through the year (Collias et al. 1974 cited in PSAT 2007, p.107; Newton et al. 2002). Dissolved oxygen levels measured during 2004 were at the historical low point for any recorded observations (PSAT 2007, p.107). Although records of fish kills in Hood Canal date as far back as the 1920s, repetitive fish kills during 2002, 2003, and 2004 indicate that the increasing hypoxia may be having biological consequences (PSAT 2007, p.107). Unfortunately, the cause(s) of the increasing hypoxia in Hood Canal have not been identified as yet.

These hypoxic events in Oregon and Washington occur right within the marine areas used by murrelets. In Oregon, the events overlap the area with the highest murrelet densities (between Newport and Florence). In Washington, the 2006 event stopped just south of the area with the highest murrelet density along the Washington coast. These seasonal dead zones begin as early as June and wrap up in September; therefore, these events encompass most of the murrelet breeding season. These events result in significant mortality of fish and invertebrates (Grantham et al 2004; Chan et al 2008). Therefore, these "dead zone" events may be contributing to low food availability during the murrelet breeding season and may be contributing to low reproductive success.

*Prey Availability***.**

Pacific herring. Many fish populations have been depleted due to overfishing, reduction in the amount or quality of spawning habitat, and pollution. As of 2004, only 50 percent of the Puget Sound herring stocks were classified as healthy or moderately healthy, with north Puget Sound's stock being considered depressed and the Strait of Juan de Fuca's stocks being classified as critical (WDFW 2005). While herring spawning biomass varies from year to year, most stocks in Puget Sound declined between 2002 (17,700 tons), 2004 (11,000 tons, a decrease of about 40 percent from 2002), and 2006 (12,000 tons) (PSAT 2007 p.52). Herring spawning biomass levels in the Strait of Juan de Fuca region have also been declining; following a peak spawning biomass of 3,200 tons in 1980, the recent Discovery Bay herring stock spawning biomass levels have been between 200 tons and 250 tons per year (PSAT 2007, p.53). Currently, the Dungeness/Sequim Bay stock is also at a very low level of abundance. There is limited information available for the Washington coastal herring populations, but these populations appear to have relatively high levels of abundance (WDFW 2005).

Natural mortality in some of these stocks has increased (e.g. the mean estimated annual natural mortality rate for sampled stocks from 1987 through 2003 averaged 71 percent, up from 20 to 40 percent in the late 1970s) (WDFW 2005). In addition, scientists have shown high body burdens of polychlorinated biphenyls (PCBs) in herring from the central and southern basins of Puget

Sound to be comparable to herring from northern Europe's severely contaminated Baltic Sea (PSAT 2007, p. 129). There is currently only one commercial herring fishery which operates primarily in south and central Puget Sound (WDFW 2005) where herring stocks are healthier. There are herring fisheries in Willapa Bay and Grays Harbor, but no direct harvest is allowed in the coastal waters. The decline of some herring stocks may be affecting the forage base for murrelets in Puget Sound.

Pacific herring abundance and distribution information for Oregon is not readily available. However, the Oregon Department of Fish and Wildlife has a Developmental Fisheries Program that requires a permit to harvest herring within state waters. Up to 15 permits are issued annually.

As of 2004, herring stocks in California had been depressed for the previous 8 to 10 years following the last major El Nino conditions. The predominant age classes were 2 and 3 year olds, with the much larger 6, 7, and 8 year-old fish very scarce in recent years (State of California 2004). There is little to no information on where the herring are during the non-breeding season. Most herring spawning occurs in the San Francisco Bay, where most of the commercial herring fishing occurs in California. In 2004, the San Francisco Bay herring population was near the lowest abundance level observed since the 1970s. A minor amount of spawning and minimal fishing occurs in Tomales and Humboldt Bays, and occasional spawning and no fishing occurs in Crescent City harbor. Herring fishing in Monterey Bay occurs outside the breeding season, and is for bait and aquarium fish food.

Surf smelt. No rigorous assessments of Washington's surf smelt stocks exist. However, recent smelt catch data show an uneven distribution of spawning activity and adults in Puget Sound (Rice 2006, p.69). Limited research undertaken by Rice (2006) documented significant differences in surf smelt embryo tolerance to environmental conditions between modified and natural beaches, suggesting continued human-caused modification of spawning beaches could contribute to surf smelt population declines. There are commercial and recreational fisheries for surf smelt in Washington. While WDFW contends the amount of harvest does not appear to be impacting the surf smelt stocks (Bargmann 1998, p.33), as stated previously, there are no stock assessments for this species on which to base this contention. We have no information on the status of this species in Oregon or California.

Sand lance. There are no population assessments of Washington sand lance. Nor are there directed commercial fisheries for sand lance in Washington (Bargmann 1998, p.30). We have no information on the status of this species in Oregon or California.

Anchovy. Northern anchovies (*Engraulis mordax*) have appeared in south Puget Sound over the past decade and their geographic distribution and abundance seems to be expanding (PSAT 2007, p. 54). Recent reports from many parts of the central and south Sound indicate prevalence of post-larval anchovies in the nearshore in late summer and early fall, with juvenile and adult fish visible in offshore waters throughout much of the year. Anchovies are taken commercially within coastal and estuarine waters of Washington. While the current harvest level doesn't appear to be impacting anchovy stocks, there is no current abundance information (Bargmann 1998, p.28). We have no information on the status of this species in Oregon or California.

Sardine. In the 1940s the Pacific sardine (*Sardinops sagax caerulea*) fishery began to collapse due to overfishing. In 1967, limits were placed on harvest, and in 1974, directed fishing was stopped. Directed fishing was again allowed after 1981 when the fishery began to increase. In 1999, the Coastal Pelagic Species Fishery Management Plan was implemented to manage Pacific sardines and other coastal pelagic species. Under the management plan, the Pacific sardine population is assessed annually to provide a scientific basis for annual harvest quota that is established by the Pacific Fishery Management Council for the U.S. fishery (NOAA 2009b). Under a regulated fishery, recruit abundance increased rapidly to a high of 9.79 billion fish in 1994-95. Since then, and as of 2006, recruitment has declined with the exception of 2003 (Hill et al. 2007).

Prey Quality and Trophic Level Changes. Prey quality can contribute substantially to the reproductive success or failure of seabirds. Dietary energy content is often the limiting factor for seabird breeding success (Litzow et al. 2002). Research on a variety of seabirds related to the murrelet (kitiiwakes, tufted puffins, and pigeon guillemots) indicates reproductive success and chick survival is higher when diets consist of high-lipid content prey (Litzow et al. 2002. p.292; Romano et al. 2006). Nestlings reared on high-lipid prey ingest more energy per unit of biomass and metabolize it more efficiently (Romano et al. 2006, p.411). Romano et al. (2006, pp.410-411) documented large differences in the body mass growth of nestlings fed different diets, although there was less difference in the growth of wing feathers. This suggests undernourished nestlings may allocate nutrients to wing growth instead of mass gain, thereby increasing the chance that the nestling will be underweight at fledging. Litzow et al. (2002, p.292) theorize that below some threshold of high-lipid prey availability, the guillemots they studied were unable to achieve the maximum rates of provisioning needed for chicks to fully develop. Prey type (high vs. low-lipid content) may also affect stress levels. Studies by Kitaysky (et al.1999, 2003, 2005, 2007) indicate baseline levels of corticosterone are significantly higher in kittiwake nestlings fed pollock (low-lipid content) than in those fed an equal biomass of sand lance or herring.

Energetic value varies greatly among potential murrelet prey in the California Current System, where in general higher trophic level species have greater caloric value (Becker et al. 2007, p.272). For example, for a murrelet to obtain the same energetic value as eating an anchovy, approximately 2 to 12 mid-trophic or 45 low-trophic prey items would need to be consumed. To compensate for a sardine, approximately 3 to 20 mid-tropic or 74 to 80 low-trophic prey items would need to be consumed.

Murrelet diets appear to reflect what is most abundant and/or of the highest quality of prey available at the time (Becker et al. 2007. p.274; Kuletz 2005). However, evidence from California and British Columbia indicates historic prey was of higher quality than prey currently used by murrelets. Specifically, they have shifted to lower trophic-level food items (e.g. krill, sandlance, and rock fishes). In British Columbia, Norris et al. (2007, p.879) found the pre-1900s murrelet diet was primarily (61 percent) comprised of fish, and euphausiids comprised a smaller portion (27 percent) of their diet. However, after 1970, euphausiids became the primary (61 percent) diet component. In California, Becker and Beissinger (2006, p.475) found the proportion of high-trophic level prey in murrelet diets declined strongly from the historic to the modern era, while the proportion of low-trophic level prey increased. These changes in diet

could be in response to reductions of higher-trophic level prey (e.g sardines in California) as a consequence of over-fishing or regional changes in climate (Becker and Beissinger 2006, p.477; Norris et al. 2007, p.880). There are no similar diet-related studies for Oregon or Washington. However, we believe it is reasonable to assume similar shifts to lower-trophic-level food items have occurred in Washington's Puget Sound because the British Columbia study was conducted in Georgia Basin (adjacent/connected with Puget Sound waters), the available prey species are the same, and the historic level of fishing and/or climate variation would be similar. The same reasoning cannot be applied to the Washington coast, Oregon, or northern California at this time; therefore we are unable to determine or conclude whether the murrelets that occupy these areas are also feeding at a lower trophic level.

The potential effects of the decline in higher trophic-level food items are most significant during egg development (Becker and Beissinger 2006, p.477). Murrelets lay a single egg weighing about 25 percent of their prebreeding body mass, which suggests that egg production is energetically costly and dependant on the availability of adequate prey. For example, a large proportion (50-90 percent) of murrelets forego breeding in central California and may do so because they cannot find sufficient food resources during preparation for breeding (Peery et al. 2004, pp.1094-1095). Norris et al. (2007, p.879) found breeding success increased when murrelet's pre-breeding diet consisted of higher-trophic level prey (i.e. they found a strong correlation between the pre-breeding diet and murrelet abundance 3-4 years later (the time lag for young-of-the-year to attain breeding age)).

Climate Change. Climate change was not identified as a threat in the 1992 finding which listed the murrelet as threatened, nor in the analysis for the 2004 5-year review (USFWS 2004). In the intervening time, considerable research has provided further evidence for the likelihood and potential consequences of climate change associated with greenhouse gas emissions. While there is general consensus regarding global warming (as noted above), the effects to the coastal marine environment are less clear. Studies of future marine environments under global warming involve complex and interacting atmospheric and oceanic circulation dynamics, often requiring models, and different models can produce different outcomes.

Within the marine environment, effects on the murrelet food supply (amount, distribution, quality) provide the most likely mechanism for climate change impacts to murrelets. The murrelet diet is not well studied, which hampers assessment of climate change effects related to prey, but effects on nutrient levels, and primary productivity are of concern, as are effects on prey abundances, quality, and distribution. Climate-related factors most likely to affect murrelet prey and foraging include sea surface temperature, thermal stratification, nutrient input, increased storm effects, currents, upwelling and other circulation patterns, and increased turbidity.

Studies in British Columbia (Norris et al. 2007) and Conservation Zone 6 (Becker and Beissinger 2006) have documented long-term declines in quality of murrelet prey, and one of these studies (Becker and Beissinger 2006) linked variation in coastal water temperatures, murrelet prey quality during prebreeding, and murrelet reproductive success. These studies indicate that murrelet recovery may be affected as long-term trends in ocean climate affect prey resources and reproductive rate.

El Niño events have become more frequent, persistent and intense during the last 20-30 years (Snyder et al. 2003, p.1), but it is not known whether this represents natural variation or an effect of climate change. While murrelets have likely adapted to occasional adverse ocean conditions, should strong El Niño events continue to be more frequent, the cumulative effects of repeated El Niño events in a short period with other threats "could contribute to serious population declines or extirpations" (USFWS 1997, p.78-79).

Upwelling patterns, sea surface temperatures (SST), and ocean water stratification can all affect marine productivity in the murrelet's coastal environment. There is general agreement that sea surface temperatures (SST) will increase as a result of global warming, and a number of studies predict increased stratification of ocean waters (Appendix A). According to many studies, SST in the CCS has increased by 0.5 to 1.0° C (about 1 to 2° F) over the past 50 years (Sydeman and Elliott 2008) and in the Straits of Juan de Fuca SST has undergone a long-term warming trend of 1.7° F (0.9° C), nearly all of which has taken place since the early 1970s (Rucklehaus and McClure 2007, p. 52). Effects on the murrelet's near-shore environment are less clear, where upwelling of cold waters can moderate SST.

Should climate change affect the timing, variability, and/or magnitude of coastal upwelling in the species' range, it could affect prey resources. On some of these points, the available information is not conclusive, with studies to date reaching different conclusions on whether such upwelling changes are expected. Bakun (1991) outlined a physical mechanism by which coastal upwelling should intensify under global warming. While Bakun's mechanism has received much support, and is based on simple physical principles, two modeling studies have predicted little change in the magnitude and seasonality of upwelling in the next century (Mote and Mantua 2002; Mote et al. 2008, p.10).

Upwelling appears to have been more variable in recent decades, with an apparent general increase in west coast upwelling (Schwing and Mendelssohn 1997, cited in Sydeman and Elliott 2008). While consistent with general predictions under global warming of Bakun and others, this could represent natural variation or an effect of climate change. Others forecast delays and/or greater variability in the upwelling season (State of California 2009) or just to the south in southern California (Roemmich and McGowan 1995). One modeling study found that north of San Francisco Bay (Conservation Zones 2-5), future upwelling may be delayed by up to a month, but more intense upwelling in the summer could possibly ameliorate increases in SST (Snyder et al. 2003); their models predicted little change for the Conservation Zone 6 area. Another model that focused on California and southern Oregon, and which took into account feedback between continental warming and marine conditions, found stronger upwelling north of Point Conception during the peak-to-late upwelling season (August-September) (Diffenbaugh et al. 2004, p.27). One potential effect of extremely strong upwelling winds could be the transport of prey communities seaward beyond the near-shore foraging range of murrelets.

The information above and in Appendix A indicates considerable variability in future conditions in the California Current system. Some of the variability may be due to studies focusing on different aspects, regions, or spatial scales, but there also appear to be some uncertainty about the net result of different aspects of climate change interacting, such as increased upwelling and

increased stratification. Within this uncertainty, positive changes (for murrelet food supply) appear rare in forecasts, with the possible exception of increased upwelling. While upwelling is generally associated with increased productivity, at some level increased winds and upwelling could negatively effect the coastal marine ecosystems, by reducing the concentration of marine organisms, through increased mixing and transport seaward of surface water and organisms (out of the murrelet's near-shore environment) (Snyder et al. 2003, p.4). In another example of the complexity of the system, Peery et al. (2009) examined murrelet foraging associated with upwelling dynamics in Conservation Zone 6 and found birds spent more time diving during upwelling, increased their foraging ranges with longer periods of sustained relaxation, and reduced their foraging ranges after transitions to upwelling. One hypothesis for this observation is that prey were less aggregated and thus less available in the mixed water column during upwelling (J. Adams, personal communication).

Water circulation in Puget Sound is sensitive to the timing and amount of freshwater inflow and salinity of ocean waters mixing within the Sound. The timing and amount of freshwater inflow in expected to shift, resulting in lower flows in late spring and summer. These changes will likely produce fresher waters during winter and saltier waters during summer, resulting in stronger stratification in winter and weaker stratification in the summer (Rucklehaus and McClure 2007, p.53).

Among potential negative effects, increasing SST and associated changes may have a high potential to negatively affect murrelets. If recent El Niño and warm-water events are an indicator of future effects of increased sea surface temperatures, murrelet prey base could be negatively affected. Based on the response of other seabirds such as Cassin's auklets (Sydeman et al. 2006), and of a study of historic versus recent murrelet diet in Conservation Zone 6 (Becker and Beissinger 2006), warmer coastal waters tend to adversely affect prey quality and result in lowered reproduction.

Warmer water temperatures and stronger winter stratification in Puget Sound is predicted to contribute to decreased dissolved oxygen in deep waters. As SST rises, biological productivity (plant and animals) will increase, resulting in more organic material delivered to the bottom (increased decomposition) which increases the consumption of dissolved oxygen at depth (Rucklehaus and McClure 2007, p.53), potentially leading to increased or more extensive "dead zones." The appearance of "dead zones" has been limited geographically to date, and not demonstrated to be the result of climate change, nor part of a larger emerging pattern. However, should this phenomenon become more widespread, it could affect the near-shore waters where murrelets feed. The absence of prey during such events could have local, short-term effects on murrelets, such as reduced reproduction.

Harmful algal blooms can impact coastal seabirds not only through prey toxicity, but by producing compounds that reduce feather waterproofing and result in hypothermia (Jessup et al. 2009). The frequency and duration of HABs in Puget Sound are expected to increase as a consequence of increased water temperatures allowing earlier and longer lasting blooms (Rucklehaus and McClure 2007, p.54). How climate change will influence HABs within the CCS will depend upon changes in SST and upwellings.

Climate change is anticipated to result in sea level rise and decreases in the pH of marine waters. The rate of rise in the Pacific Northwest is projected to be faster than the global average and is likely to increase both the pace and extent of the erosion and nearshore habitat loss affecting Puget Sound shorelines (Rucklehaus and McClure 2007, p.53). In addition, as sea level rises, a greater amount of shoreline within Puget Sound will likely be armored to protect public property and reduce threats to public safety (Penttila 2007, p.18). Current levels of shoreline armoring within Puget Sound has interfered with natural erosion of upland material (organic and inorganic debris) onto the beach and into the intertidal area, caused beach scouring, and resulted in changes in population structure of epibenthic and benthic organisms.

Increasing acidification of marine waters may have significant impacts on marine food-webs. Calcifying species of plankton are expected to suffer serious negative impacts from increased ocean acidification. The negative impacts of increased acidity on plankton may cause negative impacts on many other species which are important food-sources for murrelet and their prey (Ruckelshaus and McClure 2007, p.55).

Summary, threats to marine environment. In the analysis for the 2004 5-year review, McShane et al. (2004, p.38) acknowledged changes in the food web and prey availability can have profound effects on murrelets; however, they concluded these factors are difficult to quantify. New information regarding prey species indicates declining populations for those species with assessments. There are commercial and recreational fisheries for some prey species stocks and the Pacific herring in Puget Sound are carrying high body loads of PCBs. In addition, new information indicates prey quality has declined over the last decade and murrelets are now feeding at lower trophic levels in central California and Puget Sound and possibly throughout the 3-state area, but information is not currently available for the Washington and Oregon coast areas.

Murrelets are exposed to HABs and dead zones throughout the 3-state area, although the potential effects may be more pronounced in specific areas, such as the Oregon coast, Monterey Bay, and Puget Sound. These events result in significant mortality of fish and invertebrates and may be contributing to low food availability during the murrelet breeding season; thereby contributing to low murrelet reproductive success. In addition to the impacts to prey resources, HABs from certain algae species produce biotoxins that result in domoic acid poisoning or paralytic shellfish poisoning, causing murrelet mortality. HABs and dead zones may have been occuring all along and have just begun to be studied; however, scientists predict the scope and length of these events are likely to increase.

Climate change is likely to result in changes to the murrelet's marine environment. While physical changes to the near-shore environment appear likely, much remains to be learned about the magnitude, geographic extent, and temporal and spatial patterns of change, and their effects on murrelets. Limitations on our knowledge of murrelet prey, and how global warming could affect those prey, constrain our ability to forecast effects. Dealing with those limitations should be a research priority, to better understand how climate change will affect murrelet recovery and a recovery strategy.

While the differing predictions prevent a conclusive threat assessment, the predicted direction of change for most variables considered suggests that few changes are likely to benefit murrelets, with many more having the potential to be neutral or adversely affect murrelets. In view of that, it appears most likely that the murrelet prey base will be adversely affected to some degree. While seabirds such as the murrelet have life-history strategies adapted to variable marine environments, ongoing and future climate change could present changes of a rapidity and scope outside the adaptive range of murrelets. The reduced distribution of nesting habitat also constrains the ability of the species to respond to shifts in prey conditions, as nesting birds are limited to foraging to waters relatively near their inland nest sites. Also, the limited evidence available indicates substantial nest site fidelity, and does not suggest that individual murrelets will abandon a nesting area that becomes unsuitable, and move to a new, distant nest site.

Therefore, the new information suggests there is a change in the level of threats in the marine environment.

2.3.2.2 Overutilization for commercial, recreational, scientific, or educational purposes:

The 2004 5-year review stated there was no evidence of overutilization of murrelets for commercial, recreational, scientific or educational purposes. This statement remains true regarding commercial, recreational, and educational purposes.

Since Oct 1, 2003, the Service has issued section 10(a)(1)(A) recovery permits to four individuals for scientific research on murrelets in Washington, Oregon, and California. Through 2008, these permits authorized the lethal take of 1 murrelet; the number of murrelets authorized to be harassed per year ranged from 55 to greater than 145; and one permit authorized the harassment of murrelets associated with 11 trees per year. Recovery permits for future years (through 2013) have been issued to four individuals. All of the harassment authorized by these permits is for climbing nest trees or the capture/handling/tagging of murrelets at sea.

At the time the permits for the at-sea capture/handling/tagging were issued, there was little or no data available regarding the effects of radio transmitters. Based on radio telemetry work done in California, Peery et al. (2006b, p.85) determined survival rates for transmittered birds are lower than for non-transmittered birds and the likely causes for the lower survival rates are increased underwater drag (which reduces diving speed and foraging efficiency) or increased vulnerability to predators. In California, Peery et al. (2006b, p.83) reported mortalities of 12 radio-tagged murrelets. While none of the mortalities appear to be directly related to the radio transmitter (2 predation, 2 domoic acid, and 1 physical injury/trauma), the cause of mortality is unknown for 7 of these cases. While no mortalities of radio-tagged murrelets have been reported in studies from Washington (Bloxton and Raphael 2008) and Oregon, the amount of information available from those studies is not comparable to the California study and in some cases, not yet finalized.

The conclusion in McShane et al. (2004, p.6-10) regarding scientific research was that while individual murrelets are affected by telemetry and tree-climbing projects, these disturbances are relatively small scale, occur infrequently, and are unlikely to affect murrelet populations. The greatest impact to murrelet populations is removing adults. The recovery permits issued between October 1, 2003 and April 30, 2009, authorized the lethal removal of 1 adult and may have

allowed for the indirect removal due to transmitter effects of many more individuals each year. Therefore, these recovery permits may be impacting murrelet populations, especially if the targeted population is small, such as the Conservation Zone 6 population in California.

Based on this information, it appears that overutilization due to research of murrelets may have occurred since the previous 5-year review, especially in Conservation Zone 6. However, within the last year, the Service has become increasingly concerned regarding the status of the murrelet and has been taking a much closer look at both recovery permits and take authorized under sections 7 and 10 (Habitat Conservation Plans).

Based on our review, overutilization for commercial, recreational, or educational purposes does not pose a threat to murrelets. Overutilization due to research may have occurred since the analysis for the 2004 5-year review. However, the types of research activities that are the cause for concern have been receiving more scrutiny from the Service since 2008 to ensure the benefits of the research warrant the associated impacts.

2.3.2.3 Disease or predation:

Disease. In the analysis for the 2004 5-year review, we did not identify disease as a threat to the murrelet. However, bacterial, fungal, parasitic, and viral diseases and biotoxins were acknowledged to affect numerous populations of seabirds, but not alcids in the 2004 5-year review science report (McShane et al. 2004, p.6-12). Information from McShane et al. (2004, p.6-12) regarding West Nile Virus has not changed. This virus has not been observed in murrelets, but has been detected in other marine bird species, such as cormorants and many species of gulls, and forest-dwelling species, such as spotted owls, goshawks, corvids, and many passerine species (information available on the Centers for Disease Control and National Wildlife Health Center websites). See Factor A for more information on threats from Domoic acid.

A new disease that emerged subsequent to the analysis for the 2004 5-year review is highly pathogenic avian influenza (HPAI). As of October 2007, HPAI has not been detected in wild birds anywhere in North America (USGS 2007, p.2) and based on the interactive map (available at http://www.nwhc.usgs.gov/map), as of April 27, 2009, there continue to be no HPAI cases in North America.

Predation. In the analysis for the 2004 5-year review, predation was identified as being a significant threat to long term demography. New information provided here supports the findings in McShane et al (2004). Predation has two primary components; losses of adults or fledged juveniles and nest predation (eggs or chicks). Adult/juvenile predation may occur at sea or inland. There is no significant new information concerning at-sea or terrestrial non-nest predation on murrelets.

The list of potential nest predators has not changed since the analysis for the 2004 5-year review, though there are additional details on the capability of jays and ravens to completely remove eggs, (Hebert and Golightly 2007. p.222), further documentation of avian and mammalian predators of artificial nests (Malt and Lank 2007, p.165; Marzluff and Neatherlin 2006, p.310),

and the first documentation of a Douglas squirrel rolling a recently abandoned egg off a murrelet nest (Thomas Bloxton, pers comm. as cited in Malt and Lank 2007, p.170). Corvids remain the predator with the likely greatest impact on murrelets.

Malt and Lank (2007, p.165) recorded predation rates of 35 percent on artificial nests in south-western British Columbia. Hebert and Golightly (2006, pp.98-99) calculated nest predation rates in Redwood National and State Parks based on 37 nesting attempts detected with radiotelemetry. They found predators may have caused 64, 39, and 50 percent nest failure rates in 2001, 2002, and 2003, respectively, or an annual average of 51 percent. Peery et al. (2004, pp.1093-1094) documented predators as the cause of nest failure for 67 percent of known fate nests (n=9) in the Santa Cruz Mountains of California. When nests where no intact egg or chick was found were included, 13 of 16 failed nests (81 percent) were likely lost to predators.

The ultimate factors affecting rates of predation on murrelet nests remain somewhat elusive, though key elements still appear to be proximity to humans, abundance of avian predators, and proximity and type of forest edge to the nest (USFWS 2004, p.19).

Human presence and corvid abundance. Marzluff and Neatherlin 2006 (p.310) reported that the rate of predation of artificial nests on the Olympic Peninsula was significantly correlated with corvid abundance, primarily related to crow abundance near human settlements and campgrounds. Crows were shown to use campgrounds significantly more frequently relative to occurrence than other land cover types (Neatherlin and Marzluff 2004, p.712). The concentration of use by crows in campgrounds was significant and positively correlated with campground size (Neatherlin and Marzluff 2004, p.714), though there was high individual variation (Neatherlin and Marzluff 2004, p.713). In the Santa Cruz Mountains of California, Suddjain (2005, p.6) found Steller's jays 8.8 times more numerous in standard campgrounds or immediate vicinity than control areas more than 300 m from campgrounds, picnic areas, or residential areas. Jay density was significantly positively correlated with the number of occupied campsites. These patterns remained through 2008 (Suddjian 2008). Suddjian (2005, p.7) also found that raven numbers in campgrounds exceeded those in control areas by 28 times based on pooled data (ravens were generally uncommon). In Redwood National and State Parks, recent data show that campground areas contained a significantly higher number of Steller's jays (5 times higher) as compared to the two control category types. Picnic areas averaged approximately a third (compared to a half in 2007) as many jays as the campgrounds but were also significantly higher than the control areas (Bensen 2008, p.12).

Artificial nests in high Steller's jay use areas lasted only half as long as those in low-use areas (Vigallon and Marzluff 2005, p.45). While jays did not perform nest-specific searches, they predated nests they came upon. Hebert and Golightly (2006, p.38) noted that the presence of corvids in the vicinity of nest trees did not increase during periods of disturbance during a study in Redwood National and State Parks, though this was not the focus of the study.

The increase in predators in association with human presence (recreation sites or housing), and therefore the probability that predators will depredate a murrelet nest, is likely to be particularly important in California where 76 percent of habitat within 0.5 mile of known occupied sites and detections occur either within or immediately adjacent to lands managed primarily for recreation

(e.g. National, State and County Parks in the coastal redwood ecosystem) (G. Goldsmith in litt 2009). Some of these areas also have substantial human populations in the vicinity of the nesting habitat. Such areas are dense focal points for human recreation and therefore higher predator populations.

Forest fragmentation and edge effects on potential predation of murrelets. Two studies specifically addressed the potential effect of forest fragmentation and edges. Malt and Lack (2007) used artificial nests and nestlings to test nest vulnerability, coupled with predator surveys, in two regions of southwest British Columbia. When considering all predators, nest disturbance was higher at edges relative to interior stands with no significant edge-type effect. When considering only avian predators, nests near hard edges had higher disturbance levels than interior locations, with no significant edge effect from soft or natural edges. In both cases, they reported a positive correlation between the percent old growth on the landscape and the level of nest predation (higher predation was seen with higher levels of old growth (Malt and Lack 2007, p.165). Predator surveys revealed that Stellar's jays are more likely to be found at hard edge than interior or soft edge at Desolation Sound. There was no similar effect at Nimpkish Valley or with gray jays (Malt and Lack 2007, p.166). At the landscape scale, egg disturbance by avian predators was higher in areas with larger amounts of old growth. This may be a result of egg disturbance by gray jays which were observed more often in areas with more old growth (Malt and Lack 2007, p.168). In contrast, the increase in predation at hard edges may be caused by Stellar's jays, a generalist predator which uses gaps and edges and was detected at higher levels along hard edges (Malt and Lack 2007, p.169).

Marzluff et al. (2004) studied habitat use by Steller's jays on the Olympic Peninsula. They found that Steller's jays made highest use of areas within their home range that have high densities of land cover patches, high levels of contrasting edge, low juxtaposition of land covers, complex-shaped landcover patches, and an abundance of young forest/ barren/agricultural/settled land cover relative to mature forests or clearcuts. However, they did note that individual jays varied considerably in their use of specific resources. Most jays significantly concentrated their activities in areas of their home range with either abundant high-contrast edges (10 jays), many patches (14 jays), or both edges and patches (4 jays) (Marzluff et al. 2004, p.1419). The proximity of home range areas to small human settlement/campgrounds also appeared to affect use of edges, with high-contrast edges used more often if they were near settlements or campgrounds (Marzluff et al. 2004, pp.1419-1420). The authors stated that "[W]e support the research hypothesis that Steller's jays use fragmented landscapes more than contiguous landscapes because only five of 25 individuals did not significantly concentrate their use in portions of their home range with abundant edge or abundant patches." (Marzluff et al. 2004, p.1422).

A radio-telemetry study in British Columbia showed that as clearcuts become overgrown with berry producing shrubs which attract predators (corvids) a lower breeding success was observed at nests closer to old clearcuts (Zharikov et al. 2006, p. 117). Breeding success was based on assumptions from radiotelemetry data.

In the 2004 5-year review, (USFWS 2004, p. 19) we noted nest failure rates due to predation of 68 to 100 percent (Hebert and Golightly 2003, Peery et al. in prep as cited in McShane et al

2004.) in real nests, and 81 to 86 in artificial nests (Luginbuhl et al. 2001, Marzluff and Restani 1999). The key elements affecting predation rates appeared to be proximity to humans, abundance of avian predators, and proximity and type of forest edge to the nest. Based on the latest information, we still find murrelets to be highly vulnerable to nest predation. New information continues to confirm the importance of nest predation in limiting murrelet nest success.

2.3.2.4 Inadequacy of existing regulatory mechanisms:

Information is provided below to update the analysis since the 2004 5-year review. This includes information on the revisions of plans and regulations within the range of the murrelet that address increased or decreased regulatory protection with respect to murrelets. In addition, properties that are now managed for conservation benefits for the murrelet as a result of purchase, conservation easements or changes to land allocations are listed below. While these additions do not add to the amount of murrelet habitat, they now have adequate or additional regulatory mechanisms to protect them for murrelet conservation. Other than the revisions below we know of no new additional regulations that have been implemented to address the threats to the murrelet. Therefore, we continue to assume that the threat posed by the inadequacy of existing mechanisms has been reduced since listing. For additional information on relevant regulatory mechanisms please see Appendix B: Factor D.

Northwest Forest Plan (Survey and Manage and Aquatic Conservation Strategy): In 2004, the NWFP was revised to address concerns related to the Survey and Manage process. This revision discontinued the application of the Survey and Manage process. While significant to some species, this revision does not appear to have caused changes to the net conservation benefit of the Northwest Forest Plan for the murrelet. In addition, in March 2004, the Aquatic Conservation Strategy (ACS) was revised and the Services issued biological opinions that eliminated the requirement that each timber sale must promote attainment of the ACS objectives. However, in March 2006, the courts ruled that the amendment violated the Act. At this point no revision of ACS has occurred and therefore no change to conservation benefits for murrelet as a result of this proposed revision has resulted.

BLM Western Oregon Plan Revisions: The Records of Decision for the Bureau of Land Management (BLM) Western Oregon Plan Revisions under the Northwest Forest Plan (NWFP) were signed on December 30, 2008. These Records of Decision and associated resource management plans (RMPs) replace the RMPs for BLM-administered lands in western Oregon that were approved under the Northwest Forest Plan. Murrelet management under the new RMPs is accomplished by (1) blocked Late Successional Management Areas (LSMAs), (2) stand-level LSMAs for murrelets outside block LSMAs, (3) requirements to identify and protect occupied stands and certain nearby stands, and (4) prohibitions against disrupting occupied murrelet sites.

LSMAs were originally designed as blocks of BLM land managed to, in part, maintain habitat for northern spotted owls and murrelets and promote development of nesting habitat for murrelets where it does not currently occur, similar to the LSRs of the NWFP. In addition, stand-level LSMAs were designated for stands determined to be occupied by murrelets under the

NWFP. Within the range of the murrelet on BLM lands in Oregon, 323,200 acres were initially mapped as LSMAs.

Additional stands were designated as LSMA outside the blocks, including all stands 80 years of age or older within the 1996 murrelet critical habitat and 35 miles of the coast. This adds an additional 41,000 acres. Combined, 364,200 acres of Oregon BLM lands are protected as LSMAs under the Western Oregon BLM Records of Decision. This compares to 484,300 acres under the NWFP on the same landscape. Much of the differences in acreage between the two plans are the result of refined mapping methods. Stands that are determined to be occupied by murrelets in the future would add additional LSMA acreage.

The RMPs include the requirement to survey suitable lands for murrelets prior to activities that would degrade or remove murrelet suitable habitat regardless of land use allocation, and to delineate and protect occupied stands. These requirements are the same as those in the NWFP. In addition, the plans prohibit disruptions in occupied murrelet habitat.

National Forest Management Act: We are unaware of any substantive changes to the NFMA that might affect conservation of the murrelet.

Habitat Conservation Plans and Safe Harbor Agreements. Habitat Conservation Plans (HCPs) and Safe Harbor Agreements (SHAs) in murrelet habitat are developed to provide long term certainty for both murrelets and landowners. HCPs provide a framework for people to complete projects while conserving at-risk species of plants and animals. A Safe Harbor Agreement (SHA) is a voluntary agreement involving private or other non-Federal property owners whose actions contribute to the recovery of species listed as threatened or endangered under the Act . In exchange for actions that contribute to the recovery of listed species on non-Federal lands, participating property owners receive formal assurances from the Service that if they fulfill the conditions of the SHA, the Service will not require any additional or different management activities by the participants without their consent. Central to this approach is that the actions taken under the SHA will provide a net conservation benefit that contributes to the recovery of the covered species.

Only one HCP and two SHAs in Washington State have been completed since the analysis for the 5-year review. These plans provide conservation benefits to the murrelet through the protection of forage fish spawning areas and the protection of nest trees and adjacent habitat if occupied. Although an HCP on Elliot State Forest lands in Oregon it is underway is has yet to be completed. No HCPs or SHAs have been completed in California since the analysis for the 5-year review.

Protected Murrelet Habitat: Habitat protected under Natural Resource Damage Assessment (NRDA) funds (Table 8), Conservation Agreements, Cooperative Endangered Species Conservation Funds (CESCF) and the National Coastal Wetland Conservation Grant (NCWCG) through conservation easements or purchases provides protection of known occupied murrelet nesting and/or foraging habitat, nesting buffers and the creation of additional murrelet habitat over time. For specific information on these areas please see Appendix B: Factor D.

Table 8 Acreages conserved under NRDA funds for murrelets

Spill Name/Year	Area	Total acreage
Tenyu Maru/1991	Teal Slough, WA	338
Tenyu Maru/1991	Anderson Point, WA	566
Tenyu Maru/1991	Waatch River Valley, WA	
Texaco-Anacortes/1991	Fidalgo Bay, WA	82
New Carissa/1999	Reed Creek, OR	3,851
New Carissa/1999	Arnold Creek, OR	412
Stuyvesant/Humboldt Coast/1999	Miracle Mile, CA	650 (142)
Stuyvesant/Humboldt Coast/1999	Big Mynot/E.Fork Hunter, CA	298 (77)
Stuyvesant/Humboldt Coast/1999	U.C. Regents Girl Scout Creek, CA	80

Quinault Indian Reservation North Boundary Area: In 2006, the Service completed conservation easements with the Bureau of Indian Affairs and the Quinault Indian Nation for 2,925 ac of forested land in the North Boundary Area (NBA). The NBA has been surveyed and is known to be occupied by murrelets (as determined by surveys under the PSG protocol). When the full extent of the conservation easements are implemented, they will apply to 4,262 acres (2,980 ac of old-growth and 1,282 ac of second growth). The purpose of the conservation easement is to preserve, protect, restore, enhance, maintain, and promote the functional value of existing and potential future late-successional forest and its use as habitat for the murrelet and other species dependent on late successional forest habitat.

Cooperative Endangered Species Conservation Funds (Non-traditional Section 6). We do not believe this program was discussed in the analysis for the 2004 5-year review. Since 1994, in Washington State, approximately 10,560 acres have been permanently conserved under the CESCF (S6) that have or will have habitat that could benefit murrelets. In Oregon, the 193-acre Big Creek property will be purchased to benefit at least 11 species of conservation concern, including the murrelet. In California, approximately 25,000 acres was purchased through the Mill Creek acquisition. All properties are intended to be managed for the long term conservation benefit of murrelets. Management of these lands may not impede the conservation benefit of murrelets and the Service has approval over each of the management plans. Within these areas, not all of the acreage is currently suitable murrelet habitat. See Table 9 for total acreages and the amount of currently suitable murrelet habitat.

Table 9 Acreages conserved under CESCF for murrelets in Pacific Northwest

Area	Total acreage	Acres of terrestrial murrelet habitat
Hoh, WA	6,000	1,000
Cedar, WA	20	0
Boulder, WA	1,894	200
Ellsworth, WA	800	200
Ashford, WA	1,800	Maybe 100
Barr, WA	46	46
Big Creek, OR	193	?
Mill Creek, CA	25,000	121
TOTAL	10753	

National Coastal Wetland Conservation Grant. The National Coastal Wetlands Conservation Grant Program was established by the Coastal Wetlands Planning, Protection and Restoration Act of 1990. Under the Program, the Service provides matching grants to States for acquisition, restoration, management or enhancement of coastal wetlands. The Act also establishes a role for the Service in interagency wetlands restoration and conservation planning. In Washington State, approximately 10,766 acres were protected and restored during 2004 to 2009 and provide protection of marine forage species for the murrelet. We are unaware of any acreage identified under the NCWCG in Oregon or California that provides conservation benefits to the murrelet. In addition, marine properties in California are publicly owned or considered public domain. Properties purchased under this program in California are currently all focused on coastal freshwater or brackish/tidal wetlands, and/or are located south of the murrelet range.

New National Monuments. There are no changes since the analysis for the 2004 5-year review was completed other than under the California Coastal National Monument.

California Coastal National Monument. Under the authority of the Antiquities Act of 1906, the California Coastal National Monument (CCNM) was established by Presidential Proclamation number 7264, on January 11, 2000**.** In 2005, the BLM approved a resource management plan for the CCNM (BLM 2005), which contains broad direction for the protection of the geologic formations and habitats for seabirds, and focuses on multi-agency and other partnerships and involvement of local communities as the keys to management and protection. The section 7 consultation on the resource management plan concluded that increased visitor use in the waters surrounding the CCNMs may subject foraging or loafing murrelets to some increased disturbance; however, increased educational and interpretive activities were expected to minimize the potential for such disturbance.

New Wilderness areas**.** The following wilderness areas have been designated within the murrelet's inland range since the analysis for the 2004 5-year review was completed (Table 10).

Table 10 Newly Identified Wilderness Areas Within the Murrelet Inland Range

Wilderness Name	Agency	State	Acreage	Year Designated	Conservation Zone
Copper Salmon Wilderness	FS	OR	13,700	2009	3
Wild Sky Wilderness	FS	WA	106,577	2008	1
King Range Wilderness[a]	BLM	CA	42,585	2006	4 & 5
Mount Lassic Wilderness[a]	FS	CA	7,279	2006	inland of 4*
Rocks and Islands Wilderness[a]	BLM	CA	5	2006	4 & 5
South Fork Eel Wilderness	BLM	CA	12,915	2006	5*

* Conservation Zone 4 extends inland 25 miles, but Mount Lassic Wilderness is within NWFP habitat zone 2.
[a] Within range of murrelet, but does not include murrelet habitat

State Forest Plans

*Washington and Oregon***.** There are no new or revised State forest plans since the analysis for the 2004 5-year review was completed.

*California***.** The Jackson Demonstration State Forest Management Plan (Plan), finalized in January 2008, directs the management of Jackson Demonstration State Forest (JDSF) for the next 10 to 15 years. The JDSF is a 48,652-acre redwood/Douglas-fir forest located in Mendocino County between Fort Bragg and Willits.

Murrelets are known to occur in Lower Russian Gulch on State Park property adjacent to the JDSF. The Plan addresses murrelet habitat through recruitment of late successional habitat along Class I and Class II streams, the designation of 1,549 acres in the Upper Russian Gulch and lower Big River, and designation of the Mendocino Woodlands special treatment area as areas devoted to development of late seral forest habitat. Areas composed of second-growth forest are delineated for three old-growth groves to enhance functional characteristics, minimize edge and increase size: Road 334 Grove (492 acres), Upper James Creek Grove (38 acres), and Waterfall Grove Complex (250 acres). Additionally, the Plan proposes a multi-agency assessment process to further assess the best approach to recruiting and protecting potential habitat on JDSF. Surveys for murrelets will be conducted on all project sites with potential habitat. Disturbance buffers and seasonal restrictions will be implemented.

Ocean Regulations

The Outer Continental Shelf Lands Act of 1953 (OCSLA) (43 U.S.C. 1331 et. seq.) provides the Secretary of the Interior, on behalf of the Federal Government, with authority to manage the mineral resources, including oil and gas, on the outer continental shelf (OCS) and defines the OCS as all submerged lands lying seaward of the State/Federal boundary. The Federal Oil & Gas Royalty Management Act of 1982 (30 U.S.C. 1701) mandates protection of the environment and conservation of Federal lands in the course of building oil and gas facilities.

A Federal moratorium on offshore drilling and platform development was initiated by the U.S. Congress in 1982 (U.S. Department of Energy (DOE) 2005). On October 1, 2008, the 1982 offshore drilling moratorium expired and was not renewed by the U.S. Congress. With the lifting of the moratorium, it will be several years before production in previously restricted areas could occur as the total time required to obtain a lease, explore and develop the area, and begin actual production is between 4 and 12 years, or more (Energy Information Administration 2009). In addition, the 2007-2012 plan does not include any leases planned for the DPS of the murrelet although that could change very rapidly. On September 16, 2008, the U.S. House of Representatives passed bill H.R. 6899, the Comprehensive American Energy Security and Consumer Protection Act, which would allow oil and natural gas exploration and production between 50 and 100 mi (80161 km) off the U.S. coasts. The U.S. Senate has received but not yet voted on H.R. 6899. Fossil fuel (e.g., petroleum and natural gas) energy use and production is and will likely continue to be a significant societal issue for the United States in the foreseeable future. Consequently, it is foreseeable that within the next 15 years, offshore oil and gas platform development may occur off the coasts of Washington, Oregon, and California. Oil development as it relates to oil spills (See Factor E), may have detrimental affects on murrelets.

The Oil Pollution Act of 1990 (33 U.S.C. 2701-2761) amended the Clean Water Act and addressed the wide range of problems associated with preventing, responding to, and paying for oil pollution incidents in navigable waters of the United States. It created a comprehensive prevention, response, liability, and compensation regime to deal with vessel- and facility-caused

oil pollution to U.S. navigable waters. The OPA requires a phase-out of single-hull tankers from U.S. waters by 2015. National Research Council (1998, p. 147) report that although the mandatory phase-out schedule of section 4115 of the OPA bans all single-hull tankers (without double bottoms or double sides) from U.S. trade after 2010, it is probable that under the deepwater port and lightering zone exemption, large single-hull vessels up to 30 years of age will operate in the United States through 2015. For this status review, we could not find specific information indicating how many single-hull tankers currently utilize Washington, Oregon, or California waters, and whether compliance with the double-hull provisions of section 4115 of the OPA will be achieved.

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 has considered revising their tug escort requirements (WDOE 2005); however, the current requirement of an escort of a tug or tugs for all oil tankers 40,000 deadweight tonnage or greater when not in ballast (WAC 363-116-500**)** remains in place.

Summary. Based on the information provided above we continue to assume that the threat posed by the inadequacy of existing mechanisms has been reduced since listing (For further information on applicable regulations and laws see Appendix B: Factor D).

2.3.2.5 Other natural or manmade factors affecting its continued existence:

Oil Spills

The following information provides new oil spill information and updates previous oil spill data since the analysis for the 2004 5-year review in Tables 11 and 12 (McShane et al. 2004, Tables 5.4-1 and 5.4-2, pp.5-18 and 5-19).

*Washington***.** No major oil spills with known murrelet injuries have occurred since the analysis for the 2004 5-year review.

In McShane et al. (2004, pp. 5-18 and 5-19) they note the tables do not include the Chevron Texaco spill (also known as the Foss Pt. Wells spill) that occurred on December 30, 2003. No seabird mortality associated with this spill was documented; therefore this spill has not been added to Table 11 or Table 12 below.

Since the murrelet was listed, the amount of oil tanker and shipping traffic has continued to increase (USFWS 1997; 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 occur in these same waters each year (WDOE 2004). Individually these vessels may carry up to 33 M gal of crude oil or refined petroleum products, but collectively, they carry about 15.1 B gal across Puget Sound waters each year (WDOE 2004). These numbers are expected to increase as the human population and commerce continues to grow.

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 (USFWS 2009). 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 through direct mortality or impacting their ability to feed.

*Oregon***.** We are not aware of any murrelet mortality from oil spills in Oregon since the analysis for 2004 5-year review. Table 11 has been updated to reflect two murrelets that were recovered in association with the Oregon-Washington Mystery Spill (so named because we do not know the source of the oil). This event happened at essentially the same time as New Carissa, but far to the north on the northern Oregon-southern Washington coasts. These murrelets were not visibly oiled, but that does not rule out oiling as a factor in their death. Other seabirds assumed to be associated with this spill also were found on beaches in Conservation Zone 2; however, no murrelets were found. When the modeling for this spill is completed, there may be murrelets attributed to Washington's Conservation Zone 2, in addition to Conservation Zone 3.

*California***.** The updates for oil spills in California are provided in the Table 11. The mortality estimates for the Kure and Stuyvesant spills and have been changed to incorporate new information from Natural Resource Damage Assessments completed since analysis for the 2004 5-year review. There was one new spill in 2007 that resulted in the recovery of 3 murrelets. DNA indicated these murrelets were not from central CA (i.e., not Conservation Zone 6); however for the purposes of this review, these murrelets will be attributed to Conservation Zone 6.

Oil spill summary. Based on the new information available, we have determined that while localized impacts from oil spills can be severe, they do not appear to have increased from our analysis for the 2004 5-year review. Severe localized impacts result from direct mortality through oiling and impacts to reproductive success through changes in prey base, marine habitat and disturbance. There have been no additional regulations or changes to regulations to address this threat, nor have recovery actions reduced it. Its magnitude appears to be unchanged at this time.

Table 11 Summary of oil spill mortality of murrelets in Conservation Zones 1-6, 1977-2008. This table copies and updates Table 5.4-1 from McShane et al. (2004, p. 5-18). The gray shading indicates new/adjusted information.

No.	Mo.	Year	Oil Spill Name	Conservation Zone	No. Murrelets Recovered[3,4]	Estimated Mortality[1]	Sources[2]
1	Dec	1984	Whidbey Island	1	0	[10-20]	1
2	Dec	1985	ARCO Anchorage	1	1	[10-20]	1
3	Feb	1991	Texaco Anacortes	1	0	[10-20]	1
4	Mar	1984	Mobil oil	2	1	[10-20]	1
5	Dec	1988	Nestucca	2	2-13[5]	8 [20-260][6]	1,2
6	Jul	1991	Tenyo Maru	2	[40]	[175-350][7]	1,3
7	Feb	1979	Lincoln Co. Coast	3	[1-10]	[10-200][8]	4
8	Mar	1980	Lincoln Co. Coast	3	[1-10]	[10-200][8]	5
9	Nov	1983	Blue Magpie	3	2-4	[20-80]	1
6	Jul	1991	Tenyo Maru	3	[5]	[25-50][7]	
10	Feb-Mar	1999	New Carissa	3	26	262	6
11	Mar	1999	Oregon/Washington Mystery Spill	3	2	[20]	16
12	Nov	1997	Kure/Humboldt Bay	4		130[12]	7
13	Sept	1999	Stuyvesant	4			8
14	Nov	1984	Puerto Rican	6	1-3	[10-60]	1,9
15	Feb	1986	Apex Houston	6	5	12 [50-100][6]	1,10
16	Dec-Feb	1989-1990	San Mateo Co. Coast	6		[10-50][11]	
17	Dec-Mar	1990-1991	San Mateo Co. Coast	6		[10-50][11]	
18	Dec-Jan	1992-1993	San Mateo Co. Coast	6		[10-50][11]	
19	Nov	1996	Cape Mohican	6	0	[6-12]	11
20	Aug	1998	Command	6	0	6-12	12, 13
21		1990-2003	Luckenbach	6	3	45[12]	14
22	Nov	2007	Cosco Busan	6[13]	3	13	15

[1] Numbers in square brackets were estimated roughly during the 2004 EDAW review. In Conservation Zones 1-4, rough estimates were made using a correction factor of 10-20 times those recovered (Ford et al. 2002). In Conservation Zone 1, minimum recovery of 1 murrelet was assumed (due to the high likelihood of missing small numbers of oiled murrelets) without carcass recovery for certain spills. In Conservation Zone 6, Ford (2002) estimated 6-12 oiled murrelets in the 1998 Command oil spill without carcass recovery, which was applied to other spills without carcass recovery in Conservation Zone 6.

[2] Sources: 1 (Carter and Kuletz 1995); 2 (Momot 1995); 3 (TMOSNRT 2000); 4 (Watson 1979); 5 (Nehls 1980); 6 (Ford et al. 2001); 7 (Final DARP, 2008); 8 (Final DARP, 2007); 9 (PRBO 1985); 10 (Carter et al. 2003); 11 (Carter 2003); 12 (Ford 2002); 13 (COSNRTC 2003); 14 (Final DARP, 2006); 15 (NRDA Fact Sheet --Bird Injury 2/2008)

2 Sources: 1 (Carter and Kuletz 1995); 2 (Momot 1995); 3 (TMOSNRT 2000); 4 (Watson 1979); 5 (Nehls 1980); 6 (Ford et al. 2001); 7 (Final DARP, 2008); 8 (Final DARP, 2007); 9 (PRBO 1985); 10 (Carter et al. 2003); 11 (Carter 2003); 12 (Ford 2002); 13 (COSNRTC 2003); 14 (Final DARP, 2006); 15 (NRDA Fact Sheet --Bird Injury 2/2008 (Data provided by Carolyn Marn, Sacramento FWO, 7 May 2009)

[3] For the 1977-2001 period, we assumed minimal rates of 1-2/year in Conservation Zone 1, 1/year in Conservation Zones 2-4, none in Conservation Zone 5, and 1-3/year in Conservation Zone 6.

[4] NA, not applicable.

[5] Low end of range is number of murrelets recovered; high end of the range includes unidentified alcids.

[6] Estimated mortality of 8 murrelets during the Nestucca oil spill and 12 murrelets during the Apex Houston oil spill probably were heavily underestimated. Numbers in square brackets were used in this review.
[7] This spill occurred mainly in Conservation Zone 2 but also in northern Conservation Zone 3. Since the majority of this spill occurred in Washington in the breeding season (70% juveniles killed; Warheit 1996), we assumed that 40 of 45 murrelets recovered were from Conservation Zone 2 and 5 of 45 were from Conservation Zone 3.
[8] Recovery of 1-10 murrelets was assumed, based on location and available spill information (Ford et al. 2001).
[9] Some oil mortality has occurred at the lower end of Conservation Zone 5 but we have assumed that these birds belong to the Conservation Zone 6 breeding population.
[11] These mortalities may be also be accounted for in the final total of 45 Luckenbach birds
[12] Numbers were updated in 2009: Luckenbach total includes Point Reyes Tarball Incidents and 2000-2003 Luckenback incidents cited in original 5-yr review table (which have been removed from this version of table); Kure and Stuyvesant spill mortalities were updated based on Final DARPs
[13] Spill occurred in Conservation Zone 6, but DNA analyses indicated that recovered birds were likely not from Conservation Zone 6 (data for Cosco Busan provided by Carolyn Mann, USFWS Sacramento FWO, 7 May 2009). However, for the purposes of this table and mortality estimation we have assigned the mortality to Conservation Zone 6.

Table 12 Summary of estimated oiling mortality of murrelets by Conservation Zone, 1977-2008. This table copies and updates Table 5.4-2 from McShane et al. (2004, p. 5-19). The gray shading indicates new/adjusted information.

Conservation Zone	Period	Reported Spills[1]	Chronic[2]	Annual Mortality
	1977-1992	30-60	16-32	2.9-5.8
	1993-2003	0	11-22	1.0-2.0
1	2004-2008	0	5-10	1-2
	1977-1992	205-630	16	13.8-40.4
	1993-2003	0	11	1
2	2004-2008	0	5	1
	1977-1992	65-530	16	5.1-34.1
	1993-2003	282	11	26.6
3	2004-2008	0	5	1
	1977-1992	0	16	1
	1993-2003	265	11	25.1
4	2004-2008	0	5	1
	1977-1992	0	0	0
	1993-2003	0	0	0
5	2004-2008	0	0	0
	1977-1992	80-260	16-48	6.0-19.3
	1993-2003	189-241	11-33	18.2-24.9
6	2004-2008	3	5-15	1.6-3.6
	1977-1992	380-1,480	80-128	28.8-100.5
	1993-2003	704-768	55-88	69.0-77.8
Total	2004-2008	3	25-40	5.6-8.6

[1] See Table 12 for estimates per reported spill.
[2] Conservative annual chronic oiling mortality rates were assumed (Conservation Zone 1 = 1-2; Conservation Zone 2-4 = 1; Conservation Zone 5 = 0; Conservation Zone 6 = 1-3).

Gillnets

Murrelet mortality associated with gill-nets remains zero in California and Oregon, as discussed in McShane et al. (2004). McShane et al (2004) documented murrelet mortality in Washington and the following review updates or provides new information not considered in McShane et al.

(2004). Measures taken to reduce gill-net related mortalities in Washington have remained the same since the last analyses (i.e. area closures, time-of-day restrictions, etc.). However, both treaty and non-treaty gill-net fishing continue to occur in the Straits of Juan de Fuca and Puget Sound.

In 2001, the Service issued a Biological Opinion to NOAA for the non-treaty fisheries. This Biological Opinion, allowed for a maximum removal of up to 6 murrelets per year over 10 years. While this level of removal was considered in the analysis provided in McShane et al. (2004), the removal is anticipated to continue through 2011 and is therefore also pertinent to this review. In 2004, the Service authorized the removal of up to 9.6 adults and 1 chick per year over 10 years in a Biological Opinion to the Bureau of Indian Affairs for tribal treaty fisheries. Murrelet mortality has not been documented in these fisheries, however, there is very limited to no seabird observer coverage of these fisheries, therefore, a conclusion that no mortality occurs cannot be made.

As summarized in McShane et al. (2004, p. 5-30) gill-net fishing effort up through 2003 had declined below pre-1900s effort levels. For this review, fishing effort for the tribal treaty fisheries was only available for 2004 and 2005. Based on the information supplied, there have been a consistent number of landings in some fishing areas since 1999 and some areas have seen increased drift-gillnet and/or set-gillnet landings. In the all citizen fisheries, gillnet and purse seine landings increased each year from 2004 through 2007 (2008 information is not yet available). Although still well below the pre-1990s fishing effort, since 2003, fishing effort in at least some portions of Puget Sound has risen.

Based on the new information available, we have determined that gill nets may be responsible for direct mortality of murrelets, but the impacts continue to be localized to the Puget Sound area and northern Washington coast. There have been no additional regulations or changes to regulations to address this threat, nor have recovery actions reduced it. Fishing effort appears to have risen in some portions of Puget Sound since the analysis for the 2004 5-year review; therefore, locally this threat may be increasing.

Derelict Fishing Gear

Subsequent to the analysis for the 2004 5-year review, entanglement in derelict fishing nets has been identified as a threat to marine mammals, seabirds, shellfish, and fish in Puget Sound and the Straits of Juan de Fuca. Derelict fishing gear consists of nets and crab pots which have been lost, abandoned, or discarded in the marine environment. This gear can persist in the marine environment and continue "fishing" (capturing sealife) for decades (NRC 2007). Not only does derelict gear result in direct mortality of species, it destroys and degrades marine habitat by accumulating sediment, scouring bottom substrate, impeding plant and sessile animal growth, and blocking access to habitat used for foraging and escaping predators (June and Antonelis 2009, p. 3). A recent survey estimated there are 3,900 derelict nets and 14,000-20,000 derelict crab pots in Puget Sound (Northwest Straits Foundation 2007, pp. 9 and 13). Derelict fishing gear also occurs along the Washington coast and the outer Straits of Juan de Fuca; however, in this high energy environment, the time a derelict net remains suspended may be shorter when compared to a lower energy environment like the inner Puget Sound (NRC 2007, p. 13).

Average catch rates for the derelict nets is 0.42 fish per day (i.e. maybe killing 120,000 fish per year) and 0.24 birds per day (i.e. may be killing 44,000 birds per year); however, these rates may be low because decomposition to a pile of bones can take as little as 3 days (Natural Resource Consultants 2008, pp. 8-11). To date, murrelets are not included in the list of birds known to be killed by derelict nets. However, the bone/species identification process has not been completed for the test nets. In addition, over 50 percent of the derelict nets in Puget Sound occur in waters where murrelet densities are the highest in Washington (i.e. Straits of Juan de Fuca and San Juan Islands) and the nets primarily occur within murrelet foraging depth. Therefore, it is reasonable to assume that murrelets are also victims of derelict nets in Puget Sound.

The Northwest Straits Initiative has on ongoing effort to remove all derelict gear from Puget Sound and the Straits of Juan de Fuca by 2012. As of November 2008, 972 derelict nets and 1,636 crab pots have been removed, restoring more than 211 acres of marine habitat (NRC 2008).

Based on the lack of near-shore net fisheries and the high energy environment, we anticipate the presence of derelict fishing nets along the coasts of Oregon and California to be limited. However, pot fisheries take place all along the coast. While pots are unlikely to result in murrelet mortality, they do present a potential danger to murrelet prey species. However, to our knowledge, there is no information regarding the number of derelict pots along the entire outer coast, nor is there information regarding the potential threat posed to murrelet prey species.

Impacts from derelict fishing gear (nets and pots) are a new threat. The threat from derelict fishing nets appears to be localized to Conservation Zone 1 and the severity of the threat in this Conservation Zone is high. The scope and severity of the threat posed to murrelet prey from derelict pot fishing gear has yet to be determined.

Energy Development Projects and Energy Production

Wave and tidal energy projects**.** Section 23(b)(1) of the Federal Power Act of 1920 grants jurisdiction to the Federal Energy Regulatory Commission (FERC) for the licensing of hydropower development (for example, wave energy projects) in offshore waters of the United States. FERC licensing procedures include analyzing potential project effects on natural resources including, but not limited to, water quality, water use, marine mammals, fish, birds, geology, land use, ocean use, navigation, recreation, aesthetics, and cultural resources.

The threat(s) these projects may pose to murrelets varies greatly, depending upon the proposed location and type of equipment. In some cases, such as tidal energy projects that will use underwater turbines, the threat may be mortality. In other cases, the projects may degrade marine habitat through shading, collision/entanglement obstacles, night-lighting, changes in prey abundance, and/or increased human presence. In some cases, the project may have little or no impact to murrelets. The following summarizes those wave and tidal projects that we are currently aware have been proposed and are moving forward through the permitting and testing phases or already occur within murrelet habitat.

In Washington four wave or tidal projects are being considered for energy development. One wave energy project was proposed in Makah Bay. However, in February 2009, the company that had proposed the project surrendered their FERC license. The future of this project is unclear at this time. Two experimental tidal energy projects are proposed to be deployed in Admiralty Inlet in Puget Sound. Grays Harbor Energy LLC has received a Preliminary Permit from the Federal Energy Regulatory Commission (FERC) to study the potential feasibility of one offshore wave energy generation platform in shallow coastal waters 2.8 miles off of the towns of Westport and Ocean Shores in Grays Harbor County. The FERC preliminary permit is just for studies, it does not allow any project to be installed, but it does give the project developer the exclusive right to develop the site and protect its investment in the studies and permit applications.

In Oregon three wave projects and one tidal project are being considered for energy development. The FERC has issued at least six preliminary permits for wave energy on the Oregon coast; three are no longer active, and have been withdrawn or dismissed. The remaining three are proposed to be located offshore of Tillamook County, Douglas County, and Coos County; all are within 3 miles of the coastline. At this time, none of the three active projects have structures in the ocean. The proposed Reedsport OPT Wave Park in Douglas County is anticipated to install a pilot buoy in 2010, and install an additional 10 buoys for a larger pilot study at a later date. The other two proposed projects, one in Tillamook County and one in Coos County, are earlier in the permitting process and installation of structures in the ocean is as of yet unscheduled. One proposed tidal energy project, using oscillating water column technology on an existing jetty, is located in Douglas County at the mouth of the Umpqua River. Installation is not yet scheduled.

In California, we are aware of at least five proposed wave energy projects that occur within the range of the murrelet: 2 off Humboldt county, 1 off Mendocino county, and 2 off San Francisco bay. One of the wave energy projects proposed in Humboldt County had received a FERC license, however, in February 2009, the company that had proposed the project surrendered their FERC license. The future of this project is unclear at this time.

Offshore Wind Projects**.** At this time we are unaware of any offshore wind energy projects proposed along the coasts of Washington, Oregon, or California.

On Shore Wind Projects**.** The threat(s) on-shore wind energy projects pose to murrelets may include direct mortality and habitat removal. The following are those projects that we are currently aware have been proposed and are moving forward through the permitting and testing phases.

In Washington**,** all three of the following on-shore wind energy projects occur within the range of murrelets in southwest Washington (i.e. murrelets associated with Conservation Zone 2). The Grayland project consists of the installation of four wind turbines near the town of Grayland. This project has been approved by Pacific County. Murrelet habitat occurs within 500 feet and murrelets have been detected at the installation site. The Radar Ridge project is located on lands conditionally leased to the applicant by Washington Department of Natural Resources (WDNR). The feasability of this project is currently undergoing analysis by the WDNR. The proposed site is adjacent to an area known to be occupied by murrelets and murrelets have been detected flying

over the site. Until all of the data have been obtained and WDNR has completed their analysis, the future installation of wind turbines as this location is uncertain. The Pe Ell project is currently undergoing analysis. The proposed installation site is a combination of private timber company and WDNR lands. The WDNR lands are under a conditional lease, which can be rescinded pending the outcome of the analysis.

In Oregon, we are unaware of any on-shore wind energy projects proposed along the coast. There is one land-based wind turbine project in California that has been proposed that could affect murrelets. The proposed Bear River Ridge project is located in Conservation Zone 4, on a ridgetop area in Humboldt County that murrelets have been documented to traverse. The proposed project is in a preliminary stage, and the proponent has not applied for nor received any permits to date.

Liquefied Natural Gas Terminals and Pipelines**.** Four liquefied natural gas (LNG) terminals have been proposed in Oregon, each with associated pipelines through the inland range of the murrelet. No such installations are currently proposed in California or Washington (except where Oregon projects extend).

A pre-application was filed for the Port Westward LNG facility in the Columbia River near Clatskanie, Oregon, on April, 2005. The project was suspended in 2006.

Bradwood Landing LNG Facility in the Columbia River near Bradwood, Oregon, began the regulatory process in March 2005. FERC approved the facility in January 2009. The State of Oregon and the U.S. Department of Justice are appealing the decision to the 9th Circuit Court. No construction has been initiated. There are two natural gas pipelines potentially associated with this facility. The 30 mile Northern Star pipeline goes from Bradwood to near Longview, Washington, and does not affect murrelet habitat. The 212 mile Palomar natural gas pipeline starts near Bradwood, Oregon and ends near Madras on the east side of the Cascades. This pipeline would traverse the murrelet inland range, potentially resulting in the loss or fragmentation of some murrelet nesting habitat. The pipeline route is not final yet, so exact amounts of habitat affected are not available.

A pre-application was filed on the Oregon LNG facility near Astoria, Oregon in June 2007. This process is ongoing. The associated 120 mile Oregon natural gas pipeline goes from Astoria to Mollala, Oregon. This pipeline would traverse the murrelet inland range, potentially resulting in the loss or fragmentation of some murrelet nesting habitat. The pipeline route is not final yet, so exact amounts of habitat affected are not available.

The Jordan Cover Energy Project, in Coos Bay, Oregon, was initiated with a notice of intent in November 11, 2004. FERC issued a final EIS on the project on May 1, 2009. The project also involved the construction of the 231 mile Pacific Connector Gas Pipeline from Coos Bay to Malin in the Klamath Basin. The pipeline would traverse the murrelet inland range, potentially resulting in the loss or fragmentation of some current and future murrelet nesting habitat. The pipeline route is not final yet, so exact amounts of habitat affected are not available.

Summary -Energy Development Projects and Energy Production. Based on the latest information, we find that murrelets may be highly vulnerable in localized areas from energy development and production. This includes direct mortality from strikes, as well as loss of habitat and fragmentation, and impacts to reproductive success through changes in prey base, marine habitat and disturbance.

Disturbance in the marine environment

Subsequent to McShane et al. (2004), the Service began considering impacts to murrelets from activities in the marine environment. These impacts could be experienced underwater, on the surface, or both and could result in mortality, injury, or disturbance. There is little empirical data regarding the probability of lethal responses, sublethal injuries, physiological responses (particularly stress responses), behavioral responses, or social responses by murrelets to human activities in the marine environment. However, for the Service's analyses, we reviewed the best scientific and commercial data on the probable responses of other species and then used this information to make inferences about the probable responses of murrelets. Based on best available information, we consider murrelets to be potentially effected by exposure to elevated underwater and above water sound levels, boat traffic, and reductions of prey or prey habitat.

Most of these impacts occur in Puget Sound and Grays Harbor in Washington State. Similar activities either do not take place along the outer coasts of Washington, Oregon, and California or have not yet been analyzed. For example, boat traffic is known to occur all along the coast were murrelets occur, but the impacts have not yet been analyzed.

Exposure to elevated sound levels**.** High underwater sound pressure levels (SPLs) are known to have negative physiological and neurological effects on a wide variety of vertebrate species including fishes, mammals, and birds (Cudahy and Ellison 2002; Fothergill et al. 2001; Steevens et al. 1999; U.S. Department of Defense 2002; Yelverton and Richmond 1981; Yelverton et al. 1973). The injuries associated with exposure to high SPLs are referred to as barotraumas, and include hemorrhage and rupture of internal organs, hemorrhaged eyes, temporary stunning, and ruptured eardrums (Hastings and Popper 2005; Turnpenny and Nedwell 1994; Yelverton and Richmond 1981; Yelverton et al. 1973; Yelverton et al. 1975). Sublethal injuries that do not immediately result in mortality could include internal organ damage, loss of vision, or hearing loss, all of which can significantly impair an individuals ability to carry out essential life functions such as flying, diving, breeding, feeding, and predator avoidance. Activities that we consider to potentially result in these effects include, but are not limited to, underwater detonations and pile driving. Both of these activities occur on a regular basis in Puget Sound and since 2004, the Service has authorized incidental take in the form of harm of 113 murrelets and murrelets associated with 60,811 acres of marine habitat within Conservation Zones 1 and 2. Harm may occur over multiple years within some of these acres.

As in the terrestrial environment, murrelets may be exposed and respond to noise in the marine environment. While there are no known studies or data available that evaluate the behavioral response of murrelets (or other alcids) to noise in the marine environment, behaviors that we believe could indicate disturbance of murrelets in the marine environment include aborted feeding attempts; multiple delayed feeding attempts within a single day or across multiple days,

multiple interrupted resting attempts, and precluded access to suitable foraging habitat. Since 2004, the Service has authorized incidental take in the form of harassment of all murrelets associated with 56,785 acres of marine habitat within Conservation Zones 1 and 2 and all murrelets that may occur within 4,624 meters of the Anacortes Ferry Terminal. In some instances multiple years of harassment occur, depending upon the duration of the project.

Boat traffic**.** Recent research by Speckman et al. (2004) and Bellefleur et al. (2009) further corroborate information presented in McShane et al. (2004, pp. 5-36 through 5-37) that boat traffic elicits behavioral responses in murrelets. Boat disturbance can decrease the amount of time available for murrelets to forage or murrelets may be unable to forage effectively due to increased vigilance and time spent escaping. Boat disturbance may cause an energetic impact on murrelets due to the cost of flight compounded with being flushed off preferred feeding grounds (Bellefleur et al. 2009, p. 536). Bellefleur et al. (2009, p. 536) suggest juveniles may be at greater risk of negative impacts from boat traffic because of their propensity to flush in response to boat traffic. Murrelets may or may not habituate to boat traffic. While Bellefleur et al. (2009, p. 536) found the mean flushing distance decreased in areas with high boat density, suggesting murrelets may tolerate close encounters; they also found the percentage of murrelets that flushed in high boat density areas increased, suggesting murrelets are less committed to foraging in areas with many boats.

Negative impacts on a birds' daily energy budget can occur when outside influences reduce foraging and/or increase energetically costly behaviors, such as diving and flight (diving ducks: Korschgen et al. 1985, American coot [*Fulica americana*]: Schummer and Eddleman 2003). Research on marbled and Kittlitz's (*Brachyramphus brevirostris*) murrelets document that these species are negatively affected by human activities in the marine environment (Agness et al. 2008; Bellefleur et al. 2009). Reactions to disturbances include both flying and diving. Flying is energetically expensive for alcids, due to their short wings and heavy bodies (Pennycuick 1987). Although significantly more murrelets choose to dive rather than fly (Bellefleur et al. 2009, p. 535), they will react by flying when approached from greater distances or at faster speeds and juveniles are more likely to fly than adults (Bellefleur et al. 2009, pp. 534-535). Of the murrelets that reacted by flying, 83 percent left the feeding area (> 200 m) (Bellefleur et al. 2009, p. 535).

Murrelet survival and reproduction is dependant upon an adequate quantity of high quality food throughout the year. Adequate food resources are necessary to survive winter, undergo molts, prepare for breeding in the spring, and to feed chicks during rearing. Wintertime distribution of murrelets appears to be related to concentrations of prey species (Dawson et al. 2007). Murrelets must select foraging sites that provide adequate prey resources, such as consistent levels of higher trophic-level fishes (Becker 2001), which are within swimming distance (Carter and Stein 1995, Nelson 1997) during the pre-basic molt when they are flightless. Murrelets can make substantial changes in foraging sites during the breeding season, but many birds routinely forage in the same general areas and at productive foraging sites (Carter and Sealy 1990, Whitworth et al. 2000, Becker 2001, Hull et al. 2001, Mason et al. 2002, and Piatt et al. 2007). Peery et al. (2009, p. 127) found murrelets (whether breeding or not) remained within a few kilometers of nesting habitat during the breeding season. During incubation, foraging murrelets double their diving activity because they must get two days worth of provisions during the one day on the water (Peery et al. 2009, p. 128), so they must select a highly productive foraging location.

Thus, these select foraging sites are important to murrelet survival and reproduction and human activities that limit access to these areas may result in reduced reproduction or survival, especially if the human activities result in increased diving or relocation to a less favorable foraging area or a foraging area further from the nesting habitat.

Adult murrelets holding fish commonly respond to disturbance by diving, regardless of disturbance speed, size, or approach distance (Speckman et al. 2004, p. 33). This dive behavior was not observed for fish-holders in the absence of disturbance; therefore, the combination of the time and effort invested in the held fish, the greater flight lift-off cost (due to fish mass), and the unwillingness of the bird to expend energy by taking off, may make a dive response the only prudent option. In addition, Speckman et al. (2004, p. 33) found some murrelets ate fish they were holding if repeatedly disturbed. The biological impacts of this behavior could be significant to the adult murrelet that expends additional energy to catch another fish and to their chick if a meal is not delivered (Speckman et al. 2004, p. 33).

As concluded in McShane et al. (2004, p. 5-37), research regarding disturbance in the marine environment has not been empirically correlated with effects on reproductive success or Conservation Zone populations. While there may not be empirical data, it is reasonable to assume based on the recent studies that within areas with high boat density or fast moving boats, murrelets are more likely to move away, possibly to a less desirable foraging location. Within the 3-state area, there are areas (such as Puget Sound and Monterey Bay) where murrelets co-occur with substantial boat traffic, recreational and commercial. Within these areas, boat traffic may be causing energetic impacts on murrelets that they are unable to compensate for, especially during the pre- and breeding seasons.

Disturbance in the terrestrial environment:

Since the analysis for the 2004 5-year review one study has concluded and documented murrelet nesting and nest success as it relates to disturbances. Golightly et al. (2009, pp. 8 and 16) found that murrelets were more likely to nest further away from paved roads than random sites. Golightly et al. (2009, p. 19) suggest that murrelets are selecting nest habitat away from roads or that nests closer to paved roads had failed before the start of their study. Vehicular traffic noise appeared to have little or no effect on murrelet nesting success (Hebert and Golightly 2006, pp. 34 and 35; Golightly et al. 2009, p. 18). However, because nests were located farther from paved roads than random sites, it is possible that paved roads are an indicator of disturbance or predatory activities regardless of sound levels (Golightly et al. 2009, p. 18).

Distance to nearest trail also was not a good predictor of nest success (Golightly et al. 2009, p. 35; Hebert and Golightly 2006, pp. 20, 21 and 56). Observations of incubating adult and chick responses to disturbance events resulted in no flushing and no significant increase in corvid presence (Hebert and Golightly 2006, pp. 22, 28 and 68). However, adults spent more time with their heads raised, and their bill up during the disturbances, compared to the pre- and post-disturbance periods. The relevance of the behavior changes seen in adults tending nests is at present unknown (Hebert and Golightly 2006, p. 35). Hebert and Golightly (2006, p. 36) conclude that noise disturbance lasting 10 to 15 minutes, at a distance greater than 25 meters from the nest does not appear to induce long-term behavioral changes. Although, all seven nests

that had incubating adults exposed to the sound of an operating chainsaw failed to produce a fledgling (Hebert and Golightly 2006, p. 29).

Chicks also spent more time with their heads raised, and their bill up during the disturbance trials, although compared to pre- and post-disturbance trials, the relationship was not statistically significant (Hebert and Golightly 2006, p. 36). All three chicks fledged (Hebert and Golightly 2006, p. 29).

In summary, Hebert and Golightly (2006, p. 40) continue to recommend avoiding extended disturbance to incubating adults and avoiding disturbance to chicks at the time food deliveries are most likely: early morning and late evening.

Since the analysis for the 2004 5-year review, the Service has authorized incidental take in the form of harm of 6 juveniles and all murrelets associated with 835 acres of activities in Washington. The Service has also authorized incidental take in the form of harassment of 80 murrelets, all murrelets associated with almost 30,000 acres, and an unquantified number of murrelets associated with helicopter and fixed-wing flights. These murrelets could be associated with either Conservation Zone 1 or 2. The Service authorized incidental take in the form of harm of 276 murrelets and the harassment of all murrelets associated with almost 9,500 acres of activities in Conservation Zone 3 and has authorized the harm of 18 murrelets and the harassment of all murrelets associated with almost 144,000 acres of activities in Conservation Zone 4. The Service authorized no incidental take in the form of harm or harassment of murrelets in Conservation Zone 5, and issued only 1 biological opinion in 2006 for harassment of an unknown low number of individuals in Conservation Zone 6.

Marine and Terrestrial Disturbance Summary. New information regarding disturbances from boat traffic corroborates the information provided in McShane et al. (2004); however, there have been no additional regulations or changes to regulations to minimize impacts, nor have recovery actions reduced the impacts.

The potential for mortality, injury, and disturbance due to exposure to elevated underwater sounds has been identified as a new threat. The scope of this threat appears to be localized to Washington and the severity is currently being ameliorated through section 7 consultations.

Our 2004 5-year review did not address disturbance in the terrestrial environment; however, McShane et al. (2004) indicated noise disturbance may affect murrelet fitness and reproductive success, but further research was needed. New information does not tie observed affects directly to human disturbance, but further corroborates the tie of human presence to increased predation. All of the new disturbance information is specific to the coastal redwood zone in California. Further research throughout the range is necessary to determine the severity of disturbance on murrelets.

Other Natural or Manmade Factors Summary. Since the analysis for the 2004 5-year review, we have determined the scope, severity and magnitude of the threat to murrelets from oil spills has not changed and the scope and severity of the threat from gill nets has not changed. However the magnitude of these threats in Puget Sound may be increasing. The scope and severity of

disturbances in the marine and terrestrial environments remains unchanged or unknown. In addition, we have identified three new threats, derelict fishing gear, energy development and production, and exposure to elevated underwater sound levels. The scope of each of these new threats is localized; however, energy development and production may occur throughout the listed range. The severity of each of these new threats may be high where they occur.

2.4 Synthesis

The murrelet is a small seabird of the Alcidae family. Murrelets spend most of their lives in the marine environment where they forage in near-shore areas and consume a diversity of prey species, including small fish and invertebrates. In their terrestrial environment, the presence of platforms (large branches or deformities) used for nesting is the most important characteristic of their nesting habitat. Murrelet habitat use during the breeding season is positively associated with the presence and abundance of mature and old-growth forests, large core areas of old-growth, low amounts of edge habitat, reduced habitat fragmentation, proximity to the marine environment, and forests that are increasing in stand age and height.

With declines documented separately for Conservation Zones 1 through 5 and Conservation Zone 6, we conclude that the listed population has declined significantly since 2002, the year of the estimate in the Service's previous 5-year review (McShane et al. 2004). Based on the tri-state estimate of about 24,400 birds used in the earlier 5-year review (USFWS 2004, p. 18), the 2008 population estimate of about 18,000 birds represents a decline of about 26 percent across the listed range from that estimate. This is significant new information regarding population size and trend.

The species decline has been largely caused by extensive removal of late-successional and old growth coastal forest which serve as nesting habitat for murrelets. Additional factors in its decline include high nest-site predation rates and human-induced mortality in the marine environment from disturbance, gillnets, and oil spills. In addition, murrelet reproductive success is strongly correlated with the abundance of mid-trophic level prey. Effects to the marine environment that impact the availability of that prey can occur through overfishing or oceanographic variation from weather or climate events. Affects to adults in the marine environment from disturbance events like underwater detonations or pile driving can also impact their ability to forage and successfully provide for their young.

The recovery criteria for this species have not been met. The existing criteria were meant to be interim until further information was gathered to determine the specific delisting criteria. This information included murrelet population size, trends and demographic goals for each Conservation Zone; the quantity, quality, and distribution of nesting and marine habitats and prey populations within each zone necessary to achieve recovery goals; and detailed studies of the survivorship and productivity of murrelets. While data collection and research has been on-going in these areas, we have only just determined population trend information for the murrelet. Information on the other research needs is still forthcoming. When available, this information should be used to revise the recovery criteria.

Based on the evaluation of the threats and the murrelet's population status and trends we have determined that the murrelet should remain listed as threatened. However we remain concerned about the apparent substantial downward trend of the population and the species' continued vulnerability from a broad range of threats across its entire listed range. Although some threats have been reduced, most continue unabated and new threats now strain the ability of the murrelet to successfully reproduce. In summary, if reproductive success continues to be too low to sustain the population, the observed population trends continue to decline significantly and manmade and natural threats continue at current or increased levels, a change in listing status to endangered may be warranted in the future.

3.0 RESULTS

3.1 Recommended Classification:

____ Downlist to Threatened
____ Uplist to Endangered
____ Delist
_X__ No change is needed

3.2 New Recovery Priority Number : No change

Brief Rationale: None needed.

3.3 Listing and Reclassification Priority Number, not needed.

Reclassification (from Threatened to Endangered) Priority Number: ____
Reclassification (from Endangered to Threatened) Priority Number: ____
Delisting (regardless of current classification) Priority Number: ____

Brief Rationale: None needed.

4.0 RECOMMENDATIONS FOR FUTURE ACTIONS

- Because the recovery plan is greater than 10 years old and information regarding threats and population has changed, a revision of the recovery plan is warranted.
- Information regarding marine threats, and general life history including reproduction is lacking, therefore research on these topics is needed.
- Further examine marbled murrelet population trends in the coastal redwood zone, given the magnitude and imminence of threats

5.0 REFERENCES –Follows Signature Page

U.S. FISH AND WILDLIFE SERVICE

5-YEAR REVIEW OF MARBLED MURRELET *(Brachyramphus marmoratus)*

Current Classification: Threatened Species

Recommendation resulting from the 5-Year Review:

____ Downlist to Threatened
____ Uplist to Endangered
____ Delist
_X_ No change needed

Appropriate Listing/Reclassification Priority Number, if applicable: NA

Review Conducted By: Washington Fish and Wildlife Office staff in collaboration with staff from the Arcata Fish and Wildlife Office and the Oregon Fish and Wildlife Office

FIELD OFFICE APPROVAL:

Ken S. Berg

Lead Field Office Supervisor, Fish and Wildlife Service

Date JUN 12 2009

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APPENDICES

Appendix A

Summary of potential effects of climate change on murrelet marine habitat. "CC" refers to the California Current System (Conservation Zones 2-6). "Direction of Effect" column shows estimated direction of net effect on murrelet habitat if the predicted change occurs; "0" indicates minimal effect, "-" negative effect, and "+" a net positive effect.

Climate-related Factor	Predicted Change	Direction of Effect on Murrelets	Conservation Zones Affected	Sources	Notes
Ocean acidification	Increased acidity (lower pH); may contribute to dead zones	0/-	All	Harley et al. 2006; Rucklehaus and McClure 2007	Likely to affect prey communities, esp. invertebrates.
Sea Surface Temperatures	Increased SSTs	-	All	McShane et al. 2004; State of Calif. 2009; Harley et al. 2006; IPCC 2001; Rucklehaus and McClure 2007	Could increase stratification effects
Winds	Increased winds near coasts	?	All	Harley et al. 2006	Could be positive if increases upwelling or negative if doesn't keep upwelling in check resulting in dead zones
Total upwelling	Variable predictions; no change or increasing (due to stronger along-shore winds)	0/+	All, esp. CC	Mote et al. 2008:11; Mote and Mantua 2002; Harley et al. 2006; Diffenbaugh et al 2004;	Could increase coastal productivity; McShane et al. 2004: upwelling maintains cold productive coastal waters S of WA
Upwelling seasonality	Delayed upwelling, more variability; results not consistent among models	0/-	CC, esp 2-5	Barth et al. 2007; Bane et al. 2007; Mote and Mantua 2002; Bograd et al. 2009; Schwing et al. 2006	Delayed upwelling can reduce primary productivity. Effect in Conservation Zone 1 unclear.
Upwelling timing: phenology	Potential mismatches between prey population phenology and seabird breeding seasons	0/-	2-6 (CC)	Bograd et al. 2009; Sydeman et al. 2006;	Prey potentially not available during important prebreeding period
Dead Zones	Increased frequency and large expansion of dead zones	-	All	Barth et al. 2008; Brewer and Peltzer 2009; Chan et al. 2008, Rucklehaus and McClure 2007	Documented in Conservation Zones 1 and 3 already; acidification contributes
Stratification of upper ocean waters	Increased stratification, with warmer water, lower productivity, decreased dissolved oxygen	0/-	All	Roemmich and McGowan 1995; Harley et al. 2006; Behrenfeld et al. 2006; Rucklehaus and McClure 2007	Stratification may counteract effects of increased upwelling, increase scope and length of HABs and dead zones
ENSO events	More frequent El Niño (warm) events	-	All	McShane et al. 2004; Harley et al. 2006; Snyder et al. 2003	
Sea level rise	Reduced shoreline complexity; loss of intertidal, increased bank armoring	0/-	Zone 1, esp.	Rucklehaus and McClure 2007	Conservation Zone 1 most vulnerable due to large shoreline, existing development
Freshwater inflow	Timing shift, lower flows in late spring and summer	0/-	Zone 1	Rucklehaus and McClure 2007	Strong winter stratification, weak summer stratification
Nearshore water quality	Potential increases in turbidity due to increased shoreline erosion	0/-	All	Rucklehaus and McClure 2007	Increased turbidity could reduce foraging efficiency
Winter storms	Increased intensity	0/-	All	Wingfield and Storlazzi 2007; Gower et al 2002	Could affect foraging efficiency for murrelets, and reduce prey aggregations
Marine species distribution	Northward shifts by species expected as SST increases	?	All	Harley et al. 2006; Schwing 2009	Could affect prey distribution

Appendix B

Factor D. Regulatory Mechanisms

The following list includes a brief summary of laws and regulations that were considered in the evaluation of existing regulatory mechanisms for the 5-year review. Most if not all of these laws and regulations were considered in the analysis for the 2004 5-year review. Updates if available are provided.

State Protections in California

The State's authority to conserve rare wildlife and plants is comprised of four major pieces of legislation: the California Endangered Species Act, the Native Plant Protection Act, the California Environmental Quality Act, and the Natural Community Conservation Planning Act.

California Endangered Species Act (CESA): The CESA (California Fish and Game Code, section 2080 *et seq*.) prohibits the unauthorized take of State-listed threatened or endangered species. The CESA requires State agencies to consult with the California Department of Fish and Game on activities that may affect a State-listed species and mitigate for any adverse impacts to the species or its habitat. Pursuant to CESA, it is unlawful to import or export, take, possess, purchase, or sell any species or part or product of any species listed as endangered or threatened. The State may authorize permits for scientific, educational, or management purposes, and to allow take that is incidental to otherwise lawful activities. The marbled murrelet is listed as endangered by the State of California under the California Endangered Species Act

California Environmental Quality Act (CEQA): The CEQA requires review of any project that is undertaken, funded, or permitted by the State or a local governmental agency. If significant effects are identified, the lead agency has the option of requiring mitigation through changes in the project or to decide that overriding considerations make mitigation infeasible (CEQA section 21002). Protection of listed species through CEQA is, therefore, dependent upon the discretion of the lead agency involved.

Natural Community Conservation Planning Act: The Natural Community Conservation Program is a cooperative effort to protect regional habitats and species. The program helps identify and provide for area wide protection of plants, animals, and their habitats while allowing compatible and appropriate economic activity. Many Natural Community Conservation Plans (NCCPs) are developed in conjunction with Habitat Conservation Plans (HCPs) prepared pursuant to the Federal Endangered Species Act.

California Lake and Streambed Alteration Program: The Lake and Streambed Alteration Program (California Fish and Game Code sections 1600-1616) may promote the recovery of listed species in some cases. This program provides a permitting process to reduce impacts to fish and wildlife from projects affecting important water resources of the State, including lakes, streams, and rivers. This program also recognizes the importance of riparian habitats to sustaining California's fish and wildlife resources, including listed species, and helps prevent the loss and degradation of riparian habitats.

California Coastal Act: The California Coastal Commission considers the presence of listed species in determining environmentally sensitive habitat lands subject to section 30240 of the California Coastal Act of 1976, which requires their protection. Certain local jurisdictions have developed their own Local Coastal Programs or Land Use Plans that have been approved by the Coastal Commission. Some of the major accomplishments of this act include reduction in overall development, the acquisition of prime habitat along the coast, restoration of coastal streams and rivers, and a reduction in the rate of wetland loss.

The California Forest Practice Rule. The California Forest Practice Rules (CFPR) were established by Title 14, California Code of Regulations Chapters 4, 4.5, and 10, and the Z'berg-Nejedly Forest Practice Act of 1973 to regulate timber harvest on non-Federal lands within the State of California. The Governor of California is responsible for appointing members to the California Board of Forestry. This board is responsible for approving any changes to the CFPRs. The California Department of Forestry and Fire Protection (CALFIRE) has authority over the implementation and enforcement of the CFPRs (California Department of Forestry and Fire Protection 2009).

The California Department of Fish and Game (CDFG) has trust responsibilities for wildlife within the State and, along with other State resource agencies, has the option to conduct field reviews and/or provide recommendations to CALFIRE on individual Timber Harvest Plans (THP) and Nonindustrial Timber Management Plans (NTMP).

The CFPRs are implemented through the THP and NTMP review and approval processes. Professional Foresters who are registered with the State of California (RPF) can prepare and submit THPs and NTMPs to CALFIRE for review and approval. With the exception of plans that are exempted from the preparation and submission requirements under the CFPRs, all commercial timber harvest must go through this process (California Department of Forestry and Fire Protection 2009).

The CFPRs do not contain a definition of suitable marbled murrelet nesting habitat. Consequently, each RPF makes the decision on habitat suitability on a stand by stand basis, and RPFs may or may not disclose the presence of marbled murrelet habitat. CDFG or the Service (in coordination with CDFG) often do not have the resources to review the THP or NTMP, and CALFIRE has the option to accept or reject any recommended changes from the wildlife agencies to the THP or NTMP.

The marbled murrelet is listed as endangered by the State of California under the California Endangered Species Act. The CFPR goal for protection of marbled murrelets is to "avoid take and jeopardy pursuant to the California Endangered Species Act". The CFPRs require that when there is evidence of an active murrelet site in or adjacent to a THP or NTMP area, CALFIRE will consult with CDFG as to whether the THP or NTMP will result in take or jeopardy (California Department of Forestry and Fire Protection 2009).

The California Endangered Species Act more narrowly defines take than does the Federal Endangered Species Act. The California Endangered Species Act prohibits only direct take. For example, during the winter months when marbled murrelets are spend most of their time foraging at-sea and are absent from their inland nesting habitat areas, their nesting habitat could

be harvested outside the breeding season. However, under the CFPR's Special Conditions section 898.2, CALFIRE is required to disapprove a plan if implementation of the plan would result in take or jeopardy in violation of the Federal Endangered Species Act (California Department of Forestry and Fire Protection 2009).

When recommendations to avoid unauthorized take of marbled murrelets are provided by CDFG or the Service they are typically included in THPs or NTMPs. However, as previously stated, CDFG only reviews a small percentage of THPs and NTMPs and RPFs do not consistently disclose the presence of murrelet habitat. Consequently, suitable marbled murrelet habitat and possibly even occupied nesting habitat likely has been lost due to this inconsistency and lack of oversight.

In summary, the practical application of the CFPRs are only partially effective at protecting suitable habitat pursuant to the Federal Endangered Species Act due to the lack of a detailed description of habitat suitability within the CFPRs and the lack of adequate resource agency staff to review THPs and NTMPs that may contain suitable marbled murrelet nesting habitat.

Marine Life Protection Act. In 1999, the California legislature approved and the governor signed the Marine Life Protection Act (MLPA; Stats.1999, Chapter 1015). Prior to the MLPA, the state of California had established three types of marine protected areas (MPAs): State Marine Reserves (SMR), State Marine Parks (SMP), and State Marine Conservation Areas (SMCA). The MLPA requires that the CDFG to reevaluate all existing MPAs, and to prepare and present to the Fish and Game Commission a master plan that will guide the adoption and implementation of a Marine Life Protection Program, which would include a statewide network of marine protected areas, including new MPAs if needed. These protection areas establish regulations on recreational and commercial harvest of marine resources. The following number and type of marine protection areas currently occur within the range of the murrelet in California: Humboldt County (1 SMR), Mendocino County (5 SMCAs); Sonoma County (1 SMP, 1 SMR, 4 SMCAs), Napa County (1 SMP), Marin County (3 SMPs, 3 CMCAs), San Francisco County (1 SMCA); Solano County (1 SMP), Alameda County (1 SMP, 1 SMCA), San Mateo County (3 SMPs, 1 SMCA), Santa Cruz County (1 SMR, 1 SMCA), and Santa Cruz County (8 SMRs, 9 SMCAs). The MLPA is being implemented through the MLPA Initiative, which has broken the marine area of California into 5 study regions, 4 of which overlap the range of the murrelet (North Coast, Central Coast, North Central Coast, and San Francisco Bay). To date, the MLPA planning process has been completed only for one of these 4 regions, the Central Coast study region, which extends from Pigeon Point (San Mateo County) south to Point Conception. The planning process established or modified 29 MPAs, which now include 17.7 percent of State waters (those out to 3 nautical miles from the shore) in the Central Coast study region.

State Protections in Oregon

Protection for State-listed Threatened or Endangered Plants: Oregon Revised Statute (ORS) 564.100 to 564.135 are pursuant to State-listed threatened or endangered plant species and are implemented, interpreted and/or prescribed in Oregon Administrative Rule (OAR) Chapter 603, Division 73. ORS 564.120(1) states that "no person shall take, import, export, transport, purchase or sell, or attempt to take, import, export, transport, purchase or sell any threatened species or endangered species" listed by the State. All federally listed plant species are automatically protected under State law as well. State agencies shall consult and cooperate with the Department of Agriculture prior to implementation of any ground- or vegetation-disturbing

land action or project to conserve and protect State-listed species. State agencies are defined in OAR 603-073-0002(16) as "any publicly funded governmental subdivision of the State of Oregon including, but not limited to, state, county, and municipal agencies, public utility districts, state institutions of higher learning, public school districts, port authorities, public irrigation districts, and publicly owned airports." Take of a State-listed plant species by a State agency may occur once that agency has either completed a formal consultation process with or obtained a permit from the Oregon Department of Agriculture. The State may also authorize a permit for the scientific taking of a threatened or endangered species for "activities associated with scientific resource management such as research, census, law enforcement, habitat acquisition and maintenance, propagation and transplantation." State agencies are responsible for ensuring that ORS 564 (and its related OAR) requirements are satisfied before any land action is initiated, whether that action is conducted by the agency itself or by another party.

Protection for State-listed Threatened or Endangered Wildlife: According to Oregon Revised Statute 496.004(19), the term "wildlife" means "fish, shellfish, wild birds, amphibians and reptiles, federal swine as defined by State Department of Agriculture rule and other wild mammals." The term is further defined in OAR 635-100-0001(5) as "fish and wildlife species, subspecies and populations." State-listed threatened and endangered wildlife species are addressed in ORS 496.171 to 496.192 and ORS 498.026, and these statutes are implemented, interpreted or prescribed in OAR Chapter 635, Division 100. Upon listing of a species in the State, the State Fish and Wildlife Commission establishes guidelines that it considers necessary to ensure the survival of individual members of the species. These guidelines may include take avoidance and protecting resources sites such as spawning beds, nest sties, nesting colonies or other sites critical to the survival of individual members of the species (ORS 496.182(2)). ORS 498.026(1) states that "no person shall take, import, export, transport, purchase or sell, or attempt to take, import, export, transport, purchase or sell any threatened or endangered species, or the skin, hides or other parts thereof, any article made in whole or part from the skin, hide or other parts of any threatened or endangered species." A permit system for the scientific taking of State-listed threatened and endangered wildlife species is managed by the Oregon Department of Fish and Wildlife. An incidental taking permit or statement issued by a Federal agency for a species listed under the Federal Endangered Species Act "shall be recognized by the State as a waiver for any state protection measures or requirements otherwise applicable to the actions allowed under the federal permit" (ORS 496.172(4)).

Oregon Forest Practices Act: The Oregon Forest Practices Act (ORS 527.610 to 527.992 and OAR Chapter 629, Divisions 600 to 665) lists protection measures specific to private and State-owned forested lands in Oregon. These measures include specific rules for resource protection, including threatened and endangered species, specifically the northern spotted owl; riparian areas along lakes, streams, springs and seeps; and wetlands. Compliance of the forest practice rules does not substitute for or ensure compliance with the Federal Endangered Species Act. Landowners and operators are advised that Federal law prohibits a person from taking certain threatened or endangered species which are protected under the Endangered Species Act (OAR 629-605-0105).

State Protections in Washington

Protection for State-listed Threatened or Endangered Wildlife. Although there is no State Endangered Species Act in Washington, the Washington Fish and Wildlife Commission has the

authority to list species (RCW 77.12.020). State listed species are protected from direct take, but their habitat is not protected (RCW 77.15.120). Under the Washington State Forest Practices Act the Washington State Forest Practices Board has the authority to designate critical wildlife habitat for State listed species affected by forest practices (WAC 222–16–050, WAC 222–16–080). Washington has prepared a Comprehensive Wildlife Conservation Strategy (CWCS) (WDFW 2005). The plan is a non-regulatory statewide approach to conservation in Washington and fulfills a requirement to access two new Federal grant programs. The draft strategy describes basic biology and distribution, general and specific problems facing the species, and general conservation strategies for the species. It also identifies specific conservation actions for the species. Development of the Washington CWCS has proceeded on a parallel track with completion of ecoregional assessments for nine ecoregions within Washington. For each ecoregion, WDFW will complete Wildlife Action Plans that will include the species-specific proposed conservation actions. However, it is unknown when the Wildlife Action Plans will be completed, what actions will be proposed, or when such actions would be implemented.

The Washington State Forest Practices Rule. The Washington State Legislature established the authority for Forest Practices Rules (FPR) in 1974. The Forest Practices Board established rules to implement the Forest Practices Act in 1976 and has amended the rules continuously over the last 30 years. Washington Department of Natural Resources (WDNR) is responsible for implementing the FPR and is required to consult with Washington Department of Fish and Wildlife (WDFW) on matters relating to wildlife, including murrelets. The FPR specifically establish marbled murrelet suitable habitat definitions, survey requirements, and review processes of forest practices that may impact murrelet habitat. The FPR provide protection to occupied (as defined by FPR) murrelet sites on private forest lands where the landowner owns more than 500 acres of land that are less than 50 miles from marine waters. For those lands that are presumed to have at least a 30 percent probability of occupancy, landowners are subject to survey requirements and those areas where occupancy is found are protected. The Washington Forest Practice Rules provide for protection of marbled murrelets through minimization of take and jeopardy pursuant to the Washington Endangered Species Act and the Federal Endangered Species Act. However, the definitions of suitable habitat, inland distance, and occupied site are negotiated definitions; therefore not all of the lands the Service considers to have features essential for conservation of murrelet are considered to be suitable habitat under FPR, are not subject to the specific murrelet FPR, and may be harvested without review by WDFW. In addition, landowners have the option to go through SEPA and get approval to harvest (however this has not occurred to date). Current FPR protect occupied (as defined by State) habitat and a 300-foot managed buffer around occupied habitat. However, there are no reasonable assurances that the maximum site size and managed buffers are adequate to protect and maintain maintain complex-structured forest isolated from human development such that the risk of predation, windthrow, and changes in microclimate are reduced.

Federal Regulations

National Environmental Policy Act (NEPA): NEPA (42 U.S.C. 4371 *et seq*.) provides some protection for listed species that may be affected by activities undertaken, authorized, or funded by Federal agencies. Prior to implementation of such projects with a Federal nexus, NEPA requires the agency to analyze the project for potential impacts to the human environment, including natural resources. In cases where that analysis reveals significant environmental effects, the Federal agency must propose mitigation alternatives that would offset those effects

(40 C.F.R. 1502.16). These mitigations usually provide some protection for listed species. However, NEPA does not require that adverse impacts be fully mitigated, only that impacts be assessed and the analysis disclosed to the public.

Clean Water Act: Under section 404, the U.S. Army Corps of Engineers (Corps or USACE) regulates the discharge of fill material into waters of the United States, which include navigable and isolated waters, headwaters, and adjacent wetlands (33 U.S.C. 1344). In general, the term "wetland" refers to areas meeting the Corps's criteria of hydric soils, hydrology (either sufficient annual flooding or water on the soil surface), and hydrophytic vegetation (plants specifically adapted for growing in wetlands). Any action with the potential to impact waters of the United States must be reviewed under the Clean Water Act, National Environmental Policy Act, and Endangered Species Act. These reviews require consideration of impacts to listed species and their habitats, and recommendations for mitigation of significant impacts.

The Corps interprets "the waters of the United States" expansively to include not only traditional navigable waters and wetlands, but also other defined waters that are adjacent or hydrologically connected to traditional navigable waters. However, recent Supreme Court rulings have called into question this definition. On June 19, 2006, the U.S. Supreme Court vacated two district court judgments that upheld this interpretation as it applied to two cases involving "isolated" wetlands. Currently, Corps regulatory oversight of such wetlands (e.g., vernal pools) is in doubt because of their "isolated" nature. In response to the Supreme Court decision, the Corps and the U.S. Environmental Protection Agency (USEPA) have recently released a memorandum providing guidelines for determining jurisdiction under the Clean Water Act. The guidelines provide for a case-by-case determination of a "significant nexus" standard that may protect some, but not all, isolated wetland habitat (USEPA and USACE 2007). The overall effect of the new permit guidelines on loss of isolated wetlands, such as vernal pool habitat, is not known at this time.

Endangered Species Act of 1973, as amended (Act; 50 CFR 1431 *et.seq*.). The Act is the primary Federal law providing protection for this species. The Service's responsibilities include administering the Act, including sections 6, 7, 9, and 10.

Section 6 of the Act. Section 6 provides a mechanism for cooperation between the U.S. Fish and Wildlife Service and States in the conservation of threatened, endangered, and candidate species. Under section 6, FWS is authorized to enter into agreements with any State that establishes and maintains an "adequate and active" program for the conservation of endangered and threatened species. Once a State enters into such an agreement, FWS is authorized to assist in, and provide Federal funding for, implementation of the State's conservation program. Federal funding, provided in the form of grants, can be used to support management, outreach, research, and monitoring projects that have direct conservation benefits for listed species, recently de-listed species, and candidate species that reside within that State. This program is known as the Cooperative Endangered Species Conservation Fund (CESCF). We do not believe this program was discussed in the analysis for the 2004 5-year review.

Since 1994, in Washington State, approximately 10,560 acres have been permanently conserved under the CESCF (S6) that have or will have habitat that could benefit marbled murrelets. In Oregon, the 193-acre Big Creek property will be purchased to benefit at least 11 species of conservation concern including the marbled murrelet. In California, approximately 25,000 acres

was purchased through the Mill Creek acquisition. All areas are intended to be managed for the long term conservation benefit of murrelets. Management of these lands may not impede the conservation benefit of murrelets and the Service has approval over each of the management plans. Within these areas, not all of the acreage is currently suitable murrelet habitat. See Table B1 for total acreages and the amount of currently suitable murrelet habitat …

Table B1. Acreages conserved under CESCF for murrelets in Washington

Area	Total acreage	Acres of terrestrial murrelet habitat
Hoh	6,000	1,000
Cedar	20	0
Boulder, WA	1,894	200
Ellsworth, WA	800	200
Ashford, WA	1,800	Maybe 100
Barr, WA	46	46
Big Creek, OR	193	?
Mill Creek, CA	25,000	121
TOTAL	10,753	

Section 7 of the Act. Section 7 of the Act directs all Federal agencies to use their existing authorities to conserve threatened and endangered species and, in consultation with the Service, to ensure that their actions do not jeopardize listed species or destroy or adversely modify critical habitat. Section 7 applies to management of Federal lands as well as other Federal actions that may affect listed species, such as Federal approval of private activities through the issuance of Federal permits, licenses, or other actions. A jeopardy determination is made for a project that is reasonably expected, either directly or indirectly, to appreciably reduce the likelihood of both the survival and recovery of a listed species in the wild by reducing its reproduction, numbers, or distribution (50 CFR 402.02). A non-jeopardy opinion may include reasonable and prudent measures that minimize the amount or extent of incidental take of listed species associated with a project. In some cases mitigation for a jeopardy opinion can include purchase or easement on a property to protect that species.

Quinault Indian Reservation North Boundary Area: In September 2004, the Secretary of the Interior and the President of the Quinault Indian Nation signed an agreement to preserve 4,207 ac of sensitive forest habitat on the Quinault Indian Reservation in Washington state. This agreement settled a lawsuit brought by the tribe after the Service issued a 1998 jeopardy biological opinion for the marbled murrelet on the Quinault's 1995 comprehensive timber management plan. Through implementation of the agreement, the Department is purchasing perpetual conservation easements on the late successional forests identified in the reasonable and prudent alternative of the biological opinion.

In 2006, the U.S. Fish and Wildlife Service completed conservation easements with the Bureau of Indian Affairs and the Quinault Indian Nation for 2,925 ac of forested land in the North Boundary Area (NBA). The NBA has been surveyed and is known to be occupied by marbled murrelets (as determined by surveys under the PSG protocol). When the full extent of the conservation easements are implemented, they will apply to 4,262 ac (2,980 ac of old-growth and 1,282 ac of second growth). The conservation easement conveys all future development rights to the Service in perpetuity, except for harvesting of minor forest products (such as brush

and mushrooms), hunting, fishing, trapping, camping, and use of trees as guidelines or tailholds for harvest in adjacent areas.

The purpose of the conservation easement is to preserve, protect, restore, enhance, maintain, and promote the functional value of existing and potential future late-successional forest and its use as habitat for the marbled murrelet and other species dependent on late successional forest habitat. Generally, the following are prohibited unless determined by the Service to be consistent with the purposes of the easement: thinning or timber harvest; salvage of dead or down trees; construction of new roads; modification of existing roads; storing, dumping, or other disposal of toxic and/or hazardous materials; conversion of native vegetation to exotic species; introduction of non-native animal species; grazing of livestock; construction or placement of buildings or other structures; application of biocides, herbicides, or other chemicals; changing the topography; human-caused fires; granting of additional easements or rights-of-way; subdivision; or transference of appurtenant water rights.

The Service administers the easements and provides the reasonable assurances that the agreement will be implemented. The old-growth forests will be retained and the second-growth forests will be managed to enhance and promote late-successional forest characteristics. Barring unforeseen circumstances, such as wildfire, the conservation effort of the easements should be effective.

Section 9 of the Act. Section 9 prohibits the taking of any federally listed endangered or threatened species. Section 3(18) defines "take" to mean "to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct." Service regulations (50 CFR 17.3) define "harm" to include significant habitat modification or degradation which actually kills or injures wildlife by significantly impairing essential behavioral patterns, including breeding, feeding or sheltering. Harassment is defined by the Service as an intentional or negligent action that creates the likelihood of injury to wildlife by annoying it to such an extent as to significantly disrupt normal behavioral patterns which include, but are not limited to, breeding, feeding, or sheltering. The Act provides for civil and criminal penalties for the unlawful taking of listed species. Incidental take refers to taking of listed species that results from, but is not the purpose of, carrying out an otherwise lawful activity by a Federal agency or applicant (50 CFR 402.02).

Section 10 of the Act. For projects without a Federal nexus that would likely result in incidental take of listed species, the Service may issue incidental take permits to non-Federal applicants pursuant to section 10(a)(1)(B). To qualify for an incidental take permit, applicants must develop, fund, and implement a Service-approved Habitat Conservation Plan (HCP) that details measures to minimize and mitigate the project's adverse impacts to listed species. Regional HCPs in some areas now provide an additional layer of regulatory protection for covered species, and many of these HCPs are coordinated with California's related Natural Community Conservation Planning program. A Safe Harbor Agreement (SHA) is a voluntary agreement whereby a section 9 permit is also granted and involves private or other non-Federal property owners whose actions contribute to the recovery of species listed as threatened or endangered under the Endangered Species Act (ESA). In exchange for actions that contribute to the recovery of listed species on non-Federal lands, participating property owners receive formal assurances from the FWS that if they fulfill the conditions of the SHA, the FWS will not require any additional or different management activities by the participants without their consent. Central to

this approach is that the actions taken under the SHA will provide a net conservation benefit that contributes to the recovery of the covered species.

HCPs and SHAs developed since the analysis for the 2004 5-year Review.

Washington

Low-effect Geoduck HCP (WDNR). An incidental take permit (ITP) was approved and issued to Washington Department of Natural Resources (WDNR) on January 8, 2009, for the commercial harvest of wildstock geoducks clams (*Panopea abrupta*) on 30,000 acres of State-owned aquatic lands. The 50-year permit covers the commercial harvest of geoduck on submerged lands in Puget Sound, the Strait of Juan de Fuca, and the San Juan archipelago. Within this broad area, commercial geoduck harvest occurs subtidally between depth contours of -18 and -70 feet (corrected to mean lower low water [MLL]) in areas that have been surveyed and found to contain harvestable numbers of geoducks. The total acreage fluctuates as newly discovered beds are added to the inventory, or the status of an existing tract is changed. The commercial status of a tract can change if a tract is rendered unharvestable by pollution, a tract gets fished down to where it is put into recovery status, or geoduck densities are too low for a viable commercial fishery. The geoduck clam is among the most commercially valuable of Puget Sound's shellfish resources. Covered activities under the HCP include the subtidal harvest of wild stock geoduck clams on State-owned aquatic lands for commercial, research, and health sampling purposes. Harvest compliance and enforcement actions taken by WDNR are also covered by the ITP. Covered species include the marbled murrelet, brown pelican, bull trout, bald eagle, coastal cutthroat and the tufted puffin. Conservation measures developed to minimize and mitigate the effects of harvest on covered species include the buffering of eelgrass beds and submerged-aquatic vegetation, protection of forage fish spawning areas, minimization of surface noise levels, and the avoidance of nesting bald eagles and tufted puffins by limiting harvest activities to 600 feet or greater from the shoreline.

Tagshinny Tree Farm (TTF). The USFWS issued an Enhancement of Survival Permit to Tagshinny Tree Farm (TTF) on February 19, 2004, in accordance with their authority and responsibility under section 10(a)(1)(A) of the Endangered Species Act of 1973, as amended (16 U.S.C. 1531 et seq.). This type of permit is commonly known as a Safe Harbor Agreement (SHA) and/or a Candidate Conservation Agreement with Assurances (CCAA). Under the terms of both the SHA and CCAA, the tree farm owners will manage 144 acres in 5 parcels of commercial timberlands in Lewis County, Washington for a period of 80 years. The TTF is typical of other privately owned tree farms in Lewis County, Washington, in that these lands are generally composed of young and simple structured conifer forests, due to past timber management practices. These forests lack many of the important habitat features that many forest species in the Pacific Northwest need to survive. For instance, large, dominant snags and large down logs are mostly absent from the tree farm. Multiple canopy layers that develop in older stands are also generally not present on the TTF. Covered actions under the SHA/CCAA are: timber harvest (cutting, felling, limbing, yarding, and yarding corridors, construction and use of landings, loading and hauling of logs); road use, maintenance, and decommissioning; site preparation; tree planting; manual brush control; prescribed burning; fire suppression; erosion control; tree thinning and pruning; administration and monitoring; conducting stand examinations and inventories, and cruising timber; painting or marking of timber or stand boundaries; and entry by wildlife biologists, foresters, and other personnel for miscellaneous activities such as assessments, land surveys, and general reconnaissance. The use of pesticides is

not a covered activity. Covered species are the marbled murrelet, spotted owl, and bald eagle. As specified in the Conservation Plan, the tree farm owners will implement longer forest rotations; retain standing dead and green recruitment trees, and large woody debris; provide riparian and wetland buffers; provide various aged forested habitats; and ensure that covered lands stay under forest management. The tree farm owner has also committed to protecting marbled murrelet nest trees and adjacent habitat, if nest trees are found to be occupied by marbled murrelets.

Port Blakely Safe Harbor Agreement: The USFWS proposes to issue an Enhancement of Survival Permit to Port Blakely Tree Farms, L.P., in accordance with their authority and responsibility under section 10(a)(1)(A) of the Endangered Species Act of 1973, as amended (16 U.S.C. 1531 et seq.). This type of permit is commonly known as a Safe Harbor Agreement (SHA). The SHA would apply to Port Blakely's James G. Eddy Tree Farm lands in the vicinity of Morton, Washington. The SHA lands would cover 45,306 acres of commercial forestland, adjacent to Gifford Pinchot National Forest and Washington Department of Natural Resources (WDNR) lands. The ownership contains mostly second-growth coniferous forests. Forest management operations that would be covered under the SHA include various types of timber harvest, road construction and maintenance, yarding, hauling, planting, slash disposal, and work associated with such actions. While Port Blakely's intent is that the SHA would be in effect for 60 years, Port Blakely has the option of vacating the SHA at any point in time with no penalty. The only restriction is that Port Blakely would be required to return to baseline conditions. Due to extended harvest rotations under the SHA, fewer total acres of forest would be harvested across Port Blakely's ownership in the 60-year permit term. Also, 380 acres of mature forest would be set aside that would otherwise have been available for harvest under current forest practices rules. While we consider these 380 non-contiguous acres to be potential murrelet habitat, it is unknown if murrelets occupy the habitat due to lack of complete surveys. The potential conservation benefit to murrelets over the permit term is considered to be small.

Oregon

As stated in the 2004 5-year review, there are no HCPs currently covering marbled murrelets in Oregon. The Oregon Department of Forestry is currently working on an HCP for the Elliott State Forest that may include incidental take and conservation measures for marbled murrelets. However, because the HCP is still in development, we will not consider any details of the work at this time.

California

There have been no HCPs or SHAs that cover murrelets signed since October 1, 2003.

Sikes Act: The Sikes Act (16 U.S.C. 670) authorizes the Secretary of Defense to develop cooperative plans with the Secretaries of Agriculture and the Interior for natural resources on public lands. The Sikes Act Improvement Act of 1997 requires Department of Defense installations to prepare Integrated Natural Resource Management Plans (INRMPs) that provide for the conservation and rehabilitation of natural resources on military lands consistent with the use of military installations to ensure the readiness of the Armed Forces. INRMPs incorporate, to the maximum extent practicable, ecosystem management principles and provide the landscape necessary to sustain military land uses. While INRMPs are not technically regulatory mechanisms because their implementation is subject to funding availability, they can be an added

conservation tool in promoting the recovery of endangered and threatened species on military lands.

National Park Service (NPS) Organic Act: The NPS Organic Act of 1916 (39 Stat. 535, 16 U.S.C. 1, as amended), states that the National Park Service "shall promote and regulate the use of the Federal areas known as national parks, monuments, and reservations … to conserve the scenery and the national and historic objects and the wildlife therein and to provide for the enjoyment of the same in such manner and by such means as will leave them unimpaired for the enjoyment of future generations." The National Park Service Management Policies indicate that the Park Service will "meet its obligations under the National Park Service Organic Act and the Endangered Species Act to both pro-actively conserve listed species and prevent detrimental effects on these species." This includes working with the Service and undertaking active management programs to inventory, monitor, restore, and maintain listed species habitats, among other actions.

National Forest Management Act (NFMA): The National Forest Management Act (36 C.F.R. 219.20(b)(i)) has required the USDA Forest Service to incorporate standards and guidelines into Land and Resource Management Plans, including provisions to support and manage plant and animal communities for diversity and for the long-term, range-wide viability of native species. Recent changes to NFMA may affect future management of listed species, particularly rare plant occurrences, on National Forests. On January 5, 2005, the Forest Service revised National Forest land management planning under NFMA (70 FR 1023). The new planning rule changed the nature of Land Management Plans so that plans generally would be strategic in nature and could be categorically excluded from NEPA analysis, and thus not subject to public review. Under this new planning rule, the primary means of sustaining ecological systems, including listed species, would be through guidance for ecosystem diversity. If needed, additional provisions for threatened and endangered species could be provided within the overall multiple-use objectives required by NFMA. The final rule did not include a requirement to provide for viable populations of plant and animal species, which had previously been included in both the 1982 and 2000 planning rules. On March 30, 2007, however, the United States District Court in *Citizens for Better Forestry et al. v. USDA* (N.D. Calif.) enjoined the USDA from implementing and utilizing the 2005 rule until it complies with the court's opinion regarding the Administrative Procedure Act, the Endangered Species Act, and the National Environmental Policy Act. On May 14, 2007, the Forest Service published a Notice of Intent to prepare an environmental impact statement to analyze and disclose potential environmental consequences associated with a National Forest System land management planning rule. The impact of any revisions of this rule to listed species is unknown at this time. A new land and resource management planning regulation under NFMA (2008 rule, 36 CRF 219) was adopted on April 21, 2008 (73 FR 21467); the 2008 rule has provisions for social, economic, and ecological sustainability, and no longer has a provision regarding habitat to support species viability. The provision for ecological sustainability states an overall goal of providing "a framework to contribute to sustaining native ecological systems by providing appropriate ecological conditions to support diversity of native plant and animal species in the plan area. The 2008 rule also specifies: "If the responsible official determines that provisions in plan components [in addition to that for ecosystem diversity] are needed to provide appropriate ecological conditions for specific threatened and endangered species, species-of-concern, and species-of-interest, then the plan must include additional provisions for these species, consistent with the limits of Agency authorities, the

capability of the plan area, and overall multiple use objectives." (2008 rule, 36 CFR 219. 10(b)(2)).

Federal Land Policy and Management Act of 1976 (FLPMA): The Bureau of Land Management is required to incorporate Federal, State, and local input into their management decisions through Federal law. The FLPMA (Public Law 94-579, 43 U.S.C. 1701) was written "to establish public land policy; to establish guidelines for its administration; to provide for the management, protection, development and enhancement of the public lands; and for other purposes." Section 102(f) of the FLPMA states that "the Secretary [of the Interior] shall allow an opportunity for public involvement and by regulation shall establish procedures … to give Federal, State, and local governments and the public, adequate notice and opportunity to comment upon and participate in the formulation of plans and programs relating to the management of the public lands." Therefore, through management plans, the Bureau of Land Management is responsible for including input from Federal, State, and local governments and the public. Additionally, Section 102(c) of the FLPMA states that the Secretary shall "give priority to the designation and protection of areas of critical environmental concern" in the development of plans for public lands. Although the Bureau of Land Management has a multiple-use mandate under the FLPMA which allows for grazing, mining, and off-road vehicle use, the Bureau of Land Management also has the ability under the FLPMA to establish and implement special management areas such as Areas of Critical Environmental Concern, wilderness, research areas, etc., that can reduce or eliminate actions that adversely affect species of concern (including listed species).

On Forest Service (FS) and Bureau of Land Management (BLM) land, management for listed species and species of concern follow FS Sensitive Species policy and OR/WA BLM Special Status Species policy (Kerwin and Huff 2007:6). For OR/WA BLM administered lands, these policies describe the need to manage for species conservation. For FS, these policies require the agency to maintain viable populations of all native and desired non-native wildlife, fish, and plant species in habitats distributed throughout their geographic range on National Forest System lands. Management "must not result in a loss of species viability or create significant trends toward federal listing" for any identified Sensitive Species (Kerwin and Huff 2007:6).

National Coastal Wetland Conservation Grant. The National Coastal Wetlands Conservation Grant Program was established by the Coastal Wetlands Planning, Protection and Restoration Act of 1990. Under the Program, the U.S. Fish and Wildlife Service provides matching grants to States for acquisition, restoration, management or enhancement of coastal wetlands. The Act also establishes a role for the Fish and Wildlife Service in interagency wetlands restoration and conservation planning. In Washington State, approximately 10,766 acres were protected and restored during 2004 to 2009 and provide protection of marine forage species for the murrelet. We are unaware of any acreage identified under the NCWCG in Oregon or California that provides conservation benefits to the murrelet. In addition, marine properties in California are publicly owned or considered public domain. Properties purchased under this program in California are currently all focused on coastal freshwater or brackish/tidal wetlands, and/or are located south of the murrelet range.

The Northwest Forest Plan. The Northwest Forest Plan was adopted to address dual concerns for the economy and threatened wildlife dependant upon old- growth forests. A team of 600 specialists drafted the Northwest Forest Plan (NWFP), which was officially adopted in 1994. U.S. Forest Service and Bureau of Land Management (BLM) lands within the range of the

Northern spotted owl (mostly West of the Cascades, including Washington, Oregon, and Northern California) are currently governed by the NWFP's rules. The Northwest Forest Plan outlines management policies for several land designations that it specified in the Plan's allocations. In 2004, the Northwest Forest Plan was revised to address concerns related to the Survey and Manage process. This revision discontinued the application of the Survey and Manage process. While significant to some species, this revision does not appear to have caused changes to the net conservation benefit of the Northwest Forest Plan for the marbled murrelet. In addition, in March 2004, the Aquatic Conservation Strategy (ACS) was revised and the Services issued biological opinions that eliminated the requirement that each timber sale must promote attainment of the ACS objectives. However, in March 2006, the courts ruled that the amendment violated the Act. At this point no revision of ACS has occurred and therefore no change to conservation benefits for marbled murrelet as a result of this proposed revision has occurred.

Forest or Resource Management Areas could revise their plans under the Northwest Forest Plan at any time. On December 30, 2008, the Records of Decision for the BLM Western Oregon Plan Revisions were signed. These Records of Decision and associated resource management plans (RMPs) replace the RMPs for BLM-administered lands in western Oregon that were approved under the Northwest Forest Plan. Marbled murrelet management under the new RMPs is accomplished by 1) blocked Late Successional Management Areas (LSMAs), 2) stand-level LSMAs for murrelets outside block LSMAs, 3) requirements to identify and protect occupied stands and certain nearby stands, and 4) prohibitions against disrupting occupied murrelet sites.

LSMAs were originally designed as blocks of BLM land managed to, in part, maintain habitat for northern spotted owls and marbled murrelets and promote development of nesting habitat for marbled murrelets where it does not currently occur, similar to the LSRs of the NW Forest Plan. In addition, stand-level LSMAs were designated for stands determined to be occupied by murrelets under the NW Forest Plan. Within the range of the marbled murrelet on BLM lands in Oregon, 323,200 acres were initially mapped as LSMAs.

Additional stands were designated as LSMA outside the blocks, including all stands 80 years of age or older within the 1996 marbled murrelet critical habitat and 35 miles of the coast. This adds an additional 41,000 acres. Combined, 364,200 acres of Oregon BLM lands are protected as LSMAs under the Western Oregon BLM Records of Decision. This compares to 484,300 acres under the NW Forest Plan on the same landscape. Stands that are determined to be occupied by murrelets in the future would add additional LSMA acreage.

The RMPs include the requirement to survey suitable lands for marbled murrelets prior to activities that would degrade or remove marbled murrelet suitable habitat regardless of land use allocation, and to delineate and protect occupied stands. These requirements are the same as those in the NW Forest Plan. In addition, the plans prohibit disruptions in occupied murrelet habitat.

Migratory Bird Treaty Act (MBTA): The MBTA and its implementing regulations (50 CFR Parts 20 and 21) directly protect certain bird species, and their eggs and nests, from being killed, taken, captured, or pursued. However, it does not protect habitat except to the extent that habitat alterations would directly kill birds.

The Lacey Act**:** The Lacey Act (P.L. 97-79), as amended in 16 U.S.C. 3371, makes unlawful the import, export, or transport of any wild animals whether alive or dead taken in violation of any United States or Indian tribal law, treaty, or regulation, as well as the trade of any of these items acquired through violations of foreign law. The Lacey Act further makes unlawful the selling, receiving, acquisition or purchasing of any wild animal, alive or dead. The designation of "wild animal" includes parts, products, eggs, or offspring.

National Wildlife Refuge System Improvement Act of 1997: This act establishes the protection of biodiversity as the primary purpose of the National Wildlife Refuge system. This has lead to various management actions to benefit the federally listed species.

The Comprehensive Environmental Response, Compensation and Liability Act of 1980 (CERCLA or Superfund) 42. U.S.C. 9601 et seq. . This is the principal statute governing the cleanup of sites contaminated with hazardous substances and responses to spills of those substances. The statute establishes liability for site cleanup, prescribes a procedure for identifying and ranking contaminated sites, provides funding for site cleanups, reduces uncontrolled releases of hazardous substances, establishes cleanup procedures that provide protection for humans and the environment, and restores injured natural resources through provisions administered by the natural resource trustees. In conjunction with OPA, it mandates a "National Oil and Hazardous Substances Pollution Contingency Plan (NCP)" to provide the organizational structure and procedures for preparing for and responding to discharges of oil and releases of hazardous substances, pollutants, and contaminants. The statute was amended by the Superfund Amendment and Reauthorization Act (SARA) in 1986, which adds extensive public "right-to-know" and emergency planning requirements, establishes a fund for leaking underground storage tanks, and imposes worker safety requirements for hazardous materials.

Natural Resource Damage Assessment Process. As required under CERCLA (above), after an oil spill or hazardous substance release, response agencies like the U.S. Environmental Protection Agency or the U.S. Coast Guard clean up the substance and eliminate or reduce risks to human health and the environment. But these efforts may not fully restore injured natural resources or address their lost uses by the public. Through the NRDA process, Damage Assessment, Remediation, and Restoration Program (DARRP) and co-trustees conduct studies to identify the extent of resource injuries, the best methods for restoring those resources, and the type and amount of restoration required. The NRDA process contains 3 steps: preliminary assessment, injury assessment and restoration planning and restoration implementation. Under this process properties may be purchased or easements undertaken to mitigate for losses experienced by natural resource damages.

Washington

Tenyo Maru Oil Spill: The Trustees used approximately $4.7 million Tenyo Maru NRDA settlement funds (from 1991 spill) to permanently protect and restore over 900 acres of coastal forest in three parcels. All of the areas are now protected from logging, development and other activities detrimental to the recovery of marbled murrelets. These include 220 acres of rare coastal old growth forest currently supporting nesting marbled murrelets, as well as high-quality second growth forest and younger stands of trees that will serve as a buffer to the old-growth stands and eventually grow into mature forests, expanding marbled murrelet nesting habitat. The 338-acre Teal Slough property is held and managed by the USFWS's Willapa National Wildlife Refuge. Two parcels are managed under a 200-year land use agreement with the Makah Tribe.

The land use agreements collectively cover about 566 ac in the Anderson Point and Waatch River Valley areas of the Reservation. The Trustees also surveyed potential marbled murrelet nesting areas, resulting in the increase of regulatory protection on an additional 3,000 acres of mature forest habitat in Washington.

Texaco-Anacortes Oil Spill: The Trustees purchased 82 acres of privately-owned tideland in Fidalgo Bay with settlement funds from the Texaco-Anacortes oil spills (1991). These newly-protected tidelands are now owned and managed by WDNR. Together with 450 acres acquired in 1999 through a similar transaction this brings the total protected area in the southern part of the bay to 532 acres. The area is proposed for management as an Aquatic Reserve. The tidelands contain important eel-grass beds and inter-tidal habitats that support and help restore forage fish, important to marbled murrelets.

Oregon

M/V New Carissa Oil Spill. Since the analysis for the 2004 5-year review was completed, two new conservation easements have provided long term commitments to manage for marbled murrelet habitat on 4,263 acres. The Reed Creek property (3,851 acres) and the Arnold Creek Property (412 acres) were purchased and will be managed to compensate the public for injuries to marbled murrelet caused by the M/V New Carissa Oil Spill that began on February 4, 1999 on the OR coast. Both parcels occur in Lincoln County, OR and will be managed by the Confederated Tribes of Siletz Indians (CTSI). The CTSI will manage the property with the purpose of creating and maintaining 2,842 acres or 2/3 of the property in murrelet habitat and were consistent with the first purpose, to provide sufficient revenue for management of the property through limited commercial timber harvest and other activities to protect and promote other late seral or mature forest conditions, native fish and wildlife.

California

Stuyvesant/Humboldt Coast Oil Spill. In California, three parcels of commercial timberlands containing murrelet nesting habitat have been protected since October 1, 2003. In 2008, 650 acres of forest in the "Miracle Mile" parcel, including 142 acres of nesting habitat, were protected by conservation easement, as part of the mitigation for the Stuyvesant/Humboldt Coast oil spill. Also in 2008, 298 acres of forest in the "Big Mynot/E. Fork Hunter" complex, including about 77 acres of nesting habitat, were protected by conservation easement, as part of the mitigation for the Kure/Humboldt Bay oil spill. For both of the above, the conservation easements were purchased from the Green Diamond Resource Company, are located in Conservation Zone 4 in Del Norte County, and are being held and managed by the Save the Redwoods League, a non-profit conservation organization. In 2006, 80 acres of forest in the "U.C. Regents Girl Scout Creek" parcel, including clusters of residual redwood old-growth trees, were protected by purchase as part of the mitigation for the Command oil spill. The Girl Scout Creek parcel is located in Conservation Zone 6 in San Mateo County, and has been transferred to California State Parks (Butano State Park) for management. All three parcels above include habitat determined to be occupied.

The Outer Continental Shelf Lands Act of 1953. The Outer Continental Shelf Lands Act of 1953 (OCSLA) (43 U.S.C. 1331 et. seq.) provides the Secretary of the Interior, on behalf of the Federal Government, with authority to manage the mineral resources, including oil and gas, on the outer continental shelf (OCS) and defines the OCS as all submerged lands lying seaward of the State/Federal boundary. The Federal Oil & Gas Royalty Management Act of 1982 (30

U.S.C. 1701) mandates protection of the environment and conservation of federal lands in the course of building oil and gas facilities. The Secretary of the Interior designated the Minerals Management Service (MMS) as the administrative agency responsible for the mineral leasing of submerged OCS lands and for the supervision of offshore operations after lease issuance. In managing the offshore oil and gas resources, the MMS conducts environmental studies, issues leases, and regulates operations conducted on the Outer Continental Shelf (OCS). The regulatory responsibilities include issuing permits for oil and gas exploration, development, and production and inspecting operations during all of these activities.

A Federal moratorium on offshore drilling and platform development was initiated by the U.S. Congress in 1982 (U.S. Department of Energy 2005). On October 1, 2008, the 1982 offshore drilling moratorium expired and was not renewed by the U.S. Congress. However, according to their website, the moratorium is still depicted on their maps. In addition, the 2007-2012 plan does not include any leases planned for the DPS of the marbled murrelet although that could change very rapidly. On September 16, 2008, the U.S. House of Representatives passed bill H.R. 6899, the Comprehensive American Energy Security and Consumer Protection Act, which would allow oil and natural gas exploration and production between 50 and 100 mi (80161 km) off the U.S. coasts. The U.S. Senate has received but not yet voted on H.R. 6899. Fossil fuel (e.g., petroleum and natural gas) energy use and production is and will likely continue to be a significant societal issue for the United States in the foreseeable future. Consequently, it is foreseeable that within the next 15 years, offshore oil and gas platform development may occur off the coasts of Washington, Oregon, and California.

The Oil Pollution Act of 1990. The Oil Pollution Act of 1990 (33 U.S.C. 2701-2761) amended the Clean Water Act and addressed the wide range of problems associated with preventing, responding to, and paying for oil pollution incidents in navigable waters of the United States. It created a comprehensive prevention, response, liability, and compensation regime to deal with vessel- and facility-caused oil pollution to U.S. navigable waters. The OPA increased federal oversight of maritime oil transportation and provided environmental safeguards by: setting new requirements for vessel construction and crew licensing and manning; mandating contingency planning; enhancing federal response capability; broadening enforcement authority; increasing penalties and potential liabilities; and creating new research and development programs. Various Federal agencies are responsible for implementing the OPA. The Environmental Protection Agency (EPA) is responsible for non-transportation-related onshore facilities and incidents in the terrestrial environment, the USCG is responsible for marine transportation-related facilities and incidents in the marine environment, MARAD (in the Department of Transportation) is responsible for promoting the U.S. merchant marine and shipbuilding industry, and the Department of Commerce (specifically, NOAA) is responsible for natural resource damage assessments relating to oil discharges. The OPA requires a phase-out of single-hull tankers from U.S. waters by 2015. National Research Council (1998, p. 147) report that although the mandatory phase-out schedule of section 4115 of the OPA bans all single-hull tankers (without double bottoms or double sides) from U.S. trade after 2010, it is probable that under the deepwater port and lightering zone exemption, large single-hull vessels up to 30 years of age will operate in the United States through 2015. For this status review, we could not find specific information indicating how many single-hull tankers currently utilize Washington, Oregon, or California waters, and whether compliance with the double-hull provisions of section 4115 of the OPA will be achieved. The OPA imposes liability for removal costs and damages

resulting from an incident in which oil is discharged into navigable waters or adjoining shorelines or the exclusive economic zone

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 has considered revising their tug escort requirements (WDOE 2005); however, the current requirement of an escort of a tug or tugs for all oil tankers 40,000 deadweight tonnage or greater when not in ballast (WAC 363-116-500**)** remain in place.

California Coastal National Monument. Under the authority of the Antiquities Act of 1906, the California Coastal National Monument (CCNM) was established by Presidential Proclamation number 7264, on January 11, 2000**.** The Presidential Proclamation defined the CCNM as all unappropriated or unreserved lands and interest in lands owned or controlled by the United States in the form of islands, rocks, exposed reefs, and pinnacles above mean high tide within 12 nautical miles of the shoreline of the State of California. The CCNM is comprised of more than 20,000 small islands, rocks, exposed reefs, and pinnacles within the corridor extending 12 nautical miles from the shoreline between Mexico and Oregon. This proclamation directed the Secretary of the Interior to manage the monument through the Bureau of Land Management (BLM). In 2005, the BLM approved a resource management plan for the CCNM (BLM 2005), which contains broad direction for the protection of the geologic formations and habitats for seabirds, and focuses on multi-agency and other partnerships and involvement of local communities as the keys to management and protection. The section 7 consultation on the resource management plan concluded that increased visitor use in the waters surrounding the CCNMs may subject foraging or loafing murrelets to some increased disturbance; however, increased educational and interpretive activities were expected to minimize the potential for such disturbance.

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