STATE OF WASHINGTON October 2016

Periodic Status Review for the Marbled Murrelet

Steven M. Desimone

Washington Department of
FISH AND WILDLIFE
Wildlife Program

The Washington Department of Fish and Wildlife maintains a list of endangered, threatened, and sensitive species (Washington Administrative Codes 232-12-014 and 232-12-011). In 1990, the Washington Wildlife Commission adopted listing procedures developed by a group of citizens, interest groups, and state and federal agencies (Washington Administrative Code 232-12-297). The procedures include how species listings will be initiated, criteria for listing and delisting, a requirement for public review, the development of recovery or management plans, and the periodic review of listed species.

The Washington Department of Fish and Wildlife is directed to conduct reviews of each endangered, threatened, or sensitive wildlife species at least every five years after the date of its listing by the Washington Fish and Wildlife Commission. The periodic status reviews are designed to include an update of the species status report to determine whether the status of the species warrants its current listing status or deserves reclassification. The agency notifies the general public and specific parties who have expressed their interest to the Department of the periodic status review at least one year prior to the five-year period so that they may submit new scientific data to be included in the review. The agency notifies the public of its recommendation at least 30 days prior to presenting the findings to the Fish and Wildlife Commission. In addition, if the agency determines that new information suggests that the classification of a species should be changed from its present state, the agency prepares documents to determine the environmental consequences of adopting the recommendations pursuant to requirements of the State Environmental Policy Act.

This document is a Periodic Status Review for the Marbled Murrelet. It provides a relevant summary of the best available science to date that informs the current status of the species and makes a recommendation as to what the conservation status should be based on the information. It is not intended to be a comprehensive species account describing the entirety of the state of knowledge of the species.

This document was reviewed by species experts and state and federal agencies. This was followed by a 90-day public comment period from July 12 to October 10, 2016. All comments received were considered during the preparation of the final periodic status review. The Department intends to present the results of this periodic status review to the Fish and Wildlife Commission for action at the November 2016 meeting.

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On the cover: photo of two murrelets by Aaron Barna; bird in winter by U. S. Fish and Wildlife Service; murrelet egg by Nick Hatch; background by Will Ritchie.

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EXECUTIVE SUMMARY

The Marbled Murrelet (*Brachyramphus marmoratus*) is a small seabird that inhabits nearshore marine environment in western North America. The distribution of murrelets in Washington includes the southern Salish Sea and the outer coast. The species was listed as threatened under the U.S. Endangered Species Act in 1992 in Washington, Oregon and California, primarily due to loss of old forest nesting habitat from commercial timber harvesting and mortality associated with net fisheries and oil spills, and was subsequently listed by the Washington Fish and Wildlife Commission as threatened in 1993. In 1997, Washington enacted State Forest Practices Rules to address impacts to murrelets from timber management on non-federal lands. Marbled Murrelets forage in the marine environment and may fly up to 55 miles inland where they nest and rear a single young on large tree limbs in mature and old conifer forests. Murrelets prey primarily on a variety of forage fishes, and sometimes on larger zooplankton. They exhibit strong site fidelity to nesting areas, appear to nest in alternate years, on average, and have a naturally low reproductive rate.

In Washington, since 1993 nesting habitat losses due to timber harvest have been substantial, with an estimated 30% cumulative loss on nonfederal lands. For all Washington land ownerships combined, the net loss was 13.3%, an average annual rate of -0.7% per year. At-sea population monitoring from 2001 to 2015 indicated a 4.4% decline in the murrelet population annually, which represents a 44% reduction since 2001. The 2015 population estimate for Washington is about 7,500 birds.

Sustained low juvenile recruitment has been identified as a main cause of the decline, but cumulative effects from threats on individuals and populations is not fully known. Vital demographic data are lacking, such as adult and post-fledging survival, and reproductive and emigration rates. Nest success is influenced by both terrestrial and marine factors, such as the availability of nesting sites and the amount and fragmentation of nesting habitat, which influences nest predation risk by avian predators such as jays, crows, and ravens. A 20% nest success rate in Washington for the period 2004-2008 was attributed to nestling starvation or adults abandoning eggs before completing incubation, suggesting low prey availability. Human marine activities appear to influence murrelet abundance and distribution in the Salish Sea. Declines in populations of forage fish species such as herring and anchovy subsequently resulted in an increased use of lower trophic level, less calorie-rich food sources (invertebrates). Ultimately, these changes to the marine food web may have influenced reproductive output. Federal and state landscape plans, and Forest Practices Rules implemented to help stem the loss of higher quality nesting habitat have been beneficial, but have not led to recovery goals being met.

The magnitude of the population decline indicates that the status of the Marbled Murrelet in Washington has become more imperiled since state listing in 1993. Without solutions that can

effectively address these concerns in the short-term, it is likely the Marbled Murrelet could become functionally extirpated in Washington within the next several decades. Therefore, our recommendation is to list the Marbled Murrelet as a state endangered species in Washington.

DESCRIPTION AND LEGAL STATUS

The Marbled Murrelet (*Brachyramphus marmoratus*) is a small seabird of the Alcidae family (Figure 1), inhabiting marine coastal waters in western North America. It has the unusual behavior among seabirds of flying considerable distances inland during the breeding season to establish nest locations. The Marbled Murrelet is considered threatened south of its Alaskan breeding range by federal and state agencies and Canada (Burger 2002, Piatt et al. 2007). The species was listed as threatened in 1992 under the U.S. Endangered Species Act in Washington, Oregon and California, primarily due to loss of old forest nesting habitat from commercial timber harvesting and mortality associated with net fisheries and oil spills (USFWS 1992). It was subsequently listed as threatened by the Washington State Fish and Wildlife Commission in 1993 (WAC 232-12-001).

Figure 1. Marbled Murrelet (left to right): adult breeding (Glenn Bartley/Vireo); chick on moss nest (Tom Hamer); adult non-breeding (Rick and Nora Bowers/Vireo).

DISTRIBUTION

Marbled Murrelets are found in coastal marine areas (generally within 5 to 8 km of shore) from the Aleutian Islands of Alaska south along the Pacific coast to central California (Ridgley et al. 2007, Nelson 1997; Figure 2). In Washington, the current and historical marine distribution of the Marbled Murrelet includes the southern Salish Sea (Puget Sound, Strait of Juan de Fuca) and the outer coast (Pacific Ocean; Figure 2). The known terrestrial nesting habitat distribution includes western Washington coniferous forest within about 55 miles of marine waters, which is the extent of the habitat analysis area as defined in the federal Northwest Forest Plan (Raphael et al. 2016). Nest locations in Washington have been documented from near sea level to 4200 feet elevation and inland to 36.5 miles from nearest marine water. An audio detection 70 miles from marine waters has been recorded (D. Lynch and W. Ritchie, USFWS, pers. comm.). Analyses of genetic samples from Washington (Bloxton and Raphael 2009), Oregon and California helped confirm an earlier finding that murrelets from mainland Alaska to northern California (the main genetic unit) are genetically distinct from peripheral populations in the central and western Aleutian Islands and from central California (Friesen et al. 2007).

NATURAL HISTORY

Nesting Habitat Requirements. The species is unusual among Alcids in that it does not nest in colonies at the marine-terrestrial interface. In the central and southern parts of its range, including Washington, the murrelet nests in coastal forests (Bradley and Cooke 2001, USFWS 2009, Barbaree et al. 2014). During April to mid-September, breeding murrelets make daily flights from marine foraging areas to tend inland nest sites.

In Washington, Marbled Murrelets usually nest in older forests dominated by western hemlock (*Tsuga heterophylla*), Sitka spruce (*Picea sitchensis*), Douglas-fir (*Pseudotsuga menziesii*) and western redcedar (*Thuja plicata*) trees that have large branches that support substantial moss, epiphytes and debris to form platforms on which a single egg is laid (Hamer and Nelson 1995, Ralph et al.1995, Nelson 1997, Nelson et al. 2006, Wilk et al. 2016; Figure 1). While most nests are on large limbs (e.g., 30-75 cm width) of trees that are >150 years old (Hamer and Nelson 1995, Burger 2002, Wilk et al. 2016), relatively younger patches of predominantly western hemlock (70-100+ years) with mistletoe infection, moss and epicormic branching have been used for nesting in southwestern Washington (Hamer and Nelson 1995, Nelson and Hamer 1995). Nesting habitat includes forest structure of sufficient height and depth to provide vertical and horizontal cover to the nest and nest tree. This structure appears to enhance microclimate conditions and minimizes predation risk by providing hiding cover (Raphael et al. 2002b, Meyer et al. 2004, Huff et al. 2006).

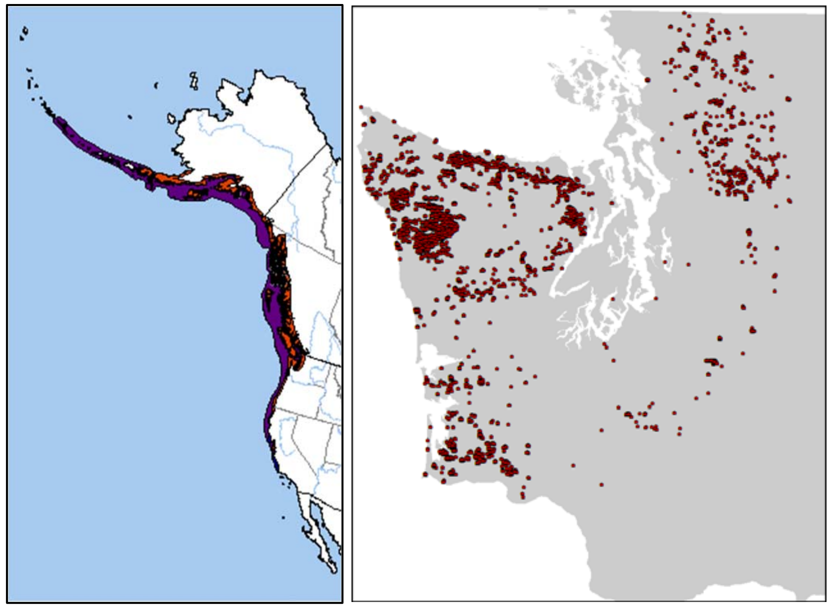

Figure 2. Global range of the Marbled Murrelet (left, Ridgely et al. 2007), and breeding season occurrences in Washington (right, WDFW Wildlife Surveys and Data Management 2016).

Foraging (Marine) Habitat and Diet. Marbled Murrelets forage in marine waters, usually within 2- 8 km of shore (Nelson 1997, Hebert and Golightly 2008, USFWS 2009). Marbled Murrelets prey primarily on forage fish such as Pacific herring (*Clupea pallasii*), northern anchovy (*Engraulis mordax*), eulachon (*Thaleichthys pacificus*), Pacific sand lance (*Ammodytes hexapterus*), surf smelt (*Hypomesus pretiosis*), juvenile rockfish (*Sebastes* spp.) and juvenile salmon (*Oncorhynchus* spp.). Fish regularly comprise 60-100% of the diet and larger zooplankton, such as krill (Euphausiacea) and Mysiids are also taken (Ralph et al.1995, Nelson 1997, Carter and Sealy 1986, Hobson 1990, Piatt et al. 2007). Murrelets have occasionally been observed using larger freshwater lakes in close proximity to marine areas for limited resting and foraging (Carter and Sealy 1986, WDFW Wildlife Surveys Data Management 2016).

Home Range and Site fidelity. The highest densities of Marbled Murrelets in Washington waters during the breeding season are found on the northern outer coast, northern Puget Sound, and the Strait of Juan de Fuca (Miller et al. 2006, Lance et al. 2013, Lance and Pearson 2016, Falxa and Raphael 2016, Figure 4). Larger areas of mature and old forests adjacent to those areas provide high quality potential nesting sites for murrelets. In Washington, straight-line distance from a known nest to the nearest marine shoreline ranged from 4–58 km (2.5-36.5 miles; WDFW Wildlife Surveys Data Management 2016). There is considerable variation in home range size and movement behavior across the species' range (Hull et al. 2001, Bloxton and Raphael 2009, Barbaree et al. 2015). In Washington, movements of radio-marked birds between the outer coast, Puget Sound, and Strait of Juan de Fuca were all observed within a season, indicating that some individuals incorporate substantial movements to secure food resources and may use portions of multiple marine regions in a single year. Several murrelets radio-tagged in Washington waters were later located along Vancouver Island to Desolation Sound (Bloxton and Raphael 2009). A bird nesting in the Hoh River drainage of the Olympic Mountains regularly foraged in the San Juan Islands, making daily flights of about 112 km (70 miles) from the nest, and sometimes visiting the Washington outer coast. A murrelet nesting in the Cascade Range foraged in the San Juan Islands >120 km (75 miles) from the nest (Bloxton and Raphael 2009). The mean home range of adults over 5 breeding seasons varied from 944-1802 km^2 (range 13 to 7,816 km^2) including marine water, land area and travel corridors (Bloxton and Raphael 2009). Northern California breeding season marine foraging areas (land excluded) were 505 ±75 km^2 (Hebert and Golightly 2008).

Marbled Murrelets exhibit strong site fidelity to nesting areas, with some birds documented nesting in the same trees in successive years and re-use of the same nest (e.g., Bloxton and Raphael 2009, Burger et al. 2009, Hebert and Golightly 2006). Multiple pairs nesting within a forest stand is well documented (see Plissner et al. 2015). Marbled Murrelets make social inland flights (usually multiple birds) to re-visit breeding areas in mid-winter (Naslund 1993, O'Donnell et al. 1995, Piatt et al. 2007).

Marbled Murrelet adults are generally assumed not to disperse widely between populations (Peery et al. 2004, Becker and Beissinger 2006, Norris et al. 2007); however, some seasonal migration does occur in Washington, as birds from British Columbia move to the sheltered waters of Puget Sound in fall and winter (Beauchamp et al. 1999).

REPRODUCTION AND SURVIVAL

The Marbled Murrelet is believed to be a relatively long-lived seabird, but reliable longevity estimates are lacking. Average lifespan is estimated at 15 years (U.S. Fish and Wildlife Service http://www.fws.gov/wafwo), and generation time has been estimated between 7 and 13 years (Burger 2002). Golightly and Schneider (2009) reported a breeding bird at least 9-11 years old.

The Marbled Murrelet has a naturally low reproductive rate; when in breeding condition, females produce a relatively large single egg (nearly 25% of body mass) and 1 brood per season (Nelson 1997). Given the high energetic cost of breeding, females are not likely to be in breeding condition every year and may nest in alternate years (Hull et al. 2001, Peery et al. 2004, Bradley et al. 2004). Both parents provision the chick daily with fish (1-8 feedings per day; Singer et al. 1991, Nelson and Hamer 1995, Jones 2001, Hebert and Golightly 2006). Marbled Murrelets have a relatively low wing area relative to body mass and consequently it is necessary for them to constantly flap their wings to remain airborne. Fledging chicks must attempt a direct flight to water without rest to avoid the fatal consequences of grounding. Nest success is influenced by both terrestrial and marine factors: the amount and juxtaposition of nesting habitat and the distribution and quality of adequate food resources (Raphael et al. 2002b; Marzluff et al. 2004; Malt and Lank 2007, 2009).

Annual survival, productivity, fecundity and reproductive viability estimates of Marbled Murrelets remain challenging data to obtain because of the difficulty of finding and capturing murrelets, and the low probability of recapturing birds from year to year. Relatively few studies have been able to achieve sample sizes needed to obtain reasonable estimates of adult survival and nesting success (Cam et al. 2003; Bradley et al. 2004; Peery et al. 2004, 2006a,b). Yearly adult survival was estimated to be 0.83-0.93 in Desolation Sound, British Columbia. Fecundity there was estimated at 0.19 to 0.23 female offspring produced per adult female per year (Cam et al. 2003). Another study using data from California and British Columbia, reported a fecundity estimate of 0.12 (Beissinger 1995). The threshold for fecundity, above which is thought to characterize a stable population, is 0.20 (Beissinger 1995:390). In British

Columbia, the likelihood of females breeding in a given year was estimated to be 0.65 (range 0.55 to 0.79) and nest success ranged from 0.38 to 0.48 over 4 years (Bradley et al. 2004).

Of 157 adult murrelets radio-tagged in Washington during 2004-2008, just 20 nests were found and monitored. Four of these nests were surmised to have been successful for a nest success rate of 0.20. Nest initiation rate was an average of 12.6% per year (Bloxton and Raphael 2009). The majority of nest failures appeared to be related to nestling starvation or adults abandoning eggs before completing incubation. This, coupled with a low nest initiation suggests low prey availability during the study (Bloxton and Raphael 2009).

In a small central California population, the estimated average proportion of breeders was 0.31, and murrelets spent more time foraging in poor reproductive years, suggesting availability of food was low, and so reproduction was limited by food availability and/or nest predation (Peery et al. 2004). At those rates, adult birds in central California are not able to replace themselves, as the fecundity estimate was so low (0.03-0.04; Peery et al. 2004).

Survival rates in central California were negatively affected by wearing radio transmitters in the year after tagging (Peery et al. (2006b). Six-year average survival estimates were 0.87 to 0.90 for control (both sexes) and 0.53 to 0.57 for radio-tagged murrelets; it was concluded that radio-tagging caused physical stressors that likely affected murrelet breeding performance and ability to pursue prey (Peery et al. 2006b).

Diet Shifts from Historical Marine Trophic Levels and Murrelet Productivity. The effects of decreased or changed prey availability during the last century, thought largely to be from depletion of forage fish, may have driven Marbled Murrelets to increasingly rely on less nutritious food sources (e.g., krill, zooplankton) and subsequently led to declines in reproductive output (Becker and Beissinger 2006, Norris et al. 2007, Gutowsky et al. 2009). Becker and Beissinger (2006) calculated about 80 krill equal the caloric value of 1 sardine. Norris et al (2007) reported a 62% drop in trophic feeding level in the northern Salish Sea (Georgia Strait, B.C.) based on nitrogen isotope data over a period of about 100 years, and suggested that the murrelet population was often limited by diet quality after the 1950s. Gutowsky et al. (2009) using similar methods reported a similar change in the diet of nestlings between 1854 and 2008 and suggested this decline in diet quality may have influenced the population decline in the Salish Sea. Becker and Beissinger (2006;) similarly found a 36% trophic level decline in murrelet diet coinciding with the collapse of the Pacific sardine fishery in the late 1940s in central California. The present-day estimates of the juvenile to adult reproductive ratio in central California were almost an order of magnitude lower (0.03 to 0.05) than the historical estimate of 0.30, which represents an 83-90% reproductive decline (Peery et al. 2006a,b) due to decreased forage supply (Becker and Beissinger 2006), while adult survival rates have likely remained unchanged (Beissinger and Peery 2007).

In response to higher ocean forage productivity, murrelet productivity in California was positively related to the proportion of mid-trophic level prey in post-breeding diets following a decadal shift to cooler conditions and lower local sea surface temperatures. This supported increased availability of higher quality prey to murrelets and improved murrelet reproductive success (Becker et al. 2007).

HABITAT AND POPULATION STATUS

Forest (Nesting) Habitat Status

Nesting habitat loss and subsequent fragmentation of remaining stands was identified as a primary factor leading to population declines and federal listing (USFWS 1997). It is estimated that less than 12-18% of the original unmanaged old-growth forest remains in western Washington (Booth 1991). The federal interagency Northwest Forest Plan (NWFP) was developed to meet requirements to primarily track status and trend of late-successional and old-growth forests, and population and habitat trends for Marbled Murrelets and Northern Spotted Owls. For murrelets, the ultimate goal is to relate population trends to nesting habitat conditions over time (Madsen et al. 1999).

Washington Nesting Habitat. In Washington, the NWFP 1993 baseline estimate of higher quality ("Suitability" Classes 3 and 4) habitat was 1.549 million acres for all ownerships combined (58% federal, 42% nonfederal). The NWFP 2012 estimate for all ownerships in Washington was 1.343 million acres of higher quality potential nesting habitat (66% federal, 34% nonfederal lands) (Raphael et al. 2016a). Most (89%) of the habitat on federal lands occurred within designation reserved areas, such as National Park, wilderness, late-successional reserves, or other congressionally or administratively withdrawn lands (Falxa and Raphael 2016). Figure 3 compares habitat amounts (all ownerships combined) on the NWFP area to Washington, and between federal and nonfederal ownership within the state.

Since 1993, loss of potential nesting habitat has occurred from timber harvest, windthrow events, fire, and forest disease. From 1993 to 2012, higher quality nesting habitat for all lands was reduced by an estimated 418,400 acres from the 1993 baseline estimate (-27% change) (Table 1; Raphael et al. 2016a). Most of this loss (95%) was attributed to timber harvest and wind throw on all ownerships (Raphael et al. 2016a), especially in southwestern Washington within the last decade (WDNR 2008). Newer habitat gained through forest growth in the 20-year period was estimated at 212,700 acres.

However, the recruitment of new Class 3 habitat just meeting threshold is of relatively lower quality than older Class 3 and Class 4 (highest quality) and so may not offset the loss of an equal amount of highest quality habitat (Falxa and Raphael 2016). Developing habitat is a gradient scale (Raphael et al. 2016a:54-55), where Class 3 is <u>relatively lower quality</u> (about 0.23 to 0.53 probability of being habitat in WA) compared to Class 4 (>0.53 probability). Thus the lower end of developing Class 3 is a threshold (at about 0.23 probability) that transitions from "Class 2- marginal" to Class 3. Therefore, the low end of Class 3 has a lower logistic probability of providing better habitat structure conditions than Class 4 and is relatively lower quality than Class 4 (Raphael et al. 2016a).

The change for all lands in Washington (gains and losses) was a net loss of about 205,700 acres of habitat, representing a -13.3% change from 1993-2012 (Figure 3; Raphael et al. 2016a). On Washington nonfederal (state and private) lands, there were 649,300 acres of Class 3 and 4 in 1993. In 2012, there were 456,000 acres, representing a 30% decline (Raphael et al. 2016a). It was estimated that 98% of the loss on nonfederal lands in Washington was attributed to timber harvest and windthrow (Table 1; Raphael et al. 2016a). The loss occurring on nonfederal lands was not further classified according to state-owned and private forest lands.

The estimated total of habitat for federal lands in Washington in 2012 was about 886,400 acres (66% of 1.343 million) (Table 2). For the 1993-2012 period there was a net change (losses plus habitat gains) of about -12,450 ac in Washington, about -1.4% change (Figure 3) (Raphael et al. 2016a).

Table 2. Acres of loss, gain and net change in Marbled Murrelet higher-quality (model classes 3 and 4) nesting habitat, and net change for the highest-quality (model Class 4) nesting habitat, from 1993 to 2012, for nonfederal and all ownerships in Washington (from Raphael et al. 2016a: Table 2-10).

Washington Nonfederal					Washington All ownerships			
Higher-quality (Classes 3+4)					Higher-quality (Classes 3+4)			
Province	**Losses**	**Gains**	**Net Change**		**Losses**	**Gains**	**Net Change**	
			Acres	**%**			**Acres**	**%**
Olympic Peninsula	137,349	50,398	-86,951	-29.1	190,238	88,436	-101,802	-11.9
Western Lowlands	130,778	48,785	-81,993	-32.0	134,437	53,379	-81,058	-30.1
Western Cascades	41,547	17,151	-24,396	-26.2	90,551	65,843	-24,708	-6.1
Eastern Cascades	657	693	36	2.7	3,220	5,033	1,813	10.0
Total	**310,331**	**117,027**	**-193,304**	**-29.8**	**418,446**	**212,691**	**-205,755**	**-13.3**

Table 1. Acres of loss, gain and net change in Marbled Murrelet higher-quality (Classes 3 and 4) nesting habitat, and from 1993 to 2012, for federal ownership in Washington (data from Raphael et al. 2016a).

Federal Washington Marbled Murrelet habitat (acres)				
	losses	gains	Net change class 3+4	Net change class 4
All owners	418,446	212,691	-205,755	-45,917
Nonfederal	(310,331)	(117,027)	(-193,304)	(-43,314)
Federal total	**108,115**	**95,664**	**-12,451**	**-2,603**

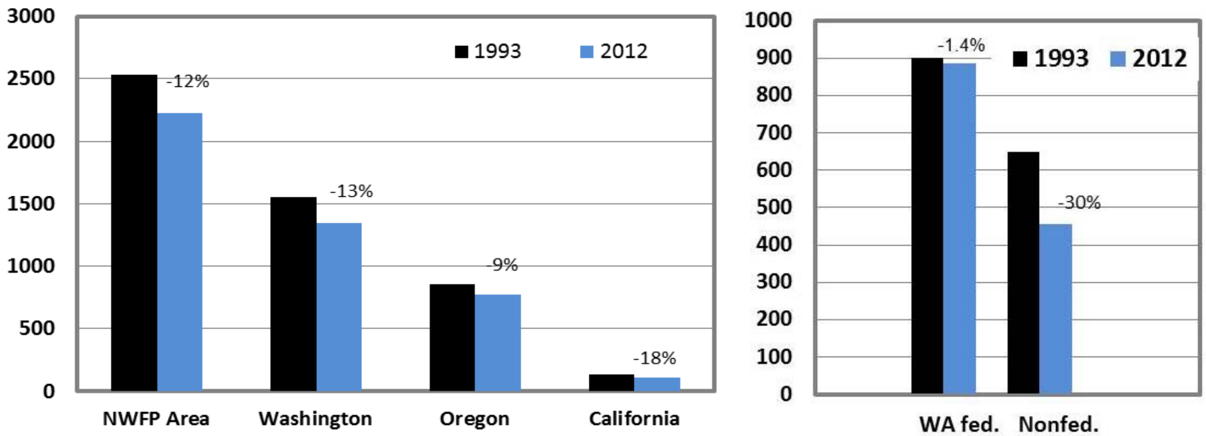

Figure 3. Net change of potential nesting habitat of higher quality (model classes 3 and 4 combined), Northwest Forest Plan Area, all ownerships (left); and Washington only (right), federal and nonfederal ownerships, 1993 vs. 2012 (1000's of acres; data from Raphael et al. 2016a).

Marine Habitat Status

Oceanic forage fish production on the outer coast of Washington is particularly influenced by both sea surface temperature and summer upwelling events. These events are influenced by both short- and long-term climatic events (e.g., El Niño and Pacific Decadal Oscillation) and local offshore winds. Lower sea surface temperatures and strong upwelling events have strong positive influences on fish populations.

In contrast, the southern Salish Sea is a non-upwelling system whereby foraging conditions are influenced more by freshwater inputs and tidal activity. The complex interaction between these two marine ecosystems – coastal ocean and inland Salish Sea – and their influence on predators and their prey are not well understood. To date, research indicates that the on-water distribution of murrelets during the breeding season is influenced primarily by the amount and pattern of higher-suitability nesting habitat and less by marine factors (Raphael et al. 2015, Raphael et al. 2016b). In addition, human activities (disturbance) appear to have a stronger influence on murrelet abundance and distribution in the Salish Sea during the breeding season than in other parts of the range (Raphael et al. 2015).

Global sea surface temperatures have increased 1.1°F since 1950, but no significant ocean warming offshore of North America was observed between 1900 to 2008, except in localized areas west of Vancouver Island (Tillmann and Siemann 2011). The coastal waters of Washington have exhibited seasonally hypoxic conditions since at least 1950, and the lowest recorded dissolved oxygen levels of the California Current System. Since 1800, outer coastal water acidity in Washington has increased by about 10 to 40 percent, translating to a pH decline of -0.05 to -0.15. This increased acidification in some areas of Puget Sound has shown disruption in calcification processes that affect development of some invertebrates, which may affect some forage fish (Tillmann and Siemann 2011).

Forage Fish Studies. Marine habitat for Marbled Murrelets in Washington in terms of forage quality and location has not been studied in detail. Pacific herring stocks in Puget Sound (in aggregate) were generally listed as "moderately healthy" as of 2012, with the exception of the Cherry Point stock, which has declined 62% since 1986 and is now regarded as "critical" (Stick et al. 2014). Other Puget Sound herring stocks in aggregate have seen a 26% decline from 1986-2010 (Stick et al. 2014). Data are lacking for herring and other forage fish stocks for the Washington outer coast. Northern anchovy stocks, smelt species and sand lance populations and demographics have been little documented in Puget Sound (Penttila 2007). Eulachon was recently listed as endangered under the U.S. Endangered Species Act.

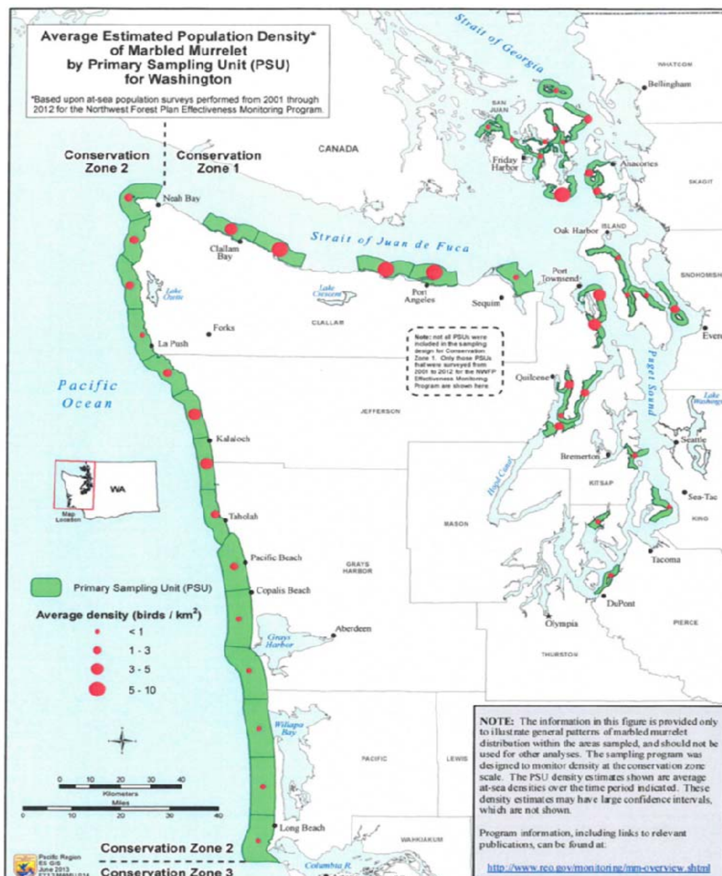

Figure 4. Average estimated at-sea population density, Zones 1 and 2, Marbled Murrelets by primary sampling unit (map from Falxa et al. 2013, used with permission).

Population Status

The "at-sea" survey methods for monitoring population size and trends were devised for the NWFP because of the difficulty of finding murrelet nests over large tracts of potential nesting habitat. Standardized transect surveys for murrelets were conducted within 1.5 km ("inshore") and 1.5 to 5-8 km ("offshore") to detect birds on the water during the breeding season (Miller et al. 2006, Falxa et al. 2016a, Figure 4). From 2000 to 2010, there was a 29% decline of the federally-listed portion of the population (Washington to central California; Miller et al. 2012). Current annual estimates of the total population for the listed range between Washington and central California overall have shown no clear trend (Falxa et al. 2016a).

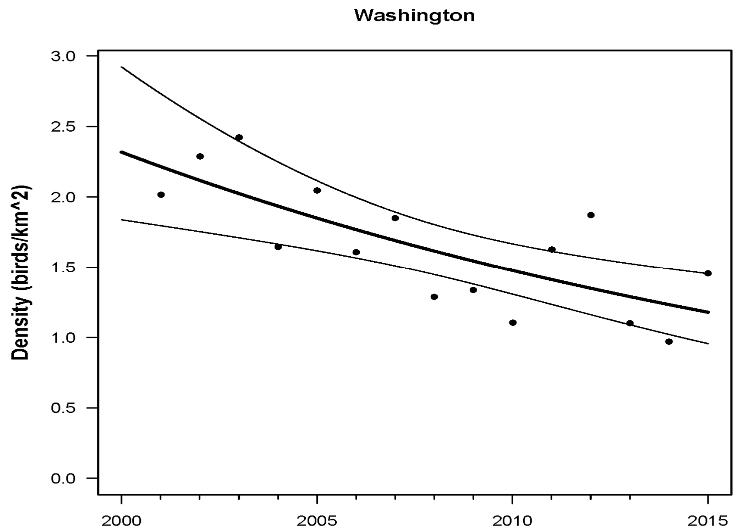

Figure 5. At-sea densities of Marbled Murrelets for 2001-2015 based on surveys conducted in Washington recovery zones 1 and 2 combined. The trend is a significant annual rate of decline in murrelet density of 4.4% (from Lance and Pearson 2016).

Washington Population. Washington data, however, have shown a significant downward trend from 2001 through 2015. The overall annual rate of change in murrelet density in Washington for 2001-2015 was -4.4% ($P = 0.002$) (95% CI = -6.8 to -1.9) (Lance and Pearson 2016, Falxa et al. 2016b; Figures 5, 6). For 2015, the population estimate for the Salish Sea was 4,290 birds, with a -5.3% average annual rate of decline for the 2001-2015 period (Lance and Pearson 2016). The population estimate for the Washington outer coast for 2015 birds indicated a declining trend of -2.8% for the same interval, but was not significant. The 2015 total population estimate for Washington (Salish Sea and outer coast combined) was 7,494 birds (95% CI = 3,667 to 11,320). The 15-year trend line represents a 44% decline in Washington Marbled Murrelet abundance from 2001-2015.

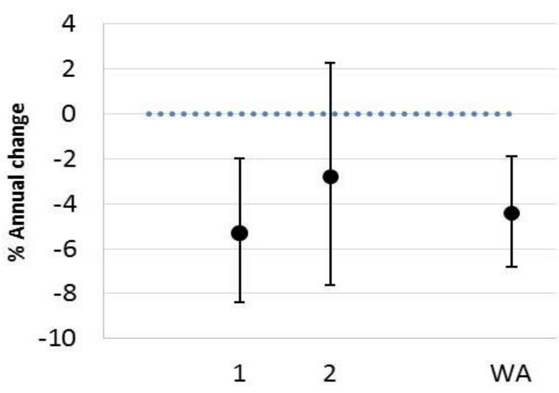

Figure 6. Marbled Murrelet population average rate of annual change from 2001-2015, with 95% confidence intervals for the Salish Sea (Zone 1), outer coast (Zone 2) and combined (WA). Dashed line (0) indicates stable population; intervals not overlapping 0 are significant (figure from Falxa et al. 2016b, used by permission).

Falxa et al. (2016a) acknowledge a possibility that a northward shift in murrelet distribution from Washington to Canada could mimic a population decline in Zone 1. However, they believed this is unlikely because: (1) the murrelet distribution at-sea during the breeding season generally coincides with the distribution of potential nesting habitat directly inland (Burger 2002, Meyer et al. 2002, Miller et al. 2002, Raphael 2006, Burger and Waterhouse 2009; Raphael et al. 2002, 2015); and (2) a large population fluctuation or population shift would suggest that breeders are shifting nest locations, which is contrary to existing evidence for nest site fidelity (Hebert et al. 2003, Piatt et al. 2007, Burger et al. 2009), and because population trend data in

B.C. from 1996-2013 do not support such a population shift, as annual murrelet population trends in B.C. are negative for 2 of 3 sampling regions adjacent to WA waters (Bertram et al. 2015).

Forest Habitat and Marine Abundance Correlations

The annual variation in murrelet numbers was more strongly correlated with the amount and configuration of adjacent nesting habitat than with trends in marine factors such as productivity and sea surface temperature (Raphael et al. 2015, Lorenz et al. 2016). Specifically, murrelet density and distribution at sea was strongly correlated with the amount of larger blocks of unfragmented areas of older forest (i.e., greater "habitat cohesion"). Washington "hotspots" were relatively higher-density areas of murrelets at sea and were identified as the Strait of Juan de Fuca, the San Juan Islands and the northern outer coast (Figure 4). These marine hotspots were areas where abundance of adjacent nesting habitat was strongly correlated with higher densities of murrelets in the adjacent waters (Raphael et al. 2015, Falxa and Raphael 2016, Lorenz et al. 2016). Moreover, the highest densities of birds were offshore of reserved federal lands from Washington to California (Meyer et al. 2002; Cooper et al. 2006; Raphael et al. 2002a, 2015, 2016b). In British Columbia, 6 separate watershed-level radar studies supported a linear relationship between murrelet counts at sea and proximity to inland areas of more contiguous habitat, and murrelets did not aggregate offshore where adjacent nesting habitat had been significantly reduced due to harvest (Burger and Waterhouse 2009).

FACTORS AFFECTING CONTINUED EXISTENCE

Adequacy of Regulatory Mechanisms

The U.S. Fish and Wildlife Service assembled an expert panel of scientists to form a Recovery Implementation Team (USFWS 2012) to develop a prioritized list of actions to help stem the Marbled Murrelet population decline in the short-term. They concluded that sustained low recruitment of young into the population is the main cause of decline, and identified 5 main mechanisms contributing to the decline: 1) ongoing and historical loss of forest nesting habitat; 2) low nest success from predation on eggs and chicks in nest; 3) changes in marine forage conditions affecting abundance, distribution and quality of prey; 4) post-fledging mortality; and 5) cumulative and interactive effects from factors on individuals and populations. These and other threats are summarized in the sections below.

Federal Critical Habitat. The federal recovery plan (USFWS 1997) for the Marbled Murrelet specifies actions necessary to halt the species' decline, including designating critical habitat (nesting) considered essential to the conservation of the species in Washington, Oregon and California (USFWS 1997). This designation was recently reaffirmed (80 Federal Register 164:51506, August 2015). The primary objectives of the federal recovery plan were to stabilize murrelet populations at or near their listing date levels by maintaining or increasing productivity and removing or minimizing threats to survivorship, largely through conservation and recovery of nesting habitat (USFWS 1997).

The persistence of nesting habitat on federal lands has been largely successful, because >99% of designated federal critical habitat in Washington occurs there (Falxa and Raphael 2016). However, the federal recovery plan (USFWS 1997) goals of maintaining and increasing populations, eliminating threats to survivorship, and stemming the decline of nest habitat for Washington have not yet been met.

Over the next 50 to 100 years, the amount of nesting habitat on federally protected lands should increase as forests mature. Implementation of the Northwest Forest Plan at a level lower than anticipated, in conjunction with designation of critical habitat, has limited the rate of habitat loss on federal land, such that the net loss on federal lands from all causes is only 5% of total net loss among all ownerships for

Washington (Raphael et al. 2016a; Tables 1, 2). Critical Habitat for Marbled Murrelet in marine areas has not been designated to date (80 Federal Register 164, August 2015); however, the northern outer Washington coast from Cape Flattery to Copalis has been designated as Olympic National Marine Sanctuary and National Wildlife Refuge.

Federal Habitat Conservation Plans and Acquisitions. Seven Habitat Conservation Plans (HCPs) that include Marbled Murrelet as a covered species have been implemented in Washington since the 1992 listing (USFWS 2009). These plans vary considerably in scale and scope of murrelet habitat protection and this variation is based on ownership objectives, forestry operations, capabilities, and geographic location. Of note, Washington Department of Natural Resources (WDNR) is currently developing a final long-term conservation strategy amendment for their HCP (WDNR 1997a). It is estimated that about 15.5% (approx. 213,000 ac) of the potential nesting Marbled Murrelet habitat in Washington currently exists on WDNR-managed lands; of this, about 40,000 acres are designated as Marbled Murrelet occupied habitat and currently deferred from harvest (Raphael et al. 2008; S. Horton, WDNR, pers. comm.). Since 1997, habitat loss on WDNR lands has been largely consistent with WDNR's HCP (WDNR 1997b) and interim strategy, plus the salvage of unforeseen windthrow or diseased habitat (S. Horton, WDNR, pers. comm.). Also of note, Seattle Public Utilities (2000) HCP committed to maintain existing mature and old forest, using active and passive restoration to aid recovery of old forest conditions for wildlife, including murrelets, over about 86,000 acres, with about 17% (14,623 acres) of the covered lands currently in forest ≥190 years old.

The USFWS Cooperative Endangered Species Conservation Fund has made purchase possible of about 15,000 acres of private forest lands in Washington for murrelet and other threatened and endangered species conservation through Section 6 of the ESA. About 1,500 acres of these lands are currently recognized as potential nesting habitat, with the majority being of higher quality (USFWS 2009; M. Acker, USFWS pers. comm.).

State Forest Practices Rules. The WDNR adopted the state Forest Practices Rules for state and private lands to help augment the federal recovery plan efforts. The Washington Forest Practices Rules (FPR) regulate timber harvest on state, county, private, and municipal lands that do not have a federal HCP, Safe Harbor Agreement or other federal agreement (WDNR 1997b). The rules for Marbled Murrelet require forest landowners to identify potential nesting habitat, and to conduct surveys (i.e., Evans Mack et al. 2003) to detect murrelets before modification or alteration of habitat can be permitted. If surveys determine there is a high likelihood that nesting birds are present within a given forest patch, the contiguous habitat is designated "occupied" and further environmental review through the State Environmental Policy Act could be undertaken to evaluate whether proposed forest practice activities would pose a likely adverse impact to the environment. If that assessment concludes there would be no impact, then the habitat may be harvested (WDNR 1997b). Management including harvest is allowed on nonfederal lands if the habitat was surveyed to protocol and found "not occupied," or, if the landowner has an accepted alternative plan or agreement such as a HCP. The rules also allow management in lower quality habitat that does not meet the definition of habitat as defined in the Forest Practices Rules without surveys. Some unintended loss of habitat has occurred (mostly minor) when rule-defined habitat was unreported or was not correctly identified through the Forest Practices Applications process (WDFW, unpubl. data). For the period 2013-2015, survey quality and compliance reviews conducted by WDFW showed that about 300 acres per year of rule-defined habitat on private lands had completed the FPR survey requirement and were no longer constrained by state regulation for murrelets, and thus available for management (S. Desimone, unpublished data).

Outside of federal HCPs and Safe Harbor Agreements, or state Forest Practices alternative plans, no real incentive yet exists for private landowners to grow habitat to help with recovery goals. One unfortunate circumstance of FPR and land ownership patterns is that some smaller occupied stands may become isolated and insular in landscapes dominated by younger forests and recently cut lands. These patches are vulnerable to edge effects and wind disturbance events over time so that the habitat provides increasingly less function, or eventually blow down completely. In aggregate, the degradation of these areas over the landscape during the last two decades has likely had some impact on the breeding population in areas regulated by FPR.

Continued Risks and Threats

Ongoing Loss of Forest Nesting Habitat. From 1993 to 2012 across the entire Northwest Forest Plan area, there was a 27% net loss of potential nesting habitat on nonfederal lands and about 2% net loss on federal lands. Habitat loss to timber harvest since 1993 has been greatest in Washington, with a 30% net loss on nonfederal lands. Aside from harvest loss, degradation is occurring from chronic wind disturbances and smaller storms (WDNR 2008). Wind damage occurs more frequently along hard forest edges where there is significant contrast between older, interior forest conditions and adjacent recently harvested or younger regeneration stands. High contrast edges also affect interior forest microclimate well inside the forest edge, modifying sunlight, temperature and humidity, and may reduce moss and epiphyte abundance for development and maintenance of potential nesting platforms (Chen et al. 1995, van Rooyen et al. 2011).

Habitat fragmentation, forest edge, and predation. Breeding success of Marbled Murrelets may be driven by the distribution of potential nest predators, which in turn is affected by the landscape pattern. Degradation of existing nesting habitat by human influence is an ongoing problem in Washington. Forest edge effects from timber harvest patterns are largely a direct result of habitat fragmentation. Increasing fragmentation can lead to higher predation levels by corvids (jays, crows and ravens) by reducing the size of the habitat patch and increasing the high contrast edge around habitat patches (Divoky and Horton 1995). Predation rates by corvids on murrelet eggs and chicks were higher when nests were within 50 meters of hard-edged forest, but the relationship varies with proximity to human activity and the structure of the adjacent forest (Raphael et al. 2002b). Predation in nesting stands was higher with increasing proximity to forest edge when the matrix landscape contained human settlement and recreation sites, but not as great when the adjacent forest was dominated by young and regenerated forests without humans (Raphael et al. 2002b, Marzluff et al. 2004, Marzluff and Neatherlin 2006). Predation risk was lower in nest patches with increasing average tree height in the adjacent developing stands without human presence (Malt and Lank 2007, 2009). Predator density can also increase at high-use recreational sites within or near murrelet habitat areas, where corvids seek human-related foods and refuse (Peery et al. 2004, Marzluff and Neatherlin 2006). Reducing the suitability and accessibility of campgrounds to corvids can help manage to decrease predation risk (Neatherlin and Marzluff 2004).

Raphael et al. (2016a) indicate high levels of habitat fragmentation throughout the NWFP area, with about half of all higher quality habitat in Washington in smaller patches classified as "edge" (>90 meters from the interior of a habitat patch) for all ownerships. On nonfederal lands in Washington and Oregon, 80-90% of total higher quality habitat was in "edge" category (Falxa and Raphael 2016). Limited data suggest that Marbled Murrelets do not nest in high densities, and do not "pack in" to remaining fragmented higher quality habitat (Conroy et al. 2002, Burger and Waterhouse 2009).

Low Nest Success. At present population trend rates, adult birds in Washington do not appear to be replacing themselves (Lance and Pearson 2015, 2016; USFWS 2012). This could be the result of low recruitment (nest success), but without reproductive information, it is unclear how low adult survival, post-fledging mortality, or birds emigrating out of state waters might contribute.

Genetic flow. Genetic research comparing historical (museum) and modern Marbled Murrelet specimens from central California suggests that largescale timber harvest and fragmentation of nesting habitat over the past century has led to genetic divergence of murrelets (Peery et al. 2006a, Piatt et al. 2007, Peery et al. 2010). The extent to which numbers of murrelet individuals may disperse from harvested nesting habitat to search for new habitat is generally unknown, but they do not appear to pack into the remaining local nesting habitat after logging (Burger 2001, Raphael et al. 2002a, Hall et al. 2009, Peery et al. 2010). It is suspected that Washington populations should have relatively less inhibited genetic flow, as they are positioned geographically in the middle of the range; however, consistently depressed population numbers off the southern Washington and northern Oregon coasts coupled with little nesting habitat in that region could lead to some inhibited genetic flow between Oregon and Washington (USFWS 2009) and possibly hamper breeding dispersal (Divoky and Horton 1995).

Changes in Marine Forage Conditions and Distribution, Abundance and Quality of Prey. Reductions of prey abundance and timing of prey availability are major concerns for seabird populations worldwide. A recent study found widespread reproductive failure in 14 seabird species worldwide (colony nesters) when forage fish and krill populations were below 1/3 of their long-term maximum prey biomass (Cury et al. 2011). There have been centennial declines in forage fish populations in the range of the Marbled Murrelet (Becker and Beissinger 2006, Norris et al. 2007, Gutowsky et al. 2009). In Puget Sound, the preservation of forage fish spawning, rearing, seasonal and migratory habitats is critical for forage stock maintenance, and habitat conservation of these stocks to some extent will depend on the application of shoreline regulations on state and private marine tidelands (Penttila 2007).

In the U.S. portion of the Salish sea (Zone 1), Raphael et al. (2015) found a slightly greater influence of human-related threats (commercial vessel traffic, pollution, fishing, shoreline alteration, climate influences) on the distribution and abundance of murrelets over time, than other marine factors such as primary productivity (surrogate for forage fish), sea temperature factors and forest habitat cohesion.

Climate Effects on Marine Habitat. Timing and abundance of prey are often dependent on ocean temperature and upwelling events (e.g., Becker et al. 2007), and these factors are closely linked with trends in climate change (Cury et al. 2011). Northwest ocean temperatures are projected to increase 2.2°F by the 2040s due to climate change (Tillmann and Siemann 2011). The Marbled Murrelet is considered "moderate to high vulnerability" to climate change, mainly due to the effects of warmer sea surface temperature in changing marine systems and associated changes in forage fish populations that can affect murrelet behavior, growth, health, reproductive success and survival (Tillmann and Siemann 2011).

Oil and Chemical Pollution. Large-scale oil spills have the potential to devastate local Marbled Murrelet populations and are a major anthropological threat. Significant Marbled Murrelet mortality in Washington has occurred during known during oil spill events in 1956, 1964, 1985, 1988 and 1991 (Neel et al. 2007). The 1991 *Tenyo Maru* oil spill near the entrance to the Strait of Juan de Fuca was thought to have killed about 9-12% of Washington outer coast murrelet population (*Tenyo Maru* Trustees 2000). No new major spills have occurred in Washington since 1991. Improvements in safety, spill response and tanker design have reduced major spills in recent years, but increasing volume of tanker and freighter traffic in the Salish Sea system presents substantial risk threat (Van Dorp et al. 2014, WDOE 2014).

Chronic smaller scale oil and chemical pollution is much harder to detect and track, and the number of murrelets actually affected is not clearly known. USFWS (2009) estimated current mortality of 2-3 Marbled Murrelets annually for Washington due to oiling. In the straits of Juan de Fuca and Georgia, 271 intentional or accidental smaller scale spills were reported from surveillance aircraft from 1997-2006, which represents a minimum estimate of 2,464 detectable spills per year, most of which are likely in the coastal areas where murrelets are typically found (O'Hara et al. 2013). These levels of chronic oil spill incidents represent a likely decline from before 1997.

Good et al. (2014) compared the persistent organic pollutants in the forage fish fed at nest locations to Rhinoceros Auklet (*Cerorhinca monocerata*) chicks in the Salish Sea to those on the Washington outer coast and found that the Salish Sea forage fish were 2-4 times more contaminated than those on the Washington coast. These Salish Sea auklets are foraging on the same forage fish species and in the same waters occupied by murrelets.

Commercial Fishing Net Mortality. Fishing net mortality, or "bycatch," of Marbled Murrelets is currently considered rare in Washington, but is subject to periodic monitoring. A purse seine monitoring study from 1996 to 2000 had no Marbled Murrelets recorded during 1,442 purse seine sets (WDFW 2004). Direct effects from gillnet entanglement likely have actually decreased in many areas over the last twelve years (NMFS and BIA 2015). From 2001 to 2014, Marbled Murrelet interactions and mortalities in Puget Sound net fisheries had not been documented in annual reporting, and interaction rates vary considerably between locations and depend on local conditions, characteristics of the fishery, and murrelet density. NOAA Fisheries' National Marine Fisheries Service modeled the probability of encountering murrelets during Treaty and non-Treaty commercial, ceremonial and recreational fisheries based on actual encounter rates and murrelet densities from at-sea surveys, which indicated that interactions between Marbled Murrelets and gillnet fisheries are relatively rare (NMFS and BIA 2015).

Alternative Energy Projects. Wind energy projects within the range of Marbled Murrelets in Washington have been proposed in recent years. To date, one project with 4 wind turbines has been completed and is in operation within 2 km of the ocean, and no monitoring reports on impacts to Washington wildlife have been produced. Of 8 other wind turbine projects proposed within the range of the murrelet on state or private land in Washington between 2010 to present, none have been built. Radar monitoring studies of murrelet flights have been conducted for most of these proposed wind turbine sites (e.g., Hamer 2009), and have found that murrelet-like targets can be detected. A U.S. Fish and Wildlife Service expert panel developed a protocol for using radar technology to survey for murrelets near proposed wind energy projects to help assess potential project impacts and needed survey intensity (Nelson et al. 2013). The protocol directs project developers to collect data on murrelet passage rates, flight paths, flight altitudes and suggests the survey effort needed on proposed project sites. They recommend careful siting of wind projects to avoid areas of known use by murrelets. Recently proposed use of tidal generators in the Salish Sea present new risks to the species and will need to be addressed.

Effects of Climate on Forest Habitat. Some future climate forecast models predict a generally warmer, drier trend for western Washington in the coastal spruce/hemlock zone (e.g., Halofsky et al. 2011). There is considerable uncertainty associated with the degree of climate change, but any warming could lead to increased fire risk and intensity, and possibly contribute to habitat loss. For nesting habitat, a reduced moisture climate could also affect moss and epiphyte development and its role in providing and sustaining potential nesting platforms in tree branches, and possibly increase prevalence of tree insect and disease outbreaks.

MANAGEMENT ACTIVITIES

Recovery Implementation Team. The Recovery Implementation Team (USFWS 2012) identified actions that state and federal resource agencies could implement in the near-term to help counter low recruitment. In the last two decades a number of management recommendations have been addressed to some extent. Conservation plans (HCP, SHA) have been developed to benefit murrelets, but it is too early to know the effectiveness of such plans for the long-term benefit to murrelets. Various projects involving forage fish species and how they may affect murrelet reproduction potential are underway with cooperating agencies (US Forest Service, WDFW, NMFS, NOAA), although budgets and time constraints limit the number of projects that can be implemented. The infrastructure for improved trash regulation and containment on state and federal public lands near murrelet nesting habitat to help control corvid numbers is in implementation phase and progress is variable among states and agencies.

The federal recovery plan (USFWS 1997) and designated federal Critical Habitat have led to federal management decisions (e.g., extremely limited manipulation of potential nesting habitat) in recent years on federal lands to realize that conservation of remaining higher quality (Class 3 and 4) habitat should be an effective short-term measure (next 3-5 decades) (Falxa and Raphael 2016). These actions are helping to conserve and restore higher quality nesting habitat adjacent to nearby productive marine habitat are most beneficial to the species (Meyer et al. 2002, Raphael 2002a, Raphael 2006), and given the species' strong site fidelity to nest areas, the dispersal and colonization of new or previously unused habitat is more likely when it is adjacent or near to areas presently used by murrelets (McShane et al. 2004, Raphael 2006, Burger and Waterhouse 2009, USFWS 2009). Malt and Lank (2007, 2009) found avian predation risk is likely reduced when existing smaller and isolated murrelet nesting stands in fragmented forest landscapes are surrounded by dense or similar structured conifer forests on longer rotations.

At-sea Monitoring. Population monitoring continues to be essential for measuring effectiveness of conservation and recovery efforts. Beginning in 2016, the Northwest Forest Plan at-sea monitoring will be changed from annual to biannual surveys. Washington Department of Fish and Wildlife will be solely responsible for implementing the surveys for state waters during the breeding season, alternating between Zones 1 and 2 in successive years (Falxa and Raphael 2016).

Pacific Seabird Group Inland Survey Protocol Revision. The Pacific Seabird Group Marbled Murrelet technical committee is currently reviewing and revising aspects of the terrestrial survey protocol (Evans Mack et al. 2003). This revision can have important management implications regarding Washington State Forest Practices Rules. A revised protocol is expected to be produced for the 2017 survey season (P. Harrison, pers. comm.).

CONCLUSION AND RECOMMENDATION

Marbled Murrelets have undergone population declines nearly range-wide within the last few decades (Piatt et al. 2007, Environment Canada 2014, Falxa and Raphael 2016). Murrelets in Washington have declined 4.4% per year between 2001 and 2015. There has been an apparent centennial decline in availability of forage fish prey resources, which in combination with nesting habitat loss, appears to have compromised nest success and survival of young. Despite progress in implementing federal forest management plans, habitat conservation plans, and state Forest Practices Rules, habitat loss has continued and the Washington Marbled Murrelet population has experienced a decline of approximately 44% over 15 years. The murrelet's low reproductive rate requires high survivorship of young for the population to grow. The magnitude of the population decline indicates that the status of the Marbled Murrelet in Washington has become more imperiled since state listing in 1993. Without solutions that can effectively address the major threats in the short-term, it is likely the situation for Marbled Murrelets will only worsen and the species could be lost from some landscapes in the decades ahead. Therefore, our recommendation is to up-list the Marbled Murrelet to the status of a state endangered species in Washington.

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i. Independent peer review; review is overseen by an independent third party.
ii. Internal peer review; review by staff internal to WDFW.
iii. External peer review; review by persons that are external to and selected by WDFW.
iv. Open review; documented open public review process that is not limited to invited organizations or individuals.
v. Legal and policy document; documents related to the legal framework for WDFW, including but not limited to: (A) federal and state statutes, (B) court and hearings board decisions, (C) federal and state administrative rules and regulations; and (D) policy and regulatory documents adopted by local governments.
vi. Data from primary research, monitoring activities or other sources.
vii. Records of best professional judgement of WDFW employees or other individuals.
viii. Other: sources of information that do not fit into one of the categories identified above.

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PERSONAL COMMUNICATIONS

Acker, Martin. Wildlife Biologist, U.S. Fish and Wildlife Service, Washington Fish and Wildlife Office, Lacey, WA.
Harrison, Peter. Wildlife Biologist, Washington Department of Natural Resources, Olympia, WA; Pacific Seabird Group Marbled Murrelet Tech. Comm. Protocol Revision co-chair.
Horton, Scott. Wildlife Biologist, Washington Department of Natural Resources, Forks, WA.
Lynch, Deanna. Wildlife Biologist, U.S. Fish and Wildlife Service, Lacey, WA.
Nelson, S. Kim. Wildlife Biologist and Associate Faculty, Oregon State University, Nash Hall, Corvallis, OR.
Ritchie, William. Wildlife Biologist, U.S. Fish and Wildlife Service, Willapa National Wildlife Refuge, WA.

APPENDIX A.

WDFW received responses to public comments during the 90-day public review period for the draft *Periodic Status Review for the Marbled Murrelet in Washington* conducted from 12 July to 10 October 2016. WDFW received >1650 individual comment letters from citizens, mainly form-letter emails. We received 5 extensive comment letters from forest products industry and non-governmental organizations. Most letters supported our recommendation. The comments presented here are summaries of the remarks provided by one or more people sharing similar views. We reviewed all public comments, and with the exception of comments that resulted in the need to clarify language, we made no other substantial changes to the Periodic Status Review (PSR) document.

Report Section	Comment and Response
General comments	Protecting Marbled Murrelet habitat will protect habitat for other species.
	Marbled Murrelets use mature and older conifer forests. Other species that use such habitats will benefit from measures that conserve murrelet habitat.
	Protecting Marbled Murrelets (and habitat) should be valued over short-term economic gain (and to alleviate adverse impacts).
	These comments reflect a policy perspective and are therefore beyond the scope of this document. However, we point out that state and federal rules and regulations are designed to address the need to protect Marbled Murrelet habitat while allowing for lawful resource extraction practices.
	Marbled murrelets continue to be impacted by "forest mismanagement…"
	Noted; the comment reflects a policy-related issue, which is outside the scope of this document.
	Government policy must reflect the danger of extinction and increase protections for this seabird. According to recent research, the most important factor in explaining the decline of the species is the decrease of suitable nesting habitat due to logging. We cannot continue funding our children's education at the expense of their ecological future.
	Noted; the comment reflects policy-related issues and is outside the scope of this Status Review document.
	The bird is on the decline and will easily become extinct in Washington if urgent conservation policy isn't enacted. We cannot allow another species to needlessly become extinct due to human activities.
	Noted; the comment reflects policy-related issues and is outside the scope of this document.
	By increasing protections for the murrelet, we protect our forests.
	Comment noted.
	The Marbled Murrelet has taken a back seat to the lumber industry. Oregon and California have both done a better job of preserving this bird and old growth trees than we in WA have done.
	Comment noted; we cannot speak to state management in Oregon and California.

General comments	
	After a storm, a raft of tree trunks, limbs, and debris had been washed into Commencement Bay. The flotsam moved north passing Poverty Bay and stretching from Normandy Park to Maury Island. I counted 10 Marbled Murrelets feeding on the fish gathered under the floating debris. In the waters off Pt Townsend we used to see many murrelets when we arrived in Seattle in the '70's. Nowadays there is only the occasional pair or single bird.
	Comment noted, thank you for the information.
	As a private citizen I have witnessed extensive loss of late successional habitat in southwest Washington that has impacted murrelets.
	Comment noted, thank you for the information.
	It has been nearly 20 years after the [WDNR] HCP was signed and a Marbled Murrelet Long-Term Conservation Strategy has yet to be put into place while the murrelet population is in steep decline. The HCP has benefitted the DNR with predictability of harvest and lower costs. Corresponding benefits to the murrelet population are questionable; my concern is that we have lost important habitat in the interim.
	Comment noted.
	There is no biological support for cutting more trees in MMMA's, thereby decreasing the habitat for future generations of Marbled Murrelets. We urge you to plan to defer any potential timber sales which are parts of MMMAs. We are asking you to follow the Science Team's recommendations by adopting a conservation strategy now.
	These comments reflect a policy perspective and are therefore beyond the scope of this document. However, we point out that state and federal rules and regulations are designed to address the need to protect Marbled Murrelet habitat while allowing for lawful resource extraction practices.
	Protecting the bird will have some positive effects. The nesting habitat that is currently suitable and those trees that will become suitable in future decades and centuries will be managed with much more care. The carbon stored in old growth trees and the carbon dioxide that is being taken in by growing forests are more likely to remain in the forest rather than being harvested and soon converted back into atmospheric gases.
	Comment noted.
	The PSR does not point out that we must arrest the further loss of suitable habitat and forest fragmentation is a severe threat that needs to be ameliorated.
	Comment noted; The PSR is not designed to provide management recommendations. The purpose of the PSR is to review the current status of the species and provide recommendations to the Fish and Wildlife Commission regarding Washington legal status.
	It is clear that recovery of the species will increasingly rely on greater conservation efforts on nonfederal land in the near term. It stands to reason that non-federal lands may also play an increasing role in providing terrestrial nesting areas as forests mature.
	Noted; the comment reflects a policy-related issue, which is outside the scope of this document.

Habitat and Population Status	Marbled Murrelets have been impacted by the extent and duration of past nesting habitat loss: an overall loss of 82% of old-growth forests statewide (Booth 1991) plus a net loss of 13% of habitat statewide over the past 20 years alone.
	Comment noted; WDFW appreciates the information.
	Absent some significant regulatory shifts, recent modeling demonstrates that Washington's murrelet population will continue to decline and risk extirpation in the coming decades.
	Comment noted *WDFW appreciates the information and the concern. We are aware of these data.*
	The Marbled Murrelet population has stabilized since 2010-2012 in both their entire range and within Washington.
	For the listed range of WA, OR, and CA combined for 2000-2013, we acknowledge there was no significant trend detected for population increase or decrease. However, in general, we see negative point estimates for declines in the Washington conservation zones and see stable or increasing populations to the south in recent years. *In Washington, the slopes for both zones 1 and 2 are negative and one zone has strong evidence for a decline as of 2015. Overall, Washington State Zones 1 and 2 combined show a significant decline of 4.4% per year.* *The most recent published trend information, including season 2015 data (Lance and Pearson 2016), indicates that at the scale of individual conservation zones, there was evidence for a population decline in Conservation Zone 1 (5.3% decline per year; 95% CI: -8.4 to -2.0%) (Lance and Pearson 2016 Table 2; Figures 2 and 4). The data also indicate that there is a negative trend in Conservation Zone 2, but the upper confidence interval overlaps zero – therefore, the trend for this Conservation Zone is less certain. The confidence interval for the Zone 2 trend has overlapped zero in some recent years and not in others suggesting both strong and weak evidence for a decline depending on the year (e.g., compare trend estimates for this zone using data through 2013, 2014, and 2015).*
	"…in addition to murrelet population stabilization since 2010-2012, the habitat loss has stabilized dramatically as well."
	Regarding murrelet population stabilization, please see comment response above. Regarding habitat loss, we know of no information that would corroborate this statement. The estimated loss on non-federal lands for Washington was -29.8% of the baseline from 1993-2012, and -13.3% statewide for all ownerships (Raphael et al. 2016a; PSR July 2016 Table 1). The NWFP does not have habitat change data beyond 2012, nor can a true rate be reliably calculated between one beginning point in 2010 and one ending point in 2012.
	Habitat gains and losses for years 2013 to present were not reported by WDFW Status Review.
	We do not know of any other comprehensive data set available that is comparable to the Northwest Forest Plan monitoring 20 year review (Falxa and Raphael 2016), which tracked murrelet abundance estimates and nesting habitat gains and losses at regional landscape provinces. Unfortunately, forest monitoring was only modeled up to the year 2012 (inclusive) for the NWFP report. We would appreciate a reference of any similar comprehensive data set covering nesting habitat for these years that we could include in the PSR.
	Commenter states "Interestingly, 'in terms of nesting habitat persistence on federal land, the

	NWFP' (which includes all federal critical habitat) 'has been largely effective for Washington' …, as >99% of designated critical habitat in Washington occurs on federal lands."
Habitat and Population Status	*The commenter has misquoted language in the PSR, leaving out an important phrase (the elipse above): ...'has largely been effective for Washington **federal lands'** which misconstrued the meaning of the sentence. Because 99% of the designated federal critical habitat is on federal lands, it has been effective for persistence of nesting habitat on the Washington federal lands only, not the entirety of the state. We do not imply it has been effective for all ownerships in Washington; this would not be the case. This statement has been clarified in the final draft.*
	Population estimates from Zone 1 may not be reliable because of "highly volatile" population numbers from year to year. Downward trend in Zone 1 is a cause of perceived population declines as a whole, but likely affected by irregular attendance by Canadian birds. If Zone 1 fluctuations are not due to habitat on land, but to forage fish spatial shifts, then Zone 1 trends are not representative.
	Falxa et al. (2016:30) acknowledge the possibility that a northward shift in murrelet distribution from Washington to Canada could mimic a population decline in Zone 1. However, the authors think this possibility is unlikely because: (1) the murrelet distribution at sea during the breeding season generally coincides with the distribution of potential nesting habitat directly inland (Burger 2002, Meyer et al. 2002, Miller et al. 2002, Raphael 2006, Burger and Waterhouse 2009, Raphael et al. 2002, 2015);and (2) a large population fluctuation or population shift would suggest that breeders are shifting nest locations, which is contrary to existing evidence for nest site fidelity (Hebert et al. 2003, Piatt et al. 2007, Burger et al. 2009), and because population trend data in B.C. from 1996-2013 do not support such a population shift, as annual murrelet population trends in B.C. are negative for 2 of 3 sampling regions adjacent to WA waters (Bertram et al. 2015). This clarification has been included in the final draft.
	Trends derived from monitoring from zones 2-5 suggest populations not declining. Plots for Conservation zones 2-4 shows much lower variability that individual zone plots. Despite reported habitat loss there is no decline of murrelets in Conservation zones 2-4.
	Our review is focused on the status of the murrelet in Washington State only. In Washington, the slopes for both zones 1 and 2 are negative and one zone has strong evidence for a decline as of 2015. The most recent published trend information (Lance and Pearson 2016) indicates that at the scale of individual conservation zones, there was evidence for a population decline in Conservation Zone 1 (5.3% decline per year; 95% CI: -8.4 to -2.0%) (see Table 2 and Figures 2 and 4). The data also indicate that there is a negative trend in Conservation Zone 2, but the upper confidence interval overlaps zero – therefore, the trend for this Conservation Zone is less certain. The confidence interval for the Zone 2 trend has overlapped zero in some recent years and not in others suggesting both strong and weak evidence for a decline depending on the year (e.g., compare trend estimates for this zone using data through 2013, 2014, and 2015). Falxa et al. (2016a:24) show adequate power to detect trends: 95% power to detect 4% decline in Zone 1 and Zone 2 (19 years and 22 years resp.). Zone 3, the next most southerly zone was not sampled in 2015 and, as a result trends cannot be assessed through 2015. In general, we see negative point estimates for declines in the Washington conservation zones and see stable or increasing populations to the south in recent years.
	It is our belief that the underlying data and habitat models for murrelet nesting are not sufficiently reliable for their intended purposes. High AUC values of Maxent nesting habitat models may be overestimating habitat model goodness; this is supported by low correlation

	over time in nesting habitat area and population trends; and the model is dubious and not suitable for management purposes.
	WDFW assumes that Northwest Forest Plan (NWFP) model verification was conducted in accordance with accepted statistical principles and peer review, and as such represents the best available estimates of habitat on an ecoregion scale. The authors of the Maxent models used in Raphael et al. (2016a) did not rely on AUC (Area Under Curve) values only to assess model performance. Their models claim to have "very good (if not "excellent) classification skill as measured by the AUC and gain values and also were well-calibrated as evidenced by the P/E (AAF) plots and associated Spearman test results" (Raphael et al. 2016a:84-85). In addition, the sources of uncertainty with their models that the authors discuss "should predispose the models to perform worse – not better. Nonetheless, even with the 'deck stacked against' good models, good models were generated" (Raphael et al. 2016a:84-85). The authors state that using maps at face value to locate specific stands or patches of murrelet habitat on a specific ownership is not appropriate at any scale without ground verification methods. The most appropriate use of the data is across landscapes, counties and larger watersheds or ecoregions and should be based on USGS hydrologic units of size 6 or larger.
	Any robust quantification of habitat change should also include habitat recruitment during the same period.
	Table 1 in the PSR reports habitat gains (recruitment) for Washington from the NWFP model for both federal and non-federal lands ("Gains" columns). Details for habitat gains are explained briefly in Raphael et al. (2016a:77, 82, 84, 86; Tables 2-9, 2-10). WDFW reported habitat gain figures directly from these tables. Raphael et al. (2016a) do state that consistent criteria were used between model years for both gains and losses. While the methods for detecting habitat gains were less effective at distinguishing real from false gains, there is high confidence that real habitat loss has occurred 1993-2012 (Raphael et al. 2016a).
	There is a low correlation over time in available nesting habitat and population trends, so that the data in the PSR do not provide an adequate basis for the conclusion that forest habitat loss is a primary factor in the decline for the last 15 years.
	This is explained in the section: Forest Habitat and Marine Abundance Correlations*; we provide additional language below to clarify. (The reader can consult the references provided below; we did not add all of this to the PSR text because of space and time constraints.)* *For Zones 2-5, nearly 60% of the influence on murrelet at-sea abundance is explained by terrestrial factors, and for Zone 1, murrelet distribution and abundance was most influenced by the total amount of nesting habitat present in the zone (>50% of influence), indicating amount and composition of habitat on the landscape was a driver of bird distribution and abundance (Raphael et al. 2016b: figure 3-9). Also Figures 3-2 and 3-4 in Raphael et al. (2016b) suggest fairly strong correlations between the residual of murrelet abundance and nesting habitat. Finally, as we state above, the murrelet distribution at sea during the breeding season generally coincides with the distribution of potential nesting habitat directly inland in several studies that have examined this relationship to date (Burger 2002, Meyer et al. 2002, Miller et al. 2002, Raphael 2006, Burger and Waterhouse 2009, Raphael et al. 2002, 2015, 2016b). As the authors point out, these correlations do not necessarily establish cause-effect relationships but they do support the hypothesis that nesting habitat may be the factor limiting population stabilization and recovery.*
	If not all nesting habitat is occupied, nesting habitat is not limited, so then claiming nesting habitat is driving current population changes is not supported.
	The at-sea distribution and abundance is driven by both the amount of higher quality habitat and habitat cohesion (i.e., the amount of unfragmented habitat) adjacent to marine hotspots

	of murrelet abundance (See Raphael 2006, Raphael et al. 2015, 2016b). In British Columbia, 6 separate watershed-level radar studies supported a linear relationship between murrelet counts at sea and proximity to inland areas of habitat, and murrelets did not aggregate offshore where adjacent nesting habitat had been significantly reduced due to harvest (Burger and Waterhouse 2009).Because habitat is defined by both small-scale features (tree size and structure) and landscape-level features (e.g., habitat cohesion), it can be difficult to assess whether or not nesting habitat is limited. It is possible differences in habitat quality influence murrelet choice of nesting habitat. There is some evidence to suggest that nesting density of murrelets can be somewhat lower than previously thought, as Conroy et al. (2002) estimated active nest density was 0.14/hectare (~1 nest per 9 ha) in unfragmented old forest in B.C. Clearly this is an area of research that needs to be further investigated.
	If relative availability of higher quality habitat trended upward over the period of declining population, it does not logically follow that nesting habitat is limiting, or that timber harvest during this time contributed to the observed declines in population.
	There has been a net loss of higher quality nesting habitat in all conservation zones except for Zone 5, and we found no data detecting upward trends in habitat availability. In addition, there is a fairly strong relationship between murrelet population change and changes in the higher quality habitat (see Figure 3-5 in Raphael et al. [2016b:105]).
	Any trend in population (up or down) due to habitat manipulation would logically be in response to earlier trends in habitat and reproductive success, not current conditions, with majority of population persisting at sea. Therefore, while contemporary trends in nesting habitat appear correlated with population trends in Washington, causation is not apparent. Lack of a temporal delay suggests caution needed with the declining population interpretation.
Habitat and Population Status	*Apparent population declines according to demographic models and the most recent work by the Effectiveness Monitoring Team suggest that populations have been declining for a long period of time (Divoky and Horton 1995, USFWS 1997, McShane et al. 2004, Miller et al. 2010) and, in the northern portions of the continental U.S. range, are continuing to decline (Lance and Pearson 2016).* *There is likely a temporal delay in population responses to the factors that are driving population changes in species like Marbled Murrelet because they are long-lived and have a relatively low reproductive rate. However, the recent analyses contained in Falxa and Raphael (2016) allow for this temporal delay. The changes in nesting habitat reported in Raphael et al. (2016a) occurred between 1993 and 2012, while the population changes reported in Falxa et al. (2016a) occurred between 2000 and 2013. Consequently, the comparison between murrelet population and habitat changes in Raphael et al. (2016b) allows for up to a 7-year delay for populations to respond to the habitat changes.*
	Changes in forest structure due to natural or anthropogenic cause are not a permanent loss of habitat area. The PSR table 1 indicates more than 10,000 acres per year (over the period 1993 to 2012) were added to higher quality category of potential nest habitat due to forest maturation. WDFW states [July 2016 draft PSR, page 5] "…the recruitment of relatively lower quality habitat may not offset the loss of an equal amount of high quality habitat (Falxa and Raphael 2016)." It appears that 212,700 acres are categorized as higher quality, and it is not clear why the department suggests it to be "relatively lower quality". In context, it appears that the 212,691 acres [Class 3+4 Gains, Table 1] is categorized as "Higher quality" thus it is not clear why the Department suggests it to be relatively lower quality.
	WDFW appreciates the opportunity to provide further clarification. WDFW acknowledges changes in forest structure are not permanent and habitat gains have happened; however a greater amount of habitat was lost in the same time period. Forest used as nesting habitat

	may take 100- 200 years to develop after a stand leveling disturbance (depending on geographic location) and over that time frame several generations of murrelets may have lost the opportunity to reproduce in those areas. Raphael et al. (2016a:84-86) provide detail on the uncertainty regarding modeling the gains in habitat. *In the PSR, Table 1, we refer to 'suitability Classes 3+4' (Raphael et al. 2016a) as "higher-quality Classes 3 +4". We use the term "highest quality" in the PSR to reflect 'Class 4- highest suitability'. On the gradient scale of habitat (Raphael et al. 2016a:54-55), 'Class 3- moderate suitability' is relatively lower quality (about 0.23 to 0.53 probability for WA) compared to Class 4 (>0.53 probability). Thus the lower end of developing Class 3 is a threshold that transitions from "Class 2- marginal suitability" to Class 3 (at about 0.23 probability). Therefore, the low end of Class 3 has a lower logistic probability of providing better habitat structure conditions than Class 4 ("highest quality"), and is not an immediate and equal habitat quality replacement value for losses of highest quality. This is clarified in less detail in the Final draft.*
	It is inappropriate to exclude data from post-2010 [at-sea] surveys…which… show a dramatic increase in population between 2010 and 2013.
	Please see Figure 5 in the PSR, which clearly shows survey year data for 2001 through and including year 2015. For Washington survey zones 1 and 2 combined, there was not an increase in the population trend line, in fact the opposite, as the trend for WA was significant at -4.4% per year. The trend line regression data has 95% power to detect a significant trend only if all survey year estimates are included over the full sampling time frame (2001-2015); it is statistically inappropriate to extract the last few data points to determine a trend.
	Changes in habitat due to timber harvest have occurred only in unoccupied sites since regulatory protections have been established in the 1990s.
	Raphael et al. (2016) state that the primary causes of nesting habitat loss on federal and non-federal lands was fire and timber harvest. They do not provide insights into the relative loss of occupied and unoccupied stands. In addition the definition of murrelet habitat included in the Washington Forest Practices Rules does not capture all Marbled Murrelet habitat and there is an exception for small forest landowners. Moreover, some Habitat Conservation Plans allow for harvest of Marbled Murrelet habitat. Finally, recent analysis indicate that the established survey protocol (Evans Mack et al. 2003) is not adequate and some sites may have been incorrectly classified as unoccupied.
Factors Affecting Continued Existence Adequacy of Regulatory Mechanisms	There is uncertainty expressed about WDNR's Long-term Conservation Strategy for the Marbled Murrelet and the importance of maintaining habitat on state-owned lands. The USFWS recognizes preserving marbled murrelet habitat in SW Washington is critical to the species' survival and recovery.
	Comment noted. This comment reflects policy-related issues outside the scope of this Status Review.
	This process would benefit greatly from a state recovery plan for murrelets which shall include target population objectives, criteria for reclassification, and an implementation plan for reaching population objectives (WAC 232-12-297 (11.1).
	Comment noted. This comment reflects policy-related issues outside the scope of this Status Review.
	State Forest Practices Rules have clearly failed to prevent further loss of old forest nesting habitat from commercial timber harvesting. To prevent the unintended harvest of existing murrelet habitat on private lands (~129,000

	acres at higher survey threshold, 5-7 platforms per acre) prior to conducting protocol surveys, the lower threshold (2-5 platforms per acre) for meeting the regulatory habitat definition should be applied whether or not it is located within a marbled murrelet detection area. We urge WDFW to assess, and the Forest Practices Board to revise the Forest Practices Rules for marbled murrelets consistent with the best available science.
	Comment noted. This comment reflects policy related issues outside the scope of this Status Review. We cannot comment on future direction by the Forest Practices Board to WDFW, as it is a policy-related issue and not within the scope of this Periodic Status Review.
	Murrelet population in Washington continues to be impacted by nest predation, declines in forage fish populations and mortality from net fisheries and pollution. Murrelets continue to decline due to habitat loss, habitat fragmentation, high nest predation rates, low fecundity and low adult survival. The marbled murrelet's population continues to decrease precipitously.
	Comment noted.
Continued Risks Threats	Forage fish declines may be a driver of murrelet declines in Washington. Prey type and abundance declines may be a contributor to Marbled Murrelet declines.
	Comment noted, and WDFW agrees; however, additional research in more marine regions of Washington is needed to fully investigate this factor. Forage fish availability is one factor. When assessing both marine and terrestrial factors on changes in the distribution and abundance of murrelet populations, terrestrial factors appear to have the greatest influence (Raphael et al. 2016b, and Raphael et al. 2015). Again, these correlations do not indicate cause and effect but instead support the hypothesis that terrestrial factors and nest habitat (amount and cohesion) have the greatest influence of murrelet population trends.
	There will be future loss of nesting habitat due to natural disturbance such as fire windthrow, and disease (likely to be exacerbated by more extreme climatic conditions.
	The effects of climate change on Marbled Murrelets are not clear at this time, but modeling indicates that precipitation and snow pack will decrease through time and some forest landscapes may experience higher risk of less epiphyte (moss and lichen) branch cover and possibly canopy-replacing fires and other impacts. Such events could impact Marbled Murrelets and other species.
Recommendation and Conclusion	The Marbled Murrelet should be up-listed as an endangered species in Washington due to reasons such as declining population and habitat loss. Classifying the murrelet as a state endangered species is warranted based on its declining population, and is an important step in its recovery.
	Thank you for your comment. WDFW is recommending that the status of the Marbled Murrelet be up-listed from state threatened in 1993 to state endangered.

WASHINGTON STATE STATUS REPORTS, PERIODIC STATUS REVIEWS, RECOVERY PLANS, AND CONSERVATION PLANS

Status Reports

2015 Tufted Puffin
2007 Bald Eagle
2005 Mazama Pocket Gopher, Streaked Horned Lark, and Taylor's Checkerspot
2005 Aleutian Canada Goose
2004 Killer Whale
2002 Peregrine Falcon
2000 Common Loon
1999 Northern Leopard Frog
1999 Olympic Mudminnow
1999 Mardon Skipper
1999 Lynx Update
1998 Fisher
1998 Margined Sculpin
1998 Pygmy Whitefish
1998 Sharp-tailed Grouse
1998 Sage-grouse
1997 Aleutian Canada Goose
1997 Gray Whale
1997 Olive Ridley Sea Turtle
1997 Oregon Spotted Frog
1993 Larch Mountain Salamander
1993 Lynx
1993 Marbled Murrelet
1993 Oregon Silverspot Butterfly
1993 Pygmy Rabbit
1993 Steller Sea Lion
1993 Western Gray Squirrel
1993 Western Pond Turtle

Periodic Status Reviews

2016 Taylor's Checkerspot
2016 Columbian White-tailed Deer
2016 Streaked Horned lark
2016 Killer Whale
2016 Greater Sage-grouse
2016 Northern Spotted Owl
2016 Snowy Plover
2016 Western Gray Squirrel
2015 Brown Pelican
2015 Steller Sea Lion

Recovery Plans

2012 Columbian Sharp-tailed Grouse
2011 Gray Wolf
2011 Pygmy Rabbit: Addendum
2007 Western Gray Squirrel
2006 Fisher
2004 Sea Otter
2004 Greater Sage-Grouse
2003 Pygmy Rabbit: Addendum
2002 Sandhill Crane
2001 Pygmy Rabbit: Addendum
2001 Lynx
1999 Western Pond Turtle
1996 Ferruginous Hawk
1995 Pygmy Rabbit
1995 Upland Sandpiper

Conservation Plans

2013 Bats

<u>Status reports and plans are available on the WDFW website at</u>:
http://wdfw.wa.gov/publications/search.php